Short Selling Around the Expiration of IPO Share Lockups

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Abstract

We are the first to examine daily short selling activity around the expiration of initial public offering (IPO) share lockups. Overall, short selling is abnormally high over several weeks leading up to the lockup expiration date, peaks one day before the lockup expiration date, and declines in the following week. We find that more abnormal short selling prior to the lockup expiration date is associated with poorer stock returns on the lockup expiration date, suggesting that short sellers are informed. We also find some weak evidence that short sellers front-run insider sales. Unlike VC-backed IPO stocks, PE-backed IPO stocks do not experience a negative return or trading volume jump on the lockup expiration date.

Key words: short sales, initial public offerings (IPOs), share lockup expiration, venture capital (VC), private equity (PE), buyout fund, insider sales

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> Yelp Inc.'s stock soared Wednesday, defying expectations on a day when executives and early investors were allowed to sell millions of new shares. Market participants widely attributed the online-reviews service's sharp rise to investors who had bet against the stock but then switched their positions en masse, in what is known as a "short squeeze." These investors appeared to reverse course when it quickly became clear in early trading that the end of a "lockup" preventing certain Yelp shareholders from selling wasn't going to doom the stock.…"The lesson for all those people that got short in anticipation of the lockup [ending] is there is no such thing as a sure thing," said Michael Shea, a managing partner at Direct Access Partners, an institutional brokerage firm.
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> ---"Short Sellers Cry Out For Yelp," *Wall Street Journal* (30 August 2012), by Steven Russolillo and David Benoit

1. Introduction

A typical initial public offering (IPO) sells about one third of the outstanding shares to the general public, leaving the rest of the shares being mostly locked up for a few months after the IPO. IPO share lockup expiration dates represent the first time when the shares that are locked up can be sold on the market, and consequently, the public float may be increased significantly. IPO share lockup expiration dates are usually associated with more active trading and more volatile returns. While the share lockup expiration date is pre-scheduled and trading activity on this day is widely watched by market participants, it is not known beforehand how many shares will be sold by insiders, and more importantly, how the stock price behaves on the lockup expiration date.

Although the literature documents an average abnormal return of -1.5% on the lockup expiration date (Field and Hanka, 2001), returns vary significantly from firm to firm on this widely-watched date. For example, Odimo Inc, a venture capital (VC)-backed online retailer of watches, jewelry, and luxury goods that went public in February 2005, saw its share price tumble 33% on its lockup expiration date. In contrast, shares of PokerTek Inc., a maker of electronic poker tables that went public in October 2005, surged 14% on its lockup expiration date. In our opening example above, VC-backed Yelp Inc.' stock soared nearly 23% on August 29, 2012, its lockup expiration date, which leads to the comment quoted in this Wall Street Journal article that "The lesson for all those people that got short in anticipation of the lockup [ending] is there is no such thing as a sure thing." The significant cross-sectional variation of stock returns on lockup expiration dates creates valuable trading opportunities and often results in a huge jump in the trading volume upon the expiration of share lockups.

To the best of our knowledge, we are the first to examine daily short selling activity around the expiration of IPO share lockups. Several questions are interesting to answer using daily short sale data. First, does short selling increase in the days leading up to the lockup expiration date? If short sellers expect price decline on the lockup expiration date on average, they may increase short selling right before the lockup expiration date. In addition, the previous literature documents that the abnormal return around the lockup expiration date is more negative for VC-backed IPOs than for non-VC-backed IPOs (see Field and Hanka, 2001, Bradley et al., 2001). Given this finding, does short selling increase more for VC-backed IPO stocks than for non-VC-backed IPO stocks before the lockup expiration date? Furthermore, buyout fund-backed IPOs represent the largest group of IPOs (40%) in our sample, and the average firm size for a buyout

fund-backed IPO is more than twice as large as that for a VC-backed IPO.[1] The previous literature on IPO lockup expiration does not examine buyout fund-backed IPOs, because the literature is mostly based on sample periods that ended more than 10 years ago and there were not many buyout fund-backed IPOs during that time period. Buyout fund-backed IPOs represent 12% of the IPOs during the period from 1990 to 2000 and 30% of the IPOs during the period from 2001 to 2012.[2] We examine whether short sellers trade buyout fund-backed IPO stocks differently. For convenience, we use buyout fund-backed IPOs and private equity (PE)-backed IPOs interchangeably throughout this paper.

Second, is short selling before the lockup expiration date informative about the abnormal return on the lockup expiration date? If short sellers have an information advantage over other traders, we expect to see more active short selling for IPO stocks with a more negative abnormal return on the lockup expiration date. Third, we examine whether short selling is related to insider selling around the lockup expiration date.

We have several findings. First, overall, short selling is abnormally high over several weeks leading up to the lockup expiration date, peaks one day before the lockup expiration date, and declines in the following week. Short selling before the lockup expiration date is heavier for buyout fund-backed IPO stocks than for other stocks.[3] This finding might reflect short sellers' expectation about heavier insider selling upon lockup expiration for buyout fund-backed IPO stocks. This expectation is consistent with a popular view that buyout funds are short-term oriented and do not maintain their ownership of companies for a sustained time (e.g., Kosman 2009). However, unlike for VC-backed IPO stocks, we do not find a negative return or a jump in

[1] Note that only 6% of the IPOs in our sample are reverse leveraged buyouts, and the majority of the buyout-backed firms have never had their stocks listed on an exchange before.
[2] These statistics are obtained from Jay Ritter's website.
[3] About 40% of the IPOs in our sample are buyout fund-backed IPOs, 37% are VC-backed IPOs, and 23% are non-sponsored IPOs.

trading volume on the lockup expiration date for buyout fund-backed IPO stocks. The results seem to be consistent with the "patient capital" view for private equity funds (e.g., Finkel and Greising, 2010).

Second, our cross-sectional regression results suggest that short selling over several days prior to the lockup expiration date is informative about the stock return on the lockup expiration date. In particular, a one standard deviation increase in the market-adjusted return on the lockup expiration date (4.5%) is associated with a 10.8% decrease in the abnormal short selling during five trading days prior to the lockup expiration date, where the abnormal short selling is computed as the percentage deviation of the short-to-trading volume ratio from the individual stock's average short-to-trading volume ratio over the benchmark period. Given that the average abnormal short selling is 39% during the five trading days prior to the lockup expiration date, a 10.8% decrease represents 27% of the average abnormal short selling. Furthermore, we confirm that the abnormal return on the lockup expiration date is more negative for VC-backed IPO stocks than for non-VC-backed IPO stocks, consistent with the literature; meanwhile, we do not find the short selling prior to the lockup expiration date to be more informative about the stock return on the lockup expiration day for VC-backed IPO stocks than for non-VC-backed IPO stocks. We discuss reasons for this finding.

Third, we find some weak evidence that short sellers front run insider sales. We find that 10% of the IPO firms have insider sales during the six-day period following the expiration of share lockups, and insider selling ranges from zero to 24% of the outstanding shares. Note that we can only estimate a lower bound of the true insider selling, because for buyout fund-backed and VC-backed firms, insider selling may take the form of limited partnership fund distribution, which is typically not captured by insider filing data. The inability of insider filing data to

capture the insider selling in disguise (i.e., fund distribution) prevents us from finding stronger evidence. We find that insider selling during the post-lockup expiration six-day period can partly explain short selling prior to the lockup expiration date. In particular, a one standard deviation increase in insider selling during the six days following the lockup expiration (1.71%) is associated with a 0.07% increase in the abnormal short selling during the five days prior to the lockup expiration date. Furthermore, after controlling for insider selling, our finding that short selling prior to the lockup expiration date is informative about the stock return on the lockup expiration date remains robust, which suggests that short sellers' private information is more than the reported insider selling around lockup expiration dates.

Although our primary focus is short selling around the expiration of IPO share lockups, we also find that the SDC new issues database reports a lockup expiration date that is one day earlier than the actual lockup expiration date for 78% of the IPOs in our sample. We conjecture that this one day error may contribute, in part, to the finding in the literature that trading volume jumps one day after the lockup expiration date rather than on the lockup expiration date itself. For example, see Field and Hanka (2001, Figure 3), Bradley, et. al (2001, Figure V), Brav and Gompers (2003, Figure 2), and Cao, Field, and Hanka (2004, Figure 1), among others, for the finding that trading volume jumps one day after the lockup expiration date.

Our study makes three contributions. First, we fill a gap in the IPO lockup expiration literature by providing empirical evidence on how short sellers trade around the lockup expiration date on a daily basis. IPO share lockup is among the most-widely watched features of IPOs. However, the existing literature on IPO lockup expiration primarily focuses on stock returns and aggregate trading activity around lockup expiration dates.[4] Due to data availability,

[4] For example, Field and Hanka (2001), Bradley et al. (2001), Keasler (2001), Brav and Gompers (2003), Cao, Field, and Hanka (2004), Brau, Lambson and McQueen (2005), among others.

no study has examined daily short selling around the expiration of IPO share lockups. Our study is made possible because the Securities and Exchange Commission (SEC)'s Regulation SHO mandates each trading venue to publicly disclose intra-day short sale transaction data.

Second, our findings increase our understanding about short selling, especially for IPO stocks. The prior literature on short selling is based on a broader sample that comprises of mostly mature firms. Indeed, until recently, the literature has mostly considered short selling in the immediate aftermarket of IPOs to be extremely difficult if not impossible. A notable exception is Edwards and Hanley (2010). Using the Regulation SHO mandated short sale data, Edwards and Hanley (2010) find that "short selling occurs on the offer day in 99.5% of the IPOs", suggesting that short selling in IPOs is not as constrained as suggested by the prior literature. In this study, we provide further evidence on daily short selling activity during the early public life of a firm.

Finally, our study adds to the literature on private equity.[5] In contrast to the view that private equity investors are short-term oriented and are likely to flip their investment quickly, our evidence suggests that private equity backers do not exit their investment at the earliest opportunity after bringing their portfolio firm public.

Our paper proceeds as follows. Section 2 discusses related literature. Section 3 outlines the data used in this study. Section 4 presents our empirical analyses and findings. Section 5 concludes the study.

[5] For example, Kaplan and Strömberg (2009), Cao and Lerner (2009), Levis (2011), Lerner, Soresen, and Stromberg (2011), Acharya, Gottschalg, Hahn, and Kehoe (2013), Huang, Ritter, and Zhang (2013), Visnjic (2013), and Fang, Ivashina, and Lerner (2013), among others.

2. Related Literature and Hypothesis Development

An extensive body of research has examined short selling.[6] However, research on short selling in IPO stocks is scant. A notable exception is Edwards and Hanley (2010), which focuses on short selling in the immediate aftermarket and documents active short selling on the first trading day for IPO stocks.[7] However, Edwards and Hanley (2010) do not examine short selling around the expiration of IPO share lockups.

IPO share lockup expiration represents a unique setting to study short selling, because IPO stocks are new to the public and are less likely to be associated with traded options. For IPO stocks without traded options, short selling becomes the only way for pessimistic investors to express their view in the stock market.

