

## The economics of PIPEs

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### ABSTRACT

Private investments in public equities (PIPEs) are an important source of finance for public corporations. PIPE investor returns decline with holding periods, while time to exit depends on the issue's registration status and underlying liquidity. We estimate PIPE investor returns adjusting for these factors. Our analysis, which is the first to estimate returns to investors rather than issuers, indicates that the average PIPE investor holds the stock for 384 days and earns an abnormal return of 19.7%. More constrained firms tend to issue PIPEs to hedge funds and private equity funds in offerings that have higher expected returns and higher volatility. PIPE investors' abnormal returns appear to reflect compensation for providing capital to financially constrained firms.

### 1. Introduction

Private placements of equity, commonly referred to as “PIPEs,” are an important source of financing for many public corporations. According to *PrivateRaise*, a leading database on PIPE transactions, between 2001 and 2015, there were 11,296 private placements of common stock by U.S. listed firms that raised \$243.9 billion. Firms raising funds through PIPEs tend to be small, with 93% of common stock PIPE issuers having market capitalization below \$1 billion. As a point of comparison, U.S. firms with market capitalization below \$1 billion raised \$240.3 billion in SEOs over the same period.

Why do so many firms turn to PIPEs for financing? Conventional wisdom is that it is a relatively expensive source, as Brophy et al. (2009) put it, a “last resort” form of financing. But how expensive is it? To calculate the cost to issuers, it is important to consider a number of attributes of the package purchased by PIPE investors. Issuers often include warrants together with the public securities they sell to

investors. In most common stock transactions, the stock is unregistered and cannot be immediately sold by investors. Since PIPE shares are usually sold at a discount, the expected return to holding them varies inversely with the expected holding period, which depends on the time it takes to register the securities as well as the thinness of the secondary market for trading these securities after they are registered. Therefore, to calculate the cost of financing through PIPEs, which is a function of the expected return and risk of these securities, one must control for the time it takes to register the securities and to sell them.

This paper evaluates the costs to issuers and the benefits to investors from PIPE financing. We rely on a comprehensive sample of 3001 common stock PIPE transactions by U.S. firms listed on NYSE or NASDAQ between 2001 and 2015. In this sample, the median investment is \$10 million, equivalent to 9.1% of the median issuer's equity market capitalization. PIPE investors receive warrants in 39% of the transactions in our sample and purchase the package of securities at an 11.2% discount relative to its market value. As a result of the discounted

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purchase price, PIPE investors earn substantially higher returns than investors who buy and sell stocks of PIPE issuers or comparable firms at market prices. Over the year following the issuance, PIPE investors average a 12.1% buy-and-hold abnormal return, compared to -5.2% for investors who buy and sell the issuers' stocks at market prices. However, there is substantial skewness in the distribution of returns, with the median PIPE investment earning an abnormal return of just 1.7% over the year after issuance. PIPE returns are skewed because the returns of the issuing firms' stocks are themselves skewed, and in addition, warrants amplify the returns of the best performing deals while having no effect on the poorly performing ones. Therefore, PIPE investing is like venture capital investing in that "home run" investments are the driver of outperformance.

An important factor affecting investors' returns is the time they hold the investments. The returns PIPE investors receive decline with the time they hold the investment because the offering discount accrues to investors immediately when the transaction closes. After that point, the long-run performance of issuing firms tends to be poor, consistent with results in the prior literature (e.g. Brophy et al., 2009; Hertz et al., 2002). Therefore, PIPE investors have an incentive to exit their stock positions as quickly as possible to capture the discount and mitigate exposure to the issuer's downside risk. However, two factors limit the ability of PIPE investors to exit their positions quickly. First, 81% of transactions in our sample involve issuance of unregistered shares that cannot be freely traded until they are registered with the SEC, which happens 100 days after issuance on average. Second, the shares of PIPE issuers are illiquid, so they cannot be sold quickly without putting downward pressure on the stock price. Consistent with the notion that PIPE investors have incentives to exit quickly, we observe increased trading volume and negative abnormal stock returns immediately after the registration date of PIPEs in our sample.

Unfortunately, it is impossible to discern from publicly available data exactly when investors liquidate their positions. Holding periods likely vary as a function of investors' reasons for making the investment. Sometimes, investors have long-run objective such as enhancing value through monitoring (Wruck, 1989), or extracting private benefits (Barclay et al., 2007), but according to Barclay et al. (2007), most private placements are made to passive investors who do not receive private benefits (83% in their sample). For these investors, returns decline with the time they hold onto the position. Therefore, to calculate the cost of raising capital to an issuing firm, we assume that investors exit as soon as possible to maximize their financial returns.

We estimate the returns to PIPE investors controlling both for registration status and the limited ability of investors to exit their positions given the thinness of trading in the underlying stocks. To calculate these "holding period adjusted" returns, we assume that investors sell a constant fraction of the daily volume each trading day from the effective registration date until they liquidate their position. The returns from this strategy, which presumably could be executed with minimal price impact, leads to returns that are still noticeably higher than investments in comparable firms at market prices. Assuming that investors sell 10% of the daily trading volume after registration, PIPE investors average a 19.7% abnormal return, compared to 3.7% for market investors, over an average holding period of 384 days.

Why do public firms raise capital under such costly terms? Examining the characteristics of PIPE issuers, it appears that their options are limited. Even though these firms are publicly traded, they are relatively small, with median book assets of \$51 million. Their operating performance in the year prior to the PIPE issuance tends to be very poor, with a median ratio of EBITDA to Book Assets of -22%. They likely do not have access to public debt markets and appear to have limited access to bank loans, as 93% of issuers lack a public debt rating and the median firm has a leverage ratio of only 7.2%. This pattern is consistent with the arguments of DeAngelo et al. (2010) and Denis and McKeon (2018) that equity offerings are often the result of ongoing operating losses and high cash burn rates.

We examine the hypothesis that the abnormal returns earned by PIPE investors reflect compensation for providing capital to poorly performing firms with limited outside options. Consistent with this view, when issuing firms appear to be more financially constrained, the capital in the PIPE is more likely to be provided by relatively risk tolerant investors such as hedge funds and private equity funds, as opposed to the insiders, corporations, and strategic partners who tend to supply capital to the other PIPEs in our sample. In addition, the returns from the PIPEs issued by more constrained firms are higher and more volatile. The PIPE market appears to be one in which PIPE investors provide financing to companies that find it costly or even impossible to obtain financing from alternative sources.

This paper contributes to several strands of literature. First and foremost, we provide novel evidence on the returns to investing in PIPEs and the cost of capital of PIPE issuers. The closest papers in the literature are Krishnamurthy et al. (2005) and Chaplinsky and Haushalter (2010), who also compute the returns to PIPE investors in earlier, non-overlapping samples from ours. Our analysis improves on these papers by accounting for registration status and trading considerations that can materially affect realized returns. We highlight the importance of "home runs" in driving the performance of a PIPE portfolio, which parallels Bessembinder's (2018) work on skewness in the cross-section of listed equity returns. We also connect the returns of PIPEs to the operating condition of the issuing firms. These results relate to Brophy et al. (2009), who study the underperformance of firms issuing structured PIPEs to hedge funds. We build on their work, although our sample does not include structured PIPEs, by computing the returns earned by PIPE investors, finding that hedge funds provide capital to the riskiest PIPE issuers and earn excess returns for bearing this risk.

Our work also contributes to the literature on the motives of private placements. Several explanations have been offered, including the alignment of shareholder and manager interests (Billett et al., 2015; Wruck, 1989), certification benefits (Floros et al., 2017; Hertz et al., 1993; Iliev and Lowry, 2017), and managerial entrenchment (Barclay et al., 2007). In our sample of PIPEs, we find evidence that investors begin to exit as quickly as possible, which supports the passive investor interpretation of Barclay et al. (2007) and is less consistent with the argument that PIPE investors help to improve corporate governance.

Finally, our work relates to the literature on the source of returns to the strategies employed by private equity and hedge funds (e.g., Kaplan, 1989a,b; Agarwal et al., 2009; Agarwal et al., 2011; Aragon, 2007; Brav et al., 2008; Fung and Hsieh, 2001; Jiang et al., 2012; Mitchell and Pulvino, 2001; Lim, 2015). We show how PIPE investors earn returns through the discounted shares and warrants they receive for providing capital to firms that could not raise capital from other sources.

## 2. Privately-negotiated investments in public firms

### 2.1. Motivation/magnitude of investment

Public firms often raise capital in privately negotiated transactions rather than through the public market. Table 1 characterizes the incidence of such investments during the 2001–2015 period. Common stock investments are most common, with 11,296 issues totaling \$243.9 billion. In addition, PIPE investors purchased 5077 convertible or preferred debt issues (\$183.0 billion), provided 1132 equity lines (\$19.2 billion), and 1747 other types of securities (\$176.9 billion). In total, PIPE investments provided \$623 billion in capital to public firms from 2001 to 2015. Since we are interested in analyzing the returns earned by investors, we focus on the common stock investments, because returns for these investments are relatively straightforward to calculate. However, we emphasize there are also a substantial number of private investments in public companies that include securities other than common stock.

**Table 1**

Time series of PIPE investments.

This table reports time series statistics on the number and dollar volume of PIPEs split by the type of securities issued. The sample includes all PIPE transactions in *PrivateRaise* from 2001 to 2015 with non-missing CUSIPs, excluding Rule 144A offerings and confidentially marketed public offerings. Common Stock includes issuance of registered or unregistered shares of common stock. Conv. Debt or Pref. includes issuance of convertible debentures or preferred stock. Equity Line is a commitment by the investor to purchase equity securities from the issuer over a set timeframe. Other Types include other types of convertible securities, non-convertible debt, non-convertible preferred stock, and prepaid warrants. All categories may include warrants in the package of securities.

