

# **Shadow Capital in Venture Financing: Selection, Valuation, and Exit Dynamic**

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## **Abstract**

Non-venture capital private equity funds (PEs), such as growth and expansion funds, and buyout funds, have become increasingly interested in investing in entrepreneurial firms, which have traditionally been an investment territory of venture capital funds (VCs). We investigate how PEs invest and perform in this space, in comparison to VCs, and the implication of PEs' participation on entrepreneurial firms. Three interesting findings emerge. First, PEs are more likely to invest in entrepreneurial firms after their typical investment period and when there was a substantial capital overhang. PEs often prefer expansion and late-stage ventures. Moreover, PEs are less reluctant to invest in companies that are not located in the same state as the fund. Second, investment size and valuation are significantly larger/higher when PEs participate in an investment round. Interestingly, PEs are less likely to use debt when they invest in entrepreneurial firms. Third, with regard to the exit strategy, we find that PEs generally prefer IPOs and secondary sales to mergers. After controlling for the exit type, we further show that PEs' participation allows entrepreneurial firms more time to get ready for exit. Our results are robust in alternative specifications and after controlling for the potential endogeneity issue related to correlated omitted variables.

## 1. Introduction

The venture capital (VC) industry has changed drastically over the past decade in both size and scope, broadening the types of participants in the market. According to Pitchbook's estimation, the availability of nontraditional capital or shadow capital (e.g., private equity funds, corporations, sovereign wealth funds, mutual funds, hedge funds, among others) in venture investing has reached approximately \$340 billion by the end of 2018.<sup>2</sup> The number of unique nontraditional investors participating in VC deals has outstripped that of traditional venture firms each year from 2013 to 2019.<sup>3</sup> This trend of increasing interest of shadow capital in venture investing raises several interesting questions: How do these shadow capitals select and invest in entrepreneurial companies? What is their impact on the financing, valuation, and exit performance of entrepreneurial firms? What is the implication of this trend for the entrepreneurial ecosystem in the long run? Very little has been studied about these non-traditional investors' increasing involvement in high-growth entrepreneurial companies with a few exceptions (e.g., Kwon et al (2017) investigated mutual funds' involvements in private firms prior to their IPOs). The focus of this paper is private equity funds that invest in entrepreneurial firms.

In 2019, VC deals with private equity funds participation count for 36.9% of total deal value, which makes private equity funds the second most important non-traditional investors (next to corporations) in the VC market. Traditionally, PEs and VCs have very different

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<sup>2</sup> Pitchbook Analyst Note: <https://pitchbook.com/news/reports/q2-2020-pitchbook-analyst-note-shadow-capital-in-venture-investing>

<sup>3</sup> Pitchbook Analyst Note: <https://pitchbook.com/news/reports/q2-2020-pitchbook-analyst-note-shadow-capital-in-venture-investing>

investment objectives, styles, and geographic target areas (Lerner, et al, 2009; Metrick and Yasuda, 2011; Ljungqvist and Richardson, 2017). For instance, VCs often focus on small, young, and high-growth private firms, while most PEs focus on larger and more mature companies, among which many are already public companies. The early-stage investment in Google by Kleiner Perkins Caufield & Byers is clearly a VC-type investment, and the leveraged buyout of Hilton Hotels by Blackstone represents a typical PE transaction. Over the years, however, there has been an increasing interest of PEs in entrepreneurial companies, which overlaps with investments that have traditionally been made by VCs. For instance, in September 2018, KKR led a \$57 million Series B investment in a healthcare startup Clarify Health Solutions. This is very different from KKR's typical transaction, such as its buyout of HCA in 2006.

Why and when do PEs expand their investment territory to the VC space? We consider two market factors and one fund level factor. The cumulative dry powder in the private equity industry or capital overhang has been increasing since 2009. By the end of 2019, the total capital overhang has reached \$3 trillion, double the amount in 2009.<sup>4</sup> The significant amount of dry powder by the PE funds on one hand indicates more capital is flowing into this industry, on the other hand, suggests that some funds are having problems deploying the capital in reasonably profitable investments in their traditional trajectory. The second market factor we consider is the relative performance of PE investments and VC investments. After a decade of underperformance to the S&P 500 (also underperformance to the PE funds) since the tech-bubble period, VCs have been picking up their steam after the financial crisis. Over the period from 2010-2018, the average PME of VC investments relative to the S&P 500 is 1.28, outperforming

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<sup>4</sup> Pitchbook Private Fund Strategies Report 2021.

that of PE investments which is 1.05.<sup>5</sup> We conjecture the better performance of VC investments in the recent decade could have driven PEs to exploit opportunities in the VC space when there is a significant capital overhang in order to boost fund performance. If this is the main reason behind the PEs' increasing investments in entrepreneurial firms, we further propose that PEs' investments in entrepreneurial firms are more likely to take place after their typical investment period.

Next, we seek to understand what kind of entrepreneurial firms PEs invest in and the impact of PEs' participation on the entrepreneurial firms in various ways, including round size, valuation, the use of debt, and the choice of the exit strategy. While both VCs and PEs are typically organized as limited partnerships, invest in illiquid and high-risk assets, play an active role in monitoring and advising, and exit through IPO or a sale, they are quite different from each other in terms of scale, the types of companies they invest, their investment styles, and capital structures traditionally.

The first consideration is scale. VCs, which invest in small and young startup companies requiring intensive active involvement, raise small funds, typically less than \$1 billion. According to NVCA 2018 yearbook, the median VC fund size is \$100 million, with an average fund size at \$218 million.<sup>6</sup> PEs, on the other hand, often raise funds of at least \$1 billion, would find it inefficient to provide the intense oversight required by early-stage companies and to deal with many small companies.

The second difference is the type of companies VCs and PEs traditionally target. VCs primarily invest in startup companies that are characterized by significant intangible assets, a

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<sup>5</sup> PitchBook Benchmarks 2020.

<sup>6</sup> Also see Appendix D with regard to the mean and median PE and VC fund sizes over time.

high level of information asymmetry and uncertainty, and years of negative earnings and cash flows. PEs traditionally invest in troubled companies that need to undergo restructuring. Most of these companies are mature companies. Although both types of companies represent high-risk, potentially high-reward investments, the expertise needed to help the company succeed is rather different.

VCs and PEs also have distinct investment styles. For instance, while VCs typically only obtain minority ownership of their portfolio companies, PEs almost always purchase a majority of their portfolio companies. The majority of VCs are attracted to technology-related industries. On the other hand, PEs invest across all industries. VCs rarely use debt.<sup>7</sup> In contrast, PEs always use a combination of equity and debt in their buyout investment. Their returns are heavily dependent on financial leverage.

These differences between PEs and VCs lead us to conjecture that when investing in entrepreneurial firms, PEs are likely to favor expansion/late-stage firms, and firms that are within the PEs' industry expertise. Financing rounds with PE participation are likely to be much larger than those without. The flux of non-traditional capital into the VC market will likely increase competition for good deals, which implies a higher valuation (Gompers and Lerner, 2000). Moreover, the additional capital from PE funds will provide the underlying firms more time, and thus reach a much larger scale before they exit. Given that firms backed by PEs are much larger in scale, we expect that they are more likely to choose IPO over mergers as their exit strategy.

Using a sample of investments in entrepreneurial companies made between January 2009 and December 2018, we examine PEs' participation in their non-traditional business with a focus

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<sup>7</sup> The use of debt in the VC deals however has been rising over the years. The debt is often provided by venture banks and venture debt funds as an extension of the runway for the entrepreneurial firm before they raise next round of equity financing. It is often used as an effective means for the entrepreneurial firm to reduce ownership dilution.

on their impact on the entrepreneurial firms. We find the cumulative dry powder of the PE industry from the previous year significantly increases the probability of a PE fund to invest in entrepreneurial firms. There is some evidence that the relative performance of PE industry to VC industry in the previous year also helps explain PEs' participation in the VC market. However, the results are only marginally significant. PEs' investments in entrepreneurial firms often took place after the PE funds' typical investment period. These findings suggest one major motivation for PEs to invest in the VC market is to deploy their dry powder. When investing in entrepreneurial firms, in comparison to VCs, PEs prefer investing in expansion and late-stage ventures. They are more willing to invest in geographically distant ventures. Most of their investments are one-time deals in the target company without follow-on investments. Among PEs' investments in entrepreneurial firms, about 60% of the investments are made by growth/expansion funds and 38% involve buyout funds. Mezzanine funds and distressed funds only account for less than 2%. Between growth/expansion funds and buyout funds, we find that buyout funds are more likely to invest in non-technology ventures, ventures that are geographically distant, and more likely to syndicate with VCs.

When investigating the impact of PEs' investments on entrepreneurial firms, we utilize the instrumental variable framework to control for the potential endogeneity of PEs' investments. Specifically, we use the capital overhang in the PE industry and the relative performance of PE industry and VC industry in the previous year as the instruments. After controlling for the endogeneity of PEs' investments, we find the round size is significantly larger when PEs are involved, everything else equal. Moreover, entrepreneurial firms are often higher priced with PEs' participation. Interestingly, we find debt is less likely to be used in rounds with PEs'

investment.<sup>8</sup> Between growth/expansion funds and buyout funds, we find buyout funds' investments increase round size and valuation more than growth/expansion funds, while growth/expansion funds are more likely to utilize venture debt in their investments.

Moreover, PEs' investments in entrepreneurial firms appear to have an impact on the entrepreneurial firms' exit choice. We document that buyout funds' investments are more likely to exit through IPOs and secondary sales, less likely to exit through mergers. In comparison to buyout funds, growth/expansion funds' investments are more likely to exit through mergers.