It is an empirical question whether short sellers try to take advantage of the expected price decline on the lockup expiration date. On the one hand, short selling may increase before the lockup expiration date because the literature has documented significantly negative stock returns around the share lockup expiration date. For example, using IPOs during the period 1988-1997, Field and Hanka (2001) find a statistically significant three-day abnormal return of -1.5% around share lockup expirations, and the effect is roughly three times larger in venture-backed firms compared to non-venture-backed firms. Bradley et al. (2001) further find that the largest losses occur for high-tech firms and firms with the greatest post-IPO stock price increases and most reputable underwriters. However, on the other hand, Ofek and Richardson (2000) and Field and Hanka (2001) show that paying the bid/ask spread eliminates much or all of the profit. Therefore,

[6] For example, Brent, Morse, and Stice (1990), DeChow, Hutton, Meulbroek, and Sloan (2001), Desai, Thiagarajan, Ramesh, and Balachandran (2002), Chen and Singal (2003), Arnold, Butler, Crack, and Zhang (2005), Asquith, Pathak, and Ritter (2005), Boehmer, Jones, and Zhang (2008), Diether, Lee, and Werner (2009), Henry and Koski (2010), among others.

[7] Their finding is consistent with Geczy et al. (2002), which finds that stock loans are made on the first day of trading for IPO stocks.

it is an empirical question whether short selling increases before the lockup expiration date. We state our hypothesis in the alternative form as follows:

Hypothesis 1: Abnormal short selling increases before the lockup expiration date.

Are short sellers informed about the stock return on the lockup expiration date? While many papers find that short sellers are informed about future stock returns, it is not necessarily so in the context of IPO share lockup expiration.[8] Given that the literature documents a negative stock return around the lockup expiration date, it is possible that a greater number of uninformed traders short sell before the lockup expiration date, hoping to make a profit from the expected price decline even without any private information. As a result, these uninformed short sellers would introduce more noise to short selling before the lockup expiration date. Therefore, it is an empirical question whether short selling is, on average, informative about the stock return on the lockup expiration date. If short selling is on average still informative, then we expect to find the following:

Hypothesis 2: Abnormal short selling prior to the lockup expiration date increases more for IPO stocks with more negative stock return on the lockup expiration date.

While the date on which a share lockup expires is publicly known in advance, a main driver of the abnormal stock return on the lockup expiration date is probably the amount of shares that are sold or intended to be sold by insiders. "Such sales can move the stock's price," as Wall Street Journal's weekly column "Lockup Expirations" warns investors. Field and Hanka (2001) examine several hypotheses that may explain why abnormal returns around lockup expirations are negative. They find that the abnormal return may be partly, but not completely,

[8] Studies finding informative short selling include Christophe, Ferri, and Angel (2004), Boehmer, Jones, and Zhang (2008), Diether, Lee, and Werner (2009), Christophe, Ferri, and Hsieh (2010), Massoud, Nandy, Saunders, and Song (2011), Brockman and Hao (2011a, 2011b), Engelberg, Reed, and Ringgenberg (2012), Kecske´s, Mansi, and Zhang (2013), among others.

caused by consistently larger-than-expected insider sales. In order to better understand the information content of short selling prior to the lockup expiration date, we examine the relation between short selling and insider sales. We are particularly interested in answering the following question: is short selling prior to the lockup expiration date informative about the upcoming insider selling on the lockup expiration date? If the answer is yes, then we expect to find the following:

Hypothesis 3: Abnormal short selling prior to the lockup expiration date increases more for IPO stocks with more insider selling soon after the lockup period expires.

3. Sample and Summary Statistics

3.1. IPO sample

We obtain a sample of IPOs conducted by U.S. domestic firms from January 2005 through December 2006 and their offering characteristics from the Securities Data Company (SDC) new issues database. We choose this sample period because the short sale data mandated by the Regulation SHO are available for the period January 2005 through mid-2007 and IPO lockup periods typically last for six months.[9] We exclude closed-end funds, real estate investment trusts (REITs), and units. We also require that the IPO stock's first price on the Center for Research in Security Prices (CRSP) is within a week of the issue date in the SDC database.[10] This initial sample includes 315 IPOs, of which 99.05% have a share lockup agreement. We further exclude

[9] While the NYSE Trade and Quote (TAQ) Regulation SHO database covers the period January 3, 2005 through July 6, 2007, we require the Regulation SHO short sale data to be available for all the exchanges, including the American Stock Exchange (AMEX), Archipelago, Boston Stock Exchange, Chicago Stock Exchange, National Association of Securities Dealers, National Association of Securities Dealers Automated Quotations (NASDAQ), National Stock Exchange (formerly known as the Cincinnati Stock Exchange), Philadelphia Stock Exchange, and the New York Stock Exchange (NYSE). Therefore, our short sale data cover the period January 2005 through May 2007.

[10] The SDC new issues database reports incorrect CUSIPs for some IPO stocks. We hand checked every IPO to ensure accurate matching with the CRSP database.

IPOs without a lockup agreement, IPOs whose lockup expiration date is later than May 31, 2007 (i.e., the last day when our Regulation SHO data are available), and IPOs with missing information in the SDC database on the number of shares restricted from selling during the lockup period.[11] Because we also use the Nasdaq's website to double check the issue date provided by the SDC database, we exclude a few IPOs that are not listed on the Nasdaq's website.[12] We exclude a few IPOs that have zero trading volume on the lockup expiration date, according to the CRSP daily stock files. Our final sample has 213 IPOs.

We use data from multiple sources. We obtain stock price, return, trading volume, and the number of shares outstanding from CRSP, accounting information from Compustat, institutional ownership from Thomson's 13f filings database, insider trading data from Thomson's insider filing files, earnings announcements from I/B/E/S, information on seasoned equity offerings (SEOs) from the SDC new issues database, and information on whether an IPO stock has traded options from the OptionMetrics database. We also use the Nasdaq's website to correct the IPO issue date provided by the SDC's new issues database. We obtain underwriters' reputation ranks from Jay Ritter's website. Our short sale data are from the TAQ database as well as eight stock exchanges, which we detail later in Section 3.4. We use the SEC's Edgar website, Edgar Online, and the Factiva database to check for company filings and news.

3.2. Lockup expiration date

While several data sources provide information on IPO lockup expiration dates, we obtain IPO share lockup expiration dates mainly from two sources: the SDC New issues database and

[11] According to the explanation provided by a client support executive at the SDC, the number of shares locked up is covered in the SDC database only if it is explicitly given in the data sources. For example, the total number of shares being locked up is not provided in the lock-up agreement section of the SEC filing by FTD Group, Inc. (SDC deal no. 1619744002): http://www.sec.gov/Archives/edgar/data/1283157/000104746905002902/a2151405z424b4.htm. While the difference between the number of shares outstanding upon completion of the IPO and the number of shares sold in the IPO can be used as a proxy for the number of shares locked up, the number of shares outstanding does not include warrants or options to purchase shares, as pointed out by the SDC client support executive.

[12] Note that the IPOs on the Nasdaq's website are not limited to stocks that are listed on the Nasdaq stock exchange.

the Nasdaq's website.[13] An IPO may have multiple lockup expiration dates. We focus on the lockup expiration date with the most shares being unlocked, because this is arguably the lockup expiration date with the biggest price movement. In addition, keeping only one lockup expiration date for each IPO also addresses potential concerns that the residuals in our regressions are not independent. The Nasdaq's website provides only one lockup expiration date for each IPO, which is not necessarily the date when the most shares are unlocked.[14] In contrast, the SDC database covers all the lockup expiration dates for each IPO. Therefore, we rely on the SDC database to identify the largest share lockup, i.e., the lockup period with the most shares being locked up.[15] For convenience, we refer to the lockup period with the most shares being locked up as the largest share lockup.

Next, we correct the issue date in the SDC database according to the issue date from Nasdaq's website. IPO prospectuses often do not list the specific lockup expiration date; instead, it often says that the lockup period expires a number of days "from the date of this prospectus." Therefore, the accuracy of the lockup expiration date depends on the accuracy of the issue date.

For about 80% of the IPOs, the SDC database and Nasdaq's website report different issue dates.[16] Using Edgar Online, we hand check all these IPOs against IPO prospectuses. We find that Nasdaq's website always has the accurate issue date. In particular, we find that the issue date

[13] The Nasdaq maintains a list of U.S. IPOs from January 1997 until present on its website. For example, the following website has all the U.S. IPOs during January 2005: http://www.nasdaq.com/markets/ipos/activity.aspx?tab=pricings&month=2005-01. Clicking on each company name will lead to a page with more information for the IPO, including the listing exchange, the pricing date, the lockup period, if there is a lockup agreement, among other information.

[14] According to the Nasdaq's website, for the period from 2005-2006, almost all the IPOs with an lockup agreement have a lockup period of 180 days. According to the SDC database, some of these IPOs have multiple lockup periods, among which 180 days is not necessarily the shortest or longest lockup periods, nor is it the lockup period when the most shares are locked up.

[15] The Wall Street Journal has a weekly column called "New to the Market", which publishes IPO lockup expiration dates for the coming week. Similar to the Nasdaq's website, the Wall Street Journal typically publishes one lockup expiration date for each IPO.

[16] We thank Jay Ritter for pointing this out in an earlier conversation.

in the SDC database is one day earlier than the issue date on Nasdaq's website for 78% of the IPOs. For 2% of the IPOs, the issue dates reported by the two data sources differ by no more than 4 days. For example, according to the SDC database, the issue date for the IPO of Rackable Systems, Inc., a provider of high-density compute servers, is June 9, 2005, and the 180-day lockup period expires on Tuesday, December 6, 2005. However, the IPO prospectus (i.e., SEC form 424B4) is dated June 10, 2005 according to the firm's filing with the SEC on the EDGAR website. According to this date of prospectus, the lockup expiration date should be Wednesday, December 7, 2005. Indeed, December 7, 2005 is mentioned as the lockup expiration date in one of the firm's SEC filings after the IPO, which confirms that the lockup expiration date is December 7, 2005 rather than December 6, 2005. For this example, Nasdaq's website reports the date of pricing accurately. Therefore, we use the issue date reported by the Nasdaq's website and the length of the lockup period reported by the SDC database to calculate the lockup expiration date.

The finding that the SDC database reports the issue date one day earlier than the actual issue date for 78% of the IPOs has important implications for the literature on IPO lockup expiration. As a result of the one day error in the issue date reported by the SDC database, we find that the SDC database often reports a lockup expiration date that is one day earlier than the actual lockup expiration date. We conjecture that this one day error contributes to the finding in the earlier literature that trading volume jumps *one day after* the lockup expiration date. For example, Field and Hanka (2001, Figure 3), Bradley, et. al (2001, Figure V), Brav and Gompers (2003, Figure 2), Cao, Field, and Hanka (2004, Figure 1), among others. These studies largely

rely on the lockup expiration dates provided by the SDC database.[17] We are not aware of any other study pointing this out.