	Common stock		Conv. debt or pref.		Equity line		Other types	
	Obs.	\$ Bil.	Obs.	\$ Bil.	Obs.	\$ Bil.	Obs.	\$ Bil.
2001	597	8.5	377	8.5	122	2.2	77	1.4
2002	511	5.7	350	7.7	54	0.7	58	0.7
2003	781	9.7	325	4.9	44	0.5	77	2.3
2004	909	10.6	454	4.4	82	1.0	51	1.2
2005	824	10.9	500	7.9	83	1.9	58	1.4
2006	1030	21.1	520	6.1	79	2.1	102	4.3
2007	1139	35.6	471	13.5	49	1.1	143	18.9
2008	714	28.6	378	68.9	41	1.0	104	18.6
2009	733	17.7	267	12.4	64	1.9	84	3.7
2010	924	22.2	253	8.4	117	1.6	66	2.3
2011	752	11.9	208	4.3	100	1.4	130	16.8
2012	601	12.3	225	7.9	81	1.1	158	17.3
2013	592	9.7	234	7.1	76	1.3	190	23.9
2014	649	14.7	256	11.0	68	0.7	201	30.0
2015	540	24.5	259	10.0	72	0.9	248	34.0
Total	11,296	243.9	5077	183.0	1132	19.2	1747	176.9

## 2.2. A typical investment

Even “common stock” PIPE transactions involve more than just common stock. To illustrate the way these investments are structured, in [Table 2](#) we provide details about a typical investment from our sample, the December 2006 investment of \$6.5 million in the equity of a medical device company called United American Health Corporation (UAHC). We choose this particular investment because it is close to the median investment size in our sample and has a number of features common to PIPE deals.

In this investment, a syndicate of investors led by a private equity firm called Heights Capital Management purchased one million shares of UAHC. The offered shares amounted to 13.3% of UAHC’s outstanding shares prior to the offering, and no insiders participated in the transaction, so there was no shareholder vote. Heights Capital put in 20% of the capital (\$1.3 million) and the remaining 80% was provided by a group of investors made up of five hedge funds, one private equity fund, and a collection of other individuals and institutional investors. This purchase occurred at \$6.50 per share, a 21% discount to the market price of \$8.20, which is larger than average discount for the sample period (see [Table 3](#) below).

In addition to the equity, investors also received 100,000 warrants on UAHC’s equity, equal to one warrant for every ten shares of common equity they purchased. The warrants had a strike price of \$8.50 per share and a term of five years, so applying the Black–Scholes model adjusted for dilution, we estimate each warrant to be worth \$3.92. These warrants effectively increase the discount investors receive. For every share with a market value of \$8.20, investors receive one tenth of a warrant, increasing the total value to \$8.59. Relative to this value, the price of \$6.50 per share represents a discount of 24.3%.

One explanation for this discount is that the shares were unregistered, so they could not be sold to the public until the firm registered them with the SEC. Unregistered PIPEs generally contain a provision requiring the firm to register the securities within a specified period of time. In this case, the provision stated that UAHC had to file a registration statement within 30 days and that the registration would become effective by the 90th day, or the 120th day if there was an SEC review. In the UAHC PIPE, the transaction closed on December 13, 2006, the registration statement was filed on January 11, 2007, and the registration statement was declared effective on January 26, 2007. The 44 day period between closing to registration for this offering is shorter than the

sample median of 62 days.

[Fig. 1](#) shows that after the effective registration date, there was a large increase in trading volume in UAHC: during the five trading days prior to the registration becoming effective, a total of 297,422 shares were traded, while in the five trading days subsequent to the effective registration date, more than three times as many shares, 983,504, were traded. Consistent with the notion that PIPE investors put downward pressure on the stock price by selling their shares immediately after they became registered, the return on UAHC stock over the five trading days after registration was –16.3%.

In addition to the equity and warrants, investors in the PIPE received a number of other rights. The warrants had anti-dilution protection, which means that if there were another equity issue at a lower price, the strike price of the warrants would be adjusted downwards. The issuing firm was prohibited from issuing other securities for 60 days, and the investors had the right of first refusal for 40% of any other equity or equity-linked securities that UAHC issued during the subsequent year. It is difficult to estimate the monetary value on these rights, but they clearly offer some value, suggesting that the 24% discount is understated relative to the true value that investors received.

While the investors in the PIPE received a number of rights that ordinary investors do not have, it is notable that they do *not* have any direct “control rights”.<sup>1</sup> In venture capital deals, it is common for investors to have rights that allow them to influence the firm’s operations, such as board representation and the right to approve compensation arrangements. In contrast, in PIPE deals, these features rarely occur. In our sample, there are control related provisions in less than 10% of PIPEs, which are usually cases in which the investment is contingent on a management change, either the CEO or the board of directors. However, even in these cases, the provisions do not give explicit control rights to the investors. The fact that control rights are not typically negotiated suggests that unlike most private equity investments, the

<sup>1</sup> Investors in the PIPE do obtain voting rights associated with their common shareholdings. However, most PIPEs involve syndicates consisting of many investors, so coordination among these small blockholders would be necessary to translate the indirect control rights of voting power into changes in firm policy.

**Table 2**

A typical PIPE: the December 2006 private placement of United American Healthcare Corporation.

This table reports the terms of a representative PIPE transaction from our sample. United American Healthcare Corporation is a provider of contract manufacturing services to the medical device industry. On December 13, 2006, UAHC issued \$6.5 million of common stock to raise capital to pay start-up costs associated with its subsidiary in Tennessee. This private placement was completed by a syndicate of 10 investors led by Heights Capital Management. At the time of issuance, UAHC was listed on NASDAQ.

<b>Basic information</b>			
Announcement date	12/14/2006	Issuance amount (\$MM)	6.5
Placement type	Unregistered PIPE	Security type	Common stock
Market cap. (\$MM)	61.9	Market stock price	\$8.20
Shares outstanding	7,544,000	PIPE issuance price	\$6.50
Offered shares	1,000,000	Offered shares (% outstanding)	13.26%
<b>Warrant terms</b>			
Warrant type	Fixed	Number of warrants	100,000
Maturity	5 years	Strike price	\$8.50
Other covenants	(i) Anti-dilution protection (weighted-average adjustment) (ii) Cashless exercise		
<b>Investor allocations</b>			
Investor name	Investor type	Investment amount	
Heights Capital Management, Inc.	Private equity	\$1,300,000	
Miscellaneous Trusts & Pension Funds	Miscellaneous	\$1,027,000	
Iroquois Capital Management, LLC	Hedge fund	\$877,500	
Braeburn Financial Group	Asset manager	\$868,850	
Hudson Bay Capital Management LP	Hedge fund	\$715,000	
Stafford Capital Management, LLC	Hedge fund	\$500,500	
Individual Investors	Individual	\$455,000	
Kensington Partners LP	Private equity	\$431,145	
Joslynda Capital, LLC	Hedge fund	\$162,500	
Nite Capital, LP	Hedge Fund	\$162,500	
<b>Rights and restrictions</b>			
(i) Mandatory registration: Issuer has to file a Registration Statement no later than the 30th day after the Closing Date. Issuer has further agreed to use its best efforts to cause such Registration Statement to be declared effective no later than the 90th day (or 120th day if the Registration Statement is subject to review by the SEC) following the Closing Date.			
(ii) Limitation on future issuance of securities: During the period beginning on the Purchase Agreement date and ending on the Trigger Date (normally the 60th trading day following the Registration Statement is declared effective), the issuer will not be permitted to offer, sell, grant any option to purchase or otherwise dispose of any of its or its subsidiaries' equity or equity equivalent securities.			
(iii) Right of participation: If, from the Trigger Date until the 1-year anniversary of the Closing Date, the issuer proposes to issue securities convertible into common stock, the issuer is required to first give the investors a chance to purchase up to 40% of such securities on the same terms.			

PIPEs in our sample appear to be passive investments in which the investors do not play an active role in the management of the issuing company.<sup>2</sup>

### 3. Sample

#### 3.1. Selection process

The starting point for our sample is the universe of 21,227 distinct PIPE transactions covered in *PrivateRaise*, a leading provider of data on PIPE transactions. *PrivateRaise* began collecting data in 2001, so our sample covers the period 2001 to 2015. We exclude 1352 Rule 144A

<sup>2</sup> Although PIPE transactions rarely contain control rights, there could be other contractual terms, such as limitations on future issuance, that indirectly influence the PIPE issuer's liquidity, capital structure, and corporate policies. In our final sample of 3001 PIPE transactions, 556 (18.5%) include at least one such limitation.

issuances and 623 confidentially marketed public offerings (CMPOs), which are included in the *PrivateRaise* database but are not truly PIPE transactions. Most of the Rule 144A offerings in the *PrivateRaise* database are convertible bonds issued by large firms (e.g. Verizon Communications) to hedge funds. A CMPO is a hybrid between a PIPE and an SEO, in which registered stock is first marketed to institutional investors, then a prospectus is filed and the offering is opened to the public.<sup>3</sup>

PIPE transactions involve a variety of security types, many of which are difficult to value. To ease the calculation of returns, we restrict our focus to common equity investments without price reset features. We do include PIPEs with attached warrants so long as there is only one warrant with a fixed strike price. These restrictions exclude 7956 investments for which the primary security is not common stock, 127 transactions with contingent adjustments to the purchase price, 443 transactions with multiple warrants, and 251 transactions for which the attached warrant did not have a fixed strike price. We exclude eight large transactions that are strategic partnerships, asset purchases using stock as currency, or transactions contingent on the completion of an IPO or a merger. Finally, we require information on investor types, which excludes 3611 transactions. These exclusion restrictions reduce the sample to 6856 PIPE transactions.

To evaluate the subsequent performance of PIPE issuers, we merge the *PrivateRaise* sample with stock price data from *CRSP*. Doing so restricts our sample to firms on NYSE or NASDAQ for analyses that use stock return data. To ensure quality of the stock return data, we include only transactions for which the pre-closing price in *CRSP* matches the pre-closing price in *PrivateRaise*. These criteria further reduce our final sample to 3001 PIPE issues from 1523 unique firms.<sup>4</sup>

#### 3.2. Sample description

There are two types of transactions in our sample, Unregistered PIPEs and Registered Direct Offerings (RDOs). These two transaction types are alike in that they are privately negotiated with a small set of accredited investors. However, they differ in that RDO shares can be sold immediately on public markets, while unregistered PIPE shares cannot be traded in the public marketplace until they are registered with the SEC or are exempt from the registration requirements.<sup>5</sup>

Unregistered PIPEs involve the issuance of unregistered shares under Regulation D of the Securities Act of 1933. In these transactions, the firm promises to file a registration statement with the SEC in a contractually

<sup>3</sup> Specifically, a typical CMPO involves an underwriter confidentially marketing a takedown of an effective S-3 shelf registration statement to a small number of investors. Before the underwriter discloses the name of the issuer, the investor must indicate interest in receiving confidential information and agree not to trade the issuer's stock until the offer is either completed or canceled. After the investors confirm interest, the issuer, underwriter, and investors negotiate terms including the offering amount, discount, and warrant coverage. Then the offering is made public and a prospectus is filed with the SEC, allowing outside investors to participate in the transaction. Typically, these documents are filed after the market close and the offering closes before the subsequent market open.