Our paper is related to a group of literature that examine style drifting in institutional investment. Institutional funds usually provide investors with stated investment objectives in terms of the focus for their investments, for example, value/growth, firm size, stages of entrepreneurial firm development, industry, among others. Style drifting refers to a deviation from the stated objectives, which is often viewed as negatively by investors who invest in a fund. For instance, Cumming, et al (2009) find some venture capital funds invest in firms of developmental stages that are not consistent with their stated focus. Hull (2018) shows that venture capital funds exhibit worse performance when investing in industries that are not their stated preferred industries. Our paper adds new insight to this topic by studying private equity funds' investment in the VC world. We show that PEs are more likely to expand their investment trajectory to the VC space when there is significant capital overhang in the PE industry. PEs choose to invest in entrepreneurial firms that are more similar to companies they traditionally

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<sup>8</sup> Early-stage firms utilize venture debt in one-third of financing rounds despite their general lack of cash flow and collateral (Davis et al, 2020). Debt financing usually occurs when the company has not yet reached a milestone, meaning that the valuation of a new outside equity financing would not be attractive (Gonz'alez-Urbe and Mann, 2017). venture debt is usually provided by venture banks or venture debt funds who outsource due-diligence and monitoring to VCs investing in the company.



work with, for instance, firms that are of later stage, in non-tech industries, and of larger investment scale.

Our paper contributes to the recent discussions on how the increase in the availability of financing to private firms decreases the net benefits of being public, which contributed to the decline in the number of IPOs. Several recent studies (e.g., Gao, Ritter and Zhou, 2013; Doidge Karolyi and Stulz, 2017; Grullon, Larkin, and Michaely, 2018) document the decline in the number of IPOs and the decrease in the number of publicly listed firms in the U.S. market. Kwon et al (2017) find that mutual funds who traditionally only invest in public companies are increasingly investing in private firms. Our study adds additional insight to this trend by showing that private equity funds also are becoming increasingly interested in investing in entrepreneurial firms. Specifically, their participation adds incremental capital to entrepreneurial firms, bids up valuation, allows these firms to stay private longer, but does not increase the probability of IPO.

The remainder is organized as follows. We discuss data and sample and provide summary statistics in section 2. In section 3, we examine PEs' selection, and impact on the round size, valuation, and exit dynamic in multivariate settings. Section 4 concludes the article.

## **2. Data, Sample, and Summary Statistics**

We obtain data on U.S. private equity investments in entrepreneurial companies between 2009 and 2018 from the Thomson One Private Equity database (owned by Refinitiv). Thomson One Private Equity database group PE funds into Growth/Expansion, Buyout, Mezzanine, Restructuring/Turnaround, and others. We only include venture capital transactions when portfolio companies were at their seed, early, expansion, and late stages. Buyout transactions involving private companies are not included in our sample. Moreover, we require the

observation to have the following data available, including investment date, investment amount, industry, location, investor name, among other things. Our final sample consists of 2,521 PE investments in entrepreneurial firms during the period from 2009-2018, among which 1,624 investments are made by Growth/Expansion Funds, and 897 are made by Buyout and other PE funds, and 41,583 traditional VC investments.

Table 1 and Fig. 1 show the yearly distribution of venture financing rounds with PE participation in deal counts and deal value. In comparison to 2009, the deal value with PE participation in venture financing rounds increased more than four folds in 2018. Among different types of PE funds, growth/expansion funds are the most active in investing in entrepreneurial firms, followed by buyout funds. Specifically, about 64% of the PEs investments are made by Growth/Expansion funds, presenting 60% of the deal value with PE participation. The number of deals with buyout funds participation account for 33% of total PE invested venture deals, presenting about 40% of the deal value.

[Insert Table 1 about here.]

[Insert Fig. 1 about here.]

In Table 2 Panel A, we summarize the characteristics of venture deals invested by PEs, in comparison to VCs' investments. We show that although PEs also invest in seed/early-stage ventures (account for about 20% of PEs' venture investments), their investments are more often in expansion stage and late-stage entrepreneurial firms (account for about 40% of PEs' venture investments). In contrast, over 30% of VC investments are in seed/early-stage ventures, with less than 25% in expansion-stage and late-stage companies. Consistent with the PEs' preference for

expansion and late-stage ventures, we find that entrepreneurial firms invested by PEs appear to be significantly older than those invested by VCs at the time of investments.

Similar to VCs, the majority of PEs' investments are in technology-related ventures. However, PEs on average are more willing to invest in non-tech ventures than VCs. It is less likely for a PE fund to invest in a venture that is out of its industry focus. PEs' venture investments are less clustered in California in comparison to VCs. Furthermore, more than 80% of PEs' venture investments are not located within the same state as the fund.

Not surprisingly, PE funds on average are much larger than (more than three folds) VC funds. They also have taken more portfolio companies to IPOs in the past three years at the time of investment. Over 50% of PEs' venture investments are new investments instead of follow-on investments. In contrast, about 57% of VCs' investments are follow-on investments. In fact, only 54% of PEs invest more than one round in the same entrepreneurial firm, while 62% of VCs do so. The average number of rounds PEs invest in the same firm is 2.2, significantly smaller than the number of rounds VCs invest in the same firm, which is 2.7. Moreover, the majority of PEs' investments in entrepreneurial firms took place after the funds' typical investment period. For instance, about 63% of PEs' venture investments took place after six years from their vintage years (57% after eight years from vintage years, and 52% after 10 years from vintage years). When focusing on new investments only, about 33% of PEs' new investments took place after six years from their vintage years (31% after eight years from vintage years, and 29% after 10 years from vintage years). These ratios are significantly higher than VCs.

In rounds with PE participation, the number of investors is significantly smaller than the rounds without PE participation. However, the size of rounds (including both equity and debt

components) with PE participation is about two times that of rounds without PE participation. More specifically, the amount of equity capital contributed by PE funds are more than double the amount contributed by VC funds. Interestingly, rounds with PE participation involve significantly less debt. The post-money valuation of PE-invested entrepreneurial firms are more than three times higher than the valuation of ventures without PE investments.

Among entrepreneurial firms that had exited by 12/31/2020, we do not find significant differences in the probability of IPO or Merger between PE investments and VC investments, nor the exit duration, which is measured as the number of months between the exit date and the date that the firm received its first investment. We do find that PE investments have significantly higher chances of pursuing secondary sales than VC investments.

In Table 2 Panel B, we further compare venture investments by Growth/Expansion funds and Buyout funds. While both types of funds allocate the majority of their capital in expansion and late-stage ventures, buyout funds are more likely to invest in seed/early-stage ventures in comparison to Growth/Expansion funds. Buyout funds are also more likely to invest in non-tech ventures and ventures that are not located in the same state as the fund.

Buyout funds tend to invest in ventures at much later rounds. Moreover, a significantly smaller percentage of buyout funds invest more than one round in the same company. The average number of rounds buyout funds invested in an entrepreneurial firm is 2.0, significantly smaller than growth/expansion funds, which is 2.34. Growth/expansion funds have a greater percentage of investments eight and ten years after their typical investment periods than buyout funds. This is mainly driven by their follow-on investments.

Buyout funds on average are significantly larger than Growth/Expansion funds, but Growth/Expansion funds have taken more portfolio companies to IPOs three years prior to the investment. Rounds involving buyout funds are about five million dollars greater in size. Buyout funds invest \$2 million more equity capital per round, but are less likely to use debt than Growth/Expansion funds. The post-money valuation of entrepreneurial firms involving Buyout funds is more than two times higher than those invested by Growth/Expansion funds.

With regard to the exit performance of PEs' investments in entrepreneurial firms, we find Buyout funds' investments exhibit significantly higher rates of success (including IPO, Mergers, and Secondary sales). Moreover, companies invested by buyout funds on average took about eight months longer to exit.

In summary, our univariate analysis shows that in comparison to VC investments, PE investments are more likely to be in firms at expansion and late-stage, non-tech firms, and firms that are located outside California. PEs often invest in entrepreneurial firms after their typical investment period and many of them only invest one round in a specific entrepreneurial firm. Rounds with PE investments are much larger than those without PE investments and are associated with significantly higher post-money valuation. We also find that there are also distinct preferences by Growth/Expansion funds and Buyout funds when investing in entrepreneurial firms. Buyout funds are more likely to invest in seed/early-stage ventures, non-tech ventures, and those not located in the same state as the fund in comparison to Growth/Expansion funds. Buyout funds often only invest one round in a specific venture at a much later round number. Rounds involving Buyout funds are much greater and with a higher valuation than those involving Growth/Expansion funds. Buyout funds' venture investments have higher success rates than Growth/Expansion funds' investments.

### **3. Multivariate Analysis: Instrumental Variable Framework**

In this section, we investigate several important questions with regard to PE investments in entrepreneurial firms in the multi-variate setting: When do PEs invest in entrepreneurial firms? What types of entrepreneurial firms do PEs invest? Does PE participation increase the total capital raised? What is the impact of PEs' investment on valuation? Do PEs use debt frequently when investing in entrepreneurial firms? What is the effect of PEs' investment on the exit dynamic? Does PEs' participation allow entrepreneurial firms to stay private longer?

#### ***3.1. When do PEs invest in entrepreneurial firms?***

In this subsection, we investigate when PEs invest in entrepreneurial firms and what kind of firms they prefer in their investments using a set of probit regressions. We further compare and contrast the investment behavior between the Growth/Expansion funds and Buyout funds in the VC space.

We start with the full sample by focusing on the general differences between PE investments and VC investments. As shown in Table 3, in specifications (1)-(5), the dependent variable is a dummy variable that is set to equal to 1 if the investor is a PE fund, and 0 if a VC fund. For the independent variables, we consider the development stage of the company (whether the company is at expansion-stage or late-stage), the industry of the company (whether it is a technology company, whether it is out of the fund's industry expertise), the geographic location of the company (whether the company is located in California, whether the company is located in the same state as the fund), whether the investment is a follow-on investment for the fund, and the natural logarithm of the time between the investment date and the fund's vintage date. In specification (1), we include year-fixed effects. In the rest of the specifications, we include two

additional controls, PE capital overhang, which is measured as the natural logarithm of total dry powder in the PE industry in the previous year, and relative performance of PE to VC investments, which is measured as the PME of PE investments to the PME of VC investments in the previous year. We conjecture that PEs are more likely to explore investment opportunities outside their traditional domain when there is a significant capital overhang. The relatively better performance of the VC sector may also lure PEs to invest in the VC space. In specifications (3)-(5), we utilize three indicator variables, *afterinvestmentperiod* ( $>6$  years,  $>8$  years, and  $>10$  years, respectively), to replace the natural logarithm of the time between the investment date and the fund's vintage date. If a PE fund makes a new investment outside its core investment domain after its typical investment period, it is more likely to be driven by the motivation of utilizing its dry powder.