An IPO firm may change the lockup expiration date due to earnings releases and SEOs.[18] We searched the Factiva news article database to identify the revised lockup expiration date and made corrections. For example, Metabolix, Inc., which went public on November 10, 2006, announced on April 30, 2007 that it will be releasing its first quarter 2007 financial results after the market close on Thursday, May 10, 2007. While the original lockup expiration date is Wednesday, May 9, 2007, "under the terms of the lock-up agreements signed in connection with the Company's initial public offering, expiration of the lockup period is extended and will end on May 28, 2007." (Business Wire, April 30, 2007) Therefore, we use May 28, 2007 as the lockup expiration date for Metabolix, Inc.

3.3. Summary statistics

Panel A of Table 1 shows summary statistics for our final sample of 213 IPOs. About 37% of the IPOs in our sample are VC-backed, and 40% are buyout fund-backed. The fraction of buyout fund-backed IPOs in our sample is in line with those in Huang, Ritter, and Zhang (2013). About 32% of the issuers are technology firms, and 71% are listed on Nasdaq. The average underpricing is 12% and the average ratio of the secondary shares offered in the IPO is 15%. The average market capitalization of the issuing firms is 642 million dollars. The average institutional ownership at the end of the quarter before the lockup expiration date is 36% of the outstanding

[17] Field and Hanka (2001), Bradley, et. al (2001), Brav and Gompers (2003), and Cao, Field, and Hanka (2004) use a large number of firms ranging from 1,497 to 2,871 IPOs, which makes it difficult to hand check the accuracy of the dates. Some studies, such as Field and Hanka (2001), check data accuracy for a small fraction of their sample IPOs. But they did not check the accuracy of the issue date.

[18] In the U.S. the lockup restriction is a contract between the underwriters and pre-issue shareholders, and the underwriters can ex post waive the selling restrictions, for example, when there is a follow-on equity offering prior to the expiration of the lockup.

shares. About 27% of the IPO stocks have traded options before the largest share lockup expiration.

As explained earlier, we focus on the lockup expiration date with the most shares being unlocked, because this is arguably the unlock date with the biggest price movement. The lockup period has a mean of 184 days and a median of 180 days. About 15% of the IPOs have another lockup expiration date before the lockup expiration date when the most shares are unlocked. The average number of shares unlocked on this lockup expiration date relative to the total number of shares outstanding is 62%. The average ratio of shares offered in an IPO is 35% of the outstanding shares. Therefore, we infer that about 3% (i.e., 1-62%-35%=3%) of the outstanding shares are unlocked before the biggest lockup.

Panel B of Table 1 shows summary statistics for VC-backed, PE-backed, and non-sponsored IPOs. There are several noticeable differences between VC-backed IPOs and PE-backed IPOs. For example, the average market capitalization is 964 million dollars for PE-backed firms, while it is 379 million dollars for VC-backed firms. The fraction of IPOs that have another lockup expiration date before the largest lockup's expiration date is 6% for PE-backed IPOs and 28% for VC-backed IPOs. In other words, compared with VC-backed IPOs, PE-backed IPOs are more likely to have the largest lockup expire before any other lockup period expires, if there is any. Furthermore, PE-backed firms have more debt than VC-backed firms, which is consistent with the finding in Levis (2011).

3.4. Measure of short selling

Our daily short-sale data are from the American Stock Exchange (AMEX), Archipelago, Boston Stock Exchange, Chicago Stock Exchange, National Association of Securities Dealers, National Association of Securities Dealers Automated Quotations (NASDAQ), National Stock Exchange (formerly known as the Cincinnati Stock Exchange), Philadelphia Stock Exchange,

and the New York Stock Exchange (NYSE). All of the above self-regulatory organizations (SROs) made tick data on short sales publicly available starting on January 2, 2005 as a result of the SEC's Regulation SHO adopted in 2004. While the short sale data for NYSE is available through the TAQ database, all other SROs make short sale data available only on their own websites. The ending date for the available Regulation SHO data varies from May to August of 2007 across the various SROs. We therefore select a sample period during which short sale data are available for all the SROs (i.e., January 2005 to May 2007). The SHO dataset also includes an indicator variable denoting whether a transaction is exempt from price test rules. Since exempt transactions apply to special cases such as trades related to "bona fide" market making, we exclude such transactions from our main empirical analysis.[19]

We aggregate the intra-day transaction data on short sale on a daily basis. We obtain stock returns, trading volume, and the number of shares outstanding from the CRSP. We then measure the *abnormal* short selling (ABSS) on date *t* as follows:

$$ABSS_t = \frac{\frac{short\ volume_t}{trading\ volume_t}}{average\ \frac{short\ volme}{trading\ volme} over\ benchmark\ period} - 1. \qquad (1)$$

Our benchmark period is from days -100 through -51. Alternatively, we use the period from the first trading date until the day before the lockup expiration date as the benchmark period. The main results are similar. Recall that 15% of the IPOs have another lockup expiration date before the expiration date of the largest share lockup. To address this concern that our benchmark period may include the first lockup expiration date for these firms, we also use the period prior to the first lockup expiration date as our benchmark period. Again, our results are robust to the alternative definition of benchmark period.

[19] Engelberg, Reed, and Ringgenberg (2012) show that exempt trades are uninformative since they represent market making activities. During the period from January 2005 to May 2007, these exempt transactions represent roughly 20% of the total transactions.

Similarly, we compute daily abnormal trading volume on date *t* as follows:

$$abnormal\ trading\ volme_t = \frac{trading\ volume_t}{average\ trading\ volme\ over\ benchmark\ period} - 1. \quad (2)$$

The benchmark period is the same as for abnormal short sale. We measure the market-adjusted return as the difference between the stock return and the CRSP equal-weighted index return.

Table 2 shows the mean and median daily abnormal short selling, abnormal trading volume and the market-adjusted return for trading days [-50, 50] around the lockup expiration date. Daily abnormal short selling is significantly positive well before the lockup expiration date. Specifically, the mean (median) abnormal short selling becomes consistently positive at the 1% significance level since 24 (2) days before the lockup expiration date. In contrast, the average daily abnormal trading volume is not significantly positive until the lockup expiration date, and the median daily abnormal trading volume is even significantly negative every day during the entire 50 days before the lockup expiration date. There is a different trading pattern for short sellers and other traders. While the market-adjusted return is significantly negative (at the 5% or 10% significance level) one day before the lockup expiration date, it is not significantly negative on the lockup expiration date itself.

Figure 1, Graph A visually presents the mean abnormal short sale, trading volume, and return in Table 2 for a shorter time window, from event day -20 through event day +20. While the mean trading volume jumps on the lockup expiration date, the mean short sale peaks one day before the lockup expiration date. In addition, we plot the buy-and-hold abnormal return from event day -20 through event day +20. Again, abnormal return is measured relative to the CRSP equal-weighted index. In Graph B of Figure 1, we further break down the sample into VC-backed, PE-backed, and non-sponsored IPOs, respectively.

4. Results

Following Christophe, Ferri, and Angel (2004), we compute the average abnormal short selling over five days prior to the event date. We denote this average abnormal short selling as *ABSS[-5,-1]*. To test whether the abnormal short selling before the lockup expiration date is informative about the stock return on the lockup expiration date, we follow Christophe, Ferri, and Angel (2004) to use the following regression model:

$$ABSS[-5,-1] = a + b_1 RET[0] + b_1 Control + \varepsilon. \quad (3)$$

The control variables include indicator variables that equal one if the IPO firm is VC-backed, PE-backed, has a top-tier underwriter, is a technology firm, has secondary shares sold in the IPO, has another lockup expiring earlier, has conducted an seasoned equity offering(SEO) earlier, and announces earnings around the lockup expiration date, respectively (and zero otherwise). The control variables also include firm size, institutional ownership, IPO underpricing, and buy-and-hold market-adjusted returns over event days [-5, -1], [-10, -6], and from the first trading day after the IPO until event day -6, etc.

Table 3 shows summary statistics for short selling, trading volume, and stock returns. Panel A is for the entire sample. The average abnormal short selling over five days prior to the lockup expiration date is 0.39, meaning that the average short selling during five days prior to the lockup expiration date is 39% higher than the average short selling over the benchmark period.

Although the three-day market-adjusted return around the lockup expiration date is -0.97%, which is statistically significant at the 5% level, the average market-adjusted return on the lockup expiration date alone is not significantly different from zero. This suggests that it is not profitable to simply short sell every IPO stock equally one day before the lockup expiration date and cover the short position at the end of the lockup expiration date, even without considering transaction

costs. However, later we show that the cross-sectional variation in the abnormal short selling before the lockup expiration date can be explained by the abnormal return on the lockup expiration date. We will detail the findings later.

Panel B of Table 3 breaks down the sample into three groups: VC-backed, PE-backed, and non-sponsored IPOs. In contrast to the negative abnormal return on the lockup expiration date for VC-backed IPOs, the abnormal return on the lockup expiration date is not negative for either PE-backed IPOs or non-sponsored IPOs. Furthermore, while the abnormal trading volume jumps significantly on the lockup expiration date for VC-backed IPOs, it increases only slightly for PE-backed IPOs and non-sponsored IPOs. In untabulated result, we find statistical significance at 1%-5% levels for the mean and median differences in abnormal return and trading volume between VC-backed vs. PE-backed IPOs. Taken together, the evidence suggests that buyout funds do not distribute shares to their limited partners on the lockup expiration date as much as VC funds do. The results seem to be consistent with the "patient capital" view for private equity funds (e.g., Finkel and Greising, 2010).

However, it is not immediately clear why PE funds do not unload their holdings in the IPO firms as much as VC funds do. On the one hand, both VCs and buyout firms have incentives to not rush distributions so that they can continue to collect management fees on assets under management (AUM). On the other hand, they also have an incentive to distribute winners early so that they can boost the internal rate of return (IRR). As Panel B of Table 3 shows, the abnormal short selling during five days prior to the lockup expiration date is heavier for PE-backed IPOs than for other IPOs. In untabulated result, we find statistical significance at the 10% level for the difference in abnormal short selling between PE-backed and non-PE backed IPOs. The heavier short selling for PE-backed IPO stocks perhaps reflects a popular view that buyout

funds are short-term oriented investors and might cash out immediately after their shares are allowed to be sold. It would be interesting to examine why buyout funds do not distribute shares on the lockup expiration date as much as VC funds do in future research.

Panel C of Table 3 breaks down the sample based on whether the IPO stock has traded options before the largest share lockup expiration. We find that only two variables are statistically different between the two groups: short selling (sv) and average short selling (sv_mean), which is consistent with the evidence in Figlewski and Webb (1993) that optioned stocks are more heavily shorted than non-optioned stocks.

4.1. Main regression results

Table 4 shows regression results for the determinants of short selling before the lockup expiration date. The dependent variable is the abnormal short selling averaged over trading days [-5,-1] prior to the lockup expiration date. The key independent variable is the market-adjusted return on the lockup expiration date. If short selling is informative about the stock return on the lockup expiration date, then we expect the coefficient on the lockup expiration date return to be negative. The t-statistics reported for all the regression analysis throughout the paper are based on heteroscedasticity-corrected standard errors.