<sup>4</sup> Many PIPE issuers tap the market repeatedly (Floros and Sapp, 2012; Gomes and Phillips, 2012). Of the 1523 firms in our sample, 871 issue only one PIPE and the other 652 firms issue an average of 3.3 PIPEs during the sample period.

<sup>5</sup> The exemption of choice for most holders of unregistered (restricted) stock is Rule 144. Rule 144 allows public resale of restricted securities if a number of conditions, such as holding period, are met. Since February 15th, 2008, an investor can resell the restricted securities issued by a public company in the marketplace after holding them for six months (previously, one year) under Rule 144. To assess whether this change to Rule 144 affects our results on trading volume and returns splitting the sample into the periods before and after 2008 and find similar results in the two sub-periods. For more details on the conditions set forth in Rule 144, please refer to: <https://www.sec.gov/rep/ortspubs/investor-publications/investorpubsrule144htm.html>.

**Table 3**

Summary statistics on PIPE issuers, transaction terms, and investor compositions.

This table reports summary statistics on PIPE issuers (Panel A), transaction terms (Panel B), and investor composition (Panel C). Each observation represents a distinct PIPE transaction. The sample consists of transactions involving common stock (registered or unregistered at issuance), with or without fixed strike price warrants. The sample is restricted to transactions with stock price data in *CRSP* and excludes transactions for which the pre-closing price in *CRSP* is different than the pre-closing price in *PrivateRaise*. Accounting figures from the year prior to issuance are collected from *Compustat*. Market leverage is the ratio of total debt to total debt plus market capitalization. Rated is an indicator equal to one if the firm has a long-term credit rating from Standard and Poor's. Asset Market-to-Book is market capitalization plus total debt divided by book assets. R&D expense is assumed to be zero when it is unreported in *Compustat*. Daily Trading Volume is the average of daily share volume times closing price over the quarter prior to the closing date of the PIPE transaction. Issued/Outstanding is the number of issued shares as a percentage of pre-issuance outstanding shares. Issued Shares/Daily Volume is the ratio of issued shares to the average daily trading volume over the quarter prior to the closing date of the PIPE transaction. Days to Mandatory File and Effect Registration are the contract terms requiring filing and effectiveness of a registration statement for PIPEs that are unregistered at issuance. The rows labeled Ex Post report the actual time to filing and effectiveness of the registration statement. Negative values of these variables are truncated at zero, affecting 6 observations. Warrant Moneyiness is the ratio of the pre-closing stock price in *PrivateRaise* to the contractual strike price of the attached warrant. For the calculation of discounts, we lose 53 observations from the full sample (3001 observations) due to the lack of contractual data (e.g., warrant term and strike price) required for the calculation of warrant value. The discount is the difference between the market value of securities purchased in the transaction and the price paid by the investor, as a percentage of the market value of securities purchased. Market values are computed using the last closing price prior to the transaction closing. Warrants are valued using the Black–Scholes call option model adjusted for dilution, with annualized volatility estimated over the trailing three months and capped at 50% and the risk-free rate interpolated from the swap curve. All ratios are winsorized at the 1% level to mitigate the impact of outliers.

Panel A: PIPE issuer characteristics									
Variables	All PIPEs			HF/PE PIPEs			Non HF/PE PIPEs		
	Mean	p50	Obs.	Mean	p50	Obs.	Mean	p50	Obs.
Revenue (\$MM)	353	20.2	2448	166	16.8	1627	723	30.0	821
Book assets (\$MM)	1245	51.2	2453	700	42.3	1631	2325	94.2	822
Market cap. (\$MM)	445	109.3	3001	252	97.9	1991	825	142.9	1010
Market leverage (%)	18.3	7.2	2441	17.2	6.3	1625	20.7	8.5	816
Rated (%)	7.2	0	2453	5.0	0	1631	11.6	0	822
Cash/assets (%)	35.0	23.9	2453	36.3	25.2	1631	32.3	19.9	822
EBITDA/assets (%)	-38.5	-22.0	2371	-42.5	-27.5	1591	-30.4	-14.8	780
PP&E/assets (%)	22.4	10.5	2395	20.9	9.3	1602	25.4	13.0	793
CapEx/assets (%)	5.8	2.2	2422	5.6	2.0	1611	6.4	2.7	811
R&D/assets (%)	25.5	10.8	2448	28.1	13.5	1627	20.2	3.9	821
Asset market-to-book	3.1	1.8	2441	3.3	1.9	1625	2.8	1.7	816
Years since IPO	8.7	6.5	2455	8.7	6.6	1631	8.8	6.3	824
Daily trading vol. (\$MM)	5.8	0.6	2455	2.6	0.6	1631	12.2	0.6	824

Panel B: PIPE terms and conditions									
Variables	All PIPEs			HF/PE PIPEs			Non HF/PE PIPEs		
	Mean	p50	Obs.	Mean	p50	Obs.	Mean	p50	Obs.
Registered (%)	19.1	0.0	3001	22.5	0.0	1991	12.5	0.0	1010
HF/PE share (%)	47.0	49.7	2529	71.9	80.0	1653	0.0	0.0	882
Issue amount (\$MM)	35.3	10.0	3001	27.7	11.3	1991	50.3	7.8	1010
Issued/outstanding shr. (%)	17.6	11.4	3001	20.2	13.3	1991	12.4	7.4	1010
Issued shares/daily volume	68.0	19.2	2455	71.6	21.6	1631	60.9	15.2	824
If Unregistered, days to:									
File reg. (mandatory)	49.9	30.0	1480	42.6	30.0	1260	91.8	45.0	220
File reg. (ex post)	55.4	29.0	875	50.0	29.0	739	85.1	38.0	136
Effect reg. (mandatory)	111	90.0	1313	106	90.0	1164	151	99.0	149
Effect reg. (ex post)	99.8	62.0	869	90.4	60.0	732	150	80.0	137
Warrants included (%)	38.8	0.0	3001	47.5	0.0	1991	21.7	0.0	1010
Warrant expiration (years)	4.6	5.0	1145	4.7	5.0	938	4.0	5.0	207
Warrant moneyiness	0.91	0.87	1150	0.90	0.87	932	0.93	0.88	218
Discounts (%)	11.2	11.1	2948	14.5	13.4	1955	4.6	6.0	993
Without warrant	5.7	7.0	1835	9.4	8.8	1044	0.9	3.2	791
With warrant	20.1	19.7	1113	20.4	19.9	911	19.1	19.4	202
Unregistered	11.6	12.0	2376	15.8	14.8	1509	4.3	5.8	867
RDO	9.5	8.8	572	10.3	9.2	446	6.8	6.9	126

Panel C: Investor composition								
Investor type	HF/PE PIPEs				Non HF/PE PIPEs			
	Participation by (%)		Shares bought by (%)		Participation by (%)		Shares bought by (%)	
	Mean	Obs.	Mean	Obs.	Mean	Obs.	Mean	Obs.
HF/PE	100	1991	71.9	1653	0	1010	0	882
Mutual fund	14.7	1991	3.7	1653	5.2	1010	3.9	882
Financial institution	26.9	1991	5.5	1653	14.7	1010	11.9	882
Trust/endowment/pension	20.7	1991	1.8	1653	7.0	1010	4.0	882
Individual investor	29.7	1991	4.6	1653	12.4	1010	7.0	882
Corporation/strategic	4.7	1991	0.7	1653	32.4	1010	33.5	882
Insurance company	4.9	1991	0.5	1653	2.3	1010	1.4	882
Insider/affiliate	8.1	1991	0.7	1653	14.7	1010	7.8	882
Broker-dealer	4.8	1991	0.4	1653	1.0	1010	0.4	882
Foreign investment house	2.6	1991	0.3	1653	1.7	1010	1.0	882
Sovereign wealth fund	1.0	1991	0.2	1653	1.9	1010	1.9	882
Miscellaneous	11.5	1991	1.4	1653	4.1	1010	1.8	882
Unknown	34.0	1991	8.2	1653	27.8	1010	25.3	882

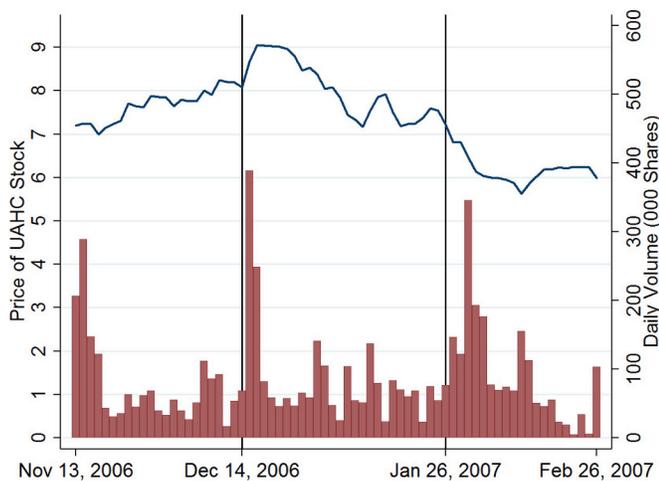


Fig. 1. UAHC prices and volumes around the December 2006 PIPE.

This figure reports the price and trading volume of United American Healthcare Corporation (UAHC) from one month before the closing of its December 2006 PIPE transaction to one month after the effective registration date for the shares sold in the offering. The vertical line on December 14, 2006 marks the announcement of the transaction after the market close. The vertical line on January 26, 2007 marks the effective registration date.

specified timeframe (30 days for the median deal). Investors in unregistered PIPEs can sell their shares after the registration becomes effective, but they cannot trade their shares on public markets before that time.

RDOs involve the issuance of shares previously registered under a shelf registration statement, so investors can sell the shares immediately after purchasing them in the offering. The warrants attached to RDOs are sometimes unregistered, with terms of registration specified as in an unregistered PIPE. Over our sample period, the proportion of registered PIPEs in our sample jumped up from 10.9% in 2001 to 28.4% in 2015. This change in the composition of PIPE offerings followed an SEC amendment to Form S-3, referred to by practitioners as the “baby shelf” rule, which allowed listed companies below \$75 million in public float to file shelf registration statements.

