Article:
Buchner, A, Mohamed, A and Wagner, N (2019) Are venture capital and buyout backed IPOs any different? Journal of International Financial Markets, Institutions and Money, 60. pp. 39-49. ISSN 1042-4431

https://doi.org/10.1016/j.intfin.2018.12.002

Are venture capital and buyout backed IPOs any different?

Axel Buchner
University of Passau, Germany

Abdulkadir Mohamed
Loughborough University, United Kingdom

Niklas Wagner
University of Passau, Germany

This version: October 2018

---

* Contact details of authors: Axel Buchner, University of Passau, Department of Business and Economics, University of Passau, 94030 Passau, Germany, email: axel.buchner@uni-passau.de; Abdulkadir Mohamed, Loughborough University, School of Business and Economics, Loughborough, LE11 3TU, UK, email: A.Mohamed2@lboro.ac.uk; Niklas Wagner, University of Passau, Department of Business and Economics, University of Passau, 94030 Passau, Germany, email: niklas.wagner@uni-passau.de.

Are venture capital and buyout backed IPOs any different?

Abstract

This paper examines the relative performance of Initial Public Offerings (IPOs) backed by either venture capital or buyout sponsors. We investigate both the operating and stock market performance for a sample of 851 IPOs listed between 2000 and 2014. We find a significant short and long run performance differences in IPOs backed by venture capital or buyout sponsors. We show that IPOs backed by venture capital sponsors are significantly more underpriced in the short run than those backed by buyouts. In the long run, we find that IPOs backed by buyouts outperform those backed by venture capital using return on assets and operating margins as measures of performances. Our results are robust using propensity score matching. Using three factor and five factor models, we find no difference in performance between venture capital and buyouts backed IPOs. This suggests that operating performance improvements post listing in buyout backed companies appear to be adequately priced during the initial listing.

Keywords: Private Equity, Buyout, Venture Capital, Initial Public Offerings
JEL Classifications: G23, G24, G32

Introduction

Private Equity (PE) firms have played a vital role in the creation of public corporations (Jain and Kini 2000; Gompers and Lerner 1997; Lerner 1994; and Megginson and Weiss 1991). The term PE refers to both buyout (BO) and venture capital (VC) investments. The main difference between the two is the type of companies and the way in which the investing funds create value for their portfolio companies.[1] Despite the large increase in both BO and VC investments and the concomitant increase in academic and practitioner literature, the historical performance of both segments remains still uncertain and even controversial. This uncertainty is driven by the uneven disclosure of private equity returns and questions about the quality of the private equity data that are available for research (see Harris, Jenkinson, and Kaplan 2014 and Higson and Stucke 2014 for a detailed discussion). Our paper adds to the stream of literature that compares the performance of both private equity segments but differs in that we only use publicly available data that is not exposed to the data limitations of common private equity datasets. We compare the long and short run performance of Initial Public Offerings (IPOs) backed by either VC sponsors or BO sponsors using publicly available stock market data. Listings on the public stock markets via IPOs are an important exit route for both VC and BO funds. Most previous studies that explore the performance of private equity backed IPOs focus on a comparison between either VC or BO backed IPOs and stand-alone IPOs (for a comparison of VC and non-VC backed IPOs see Brav and Gompers 1997; and for a comparison of BO and non-BO backed IPOs see Michala 2016 and Chou, Gombola, and Liu 2006). This paper explicitly examines differences in the short and long-run performance between IPOs backed

[1] Typically, VC funds target companies in an early stage of development with a high growth potential often in the technology sector and establish minority positions in the equity of the companies. BO funds normally target mature companies with sufficient tangible assets and stable (and well) predictable cash flows. BO funds hold majority positions (if not all) of the equity in their portfolio companies and typically use substantial amounts of debt to finance acquisitions (e.g. Metrick and Yasuda, 2011).

by VC and those backed by BO sponsors. We analyze and compare simultaneously both the operating as well as stock market performance of these backed IPOs in the U.S. market and provide several interesting new findings.

Previous studies provide strong empirical evidence that both VC and BO backed IPOs outperform comparable stand-alone IPOs. However, the question of whether BO backed IPOs outperform or underperform comparable VC backed IPOs remains largely unexplored in the previous literature. Simply comparing different previous studies on the performance of BO backed IPOs and VC backed IPOs might provide an inconsistent picture since these different studies typically analyse different markets, time periods, and sometimes even find contradictory results, which are difficult to reconcile. In addition, our paper is the first in putting a rationale around significant short and long run performance differences between IPOs backed by both types of private equity sponsors, which offers novel unique insights into the differences between the two segments. These insights would not be possible by simply comparing different studies and offer a novel theory on the fundamental question, which underpin the performance differences between VC and BO backed IPOs. Finally, also note that comparing the performance of VC and BO backed IPOs is interesting as both types of private equity sponsors have different motives when taking their portfolio companies public. In the VC segment, there is usually a large degree of information asymmetry on the quality of the portfolio companies since these funds specialize on young entrepreneurial companies with no proven track record and hard to predict future cash flows. Therefore, they may have an incentive to use IPO exits as an opportunity to establish a long-term reputation. In line with this prediction, Neus and Walz (2005) document that VC firms have an incentive to report the true quality of their IPOs during the IPO process. In contrast, BO sponsors may behave differently from the VC sponsors. This could be due to the fact that BO funds invest into established companies and prefer to exit quickly as these deals are very large in size. Hence, they may rush to exit through the IPO route and have an

incentive to fool the IPO market on the true quality of the companies taken public. Our study examines differences in the short and long-run performance between VC and BO backed IPOs. Addressing this question also allows us to analyse the important issue whether BO sponsors create more or less value than VC sponsors for the IPO firms.

We compare the performance of IPO firms backed by BO investors with those backed by VC investors. We use five performance measures: (i) initial returns at the time of listing, (ii) buy and hold returns over a period of three years post listing, (iii) return on assets over a period of three years post listing, (iv) operating margins over a period of three years post listing, and (v) the risk-adjusted outperformance (alpha) over a period of three years using the Fama and French three-factor and five factor model. The first measure is related to the short run performance of the IPO firms, while the remaining four measures are related to the long run performance. Additionally, the first two measures and the fifth measure are measures of stock market performance while the remaining are measures of operating performance. In our empirical analysis, we mainly focus on the long run performance measures as neither BO nor VC sponsors typically completely exit their backed companies at the time of listing. For example, Krishnan, Masulis, Ivanov, and Singh (2010) document that VC investors tend to hold their stocks even beyond the agreed lock up period, which usually is 180-days post IPO date. Further, short run measures of performance might to some degree be biased, in particular when assessing the long term value created by the VC or BO sponsors.

