Short-Sales Constraints and Aftermarket IPO Pricing: Evidence on Short Sellers as *De Facto* Gatekeepers[*]

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Abstract

Regulators and scholars have recognized failures on the part of professional gatekeepers to protect investors from buying overpriced securities and the role of short sellers as gatekeepers. We provide new evidence on the role of short sellers as *de facto* gatekeepers in the IPO aftermarket. IPOs provide a unique setting to analyze the effectiveness of short sellers as capital market gatekeepers, because divergence of investor opinion about fundamental value is high and floating stock is low. We find that sell-side analysts fail to fulfill their gatekeeping role since they promote IPOs that are *ex ante* more likely to become overpriced. Short sellers actively target these stocks, attempting to arbitrage overpricing. However, short-sellers' ability to shield investors from overpricing is limited due to binding short-sales constraints. The resulting equilibrium overpricing subsides as IPO lockup agreements expire and short-sales constraints are relaxed.

Keywords: Gatekeepers; Short-Sales Constraints; Divergence of Opinion; IPO Pricing.
Data Availability: Data are publicly available from sources indicated in the text.

1. Introduction

A large body of existing research suggests that capital market gatekeepers frequently fail to protect investors from the overly optimistic representations of corporate managers. This research further suggests that failures on the part of capital market gatekeepers result from conflicts of interest that make gatekeepers beholden to corporate managers. These conflicts of interest are particularly pronounced for sell-side analysts. While sell-side analysts ostensibly provide independent investment advice, they face conflicts of interest due to investment banking affiliations, incentives to generate trading revenue, the desire for ongoing access to management and the economic incentives to put the interests of their largest institutional clients ahead of other investors. Such conflicts of interest are accentuated when corporations raise new capital (e.g., Bradshaw et al. 2006).

Not all investors, however, appear to be duped by the opportunistic actions of corporate managers and analysts. Both regulators and scholars have noted that short sellers were able to identify problems at Enron before professional gatekeepers flagged them.[1] More recently, short sellers served as *de facto* gatekeepers in exposing the aggressive accounting and stock market overpricing at Valeant Pharmaceuticals, a stock that was highly recommended by sell-side analysts (e.g., Grove and Clouse 2017). Yet there is scant large sample evidence on the role of short sellers in shielding investors from overpricing. In theory, the existence of sophisticated short sellers and an efficient market for short selling should effectively insulate unsophisticated investors from buying overpriced securities (e.g., Gilson and Kraakman 1984). In practice, however, short-sales constraints could limit the ability of short sellers' to perform this gatekeeping role.

[1] See for example, Coffee (2006) and U.S. Senate (2002).

We examine the role of short sellers as *de facto* gatekeepers in the IPO aftermarket. IPOs provide a unique setting for examining short sellers' gatekeeping role for several reasons. First, it is well documented that sell-side analysts face a conflict of interest in this setting, causing them to issue inflated forecasts and stock recommendations (e.g., Michaely and Womack 1999; Dechow et al. 2000). Second, there is also evidence that investors overpay for IPOs, with large first-day returns (e.g., Logue 1973; Ibbotson 1975) and negative abnormal returns in the following years (e.g., Ritter 1991; Loughran and Ritter 1995), and especially around the expiration of IPO lockup agreements (e.g., Field and Hanka 2001; Brav and Gompers 2003). Third, there is frequently significant fundamental uncertainty about the prospects of new issuers. This enhances the ability of management and sell-side analysts to fool unsophisticated investors with optimistic forecasts of future earnings (see Miller 1977). Finally, short selling is often constrained in the IPO aftermarket, particularly when the fraction of shares offered in the IPO is small and the remainder of the shares outstanding are subject to lockup requirements.

In order to evaluate the effectiveness of short sellers as *de facto* gatekeepers, we examine their activity in the IPO aftermarket and particularly their ability to arbitrage overpricing. Our primary prediction is that short-selling activity is elevated in the IPO aftermarket, especially for new issues that are *ex ante* more likely to become overpriced in the aftermarket. In order to examine these predictions, we employ detailed data on stock loan fees and active supply utilization from the securities lending market. With elevated demand for short selling and a limited supply of shares available in the securities lending market, we also expect to find evidence of binding short-sale constraints and equilibrium overpricing in the IPO aftermarket.

To provide powerful cross-sectional tests of our predictions, we utilize the theory for explaining IPO aftermarket overpricing proposed by Miller (1977) and subsequently formalized

in Duffie et al. (2002). Within the context of this theory, investors with relatively optimistic opinions buy the stock in the immediate IPO aftermarket, while investors with relatively pessimistic opinions are unable to register their negative views due to short-sales constraints. The theory predicts that the immediate aftermarket price will exceed the consensus valuation of the stock and the magnitude of this overpricing will be increasing in the combined effects of divergence of investor opinion and short-sales constraints. The theory also predicts that IPO firms will subsequently underperform seasoned firms. This is because (i) the resolution of valuation uncertainty and (ii) the loosening of short-sales constraints due to increases in the supply of tradable shares, should cause price to revert toward the consensus valuation. This process should be accelerated at the expiration of IPO lockup agreements, as these expirations result in a sharp increase in the number of tradeable shares, thereby significantly relaxing short-sales constraints.[2]

To identify new issuers that are *ex ante* expected to become overpriced in the immediate IPO aftermarket, we develop a composite measure of divergence of opinion (*DO Score*) using a parsimonious set of characteristics from the offering prospectus, including pre-IPO sales growth, operating earnings, and investments in intangible assets. The idea underlying the *DO Score* is simple. Divergence of investor opinion about fundamental value should be greater for IPOs with higher anticipated growth, current operating losses, and larger investments in intangibles. To identify IPOs for which short-sales constraints are more likely to be binding, we focus on new issuers with a small offering size based on the number of shares offered in the IPO relative to the total number of shares outstanding in the company. Shares outstanding in the company that are

[2] This prediction distinguishes Miller's theory from a variety of theories of deliberate premarket discounting (e.g., Rock, 1986) that presume that the immediate aftermarket price is an unbiased estimate of fundamental value and are silent with respect to long-term underperformance, especially around the lockup expiration.

not offered in the IPO are typically subject to lockup agreements that prohibit the sale or loan of the shares for 180 days following the offering. The combination of small offering size with lockup agreements on the remaining shares outstanding in the company restricts the supply of lendable shares and makes short-sales constraints more binding prior to the lockup expiration.

Consistent with Miller's theory, we find that IPOs with a high *DO Score* and a small offering size are associated with larger first-day returns and more negative returns around the lockup expiration. The economic magnitudes of our results are quite striking. The average first-day positive return increases from 5.5% for IPOs with a low *DO Score* and a large offering size to 44.4% for IPOs with a high *DO Score* and a small offering size. Conversely, the average negative return around the lockup expiration decreases from -0.7% for IPOs with a low *DO Score* and a large offering size to -10% for IPOs with a high *DO Score* and a small offering size. Moreover, consistent with prior evidence on the failure of sell-side analysts to fulfill their gatekeeping role in the IPO aftermarket, we find that sell-side analysts issue relatively more optimistic stock recommendations and target prices for new issuers with a high *DO Score* and a small offering size, thereby reinforcing overpricing in the IPO aftermarket.

We next examine the effectiveness of short sellers as *de facto* gatekeepers in the IPO aftermarket by analyzing detailed data from the securities lending market, including stock loan fees and active supply utilization. The evidence confirms that IPOs with a high *DO Score* and smaller offering size are more difficult and costly to short sell. The average stock loan fee increases from 0.8% for IPOs with a low *DO Score* and a large offering size to 15% for IPOs with a high *DO Score* and a small offering size. Similarly, the average active utilization of lending inventory increases from 25% for IPOs with a low *DO Score* and a large offering size to 76% for IPOs with a high *DO Score* and a small offering size. These results confirm that

short sellers try to arbitrage overpricing in the IPO aftermarket, but face significant short-sales constraints, resulting in equilibrium overpricing. Thus, short sellers are active in performing their *de facto* gatekeeping role, but are unable to completely price protect other investors because of significant short-sales constraints in the IPO aftermarket.[3]

To shed further light on the role of short-sales constraints and arbitrage costs in facilitating equilibrium overpricing in the IPO aftermarket, we examine a hypothetical trading strategy that short sells IPOs prior to lockup expiration. We find that the strategy faces unique costs and risks, including the cost of borrowing, the cost of locating stock in the securities lending market, the idiosyncratic risk from targeting IPOs, the risk that stock loans are recalled, and the risk that stock loans become more expensive. Indeed, our analysis suggests that short selling around the lockup expiration is most costly and risky for IPOs with a top *DO Score* and a small offering size, which are precisely the stocks experiencing the most negative returns around lockup expirations. In summary, our analysis not only highlights the role of short sellers as *de facto* gatekeepers in the IPO aftermarket but also illustrates the importance of short-sales constraints and limits to arbitrage in constraining short sellers' gatekeeping role.

[3] A representative example is Twitter Inc. (NYSE: TWTR). In the last fiscal year prior to its IPO that ended on December 31, 2012, TWTR reported sales growth of nearly 200%, an operating loss of $77 million, and a high intangible intensity ratio of 38 cents in R&D and advertising per dollar of sales. TWTR offered 13% of its shares outstanding at its IPO. The 87% of the shares outstanding that were not offered in the IPO were subject to a 180-day lockup agreement. Based on this characteristics, Twitter is classified as a top *DO Score* new issuer with a small offering size. On November 7, 2013, trading opened at $45.10 and closed at $44.90, up 73 percent from the $26 offering price per share. First-day trading volume was 170% of the number of shares offered in the IPO. TWTR's lockup agreement expired on May 6, 2014, sending the stock price down by 18% and wiping out $4 billion of market value. Prior to the lockup expiration, short sellers were actively targeting TWTR with the active supply utilization peaking at 99% and stock loan fees hovering at 9%. At the same time, however, the five sell-side analysts covering TWTR were recommending the stock with a "Strong Buy" and a mean (median) consensus target price of $54.40 ($52.00).