An important consideration is that in the United States, certain private placements require shareholder approval, while other private placements can be executed with just a vote of the board of directors.<sup>6</sup> Specifically, issuances of more than 20% of outstanding shares at a discount to the market price must be approved by existing shareholders. In addition, placements to insiders owning more than 1% of shares or placements that result in a change of control require a shareholder vote. Based on these criteria, 22.1% of the private placements in our sample likely require shareholder voting.<sup>7</sup> Since having a shareholder vote is

<sup>6</sup> Holderness (2018) provides detail about these regulations as well as the comparable regulations for other countries. See Park (2013), Billett et al. (2015), and Floros et al. (2017) for studies relating shareholder approval to the characteristics of PIPE offerings.

<sup>7</sup> Our data do not contain details on pre-transaction ownership, so we treat all issuances to insiders as requiring a vote. We assume offerings of more than 50% of the post-issuance shares outstanding involve a change of control and therefore require a shareholder vote.

costly, issuances tend to cluster just below 20%; in our sample, 85% of transactions are issuances of less than 20% of outstanding shares. Furthermore, there are 220 issues (7.3% of the sample) offering between 19% and 20% of outstanding shares compared to 90 issues (3.0%) offering between 20 and 21%.<sup>8</sup>

Table 3 provides summary statistics on the sample of PIPE transactions and their issuers. A large number of PIPEs involve hedge funds and private equity funds as investors; we refer to these as HF/PE PIPEs. Since HF/PE PIPEs are potentially different from other PIPEs (non-HF/PE PIPEs), we present statistics for them separately from other PIPEs.

Panel A of Table 3 indicates that the firms raising capital through PIPEs are much smaller than typical *Compustat* firms, with median book assets of \$51.2 million (versus a median of \$606.4 million in *Compustat*). At the time of the PIPE, issuing firms are not performing well, with the median firm having an EBITDA-to-Assets ratio equal to  $-22.0\%$  (compared to a median of  $8.1\%$  in *Compustat*). The sample firms have low leverage relative to the broader population of public firms, with median market leverage of 7.2% (versus 19.4% in *Compustat*). Only 7.2% of PIPE issuers have a long-term credit rating (versus 30.5% in *Compustat*), and among the rated firms, less than one-third have an investment-grade rating. Consequently, it seems unlikely that most of our sample firms could access the public debt market, or even borrow much from banks. Firms issuing a HF/PE PIPE are even smaller, have worse operating performance, and are less likely to have a credit rating than those issuing non-HF/PE PIPEs. This pattern is consistent with the notion that the firms raising capital from hedge funds and private equity funds are more financially constrained than firms who are able to attract other investors to their PIPEs. Table IA.2 of the Internet Appendix provides summary statistics comparing our sample to the *Compustat* universe.

Panel B of Table 3 contains summary statistics on the terms and conditions of the PIPEs in our sample. The PIPE offerings have a mean size of \$35.3 million and a median size of \$10.0 million. The mean (median) transaction involves the sale of 17.6% (11.4%) of the issuer's pre-offering shares outstanding. The deals involving hedge funds or private equity funds tend to be larger than in other PIPEs relative to both the issuer's pre-offering shares outstanding (20.2% vs. 12.4%) and the liquidity of the issuing firms (72% vs. 61% of pre-offering daily trading volume). For unregistered offerings, there are pre-specified dates by which the firm must file a registration statement and by which the registration must become effective.<sup>9</sup> HF/PE PIPEs have shorter registration periods than other PIPEs; the mean (median) effective time to registration was 90 (60) days for unregistered HF/PE PIPEs and 150 (80) days for other PIPEs. In addition, HF/PE PIPEs are more likely to have

<sup>8</sup> Fig. IA.1 in the Internet Appendix provides visual evidence of a jump at 20% (significant at the 1% level). Park (2013) also documents a distribution discontinuity around the 20% threshold, although his sample has more clustering around the 20% threshold (approximately 20% of the sample). Arena and Ferris (2007) argue that firms with greater managerial entrenchment are more likely to bypass shareholder approval. Both Park (2013) and Arena and Ferris (2007) find that PIPEs bypassing shareholder approval have significantly lower announcement returns.

<sup>9</sup> Aside from the mandatory registration rights granted to PIPE investors, several transactions also include “piggy-back” or demand registration rights. Of the 3001 transactions in our sample, 365 cases included piggy-back and/or demand rights. Piggy-back registration rights are a form of registration rights that grants the investor the right to register his or her unregistered stock when either the company or another investor initiates a registration. Demand registration rights entitle an investor who owns restricted stock to force a company to register shares of common stock so that the investor can sell them to the public. Unregistered PIPE-issued stocks with these registration rights are considered more liquid than the ones without. In the Internet Appendix, therefore, we provide separate analysis of the stock performance and trading volume/turnover in this subsample of PIPEs during the first six months following the transaction closing.

warrants than other deals, with about 48% of HF/PE deals having warrants compared to about 22% of other deals.<sup>10</sup>

PIPEs are usually syndicated, with a number of different investors contributing capital in each transaction. In Panel C of Table 3, we present statistics on the investor composition of each PIPE. Hedge funds and private equity funds play a prominent role, participating in roughly two thirds of the PIPEs in our sample (1991 out of 3001 PIPEs). In these PIPEs, hedge funds and private equity funds provide an average of 72% of the capital. There appears to be a dichotomy in which hedge funds and private equity funds either provide the bulk of the capital or none at all. Therefore, we present separate results for HF/PE and non-HF/PE PIPEs throughout the paper to explore how differences in investor composition are associated with other transaction characteristics and outcomes.<sup>11</sup>

#### 4. Returns to pipe investors

As illustrated by the example of United American Health Corporation, PIPE shares are generally sold at a price that differs from the current market price of the issuer's stock. In this section, we describe how we value the package of securities offered in a PIPE transaction, summarize the discounts for our sample of PIPEs, and compute buy-and-hold abnormal returns to PIPE investors over various horizons.

##### 4.1. Measuring pipe discounts

The discount on a PIPE investment reflects the price paid relative to the true value of the package of securities the investor receives. Since 39% of the PIPEs in our sample have attached warrants, it is important to include the value of the warrants in the calculation of PIPE discounts.<sup>12</sup> For this reason, we add the value of any warrants associated with a PIPE to the market price of the equity when estimating the value of the securities the investor receives. Then, we measure the discount as one minus the price paid per share, divided by the sum of the market price of the stock and the estimated value of any attached warrants.

We value each warrant using the Black–Scholes warrant pricing

formula that adjusts for the dilution that occurs when the firm issues new shares upon exercise of the warrants<sup>13</sup>:

$$\frac{N}{N+M} C(S_t, K, T, \sigma_t, r_t)$$

where  $N$  is the number of shares outstanding,  $M$  is the number of warrants outstanding, the function  $C$  is the Black–Scholes call option pricing model,  $S_t$  is the stock price,  $K$  is the strike price,  $T$  is the time to expiration,  $\sigma_t$  is the stock volatility, and  $r_t$  is the risk-free rate for maturity  $T$ . We estimate the conditional volatility  $\sigma_t$  using the annualized standard deviation of daily returns for the three months prior to the valuation date. The risk-free rate  $r_t$  is measured with the maturity-matched swap rate.

One potential concern is that if one measures the volatility at the time of the PIPE issuance, it could be higher than expected future volatility, since PIPEs tend to be issued at times when there is unusually high uncertainty. Overstating volatility would lead the Black–Scholes formula to overstate the value of the warrants and hence the discounts and returns to the PIPE investors. For this reason, we set a ceiling of 50% for the volatility input, which reduces the estimated value of the warrants and the associated PIPE discounts.

The bottom five rows of Panel B of Table 3 summarize the estimated discounts for the PIPEs in our sample. The mean discount for all PIPEs is 11.2% and the median is 11.1%. The discount is much higher for PIPEs with attached warrants than without, averaging at 20.1% for PIPEs with warrants and 5.7% for the ones without warrants.<sup>14</sup> HF/PE PIPEs have noticeably higher discounts than other PIPEs, receiving a mean discount of 9.4% on the deals that do not have warrants and a mean discount of 20.1% on the deals that do have warrants. Interestingly, the gap in discounts between HF/PE PIPEs and non-HF/PE PIPEs mainly arises from the PIPEs without warrants. The size of discounts that non-HF/PE investors receive from the 'without-warrant' PIPEs is close to zero, averaging at 0.9%. However, when non-HF/PEs invest in the PIPEs with attached warrants, they receive a mean discount of 19.1%, which is close to the discounts on HF/PE PIPEs.

Illiquidity is an important feature of PIPE transactions that is likely to affect the offering price. Consistent with this notion, the average discount of 11.6% for unregistered PIPEs is 22% larger than the average discount of 9.5% for registered PIPEs. This difference is statistically significant at the 1% level ( $t = 2.6$ ) and likely reflects compensation for the inability of unregistered PIPE investors to sell their shares until the issuer's registration statement becomes effective.

##### 4.2. Buy-and-hold returns earned by ordinary investors and pipe investors

The return a PIPE investor receives over a particular holding period is equal to the change in the value of the equity investment plus the change in the value of any attached warrants over that period. The equity portion of this investment is affected by the discount negotiated by the investor and the return on the stock over the holding period. If the PIPE contains warrants, the change in warrant valuation will be affected by the change in the stock price and underlying parameters of the Black–Scholes valuation, including the strike price, time to expiration, and the stock volatility. It is likely that investors cannot realize the Black–Scholes value of the warrants if they wish to exit because there is

<sup>10</sup> Of the 3001 transactions in our sample, 373 were issued by foreign companies. To evaluate whether foreign issuers affect our results, we report summary statistics on PIPE terms and conditions separately for foreign and domestic issuers in the Internet Appendix Table IA.3. This table indicates that there are not significant differences between the two groups, except that domestic deals are more likely to be registered, to have higher HF/PE participation, and to have longer warrant maturities than foreign issuer deals.