Our sample consists of U.S. IPOs backed by either VC or BO funds during the period ranging from 2000 to 2014. We have a full sample of 851 IPOs out of which 533 are backed by VC funds, while the remaining 318 are BO backed IPOs. Our results on initial returns at the time of listing show that VC backed IPOs are more underpriced than BO backed IPOs. Average initial returns at the time of listing

amount to 18.9% for the sample of VC backed IPOs versus 10.7% for the sample of BO backed IPOs. This difference is statistically significant at all conventional levels. This result is interesting in the light of the study by Lee and Wahal (2004) who find that VC backed IPOs are typically more underpriced relative to stand-alone IPOs. Our study adds that within the private equity segment, VC backed IPOs are significantly more underpriced than BO backed IPOs. Our result is in line with the general intuition that VC backed IPOs are harder to value, since these companies are still in an early stage of development., While BO backed IPOs are easier to value because their portfolio companies already have an established track record and more predictable cash flows. Hence, higher information asymmetry between the private equity sponsor and outside investors in VC backed IPOs can lead to lower average offer prices since public investors initially value these firms more conservatively. This can result in a higher average underpricing of VC backed IPOs. In the long run, we find no evidence of performance differences between VC and BO backed IPOs using buy and hold returns over a period of three years as a measure of performance. However, using measures of long run operating performance such as return on assets and operating sales margin, BO backed IPOs outperform their VC counterpart. Differences in these performance measures are statistically significant at the 1% level.

In a multivariate setting, controlling for company size, leverage and volatility, we confirm for the short run that VC backed IPOs are significantly more underpriced than BO backed IPOs. In the long run, our multivariate estimation results again show that BO backed IPOs significantly outperform VC backed IPOs using return on assets and operating margins as measures of operating performance. However, our estimation results for the Fama and French three factor model reveal that the better operating performance of BO backed IPOs does not translate into a higher risk-adjusted outperformance of these companies on the stock markets. Our results suggest a similar long run underperformance of roughly 1% per month for both VC

an BO backed IPOs. For both samples, this underperformance is however only weakly significant at the 10% level. Overall these findings imply that BO backed IPOs realize significantly higher operating performance improvements as compared to VC backed IPOs, while these, on average, appear to be already adequately captured by the initial listing prices., This is because as stock market outperformance in the three year post IPO period is not significantly different between the segment of BO and VC backed IPOs.

In a robustness analysis, we finally examine whether differences in performance between VC and BO backed IPOs are due to differences in the characteristics of the IPO companies. We use propensity score technique to match each BO backed IPO company with an equivalent VC backed IPO company. We match both samples by company size, leverage ratio, volatility, and market to book value. Our results show that BO backed IPOs outperform VC backed IPOs in the matched sample in terms of operating performance which confirms that our previous results are not driven by selection effects, i.e., they are not due to the fact that buyout funds select different portfolio companies as compared to venture capital funds. This underlines that differences in the operating performance are not due to selection of different types of portfolio companies backed by VC and BO funds, but rather to the fact that BO funds add more value to their companies compared to VC funds.

Our study makes several contributions to the existing literature. Previous studies (e.g. Jain and Kini 2000; Lerner 1994; Chou, Gombola, and Liu 2006) document that private equity backed IPOs significantly outperform comparable stand-alone IPOs. Similar to our study, Levis (2011) also compares the performance of IPO firms backed by BO investors with those backed by VC investors. A major difference between the work of Levis (2011) and ours are the market and the time-frame analysed. We study U.S. IPOs and investigates a much more recent time-

frame ranging from 2000 to 2014. The study by Levis (2011) examines the U.K. market and considers a period between 1992 and 2005. However, the results are not directly comparable due to differences in the markets and time periods. Consistent with Levis (2011), we show that IPOs backed by venture capital sponsors are significantly more underprized in the short run. In the long run, however, return on assets and operating margins suggest that BO backed IPOs outperform those backed by VC sponsors post listing. Wefind no significant differences in terms of the risk-adjusted outperformance using the Fama and French three-factor and five-factor model. In contrast, Levis (2011) also finds a better market performance of BO backed IPOs in the long-run for the U:K- market. Our novel result suggests that operating performance improvements post listing in BO backed companies appear to be already adequately priced in the initial listing prices for these investments. These important insights differ from the results of Levis (2011). It remains to be analyzed whether the U.S. IPO market has a more efficient pricing compared to the U.K. market. More generally, our results also contribute to the broader literature that explores the question of whether private equity investments outperform traded stock market investments. Previous research in this area includes Cochrane (2005), Ewens (2009), Korteweg and Sorensen (2010), Driessen, Lin, and Phalippou (2012), Franzoni, Nowak, and Phalippou (2012), Axelson, Sorensen, and Stromberg (2013), and Ang, Chen, Goetzmann, and Phalippou. (2013). Our results add to this strand of the literature by showing that both VC and BO backed IPOs slightly underperform traded stocks on a risk-adjusted basis in the long run after the (partial) exit of the private equity sponsor.

The rest of the paper is organized as follow: Section 2 explains the typical private equity involvement in the IPO process and provides a literature review. Section 3 describes the data sources. Empirical findings are presented and discussed in Section 4, while Section 5 concludes.

2. PE sponsors' involvement in the IPO process and literature review

Generally, VC and BO sponsors are equity holders and in most instances participate on the board of directors of the investee company. They have the ability to guide and influence managerial decision in terms of structure, operating procedure, and exit route including the decision to go public. The process of going public itself is typically not directly controlled by the VC or BO investors, but rather by specialized investment bankers and underwriters. The aim of these intermediaries is helping the firms to achieve high valuations at the IPO date and possibly better post issue performance. It is well documented that IPO is one of the most profitable exit routes for BO and VC funds. For example, Gompers (1995) and Das et al. (2003) show that venture capital deals exited by IPOs offer very attractive returns for the fund investors. The high returns are due to the fact that VC or BO tend to take their top-performing companies public (see Schwienbacher and Giot, 2007). Often the VC and BO funds tend to work together with the same intermediaries over time when taking their portfolio companies public. Hence, they have regular interactions with these intermediaries and are in a position to ensure that they provide strong support to their portfolio companies. Additionally, intermediaries are likely to provide more support for VC or BO backed IPOs compared to none backed IPOs to establish a successful long-term relationship with the VC or BO funds.