[Insert Table 3 about here.]

Consistent with the univariate analysis, we find that PEs are significantly more likely to invest in expansion-stage and late-stage companies in comparison to VCs. Moreover, they are more willing to invest in companies that are not located in the same state as the fund. There is some evidence that PE funds are more willing to invest in non-tech companies than VCs. On the other hand, PEs are much less likely to make follow-on investments. PEs' investments in entrepreneurial firms are significantly more likely to happen after the fund's typical investment period, regardless of which threshold (6 years, 8 years, or 10 years) we use. Moreover, we find that PEs' investments in entrepreneurial firms are positively correlated with the capital overhang in the PE industry, and negatively correlated with the relative performance of the PE industry to the VC industry. Together, these findings support the notion that PEs' investments in

entrepreneurial firms are mainly motivated by their need to utilize their dry powder to boost fund performance.

In specification (5)-(8), we compare Growth/Expansion funds' venture investments to VCs, Buyout funds' venture investments to VCs, and Growth/Expansion funds' venture investments to Buyout funds' venture investments, respectively. Growth/Expansion funds and Buyout funds exhibit some similarities when they invest in entrepreneurial firms. For instance, both prefer expansion and late-stage companies. Both are more willing to invest in out-of-state ventures than VCs. Both are more likely to invest in entrepreneurial firms during the post-investment period. The direct comparison between Growth/Expansion funds and Buyout funds in the specification (8) suggests there are some distinctions in their preferred venture investments. For instance, in comparison to Growth/Expansion funds, Buyout funds are more likely to invest in non-tech ventures and out-of-state ventures. Moreover, Buyout funds are more likely to syndicate with VCs when investing in entrepreneurial firms than Growth/Expansion funds.

In summary, PE funds invest in entrepreneurial firms by focusing on expansion and late-stage ventures. Interestingly, PEs, especially Buyout funds show greater flexibility with regard to the geographic location of the portfolio company, in contrast to the local bias often found among VCs (e.g., Cumming and Dai, 2010). It is likely that many PEs, especially Buyout funds that often invest in later rounds and often participate in one round only, outsource the monitoring responsibility to VCs that have previously invested in the company. Moreover, PEs are more likely to invest in entrepreneurial firms after the fund's typical investment period, when there was a substantial amount of capital overhang, and when PE investments on average performed relatively worse than VC investments in the previous year. These findings indicate at least for



some PEs, deploying their excess capital to boost fund performance could be one of the motivations for them to participate in the VC market.

### ***3.2 Round Size, Valuation, and the Use of Debt in PE Invested Deals***

To shed light on the ways in which PE participation potentially benefits entrepreneurial companies, we seek in this section to understand the extent to which PEs' participation provides new capital to the underlying companies, the pricing of the deal, and the use of debt in a specific round. The main empirical challenge in this set of analyses is the potential endogeneity of PEs' investment in the VC space.

As shown in section 3.1., PEs have unique preferences when investing in entrepreneurial firms. These characteristics of entrepreneurial firms may endogeneously affect the size of a round, the valuation of the company, and the use of debt. To address this endogeneity issue, we adopt the instrumental variable framework. Specifically, we argue that the cumulative dry powder in the PE industry is shown to be positively correlated with the probability of PEs' investment in the VC market, which nevertheless should not have a direct causal effect on the size, or the valuation, or the use of debt in a venture investment. Similarly, the relatively poor performance of the PE industry to the VC industry from the previous year may drive some PEs to explore opportunities in the VC market, there is no obvious reason to believe this will have a causal effect on the size of the deal, the valuation of the venture, and/or whether to use debt in the venture investment.

When instruments are weakly correlated with endogenous regressors, conventional methods for instrumental variables estimation and inference become unreliable. To test whether

our instruments are weak, we performed both the Montiel-Pflueger and Anderson-Rubin Wald tests as recommended by Andrews et al (2018). Both reject the null of weak instruments.

In Table 4, we report the results for the second-stage regressions from the two-stage instrumental variable framework. In Panel A, the dependent variable is the natural logarithm of the round amount, including both equity and debt if any. In Panel B, we investigate whether debt is used in a specific round.<sup>9</sup> In Panel C, we examine the post-money valuation of the entrepreneurial firm. In specifications (1), (5), and (9), we use the full sample and compare PEs investments to VCs investments. In specification (2), (6), and (10), we focus on the differences between investments by Growth/Expansion funds and VC funds. In specifications (3), (7), and (11), we examine the differences between investments by Buyout funds and VC funds. Finally, in specifications (4), (8), and (12), we compare investments by Growth/Expansion funds and Buyout funds. The first stage regressions are probit regressions as reported in specifications (3), (6), (7) and (8) in Table 3, where we model the investment selection by PEs in comparison to VCs, Growth/Expansion in comparison to VCs, Buyout in comparison to VCs, and Growth/Expansion in comparison to Buyout, respectively.

[Insert Table 4 about here.]

Our key independent variables of interest are three indicator variables about the type of the fund. PE is set to 1 if the investor is a private equity fund, and 0 if a VC fund. Growth/Expansion is equal to 1 if the PE fund is a Growth/Expansion fund, and 0 if otherwise. Buyout is equal to 1 if the PE fund is a Buyout fund, and 0 if otherwise. In all specifications, we further control for the number of IPOs the fund managed in the past three years and its interaction with the fund type dummies, age of the entrepreneurial firm at the time of

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<sup>9</sup> In unreported regressions, we also used the natural logarithm of debt amount, and the percentage of debt to equity. The results are consistent.

investments, the number of investors participating in the round, the development stage of the firm at the time of investments, whether the firm is a non-tech venture, and whether the firm is located in California.

As shown in Table 4 Panel A, PE participation significantly increases round size. Specifically, on average, rounds with PE participation raise \$4.5 million more funding than those without PE participation, *ceteris paribus*. In specifications (2) and (3), when we compare investments of growth/expansion funds and buyout funds to VCs respectively, we find similar results. These findings suggest that PEs' participation in entrepreneurial firms provides them with additional capital that they may not be able to raise from VCs. A natural follow-up question is: Does the additional amount of private capital allow entrepreneurial firms to stay private longer and perform better? We address this question in section 3.4.

Among the control variables, we find the number of IPOs the fund managed in the past three years are positively and significantly correlated with round size. The interaction terms are not significant. We find that syndicate size or the number of investors is positively correlated with round size. Expansion stage and late-stage companies, and older companies raise larger rounds. Technology companies and companies located in California on average raise more capital. These are consistent with what has been documented in the existing literature on entrepreneurial financing.

The use of debt in venture capital financing has been on the rise over recent years, often provided by venture debt funds and venture banks to companies that need capital to extend the runway without further diluting their equity ownership. Some rounds are purely equity financed, while others are a combination of equity and debt. In Table 4 Panel B, we examine whether PEs'

investments in entrepreneurial firms are associated with the use of debt. We find PEs' investments in entrepreneurial firms are on average associated with a lower likelihood of using debt in the deal. Specifically, the probability of using debt in a round is 56% lower with PEs' participation. This is the case for both growth/expansion funds and buyout funds. This makes intuitive sense considering that an important motivation for PEs to invest in the VC space is to deploy their dry powder during their post-investment period. Between Growth/Expansion funds and buyout funds, we find a higher chance of using debt when the former is involved.

Valuation is often a contentious negotiation point between entrepreneurial firms and investors, as well as between the existing investors and new investors in venture capital investments (Hsu, 2004; Hochberg et al., 2010; Gompers et al., 2010; Cumming and Dai, 2011). For new investors, their ultimate return is positively associated with the difference between exit proceeds at a liquidity event and the price they paid up to invest in the entrepreneurial firms. For entrepreneurs and existing investors, the valuation they receive at a financing round determines how ownership stake they have to give up for a certain amount of capital infusion, which directly impact the control structure of the firm. In this section, we examine how PE participation has potentially affected the valuation of entrepreneurial firms. Gompers and Lerner (2000) provides empirical evidence that when money chases deals, investors typically offer higher valuation everything else equal. Additional capital flow from PE funds into the VC market could have increased competition among investors, which may drive up the valuation. Moreover, as new entrants to the VC market, PE funds may have to pay a premium price to existing VCs in order to access to VC type investment opportunities, especially if they have to rely on existing VCs' monitoring activities.

A caveat for the empirical analysis on the valuation of entrepreneurial firms is that valuation data is often not disclosed, resulting in a large number of missing values. In our sample, out of the 44,104 investor-company observations, only 863 observations have valuation data. In Table 4 Panel B, we follow the model in Gompers and Lerner (2000) and Cumming and Dai (2010) to examine the post-money valuation of ventures. We find PE participation is positively associated with a higher valuation. In particular, firms with PEs' investments are priced almost \$178 million higher than those without. This is not purely driven by the greater investment amount in PE deals as this way exceeds the additional equity capital infused by PEs (around \$1.3 million).<sup>10</sup> A higher valuation indicates a less diluted ownership for founders and existing VCs. The question is why PEs are willing to pay more. A plausible explanation is that PEs have to pay a premium in order to get access to the investment opportunity controlled by VCs. In addition, if PEs have to rely on existing VCs for monitoring, they will have to offer some sort of compensation (higher price) to the existing VCs.

In summary, our analysis in this section shows that PEs' participation in venture investments allows entrepreneurial firms to raise more equity capital at a relatively higher valuation everything else equal. This is not only beneficial to the founders but also the existing VCs. In the section that follows, we further investigate the relation between PEs' participation in the VC market and the landscape with regard to exit choices.

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<sup>10</sup> In unreported regressions, we follow the Heckman Two-Stage model in Gompers and Lerner (2000) and Cumming and Dai (2010) to assess the impact of missing values on our results. The first stage is a probit regression on the probability of valuation data for a specific investment being reported. Our second stage is an OLS regression whether the dependent variable is the natural logarithm of valuation. The results are qualitatively similar.

### 3.3 PEs' Preferred Exit Strategy

In this section, we analyze whether PE's investments in entrepreneurial companies make a difference in terms of companies' exit strategies. Specifically, we consider exiting through IPO, mergers, and secondary sales among the investments made between 2009 and 2018 by 12/31/2020.