Panel A of Table 4 reports the results for three regression models. Model 1 includes only the main independent variable, the market-adjusted return on the lockup expiration date, and two indicator variables that equal one if the IPO firm is VC-backed and PE-backed, respectively (and zero otherwise). Models 2 and 3 include more control variables. Specifically, Model 2 also includes the following control variables: firm size and buy-and-hold abnormal returns over event days [-5,-1] and [-10,-6]. Model 3 further includes institutional ownership, IPO underpricing, the ratio of shareholder shares to the total shares sold in the IPO, buy-and-hold abnormal return from

the first trading day after IPO until six days before the lockup expiration date, and indicator variables that equal one if the firm is a technology firm, if the IPO has a top-tier underwriter, has another lockup period expiring before the largest lockup expires, has conducted an SEO earlier, and announces earnings around the lockup expiration date, respectively (and zero otherwise).[20]

Panel A of Table 4 shows that the coefficients on the lockup expiration date return are consistently negative across the three models. Specifically, the coefficients vary from –2.32 to –2.40 and are all statistically significant at 5% or 1% level (t-statistics vary from –2.32 to –2.61). The inverse relation between the stock return on the lockup expiration date and the abnormal short selling prior to the lockup expiration date is also economically significant. A one standard deviation increase in the market-adjusted return on the lockup expiration date (0.04) is associated with a 10% decrease in the abnormal short selling over trading days [-5,-1] relative to the lockup expiration date. Given that the average abnormal short selling is 38% over trading days [-5,-1] before the unlock date, a 10% change represents 26% of the average abnormal short selling.

As a robustness check, we exclude the IPOs with earnings announcements within three days before or after the lockup expiration date. We also exclude IPOs with an SEO before the lockup expiration date.[21] The results remain qualitatively similar, as shown in Panel B of Table 4.

Next, we examine if short selling is more informative for VC-backed IPOs or PE-backed IPOs than non-sponsored IPOs. We create two interaction terms by multiplying the market-adjusted return on the lockup expiration date with the indicator variable for VC-backed IPOs and the indicator variable for PE-backed IPOs, respectively. We then add the two interaction terms

[20] We also estimate a regression model that includes accounting variables such as ROA, debt, cash, Net PPE, and CapEx. However, none of these variables has a significant coefficient and the adjusted R^2 becomes lower. For brevity, we do not tabulate the regression results. While accounting variables may be related to monthly short interest over a relatively longer time horizon, they do not seem to explain abnormal short selling over a few days.

[21] For example, an article from IPOScoop.com expresses concerns about insider selling in SEOs before lockup expiration dates: https://www.iposcoop.com/index.php?option=com_content&task=view&id=2878&Itemid=30.

separately and together to the regression models in Panel A of Table 4. Panel C of Table 4 shows the results. For brevity, we report the results only for regression Model 1. None of the interaction terms are statistically significant. In other words, we do not find any evidence that short selling is more informative for VC-backed IPOs or PE-backed IPOs than for non-sponsored IPOs.

Do traded options affect the informativeness of short selling? We exclude the IPO stocks with traded options before the largest lockup expiration date. Panel D of Table 4 reports the results. The coefficient on the abnormal short selling variable is consistently larger in Panel D than in Panel A, suggesting that short selling is more informative for stocks with no traded options. This finding is consistent with the idea that options provide an alternative venue to informed traders, particularly those with negative information.[22]

While short selling is particularly active one day before the lockup expiration date, it seems to be less informative on this day. In particular, if we skip the day immediately before the lockup expiration date and compute the average abnormal short selling over four trading days [-5,-2] before the lockup expiration date, then we find that the pre-lockup expiration short selling appears to be more informative about the lockup expiration date return. Panel E of Table 4 shows the regression results.[23] The coefficient on the lockup expiration date return increases to –3.38 and is statistically significant at the 1% level (t=–2.94). Our finding suggests that more uninformed short sellers seem to join the crowd on the day immediately prior to the lockup expiration date.

[22] Alternatively, one might argue that because market making activities are not informative about future stock returns, this finding is also consistent with the argument that the introduction of options increases short interest due to options market makers' short sale transactions. However, recall that our results are based on non-market makers' short sales only.

[23] Please also note that the coefficient on the PE indicator variable is statistically significant across the three regression models, suggesting more active short selling in PE-backed firms.

We conjecture two non-mutually exclusive reasons for why more uninformed short sellers join the crowd on the day immediately prior to the lockup expiration date. First, uninformed short sellers may overestimate the probability of a price drop on the lockup expiration date, and therefore, shorting shares one day earlier would be the best trading strategy. Second, informed short sellers may avoid shorting on the day immediately prior to the lockup expiration date, perhaps because they expect heightened short selling drives up the cost of short selling on this day. Future research on the cost of short selling around the lockup expiration date would shed more light on this issue.

4.2. Are short sellers particularly informed about the lockup expiration date return?

Given our finding that short selling is informative about the stock return on the lockup expiration date, next we examine whether short sellers are similarly informed about the stock return on a few days around the lockup expiration date. Answering this question can help us better understand short sellers' information advantage over other traders.

Engelberg, Reed, and Ringgenberg (2012) find that the negative relation between short sales and future returns is mostly driven by news days, especially days with negative news. They also find that short sellers have superior ability to analyze publicly available information, particularly for news categories such as earnings, earnings projections, high yield issuers, new products and services, stock ownership, analyst comments and ratings, bond ratings and comments, divestitures or asset sales, and lawsuits. Table 9 in their paper reports all the 39 news categories that they examine. They do not examine IPO lockup expirations.

Compared with some of the news categories examined in Engelberg, Reed, and Ringgenberg (2012), IPO share lockup expiration has some similarities and differences. For example, similar to earnings announcements, share lockup expiration dates are also pre-

scheduled. However, different from many other news categories, typically no news is publicly announced on the lockup expiration date.

We run the regression in Equation (3) for each of the two days before and two days after the lockup expiration date. In other words, in each regression, the dependent variable is the average short selling over five days before the event date, and the key independent variable is the market-adjusted return on the event day. We set the event day to be each of the days around the lockup expiration date. We do not find any evidence that short sellers are informed about the stock return on any of the two days before or after the lockup expiration date. In other words, the only event date for which there is a significantly negative relation between the pre-event date short selling and event date stock return is the lockup expiration date. For brevity, Table 5 reports the results for days -1, 0 and 1 around the lockup expiration date. While the coefficient on the market-adjusted return is statistically significant for the lockup expiration date, it is not statistically significant for the two days around the lockup expiration date. This finding is interesting given that the average market-adjusted return is not more negative on the lockup expiration date than on the two days around the lockup expiration date. However, the standard deviation of the market-adjusted return is larger for the lockup expiration date than the two days around the lockup expiration date. We conclude that short sellers are particularly informed about the stock return on the lockup expiration date.

4.3. Short selling by market makers

Our study focuses on short sale transactions made by non-market makers. However, it is an empirical question whether market makers make more informed short sales before the lockup expiration date than non-market makers. While Engelberg, Reed, and Ringgenberg (2012) find that short sales made by market-makers are not informative about future returns in general, this may not hold true for lockup expirations. Because the sudden increase in share supply on the

lockup expiration date is expected to move the stock price, the slope of the demand curve for the IPO stock is expected to affect the stock return on the lockup expiration date. It is possible that market-makers are more informed about the slope of the demand curve than other traders.

Using all the short sale transactions made by both market makers and non-market makers, we replicate the regression analysis in Table 4. Table 6 reports the results. While the coefficient on the market-adjusted return on the lockup expiration date is still negative and statistically significant, ranging from −1.56 to −1.63, the magnitude of the coefficient is about 32% smaller than the coefficient in Panel A of Table 4. The finding suggests that market making activities are less informative about future returns.

4.4. Insider selling around the lockup expiration date

In this section, we explore the extent to which short selling is related to insider selling around the lockup expiration date. Our objective is to understand if the informed short selling prior to the lockup expiration date, as we document before, can be explained by the insider sales prior to the lockup expiration date as well as the insider sales shortly after the lockup period expires.

We obtain insider trading data from the Thomson Reuters Insider Filing Data Files. Corporate insiders are defined broadly to include those that have "access to non-public, material, insider information" and these insiders are required to file SEC form 3, 4, and 5 when they trade in their companies stock (Thomson Reuters Insider Filing Data Manual).

However, insider sales in VC-backed IPO stocks or PE-backed IPO stocks may not be completely captured by the reported insider sales for the following reason. VC and PE funds are typically organized as limited partnerships. They can distribute either cash or portfolio firms' stocks to their limited partners, who are investors of the VC or PE funds. Gompers and Lerner

(1998) discuss several reasons for why VC funds prefer share distribution over cash distribution. Their footnote 3 provides a detailed explanation about VC distributions. However, share distribution makes it difficult for a researcher to identify the exit of VC funds from their investment, because VC fund investors' sale of stock are not required to be filed with the SEC unless the investor owns at least 10% of the outstanding shares of the IPO firm or is affiliated with the IPO firm. With the caveat of the data in mind, we compute insider selling using the Thomson Reuters Insider Filing Data Files.

Table 7 shows descriptive statistics for insider sales around the lockup expiration date. We have two observations. First, as shown in Panel A, insider selling is less active prior to the lockup expiration date than after the lockup expiration date, which is not surprising given that our study focuses on the biggest share lockup. Recall our discussion in Section 3.3 that insiders can sell only an average of 3% of the outstanding shares prior to the expiration of the biggest share lockup. Second, insider selling shortly after the expiration of lockup period does not seem to be active in general. Specifically, about 4.2% of the IPOs have insider selling on the lockup expiration date, and about 7.5% of the IPOs have insider selling within 5 trading days following the lockup expiration date.

Panel B of Table 7 shows insider selling during days [0, 5] relative to the lockup expiration date for VC-backed, PE-backed, and non-sponsored IPOs. The average ratio of the number of shares sold by insiders to the number of shares outstanding is 0.10% for VC-backed IPOs, 0.35% for PE-backed IPOs, and 0.11% for non-sponsored IPOs. Note that the seemingly inactive insider selling for VC-backed or PE-backed IPOs may be due to the fact that VC and PE fund distribution of shares to partners is not required to be reported to the SEC as insider sales. We acknowledge that this is the major drawback of our insider sales data. If VC and PE fund

distribution data were available, we would be able to provide a complete picture of insider selling around lockup expirations.

With the caveat about our data limitation in mind, we test whether short selling prior to the lockup expiration date can be explained by insider selling around the lockup expiration date. In particular, we measure insider selling shortly before and after the five day window over which our main short selling variable is computed. Because our short selling measure is computed over trading days [-5,-1] relative to the lockup expiration date, we first compute insider selling prior to this five-day period. Specifically, we compute insider selling over trading days [-14, -6] relative to the lockup expiration date. We then compute insider selling over days [0, 5] relative to the lockup expiration date. Our results are robust to measuring insider selling on the lockup expiration date only rather than over days [0, 5]. We measure insider selling as the aggregate shares sold by insiders divided by the total number of shares outstanding. We add these two insider selling variables into the regression model in Equation (3). If short sellers front run insider sales, then we would see short selling prior to the lockup expiration date increases more for IPOs with more insider selling shortly after the lockup period expires, even though the post-lockup expiration insider sales are not publicly known before lockup expirations.