BO and VC funds play a significant role in helping their portfolio companies develop in terms of strategy and making decisions. Often entrepreneurs might not necessarily have the business skills, networking and understanding of the market conditions. The BO and VC funds are generally experts and specialize by industry such as a technology sector and stage of development of companies in which they invest (Rock 1987). The VC and BO investors are likely to provide firms guidance in choosing an appropriate strategy for the company. Some of these strategies include

going public when the IPO market is favourable or opt for an exit through M&A when the M&A market conditions are better than the IPO market.

The level of expertise and reputation gives VC and BO funds the opportunity to influence intermediaries such as institutional investors, investment bankers and analysts whose actions have a major impact on the success of the going public process. Due to frequent interaction between the PE sponsors and financial intermediaries, they are likely to influence these intermediaries to maximize the chances of success for their IPO firms. Previous studies including Jain and Kini (2000) and Lee and Wahal (2004) find that the characteristics of the IPO firms are different between PE and none-PE backed IPOs. Overall, the VC and BO sponsors have the ability to influence institutional investors, investment bankers and analyst to support their portfolio companies. As a result, VC and BO backed companies are expected to experience successful IPOs, but the differences in their success over the short and long run remained largely unexplored in the literature.

Previous literature that examines the performance of VC and BO backed IPOs relative to stand-alone IPOs has received significant attention in the last decades. Lerner (1994) finds that VC firms take their portfolio companies public when the market is high to exploit overvaluation in the market place. Similarly, Ball et al (2011) find that Private Equity firms are likely to list their portfolio companies when the market conditions are favourable. Lee and Wahal (2004) document that young VC firms take their portfolio companies public to establish reputation and maximize the opportunity of future fund raising. These studies demonstrate that the characteristics of VC backed IPOs are different from non-backed IPOs. With regards to survival post listing, Jain and Kini (2000) find that VC backed IPOs have higher survival rates than non-VC backed IPOs. In the BO segment, Chou et al (2006) find that BO backed IPOs are more window dressed than unbacked IPOs. Stated differently, BO investors are likely to inflate the valuation of their IPOs relative to unbacked ones. Hence, the issues of market timing and window dressing seem to be

motivating factors for private equity sponsors to take their portfolio companies public. However, a recent study by Michala (2016) finds that Private Equity (i.e. VC and BO) backed IPOs are not significantly different from unbacked IPOs in terms of valuation and market timing. In particular, the study shows that the practice of going public during hot market periods has declined in the recent years.

3. Sample

Our sample comprises IPOs listed in U.S. and backed by either VC or BO funds during the period ranging from 2000 to 2014. The list of IPO firms is collected from Jay Ritter's website. We follow the literature and exclude IPOs with an offer price below $5.00 per share, a total valuation below $1.5 million, unit offers, American Depository Receipts (ADRs), closed-end funds, natural resources partnerships, Real Estate Investment Trusts (REITs), Bank and Saving Loans IPOs, and firms that are not listed on CRSP. We use the VentureXpert database to identify whether an IPO firm is backed by a VC or BO sponsor. We have checked manually stand-alone IPOs to ensure that they are not backed by a VC or BO fund. This filtration led to a sample of 851 IPOs, out of which 533 are VC backed and 318 are BO backed IPOs. Information on initial returns is collected from Jay Ritter's website, accounting data and industry classifications are collected from Compustat database, while stock price data and the Fama and French three- and five-factors are collected from CRSP database. [2]

Table 1 shows the distribution of the IPOs backed by VC and BO by year over the sample period from 2000 to 2014. The number of IPO firms backed by VC sponsors is roughly twice the number of IPOs backed by BO sponsors over the sample period.

[2] Appendix A provides definition of the variables and source of data.

During the period between 2000 and 2002 the number of VC backed IPOs are equals roughly four times the number of IPOs backed by BO sponsors. Interestingly, post 2002 the number of IPOs backed by BO sponsors has increased significantly as compared to the pre 2002 period. The number of VC backed IPOs has remained relatively stable between 2002 and 2005, but began to rise substantially after 2011. From 2007 to 2014 the number of VC backed IPOs is less than twice the number of BO backed IPOs. This suggests an increased popularity of the IPO exit route for BO sponsors in the recent years. Overall, the results show that IPO exits are an important exit route for both VC and BO funds. Furthermore, there is evidence to suggest an upward trend in the number of IPOs backed by either VC or BO sponsors since 2012. The fact that the number of VC backed IPOs is approximately twice the number of BO backed IPOs over the entire sample period is consistent with previous studies (e.g. Michala 2016). The average age of the IPO firm is 10 years, and 36 percent of the IPO firms are associated with reputable underwriters. Almost 65 percent of the IPOs are covered by reputable analyst at the time of listing. The average proceeds is 246 million USD, stock market liquidity (i.e turnover) is 61% and hot issue is 33.53 percent.

[PLEASE INSERT TABLE 1 HERE]

4. Empirical findings

4.1 Univariate Analysis

Table 4 presents descriptive statistics of the variables used in the analysis. The initial returns are calculated as the percentage price changes from the offering price to the closing price on the first day of trading. The table shows that the average initial return is 15.3% and the median is 10.3% for the full sample of both VC and BO backed IPOs. The minimum initial returns is negative at 5.9%, while the maximum initial return during our sample period amounts to 56.4%. Our average initial return of 15.3% suggests that underpricing has declined in the recent years for PE backed

IPOs. For instance, Lee and Wahl (2004) report an average underpricing of 26.82% during the period 1980 through 2000. The mean buy and hold returns in our sample equals to 24.1% over a period of three years post listing with a median of 8%. The statistically significant difference between the mean and median buy and hold returns (BHR) further suggests that the BHR are skewed to the right. Brav and Gompers (1997) find that average BHR equals 44.6% for VC backed IPOs between the periods ranging from 1972 to 1992. The lower average BHR reported for our sample is attributable to the time frame of our sample. In more recent years, VC and BO backed IPOs might be concentrated in industries that have lower risks and therefore the expected returns might be lower. On average, the return on assets is negative (-9.1%) over a period of three years post listing. The median operating margin is positive at 4.2%, while the mean is highly negative at 39.4%. This indicates that operating margins are highly skewed to the left in our sample. The average size as measured by the total assets equals $922 million with a median of approximately $400 million. The leverage ratio of the IPO companies has a mean of 19.5% and a median of 9.6%, which are comparable to the previous studies of IPO firms. The average annual stock market volatility of the IPO firms over a period of three years post listing equals 15.3%, with a median of 13.4% and a maximum of 34.5%. In terms of the age at the time of listing, buyout backed IPOs are older than VC backed IPOs and the age difference is statistically significant at 5 percent conventional level. We find no differences in underwriter reputation, analyst coverage, proceeds, turnover ratio and hot issue market between VC and buyout backed IPOs. Next, we examine the performance of the IPO firms backed by VC and BO investors.