Similar to our analysis in section 3.2, we use the instrumental variable framework to control for the endogeneity of PE investments. The first stage regressions are probit regressions as reported in specifications (3), (6), (7) and (8) in Table 3, where we model the investment selection by PEs in comparison to VCs, Growth/Expansion in comparison to VCs, Buyout in comparison to VCs, and Growth/Expansion in comparison to Buyout, respectively. The second stage regressions are a set of probit regressions where we model the probability of exits through IPO (specifications (1)-(4)), merger (specifications (5)-(8)), or secondary sales (specifications (9)-(10)). Our key independent variables of interest are three indicator variables about the type of the fund. PE is set to 1 if the investor is a private equity fund, and 0 if a VC fund. Growth/Expansion is equal to 1 if the PE fund is a Growth/Expansion fund, and 0 if otherwise. Buyout is equal to 1 if the PE fund is a Buyout fund, and 0 if otherwise. In all specifications, we further control for the number of IPOs the fund managed in the last three years and its interaction with fund type dummies, the age of the entrepreneurial firm at the time of investments, the number of investors participating in the round, the development stage of the firm at the time of investments, whether the firm is a non-tech venture, and whether the firm is located in California.

[Insert Table 5 about here.]

As shown in Table 5, we find that overall, PE investments are not more likely to exit through IPOs with the exception of Buyout funds' investments. Specifically, Buyout funds' participation increases the probability of an IPO exit by 16.5%. PEs are more likely to consider secondary sales, but have a lower probability of pursuing mergers in comparison to VCs. Between Growth/Expansion funds and Buyout funds, we show that Growth/Expansion funds' investments are significantly more likely to exit through mergers, but there is no significant difference in the probability of IPOs and secondary sales.

In Table 6, we further examine whether PE participation gives companies more time before exit, which is measured as the duration between the exit date and the date the company receiving the very first round of financing (in months). Therefore, only firms that exited by 12/31/2020 are used in this set of analysis. Similar to our earlier analyses, we used the instrumental variable framework to control for the endogeneity of PE investments. The results of the second-stage regressions are reported in Table 6. In all regressions, we control for the number of IPOs the fund managed in the past three years and its interaction with fund type dummies, the age of the entrepreneurial firm at the time of investments, the number of investors participating in the round, the development stage of the firm at the time of investments, whether the firm is a non-tech venture, and whether the firm is located in California. Furthermore, we include exit type fixed effect.<sup>11</sup>

[Insert Table 6 about here.]

We find that overall PE participation significantly increases the exit duration, regardless the development stage of the ventures when they receive PEs' investments. Given our earlier

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<sup>11</sup> In our sample, we find the duration to exit is the longest by companies that exit through secondary sales, with an average of 110 months, followed by the companies that exit through IPOs, with an average of 93 months. The average duration for companies that exit through mergers is 84 months.

finding that PEs invest significantly more equity capital than VCs, we argue that the additional capital brought in by PEs likely provided companies more time to get ready for the exit.

#### **4. Conclusions and Discussions**

Over the recent years, private equity funds are increasingly investing in the world of venture capital. In this paper, we examine why and when PEs expand their investments to the VC market, the characteristics of entrepreneurial firms invested by PEs, and the implication of PE investments for entrepreneurial firms in terms of round size, valuation, use of debt, and the choice of the exit strategy.

We show PEs' participation in the VC market is positively associated with the capital overhang in the PE industry. Most of PEs' investment in entrepreneurial firms take place after the PE funds' typical investment period. It seems PEs' investment in the VC deals to a large extent is a means of deploying their dry powder. That said, PEs' participation in the VC market has some positive implications for entrepreneurial firms. For instance, firms invested by PEs are able to raise larger rounds at a higher valuation, which provides firms more time to get ready for exit.

Our evidence on PEs' participation in the VC market and its impact on entrepreneurial firms also suggests that the emergence of various shadow capital in the VC market increases the availability of private capital to entrepreneurial firms. This has important implications for the duration companies stay private, as well as whether and how to exit. For late-stage entrepreneurial firms, when private capital is abundant at a reasonable cost of capital, exiting through the public market will be mainly driven by the liquidity needs of existing investors and



founders. For such companies, direct listing at an exchange can be a preferred approach given its speed and low cost. Alternatively, investors can exit through secondary sales as this market is getting more mature.

## References

- Chernenko, S., Lerner, J., and Zeng, Y., 2017. Mutual Funds as Venture Capitalists? Evidence from Unicorns. Working Paper, Purdue University.
- Cumming, D., D.S. Siegel, M. Wright, 2007. Private Equity, Leveraged Buyouts and Governance. *Journal of Corporate Finance* 13, 439-460.
- Cumming, D., and N. Dai, 2011. Fund Size, Limited Attention and Valuation of Venture Capital Backed Firms. *Journal of Empirical Finance* 18(1), 2-15.
- Cumming, D., G. Flemming and A. Schwienbacher, 2009. Style Drift in Private Equity. *Journal of Business Finance & Accounting* 36(5), 645-678.
- Doige, C., G. A. Karolyi, and R. M. Stulz, 2017. The U.S. Listing Gap. *Journal of Financial Economics* 123 (3), 464-487.
- Gao, X., J. Ritter and Z. Zhou, 2013. Where Have All the IPOs Gone? *Journal of Financial and Quantitative Analysis* 48 (6), 1663-1692.
- Gompers, P.A., and J. Lerner, 2010. Money Chasing Deals? The Impact of Fund Inflows on the Valuation of Private Equity Investments. *Journal of Financial Economics* 55, 281-325.
- Hochberg, Y., A. Ljungqvist, and Y. Lu, 2010. Networking as a Barrier to Entry and the Competitive Supply of Venture Capital. *Journal of Finance* 65(3), 829-859.
- Hsu, D., 2004. Why Do Entrepreneurs Pay for Venture Capital Affiliation? *Journal of Finance* 59, 1805-1844.
- Huang, S., Y. Mao, C. Wang, and D. Zhou, 2018. Public Market Players in the Private World: Implications for the Going-Public Process. Working Paper. University of Hong Kong.
- Hull, 2018. The Effect of Venture Capitalists Straying from Their Industry Comfort Zones. Working Paper. University of Massachusetts Boston.
- Kwon S., Lowry, Michelle, and Qian Y., 2017. Mutual Fund Investments in Private Firms. Working Paper, Drexel University.
- Lerner, J., Leamon, A., and Hardyman, F., 2009. *Venture Capital, Private Equity, and the Financing of Entrepreneurship*. Wiley.
- Ljungqvist, A.P. and M.P. Richardson, 2017. The Investment Behavior of Buyout Funds: Theory and Evidence. Working Paper, New York University.

Metrick, Andrew, and Ayako Yasuda, 2011. Venture capital and the finance of innovation, 2<sup>nd</sup> edition, Wiley.

National Venture Capital Association Yearbook, 2016.

## Appendix A: Definitions of Variables

Variables	Definitions
PE	Dummy variable that is set to 1 if the investor is a non-VC private equity fund, 0 otherwise.
Growth/Expansion	Dummy variable that is set to 1 if the investor is a growth/expansion fund, 0 otherwise.
Buyout	Dummy variable that is set to 1 if the investor is a buyout fund, 0 otherwise.
Expansion	Dummy variable that is set to 1 if the entrepreneurial firm is at expansion stage when receiving a specific round of financing, and 0 otherwise
Latestage	Dummy variable that is set to 1 if the entrepreneurial firm is at late stage when receiving a specific round of financing, and 0 otherwise
LnAge	Natural logarithm of the age of the entrepreneurial firm at the time of investment
Followon	Dummy variable that is set to 1 if it is an entrepreneurial firm's first round of financing, and 0 otherwise
LnRounNInvestors	Natural logarithm of the number of investors participating a specific round
LnRoundNVC	Natural logarithm of the number of VCs participating a specific round
LnTimefromfirstiv	Natural logarithm of the time from the first round
NonTech	Dummy variable that is set to 1 if the entrepreneurial firm is not in the following industries: computer related, biotechnology, communications and media, medical/health/life science, semiconductors
NonCA	Dummy variable that is set to 1 if the entrepreneurial firm is not located in California, 0 otherwise.
OutofIndFocus	Dummy variable that is set to 1 if the industry of the entrepreneurial firm is not within the stated industry focus of the investor, 0 otherwise.
OutofState	Dummy variable that is set to 1 if the entrepreneurial firm is not located within the same state of the investor, 0 otherwise.
AfterInvestmentPeriod (>6 years)	Dummy variable that is set to 1 if the investment was made 6 years after the fund's vintage year, 0 otherwise.
AfterInvestmentPeriod (>8 years)	Dummy variable that is set to 1 if the investment was made 8 years after the fund's vintage year, 0 otherwise.
AfterInvestmentPeriod (>10 years)	Dummy variable that is set to 1 if the investment was made 10 years after the fund's vintage year, 0 otherwise.