2. Background and Predictions

2.1 Short Sellers as *De Facto* Gatekeepers

It has long been argued that efficient markets should price protect unsophisticated investors from buying overpriced securities (e.g., Gilson and Kraakman 1984, Section II B). Sophisticated arbitrageurs, such as professional short sellers, should collect and unbiasedly analyze all available information and identify inefficiencies, thus resulting in efficient security prices for all.

Yet regulators, journalists and scholars have identified cases where this mechanism appears to be conspicuously absent. An oft-cited case is the abrupt collapse of Enron in 2001. Despite a host of red flags and expressions of concern from independent research firms, short sellers and the press, Enron continued to receive strong stock recommendations from sell-side analysts at major brokerage houses and maintained an excessive valuation right up until its sudden collapse (e.g., Coffee 2006; U.S. Senate 2002). In the more recent case of Valeant Pharmaceuticals, independent research firms and short sellers again struggled to expose overpricing and accounting gimmickry in the face of a slew of positive stock recommendations from sell-side analysts at major brokerage houses (e.g., Grove and Clouse 2017).

These cases share two common elements. The first is the failure of traditional gatekeepers to protect investors from overpricing. This traditional group of gatekeepers includes the board of directors, auditors, securities market regulators, sell-side analysts, and credit rating agencies. The second common element is the inability of short sellers to prevent prolonged periods of significant overpricing, despite being able to identify its presence. Thus, these cases also point to failures in the role of short sellers' *de facto* gatekeeping role. Yet there is no direct large sample evidence on the gatekeeping role of short sellers. It is possible that cases like Enron and Valeant

Pharmaceuticals are isolated examples that have been taken out of context with the benefit of hindsight. Providing large sample evidence on the gatekeeping role of short sellers requires a setting with significant variation in both the divergence of investor opinions due to fundamental uncertainty and significant short-sales constraints. The IPO aftermarket provides just such a setting.

2.2 IPO Aftermarket Pricing

The aftermarket pricing of IPOs provides two of the most enduring capital market puzzles. First, the closing price on the first trading day is usually significantly higher than the offer price. Second, the subsequent stock returns of IPOs are typically lower than the returns of seasoned securities. For example, Ritter (2016) reports an average first-day return of 17.9% and an average three-year buy-and-hold market-adjusted return of -17.8% for over 8,000 IPOs between 1980 and 2014. Prior research indicates that underperformance is particularly pronounced around the expiration of IPO share lockups. Lockup agreements prohibit pre-IPO shareholders from selling or lending their shares for a specified period of time. The typical lockup period lasts for 180 days and covers most of the shares that are not sold in the IPO. For example, Brav and Gompers (2003) examine a sample of 2,794 IPOs from 1988 to 1996 and find an average buy-and-hold market-adjusted return of -2% from ten trading days before to ten trading days after the lockup expiration.[4]

Miller (1977) provides an intuitive explanation for the above findings that relies on the inability of short sellers to serve as *de facto* gatekeepers. Miller's explanation hinges on the

[4] Field and Hanka (2001) report that the fraction of new issuers with a 180-day lockup period increased from 43% in 1988 to 91% in 1996. Brav and Gompers (2003) find lockup agreements in 99% of new issuers.

combination of heterogeneous investor opinions and short-sales constraints.[5] Divergence of investor opinion is expected to be particularly pronounced for IPOs because they are often high growth companies with a limited operating history for which it is difficult to forecast future cash flows, resulting in high valuation uncertainty (e.g., Miller 1977; Kim and Ritter 1999). With divergent investor opinions about fundamental value and a limited supply of tradable shares, the stock price will reflect the valuation estimates of the most optimistic investors who participate in the immediate IPO aftermarket, which will be above the consensus stock valuation. As the stock becomes more seasoned, the reduction in valuation uncertainty along with the increase in the supply of tradable shares should cause its price to fall toward the consensus valuation.

Miller explicitly identifies IPOs as a prime setting for overvaluation, stating that "*the prices of new issues, as of all securities, are set not by the appraisal of the typical investor, but by the small minority who think highly enough of the investment merits of the new issue to include it in their portfolio.*" Miller also suggests a non-strategic explanation for the underpricing of new issues by underwriters based on the marginal investor viewpoint: "*…if underwriters…price new issues on the basis of their own best estimates of the prices of comparable seasoned securities, they will typically underprice new issues. The mean of their appraisals will resemble the mean appraisal of the typical investor, and this will be below the appraisals of the most optimistic investors who actually constitute the market for the security.*"

[5] Diether et al. (2002) note that Miller's theory implicitly assumes "bounded rationality" in the sense that investors are either over-confident about their own valuation estimates or they make inaccurate inferences about others' valuation estimates. Miller's overvaluation story would disappear if investors learned to perfectly discount their valuations to account for the possibility that they ended up holding stock largely because others did not want it, as in Diamond and Verrecchia's (1987) rational expectations framework. Cornelli and Yilmaz (2015) extend Diamond and Verrecchia's (1987) rational expectations framework to include uncertainty about the number of informed investors in the market and show that, as long as the signal observed by the informed investors is not too precise, significant short-sales constraints will not allow prices to converge to the fundamental value.

A key requirement of Miller's overvaluation story is that short-sales constraints are sufficient to prevent pessimistic investors from registering their views via short sales in the immediate IPO aftermarket. Existing evidence related to short-sales constraints for IPOs is sparse and does not directly address the question of whether the combination of heterogeneous investor opinions and short-sales constraints can explain variation in first-day returns and subsequent underperformance, especially around the lockup expiration.[6]

Finally, a large body of research concludes that sell-side analysts fail to fulfill their gatekeeping role in the IPO aftermarket. Rajan and Servaes (1997) find that higher first day IPO returns are associated with greater analyst coverage, more optimistic analyst forecasts, and lower subsequent stock price performance. Michaely and Womack (1999) find that sell-side analysts that are affiliated with the IPO underwriter issue more biased forecasts and recommendations resulting in overpricing in the IPO aftermarket. Dechow et al. (2000) document a direct link between over-optimism in affiliated analysts' IPO earnings growth forecasts and subsequent underperformance of these IPOs. These findings both highlight the failure of traditional gatekeepers in the IPO aftermarket and the opportunity for short sellers to compete away any resulting overpricing, thereby price-protecting unsophisticated investors.

2.3 Empirical Predictions

To provide powerful tests of our hypotheses, we stratify our sample of IPOs by *ex ante* indicators of fundamental uncertainty and short-sales constraints (described in detail in the next section). We begin by testing the basic prediction of Miller's (1977) hypothesis, that divergence

[6] Geczy et al. (2002) examine short-selling activity for a sample of 311 IPOs between October 28, 1998 and October 26, 1999 using a proprietary database provided by a large securities lender, and find that short-selling costs seem to be too small to explain the IPO pricing puzzles. Edwards and Hanley (2010) examine short-selling activity for 388 IPOs from January 1, 2005 to December 31, 2006 using Regulation SHO pilot data and argue that factors other than short-sales constraints may be responsible for evidence of positive first-day returns.

of investor opinion about fundamental value combined with a limited supply of lendable shares lead to positive first-day returns:

Prediction 1: *IPOs with a combination of high divergence of investor opinion and a more limited supply of lendable shares experience more positive first-day returns.*

Miller's theory also predicts that IPOs with high divergence of investor opinion and more limited supply of shares will subsequently underperform. This is because the resolution of investor uncertainty along with the relaxation of short-sales constraints due to increases in the supply of lendable shares should cause price to fall toward the consensus valuation. This process should be accelerated around the lockup expiration as pre-IPO shareholders are allowed to sell their shares, thereby increasing the supply of lendable shares and loosening short-sales constraints. This discussion leads to our second prediction:

Prediction 2: *IPOs with a combination of high divergence of investor opinion and more limited supply of lendable shares experience more negative returns around the lockup expiration.*

It should be noted that *Prediction 2* holds even though the lockup parameters, i.e., the lockup period length and the number of locked-up shares, are known at the time of the IPO. Importantly, *Prediction 2* distinguishes Miller's theory from a variety of theories, which presume that the immediate aftermarket price is an unbiased estimate of fundamental value and attribute evidence of positive first-day returns to premarket discounting (see Ritter and Welch 2002 for a comprehensive review). For example, an important alternative explanation for positive first-day returns is Rock's (1986) winner's curse explanation. Rock (1986) presents a model with two groups of investors: the informed investors, who have perfect information about the value of the offering, and the uninformed investors, who have homogeneous expectations about the distribution of the value of the offering. If the new shares are priced at their expected value, the

informed investors crowd out the uninformed investors when good issues are offered and withdraw when bad issues are offered. The new issuer must price the shares at a discount in order to guarantee that the uninformed investors are sufficiently compensated for the adverse selection problem in the allocation process to purchase the issue. Rock's (1986) model presumes that the immediate aftermarket price is an unbiased estimate of fundamental value and predicts that premarket discounting is more pronounced for IPOs with high information asymmetry. Rock's (1986) model, however, is silent with respect to the long-run underperformance of IPOs, especially around the lockup expiration.[7]

We next examine whether sell-side analysts reinforce overpricing in the IPO aftermarket. We extend prior evidence of sell-side analyst optimism by testing whether their optimism is higher for new issuers that are more prone to overpricing in the IPO aftermarket. If sell-side analysts fail to fulfil their gatekeeping role, we expect that their stock recommendations and target prices will be more optimistic for new issuers with higher fundamental uncertainty and more binding short-sales constraints.