[PLEASE INSERT TABLE 2 HERE]

Table 3 compares the performance of the IPOs backed by VC and BO sponsors during our sample period. It is evident from the table that the level of underpricing as measured by the initial returns is higher for the sample VC backed IPOs when compared to the sample BO backed IPOs. The mean initial return equals 18.9% with a median of 15% for the VC backed IPOs, compared to 10.7% and 6.3% respectively for the BO backed IPOs. These differences in means and medians are also statistically significant at the 1% conventional level. Gompers (1996) and Lee and Wahal (2004) find that VC-backed IPOs were highly underpriced in the 1990s. Hogan et al (2001) document that underpricing is relatively low for BO backed IPOs, which is consistent with our results. Michala (2016) points out that VC backed IPOs face higher information asymmetries in the IPO market and hence the offer price is lower compared to BO backed IPOs. This higher information asymmetry can hence lead to a higher underpricing for VC backed IPOs. There is no statistically significant difference in BHR between VC and BO backed IPOs over the period of three years post listing. This result is surprising given that the level of underpricing is significantly different at the time of listing between the two sub-samples. Additionally, the results show that the measures return on assets and operating margins are statistically different between VC and BO backed IPOs in terms of mean and median values. Both measures indicate that VC backed IPOs underperform those backed by BO sponsors. The values for the mean and median size of the VC backed IPOs indicate that IPOs from VC sponsors are smaller than BO backed IPOs. In contrast, the mean and median leverage ratios of the BO backed IPOs are higher than those of the VC backed IPOs. This result is consistent with previous research (e.g. Michala 2016), which shows that BO backed IPOs are typically larger in size compared to VC backed IPOs. Finally, the results also show that the stock market volatility of VC backed IPOs is significantly higher than that of the sample BO backed IPOs. This is due to the fact that VC funds typically target portfolio companies in different industries and stages of development compared to BO funds. Particularly, VC funds tend to invest in young growth companies in the technology sector, while BO funds

tend to target well established companies with a proven track record in more conservative industries. In the next section, we examine how the short and long performance of VC backed IPOs relative to BO backed IPOs controlling for firm characteristics.

[PLEASE INSERT TABLE 3 HERE]

4.2 Multivariate Analysis

We examine differences in performance as measured by (i) initial returns and (ii) buy and hold return. We use the following equations to examine differences in performance:

$$\text{Initial\_Re turn} = \alpha + \beta_1 \text{Lnsize} + \beta_2 \text{Leverage} + \beta_3 \text{Volatility} + \beta_4 \text{VC\_dum} + \varepsilon \quad (1)$$

$$\text{BHR} = \alpha + \beta_1 \text{Lnsize} + \beta_2 \text{Leverage} + \beta_3 \text{Volatility} + \beta_4 \text{VC\_dum} + \varepsilon \quad (2)$$

Equation (1) allows us to assess the impact of the presence of a VC sponsor on short run performance of an IPO (as measures by initial returns), while Equation (2) examines the impact of the VC sponsor on the long run, controlling for the IPO characteristics at the time of listings . The variable of interest in both regression equations is the VC dummy, which is equal to one if the IPO is VC backed and zero if it is BO backed. If VC backed IPOs outperform BO backed IPOs in the short run or in the long run, we expect a positive and significant regression coefficient β_4 in both Equation (1) and (2). However, if VC backed IPOs do not outperform their BO counterpart, we expect an insignificant coefficient β_4 in both equations. Table 4 reports the results of this multivariate analysis for the short run and the long run controlling for the size of the IPO firms, leverage ratio and stock return volatility. Model I and II report regression results for our measure of short run performance, where the dependent variable is the initial returns., Model III and IV report regression

results for the long run performance. The results of Model I and II show that initial returns are significantly higher when the size of an IPO firm is large and they are significantly lower when the IPO firms are highly levered. The latter result suggests that IPO firms with higher leverage ratios at the time of listing are significantly less underpriced compared to those with lower leverage ratios. Possibly, this is due to the fact that investors tend to under-subscribe IPOs with higher leverage ratios because of perceived high potential financial risk. Also, high leverage could increase the level of uncertainty as to whether the IPO firm is raising money to finance future growth or simply tries to reduce its debt level. In Model II, we include the VC dummy to examine performance differences between VC and BO sponsored IPOs. It is clear from Model II that the VC dummy is positive and statistically significant at the 1% level. This suggests that IPOs backed by VC funds are significantly more underpriced even after controlling for the size and firm leverage. This is consistent with Michala (2016) who argues that VC backed IPOs typically face a higher level of information asymmetry. To examine the long run performance differences between VC and BO backed IPOs, we use BHR over a period of three years post listing. Model III and IV have the same specifications as Model I and II but use BHR instead of initial returns as the dependent variable. The results of Model III and IV show that the BHR are high for large IPOs, but low for IPOs characterised by high stock price volatility. As expected the coefficient on the leverage ratio is not significant at any conventional level in Model III and IV. This is not surprising, since the level of uncertainty reduces significantly post listings due to information availability on the firm's performance. Similarly, in Model IV, we include a VC dummy, which is negative, but insignificant at any conventional level. This indicates that there is no statistically significant performance difference between IPOs backed by VC and those backed by BO funds. Stated differently, the long run performance as measured by BHR is not different between IPOs backed by VC or BO funds. Taken together our results suggest that there are performance differences between VC and BO

backed IPOs in the short run, while in the long run we find no evidence of performance differences.