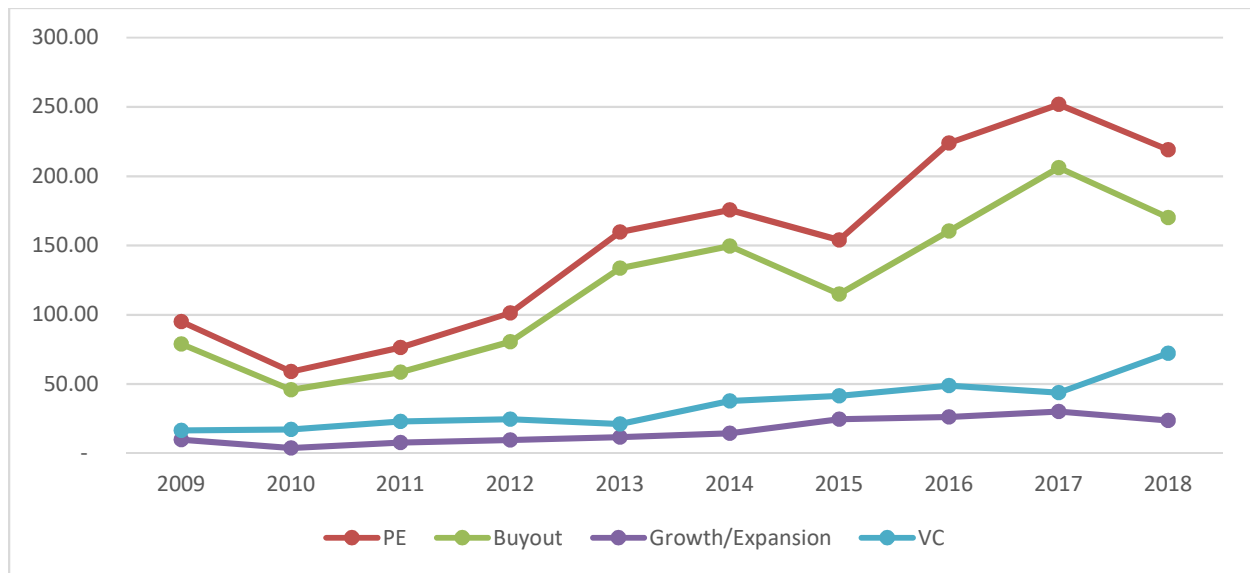
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PEoverhang	Natural logarithm of cumulative capital overhang in the PE industry in the previous year
PEVCrelativeperformance	The ratio of PE PME to VC PME from the previous year
LnRoundsize	Natural logarithm of the size of the round
LnValuation	Natural logarithm of the post-money valuation
UseDebt	Dummy variable that is set to 1 if debt is raised in a specific round, 0 otherwise
LnNIPs	Natural logarithm of the number of IPOs by the fund in the last three years
IPO	Dummy variable that is set to 1 if the entrepreneurial firm exited via IPO by 12/31/2020
Merger	Dummy variable that is set to 1 if the entrepreneurial firm exited via merger by 12/31/2020
Secondary	Dummy variable that is set to 1 if the entrepreneurial firm exited via secondary by 12/31/2020
LnExitDuration	Natural logarithm of the duration between exit date and the first investment date

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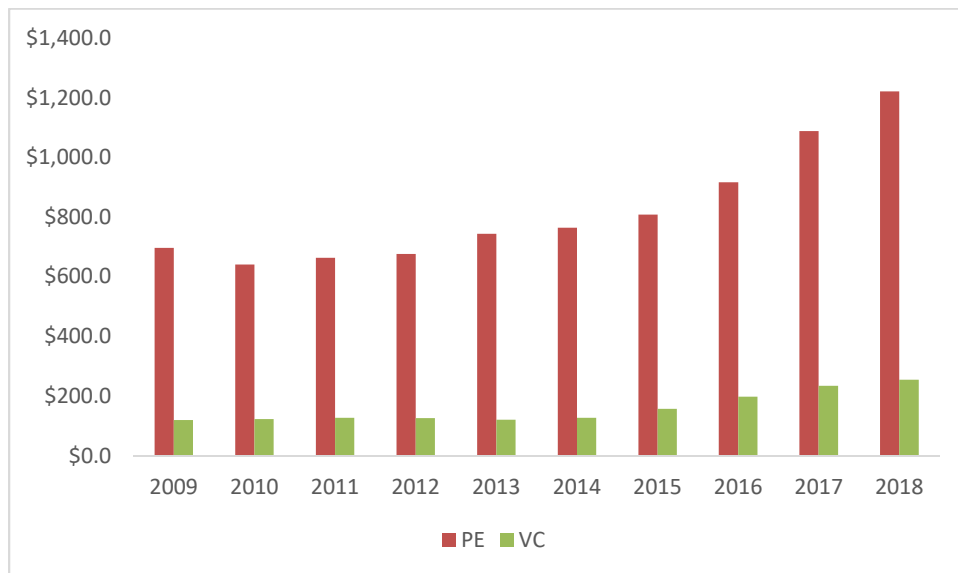
## Appendix B: Fund Raising by PEs and VCs, 2009-2018

	PE		Buyout		Growth/Expansion		VC	
	Capital Raised (\$B)	N of Funds	Capital Raised (\$B)	N of Funds	Capital Raised (\$B)	N of Funds	Capital Raised (\$B)	N of Funds
2009	95.10	145	78.86	100	9.89	28	\$16.5	148
2010	59.00	151	45.88	99	3.92	23	\$17.3	169
2011	76.34	175	58.60	114	7.78	37	\$23.1	191
2012	101.39	202	80.56	136	9.69	39	\$24.7	269
2013	159.82	292	133.54	203	11.65	57	\$21.2	290
2014	175.71	363	149.57	278	14.39	54	\$37.8	447
2015	153.94	364	114.89	259	24.67	72	\$41.4	526
2016	223.83	374	160.34	273	26.38	67	\$49.0	583
2017	251.73	422	206.14	325	30.23	69	\$43.7	573
2018	218.97	384	170.05	292	23.68	64	\$72.3	706



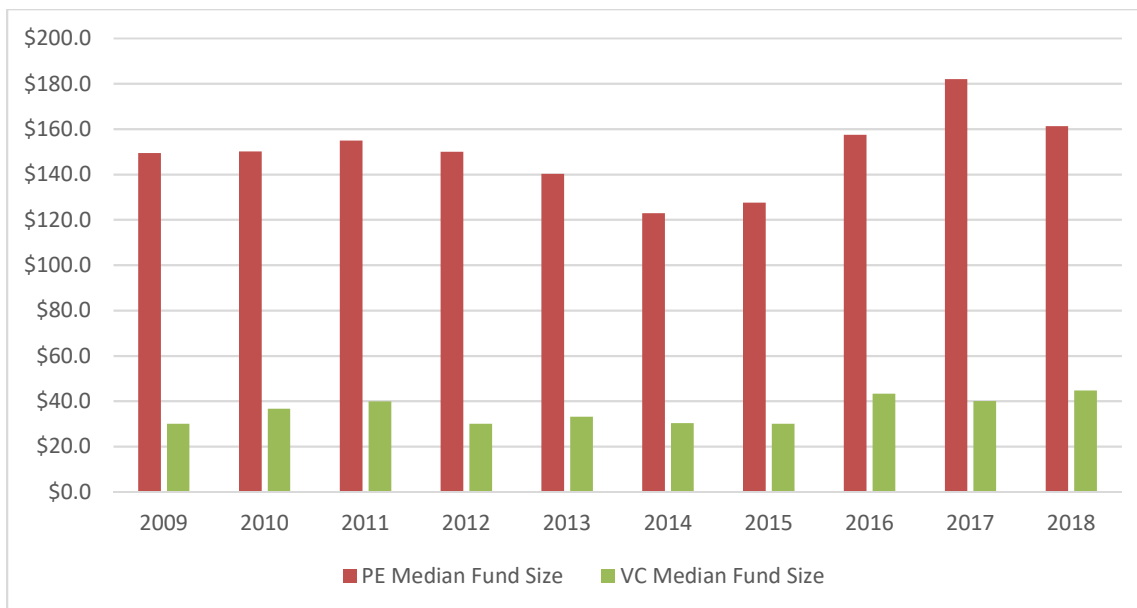
## Appendix C: Capital Overhang

	PE (\$B)	VC (\$B)
2009	\$696.9	\$119.5
2010	\$641.2	\$123.4
2011	\$663.4	\$127.4
2012	\$676.9	\$126.2
2013	\$744.3	\$120.5
2014	\$764.7	\$127.5
2015	\$808.5	\$157.6
2016	\$917.0	\$198.1
2017	\$1,088.7	\$234.4
2018	\$1,221.2	\$255.3