Prediction 3: *IPOs with a combination of high divergence of investor opinion and more limited supply of lendable shares receive more optimistic recommendations from sell-side analysts.*

These initial predictions set the stage for our primary predictions examining the role of short-sales constraints in facilitating IPO overpricing. Specifically, we predict that divergence of

[7] Relatedly, Benveniste and Spindt (1989) view premarket discounting as compensation to investors for revealing information about the IPO valuation to the underwriters during the book-building procedure, which can then be used to assist in pricing the issue. This market-feedback hypothesis is geared towards explaining deliberate discounting in the underwriting process and while it generates predictions with respect to variation in first-day returns, it is silent with respect to the long-run underperformance of IPOs, especially around the lockup expiration. Aggarwal et al. (2002) develop a model in which managers strategically underprice IPOs to maximize personal wealth from selling shares at lockup expiration. Their model predicts that more positive first-day returns generate information momentum, which leads to a higher stock price at the lockup expiration. Their model, however, is silent with respect to the implications of heterogeneous investor opinions and short-sales constraints on aftermarket IPO pricing.

investor opinion combined with a limited stock supply available for lending lead to a higher cost of borrowing in the securities lending market, thereby constraining short sellers' gatekeeping role and leading to equilibrium overpricing. Our prediction is consistent with the model of Duffie et al. (2002). In particular, Duffie et al. (2002) build a dynamic model of the determinants of stock prices, stock loan fees, and short interest where agents trade because of differences of opinion and would-be short sellers must search for security lenders and bargain over the stock loan fees. Within the context of their model, Duffie et al. (2002) find that stock loan fees increase when there is a high degree of divergence of investor opinion and a small float, i.e., a small number of tradeable shares, as in the case of IPOs offering a small fraction of their number of shares outstanding. Our fourth prediction is summarized as follows:

Prediction 4: *IPOs with a combination of high divergence of investor opinion and more limited supply of lendable shares are more costly and difficult to short sell.*

We employ a detailed database on stock loan fees and supply utilization from the securities lending market to test this prediction. The next section details our sample and research design.

3. Sample and Research Design

3.1 Sample Selection

Our sample period begins in 2007 because this is the first year in which we have detailed securities lending data available on a daily basis from Markit Securities Finance Data (formerly known as Data Explorers). We start with an initial sample of 778 domestic IPOs listed on NYSE, NASDAQ, and AMEX over the period from 2007 to 2015 obtained from the Securities Data Company (SDC) database that have Markit coverage. Following prior research (e.g., Ritter and Welch 2002), our initial sample excludes IPOs with an offering price below $5 per share and IPOs by American depository receipts (ADRs), unit offerings, real estate investment trusts

(REITs), special purpose acquisition companies (SPACs), and closed-end funds.[8] We reviewed all cases with missing pre-IPO financial accounting data from Compustat and hand-collected data directly from the offering prospectuses available from the SEC's EDGAR database.[9] IPOs with zero pre-IPO sales are excluded. To obtain our final sample, we exclude 33 IPOs with no lockup agreements and 36 IPOs with their first lockup agreements expiring sooner or later than 180 days after the IPO day.[10] Our final sample includes 709 IPOs over eight years from 2007 to 2015 with aggregate proceeds of $156.3 billion. Our sample ends in 2015 because this is the last year for which we can track IPOs for at least 180 days after the IPO day. Table 1, Panel A, reports the distribution of our sample by year. The number of IPOs ranges over time from a minimum of 15 for 2008 to a maximum of 149 for 2014, which was the most active year since 2000.

3.2 *Ex ante* Determinants of Divergence of Opinion and Short-Sales Constraints

Miller (1977) emphasizes valuation uncertainty as the key determinant of divergent investor opinions since "*the very concept of uncertainty implies that reasonable men may differ in their forecasts*." Miller also identifies IPOs as a prime setting for valuation uncertainty, stating that "*the divergence of opinion about a new issue are [sic] greatest when the stock is issued*." Miller goes on to identify "*uncertainty about the success of new products or the profitability of a*

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[8] We thank Jay Ritter for providing a list of corrections to the SDC database, all of which we have incorporated in this study. The corrections are located at https://site.warrington.ufl.edu/ritter/ipo-data/.

[9] A company undertaking an IPO discloses required information in the registration statement, typically on Form S-1. Form S-1 and its amendments are filed with the SEC and are publicly available through the SEC's EDGAR database. Most of the Form S-1 is comprised of the offering prospectus, which contains at least two years of audited financial statements. After a company's IPO registration has been declared effective, the company will typically file a final prospectus, which is usually identified as a 424B3 or 424B4 filing in the EDGAR database. For the average new issuer, the last fiscal year prior to the IPO ended 191 calendar days prior to the IPO day.

[10] Our results are not sensitive when we include the 36 IPOs with lockup agreements expiring sooner or later than 180 days after the IPO day. Our analysis and presentation of results is simplified, however, by focusing on IPOs with 180-day long lockup agreements (see, e.g., Figures 1 and 2).

major business expansion" as key sources of valuation uncertainty for IPOs and argues that "*over time this uncertainty is reduced as the company acquires a history of earnings or lack of them, and the market indicates how it will value these earnings*."

To identify *ex ante* determinants of divergent investor opinions due to valuation uncertainty, we rely on a parsimonious set of pre-IPO characteristics measured using financial accounting data from the offering prospectus, including (i) sales growth, (ii) the sign of operating earnings, and (iii) the level of R&D and advertising spending per dollar of sales—a measure of new product uncertainty. The idea underlying this parsimonious set of variables is simple. Uncertainty about future operating performance and, therefore, divergence of investor opinion should be higher for high growth new issuers experiencing operating losses, while making larger investments in intangibles. Consistent with this idea, prior research provides evidence from the general population that uncertainty over fundamental value is higher when pricing fast-growing firms and firms with high intangible intensity experiencing losses (e.g., Lakonishok et al. 1994; Chan et al. 2001; Darrough and Ye 2007; Balakrishnan et al. 2010).[11]

Next, we introduce a composite score, which we refer to as the *DO Score*, that captures variation in the *ex ante* determinants of dispersion of opinion. Specifically, an IPO scores one point for each of the following criteria: (i) it has above median sales growth, (ii) it reports an operating loss, and (iii) it has above median intangible intensity. All three inputs are measured as of the most recent fiscal year prior to the IPO. We obtain the composite *DO Score* by summing up the points and dividing by three to standardize the score to range between zero (low) and one (high). The possible intermediary values of our composite score are 0.33 and 0.66. Note that

[11] In additional analysis, we consider other pre-IPO characteristics including (i) firm size, (i) firm age measured from the incorporation date to the IPO date, (iii) the existence of venture-capital investment, and (iv) tech-industry membership. The results are generally robust with respect to these other measures.

while top-score IPOs are *ex ante* expected to have high divergence of investor opinion, a composite score of zero does not necessarily imply the absence of valuation uncertainty.

Prior research has used analyst forecast dispersion as a measure of divergence of investor opinion for the general population of stocks (e.g., Diether et al. 2002; Nagel 2005; Boehme et al. 2006). Analyst coverage of IPOs, however, typically starts forty calendar days following the IPO day, which coincides with the end of the quiet period (e.g., Bradley et al. 2003). As a result, analyst forecast dispersion is determined endogenously and simultaneously with IPO pricing. By focusing on *ex ante* determinants of divergence of investor opinion using information from the offering prospectus, we alleviate issues of simultaneity and endogeneity in our empirical tests.[12]

With respect to the securities lending market, a key determinant of the supply of lendable shares in the immediate aftermarket is the offering size, i.e., the number of shares offered in the IPO relative to the total number of shares outstanding in the company. Shares outstanding that are not offered in the IPO are typically subject to lockup agreements that prohibit the sale or loan of the shares for 180 days following the offering. IPO share lockups represent a stringent form of short-sales constraint and lockup expirations eliminate this constraint (e.g., Ofek and Richardson 2003).

The combination of small offering size with lockup agreements on the remaining shares outstanding in the company restricts the supply of lendable shares in the securities lending market. It follows that new issuers with small offering size are more likely to experience a binding short-sales constraint due to limited supply of lendable shares in the immediate IPO aftermarket and a greater loosening of this constraint around the IPO lockup expiration. On the

[12] In additional analysis, we find consistent evidence of lockup return predictability when we stratify IPOs based on analyst forecast dispersion rather than our *DO Score*. This is consistent with evidence of a significantly positive correlation between analyst forecast dispersion and *DO Score* (see the pairwise correlations in Table 1, Panel E).

flip side, new issuers with large offering size are less likely to face binding restrictions on the supply of lendable shares in the IPO aftermarket. Given that all new issuers in our sample have a lockup agreement, we identify the number of shares offered in the IPO relative to the total number of shares outstanding in the company as the key *ex ante* determinant of short-sales constraints.