[PLEASE INSERT TABLE 4 HERE]

It is evident from Table 4 that VC backed IPOs are highly underpriced relative to BO backed IPOs, while in the long run there is no evidence of significant differences in performance using BHR. The BHR is a broad measure of long run performance and might not necessarily reflect how efficient managements are at using their assets to generate earnings. Therefore, we use two alternative measures of performance: (i) return on assets (ROA) and (ii) operating margin. Table 5 shows the regression results for these two alternative measures for the full sample of VC and BO backed IPOs. The ROA measures the efficient use of assets to generate returns, while operating margin measures how much profit a company generates from the sales. We again aim to highlight whether there are significant differences between VC and BO backed IPOs in terms of these two additional measures. We use the following specifications to investigate performance differences between VC and BO backed IPOs.

$$\text{ROA} = \alpha + \beta_1 \text{Lnsize} + \beta_2 \text{Leverage} + \beta_3 \text{Volatility} + \beta_4 \text{VC\_dum} + \varepsilon \quad (3)$$

$$\text{Operating\_Margin} = \alpha + \beta_1 \text{Lnsize} + \beta_2 \text{Leverage} + \beta_3 \text{Volatility} + \beta_4 \text{VC\_dum} + \varepsilon \quad (4)$$

Equation (3) uses ROA as a measure of performance, while Equation (4) uses operating margins as dependent variable. If VC backed IPOs are more efficient than those backed by BO funds, we expect a positive coefficient β_4 in Equation (3) and (4). However, a negative and significant coefficient β_4 would indicate that VC backed IPOs underperform BO backed IPOs. We use the same sets of variables as in

Equations (1) and (2), but these are now averaged over three years post IPO date. Table 5 reports the regression results for these two alternative measures. Model I and II report the results for ROA, while Model III and IV report the results for operating margins. Model I shows that ROA is significantly lower when the IPOs are highly leveraged and show a high stock return volatility. In Model II, we include a VC dummy that takes a value of one if the IPO is backed by a VC fund and zero if it is backed by a BO sponsor. The VC dummy in Model II is negative and highly significant at the 1% level, which suggests that VC backed IPOs underperform in terms of ROA. In Model III, we show that that volatility has a negative impact on operating margins whereas higher leverage ratios have a positive impact. Put differently, the results show that operating margins increase with higher leverage ratios of an IPO firm. In Model IV, we include our variable of interest (i.e. the VC dummy) and we find that the VC dummy is negative and highly significant at 1% level. On average, operating margins of VC backed IPOs are around 3.7% lower compared to BO backed IPOs. Taken together, the results of Table 5 show that BO backed IPOs are more efficient at using their assets to generate returns and are also more profitable in terms of operating margins than VC backed IPOs. Overall, the results of Table 4 and 5 indicate that BO backed IPOs perform better in the long run than VC backed IPOs.

[PLEASE INSERT TABLE 5 HERE]

Next, we examine the long run performance of the sample IPOs using the three-factor and five-factor Fama and French model. Fama and French (1993) report that a three-factor model may do better in explaining the cross section of stock returns than a simple one-factor market model. Their three-factor model includes: RMRF, which is the excess return on the equally weighted market portfolio; SMB,

which is the return on a zero-investment portfolio formed by subtracting the return on a large firm portfolio from the return on a small firm portfolio; and HML, which is the return on a zero investment portfolio calculated as the return on a portfolio of high book to market value stocks minus the return on a portfolio of low book to market value stocks. We use monthly returns for our sample VC and BO backed IPOs and run separate regressions. The intercept from the regressions (i.e. alpha) has an interpretation similar to Jensen's alpha in the Capital Asset Pricing Model (CAPM) and measures the long run risk-adjusted outperformance. Table 6 (Panel A), reports the estimation results of the three-factor model. Model I shows the results for the VC backed IPOs, while Model II shows the results for the BO backed IPOs. As can be inferred from the table, the VC backed IPOs have higher a beta coefficient than the BO backed IPOs. This result suggests that the sample VC backed IPOs have a higher systematic risk component compared to the sample BO backed IPOs, which is consistent with previous research indicating that VC backed companies typically show a higher level of systematic risk. The intercepts equal -0.010 and -0.011 in Model I and II, respectively. This suggests a large long run underperformance of around 1% per month for both VC an BO backed IPOs. However, this evidence is only statistically significant at the 10% level. The coefficients for SMB and HML further indicate that the returns of both VC and BO backed IPOs co-vary positively with SMB factor and negatively with HML factor. Hence, the returns of both VC and BO backed IPOs resemble those of small growth stocks. Taken together, the results of Table 6 add to the previous results reported in Table 4, specifically Model IV, which shows that VC backed IPOs neither underperform nor outperform BO backed IPOs in the long run. In Panel B, we use Fama and French (2016) five factor model, which include profitability and investment. Typically, stocks with a high profitability and high total asset growth are expected to perform better in the market. The high profitability and investment also capture the high returns associated with low market beta, share repurchases and low stock return volatility (Fama and French 2016). In fact the results of Panel B in Table 6, show that the market beta is lower for the five

factors model, compared to three factors model. However, the alpha remains negative, but statistically insignificant. Overall, our results show that firm specific measures such as ROA and operating margins provide strong evidence of long run performance differences between VC and BO backed IPOs. In contrast, our results imply that market based performance measures such as BHR and the risk-adjusted outperformance from the Fama and French three-factor and five-factor model do not show long run performance differences between VC and BO backed IPOs.

[PLEASE INSERT TABLE 6 HERE]

4.3 Selection effects

Our results show that BO backed are different from VC backed IPOs in terms of operating performance measures. However, our previous analysis did not take into account that BO and VC backed companies might have different firm characteristics that drive our results. In particular, Table 3 shows that VC backed IPOs are different from BO backed IPOs in terms of size, leverage ratios, and stock return volatility. Additionally, we also expect that both types of private equity backed firms are different in terms of growth opportunities, since VC funds specialize on young growth companies and BO funds mainly invest into mature companies. This imposes serious concerns on whether our previous results could be due to selection effects. In order to address this concern, we use a propensity score model to match IPOs backed by VC funds with similar IPOs backed by BO funds. Each IPO backed by a VC sponsor in our sample is thereby matched to a sample of BO backed IPOs based on the leverage ratio, volatility, market to book value, industry and size of the company using propensity score matching. This allows us to construct a sample of IPOs backed by either VC or BO investors that share similar characteristics at the time of listing. This sub sample of IPOs provides robust results and allows to distinguish between selection effect and value added by the VC or BO sponsor. Table 7 reports the results of the propensity score matching. Panel A of Table 7

shows the univariate results of the matched sample by mean, median and standard deviations values for the VC and BO backed IPOs. It is evident from the results of Panel A that the characteristics of matched VC and Buyout sub samples are not statistically different using t-test and median test. Panel B shows the multivariate results for our four main performance measures: (i) initial returns, (ii) BHR, (iii) ROA and (iv) operating margins. It is evident from Panel A of the table that differences in characteristics between the matched samples of the VC and BO backed IPOs are not statistically significant in terms of mean and median values. Next, we use multivariate analysis to examine performance differences. Panel B of Table 7 shows the results of this multivariate analysis. The dependent variable in Model I is initial returns, Model II BHR, Model III return on assets, and Model IV is operating margins. The coefficient on the VC dummy in Model I is positive and statistically significant, suggesting that the higher underpricing of VC backed IPOs is not due to selection effects. In Model II to Model IV the coefficient on the VC dummy is also negative and highly statistically significant at 1% conventional level. This confirms that VC backed IPOs underperform BO backed IPOs in the long run and that such differences in performance are not due to firm characteristics, but rather due to the presence of a BO sponsor. Overall, the results indicate that the presence of a BO sponsor has a positive impact on the long run performance of the IPO firms. Therefore, performance differences are due to value created by BO investors and not due to the selection of the IPO firms.