<sup>11</sup> Internet Appendix Table IA.1 reports statistics on investor composition for the *PrivateRaise* universe and for our sample. In both samples, hedge funds are prominent PIPE investors, participating in about 60% and leading 44–49% of transactions. We group private equity and hedge funds together because of their similar organizational structures and pecuniary incentives. In our final sample of 3001 transactions, 398 deals (13.3%) have both hedge funds and private equity present. Out of the 2535 transactions for which investor allocations are fully reported, 551 deals are sold solely (more than 99.9% of shares) to hedge funds or private equity. We also examine other co-participating investors in the HF/PE PIPEs (see Table IA.10 of the Internet Appendix), finding that individual investors and investment banks commonly invest alongside hedge funds and private equity.

<sup>12</sup> Note that our approach is different from the 'traditional' measure of PIPE discounts. Earlier studies of PIPE transactions (e.g., Hertz and Smith, 1993; Hertz et al., 2002; Krishnamurthy et al., 2005; Wruck, 1989) do not take warrant values into consideration, but just compute the discount as the difference between the market price and the purchase price divided by the market price. However, more recent studies such as Brophy et al. (2009) and Chaplinsky and Haushalter (2010) do include warrants into their calculation of discounts and returns.

<sup>13</sup> See Black and Scholes (1973, pp. 648–649) for a discussion of the difference between the valuation formulas for warrants and exchange-traded options due to the dilution that occurs when a warrant is exercised.

<sup>14</sup> This difference mainly comes from the warrant value. The average price discount on stock is not statistically different between the transactions without warrants (5.7%) and those with warrants (7.2%). More importantly, PIPE investors do not appear to trade off discounts for warrants, since the price discounts are larger for the deals with warrants than those without (although the difference is only weakly significant at the 10% level).

not a liquid market for the warrants. For this reason, we report PIPE investor returns both with and without warrants throughout the paper to set upper and lower bounds on the returns realized by investors.

Table 4 summarizes the buy-and-hold returns to PIPE investors and ordinary investors in the issuer's stock. To measure abnormal returns, we compare the returns of an issuing firm to those of a matched firm. Matched firms are selected by considering all firms in the same 2-digit SIC industry that did not previously issue a PIPE during the sample period, then selecting the firm with the minimum sum of the absolute differences between the standardized equity book-to-market ratio, the standardized log market capitalization, and the standardized Amihud (2002) illiquidity measure. We follow Lyon et al. (1999) and use bootstrapped skewness-adjusted *t*-statistics for statistical inference.

We first present the returns to an ordinary investor who buys shares at the market price on the PIPE closing date and holds them for a fixed horizon. These returns tend to be low relative to those of the matched firms. In the full sample, the average abnormal return for the PIPE issuer over the three months after closing is  $-0.5\%$  ( $t = -0.6$ ), for six months is  $-4.2\%$  ( $t = -3.2$ ), for one year is  $-5.2\%$  ( $t = -2.7$ ), and for two years is  $-8.0\%$  ( $t = -2.4$ ). This pattern of underperformance subsequent to PIPE issuance is consistent with the findings in prior literature (Hertzel et al. (2002); Brophy et al., 2009).<sup>15</sup> If the issuing firms in our sample did not offer discounts and warrants, they would likely have trouble finding

**Table 4**  
Buy-and-hold returns to market and PIPE investors.

This table reports summary statistics of buy-and-hold returns after PIPE transactions. Market Investor Return is the return earned by purchasing the PIPE issuer's stock on the market on the transaction closing date and holding it for a fixed period. PIPE Investor Return is the return earned by purchasing securities in the PIPE transaction and holding them for a fixed period. Abnormal returns are relative to the return on a matched firm, which is obtained by considering all firms in the same 2-digit SIC industry that did not previously issue a PIPE in the sample period and selecting the firm with the minimum sum of the absolute differences between the standardized equity book-to-market ratio, the standardized log market capitalization, and the standardized Amihud (2002) illiquidity measure. Warrants are valued using the Black-Scholes call option model adjusted for dilution, with annualized volatility estimated over the trailing three months and capped at 50% and the risk-free rate interpolated from the swap curve. Observations where this sum exceeds two are excluded due to poor match quality, which removes 423 observations from the full sample. *t*-stat is the bootstrapped skewness-adjusted *t*-statistic from 1000 draws with replacement.

	Mean	StDev	<i>t</i> -stat	p25	p50	p75	Obs.
<i>Market investor abnormal return (%)</i>							
3 months	-0.5	47.9	-0.6	-23.3	-0.9	20.6	2513
6 months	-4.2	63.6	-3.2	-34.2	-5.0	25.5	2485
1 year	-5.2	97.6	-2.7	-47.9	-6.7	32.0	2422
2 years	-8.0	157.1	-2.4	-63.0	-7.6	47.3	2123
<i>PIPE investor abnormal return (excluding warrant values) (%)</i>							
3 months	10.2	53.6	7.8	-16.8	6.2	33.5	2513
6 months	6.3	70.1	4.3	-29.2	1.3	37.6	2485
1 year	4.6	103.2	2.2	-42.9	-0.9	44.3	2422
2 years	1.9	160.9	0.5	-56.0	-1.2	57.8	2123
<i>PIPE investor abnormal return (including warrant values) (%)</i>							
3 months	17.4	59.6	11.0	-13.1	10.9	40.0	2513
6 months	13.2	76.9	8.6	-25.9	4.4	43.8	2485
1 year	12.1	114.1	4.8	-39.8	1.7	50.1	2422
2 years	10.1	175.7	2.4	-55.0	0.7	62.9	2123

<sup>15</sup> The abnormal returns to ordinary investors in our sample are somewhat higher than those reported in prior literature. Hertzel et al. (2002) find average abnormal returns of  $-30\%$  over the three years after private placements in a sample covering 1980–1996. Brophy et al. (2009) find average abnormal returns of  $-11\%$  in the year after traditional PIPE offerings to hedge fund investors in a sample covering 1995–2002. These differences could arise from differences in the sample period, the holding period used in return calculations, the type of transactions considered, or the matching standards.

investors willing to hold long positions in a large quantity of newly issued equity.<sup>16</sup>

The effect of the discounts and warrants on the return to PIPE investors is illustrated in the second and third portions of Table 4, in which we report the PIPE investor's return relative to that of a matched firm's equity. In contrast to ordinary investors, PIPE investors' returns are substantially higher than the returns of matched firms because of the discounts and warrants they receive. The magnitude and statistical significance of these abnormal returns decrease with the holding period. If we only consider the stock portion of the PIPE, ignoring the value of attached warrants, PIPE investors receive an average abnormal return of  $10.2\%$  ( $t = 7.8$ ) over the three months following the PIPE's closing,  $6.3\%$  ( $t = 4.3$ ) over six months,  $4.6\%$  ( $t = 2.2$ ) over the first year, and  $1.9\%$  ( $t = 0.5$ ) over the first two years. Including the value of the warrants increases the returns to  $17.4\%$  ( $t = 11.0$ ) over three months,  $13.2\%$  ( $t = 8.6$ ) over six months,  $12.1\%$  ( $t = 4.8$ ) over one year and  $10.1\%$  ( $t = 2.4$ ) over two years.

This pattern of returns comes from the immediate accrual of the discount combined with the subsequent underperformance of the average issuer's stock. Since a large portion of the return they receive occurs immediately from the discount, passive PIPE investors have an incentive to exit their positions as soon as possible. In addition, the poor expected subsequent performance of the issuing firms' equities increases PIPE investors' incentives to exit their positions quickly.

However, the unregistered status of the equity they receive and the illiquidity of the equities they receive limits the ability of PIPE investors to exit. Therefore, some of these returns, especially for the three-month horizon, are likely to be unattainable by investors who have to sell their positions on public markets to realize profits.

More importantly, the pattern of returns indicates that two major assumptions on which buy-and-hold returns are grounded are likely to be unrealistic. First, the buy-and-hold approach assumes that an investor will not liquidate any of her positions until the end of a fixed holding period, which would be a suboptimal strategy for a passive PIPE investor. Second, it assumes that an investor can liquidate her entire position on one day, which is questionable given the thinness of the market for PIPE issuers' stock. In other words, the buy-and-hold strategy is neither desirable nor feasible from investors' standpoint.

In that regard, buy-and-hold returns are potentially a misleading measure of returns to PIPE investors, especially to passive ones who have incentives to sell their investments as quickly as possible to lock in the profits coming from the upfront discount. In Section 5, we further provide evidence supporting the argument that passive investors, as opposed to those who invest from controlling or monitoring motivation, account for a good portion of PIPE investors in our sample. We then suggest an alternative way to measure returns to PIPE investors, which incorporates the investors' likely selling strategy as well as the two real world factors that limit their ability to sell quickly: registration status and the illiquidity of the shares they purchase.

#### 4.3. Warrants and skewness in the return distribution

An important characteristic of the PIPE return distribution is its skewness, since average PIPE returns are substantially higher than median returns. This pattern occurs because of both the skewness of the underlying stock returns and the skewed return distribution of the attached warrants. When the issuer performs poorly, the warrants have little value and expire worthless. However, when the issuer performs well, the firm's stock price will exceed the exercise price and the

<sup>16</sup> Ideally, investors would like to short-sell the issuing firms' stocks to lock in the discounts they receive. Although sometimes short-selling is possible, conversations with practitioners indicate that for most PIPE offerings, it is prohibitively expensive to short sell the stock to lock in the discount and hedge against downside risk.

warrants will be valuable. Warrants therefore magnify the stock's upside but not affect its downside, which increases the skewness of the PIPE return distribution.

This skewness of returns is illustrated in Fig. 2, which reports distribution of the one year buy-and-hold abnormal returns to ordinary investors (slanted line pattern bar), the equity portion of PIPE returns (dotted bar), and PIPE returns using the Black–Scholes valuation of the attached warrants (solid color bar). The peak of the underlying stocks' return distribution is negative, which occurs because of the negative median returns earned by market investors. However, PIPE returns are more likely to be positive than ordinary investor returns because of the discount and warrants. The gap between the PIPE returns with and without warrants is largest for the highest return levels, which reflects the amplification of positive returns by the warrants.<sup>17</sup>

The high skewness of PIPE returns suggests that investing in PIPEs is somewhat like venture capital investing, in that positive average returns are driven by a small number of "home runs" in the portfolio. Investing in PIPEs can be profitable because shares are purchased at a discount and the attached warrants amplify the returns of good investments. As a result, winning investments are sufficiently profitable to drive average abnormal returns to 12.1% for a one year holding period in our sample of PIPEs, even though the median deal only outperforms its matched firm by 1.7% over the same horizon.