3.3 Timeline of Research Design

Appendix 1 illustrates the timeline of our research design. We measure the *ex ante* determinants of divergence of investor opinion, including sales growth, the operating loss indicator, and intangible intensity, using financial accounting data from the offering prospectus as of the most recent fiscal year prior to the IPO. From the offering prospectus, we also measure the offering size as the number of shares offered in the IPO (excluding the exercise of the overallotment option) divided by the number of shares outstanding in the company immediately after the IPO.[13]

At the end of the first day of trading, we measure the return from the IPO offering price per share to the closing price per share, and offer turnover as the number of shares traded on the first trading day divided by the number of shares offered in the IPO. Around the lockup expiration, we measure (i) buy-and-hold market-adjusted returns from the CRSP database, (ii) stock loan fees, and active supply utilization using daily values available from Markit's securities lending market database, and (iii) sell-side analysts' consensus target prices and stock recommendations using data from IBES' target price and recommendation detail files.

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[13] For new issuers with dual-class ownership structure (60 cases), we measure the offering size as the number of Class A shares offered in the IPO divided by the number of shares outstanding in the company immediately after the IPO. This is because Class B shares typically do not enter the supply of tradeable shares prior to the IPO lockup expiration.

3.4 Descriptive Statistics

Before presenting our empirical results, we discuss the descriptive statistics. Appendix 2 details variable definitions. Table 1, Panel B, summarizes the empirical distributions of key variables. The average new issuer reports sales growth of 85.3% in the year prior to the offering and invests nearly 90 cents in R&D and advertising per dollar of reported sales. Operating losses are reported by 37.7% of our sample. The average offering size accounts for nearly 29% of the number of shares outstanding, which indicates that the average fraction of locked-up shares is 71%. The average offering price is $15.52 per share, while 73% of IPOs in our sample have offering prices between $10 and $20, which is in line with prior evidence on the distribution of IPO prices (e.g., Ritter and Welch 2002).[14]

Consistent with prior research dating back to Logue (1973), we find evidence of positive first-day returns. The average first-day return is 17.4% with a standard deviation in excess of 27%. Consistent with prior research (e.g., Field and Hanka 2001; Brav and Gompers 2003), we also find evidence of negative returns around the lockup expiration. The average market-adjusted return cumulated from ten trading days before to ten trading days after the lockup expiration is −3.41% with a standard deviation in excess of 15%.

Turning to the securities lending market, we measure stock loan fees and active supply utilization using daily data available from Markit. Markit sources its data from a consortium of institutional lenders that collectively account for the vast majority of loanable equity inventory in the U.S. market. Markit provides the expected daily value of stock loan fees using both rates

[14] Under the book-building method used in the U.S., IPO underwriters first come up with a suggested range for the offering price. After setting the range for the offering price, the underwriters collect investors' indications of interest during the book-building process and determine the final offering price. For a description of the book-building procedure see Cornelli and Goldreich (2001, 2003). In additional analysis, we find that high IPOs with high *DO Score* are associated with a wider offering price range relative to the final offering price.

between agent lenders and prime brokers as well as rates from hedge funds to produce an indication of the current market rate. We measure active supply utilization as the quantity of current inventory on loan from beneficial owners divided by the quantity of current inventory available from beneficial owners net of shares temporarily restricted from lending.

Returning to the empirical distributions in Table 1, Panel B, we find that around the lockup expiration the average stock loan fee is 4.27% per annum, while the average active supply utilization is hovering at 43%. In contrast, Table 1, Panel C, shows that for the general population the average stock loan fee is 0.98% per annum, while the active supply utilization is below 19%.[15] These differences are even more striking when we consider value-weighted averages for the general population. On a value-weighted basis, the average stock loan fee is 0.44% per annum, with active supply utilization of 6.85%.

With respect to sell-side analysts, Table 1, Panel D, shows evidence of higher optimism for new issuers relative to the general population. Focusing on the average new issuer, we find that the consensus target price is 31% higher than the prevailing stock price prior to IPO lockup expirations and -24% below the one-year-out stock price. Turning to the average firm in the general population, the consensus target price is 18.5% higher than the prevailing stock price and -8.9% below the one-year-out stock price. Turning to stock recommendations, we find consistent evidence of optimism among sell-side analysts with a recommendation in excess of a "Buy" for the average new issuer. Consistent with the idea that valuation uncertainty is elevated in the IPO setting, we find that the analyst forecast dispersion, a measure of divergence of investor opinion that has been used for the general population of stocks (e.g., Diether et al. 2002;

[15] The general population includes U.S. firms listed on NYSE, AMEX, and NASDAQ, excluding IPOs, penny stocks, micro-cap stocks, ADRs, unit stocks, closed-end funds, and REITs over the period from 2007 to 2015.

Nagel 2005; Boehme et al. 2006), is significantly higher for new issuers relative to the general population.

The correlation matrix in Table 1, Panel E shows that our *DO Score* is positively correlated with other commonly used measures of differences of opinion, including share turnover in the IPO aftermarket and analyst forecast dispersion. The key advantage of our *DO Score* is that it is based on pre-IPO characteristics and therefore allows to *ex ante* identify new issuers with high divergence of investor opinion. The correlation matrix also shows that offering size is positively correlated with the total and active supply of lendable shares while it is negatively related with stock loan fees and the level of active supply utilization in the IPO aftermarket, which is consistent with the notion that offering size is a key *ex ante* determinant of supply conditions in the securities lending market. The -21% correlation between *DO Score* and offering size suggests that hard-to-value new issuers are more likely to have lower offering size and therefore are more likely to be constrained in the securities lending market. The correlation between *DO Score* and offering size, however, is far from perfect thereby allowing us to intersect partitions of low and high *DO Score* with partitions of small and large offering size.

Table 1, Panel F, presents the sample distribution across partitions formed based on *DO Score* and independent sorts based on offering size. We stratify our sample of new issuers into three portfolios of small, medium, and large offering size using the first and third quartile cutoffs of the empirical distribution of offering size. The two key portfolios of interest are (i) new issuers with high *DO Score* and small offering size, which is the group that Miller's theory predicts to be more susceptible to overpricing in the immediate IPO aftermarket due to the combination of higher *ex ante* dispersion of investor opinions with more binding short-sales

constraints, and (ii) new issuers with low *DO Score* and large offering size, which are predicted to be less susceptible to pricing distortions.

4. Empirical Results

4.1 Evidence from the First Trading Day

Table 2 examines variation in first-day returns across partitions formed based on the *DO Score*, our *ex ante* measure of differences of investor opinion about fundamental value, and offering size, a key determinant of binding restrictions in the supply of lendable shares in the immediate IPO aftermarket. Consistent with our first prediction in Section 2, the portfolio results in Table 2, Panel A, provide evidence that first-day returns are more positive for IPOs that are *ex ante* expected to have high divergence of investor opinion and more limited supply of lendable shares. The average first-day return is 44.36% for new issuers with high *DO Score* and small offering size (top portfolio), while the average first-day return is 5.53% for new issuers with low *DO Score* and large offering size (bottom portfolio). Table 2, Panel B, shows that the first-day return spread of 38.84% across the top and bottom portfolios is not only economically large but also statistically significant. The spread in first-day returns from the bivariate sort based on *DO Score* and offering size is more than two times that from the univariate sort based on *DO Score* alone.

The regression results in Table 2, Panel C provide consistent evidence of a significantly positive interaction effect between high *DO Score* and the indicator for small offering size on first-day returns, after controlling for year fixed effects and industry fixed effects. Evidence of a significantly positive coefficient on $DO\ Score \times Small\ Offer$ is not sensitive to including other determinants of first-day returns explored in prior research (e.g., Lowry and Schwert 2010), including the natural logarithm of the IPO value measured as the offering price multiplied

by the number of shares outstanding in the company ($IPO\ Value$), an indicator variable for new issuers listed on NASDAQ, the natural logarithm of firm age measured from the year of incorporation (Age), the number of shares offered by selling shareholders divided by the number of shares offered in the IPO ($Selling\ Shareholders\ \%$), and the cumulative market return over the fifteen trading days before the first IPO trading day ($Market\ Return$). The evidence is also not sensitive to the inclusion of indicator variables for prestigious underwriters, Big-Four auditors, and prestigious advising law firms.[16] In fact, we find that none of these indicators has incremental explanatory power for first-day returns.

Overall, the evidence supports our prediction that IPOs with a combination of high divergence of investor opinion and more limited supply of lendable shares experience more positive first-day returns. Our evidence extends prior studies on the relation between heterogeneous investor opinions due to valuation uncertainty and first-day returns (e.g., Beatty and Ritter 1986; Houge et al. 2001; Cook et al. 2006; Gao et al. 2006). To be clear, while the evidence is consistent with Miller's overvaluation story, we do not preclude deliberate premarket discounting as a non-mutually exclusive explanation for positive first-day returns. Theories of deliberate premarket discounting, however, presume that the immediate aftermarket price is an unbiased estimate of fundamental value and are silent with respect to long-term underperformance, especially around the IPO share lockup expiration. Next, we search for predictability in stock returns around IPO lockup expirations.

[16] The indicator variable for prestigious underwriters $= 1$ if Loughran and Ritter's (2004) underwriter rank score is equal to 9; $= 0$ otherwise. The indicator variable for prestigious law firms$= 1$ if the law firm advising the issuer is included in the Legal 500 top-four tiers; $= 0$ otherwise. The indicator variable for Big-Four auditors $= 1$ if the issuer's auditor is Deloitte & Touche, Ernst & Young, KPMG, or PwC; $= 0$ otherwise.