[PLEASE INSERT TABLE 7 HERE]

4.4 Robustness

Previous studies (Gompers, 1996; Lee and Wahal, 2004; Neus and Walz, 2005, Levis, 2011) have shown that age of the IPO firm, underwriters reputation, net proceeds, hot IPO market, analyst coverage and stock liquidity could influence the short term and long term performance. In Table 8, we control for all these variables

measured at the time of listing and investigate whether differences in performance between VC and buyout backed IPOs are driven by IPO firm characteristics. The dependent variable in Model I is the initial returns, Model II is BHR, Model III is ROA and Model IV is profit margins. It is evident in Model II through Model IV that VC backed underperform buyout backed IPOs. The underperformance of VC backed IPOs controlling for additional factors is not different compared to the results reported in Table 4 and 5 above. Overall, the results of Table 8 show that buyout backed IPOs outperform VC backed IPO in the long run despite the underperformance in the short run.

[PLEASE INSERT TABLE 8 HERE]

5. Conclusion

This paper examines the performance of IPO firms backed by VC investors against those backed by BO sponsors. We find that within the segment of private equity backed IPOs, those backed by VC sponsors are more underpriced than BO backed IPOs at the time of listing. The difference in underpricing is statistically significant at all conventional levels using our full sample and a sub sample of matched IPOs. In the long run, we find no performances difference using buy and hold returns. However, using operating performance measures at a company level such as return on assets and operating sales margin over a period of three years post listing, we find significant performance differences in the long run. We further, examine whether performance differences are due to selection effects. Our results show that VC backed IPOs matched with BO backed IPOs underperform in the long run using BHR, return on assets and operating margins. Taken together, our results suggest that BO backed outperform their counterpart VC backed IPOs. However, we do not find any significant difference between the long run performance between both types of IPOs in terms of the risk-adjusted outperformance as measured by the Fama and French three-factor and five factor model. Our results are important for long term investors and entrepreneurs seeking funding from either VC or BO sponsors.

References

Ang, A., Chen, B., Goetzmann, W. N., Phalippou, L., 2013. Estimating private equity returns from limited partner cash flows. Working paper, Columbia University.

Axelson, U., Sorensen, M., Stromberg, P. 2013. The alpha and beta of buyout deals. Working paper, Columbia Business School.

Brav, A., Gompers, P.A., 1997. Myth or reality? The long-run underperformance of initial public offerings: evidence from venture and non-venture capital-backed companies. Journal of Finance 52 (5), 1791–1821.

Chou, D.-W., Gombola, M., Liu, F.-Y., 2006. Earnings management and stock performance of reverse leveraged buyouts. Journal of Financial and Quantitative Analysis 41 (2), 407–438.

Cochrane, J. H., 2005. The risk and return of venture capital. Journal of Financial Economics 75 (1), 3–52.

Driessen, J., Lin, T.-C., Phalippou, L., 2012. A new method to estimate risk and return of non-traded assets from cash flows: The case of private equity funds. Journal of Financial and Quantitative Analysis 47 (3), 511–535.

Ewens, M. (2009). A new model of venture capital risk and return. Working paper, University of California San Diego.

Fama, E. and French, K., 1993. Common risk factors in the returns of stocks and bonds. Journal of Financial Economics 33, 3-55.

Fama, E. and French, K. 2016. Dissecting anomalies with a five-factor model. Review of Financial Studies, 29,69-103.

Franzoni, F., Nowak, E., Phalippou, L., 2012. Private equity performance and liquidity risk. Journal of Finance 67(6), 2341-2373.

Gompers, P.A., 1996. Grandstanding in the venture capital industry. Journal of Financial Economics 42 (1), 133–156.

Gompers, A., Lerner, J., 1997. Venture capital and the creation of public companies: do venture capitalists really bring more than money? Journal of Private Equity, 15-33.

Harris, R. S., T. Jenkinson, T., Kaplan, S. N., 2014. Private equity performance: What do we know? Journal of Finance 69, 1851–1882.

Higson, C., Stucke, R., 2014. The performance of private equity. Working paper, University of Oxford.

Hogan, K.M., Olson, G.T., Kish, R.J., 2001. A comparison of reverse leveraged buyouts and original initial public offers: factors impacting their issuance in the IPO market. Financial Review 36 (3), 1–18.

Jain, B.A., Kini, O., 2000. Does the presence of venture capitalists improve the survival profile of IPO firms? Journal of Business Finance and Accounting 27 (9–10), 1139–1176.

Korteweg, A., Sorensen, M., 2010. Risk and return characteristics of venture capital backed entrepreneurial companies. Review of Financial Studies 23 (10), 3738–3772.

Krishnan, C., Masulis, R., Ivanov, V. and Singh, A., 2010. Venture Capital Reputation, Post-IPO Performance and Corporate Governance. Journal of Financial and Quantitative Analysis 46, 1295-1333.

Lee, P.M., Wahal, S., 2004. Grandstanding, certification and the underpricing of venture capital backed IPOs. Journal of Financial Economics 73 (2), 375–407.

Lerner, J., 1994. Venture capitalists and the decision to go public. Journal of Financial Economics 35 (3), 293–316.

Levis, M. 2011, The performance of private equity backed IPOs. Financial Management, 40, 253-277.

Megginson, W.L., Weiss, K.A., 1991. Venture capitalist certification in initial public offerings. Journal of Finance 46 (3), 879–903.

Metrick, A., Yasuda, A., 2011. Venture capital and other private equity: A survey. European. Financial Management 17 (4), 619–654.

Michala, D. 2016. Are private equity backed initial public offerings any different? timing, information asymmetry and post-IPO survival. Journal of Corporate Finance. Forthcoming.

Neus, W., Walz, U., 2005. Exit timing of venture capitalists in the course of an initial public offering. J. Financial Intermediation 14 (2), 253–277.Ball et al (2011)

Rock, A. 1987. Strategy versus tactics from a venture capitalists. Harvard Business Review. 65, 63-7.

Schwienbacher, A., Giot, P., 2007. IPOs, trade sales and liquidations: Modeling venture capital exits using survival analysis. Journal of Banking and Finance 31 (3), 679–702.

Table 1: Distribution of IPO firms

The table shows the distribution of our sample VC and BO backed IPOs over time.