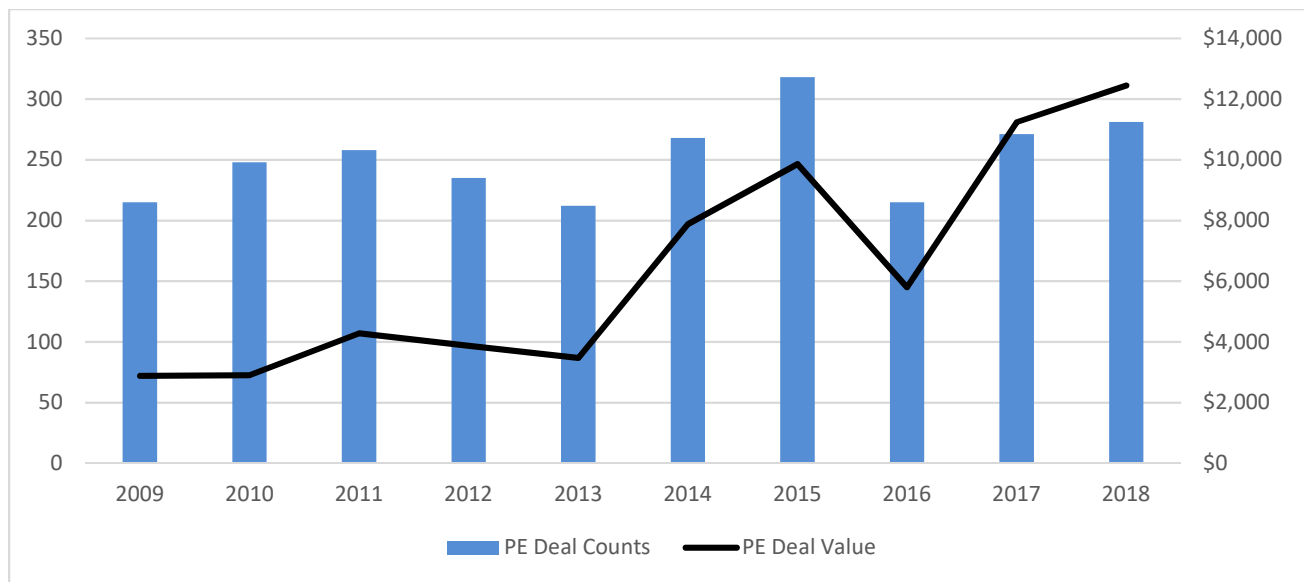


## Appendix D: Fund Size

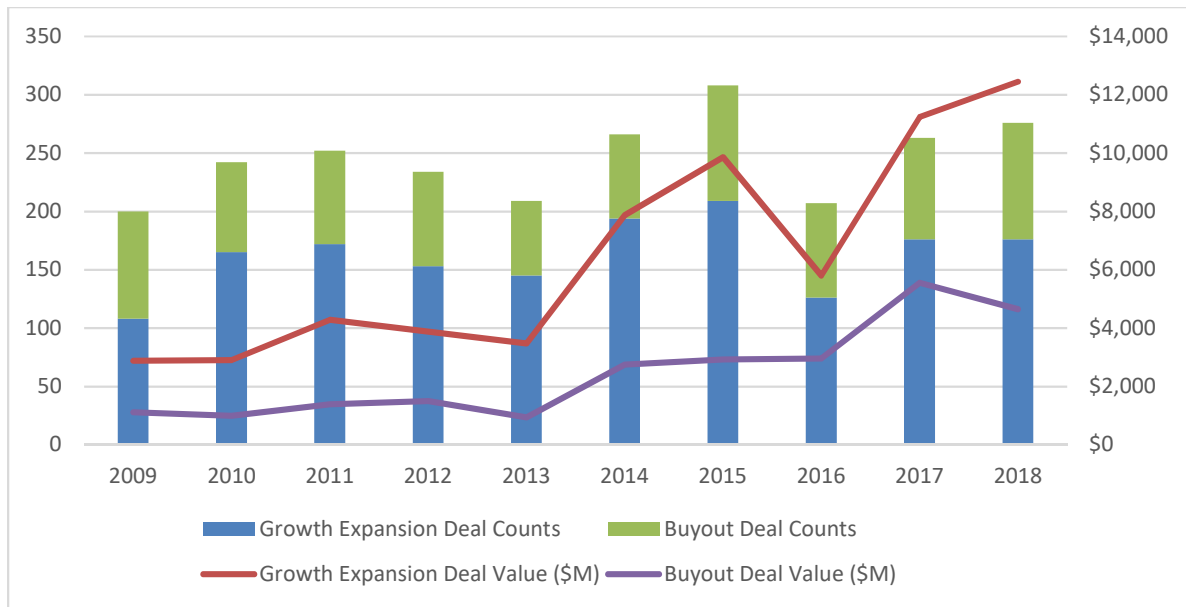
	PE (\$M)		VC (\$M)	
	Mean	Median	Mean	Median
2009	\$528.0	\$149.4	\$90.7	\$30.0
2010	\$358.6	\$150.1	\$106.2	\$36.7
2011	\$434.2	\$155.0	\$122.4	\$39.8
2012	\$467.4	\$150.0	\$104.4	\$30.0
2013	\$537.4	\$140.2	\$90.1	\$33.1
2014	\$548.2	\$123.0	\$101.9	\$30.3
2015	\$447.7	\$127.6	\$114.2	\$30.0
2016	\$599.0	\$157.5	\$131.0	\$43.2
2017	\$626.7	\$182.0	\$139.7	\$40.0
2018	\$795.1	\$161.4	\$152.5	\$44.7







**Fig. 1a Private Equity Investment in Entrepreneurial Firms by Year, 2009-2018**



**Fig. 1b Growth Expansion Funds Investment in Entrepreneurial Firms vs. Buyout Funds**

**Investment in Entrepreneurial Firms, 2009-2018**

**Table 1 Year Distribution of PE Investment in Entrepreneurial Companies, 2009-2018**

Year	Deal Counts	Growth/Expansion	Buyout	Deal Value (\$M)	Growth/Expansion (\$M)	Buyout (\$M)
2009	215	108	92	\$ 2,881	\$1,642	\$1,113
2010	248	165	77	\$ 2,902	\$1,898	\$1,001
2011	258	172	80	\$ 4,283	\$2,855	\$1,392
2012	235	153	81	\$ 3,878	\$2,356	\$1,507
2013	212	145	64	\$ 3,477	\$2,538	\$ 941
2014	268	194	72	\$ 7,879	\$5,083	\$2,758
2015	318	209	99	\$ 9,858	\$6,667	\$2,930
2016	215	126	81	\$ 5,805	\$2,722	\$2,964
2017	271	176	87	\$ 11,247	\$5,526	\$5,559
2018	281	176	100	\$ 12,448	\$7,603	\$4,650
Total	2521	1624	833	\$ 64,758	\$38,890	\$24,915

**Table 2 Characteristics of Private Equity Investments in Entrepreneurial Companies**

Our sample consists of 44,104 investments in entrepreneurial firms made by PEs and VCs between 2009 and 2018. Panel A compares PE investments to VC investments in entrepreneurial firms. Panel B compares investments by Growth/Expansion funds to investments by Buyout funds. Company characteristics include their development stage, industry and geographic location. Deal characteristics include round number, number of investors, whether it is a follow-on investment, round size, amount of debt, fund equity capital invested, and valuation. Fund characteristics include fund size, whether the investment is out of the fund's industry focus, whether the investment is out of the state where the fund is located, whether the investment was made after the investment period. Exit characteristics include IPO, Merger, Secondary Sales, and exit duration which is measured as the number of months between the first investment date and the exit date. Please refer to appendix for detailed explanations for all the variables. Significance is marked with \* at 10%, \*\* at 5%, and \*\*\* at 1%.

Panel A: Investments by PEs vs. Investments by VCs

<i><b>Company Characteristics</b></i>	Traditional VCs	PEs	P-value of Diff.
Seed/Early	32.32%	19.04%	0.000***
Expansion	15.06%	20.51%	0.000***
Late Stage	9.48%	19.24%	0.000***
Company Age at Investment	3.01	3.39	0.000***
Biotechnology	5.65%	2.02%	0.000***
Media/Communication	2.28%	2.86%	0.063*
Computer	37.75%	43.55%	0.000***
Medical/Life Science	4.76%	3.53%	0.005***
Semiconductor	1.63%	0.71%	0.000***
Non-Tech	4.78%	6.11%	0.003***
Out of Fund Industry Focus	12.40%	8.65%	0.000***
CA	26.29%	23.21%	0.001***
Out of Fund State	71.00%	81.00%	0.000***
<i><b>Fund Characteristics</b></i>			
% Follow-on Investments	56.64%	46.25%	0.000***
Investment Year from Fund Vintage Year (>6)	44.91%	63.19%	0.000***
Investment Year from Fund Vintage Year (>8)	33.59%	56.88%	0.000***
Investment Year from Fund Vintage Year (>10)	25.07%	52.20%	0.000***
New Investment 6 years after Fund Vintage Year	14.46%	33.04%	0.000***
New Investment 8 years after Fund Vintage Year	11.93%	30.70%	0.000***
New Investment 10 years after Fund Vintage Year	10.10%	28.64%	0.000***
% invested more than one round in the company	62.24%	54.54%	0.000***
Number of Rounds Fund Invested in the Company	2.66	2.23	0.000***
Fund Size (\$M)	183	670	0.000***
N of IPOs in the Last Three Years	0.54	1.62	0.000***
<i><b>Deal Characteristics</b></i>			
Round Number	3.97	3.93	0.533
N of Investors	2.03	1.78	0.000***
Round Size (\$M)	13.5	25.7	0.000***

Debt Amount (\$M)	0.23	0.10	0.039**
Equity Contributed by Fund (\$M)	3.08	8.13	0.000***
Valuation (\$M)	14.70	49.90	0.000***
<b><i>Exit</i></b>			
IPO	8.40%	7.60%	0.164
Merger	23.00%	21.60%	0.105
Secondary Sales	1.30%	3.90%	0.000***
Exit Duration (months)	87.34	87.79	0.786
N of Observations	41583	2521	

Panel B: Investments by Growth/Expansion Funds vs. Investments by Buyout Funds

<b><i>Firm Characteristics</i></b>	Growth/Expansion	Buyout	P-value of Diff.
Seed/Early	17.80%	22.69%	0.004***
Expansion	21.18%	19.93%	0.259
Later Stage	18.60%	20.40%	0.468
Company Age at Investment	3.24	3.49	0.093*
Biotechnology	0.80%	4.30%	0.000***
Media/Communication	3.02%	2.28%	0.292
Computer	46.50%	39.50%	0.000***
Medical/Life Science	1.60%	7.02%	0.000***
Semiconductor	0.86%	0.48%	0.294
Non-Tech	4.80%	6.96%	0.000***
Out of Fund Industry Focus	8.31%	8.40%	0.939
CA	24.45%	21.25%	0.076*
Out of Fund State	78.76%	85.35%	0.000***
<b><i>Fund Characteristics</i></b>			
Follow-on Investments	46.98%	45.98%	0.637
Investment Year from Fund Vintage Year (>6)	64.59%	63.27%	0.516
Investment Year from Fund Vintage Year (>8)	59.79%	54.02%	0.006***
Investment Year from Fund Vintage Year (>10)	55.97%	47.54%	0.000***
New Investment 6 years after Fund Vintage Year	33.25%	34.21%	0.633
New Investment 8 years after Fund Vintage Year	31.40%	30.85%	0.78
New Investment 10 years after Fund Vintage Year	29.43%	28.45%	0.612
Syndicate with VCs	39.47%	41.90%	0.246
% Invested More than One Rounds in the Company	56.40%	51.17%	0.000***
Number of Rounds Invested in the Company	2.34	2.03	0.000***
Fund Size (\$M)	234	1570	0.000***
N of IPOs in the Last Three Years	2.03	0.90	0.000***
<b><i>Deal Characteristics</i></b>			

Round Number	3.73	5.10	0.000***
N of Investors	1.75	1.85	0.041**
Round Size (\$M)	23.9	29.4	0.029***
Debt Amount (\$M)	0.13	0.04	0.037**
Equity Contributed by Fund (\$M)	7.70	9.20	0.025***
Valuation (\$M)	35.20	82.3	0.032**
<i>Exit</i>			
IPO	6.80%	29.63%	0.000***
Merger	23.28%	58.14%	0.000***
Secondary Sales	3.80%	11.85%	0.000***
Exit Duration (months)	84.49	92.76	0.016**
N of Observations	1624	270	