Table 8 shows that short selling prior to the lockup expiration date can be explained by both the insider selling before and after the lockup expiration. Given the fact that the exact level of insider selling after lockup expiration is not publicly known before the lockup expiration date, we interpret the empirical evidence as consistent with the existence of short sellers front-running insider sales around the lockup expiration date.[24] Note that the coefficient on the stock return on the lockup expiration date is not reduced in magnitude or become less statistically significant

[24] Our evidence is consistent with the finding in Khan and Lu (2013) that, short sellers, facilitated by leaked information, front-run large insider sales.

after controlling for insider selling before and after the lockup expiration. This suggests that short sellers' private information is more than the reported insider sales shortly after the lockup expiration date.

Our finding of short sellers front-running insiders is robust to deleting IPOs for which the issuing firm conducted an SEO within 14 days following the lockup expiration date. An SEO might include selling shareholders' shares, which would result in reported insider sales on the SEO's issue date. In this case, insider sales in the SEO should have been disclosed in the equity issuer's registration statement with the SEC (SEC form S-4) before the issue date. Therefore, if there is an SEO soon after the lockup expiration date, it is likely that insider sales in the SEO are publicly known beforehand. In untabulated results, we find that only 4 IPO firms conducted an SEO within 14 days following the lockup expiration date, and deleting these 4 firms does not change our main finding.

While the relation between insider selling and short selling is statistically significant at the 5% level or above, the economic significance does not appear to be large. Specifically, according to the first regression model in Table 8, the coefficient on insider selling during days [-14,-6] relative to the lockup expiration date is 0.02. A one standard deviation increase in insider selling during days [-14,-6] relative to the lockup expiration date (6.07%) is associated with a 0.12% increase in the abnormal short selling during days [-5,-1] relative to the lockup expiration date. Similarly, the coefficient on insider selling during days [0, 5] relative to the lockup expiration date is 0.04. A one standard deviation increase in insider selling within five trading days subsequent to the lockup expiration (1.71%) is associated with a 0.07% increase in the abnormal short selling during the five trading days before the lockup expiration date. Taken together, we

can at best claim that we find weak evidence that short sellers front-run insider sales around IPO lockup expirations.

4. Conclusion

In this study, we examine daily short selling activity around the expiration of IPO share lockups. Overall, short selling is abnormally high over several weeks leading up to the lockup expiration date, peaks one day before the lockup expiration date, and declines in the following week. We find informed abnormal short selling prior to the lockup expiration date. We also find some weak evidence that short sellers front-run insider sales.

The past ten years have witnessed an increasing number of PE-backed IPOs in the U.S. market. The increase is particularly heightened during our sample period of 2005-2006. Indeed, PE-backed IPOs account for 40% of our sample and VC-backed IPOs account for 37% of our sample. Consistent with a popular view that PE funds aim for short-term profits and thus might cash out soon after bringing a firm public, we find that short selling prior to the lockup expiration date is heavier for PE-backed IPO stocks than for other IPO stocks. However, we find neither a negative return nor a jump in trading volume on the lockup expiration date for PE-backed IPO stocks.

Due to data limitation, we are unable to answer several interesting questions. For example, why aren't the stock returns negative on the lockup expiration date for PE-backed IPO stocks as for VC-backed IPO stocks? Why doesn't the trading volume jump on the lockup expiration date for PE-backed IPO stocks as much as for VC-backed IPO stocks? How long do private equity firms maintain their investment in their portfolio firms after the firm goes public? Given that private equity firms play an increasingly important role in supporting private and young firms, it is important for future research to shed light on these issues.

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Table 1. Summary Statistics

The sample includes 213 IPOs conducted by U.S. domestic firms from January 2005 through December 2006, excluding closed-end funds, REITs, units, IPOs whose first trading price appears in CRSP more than 7 days from the issue date provided by the SDC database, IPOs without a lockup agreement, IPOs whose lockup expiration date is later than 5/31/2007 (the last day when our Regulation SHO data are available), IPOs with missing information (in the SDC database) on the number of shares locked during the lockup period, IPOs that are not listed on the Nasdaq's website, IPOs that have a zero trading volume on the unlock date (according to the CRSP). If an IPO has multiple unlock dates, we keep only the unlock date with the most shares being unlocked. Topr is an indicator variable that equals one if the bookrunner's reputation rank is 9 and zero otherwise. VC is an indicator variable that equals one if the IPO firm is backed by VC and zero otherwise. PE is an indicator variable that equals one if the IPO firm is backed by private equity (buyout funds, not VCs) and zero otherwise. Tech is an indicator variable that equals one if the IPO firm is a technology firm and zero otherwise. Following Lougran and Ritter (2004), we define technology stocks as those in SIC codes 3571, 3572, 3575, 3577, 3578 (computer hardware), 3661, 3663, 3669 (communications equipment), 3671, 3672, 3674, 3675, 3677, 3678, 3679 (electronics), 3812 (navigation equipment), 3823, 3825, 3826, 3827, 3829 (measuring and controlling devices), 3841, 3845 (medical instruments), 4812, 4813 (telephone equipment), 4899 (communications services), and 7371, 7372, 7373, 7374, 7375, 7378, and 7379 (software). Nasdaq is an indicator variable that equals one if the IPO stock is listed on Nasdaq and zero otherwise. Mktcap is the market capitalization in $million, measured using the market closing price on the first trading day. Shoff is the ratio of the shares offered in the IPO to the total outstanding shares. Maxp is the fraction of the outstanding shares that are locked up for the largest share lockup (i.e., the lockup that restricts the most shares from being sold in the market). Unlockp2 is shares unlocked scaled by shares offered in the IPO. Maxld is the lockup period length measured in days. Prelock is an indicator variable that equals one if there is an unlock date before the unlock date with the most shares unlocked, and zero otherwise. SEO is an indicator variable that equals one if the firm made seasoned offers before the unlock date or within two weeks after the unlock date, and zero otherwise. preSEO is an indicator variable that equals one if the firm made seasoned offers before the unlock date, and zero otherwise. Earning is an indicator variable that equals one if earnings is announced within 3 days of the unlock date, and zero otherwise. Hold2 is 13f holdings prior to the unlock date. Underp is underpricing. Secondary is the ratio of shareholders' shares to the total shares offered in the IPO. Options is an indicator variable that equals one if the IPO stock has traded options before the lockup expiration date, and zero otherwise. Accounting variables are obtained from unrestated quarterly Compustat file as of the quarter immediately prior to the lockup expiration date. Sales is quarterly sales in $million (SALEQ). ROA is income before extraordinary items scaled by total assets (IBQ/ATQ). Debt/Assets is total liability scaled by total assets (LTQ/ATQ). Cash/Assets is cash and cash equivalent scaled by total assets (CHECHQ/ATQ). Net PPE/Assets is net property, plant, and equipment scaled by total assets (PPENTQ/ATQ). CapEx/Assets is capital expenditures scaled by total assets (CAPXQ/ATQ). Panel A reports summary statistics for the full sample. In Panel B, we break down the sample into VC-backed, PE-backed, and non-sponsored IPOs.

Panel A. All IPOs

Variable	Mean	Median	Std Dev
topr	0.36	0.00	0.48
vc	0.37	0.00	0.48
pe	0.40	0.00	0.49
tech	0.32	0.00	0.47
nasdaq	0.71	1.00	0.46
Mktcap ($million)	642.12	348.18	1073.88
Shoff (%)	35.48	31.22	17.50
maxp	0.62	0.65	0.18
unlockp2 (%)	219.48	203.64	132.97
Maxld (days)	184.01	180.00	40.32
prelock	0.15	0.00	0.36
SEO	0.10	0.00	0.30
preSEO	0.08	0.00	0.26
earning	0.08	0.00	0.26
hold2	0.36	0.32	0.23
underp	0.12	0.07	0.19
secondary	0.15	0.00	0.25
Options	0.27	0.00	0.44
Sales ($million)	123.54	38.75	272.03
ROA	-0.01	0.01	0.07
Debt/Assets	0.47	0.40	0.36
Cash/Assets	0.09	0.02	0.23
Net PPE/Assets	0.17	0.07	0.20
CapEx/Assets	0.04	0.02	0.05

Panel B. VC-backed, PE-backed, and Non-sponsored IPOs

	VC-backed IPOs (N=79)		PE-backed IPOs (N=86)		non-sponsored IPOs (N=48)	
Variable	Mean	Median	Mean	Median	Mean	Median
topr	0.44	0.00	0.36	0.00	0.23	0.00
tech	0.46	0.00	0.21	0.00	0.29	0.00
nasdaq	0.94	1.00	0.53	1.00	0.65	1.00
mktcap	379.02	265.90	963.95	471.69	498.54	296.60
shoff	29.17	26.76	38.93	36.17	39.67	32.65
maxp	0.66	0.71	0.60	0.62	0.59	0.61
unlockp2	259.96	262.82	197.74	168.07	191.79	170.63
maxld	183.49	180.00	180.44	180.00	191.25	180.00
prelock	0.28	0.00	0.06	0.00	0.13	0.00
SEO	0.10	0.00	0.12	0.00	0.06	0.00
preSEO	0.08	0.00	0.09	0.00	0.04	0.00
earning	0.11	0.00	0.07	0.00	0.02	0.00
hold2	0.31	0.28	0.44	0.41	0.32	0.26
underp	0.14	0.08	0.08	0.05	0.13	0.09
secondary	0.11	0.00	0.21	0.00	0.11	0.00
Options	0.16	0.00	0.35	0.00	0.29	0.00
Sales ($million)	23.73	11.38	222.30	95.92	110.86	37.78
ROA	-0.04	-0.02	0.01	0.01	0.00	0.01
Debt/Assets	0.28	0.24	0.64	0.67	0.49	0.38
Cash/Assets	0.16	0.16	0.04	0.00	0.05	0.01
Net PPE/Assets	0.09	0.05	0.22	0.13	0.21	0.11
CapEx/Assets	0.03	0.01	0.04	0.02	0.06	0.03

Table 2. Daily abnormal short sale, trading volume, and market-adjusted return around lockup expirations

The sample includes 213 IPOs conducted by U.S. domestic firms from January 2005 through December 2006, excluding closed-end funds, REITs, units, IPOs whose first trading price appears in CRSP more than 7 days from the issue date provided by the SDC database, IPOs without a lockup agreement, IPOs whose lockup expiration date is later than 5/31/2007 (the last day when our Regulation SHO data are available), IPOs with missing information (in the SDC database) on the number of shares locked during the lockup period, IPOs that are not listed on the Nasdaq's website, IPOs that have a zero trading volume on the unlock date (according to the CRSP). If an IPO has multiple unlock dates, we keep only the unlock date with the most shares being unlocked. Day 0 is the IPO lockup expiration date. Abnormal short sale= short sale /mean daily short sale-1, where short sale is scaled by trading volume and the mean daily short sale is calculated over the benchmark period [-100, -51]. Abnormal trading volume =trading volume/mean trading volume-1, where the mean trading volume is calculated over the benchmark period [-100, -51]. Market-adjusted return is the difference between the stock return and the CRSP equal-weighted return. Superscripts ***, **, and * indicate statistical significance at the 1, 5, and 10 percent levels, respectively.