IPO Year	VC Backed IPOs		BO Backed IPOs	
	Number	Percentage	Number	Percentage
2000	18	3.38	4	1.26
2001	28	5.25	6	1.89
2002	26	4.88	9	2.83
2003	24	4.50	14	4.40
2004	24	4.50	15	4.72
2005	24	4.50	14	4.40
2006	16	3.00	18	5.66
2007	35	6.57	23	7.23
2008	40	7.50	24	7.55
2009	39	7.32	25	7.86
2010	28	5.25	23	7.23
2011	33	6.19	32	10.06
2012	48	9.01	30	9.43
2013	60	11.26	37	11.64
2014	90	16.89	44	13.84
Total	**533**		**318**	

Table 2: Descriptive statistics

The table shows descriptive statistics of the full sample of private equity backed IPOs. Initial returns is the percentage difference between the offer price and first day closing price of the IPO, BHR is the buy and hold return measured over a period of 36 months post IPO date, ROA is the return on assets of the IPO firm, Operating margin equals the operating profit scaled by total sales of the IPO firm, Size equals the total value of assets of the IPO firm measured in USD million, Leverage is the ratio of long term liabilities to total assets of the IPO firm, Volatility is the standard deviation of the stock returns measured over a period of 36 months post listing.

Full sample	**Mean**	**Median**	**STD**	**Min**	**Max**
Initial Returns	0.153	0.103	0.182	-0.059	0.564
BHR	0.241	0.080	0.778	-0.827	1.873
ROA	-0.091	0.004	0.226	-0.872	0.104
Operating margin	-0.394	0.042	1.173	-4.305	0.265
Size	922.169	399.944	1082.101	19.250	3327.534
Leverage	0.195	0.096	0.221	0.000	0.641
Volatility	0.153	0.134	0.071	0.073	0.345
Age	10.522	8.000	5.000	5.000	20.000
Underwriter reputation	0.367	0.000	0.575	0.000	1.000
Analyst coverage	0.651	1.000	1.171	0.000	6.000
Proceeds	246.633	247.000	5.029	230.000	264.000
Turnover (%)	61.046	61.034	3.045	50.498	71.251
Hot issue (%)	33.539	33.576	3.057	22.655	43.782
No of obs	**851**				

Table 3: Univariate analysis

The table shows the mean and median values for IPOs backed by VC and BO sponsors, respectively. T-test measures the difference in means, while Z-score tests the difference in medians. Other variables are as defined in Table 2. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

	VC backed		Buyout backed		Diff means and medians	
Variables	Mean	Median	Mean	Median	t-test	Z-score
Initial Returns	0.189	0.150	0.107	0.063	-12.93***	-9.71***
BHR	0.271	0.109	0.204	0.071	1.21	3.16***
ROA	-0.160	-0.071	-0.006	0.025	29.90***	28.44***
Operating margin	-0.720	-0.068	0.009	0.093	23.60***	31.72***
Size	479	209	1468	1092	35.63***	36.99***
Leverage	0.092	0.001	0.323	0.337	36.08***	31.90***
Volatility	0.166	0.148	0.137	0.117	-16.96***	-18.05***
Age	8.400	7.000	12.672	10.000	1.96**	1.98**
Underwriter reputation	0.359	0.000	0.377	0.000	1.14	1.01
Analyst coverage	0.594	1.000	0.707	1.000	-1.61	-1.53
Proceeds	246.54	246.000	248.744	247.000	1.31	1.42
Turnover (%)	60.952	60.905	61.162	61.167	1.44	1.41
Hot issue (%)	33.555	33.607	33.520	33.528	-1.23	-1.22
No of obs	**533**		**318**			

Table 4: Multivariate analysis: Initial returns and BHR

The table shows OLS regression results. The depended variable in Model I and II is initial returns, while in Model III and IV it is buy and hold returns (BHR). VC is a dummy variable taking a value of one if the IPO is backed by a VC sponsor and zero if it is backed by a BO sponsor. The control variables in Model III and IV are averaged over a period of three years post listing. All regression models include industry and year fixed effects. The variables are as defined in Table 2. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

Variables	**Initial returns**				**BHR**			
	Model I		Model II		Model III		Model IV	
	Ceoff	T-test	Ceoff	T-test	Ceoff	T-test	Ceoff	T-test
Ln size	0.011***	(3.950)	0.018***	(6.340)	0.040***	(3.900)	0.040***	(3.830)
Leverage	-0.048***	(-3.020)	-0.033**	(-2.040)	-0.055	(-0.960)	-0.058	(-0.980)
Volatility	-0.006	(-0.150)	-0.030	(-0.730)	-3.394***	(-22.800)	-3.384***	(-22.700)
VC			0.058***	(7.510)			-0.007	(-0.230)
Constant	0.042	(1.480)	-0.024	(-0.830)	-0.011	(-0.090)	-0.011	(-0.080)
Industry & Year	Y		Y		Y		Y	
Adj R-square	0.088		0.098		0.101		0.112	
No of obs	**851**		**851**		**851**		**851**	

Table 5: Multivariate analysis: ROA and operating margins

The table shows OLS regression results. The depended variable in Model I and II is return on assets (ROA), while in Model III and IV it is operating margins. VC is a dummy variable taking a value of one if the IPO is backed by a VC sponsor and zero if it is backed by a BO sponsor. All control variables in Model I to Model IV are averaged over a period of three years post listing. All regression models include industry and year fixed effects. The variables are as defined in Table 2. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

Variables	**Return on assets (ROA)**				**Operating margins**			
	Model I		Model II		Model III		Model IV	
	Ceoff	T-test	Ceoff	T-test	Ceoff	T-test	Ceoff	T-test
Ln size	0.002	(1.380)	0.001	(0.880)	0.028	(11.010)	0.025***	(9.910)
Leverage	-0.044***	(-4.900)	-0.053	(-5.680)	0.039**	(2.820)	0.012	(0.870)
Volatility	-0.345***	(-14.940)	-0.327***	(-14.220)	-0.472***	(-12.920)	-0.459***	(-12.760)
VC			-0.014***	(-3.120)			-0.037***	(-5.410)
Constant	0.062***	(3.030)	0.069***	(3.360)	-0.005	(-0.170)	0.024	(0.780)
Industry & Year	Y		Y		Y		Y	
Adj R-square	0.112		0.131		0.121		0.141	
No of obs	**851**		**851**		**851**		**851**	

Table 6: Three factor model

The table shows the estimation results for the Fama and French three-factor model. Model I shows the results for the sample VC backed IPOs, while Model II shows the results for the sample buyout backed IPOs. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