## 5. Registration status, illiquidity, and holding period adjusted returns

### 5.1. Abnormal volume and returns around closing and registration dates

As noted in the introduction, PIPE investors are incentivized to exit their investments as quickly as possible to capture the discount and mitigate exposure to the issuer's downside risk. We evaluate the extent to which this behavior occurs by examining abnormal trading volume and price movements in PIPE issuers' shares immediately following the closing date and the effective registration date for various subsamples split by the investor type and the registration status. For registered PIPEs, the shares are tradable immediately upon closing, so the two dates are the same. For unregistered PIPEs, the registration date averages 100 days subsequent to the closing date (Table 3).

We present statistics on trading volume in Table 5, with the full sample of PIPEs presented in Panel A, HF/PE PIPEs in Panel B, and non-HF/PE PIPEs in Panel C. In each panel, registered PIPEs average substantially higher trading volume after closing (and registration) relative to the quarter prior to this date. Issuers of registered PIPEs have average daily trading volume that is 49.1% higher ( $t = 7.2$ ) in the week following closing, 41.2% ( $t = 6.8$ ) in the two weeks following closing, and 38.0% ( $t = 5.9$ ) higher in the month following closing. However, these large average jumps in trading volume appear to be driven by large increases for a minority of firms, since the median abnormal volume around the time of the PIPE is close to zero for all windows around the closing date.<sup>18</sup>

The trading volume in a registered PIPE issuer's stock is likely to contain both selling by PIPE investors who are trying to liquidate some of their positions and buying by outside investors who react to the positive news of successful securing of capital. These two factors should have offsetting effects on the issuing firm's price. It is impossible to know what fraction of the abnormal volume following PIPE offerings represents selling by PIPE investors, or how long these investors actually

hold the shares they acquire. However, the returns around the closing of registered PIPEs provide some insight. The abnormal return around the closing of registered PIPEs is  $-2.5\%$  ( $t = -2.3$ ) suggesting that the price pressure effect seems to dominate the effect of positive news.

Unregistered PIPEs provide a setting that makes it possible to identify the price pressure effect separately from the information effect, since the provision of capital to issuing firms and the selling by PIPE investors happen at different times. Following the closing of unregistered PIPEs, trading volumes significantly increase for the full sample as well as for the two subsamples. This increase in trading volume, unlike in registered PIPEs, does not include selling by PIPE investors since their shares are not registered at this time. The statistically significantly positive 4.1% ( $t = 7.6$ ) abnormal return around closing indicates that a successful offering of PIPE provides positive news regarding the resolution of uncertainty about the firm's capital raising and investment.

The information effect of capital raising is reflected in the trading volume and return when the transaction closes. In the absence of additional news about the company's prospects that coincides with the registration date, the subsequent increase of trading volume and price movements around the registration of unregistered PIPE securities most likely reflects selling by PIPE investors rather than trading on news. Table 5 indicates that after the registration of originally unregistered PIPEs, there is another spike in trading volume, with about a 30% increase. This increase in volume is accompanied by significantly negative abnormal returns averaging  $-3.2\%$  ( $t = -6.6$ ), consistent with selling by PIPE investors driving down the price of the issuer's shares immediately after investors can begin selling their positions. Further splitting the unregistered PIPE sample by investor types in Panels B and C reveals that this price pressure effect is mainly driven by HF/PE investors. For the firms issuing an unregistered PIPE to non-HF/PE investors, neither the volume nor the returns around the effective registration date is statistically significantly different from zero. This pattern suggests that HF/PE investors are more likely to be arms-length/short-term investors and have stronger incentives than other types of investors to sell their shares as soon as they can (Dai, 2007; Billett et al., 2015).

### 5.2. Trading volume and the time required to exit a pipe investment

An important issue facing PIPE investors is that the stocks they purchase are relatively illiquid, since they were usually issued by small, poorly-performing companies which typically have high information asymmetry. Therefore, if a PIPE investor wishes to exit her position by selling shares in the secondary market, her ability to do so without depressing the price is limited unless she spreads the sales over a long period of time. In the bottom portion of Panel A of Table 5, we present calculations of the ratio of shares offered in the PIPE to post-registration volume over various horizons following the PIPE issuance. This calculation provides insight into the ability of PIPE investors to exit their positions within each horizon, since within a particular time period, there is a limit to the fraction of volume an investor trade without having price impact.

These calculations indicate that it would be impossible for investors in the average PIPE to sell all of their shares during the first month following registration, since the mean ratio of offered shares to volume is 4.14 for unregistered PIPEs and 1.16 for registered ones. While we do not know what fraction of trading volume is made up of selling by PIPE investors, a reasonable assumption would be that PIPE investors limit their trades to a maximum of ten percent of the daily volume to avoid depressing the stock price substantially. Under this assumption about trading behavior, it would take at least two years for them to exit the average unregistered investment and six to 12 months to exit the average investment in a registered PIPE.

Therefore, the ability of investors to sell their shares quickly appears to be inhibited by the illiquidity of PIPE issuers. Moreover, our sample contains PIPEs that are likely to be relatively more liquid because the issuers are traded on NYSE or NASDAQ. The common stock PIPEs that

<sup>17</sup> This figure is similar to Fig. 1 of Chaplinsky and Haushalter (2010).

<sup>18</sup> The trading volume effects could be driven by the increase in float following the issuance of new shares. In Internet Appendix Table IA.4, we repeat the analysis in Table 6 using turnover (i.e., volume/shares outstanding), instead of volume, as a measure of abnormal trading activity and confirm that our results are not affected by how trading activity is measured.

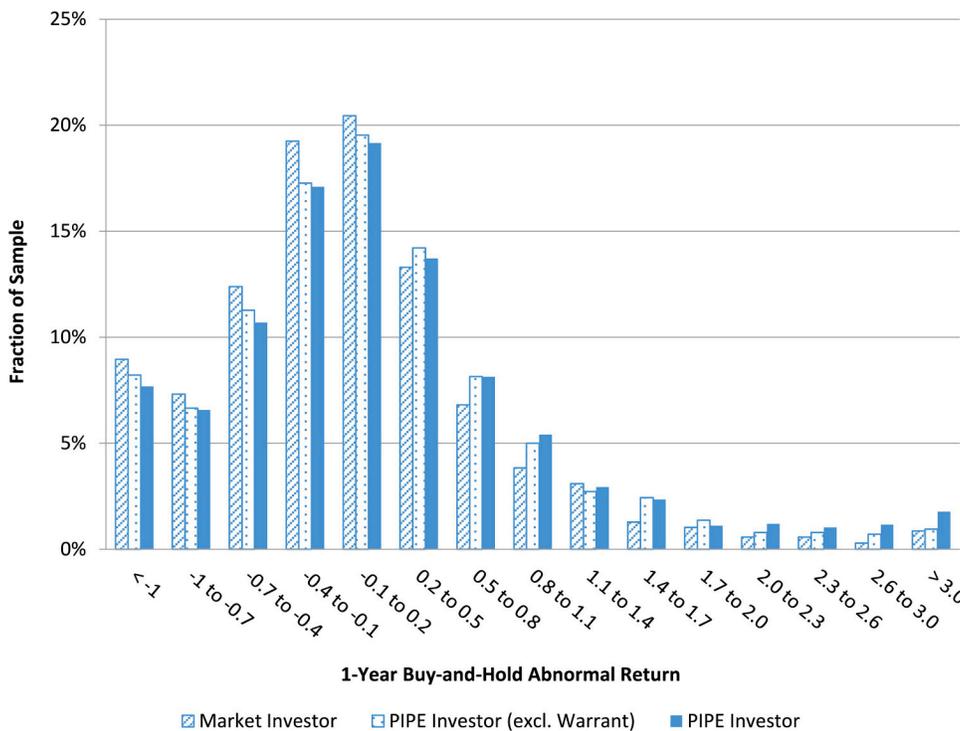


Fig. 2. Distribution of returns to market and PIPE investors.

This figure reports histograms of the distributions of returns to regular investors in PIPE stocks and participants in PIPE transactions. Market Investor Return is the return earned by purchasing the PIPE issuer’s stock on the market on the transaction closing date and holding it for a fixed period. PIPE Investor Return is the return earned by purchasing securities in the PIPE transaction and holding them for a fixed period. Abnormal returns are relative to the return on a matched firm, which is obtained by considering all firms in the same 2-digit SIC industry that did not previously issue a PIPE in the sample period and selecting the firm with the minimum sum of the absolute differences between the standardized equity book-to-market ratio, the standardized log market capitalization, and the standardized Amihud (2002) illiquidity measure. (For interpretation of the references to color in this figure, the reader is referred to the web version of this article.)

were excluded from our sample trade over-the-counter and therefore are likely to be even more difficult to exit than the PIPEs in our sample.

5.3. Holding period adjusted returns

A PIPE is a type of investment for which returns depend on the holding period, since a large portion of the returns come from the discount received at the time of the investment. Investors have an incentive to sell their PIPE shares as soon as possible, but are limited by registration requirements and low trading volume.<sup>19</sup> It is impossible to know the actual holding periods of investors without detailed data on the way their holdings change over time.

We suggest an approach to gauge PIPE investors’ returns that is motivated by two empirical patterns established in this study and/or in previous studies. First, the facts that most PIPE issuers show long-term underperformance and that volume increases after registration suggest that at least some of PIPE investors try to unload their positions as soon as they can. Second, there is an unobservable limit on the number of shares an investor can sell on a particular day, since selling too aggressively will drive down transaction prices. To approximate the returns an investor would obtain with a feasible exit strategy, we assume

that the PIPE investors follow a strategy of selling a constant fraction of the daily volume until their position is liquidated and calculate the returns from this strategy. We perform these calculations assuming that the PIPE investors sell five, ten, or twenty percent of the daily volume each trading day, respectively, until their position is liquidated.<sup>20</sup>

We acknowledge that this approach likely misstates returns because it requires the simplifying assumption that PIPE investors want to exit their position as quickly as possible. It also ignores coordination issues or “run-like” behavior among investors in the syndicate, which is impossible to observe and would be overly complicated to model given our data. However, this approach can provide a plausible benchmark of returns that an arms-length investor can obtain under what is likely to be a feasible trading strategy.