	Mean			Median		
Day	ret_mkte(%)	absvp	abvol	ret_mkte(%)	absvp	abvol
-50	-0.20	0.18**	0.03	-0.05	-0.05	-0.42***
-49	0.02	0.09	0.04	0.02	-0.12	-0.45***
-48	0.09	0.20	-0.09	-0.18	-0.12	-0.44***
-47	-0.29	0.13	0.00	-0.25**	-0.18	-0.40***
-46	0.03	0.14**	-0.04	-0.15	-0.12	-0.41***
-45	0.02	0.10	0.09	-0.09	-0.13	-0.37***
-44	0.23	0.19**	0.80	0.25	-0.03	-0.41***
-43	-0.04	0.17**	0.10	-0.09	-0.06	-0.39***
-42	0.22	0.08	0.38*	0.01	-0.23	-0.41***
-41	0.33	0.14*	0.03	0.13	-0.11	-0.41***
-40	-0.07	0.34***	0.09	-0.21	0.01	-0.42***
-39	0.20	0.18**	-0.01	-0.01	-0.09	-0.44***
-38	-0.19	0.22***	0.10	-0.12	-0.12	-0.43***
-37	0.28	0.19**	-0.02	0.12	-0.08	-0.42***
-36	-0.03	0.21***	-0.01	-0.03	-0.05	-0.42***
-35	-0.01	0.31***	-0.04	0.03	-0.04	-0.46***
-34	-0.47**	0.18***	0.02	-0.52***	0.02	-0.42***
-33	0.06	0.12	0.03	0.06	-0.18	-0.43***
-32	0.32	0.14**	0.10	-0.06	-0.13	-0.47***
-31	0.18	0.28***	-0.06	-0.04	-0.02	-0.46***
-30	0.22	0.12	0.17	0.10	-0.13	-0.51***
-29	-0.35	0.28***	0.03	-0.29	-0.03	-0.45***
-28	0.04	0.28***	0.09	-0.20	-0.07	-0.37***
-27	0.27	0.25***	-0.08	0.21	0.01	-0.46***
-26	-0.21	0.10	0.00	-0.30**	-0.08	-0.51***
-25	0.09	0.13*	-0.01	-0.10	-0.12	-0.46***
-24	-0.11	0.20***	0.05	-0.19	-0.03	-0.49***
-23	0.05	0.36***	-0.04	-0.38	-0.01*	-0.50***
-22	0.15	0.20***	0.08	-0.11	-0.06	-0.51***
-21	-0.10	0.27***	-0.09	-0.17	-0.04	-0.45***
-20	-0.19	0.21***	-0.02	-0.14	-0.04	-0.53***
-19	0.07	0.20***	-0.10	-0.07	-0.07	-0.52***
-18	-0.14	0.29***	-0.09	-0.31	-0.06	-0.48***
-17	-0.11	0.25***	0.13	-0.22	-0.08	-0.39***
-16	0.03	0.31***	-0.03	-0.03	0.06***	-0.46***
-15	0.06	0.35***	-0.16***	-0.26	0.04*	-0.43***
-14	0.47**	0.46***	0.09	0.17	0.11***	-0.48***
-13	-0.23	0.39***	-0.01	-0.35**	0.06**	-0.38***
-12	-0.14	0.19***	0.06	-0.33	0.04	-0.44***
-11	-0.09	0.45***	-0.02	-0.10	0.14***	-0.44***
-10	-0.10	0.37***	0.36	-0.30	0.04***	-0.46***
-9	-0.28	0.38***	0.06	-0.53***	0.08***	-0.40***
-8	-0.05	0.43***	0.18	-0.27	0.13***	-0.35***

-7	-0.01	0.36***	0.13	-0.04	0.02**	-0.40***
-6	0.40*	0.40***	0.09	-0.02	0.09***	-0.40***
-5	-0.22	0.36***	0.08	-0.41**	0.08***	-0.40***
-4	-0.08	0.34***	0.12	-0.27	0.04	-0.38***
-3	-0.21	0.28***	0.28	-0.22*	-0.04**	-0.36***
-2	-0.08	0.46***	0.24	-0.15	0.05***	-0.38***
-1	-0.34*	0.50***	0.17	-0.31**	0.14***	-0.37***
0	-0.37	0.25***	0.84***	-0.25	-0.06	-0.35
1	-0.28	0.33***	0.84***	-0.25	-0.10	-0.27
2	0.20	0.32***	0.53***	0.05	-0.04	-0.32
3	-0.02	0.31***	0.46***	-0.07	-0.03	-0.33*
4	-0.33	0.14	0.47***	-0.34*	-0.22	-0.18
5	-0.02	0.21**	0.38***	-0.06	-0.16	-0.26
6	-0.22	0.20**	0.27***	-0.17	-0.16	-0.22
7	0.19	0.34***	0.06	-0.07	-0.09	-0.34**
8	0.02	0.20**	0.22*	0.03	-0.06	-0.29
9	-0.18	0.30***	0.12	-0.17	-0.03**	-0.38***
10	-0.26	0.16*	0.49***	-0.37*	-0.18	-0.24
11	0.05	0.18**	0.44***	-0.04	-0.11	-0.34
12	-0.20	0.34***	0.82***	-0.30	-0.02	-0.18
13	0.27	0.30***	0.89***	0.11	-0.04	-0.26
14	-0.36	0.22**	0.91*	-0.38**	-0.12	-0.19
15	0.09	0.18**	0.50***	0.03	-0.09	-0.18
16	0.04	0.20**	0.48***	-0.14	-0.11	-0.21
17	-0.03	0.21**	0.62***	-0.04	-0.13	-0.23
18	0.20	0.16*	0.75**	0.04	-0.17	-0.30
19	0.07	0.20**	0.73***	-0.19	-0.06	-0.32
20	0.01	0.08	0.56***	-0.07	-0.19*	-0.31
21	-0.45	0.36**	0.40**	-0.22	-0.04	-0.30**
22	0.03	0.08	0.52***	-0.08	-0.17	-0.36
23	0.07	0.15*	0.45***	0.05	-0.16	-0.31
24	-0.05	0.20**	0.84***	0.19	-0.03	-0.27
25	-0.06	0.19**	0.76***	-0.24	-0.14	-0.29
26	-0.10	0.21**	0.48***	-0.12	-0.10	-0.25
27	0.21	0.16**	1.07**	0.01	-0.07	-0.24
28	0.26	0.16**	0.57***	0.01	-0.07	-0.28
29	0.09	0.29***	0.53***	-0.07	0.01	-0.30
30	-0.10	0.14	0.73***	-0.20*	-0.12	-0.20
31	0.19	0.24***	0.56**	0.08	-0.09	-0.29
32	1.40	0.34***	3.10	0.03	0.08**	-0.32
33	0.08	0.27***	2.92	0.07	-0.01	-0.26
34	-0.17	0.16**	1.68**	0.03	0.00	-0.23
35	0.07	0.17**	1.22*	0.00	-0.04	-0.25
36	0.04	0.25***	1.29**	-0.03	-0.06	-0.15
37	0.02	0.19***	0.62***	-0.08	-0.06	-0.27
38	-0.13	0.31***	1.36	-0.37*	-0.05**	-0.34
39	0.13	0.35***	1.91	-0.06	0.01**	-0.36*
40	0.29	0.20***	1.74	-0.01	0.00	-0.29**
41	0.05	0.19**	2.45	0.02	-0.09	-0.25
42	0.43	0.26***	2.09*	-0.03	0.03	-0.30
43	0.15	0.28***	1.03	-0.09	-0.04	-0.34
44	0.08	0.44***	1.05*	0.13	-0.04**	-0.20
45	-0.09	0.22***	1.13	-0.26	-0.03	-0.22
46	0.04	0.28**	0.81*	0.00	-0.13	-0.27
47	-0.20	0.36***	0.66*	-0.10	0.05**	-0.31
48	0.13	0.39***	0.84	0.05	0.10***	-0.20
49	0.35*	0.43***	0.68*	0.08	0.13***	-0.26
50	0.05	0.27***	0.82***	-0.18	-0.05	-0.27

Table 3. Short selling prior to the lockup expiration date and market return on the lockup expiration date

The sample includes 213 IPOs conducted by U.S. domestic firms from January 2005 through December 2006, excluding closed-end funds, REITs, units, IPOs whose first trading price appears in CRSP more than 7 days from the issue date provided by the SDC database, IPOs without a lockup agreement, IPOs whose lockup expiration date is later than 5/31/2007 (the last day when our Regulation SHO data are available), IPOs with missing information (in the SDC database) on the number of shares locked during the lockup period, IPOs that are not listed on the Nasdaq's website, IPOs that have a zero trading volume on the unlock date (according to the CRSP). If an IPO has multiple unlock dates, we keep only the unlock date with the most shares being unlocked. This table reports summary statistics for short selling, trading, and stock returns around the lockup expiration date. Day 0 is the lockup expiration date. annret_mkte_per is the market-adjusted return (in percent) on the lockup expiration date, where the market return is measured as the CRSP equal-weighted return. Annret_per is the stock return (in percent) on the lockup expiration date. Cmar1_per is the market adjusted return during the 3-day window [-1, 1], using equal weighted CRSP index. sv is the daily ratio of shorting volume to trading volume averaged over trading days [-5,-1]. sv_mean is the daily ratio of shorting volume to trading volume averaged over the benchmark period [-100, -51]. absvp is the daily abnormal short sale averaged over trading days [-5,-1], where the abnormal short sale is measured as sv/sv_mean-1. Mom_per is the market-adjusted return (in percent) during trading days [-10,-6], where the market return is measured as the CRSP equal-weighted return. Ret_per is the market-adjusted return (in percent) during trading days [-5,-1], where the market return is measured as the CRSP equal-weighted return. Abvol is the abnormal trading volume on the lockup expiration date and is measured as the trading volume scaled by the average trading volume over the benchmark period [-100,-51], then minus one. diff_cumret_mkrete is the buy-and-hold market adjusted return from the issue date to day -6 (in percent). In Panel C, column "mean diff." shows whether means are significantly different between the two groups compared in the panel, and column "median diff." shows whether medians are significantly different between the two groups compared in the panel. T-tests are used to test for significant differences in means. Wilcoxon tests are used to test for significant differences in medians. Superscripts ***, **, and * indicate statistical significance at the 1, 5, and 10 percent levels, respectively.