**Table 3: When Do PEs invest in Entrepreneurial Firms?**

This table shows the results of a set of probit regressions pertaining to the type of entrepreneurial firms PEs invest and when PEs invest in entrepreneurial firms. Specifications (1) – (5) use the full sample. The dependent variable in specifications (1)–(5) is a dummy variable, *PE*, which is set to equal to 1 if the investor is a growth/expansion fund, or buyout fund, or other private equity funds, and 0 if the investor is a VC fund. Specification (6) focuses on investments by Growth/Expansion funds. The dependent variable in specification (6) is a dummy variable, Growth/Expansion, which is set to equal to 1 if the investor is a growth/expansion fund, and 0 if the investor is a VC fund. Specification (7) focuses on investments by Buyout funds. The dependent variable in the specification (7) is a dummy variable, Buyout, which is set to equal to 1 if the investor is a buyout fund, and 0 if the investor is a VC fund. Specification (8) compares investments by Growth/Expansion funds and Buyout funds. The dependent variable in specification (8) is a dummy variable, Growth/Expansion, which is set to equal to 1 if the investor is a Growth/Expansion fund, and 0 if the investor is a buyout fund. In all specifications, we control for the company development stage, company industry, location, number of VC investors, whether the company is within the industry focus of the fund, whether the company is located in the same state as the fund, and whether it is a new investment or follow-on investment for the fund. In specification (1), we further include the age of fund at the time of investment and investment year fixed effects. In specifications (2)–(8), we replace year fixed effects with PE capital overhang from the previous year and the relative performance of PE investments to VC investments from previous year measured as the ratio of PME of PE industry to PME of the VC industry from previous year. In specifications (3)–(8), we replace the age of the fund at the time of investment with indicator variables which is set to equal to 1 if the investment occurred after six, eight, and ten years starting from the fund vintage year, respectively. Variable definitions can be found in the Appendix. Standard errors are clustered by portfolio companies and are reported under the coefficients. Significance is marked with \* at 10%, \*\* at 5%, and \*\*\* at 1%.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	PE	PE	PE	PE	PE	GE vs VC	Buyout vs. VC	GE vs. Buyout
Expansion	0.3034*** (0.0323)	0.2922*** (0.0319)	0.2894*** (0.0314)	0.2930*** (0.0315)	0.2892*** (0.0316)	0.2894*** (0.0360)	0.2128*** (0.0456)	0.0297 (0.0715)
Later	0.3713*** (0.0349)	0.3584*** (0.0344)	0.3514*** (0.0340)	0.3478*** (0.0341)	0.3511*** (0.0342)	0.3038*** (0.0396)	0.3092*** (0.0484)	0.0080 (0.0716)
NonTech	-0.0615 (0.0512)	-0.0684 (0.0511)	-0.0934* (0.0505)	-0.0881* (0.0505)	-0.0796 (0.0505)	-0.1953*** (0.0621)	0.0699 (0.0661)	-0.4132*** (0.1086)
NonCA	0.0086 (0.0308)	0.0157 (0.0306)	-0.0190 (0.0301)	-0.0133 (0.0302)	-0.0031 (0.0303)	-0.0406 (0.0350)	0.0458 (0.0429)	-0.0388 (0.0709)
Out_of_Ind_Focus	0.0344 (0.0403)	0.0332 (0.0402)	-0.0642 (0.0398)	-0.0439 (0.0400)	-0.0298 (0.0401)	-0.0432 (0.0467)	-0.1069* (0.0583)	0.0213 (0.0984)
Out_of_State	0.2560*** (0.0310)	0.2626*** (0.0307)	0.2729*** (0.0302)	0.2686*** (0.0303)	0.2641*** (0.0304)	0.1857*** (0.0350)	0.3601*** (0.0448)	-0.2993*** (0.0757)
LnRoundNVC	-1.5371*** (0.0277)	-1.5369*** (0.0277)	-1.5693*** (0.0275)	-1.5563*** (0.0276)	-1.5386*** (0.0276)	-1.5668*** (0.0326)	-1.3300*** (0.0399)	-0.1085** (0.0527)

Followon	-0.2206*** (0.0242)	-0.2189*** (0.0241)	-0.1704*** (0.0238)	-0.1557*** (0.0237)	-0.1375*** (0.0237)	-0.1418*** (0.0277)	-0.1443*** (0.0342)	0.0163 (0.0530)
Lntimefromfundfirstivs	0.2776*** (0.0125)	0.2759*** (0.0124)						
Afterinvestmentperiod (>6 years)			0.3123*** (0.0238)			0.3230*** (0.0278)	0.2298*** (0.0343)	
Afterinvestmentperiod (>8 years)				0.3726*** (0.0234)				
Afterinvestmentperiod (>10 years)					0.4390*** (0.0237)			
PEoverhang		0.2443*** (0.0680)	0.2698*** (0.0670)	0.2197*** (0.0673)	0.1884*** (0.0673)	0.2171*** (0.0777)	0.2873*** (0.0956)	-0.1644 (0.1535)
PEVCrelativeperformance		-0.0151 (0.0098)	-0.0166* (0.0096)	-0.0179* (0.0096)	-0.0175* (0.0097)	-0.0291** (0.0115)	0.0044 (0.0132)	-0.0388* (0.0218)
Constant	-1.1288*** (0.0614)	-2.9570*** (0.5071)	-2.7375*** (0.5000)	-2.3855*** (0.5012)	-2.1813*** (0.5016)	-2.4753*** (0.5801)	-3.6186*** (0.7144)	2.0002* (1.1432)
Investment Year Fixed Effect	Yes							
Observations	44,104	44,104	44,104	44,104	44,104	43,207	42,416	2,457
Pseudo R-squared	0.286	0.285	0.267	0.271	0.275	0.260	0.219	0.0127



**Table 4 Round Size, Valuation, and the Use of Debt in PE Invested Deals**

This table examines the effect of PEs' participation on the size of a specific round (Panel A), the use of debt in a specific round (Panel B), and the valuation of a specific round (Panel C). All the regressions control for the endogeneity of PE investment using the instrumental variable framework. The setup of the first-stage regressions are reported in Table 3. Panel A reports the second-stage regressions where the dependent variable is the natural logarithm of round size. Panel B presents the second-stage probit regressions where the dependent variable is the probability of using debt in a specific round. Panel C reports the second-stage regressions where the dependent variable is the natural logarithm of valuation. The key independent variable of interest is fund type. PE is set to equal to 1 if the investor is a PE fund and 0 if the investor is a VC fund. Growth/Expansion is set to equal to 1 if the investor is a Growth/Expansion fund and 0 otherwise. Buyout is set to equal to 1 if the investor is a Buyout fund and 0 otherwise. In all specifications we control for the number of IPOs the fund had in the past three years and its interaction with fund type dummies, the age of the company at the time of investment, LnNinvestors, company development stage at the time of investment, company industry, and company location. Variable definitions can be found in the Appendix. Standard errors are clustered by portfolio companies and are reported under the coefficients. Significance is marked with \* at 10%, \*\* at 5%, and \*\*\* at 1%.

Panel A: Round Size

Variables	(1)	(2)	(3)	(4)
PE	1.4894*** (0.4459)			
PE x LnIPOs	0.0215 (0.1420)			
Growth/Expansion		3.2638*** (0.5635)		5.7671** (2.3513)
G/E x LnIPOs		-0.0566 (0.1629)		-0.6449* (0.3315)
Buyout			4.0409*** (1.0896)	
Buyout x LnIPOs			0.2912 (0.2876)	
LnIPOs	0.7508*** (0.0474)	0.7356*** (0.0472)	0.6965*** (0.0477)	1.0288*** (0.2830)
LnAge	0.2967*** (0.0418)	0.2635*** (0.0421)	0.2661*** (0.0416)	0.4333** (0.1969)
Lnninvestors	2.3722*** (0.1139)	2.4572*** (0.1117)	2.2451*** (0.1083)	3.2288*** (0.3562)
Expansion	1.1057*** (0.0741)	1.1103*** (0.0735)	1.1246*** (0.0744)	0.9996*** (0.2922)
Later	0.7469*** (0.0976)	0.8165*** (0.0966)	0.7295*** (0.0966)	0.5712 (0.3775)
NonTech	-0.1909 (0.1336)	-0.0770 (0.1290)	-0.1949 (0.1362)	-0.0741 (0.6136)
NonCA	-0.5851*** (0.0656)	-0.5450*** (0.0656)	-0.5724*** (0.0666)	-1.3919*** (0.2654)
Constant	11.4343*** (0.1419)	11.3156*** (0.1390)	11.5550*** (0.1355)	7.3061*** (1.8743)
Observations	44,104	43,207	42,416	2,457
R-squared or Pseudo R-Squared	0.074	0.075	0.076	0.093

Panel B: Use of Debt

Variables	(1)	(2)	(3)	(4)
PE	-3.7859*** (0.3730)			
PE x LnNIPOs	-0.5970*** (0.1802)			
Growth/Expansion		-5.1310*** (0.5044)		2.6017** (1.3263)
G/E x LnNIPOs		-0.6837*** (0.1967)		-0.2342 (0.3499)
Buyout			-10.5837*** (1.2583)	
Buyout x LnNIPOs			-0.3265 (0.3488)	
LnNIPOs	-0.0021 (0.0367)	-0.0010 (0.0368)	0.0275 (0.0373)	-0.3854 (0.3187)
LnAge	0.5896*** (0.0233)	0.5927*** (0.0234)	0.6068*** (0.0246)	0.3151*** (0.0780)
Lnninvestors	-1.0248*** (0.0914)	-1.0155*** (0.0895)	-0.9831*** (0.0924)	-0.2761 (0.2268)
Expansion	-1.3202*** (0.1124)	-1.3461*** (0.1176)	-1.3946*** (0.1188)	-0.8047*** (0.2711)
Later	-1.1227*** (0.1212)	-1.1384*** (0.1217)	-1.1604*** (0.1196)	-1.0036*** (0.2465)
NonTech	-0.6166*** (0.1637)	-0.6437*** (0.1640)	-0.5960*** (0.1782)	0.2224 (0.4201)
NonCA	1.0453*** (0.1229)	1.0275*** (0.1222)	1.1149*** (0.1223)	0.3173 (0.2642)
Constant	-1.8967*** (0.1344)	-1.9052*** (0.1327)	-2.0358*** (0.1357)	-3.8423*** (0.9103)
Observations	44,104	43,207	42,416	2,457
R-squared or Pseudo R-Squared	22.87	22.83	23.15	0.194