The middle set of columns of Table 6 contain estimates of the returns received by regular and PIPE investors assuming the investors sell ten percent of the daily volume every day subsequent to registration (our baseline specification). The second row of Table 6 shows that it would take 384 calendar days on average, or slightly over one year, to sell the position. Market investors perform somewhat (3.7%) better than peer firms on average, but the median PIPE issuer does slightly worse (−0.6%), suggesting that the issuing firms have a somewhat more skewed distribution than their matched firms. PIPE investors, however, do much better than investors in peer firms. On average, PIPE investors earn 19.7% abnormal returns over 384 days.

In the left and right sets of columns, we present estimates of holding period adjusted returns assuming faster (selling 20% of daily volume) or slower (selling 5% of daily volume) times to exit. Not surprisingly, faster (slower) selling results in a shorter (longer) holding period. Although the average abnormal returns are similar across different exit specifications

<sup>19</sup> Some PIPE transactions involve explicit sale restrictions that also limit an investor’s ability to exit in a specified timeframe after issuance. In the full sample of common stock PIPEs, 302 out of 3001 transactions contain this sort of sale restriction. The implications of these restrictions are not straightforward to assess, as they often overlap with the time to registration and are implemented in a staggered way. Internet Appendix Table IA.7 reports that holding period adjusted returns are quantitatively similar after excluding transactions with sale restrictions from the sample.

<sup>20</sup> While these percentage assumptions are ad hoc, they approximate the upper bound on the rate of selling without price impact as indicated by conversations with practitioners. As an alternative upper bound, Table 5 indicates that price impact is substantial when PIPE investors sell 23% (= 30/(100+30)) of volume, given the significant negative abnormal return associated with a 30% increase in volume after the PIPE shares are registered, presumably attributable to investors selling at the first opportunity.

**Table 5**

Summary of trading volume and returns around closing and registration dates.

This table reports summary statistics on trading volume and returns in PIPE stocks. Panel A presents the statistics for the full sample, and in Panels B and C the sample is split into PIPEs with and without hedge funds and private equity funds participation. Each observation represents a distinct PIPE transaction. The registration date is defined as the effective date of the registration statement for unregistered PIPEs and the closing date of the transaction for registered PIPEs. Daily Abnormal Volume is defined as the difference between the average daily volume in a window after closing (registration) and the average daily volume over the three months prior to closing (registration). Raw Return around closing (registration) date is the stock return from 4 trading days before to 5 trading days after the registration date. Abnormal Return is the raw return minus the CAPM benchmark return over that window. Fraction of Post-Registration Volume Required to Sell Issued Shares is the ratio of issued shares to realized volume over various windows after registration and describes the amount of daily volume the PIPE investors would need to trade to exit their positions. *t*-stat is from a regression of the variable of interest on a constant, with standard errors clustered by month of closing. All ratios (except returns) are winsorized at the 1% level to mitigate the impact of outliers.

Panel A: Full sample												
Variables	Unregistered								Registered			
	At closing				At registration				At closing and registration			
	Mean	p50	<i>t</i> -stat	Obs.	Mean	p50	<i>t</i> -stat	Obs.	Mean	p50	<i>t</i> -stat	Obs.
<i>Daily abnormal volume (%)</i>												
1 week	55.7	3.4	13.7	2425	30.5	-10.3	4.6	865	49.1	2.9	7.2	573
2 weeks	46.2	1.2	12.7	2425	26.9	-5.0	5.0	853	41.2	0.0	6.8	573
1 month	41.1	-0.4	11.2	2424	34.8	-5.2	5.6	853	38.0	-0.5	5.9	573
<i>Returns (%)</i>												
Raw return	4.2	0.8	7.5	2427	-2.9	-1.7	-5.4	865	-2.1	-4.0	-1.9	573
Abnormal ret.	4.1	0.6	7.6	2427	-3.2	-2.2	-6.6	865	-2.5	-3.7	-2.3	573
<i>Percentage of post-registration volume required to sell issued shares (%)</i>												
1 month					414	124	15.7	859	116	58.8	14.6	571
3 months					124	43.3	14.9	850	36.4	18.9	14.6	571
6 months					52.8	19.9	15.5	850	17.6	8.9	14.5	570
12 months					23.5	8.5	14.9	846	7.8	4.0	13.6	567
24 months					10.6	3.8	13.0	824	3.4	1.7	11.5	555
Panel B: HF/PE PIPEs												
Variables	Unregistered								Registered			
	At closing				At registration				At closing and registration			
	Mean	p50	<i>t</i> -stat	Obs.	Mean	p50	<i>t</i> -stat	Obs.	Mean	p50	<i>t</i> -stat	Obs.
<i>Daily abnormal volume (%)</i>												
1 week	56.5	5.3	11.5	1542	36.0	-9.9	4.7	731	49.2	5.3	6.6	447
2 weeks	48.4	3.4	10.7	1542	31.1	-4.3	5.0	723	44.5	4.3	6.4	447
1 month	42.2	1.0	9.6	1542	39.9	-3.9	5.6	723	40.8	1.5	5.5	447
<i>Returns (%)</i>												
Raw return	3.5	0.0	5.7	1543	-3.3	-2.0	-6.0	731	-3.0	-4.7	-2.4	447
Abnormal ret.	3.3	0.0	5.5	1543	-3.6	-2.6	-6.9	731	-3.6	-4.8	-2.8	447
Panel C: Non-HF/PE PIPEs												
Variables	Unregistered								Registered			
	At closing				At registration				At closing and registration			
	Mean	p50	<i>t</i> -stat	Obs.	Mean	p50	<i>t</i> -stat	Obs.	Mean	p50	<i>t</i> -stat	Obs.
<i>Daily abnormal volume (%)</i>												
1 week	54.3	0.1	9.0	883	0.2	-18.0	0.0	134	48.9	-7.8	3.3	126
2 weeks	42.5	-2.4	8.1	883	3.4	-12.5	0.4	130	29.6	-8.5	2.8	126
1 month	39.2	-5.1	7.4	882	6.3	-13.0	0.7	130	28.3	-7.0	2.7	126
<i>Returns (%)</i>												
Raw return	5.5	1.9	6.2	884	-0.8	-0.3	-0.6	134	1.1	0.2	0.6	126
Abnormal ret.	5.4	1.4	6.4	884	-1.0	-0.4	-0.9	134	1.4	0.3	0.8	126

(varying between 18.0% and 24.5%), the holding period differs significantly. Specifically, selling 20% of daily volume allows a much faster exit (271 days vs. 384 days) but yields a similar average abnormal return (18.0% vs. 19.7%). With annualized returns, we can more clearly see the effect of a faster rate of selling, as annualized returns under the faster selling specification are 97.2% compared to 67.6% under the baseline specification.<sup>21</sup> Similarly, selling 5% of daily volume instead results in a

longer holding period of 527 days, although PIPE investors earn slightly higher abnormal returns on average (24.5% vs. 19.7%).

Although the average abnormal returns to PIPE investors seem high, the distribution of returns is highly skewed, so that a median PIPE investor earns only an abnormal return of on 7.8% in the baseline specification. It is also worth mentioning the distinction between the returns to HF/PE investors and to non-HF/PE ones. On average, it takes *longer* for HF/PE investors to exit their positions than non HF/PEs (405 vs. 295 days in the baseline specification), assuming that both groups follow the same trading strategy. Although HF/PEs appear to have a stronger incentive to exit quickly (see Table 5), this goal can be harder to achieve because they tend to acquire a larger number of shares relative to the liquidity of the issuer. HF/PEs also receive much higher average abnormal holding period adjusted returns than non-HF/PE (21.8% vs. 10.6%), with this difference coming from the value of attached warrant. Excluding the warrant value, the average abnormal returns to the two

<sup>21</sup> Although we report the annualized returns for ease of comparison, they should be interpreted with caution. For the transactions with very short holding periods (as short as 2 days in our sample), compounding returns over a year generates extremely large numbers, which biases the average annualized returns. To address the impact of extreme outliers, we drop observations with less than one month holding period for the calculation of annualized returns. However, this cut-off is arbitrary and the average return is still affected by some large compounded numbers.

**Table 6**

Holding period adjusted returns to market and PIPE investors.

This table reports summary statistics of holding period adjusted returns after PIPE transactions, assuming that PIPE investors sell 5%, 10%, and 20% of post-registration daily trading volume, respectively. Market Investor Return is the return earned by purchasing the PIPE issuer's stock on the market on the transaction closing date and selling a fixed percentage of post-registration volume daily until exiting. PIPE Investor Return is the return earned by purchasing securities in the PIPE transaction and selling a fixed percentage of post-registration volume daily until exiting. Abnormal returns are relative to the return on a matched firm, which is obtained by considering all firms in the same 2-digit SIC industry that did not previously issued a PIPE in the sample period and selecting the firm with the minimum sum of the absolute differences between the standardized equity book-to-market ratio, the standardized log market capitalization, and the standardized Amihud (2002) illiquidity measure. The return to matched firm is calculated assuming that investors sell the matched stock at the same rate as the PIPE stock. Warrants are valued using the Black–Scholes call option model adjusted for dilution, with annualized volatility estimated over the trailing three months and capped at 50% and the risk-free rate interpolated from the swap curve. In calculation of annualized returns, observations with less than one month holding period have been dropped to mitigate the impact of outliers. All returns are winsorized at the 1% and 99% level. *t*-stat is the bootstrapped skewness-adjusted *t*-statistic from 1000 draws with replacement.