4.2 Evidence from IPO Share Lockups

IPO lockup agreements are intended to keep pre-IPO shareholders from immediately selling their stock when a company raises public capital, thereby creating unique supply constraints in the securities lending market. A key prediction based on Miller's (1977) theory is that new issuers with high valuation uncertainty and a restricted supply of lendable shares are more likely to become overpriced in the immediate IPO aftermarket and to experience a price correction around the lockup expiration when an increased stock supply comes to the market. As we explain in Section 2, this prediction distinguishes Miller's overvaluation story from theories that attribute positive first-day returns to deliberate premarket discounting and make no predictions concerning abnormal return performance around the lockup expiration (e.g., Rock's 1986 winner's curse explanation).

Table 3 examines variation in stock returns around IPO lockup expirations. We measure market-adjusted buy-and-hold returns over the window from ten trading days before to ten trading days after the lockup expiration. We use the CRSP value-weighted index including distributions to proxy for the stock market portfolio. Consistent with prior research (e.g., Brav and Gompers 2003), we find that the average new issuer experiences negative abnormal returns around the IPO lockup expiration. Importantly, we uncover predictable variation in lockup returns with *ex ante* determinants of divergence of investor opinion and short-sales constraints.

Specifically, the portfolio results in Table 3, Panel A, provide evidence that lockup returns are more negative for new issuers with a combination of high divergence of investor opinion and more limited supply of lendable shares. The average market-adjusted lockup return is -10.11% for new issuers with high *DO Score* and small offering size, while the average first-day return is -0.68% for new issuers with low *DO Score* and large offering size. Table 3, Panel B, shows

that the lockup return spread of -9.43% across the top and bottom portfolios is both economically large and statistically significant. The regression results in Table 3, Panel C, provide consistent evidence of a significantly negative interaction effect between high *DO Score* and the indicator for small offering size on lockup returns, after controlling for year and industry fixed effects as well as other new issuer characteristics. In addition, we find that the indicator variables for prestigious underwriters and advising law firms, as well as the presence of a Big-Four auditor have no explanatory power for IPO lockup returns.

Taken together, the evidence in Tables 2 and 3 is consistent with Miller's theory and highlights the importance of the interaction of divergence of investor opinions and short-sales constraints. Indeed, we find the strongest evidence of overpricing—as indicated by evidence of positive first-day returns followed by significantly negative lockup returns—among new issuers with high *DO Score* and small offering size, i.e., new issuers that are *ex ante* more likely to have a combination of high divergence of investor opinion with more limited supply of lendable shares. On the flip side, we do not find evidence of significant overpricing among new issuers with low *DO Score* and large offering size—as indicated by the lack of evidence of significantly negative lockup returns. We also do not find evidence of significant overpricing among new issuers with high *DO Score* and large offering size or new issuers with low *DO Score* and small offering size.

Figure 1 provides additional evidence with respect to variation in the aftermarket performance of IPOs. The figure plots average market-adjusted stock returns cumulated forward starting from the IPO day (day 0) to 270 calendar days after the trading debut of (i) all IPOs (solid black line), (ii) IPOs with top *DO Score* and small offering size (dotted red line), and (iii) IPOs with zero *DO Score* and large offering size (dashed green line). The vertical line indicates

the lockup expiration on the 180th calendar day after the IPO day. Starting with our full sample of new issuers, Figure 1 shows a price jump relative to the offering price on the first trading day, which is consistent with longstanding evidence of positive first-day returns, followed by a price drop six months later around the IPO lockup expiration, which is consistent with Brav and Gompers' (2003) evidence of negative abnormal lockup returns. Stratifying new issuers based on *DO Score* and offering size, Figure 1 shows that IPOs with a combination of high *DO Score* and small offering size are associated with significantly more positive first-day returns and more negative abnormal lockup returns, while new issuers with a combination of low *DO Score* and large offering size exhibit no evidence of abnormal returns around the lockup expiration.[17]

Taken together, the evidence supports our prediction that new issuers that are *ex ante* expected to have high divergence of investor opinion and more limited supply of lendable shares are more likely to become overpriced in the immediate IPO aftermarket and experience more negative returns around the IPO lockup expiration. Although consistent with Miller's overvaluation story, our evidence of predictably negative lockup returns for new issuers with a combination of high *DO Score* and small offering size is actually inconsistent with predictions based on rational expectations models. Within the context of such models, on average, investors should correctly anticipate the number of shares sold around the lockup expiration and abnormal lockup returns should be zero (e.g., Allen and Postlewaite 1984).[18]

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[17] Focusing on new issuers with a combination of high *DO Score* and small offering size, we also observe evidence of negative abnormal returns over the trading month leading to the IPO lockup expiration. This finding is consistent with increased short-selling activity over the days leading up to the lockup expiration (we provide direct evidence in Section 4.4). In addition, we find evidence of a downward post-lockup drift, which is consistent with a gradual incorporation of the views of more pessimistic investors and a gradual reversion toward the consensus valuation.

[18] Within the context of rational expectations model, our evidence of significantly negative abnormal lockup returns for new issuers with a combination of high *DO Score* and small offering size suggests that investors have been surprised by the number of shares sold around the lockup expiration.

4.3 Evidence from Sell-Side Analysts

Prior to examining the effectiveness of short sellers as gatekeepers in the IPO aftermarket, we test whether sell-side analysts play a gatekeeping role. Coffee (2006) argues that regardless of the rules in place, the sell-side analyst remains a "*salesman with an incorrigible bias toward optimism*." For the IPO setting, Coffee (2006) notes that the "*independent analyst has roughly the same biases and tendency towards excessive optimism as the analyst employed by the large underwriter*."

Table 4 provides evidence of variation in analysts' consensus stock recommendations and target prices across new issuers stratified based on *DO Score* and offering size. Our prediction is that new issuers with greater *ex ante* divergence of opinion and smaller supply of shares will be more highly recommended by analysts. Consistent with this prediction, Table 4, Panel A, provides evidence that the average consensus stock recommendation score, which ranges from one (strong sell) to five (strong buy), is 4.10 for new issuers with a combination of high *DO Score* and small offering size and 3.70 for new issuers with a combination of low *DO Score* and large offering size. The spread in the consensus stock recommendation score is similar across affiliated analysts, i.e., sell-side analysts affiliated with the investment banks in the underwriter syndicate, and all other sell-side analysts. Turning to Table 4, Panel B, we find evidence that the percentage deviation of the consensus target price from the new issuer's offer price—a measure of expected returns relative to the offer price—is 72.2% for IPOs with a combination of high *DO Score* and small offering size, which is nearly two times that for IPOs with a combination of low *DO Score* and large offering size. Again, we find consistent evidence of optimism in target prices across affiliated analysts and all other analysts.

Overall, we find evidence that sell-side analysts fail to fulfill their gatekeeping role in the IPO aftermarket. In fact, our evidence suggests that sell-side analysts, regardless of whether or not they are affiliated with the investment banks in the underwriter syndicate, reinforce overpricing in the IPO aftermarket. They do so by promoting new issuers that are more prone to overpricing, i.e., new issuers with a combination of greater valuation uncertainty and more limited supply of lendable shares in the immediate aftermarket.

4.4 Evidence from the Securities Lending Market

Our findings so far provide evidence that new issuers with a combination of high divergence of investor opinion and more limited supply of lendable shares become overpriced in the immediate IPO aftermarket and experience a significant price correction around the IPO lockup expiration. Next, we analyze detailed data from the securities lending market to test whether such IPOs are also more difficult and costly to short sell. Our analysis provides direct evidence on the effectiveness of short sellers as *de facto* gatekeepers in the IPO aftermarket.

4.4.1 Variation in Stock Loan Fees and Active Supply Utilization

Stock loan fees are determined by supply and demand in the securities lending market and reveal how much investors must pay to gain short exposure.[19] Prior research has focused on the level of short interest, measured as the ratio of shares shorted to shares outstanding. The problem with short interest is that a low value can reflect either low demand or limited supply of shares in the securities lending market. In fact, a low or zero value of short interest may simply indicate that a stock is difficult or costly to borrow and sell short (e.g., Chen et al. 2002). Stock loan fees, in contrast, provide a direct measure of the cost of short selling.

[19] For detailed discussions of the mechanics of the securities lending market, see D'Avolio (2002); Jones and Lamont (2002); Duffie et al. (2002); Cohen et al. (2007); Reed (2013).

Table 5 examines variation in stock loan fees prior to the IPO lockup expiration across new issuers stratified based on *DO Score* and offering size. Table 5, Panel A, provides evidence that new issuers with a combination of high *DO Score* and small offering size are more costly to short. The average stock loan fee (per annum) is 15.08% for new issuers with high *DO Score* and small offering size, while the average stock loan fee is 0.83% for new issuers with low *DO Score* and large offering size. Table 5, Panel B, shows that the stock loan spread of 14.26% across the top and bottom portfolios is not only economically large but also statistically significant. The regression results in Table 5, Panel C, provide consistent evidence of a significantly positive interaction effect between high *DO Score* and the indicator for small offering size on stock loan fees, after controlling for year and industry fixed effects as well as other new issuer characteristics.

Next, we examine variation in active supply utilization prior to the IPO lockup expiration measured as the quantity of current inventory on loan from beneficial owners divided by the quantity of current inventory available from beneficial owners net of shares temporarily restricted from lending. Beneish et al. (2015) argue that active supply utilization—effectively the percentage of lendable shares that are actually on loan—measures the "supply slack" in the securities lending market, thereby offering a good instrumental variable for the otherwise unobservable *marginal* cost of borrowing in the securities lending market.