Panel A. All IPOs

Variable	Mean	Median	Std Dev
absvp	0.39***	0.16***	0.81
sv	0.19***	0.18***	0.10
sv_mean	0.15***	0.14***	0.07
annret_per (%)	-0.31	-0.28	4.49
annret_mkte_per (%)	-0.37	-0.25	4.48
cmar1_per (%)	-0.97**	-0.84*	6.50
abvol	0.84***	-0.35	3.74
ret_per (%)	-0.10	-0.10	1.42
mom_per (%)	0.56	0.17	7.73
diff_cumret_mkrete (%)	-0.23	-4.95	36.32

Panel B. VC-backed, PE-backed, and Non-sponsored IPOs

	VC-backed IPOs (N=79)		PE-backed IPOs (N=86)		Non-sponsored IPOs (N=48)	
Variable	Mean	Median	Mean	Median	Mean	Median
absvp	0.37***	0.11***	0.49***	0.28***	0.24**	0.07**
sv	0.19***	0.17***	0.20***	0.19***	0.18***	0.18***
sv_mean	0.15***	0.14***	0.15***	0.15***	0.15***	0.14***
annret_per	-1.51**	-0.79**	0.27	0.08	0.65	0.41
annret_mkte_per	-1.58**	-0.82**	0.20	0.03	0.58	0.55
cmar1_per	-2.98***	-2.21***	0.06	0.12	0.52	0.28
abvol	2.15***	0.04**	0.17	-0.39**	-0.12	-0.52**
ret_per (%)	-0.26	-0.39*	0.04	0.00	-0.09	0.02
mom_per (%)	1.41	0.90	1.14*	0.49	-1.89	-2.00***
diff_cumret_mkrete(%)	0.21	-9.81	-1.44	-5.95	1.20	3.86

Panel C. IPOs with traded options vs. without traded options

	Mean Diff.	Median Diff.	IPOs with traded options (N=57)			IPOs without traded options (N=156)		
Variable			Mean	Median	Std Dev	Mean	Median	Std Dev
absvp			0.40***	0.26***	0.58	0.38***	0.13***	0.88
sv	***	***	0.23***	0.22***	0.08	0.18***	0.16***	0.11
sv_mean	***	***	0.18***	0.17***	0.06	0.14***	0.13***	0.07
annret_per			-0.19	-0.36	2.84	-0.35	-0.27	4.97
annret_mkte_per			-0.34	-0.30	2.77	-0.39	-0.21	4.97
cmar1_per			-0.31	-0.24	5.17	-1.21**	-1.03**	6.92
abvol			0.55*	-0.22	2.19	0.95***	-0.39	4.16
ret_per (%)			-0.30	-0.32	1.56	-0.02	-0.04	1.37
mom_per (%)			0.70	0.20	7.33	0.50	0.04	7.89
diff_cumret_mkrete(%)			4.88	6.83	36.90	-2.10	-9.42*	36.04

Table 4. Determinants of short selling prior to the lockup expiration date

The sample includes 213 IPOs conducted by U.S. domestic firms from January 2005 through December 2006, excluding closed-end funds, REITs, units, IPOs whose first trading price appears in CRSP more than 7 days from the issue date provided by the SDC database, IPOs without a lockup agreement, IPOs whose lockup expiration date is later than 5/31/2007 (the last day when our Regulation SHO data are available), IPOs with missing information (in the SDC database) on the number of shares locked during the lockup period, IPOs that are not listed on the Nasdaq's website, IPOs that have a zero trading volume on the unlock date (according to the CRSP). If an IPO has multiple unlock dates, we keep only the unlock date with the most shares being unlocked. In Panels A-D, the dependent variable is the mean abnormal short sale over days [-5,-1]. Panel A reports regression results for the full sample. In Panel B, the sample excludes the IPOs with earnings announcements within three days before or after the lockup expiration date as well as IPOs with an SEO before the lockup expiration date. Panel C reports results for regressions with interaction terms between the event day announcement return and the VC and PE indicator variables. In Panel D, the sample excludes stocks with traded options before the expiration date of the largest share lockup. In Panel E, we measure the dependent variable as the mean abnormal short sale over days [-5,-2]. T-statistics are based on heteroscedasticity-corrected standard errors. Superscripts ***, **, and * indicate statistical significance at the 1, 5, and 10 percent levels, respectively.

Panel A. Main Regressions (N=213)

Dependent variable=mean abnormal short sale over days [-5,-1]

Parameter	Estimate	*t*-stat	Estimate	*t*-stat	Estimate	*t*-stat
Intercept	0.25***	2.69	0.02	0.05	0.16	0.41
annret_mkte	-2.39***	-2.61	-2.32**	-2.32	-2.40**	-2.34
vc	0.08	0.57	0.08	0.60	0.18	1.19
pe	0.24*	1.84	0.21	1.50	0.22	1.30
ret			1.55	0.47	0.76	0.21
mom			-0.19	-0.27	-0.58	-0.76
lnmktcap			0.04	0.83	0.02	0.37
maxp					-0.08	-0.27
hold2					0.21	0.74
tech					-0.05	-0.42
topr					-0.10	-0.82
diff_cumret_mkrete					0.30*	1.68
underp					-0.15	-0.52
secondary					0.05	0.25
prelock					-0.14	-0.99
preSEO					-0.01	-0.04
earning					-0.25	-1.44
Adjusted R^2	0.017		0.01		-0.010	

Panel B. Excluding IPOs with earnings announcements within three days before or after the lockup expiration date as well as IPOs with an SEO before the lockup expiration date (N=182)

Dependent variable=mean abnormal short sale over days [-5,-1]

Parameter	Estimate	*t*-stat
Intercept	0.13	0.33
annret_mkte	-2.38**	-2.19
vc	0.19	1.15
pe	0.23	1.23
ret	-0.83	-0.22
mom	-0.74	-0.82
lnmktcap	0.02	0.37
maxp	-0.08	-0.24
hold2	0.18	0.51
tech	-0.09	-0.64
topr	-0.10	-0.72
diff_cumret_mkrete	0.00	1.25
underp	0.17	0.49
secondary	0.17	0.76
prelock	-0.15	-0.92
Adjusted R^2	-0.019	

Panel C. With interaction terms (N=213)

Dependent variable=mean abnormal short sale over days [-5,-1]

Parameter	Estimate	*t*-stat	Estimate	*t*-stat	Estimate	*t*-stat
Intercept	0.25***	2.66	0.26***	2.73	0.26***	2.68
annret_mkte	-2.12**	-2.13	-3.72**	-2.39	-3.32*	-1.74
annret_mkte×pe	-2.22	-0.77			-1.03	-0.31
annret_mkte×vc			1.93	0.98	1.53	0.68
vc	0.08	0.61	0.08	0.58	0.08	0.60
pe	0.25*	1.86	0.24*	1.79	0.24*	1.79
Adjusted R^2	0.014		0.015		0.010	

Panel D. Excluding IPOs with traded options (N=156)

Dependent variable=mean abnormal short sale over days [-5,-1]

Parameter	Estimate	*t*-stat	Estimate	*t*-stat	Estimate	*t*-stat
Intercept	0.28**	2.29	-0.16	-0.37	0.00	0
annret_mkte	-2.64***	-2.77	-2.54**	-2.28	-2.69**	-2.36
vc	0.03	0.2	0.01	0.04	0.10	0.5
pe	0.20	1.14	0.13	0.65	0.19	0.68
ret			3.26	0.75	2.45	0.52
mom			0.03	0.04	-0.16	-0.17
lnmktcap			0.09	1.07	0.08	0.63
maxp					0.02	0.05
hold2					-0.15	-0.27
tech					-0.06	-0.37
topr					-0.17	-0.97
diff_cumret_mkrete					0.00	1.05
underp					-0.14	-0.24
secondary					-0.07	-0.21
prelock					-0.11	-0.63
preSEO					0.29	0.85
earning					-0.32	-1.49
Adjusted R^2	0.01		0.00		-0.02	

Panel E. Mean abnormal short sale over days [-5,-2], skipping day -1 (N=213)

Dependent variable=mean abnormal short sale over days [-5,-2]

Parameter	Estimate	*t*-stat	Estimate	*t*-stat	Estimate	*t*-stat
Intercept	0.10	1.09	-0.28	-0.91	-0.21	-0.53
annret_mkte	-3.38***	-2.94	-3.24***	-2.58	-3.37***	-2.62
vc	0.21	1.46	0.22	1.49	0.29*	1.72
pe	0.41***	3.02	0.36**	2.56	0.39**	2.30
ret			3.11	0.89	2.55	0.70
mom			-0.41	-0.59	-0.76	-0.98
lnmktcap			0.07	1.31	0.04	0.56
maxp					0.06	0.19
hold2					0.32	1.18
tech					0.07	0.51
topr					-0.11	-0.86
diff_cumret_mkrete					0.32*	1.70
underp					-0.19	-0.66
secondary					0.02	0.09
prelock					-0.04	-0.29
preSEO					0.07	0.28
earning					-0.28*	-1.70
Adjusted R^2	0.05		0.05		0.04	

Table 5. The informativeness of short selling around the lockup expiration date

The sample includes 213 IPOs conducted by U.S. domestic firms from January 2005 through December 2006, excluding closed-end funds, REITs, units, IPOs whose first trading price appears in CRSP more than 7 days from the issue date provided by the SDC database, IPOs without a lockup agreement, IPOs whose lockup expiration date is later than 5/31/2007 (the last day when our Regulation SHO data are available), IPOs with missing information (in the SDC database) on the number of shares locked during the lockup period, IPOs that are not listed on the Nasdaq's website, IPOs that have a zero trading volume on the unlock date (according to the CRSP). If an IPO has multiple unlock dates, we keep only the unlock date with the most shares being unlocked. This table reports the results for regressions in Equation (3) for days -1, 0, and 1. In each regression, the dependent variable is the average short selling over five days before the event date, and the key independent variable is the market-adjusted return on the event day. We set the event day to be each of the days around the lockup expiration date. Superscripts ***, **, and * indicate statistical significance at the 1, 5, and 10 percent levels, respectively.

Dependent variable= average abnormal short sale over five days before the event day						
	Event day					
	Day -1		Day 0		Day 1	
Parameter	Estimate	*t*-stat	Estimate	*t*-stat	Estimate	*t*-stat
Intercept	0.11	1.19	0.25***	2.69	0.30***	3.21
annret_mkte	-0.47	-0.27	-2.39***	-2.61	-0.49	-0.37
vc	0.27**	2	0.08	0.57	-0.02	-0.13
pe	0.38***	2.89	0.24*	1.84	0.16	1.17
Adjusted R^2	0.017		0.017		-0.003	

Table 6. Determinants of short selling prior to the lockup expiration date (all short sales)

The sample includes 213 IPOs conducted by U.S. domestic firms from January 2005 through December 2006, excluding closed-end funds, REITs, units, IPOs whose first trading price appears in CRSP more than 7 days from the issue date provided by the SDC database, IPOs without a lockup agreement, IPOs whose lockup expiration date is later than 5/31/2007 (the last day when our Regulation SHO data are available), IPOs with missing information (in the SDC database) on the number of shares locked during the lockup period, IPOs that are not listed on the Nasdaq's website, IPOs that have a zero trading volume on the unlock date (according to the CRSP). If an IPO has multiple unlock dates, we keep only the unlock date with the most shares being unlocked. Superscripts ***, **, and * indicate statistical significance at the 1, 5, and 10 percent levels, respectively.