	Slower selling specification (selling 5% of daily volume)				Base-line specification (selling 10% of daily volume)				Faster selling specification (selling 20% of daily volume)			
	Obs.	Mean	p50	<i>t</i> -stat	Obs.	Mean	p50	<i>t</i> -stat	Obs.	Mean	p50	<i>t</i> -stat
Market investor abnormal return (%)	1232	8.9	1.8	3.8	1244	3.7	-0.6	2.1	1261	1.9	-1.2	1.1
PIPE investor abnormal return												
Holding period (days)	1232	527	443	47.1	1244	384	288	45.6	1261	271	177	38
Excluding warrants (%)	1232	15.5	5.6	5.8	1244	11.2	4.1	5.5	1261	8.5	3.6	4.6
With warrants (%)	1232	24.5	8.9	9.0	1244	19.7	7.8	8.8	1261	18.0	7.8	8.1
Annualized (%)	1206	70.5	8.3	17.6	1181	67.6	9.2	17.5	1133	97.2	11.9	16.6
Annualized, warrant valued at expiration (%)	1205	29.8	5.3	12.7	1181	30.9	4.0	9.4	1133	35.9	5.9	7.8
PIPE investor abnormal return: HF/PE PIPEs												
Holding period (days)	997	551	470	39.3	1009	405	303	42.2	1026	285	196	39
Excluding warrants (%)	997	16.6	6.1	5.7	1009	12.0	4.3	5.2	1026	9.0	3.0	4.4
With warrants (%)	997	27.0	9.8	8.5	1009	21.8	8.8	8.6	1026	19.6	9.3	7.8
Annualized (%)	979	71.0	8.8	16.1	964	62.8	9.7	14.8	938	87.0	13.7	14.3
Annualized, warrant valued at expiration (%)	979	28.8	5.6	11.5	964	24.6	4.0	7.3	938	26.2	5.3	5.8
PIPE investor abnormal return: non HF/PE PIPEs												
Holding period (days)	235	425	319	24.5	235	295	198	19.2	235	209	128	17
Excluding warrants (%)	235	10.7	4.7	2.1	235	8.2	3.5	1.8	235	6.3	4.2	1.5
With warrants (%)	235	13.7	5.8	2.7	235	10.6	3.8	2.3	235	11.0	4.3	2.4
Annualized (%)	227	68.3	4.7	6.3	217	89.1	6.1	7.3	195	146.0	8.4	6.9
Annualized, warrant valued at expiration (%)	226	34.0	3.9	5.2	217	58.9	5.3	6.1	195	82.6	6.6	5.6

groups are not noticeably different (12.0% vs. 8.2%). In terms of annualized returns, however, due to the effect of longer holding period, returns to HF/PEs are smaller than those to non-HF/PEs (62.8% vs. 89.1%).

One issue with respect to the calculation of holding period adjusted returns is the treatment of warrants. As discussed in Section 4.1, we estimate the value of warrants assuming they can be sold at the Black–Scholes price at the end of holding period. This approach requires that the market for warrants is liquid, which is unlikely to be true in reality. Accordingly, we also calculate annualized returns assuming that warrants are held until expiration and pay out their intrinsic value at that time. Not surprisingly, the returns under this approach lie between the returns without warrants and the returns with warrants valued at the Black–Scholes price. Another pattern that emerges from a more conservative valuation approach is that the value of warrants accounts for a significant portion of the returns to PIPE investors, especially to HF/PEs. The average annualized return to HF/PE investors drops from 62.8% to 24.6% when warrants are held to expiration instead of sold for the Black–Scholes value at the end of the holding period.

## 6. Issuers' costs of finance and pipe investor returns

These calculations suggest that, despite the fact that returns decline with holding periods and there are impediments to selling the stock acquired in a PIPE as quickly as an investor would like, PIPE investors do earn substantially higher returns than investors who purchase equity in a similar company that does not issue a PIPE. A natural question to ask is whether these higher returns occur because of the financial constraints and associated weak negotiating position of PIPE issuers.

The notion that the returns represent compensation for providing capital to a financially constrained firm that could not raise capital from other sources has several empirical predictions. First, we expect that when PIPE issuers are more financially constrained, we should be more likely to observe more risk tolerant investors such as hedge funds or

private equity funds providing capital to them. Second, we expect that the size of discount and the holding period adjusted expected returns should increase with the PIPE issuers' financial constraints. Third, we expect that the volatility of returns to PIPE investors should be higher when the issuer is more financially constrained.

We test these hypotheses and present the results in Table 7. In Columns 1 and 2, we present estimates of equations predicting whether there is a hedge fund or private equity fund participating in the PIPE syndicate (Column 1) and the share of capital that hedge funds and private equity funds provide (Column 2). As independent variables, we include measures of firm size, profitability, intangibility, age, illiquidity, and institutional holdings. Presumably, size, profitability and firm age are negatively correlated with financial constraints, while intangibility is positively correlated with them. We include a measure of illiquidity because when incentives to exit quickly are stronger, investors are more likely to avoid illiquid stocks. If investors anticipate greater difficulty unwinding an equity position, they could require a higher discount. We also include institutional holdings as a measure of the ease of hedging an illiquid stock position (e.g., by shorting the stock). The coefficient estimates in Columns 1 and 2 indicate that smaller, less profitable firms with more intangible assets are more likely to have hedge fund and private equity fund investors. These results are consistent with the view that hedge funds and private equity funds are more likely to invest in PIPEs of more constrained companies. In terms of magnitudes, when the firm size increases from the 25th percentile (\$41 million market capitalization) to the 75th percentile (\$232 million market capitalization), holding other variables at their mean values, the likelihood of HF/PE participation decreases by 36%. Likewise, an increase of intangibility from the 25th percentile to the 75th percentile is associated with a 5.6% higher probability of HF/PE participation. The coefficients on illiquidity indicate that HF/PEs prefer, holding all else equal, more liquid stock, presumably because they have stronger incentives to exit quickly (Table 5). In addition, they prefer stocks with larger institutional ownership so that hedging their positions is easier.

**Table 7**

Issuers' financial condition and their cost of finance.

This table presents the relation between the issuers' financial conditions and various measures that characterize their cost of finance. Probit (Column 1) or OLS (Columns 2–5) coefficient estimates and corresponding *t*-stats (in parentheses) are reported. The dependent variables are the indicator variable of HF/PE participation (Column 1), the percentage of shares bought by HF/PE investors (Column 2), the size of discount including warrant value (Column 3), holding-period adjusted returns as calculated in Table 6 (Column 4), and the annualized standard deviation of issuers' daily stock returns over the holding period (Column 5), respectively. Holding periods are computed based on the baseline specification of selling 10% of post-registration daily volume. Size is the natural log of market capitalization. Profitability is the ratio of EBITDA to book assets. Intangibility is one minus the ratio of PP&E to book assets. Age is the number of years since IPO. Illiquidity is the Amihud (2002) price impact measure. All ratios, holding period adjusted returns, and the volatility of returns are winsorized the 1% level to mitigate the impact of outliers. All specifications include year fixed effects. Standard errors are robust to heteroskedasticity and account for double clustering by firm and issue month. \*\*\*\*\*, \*\*, and \* correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Dep. var.	HF/PE participation (1)	HF/PE share (2)	Discount (3)	HP-adj. return (4)	Volatility of returns (5)
Size	-0.207*** (-8.45)	-0.053*** (-7.18)	-0.022*** (-4.29)	-0.058** (-2.30)	-0.115*** (-7.24)
Profitability	-0.146*** (-2.63)	-0.084*** (-4.86)	-0.006 (-0.75)	0.007 (0.12)	-0.180*** (-5.77)
Intangibility	0.191* (1.73)	0.047 (1.30)	0.020 (0.87)	0.082 (0.86)	0.012 (0.20)
Age	0.002 (0.53)	0.002* (1.91)	-0.000 (-0.10)	0.001 (0.43)	-0.004** (-2.40)
Illiquidity	-0.018*** (-4.47)	-0.006*** (-3.91)	-0.001 (-0.71)	-0.007 (-1.57)	-0.005*** (-3.65)
Institutional holdings	0.491*** (3.74)	0.146*** (3.55)	-0.031 (-1.55)	0.114 (1.02)	-0.241*** (-4.13)
Constant	0.557*** (3.20)	0.397*** (7.30)	0.189*** (3.54)	0.346* (1.75)	1.585*** (10.28)
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	2296	1934	2259	959	959
Adjusted (Pseudo) $R^2$	0.0755	0.0948	0.0342	0.0142	0.294

In Column 3, we present equations predicting discounts on PIPEs using the same specification as in the prior columns. We find that firm size is negatively related to the size of discount to the extent that a one standard deviation (1.45) increase in firm size is associated with a 3.2% decrease in discounts, which would represent a 29% decrease from the average discount of 11%. This finding is consistent with the view that the discounts exist as compensation to PIPE investors for providing capital to financially constrained firms.

In Column 4, we estimate the extent to which holding period adjusted returns are a function of financial constraints, using the returns calculated assuming that investors sell 10% of the daily volume each day. The coefficient on size is negative and substantial in magnitude: a one standard deviation (1.45) increase in firm size is associated with an 8.4% decrease in holding period adjusted return, equivalent to about 43% of the mean return. This finding is also consistent with the notion that when firms are more financially constrained, they have to offer potential investors larger expected returns through the use of discounts and warrants.

In Column 5, we estimate the extent to which the volatility of returns facing PIPE investors is a function of issuers' financial constraints. We measure the volatility of PIPE investor returns as the annualized standard deviation of issuers' daily stock returns over the holding period, where holding period is computed assuming that investors sell 10% of the daily trading volume. Similar to the results for expected returns, we find that firm size, profitability, and age are negatively associated with the volatility of returns. These results are consistent with the view that PIPEs issued by more financially constrained firms are riskier than PIPEs issued by less financially constrained firms.

Overall, the results in Table 7 are consistent with the view that the returns earned by PIPE investors are a function of the issuer's financial constraints and the negotiating leverage possessed by informed investors when there are few alternative sources of external capital. Capital is provided to the most financially constrained firms by the most risk tolerant investors, hedge funds and private equity funds. PIPEs from more financially constrained firms have both higher holding period adjusted returns and higher risk. These results are all consistent with the view that the excess returns earned by PIPE investors are compensation

for the risks they face by providing capital to financially constrained firms.

## 7. Conclusion

PIPEs are an important source of financing for relatively small public firms without sufficient internal cash flow to finance investment. The cost of this financing is the expected return investors receive, which depends on issuing firms' returns, discounts and warrants associated with the offering, and investors' holding periods. We introduce a novel methodology to estimate expected returns accounting for these factors and find that PIPE investors earn returns that are significantly higher than the expected returns on equity investments in firms with similar characteristics.

Overall, our results suggest that PIPEs are an expensive source of financing for firms that do not have access to alternative sources of capital. We document that firms in worse condition have a higher cost of capital, as evidenced by higher average returns to investors in their PIPE offerings, and are more likely to obtain financing from relatively risk-tolerant hedge funds and private equity funds. The performance of PIPEs as an asset class is driven largely by "home run" deals with huge returns, which underscores the importance of diversification when undertaking illiquid investments with convex payoffs.

## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:[10.1016/j.jfi.2019.100832](https://doi.org/10.1016/j.jfi.2019.100832).

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