Table 6, Panel A, provides evidence that new issuers with a combination of high *DO Score* and small offering size are associated with higher active supply utilization, which is indicative of higher marginal cost of borrowing in the securities lending market. The average utilization is 76.3% for new issuers with a combination of high *DO Score* and small offering size, while the average utilization is 24.61% for new issuers with a combination of low *DO*

Score and large offering size. Table 6, Panel B, shows that the utilization spread of 51.69% across the top and bottom portfolios is both economically large and statistically significant. The regression results in Table 6, Panel C, provide consistent evidence of a significantly positive interaction effect between high *DO Score* and the indicator for small offering size on active supply utilization after controlling for year and industry fixed effects as well as other new issuer characteristics.

Overall, the evidence supports our prediction that new issuers with a combination of high divergence of investor opinion and more limited supply of lendable shares are not only more likely to become overpriced in the immediate IPO aftermarket but also tend to be more costly and difficult to short, as indicated by the higher stock loan fees and active supply utilization. Next, we probe the dynamics of the securities lending market in the IPO aftermarket.

4.4.2 Stock Loan Fee Dynamics

Figure 2 provides evidence with respect to the dynamics of the securities lending market. The figure plots average stock loan fees starting from the IPO day (day 0) to 270 calendar days after the trading debut of (i) all IPOs (solid black line), (ii) IPOs with top *DO Score* and small offering size (dotted red line), and (iii) IPOs with zero *DO Score* and large offering size (dashed green line). The vertical line indicates the lockup expiration on the 180th calendar day after the IPO day. Starting with our full sample of new issuers, stock loan fees range between 3% and 4% in the IPO aftermarket, which is significantly higher than the 0.98% average stock loan fees for the general population. Stratifying new issuers based on *DO Score* and offering size, we uncover interesting dynamics in the securities lending market. With respect to new issuers with a combination of low *DO Score* and small offering size, we find that stock loan fees (per annum) range between 8% and 10% over the first three months of trading, trend upwards for the

subsequent three months reaching a peak at 16% at the IPO lockup expiration, and experience a rapid drop to 6% in the three months following the lockup expiration. Evidence of a sharp increase in stock loan fees just prior to the lockup expiration is consistent with increased short-selling demand. In addition, evidence of a sharp decline in stock loan fees after the IPO lockup expiration is consistent with a relaxation of short-sale constraints in the securities lending market. In contrast, the average stock loan fees for IPOs with a combination of low *DO Score* and large offering size fluctuate around 1% per annum, which is close to the average stock loan fees for the general population, and do not exhibit significant variability in the IPO aftermarket.

4.4.3 Short Selling IPO Lockups in Practice: A Risky Business

The evidence above suggests that short sellers do not completely arbitrage mispricing in the IPO aftermarket due to short sales constraints. To provide further evidence to corroborate this explanation, we examine the investment returns available to short sellers targeting IPO lockups. Our hypothetical trading strategy involves constructing a portfolio in calendar time throughout our sample period that borrows at the risk free rate, takes a long position in the stock market index, and an offsetting short position that equal-weights across available IPO share lockup periods, i.e., IPOs that are within ten trading days before and after each lockup expiration.[20] This strategy yields a payoff approximating market-adjusted lockup return minus the stock loan fee.

Table 7, Panel A, reports the mean and standard deviation of the daily returns to our hypothetical trading strategy, along with the corresponding annualized Sharpe ratios. As a passive benchmark, we also report the mean and standard deviation of the daily stock market

[20] On trading days with multiple overlapping lockup expiration windows, we measure the equal-weighted payoff across overlapping IPO lockups. On trading days that are not spanned by any IPO lockup windows, we set the payoff to zero. We also considered a trading strategy that takes a short position in IPO lockups but does not hedge out the market return. This strategy results in lower Sharpe ratios.

index return in excess of the risk free rate, which corresponds to the payoff from a trading strategy that takes a long position in the stock market index and is financed by borrowing at the risk free rate. We use the CRSP value-weighted index including distributions to proxy for the market portfolio and the one-month T-bill rate to proxy for the risk free return.

We find that the average daily payoffs to short sellers are higher for IPOs with a combination of high *DO Score* and small offering size. The average daily payoff is 0.55% or 298% per annum, and comes with an annualized Sharpe ratio of 2.51. In comparison, the passive trading strategy that buys the stock market index and is financed by borrowing at the risk free yields an average daily payoff of 0.03% or 8% per annum, corresponding to an annualized Sharpe ratio of 0.33. The difference in Sharpe ratios suggests that there is a premium for short selling IPO lockups.[21] The premium for targeting IPO lockups, however, is unlikely to be fully attainable in practice. This is because our payoff calculation ignores (i) the possibility that short sellers are unable to actually locate shares to borrow at the rates quoted on Markit; (ii) the possibility that a stock loan is recalled and that another loan cannot be located to replace it; and (iii) the requirement that short sellers post additional collateral if prices rise. As discussed in Lamont and Thaler (2003) and Mitchell et al. (2002), the stock lending market is a fragmented over-the-counter market and, therefore, the existence of a transaction on Markit does not imply a liquid market at the quoted rates. In addition, the combination of small active supply with high utilization, especially for IPOs with low *DO Score* and small offering size, implies that the stock lending market may be too thin for large-scale short-selling operations.

[21] In additional analysis, we find that the premium for targeting IPO lockups is not explained by variation in risk-factor loadings based on Fama and French's (1993) three-factor model or Fama and French' (2015) five-factor model.

Recall risk is a particularly pernicious risk of short selling. Most institutional lenders in the U.S. maintain the right to terminate a stock loan at any time. If the lender recalls the borrower's loan, it is the borrower's responsibility to return shares to the lender by either buying shares in the market or borrowing shares from another lender. If the borrower fails to return the shares, the lender can institute a "buy-in" using the borrower's collateral to buy shares to cover the loan. Loan recalls can force borrowers to unwind their trading positions sub-optimally and can expose borrowers to the possibility of being "squeezed" at an unattractive price.[22] With respect to the risk that stock loans become more expensive, D'Avolio (2002) proposes that a short seller is concerned not only with the level of fees, but also with fee variance. More recently, Engelberg et al. (2015) interpret a stock loan recall as an extremely high loan fee and argue that recall risk and fee changes are manifestations of the same underlying event, namely changes in lending conditions, and therefore are not independent risks. Engelberg et al. (2015) introduce the variance of stock loan fees as proxies for short-selling risk and find evidence that stocks with high short-selling risk have lower future returns, decreased price efficiency, and lower short-selling activity by arbitrageurs.

Table 7, Panel B, explores variation in short-selling risk. Following Engelberg et al. (2015), we measure short-selling risk as the standard deviation of stock loan fees and stock market prices. Focusing on the window from ten trading days before to ten trading days after the IPO lockup expiration, we find that short-selling risk is higher for new issuers that are more likely to become overpriced in the IPO aftermarket. Arranging our sample based on high *DO*

[22] Mitchell et al. (2002) empirically examine arbitrage activity for situations in which the market value of a company is less than its subsidiary and find that short-selling risk can limit arbitrage activity. They specifically discuss recall risk, noting that "*the possibility of being bought-in at an unattractive price provides a disincentive for arbitrageurs to take a large position*."

Score and small offering size effectively separates new issuers with higher variance in stock loan fees and more volatile stock market prices.

Table 7, Panel C, reports the frequency distribution of the number of new issuers with overlapping IPO lockup windows on any given trading day across portfolios. The evidence highlights lack of diversification for short sellers targeting IPO lockups. Focusing on new issuers with a combination of high *DO Score* and small offering size, the evidence shows that on any given trading day arbitrageurs would have been able to target more than three overlapping IPO lockups for only 2% of the 2,251 trading days in our sample period. Clearly, targeting IPO lockups entails poorly diversified portfolios with substantial idiosyncratic risk.[23]

Overall, we conclude that the premium for short selling IPO share lockups likely reflects compensation for the unique costs and risks facing short sellers. Indeed, our analysis provides evidence that short selling IPO lockups is costly and risky especially when targeting new issuers that are *ex ante* expected to become overpriced in the immediate IPO aftermarket.[24] Our hypothetical trading strategy illustrates the importance of short-sales constraints and limits to arbitrage in constraining short sellers' *de facto* gatekeeping role in the IPO aftermarket.

[23] We note that arbitrageurs' ability to construct synthetic short positions in the options market by buying puts and writing calls is limited when targeting IPO lockups. This is because several IPOs do not have tradable options prior to lockup expiration. In addition, given that the cost of buying puts depends on the put writers' cost of hedging their synthetic long positions by shorting the stock, the cost of synthetic shorts moves hand-in-hand with the cost of borrowing the stock in the securities lending market (see, e.g., Grundy et al. 2012; Reed 2013). Relatedly, Li and Zhu (2016) argue that arbitrageurs may use exchange-traded funds (ETFs) to create synthetic short positions. We are aware of only one ETF offering exposure to a portfolio of new issuers listed in the U.S. throughout our sample period: the First Trust U.S. IPO Index Fund (NYSE ARCA: FPX), which was incepted on 04/12/2006. Short selling the FPX, however, would not offer a close substitute for short-selling high *Miller Score* IPOs. This is because the fund targets mid- and large-cap IPOs during the first 1,000 trading days and is not tilted toward IPOs that are *ex ante* expected to be overpriced in the immediate aftermarket. In addition, using Markit data we find that the FPX has been mostly on special in the securities lending market since its inception.

[24] Our evidence of a shorting premium for targeting IPO lockups complements Drechsler and Drechsler's (2014) evidence of positive abnormal returns for their cheap-minus-expensive-to-short portfolio of stocks in the general population, which they interpret as compensation for the costs and risks associated with short selling.