Panel C: Valuation

Variables	(1)	(2)	(3)	(4)
PE	5.1827*** (0.8380)			
PE x LnNIPOs	-0.7317*** (0.2073)			
Growth/Expansion		6.4797*** (1.1035)		-10.2120*** (3.5414)
G/E x LnNIPOs		-0.9454*** (0.2327)		0.4726 (0.4885)
Buyout			8.5804*** (1.7607)	
Buyout x LnNIPOs			-1.4246*** (0.3746)	
LnNIPOs	0.7739*** (0.1409)	0.7726*** (0.1434)	0.6559*** (0.1177)	-0.2250 (0.4462)
LnAge	0.4598*** (0.1417)	0.4779*** (0.1422)	0.4989*** (0.1350)	0.1469 (0.4289)
Lnninvestors	0.6921*** (0.2262)	0.6225*** (0.2260)	0.4519** (0.2134)	-0.6546 (0.5119)
Expansion	1.1473*** (0.2497)	1.1205*** (0.2548)	1.1685*** (0.2557)	1.2143*** (0.3529)
Later	0.3397 (0.3439)	0.2836 (0.3539)	0.5067 (0.3207)	1.1827** (0.5213)
NonTech	1.2239** (0.5072)	1.2304** (0.5491)	1.0654** (0.4959)	0.0358 (0.8863)
NonCA	-1.0299*** (0.2416)	-1.0516*** (0.2484)	-1.0343*** (0.2383)	-0.9612** (0.3920)
Constant	17.1517*** (0.3866)	17.2649*** (0.3843)	17.6067*** (0.3733)	27.5488*** (2.4860)
Observations	863	832	824	68
R-squared or Pseudo R-Squared	0.433	0.416	0.472	0.433

**Table 5 PEs' Preferred Exit Strategy**

We examine the PEs' preferred exit strategy using the instrumental variable framework to control for the endogeneity of PE investment. The setup of the first stage regressions are reported in Table 3. The results of the second-stage probit regressions are reported in this table. Specifically, we investigate whether PEs prefer IPO, or Merger, or Secondary in comparison to VCs. The key independent variable of interest is fund type. PE is set to equal to 1 if the investor is a PE fund and 0 if the investor is a VC fund. Growth/Expansion is set to equal to 1 if the investor is a Growth/Expansion fund and 0 otherwise. Buyout is set to equal to 1 if the investor is a Buyout fund and 0 otherwise. In all specifications we control for the number of IPOs the fund managed in the past three years and its interaction with fund dummies, company age, number of investors, company development stage, company industry, and company location. Variable definitions can be found in the Appendix. Standard errors are clustered by portfolio companies and are reported under the coefficients. Significance is marked with \* at 10%, \*\* at 5%, and \*\*\* at 1%.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	IPO	Merger	Secondary	IPO	Merger	Secondary	IPO	Merger	Secondary	IPO	Merger	Secondary
PE	0.4212*				-0.8889***				1.4450***			
	(0.2539)				(0.1569)				(0.2617)			
PE x LnNIPs	-0.3242***				0.0850				-0.0482			
	(0.0846)				(0.0580)				(0.0957)			
GrowthExpansion		0.4406		-0.7394		-0.9018***		2.5356***		1.6513***		-1.7147
		(0.3328)		(1.0048)		(0.2075)		(0.7706)		(0.3537)		(1.3452)
GE x LnNIPs		-0.3319***		-0.0918		0.0528		-0.1321		-0.1437		-0.2570
		(0.1023)		(0.1967)		(0.0665)		(0.1206)		(0.1157)		(0.1940)
Buyout			1.2958**				-2.3209***				2.8343***	
			(0.5680)				(0.3865)				(0.6237)	
Buyout x LnNIPs			-0.2816*				0.1294				0.1726	
			(0.1691)				(0.1148)				(0.1666)	
LnNIPs	0.3716***	0.3728***	0.3690***	0.0997	-0.0300	-0.0332	-0.0324	0.1194	-0.0653	-0.0638	-0.0631	0.0973
	(0.0287)	(0.0287)	(0.0288)	(0.1656)	(0.0255)	(0.0255)	(0.0255)	(0.1065)	(0.0417)	(0.0419)	(0.0424)	(0.1574)
Lnage	0.3472***	0.3455***	0.3504***	0.3061***	0.1555***	0.1603***	0.1661***	-0.0288	0.2246***	0.2239***	0.2063***	0.2991***
	(0.0305)	(0.0308)	(0.0310)	(0.0788)	(0.0190)	(0.0192)	(0.0195)	(0.0470)	(0.0385)	(0.0394)	(0.0407)	(0.0804)
Lnninvestors	0.5455***	0.5386***	0.5450***	0.6087***	-0.0896*	-0.0626	-0.0777	0.1539	-0.0270	-0.0547	-0.0288	-0.6346***
	(0.0837)	(0.0828)	(0.0802)	(0.1800)	(0.0536)	(0.0525)	(0.0519)	(0.1250)	(0.1195)	(0.1198)	(0.1187)	(0.2247)
Expansion	-0.3781***	-0.3670***	-0.3845***	-0.4519***	0.0251	0.0099	0.0194	0.0594	-0.0510	-0.0460	-0.0174	-0.0860
	(0.0681)	(0.0684)	(0.0687)	(0.1463)	(0.0368)	(0.0371)	(0.0372)	(0.0922)	(0.0817)	(0.0833)	(0.0827)	(0.1504)
Later	-0.1306**	-0.1216*	-0.1331**	-0.1314	0.1238***	0.1080**	0.1148**	0.1073	0.0625	0.0828	0.0865	0.1031

	(0.0653)	(0.0661)	(0.0663)	(0.1534)	(0.0455)	(0.0458)	(0.0466)	(0.1014)	(0.0856)	(0.0877)	(0.0917)	(0.1370)
NonTech	-0.3445**	-0.3716**	-0.3729**	-0.0728	-0.4159***	-0.4282***	-0.4065***	0.1702	-0.2655**	-0.2905**	-0.3443**	-0.2204
	(0.1604)	(0.1687)	(0.1565)	(0.3509)	(0.0714)	(0.0718)	(0.0739)	(0.1976)	(0.1227)	(0.1269)	(0.1350)	(0.3288)
NonCA	0.0519	0.0657	0.0523	-0.2551*	0.0212	0.0189	0.0215	0.1066	0.3341***	0.3234**	0.3397***	0.3062
	(0.0567)	(0.0573)	(0.0576)	(0.1448)	(0.0344)	(0.0346)	(0.0350)	(0.1046)	(0.1267)	(0.1281)	(0.1311)	(0.2314)
Constant	-2.5042***	-2.5037***	-2.5077***	-1.6746**	-0.7848***	-0.8223***	-0.8109***	-2.7125***	-2.7817***	-2.7312***	-2.7599***	-0.6638
	(0.1104)	(0.1099)	(0.1064)	(0.7841)	(0.0639)	(0.0629)	(0.0612)	(0.5962)	(0.1718)	(0.1729)	(0.1686)	(1.0978)
Observations	44,104	43,207	42,416	2,457	44,104	43,207	42,416	2,457	44,104	43,207	42,416	2,457
R-squared or Pseudo R-squared	0.0998	0.1007	0.1015	0.0802	0.0152	0.0149	0.0166	0.0093	0.0571	0.0521	0.0487	0.0756

**Table 6 Do PE-Invested Entrepreneurial Firms Stay Private Longer?**

We examine whether entrepreneurial firms stay private longer when PEs participate using the instrumental variable framework to control for the endogeneity of PE investment. The setup of the first stage regressions are reported in Table 3. The results of the second-stage OLS regressions are reported in this table. The dependent variable is the natural logarithm of the time between the first round of financing to the date of exit. The key independent variable of interest is fund type. PE is set to equal to 1 if the investor is a PE fund and 0 if the investor is a VC fund. Growth/Expansion is set to equal to 1 if the investor is a Growth/Expansion fund and 0 otherwise. Buyout is set to equal to 1 if the investor is a Buyout fund and 0 otherwise. In all specifications we control for company age, number of investors, company development stage, company industry, company location, and exit type fixed effects. Variable definitions can be found in the Appendix. Standard errors are clustered by portfolio companies and are reported under the coefficients. Significance is marked with \* at 10%, \*\* at 5%, and \*\*\* at 1%.

Variables	(1)	(2)	(3)	(4)
PE	0.2010*** (0.0763)			
PE x LnNIPs	-0.0067 (0.0274)			
Growth/Expansion		0.2798*** (0.1025)		0.4758 (0.4972)
G/E x LnNIPs		-0.0152 (0.0327)		-0.0542 (0.0642)
Buyout			0.3678* (0.1895)	
Buyout x LnNIPs			0.0257 (0.0592)	
LnNIPs	-0.0344*** (0.0096)	-0.0405*** (0.0098)	-0.0347*** (0.0096)	0.0051 (0.0535)
LnAge	0.5734*** (0.0106)	0.5731*** (0.0105)	0.5776*** (0.0107)	0.4944*** (0.0278)
Lnninvestors	0.0626*** (0.0242)	0.0562** (0.0241)	0.0583** (0.0236)	-0.0454 (0.0727)
Expansion	-0.0717*** (0.0187)	-0.0614*** (0.0188)	-0.0708*** (0.0186)	-0.1837*** (0.0525)
Later	0.0197 (0.0177)	0.0253 (0.0181)	0.0223 (0.0179)	-0.0415 (0.0438)
NonTech	-0.0784* (0.0423)	-0.0859** (0.0437)	-0.0827* (0.0438)	0.0746 (0.1090)
NonCA	0.1837*** (0.0186)	0.1910*** (0.0191)	0.1806*** (0.0189)	0.1919*** (0.0570)
Constant	3.2917*** (0.0794)	3.3583*** (0.0323)	3.2902*** (0.0813)	3.3137*** (0.4164)
Observations	14,947	14,661	14,352	849
R-squared or Pseudo R-Squared	0.536	0.533	0.539	0.506