	Model I		Model II	
Panel A: three factor	Coef.	T-test	Coef.	T-test
Market excess returns	1.564***	(7.72)	1.212***	(14.39)
SMB	0.948***	(6.73)	0.436***	(7.45)
HML	-0.772**	(-2.66)	-0.223*	(-1.75)
Alpha (monthly)	-0.010*	(-1.66)	-0.011*	(-1.75)
Panel B: Five factor				
Market excess returns	1.116***	(4.33)	1.011***	(6.22)
SMB	1.011***	(5.11)	0.711***	(4.11)
HML	-0.994**	(-2.011)	-0.332*	(-1.88)
Profitability	0.221*	(1.86)	0.361**	(2.10)
investments	-0.055	(-1.22)	0.041	(-1.02)
Alpha (monthly)	-0.001	(-1.22)	0.006	(1.44)

Table 7: Propensity score matching

This table shows the results of the propensity score matching. Panel A shows the univariate analysis of the matched samples of VC and BO backed IPOs. Panel B shows the multivariate analysis using OLS regression analysis. Model I shows the results when the dependent variable is initial return, Model II when the dependent variable is BHR, Model III when the dependent variable is return on assets (ROA), and Model IV when the dependent variable is operating margins. Other variables are as defined in Table 2. We control for year and industry fixed effects. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

Panel A: Univariate	**VC**			**Buyout**			**T-test**	**Z-value**
	Mean	**Median**	**STD**	**Mean**	**Median**	**STD**		
Leverage	0.167	0.022	0.285	0.203	0.014	0.344	1.110	0.911
Volatility	0.201	0.165	0.128	0.170	0.146	0.124	-1.011	-1.112
Market to book	11.314	6.455	13.979	9.770	5.809	13.429	-1.211	-1.001
InSize	5.445	5.374	1.514	6.287	6.007	1.496	0.982	0.991
No of obs	**247**			**104**				

Panel B: Multivariate	Model I		Model II		Model III		Model IV	
	Coeff	T-test	Coeff	T-test	Coeff	T-test	Coeff	T-test
Lnsize	0.002	(0.320)	0.018	(0.650)	0.001	(0.260)	0.001	(0.100)
Leverage	0.006	(0.220)	0.055	(0.400)	0.017	(1.250)	0.001	(0.040)
Volatility	-0.112*	(-1.820)	-0.230	(-0.740)	-0.044	(-1.300)	0.039	(0.530)
VC	0.245***	(6.170)	-0.256***	(-3.260)	-0.283***	(-4.460)	-0.145***	(-7.990)
Constant	0.017	(0.440)	-0.242	(-1.240)	0.028	(1.380)	0.123**	(2.700)
Industry and Year	Y		Y		Y		Y	
Adjusted R-square	0.081		0.090		0.901		0.089	
No of obs	**351**		**351**		**351**		**351**	

Table 8: Multivariate analysis:

The table shows OLS regression results. The depended variable in Model I is the initial return, Model II is buy and hold returns, Model III is ROA and Model IV is Operating profits. All control variables are measured at the time of IPO. All regression models include industry and year fixed effects. The variables are as defined in Table 2. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

Variables	**Dep: Initial returns**		**Dep: BHR**		**Dep: ROA**		**Dep: Profit margins**	
	Model I		Model II		Model III		Model IV	
	Ceoff	T-test	Ceoff	T-test	Ceoff	T-test	Ceoff	T-test
Ln size	0.018	(1.290)	0.040***	(3.770)	0.011**	(2.850)	0.025***	(9.790)
Leverage	-0.032**	(-1.970)	-0.056	(-0.940)	-0.052***	(-5.630)	0.013	(0.910)
Volatility	-0.032	(-0.780)	-3.409***	(-7.710)	-0.328***	(-4.240)	-0.459***	(-6.640)
VC	0.025***	(7.460)	-0.021**	(-2.190)	-0.021***	(-3.050)	-0.013***	(-5.330)
Ln Age	0.001	(0.130)	0.012	(1.110)	0.002	(1.040)	0.003	(0.130)
Underwriter Reput	0.005	(1.070)	0.017*	(1.650)	0.022	(1.870)	0.024*	(1.850)
Analyst coverage	-0.011	(-0.070)	-0.009	(-1.040)	0.011	(0.270)	0.001	(0.330)
Ln Proceeds	0.058**	(2.430)	0.087**	(2.570)	0.044*	(1.770)	0.037*	(1.670)
Turnover	0.011*	(1.870)	0.013*	(1.880)	0.021**	(2.290)	0.023**	(2.850)
Hot issue	0.011**	(2.110)	0.006	(1.540)	0.010*	(1.720)	0.011*	(1.760)
Constant	0.051**	(2.665)	0.055***	(3.322)	0.015	(1.170)	0.024	(1.780)
Industry & Year	Y		Y		Y		Y	
Adj R-square	0.131		0.142		0.133		0.152	
No of obs	**851**		**851**		**851**		**851**	

Appendix A: Definition of the variables

Variables	Definitions	Source
Initial Returns	Initial returns is the percentage difference between the offer price and first day closing price of the IPO	J Ritter website
BHR	BHR is the buy and hold return measured over a period of 36 months post IPO date,	CRSP database
ROA	ROA is the return on assets of the IPO firm,	COMPUSTAT database and IPO prospectus
Operating margin	Operating margin equals the operating profit scaled by total sales of the IPO firm,	COMPUSTAT database and IPO prospectus
Size	Size equals the total value of assets of the IPO firm measured in USD million,	COMPUSTAT database and IPO prospectus
Leverage	Leverage is the ratio of long term liabilities to total assets of the IPO firm,	COMPUSTAT database and IPO prospectus
Volatility	Volatility is the standard deviation of the stock returns measured over a period of 36 months post listing.	CRSP database
Age	Age is the difference between founding date and IPO date in years.	J Ritter website
Underwriter reputation	Underwriter reputation is a dummy equal to one if the underwriter is reputable one and zero otherwise.	J Ritter website
Analyst coverage	Analyst coverage is a dummy and equal to one, if the IPO is covered by reputable analyst and zero otherwise.	J Ritter website

Continue

Proceeds	Proceeds are the proceeds raised at the IPO.	IPO Prospectus
Turnover (%)	Turnover is the turnover at the time of listing and measured as first day volume divided by the number of shares issued.	J Ritter website
Hot issue (%)	Average initial returns of IPOs issued during the three months prior to the month of the IPO (similar to a measure used by Demers and Joos 2007).	J Ritter website