5. Conclusion

Focusing on a parsimonious set of characteristics available from the IPO prospectus, we find evidence that new issuers with a combination of high divergence of investor opinion about fundamental value and more limited supply of lendable shares become overpriced in the immediate IPO aftermarket and experience a significant price correction around the IPO lockup expiration. Using detailed data from the securities lending market, we provide direct evidence on the role of short sellers as *de facto* gatekeepers in the IPO aftermarket. While sell-side analysts promote new issuers that are *ex ante* more likely to become overpriced in the immediate IPO aftermarket, short sellers actively target these stocks and attempt to arbitrage overpricing. Short-sellers' ability to shield investors from overpricing in the IPO aftermarket, however, is limited due to binding short-sales constraints. Evidence of overpricing subsides as IPO lockup agreements expire and short-sales constraints are relaxed.

Overall, our paper provides evidence on the role of short sellers as *de facto* gatekeepers in the IPO aftermarket—a setting that is especially prone to overpricing due to the combination of heterogeneous investor beliefs about fundamental value with limited supply of shares available in the securities lending market. Our evidence has broader implications for the effectiveness of short sellers as gatekeepers in other settings where divergence of investor opinion is high and the floating stock is low. One potential such setting is the subset of firms that have Fama and French's (2015) "lethal combination" of small size, high investment, and low profitability that is known to lead to abnormally low stock returns.

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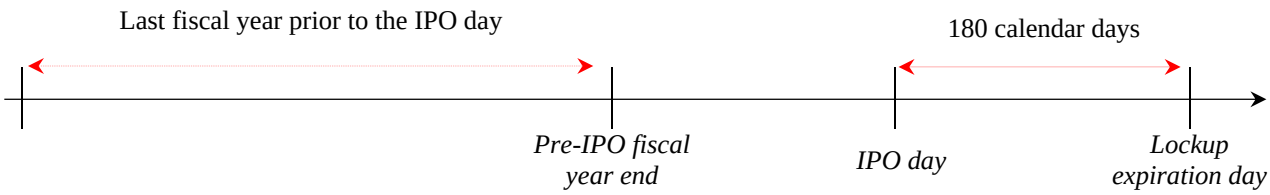
Appendix 1
Timeline of Research Design



Note: This figure describes our research design timeline. The mean (median) distance in calendar days between the pre-IPO fiscal year end and the IPO day is 191 (197) days.

Appendix 2
Variable Definitions

IPO Characteristics	
Offer Price	Offer price per share.
Proceeds	Amount of proceeds in millions of U.S. dollars from the initial offering.
IPO Value	IPO value in millions of U.S. dollars measured as the offering price multiplied by the number of shares outstanding in the company.
Sales Level	Sales in millions of U.S. dollars reported as of the last fiscal year prior to the IPO.
Total Assets	Total assets in millions of U.S. dollars reported as of the last fiscal year prior to the IPO.
Age	Firm age measured from the year of incorporation.
NASDAQ	Indicator variable $= 1$ if the firm is listed on the Nasdaq Stock Market; $= 0$ otherwise.
Selling Shareholders %	Number of shares offered by selling shareholders divided by the number of shares offered in the IPO.
Market Return	Cumulative equal-weighted market return over the fifteen trading days before the first IPO trading day.
Sales Growth	Percentage year-over-year growth in sales measured as of the last fiscal year prior to the IPO.
Operating Loss	Indicator variable $= 1$ for negative earnings before interest and tax expenses reported as of the last fiscal year prior to IPO; $= 0$ otherwise.
Intangible Intensity	R&D plus advertising expenses divided by sales as of the last fiscal year prior to the IPO. We set missing values for R&D or advertising expenses to zero.
DO Score	Our composite divergence of investor opinion score using pre-IPO characteristics. A new issuer scores one point for each of the three criteria: (i) it has above median pre-IPO sales growth, (ii) it reports a pre-IPO loss, and (iii) it has above median intangible intensity. To obtain a standardized score, we sum up the points and divide by three.
Offering Size	Number of shares offered in the IPO divided by the number of shares outstanding in the aftermarket.
Small Offer	Indicator variable $= 1$ if the new issuer's offering size is below the 25^{th} percentile; $= 0$ otherwise.
IPO Aftermarket Characteristics	
First Day Return	First trading day return measured from the IPO offering price per share to the closing price per share on the first trading day.
Lockup Return	Buy-and-hold market adjusted stock return from ten trading days before to ten trading days after the IPO lockup expiration.
First Day Turnover	Number of shares traded on the first trading day divided by the number of shares offered in the IPO.

Securities Lending Market Characteristics	
$Total\ Supply$	The quantity of current inventory of lendable shares available from beneficial owners divided by the number of outstanding shares.
$Active\ Supply$	The quantity of current inventory of lendable shares available from beneficial owners minus shares temporarily restricted from lending divided by the number of outstanding shares.
$Demand$	The quantity of current inventory on loan from beneficial owners divided by the number of outstanding shares.
$Utilization$	Active supply utilization over the ten trading days before to ten trading days after the lockup expiration. We measure utilization as the quantity of current inventory on loan from beneficial owners divided by the quantity of current inventory available from beneficial owners net of shares temporarily restricted from lending.
$Stock\ Loan\ Fee$	Indicative stock loan fees from Markit over the ten trading days before to ten trading days after the lockup expiration.
Gatekeeper Quality Indicators	
$Prestigious\ Underwriter$	Indicator variable $= 1$ if Loughran and Ritter's (2004) underwriter rank score is equal to 9; $= 0$ otherwise.
$Prestigious\ Law\ Firm$	Indicator variable $= 1$ if the law firm advising the issuer is included in the Legal 500 top-four tiers; $= 0$ otherwise.
$Big\ Four\ Auditor$	Indicator variable $= 1$ if the issuer's auditor is Deloitte & Touche, Ernst & Young, KPMG, or PwC; $= 0$ otherwise.
Sell-Side Analysts' Forecasts	
$Target\ Price/Offer\ Price - 1$	The percentage deviation of sell-side analysts' median consensus target price from the offer price available as of ten trading days prior to the IPO lockup expiration.
$1YR\ Out\ Price/Target\ Price - 1$	The percentage deviation of the one-year-out stock price (including cumulated distributions) from the sell-side analysts' median consensus target price available as of ten trading days prior to the IPO lockup expiration.
$Stock\ Recommendation$	Sell-side analysts' median consensus stock recommendation score available as of ten trading days prior to the IPO lockup expiration. The recommendation score ranges from one (Strong Sell) to five (Strong Buy).
$Analyst\ Dispersion$	Sell-side analyst forecast dispersion measured as the standard deviation of one-year-out EPS forecasts scaled by total assets per share. To measure dispersion, we require coverage by at least three sell-side analysts as of ten trading days prior to the lockup expiration and use the most recent individual analyst forecasts.

Note: Firm and year subscripts are omitted for brevity.

Table 1
Descriptive Statistics

Panel A: Sample Distribution by Year.

Offer year	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
# of IPOs	114	15	34	66	52	68	121	149	90	709
Proceeds ($B)	21.6	4.2	9.6	10.4	15.6	12.8	28.5	35.1	18.4	156.3

Panel B: Empirical Distributions of Key Variables.

Variable	*Mean*	*Std. Dev.*	*Percentiles*		
			25^{th}	50^{th}	75^{th}
Offer Price ($)	15.52	6.38	12.00	15.00	18.00
Proceeds ($MN)	220.40	348.59	75.00	113.90	223.12
IPO Value ($MN)	1,027.46	1,866.11	271.49	489.84	1,012.35
Sales Level ($MN)	644.81	1,947.99	48.50	110.88	362.02
Total Assets ($MN)	1,549.40	8,232.31	54.74	142.81	836.40
Age	8.88	8.57	1.00	7.00	12.00
NASDAQ	55.71%	49.71%	0.00%	100.00%	100.00%
Selling Shareholder %	11.08%	24.10%	0.00%	0.00%	7.35%
Market Return	0.59%	3.68%	-1.99%	0.64%	2.99%
Sales Growth	85.29%	214.11%	11.03%	32.06%	71.61%
Operating Loss	37.66%	48.49%	0.00%	0.00%	100.00%
Intangible Intensity	90.31%	350.58%	0.03%	5.75%	25.03%
DO Score	45.93%	37.26%	0.00%	33.33%	66.67%
Offering Size	28.89%	18.83%	18.10%	24.39%	32.99%
First Day Return	17.36%	27.04%	0.00%	10.00%	26.67%
Lockup Return	-3.41%	15.29%	-11.49%	-2.90%	5.06%
Stock Loan Fee	4.27%	11.70%	0.41%	0.61%	2.42%
Utilization	42.91%	33.70%	12.80%	32.39%	73.84%
Prestigious Underwriter	43.44%	49.60%	0.00%	0.00%	100.00%
Prestigious Law Firm	50.92%	50.03%	0.00%	100.00%	100.00%
Big Four Auditor	79.97%	40.05%	100.00%	100.00%	100.00%

Panel C: Securities Lending Market Characteristics around IPO Lockups.

Mean Values	(1) IPO Sample (709 firms)	(2) General Population (3,552 firms)	(2) – (1)	*t-stat.*
Total Supply	8.07%	21.96%	13.88%	*44.53*
Active Supply	7.55%	21.68%	14.13%	*45.94*
Demand	3.29%	4.16%	0.88%	*4.78*
Utilization	42.91%	18.78%	-24.13%	*-18.94*
Stock Loan Fee	4.27%	0.98%	-3.28%	*-7.47*

Panel D: Securities Analysts' Characteristics around IPO Lockups.