Dependent variable = average abnormal short sales over event days [-5,-1]

Parameter	Estimate	*t*-stat	Estimate	*t*-stat	Estimate	*t*-stat
Intercept	0.21**	2.47	0.09	0.36	0.07	0.21
annret_mkte	-1.59**	-2.23	-1.56**	-2.13	-1.63**	-2.18
vc	-0.08	-0.69	-0.09	-0.76	-0.07	-0.57
pe	0.19*	1.68	0.16	1.38	0.15	1.12
ret			2.46	1.05	1.89	0.77
mom			0.43	0.70	0.31	0.47
lnmktcap			0.02	0.54	0.02	0.30
maxp					0.06	0.32
hold2					0.12	0.49
tech					0.01	0.08
topr					-0.08	-0.81
diff_cumret_mkrete					0.00	0.73
underp					-0.13	-0.64
secondary					0.09	0.48
prelock					0.00	-0.04
preSEO						
earning						
Adjusted R^2	0.03		0.02		-0.01	

Table 7. Insider sales around the lockup expiration date

The sample includes 213 IPOs conducted by U.S. domestic firms from January 2005 through December 2006, excluding closed-end funds, REITs, units, IPOs whose first trading price appears in CRSP more than 7 days from the issue date provided by the SDC database, IPOs without a lockup agreement, IPOs whose lockup expiration date is later than 5/31/2007 (the last day when our Regulation SHO data are available), IPOs with missing information (in the SDC database) on the number of shares locked during the lockup period, IPOs that are not listed on the Nasdaq's website, IPOs that have a zero trading volume on the unlock date (according to the CRSP). If an IPO has multiple unlock dates, we keep only the unlock date with the most shares being unlocked. Sale1 (in percent) is the total shares sold by insiders scaled by shares outstanding. Sale2 (in percent) is the total shares sold by insiders scaled by shares offered.

Panel A. insider sales around the unlock date

Variable	N	Mean	Median	Std. Dev.
Days [-14,-6]: 9 firms have insider sales				
sale1	213	0.80	0.00	6.07
sale2	213	2.42	0.00	18.82
Days [-5,-1]: 1 firm has insider sales				
sale1	213	0.01	0.00	0.14
sale2	213	0.04	0.00	0.54
Day 0: 9 firms have insider sales				
sale1	213	0.13	0.00	1.66
sale2	213	0.48	0.00	6.01
Days [1,5]: 16 firms have insider sales				
sale1	213	0.07	0.00	0.43
sale2	213	0.23	0.00	1.43

Panel B. insider sales during days [0,5] relative to the unlock date, broken down into VC-backed, PE-backed, and non-sponsored IPOs

	N	Mean	Median	Std. Dev.
All IPOs: 21 firms have insider sales				
sale1	213	0.20	0.00	1.71
sale2	213	0.72	0.00	6.17
VC-backed: 8 firms have insider sales				
sale1	79	0.10	0.00	0.46
sale2	79	0.37	0.00	1.75
PE-backed: 9 firms have insider sales				
sale1	86	0.35	0.00	2.62
sale2	86	1.30	0.00	9.52
Non-sponsored: 4 firms have insider sales				
sale1	48	0.11	0.00	0.63
sale2	48	0.25	0.00	1.42

Table 8. Relation between short selling prior to the lockup expiration date and insider selling around the lockup expiration date

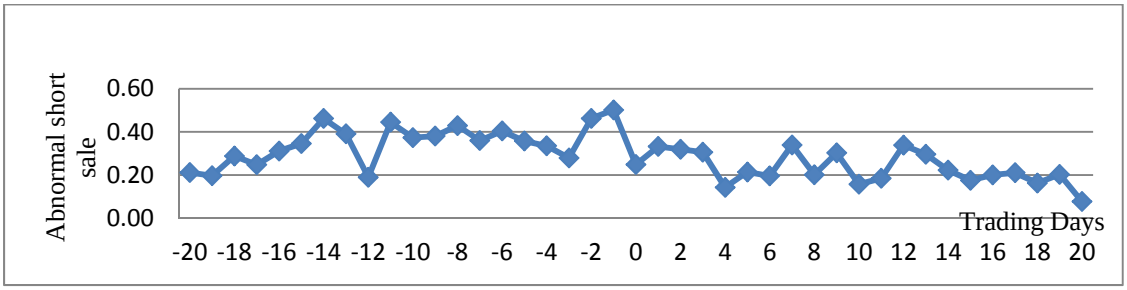
The sample includes 213 IPOs conducted by U.S. domestic firms from January 2005 through December 2006, excluding closed-end funds, REITs, units, IPOs whose first trading price appears in CRSP more than 7 days from the issue date provided by the SDC database, IPOs without a lockup agreement, IPOs whose lockup expiration date is later than 5/31/2007 (the last day when our Regulation SHO data are available), IPOs with missing information (in the SDC database) on the number of shares locked during the lockup period, IPOs that are not listed on the Nasdaq's website, IPOs that have a zero trading volume on the unlock date (according to the CRSP). If an IPO has multiple unlock dates, we keep only the unlock date with the most shares being unlocked. The regression model is Equation (3), in which the dependent variable is the average abnormal short sales over trading days [-5,-1] relative to the lockup expiration date. The following two additional regressors are added to the models in Table 4: Sale1 is the total number of shares sold by insiders during trading days [0,5] relative to the lockup expiration date scaled by the number of shares outstanding (in percent). Presale1 is the total number of shares sold by insiders during trading days [-14,-6] relative to the lockup expiration date scaled by the number of shares outstanding (in percent). Superscripts ***, **, and * indicate statistical significance at the 1, 5, and 10 percent levels, respectively.

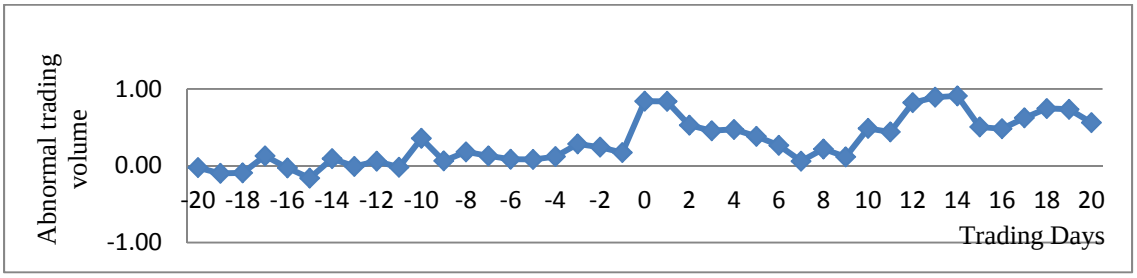
Dependent variable = the average abnormal short sales over event days [-5,-1]						
	Model 1		Model 2		Model 3	
Parameter	Estimate	*t*-stat	Estimate	*t*-stat	Estimate	*t*-stat
Intercept	0.25***	2.64	0.06	0.20	0.07	0.18
sale1	0.04***	5.87	0.04***	4.45	0.05***	4.11
Presale1	0.02**	2.22	0.02**	2.20	0.03***	3.35
annret_mkte	-2.48***	-2.72	-2.46***	-2.49	-2.53**	-2.45
vc	0.07	0.50	0.07	0.49	0.19	1.21
pe	0.20	1.51	0.18	1.24	0.20	1.12
ret			0.66	0.20	-0.06	-0.02
mom			-0.07	-0.10	-0.45	-0.59
lnmktcap			0.03	0.66	0.04	0.64
maxp					-0.07	-0.24
hold2					0.20	0.71
tech					-0.05	-0.38
topr					-0.13	-1.07
diff_cumret_mkrete					0.28	1.54
underp					-0.02	-0.07
secondary					0.03	0.16
prelock					-0.12	-0.88
preSEO					-0.42**	-2.37
earning					-0.34**	-2.06
Adjusted R^2	0.04		0.02		0.02	

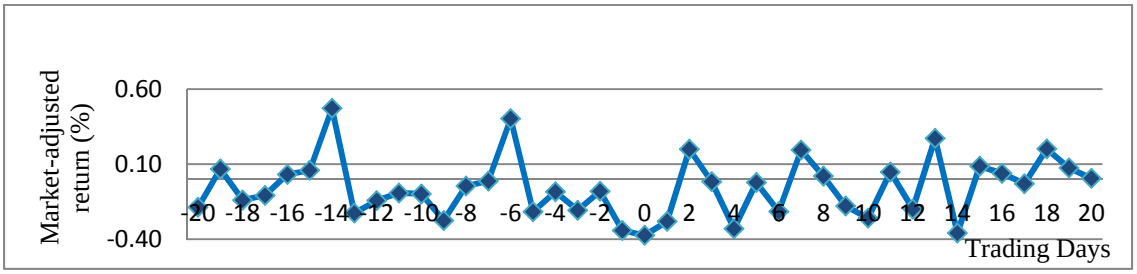
Figure 1. Daily abnormal short sale, trading volume, market-adjusted returns, and buy-and-hold abnormal returns around lockup expiration date

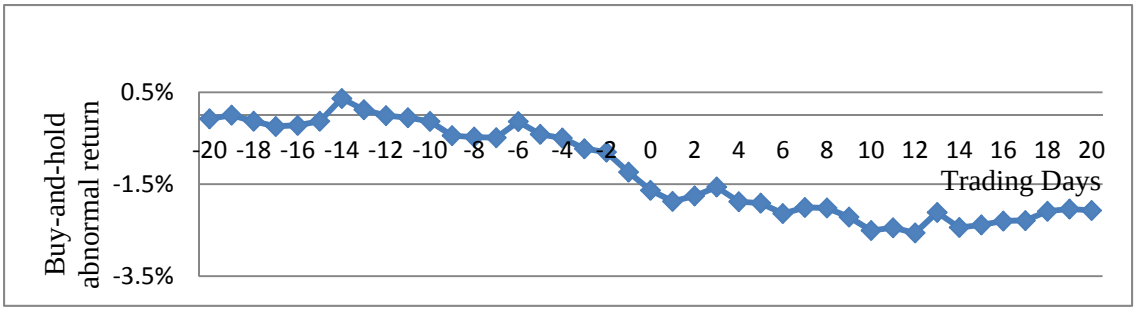
The sample includes 213 IPOs conducted by U.S. domestic firms from January 2005 through December 2006, excluding closed-end funds, REITs, units, IPOs whose first trading price appears in CRSP more than 7 days from the issue date provided by the SDC database, IPOs without a lockup agreement, IPOs whose lockup expiration date is later than 5/31/2007 (the last day when our Regulation SHO data are available), IPOs with missing information (in the SDC database) on the number of shares locked during the lockup period, IPOs that are not listed on the Nasdaq's website, IPOs that have a zero trading volume on the unlock date (according to the CRSP). If an IPO has multiple unlock dates, we keep only the unlock date with the most shares being unlocked. Day 0 is the IPO lockup expiration date. Abnormal short sale= short sale /mean daily short sale-1, where short sale is scaled by trading volume and the mean daily short sale is calculated over the benchmark period [-100, -51]. Abnormal trading volume =trading volume/mean trading volume-1, where the mean trading volume is calculated over the benchmark period [-100, -51]. Market-adjusted return is the difference between the stock return and the CRSP equal-weighted return. Buy-and-hold abnormal return is measured relative to the CRSP equal-weighted index.

Graph A. All the IPOs









Graph B. VC-backed IPOs, PE-backed IPOs, and Non-sponsored IPOs