Mean Values	(1) IPO Sample (709 firms)	(2) General Population (3,552 firms)	(2) – (1)	*t-stat.*
$Target\ Price/Current\ Price - 1$	30.97%	18.45%	-12.53%	*-6.55*
$1YR\ Out\ Price/Target\ Price - 1$	-23.52%	-8.88%	14.64%	*10.81*
Stock Recommendation	4.03	3.60	-0.43	*-18.49*
Analyst Dispersion	13.8%	0.83%	-12.97%	*-7.55*

Panel E: Pairwise Pearson (Spearman) Correlations above (below) Main Diagonal.

	Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1)	*DO Score*		0.14	0.27	-0.21	-0.18	-0.15	0.23	0.41
(2)	*First Day Turnover*	0.17		-0.02§	-0.19	0.01§	0.02§	0.31	0.33
(3)	*Analyst Dispersion*	0.59	0.00§		0.00§	-0.10	-0.09	0.01§	0.13
(4)	*Offering Size*	-0.20	-0.29	-0.01§		0.38	0.40	-0.13	-0.22
(5)	*Active Supply*	-0.22	0.10	-0.21	0.33		0.98	-0.06	-0.23
(6)	*Total Supply*	-0.18	0.11	-0.17	0.37	0.97		-0.05§	-0.17
(7)	*Stock Loan Fee*	0.42	0.24	0.31	-0.26	-0.43	-0.35		0.46
(8)	*Utilization*	0.43	0.29	0.31	-0.27	-0.31	-0.25	0.76	

Note: All pairwise correlations are significantly different from zero at the 10% level or better, except for those indicated by §.

Panel F: Sample Distribution across Dispersion Score and Offering Size Partitions.

$DO\ Score$	All IPOs	$Offering\ Size$		
		$Small$	$Medium$	$Large$
0 (Low)	206	37	97	72
0.33	182	45	86	51
0.66	168	43	88	37
1 $(High)$	153	52	84	17
All IPOs	709	177	355	177

Table 2
IPO First-Day Returns

Panel A: Portfolio Results.

DO Score	All IPOs	*Offering Size*		
		Small	*Medium*	*Large*
0 (*Low*)	10.82%	11.47%	14.50%	5.53%
t-statistic	*8.24*	*4.83*	*5.97*	*4.70*
0.33	13.59%	16.90%	14.20%	9.64%
t-statistic	*7.93*	*4.56*	*6.44*	*2.69*
0.66	19.85%	31.90%	17.54%	11.35%
t-statistic	*9.57*	*6.30*	*7.05*	*3.13*
1 (*High*)	27.92%	44.36%	22.11%	6.37%
t-statistic	*9.57*	*7.35*	*6.99*	*1.27*
High − Low	17.11%	32.90%	7.61%	0.84%
t-statistic	*5.35*	*5.07*	*1.91*	*0.16*

Panel B: Top and Bottom Portfolio Results.

	First Day Return
Low DO Score & Large Offer	5.53%
t-statistic	*4.70*
High DO Score & Small Offer	44.36%
t-statistic	*7.35*
Spread	**38.84%**
t-statistic	*6.32*

Panel C: Full Sample Regression Results.

	Dependent Variable $= First\ Day\ Return$		
	(1)	(2)	(3)
$Intercept$	0.210	0.218	-0.058
	2.63	*2.78*	*-0.37*
$\boldsymbol{DO\ Score}$	**0.198**	**0.123**	**0.125**
	8.39	***3.23***	***3.01***
$Small\ Offer$	.	-0.028	-0.060
		-1.06	*-2.66*
$\boldsymbol{DO\ Score \times Small\ Offer}$	.	**0.250**	**0.247**
		3.07	***2.85***
$Prestigious\ Underwriter$	.	.	-0.005
			-0.27
$Big\ Four\ Audit\ Firm$	.	.	-0.045
			-0.86
$Prestigious\ Law\ Firm$	.	.	0.001
			0.06
$log(IPO\ Value)$	.	.	0.044
			2.67
$NASDAQ$	.	.	0.029
			1.96
$log(Age)$	.	.	0.020
			1.94
$Selling\ Shareholders\ \%$	.	.	-0.050
			-2.48
$Market\ Return$	.	.	0.727
			3.29
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Adjusted R^2	12.9%	17.1%	19.4%

This table reports evidence of variation in first-day returns with pre-IPO characteristics. We measure the first-day return as the return from the IPO offering price per share to the closing price per share on the first trading day. Panel A reports portfolio mean values of first-day returns across partitions formed based on *DO Score* and *Offering Size*. Panel B reports the spread of first-day returns between the portfolio with a combination of low *DO Score* and large offering size and the portfolio with a combination of high *DO Score* and small offering size. Panel C reports results from OLS regressions of first-day returns on *DO Score*, the indicator for small offering size (*Small Offer*), and their interaction, along with other new issuer characteristics, as well as year and industry fixed effects. Industry fixed effects are based on Fama and French's (1997) 12-industry classification. The t-statistics are based on standard errors clustered by year. Our sample includes 709 IPOs over the period from 2007 to 2015. Appendix 2 provides detailed variable definitions.

Table 3
IPO Lockup Returns

Panel A: Portfolio Results

DO Score	All IPOs	*Offering Size*		
		Small	*Medium*	*Large*
0 (*Low*)	0.16%	2.72%	-0.18%	-0.68%
t-statistic	*0.21*	*1.62*	*-0.22*	*-0.42*
0.33	-1.59%	-0.31%	-3.14%	-0.13%
t-statistic	*-1.45*	*-0.14*	*-1.98*	*-0.06*
0.66	-5.55%	-6.07%	-5.13%	-5.95%
t-statistic	*-3.85*	*-2.11*	*-2.61*	*-1.85*
1 (*High*)	-8.01%	-10.11%	-8.10%	-1.13%
t-statistic	*-6.44*	*-4.49*	*-5.01*	*-0.33*
High − Low	-8.17%	-12.83%	-7.92%	-0.45%
t-statistic	*-5.61*	*-4.57*	*-4.33*	*-0.12*

Panel B: Top and Bottom Portfolio Regression Results.

	Average Lockup Return
Low DO Score & Large Offer	-0.68%
t-statistic	*-0.42*
High DO Score & Small Offer	-10.11%
t-statistic	*-4.49*
Spread	**-9.43%**
t-statistic	*-3.39*

Panel C: Full Sample Regression Results.

	Dependent Variable $= Lockup\ Return$		
	(1)	(2)	(3)
$Intercept$	-0.012	-0.022	0.054
	-0.61	*-1.11*	*1.08*
$\boldsymbol{DO\ Score}$	**-0.065**	**-0.050**	**-0.049**
	-3.97	***-3.08***	***-2.68***
$Small\ Offer$	.	0.038	0.047
		2.46	*2.40*
$\boldsymbol{DO\ Score \times Small\ Offer}$	.	**-0.060**	**-0.065**
		-2.57	***-2.97***
$Prestigious\ Underwriter$	.	.	-0.001
			-0.11
$Big\ Four\ Audit\ Firm$	.	.	0.003
			0.11
$Prestigious\ Law\ Firm$	.	.	0.004
			0.52
$log(IPO\ Value)$	.	.	-0.009
			-1.49
$NASDAQ$	.	.	-0.016
			-1.84
$log(Age)$	.	.	-0.008
			-1.58
$Selling\ Shareholders\ \%$	.	.	-0.014
			-0.86
$Market\ Return$	.	.	-0.182
			-1.50
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Adjusted R^2	6.4%	6.5%	6.3%

This table reports evidence of variation in lockup returns with pre-IPO characteristics. We measure the lockup return as the buy-and-hold market adjusted return over the window from ten trading days before to ten trading days after the lockup expiration. We use the CRSP value-weighted index including distributions to proxy for the market portfolio. Panel A reports portfolio mean values of lockup returns across partitions formed based on *DO Score* and *Offering Size*. Panel B reports the spread of lockup returns between the portfolio with a combination of low *DO Score* and large offering size and the portfolio with a combination of high *DO Score* and small offering size. Panel C reports results from OLS regressions of lockup returns on *DO Score*, the indicator for small offering size (*Small Offer*), and their interaction, along with other new issuer characteristics, as well as year and industry fixed effects. Industry fixed effects are based on Fama and French's (1997) 12-industry classification. The t-statistics are based on standard errors clustered by year. Our sample includes 709 IPOs over the period from 2007 to 2015. Appendix 2 provides detailed variable definitions.

Table 4
Variation in Sell-Side Analyst Optimism:
Top and Bottom Portfolio Results

Panel A: Stock Recommendation Score Scaled from One (Strong Sell) to Five (Strong Buy).

	All Analysts	*Affiliated Analysts*	*Other Analysts*
Low DO Score & Large Offer	3.70	3.73	3.66
t-statistic	*41.47*	*42.99*	*36.15*
High DO Score & Small Offer	4.10	4.15	4.01
t-statistic	*58.60*	*49.05*	*46.89*
Spread	**0.40**	**0.42**	**0.35**
t-statistic	***3.56***	***3.41***	***2.67***

Panel B: $Target\ Price/Offer\ Price - 1$.

	All Analysts	*Affiliated Analysts*	*Other Analysts*
Low DO Score & Large Offer	34.79%	29.01%	26.65%
t-statistic	*8.55*	*6.41*	*5.88*
High DO Score & Small Offer	72.20%	79.50%	73.52%
t-statistic	*7.37*	*7.73*	*6.77*
Spread	**37.41%**	**50.49%**	**46.87%**
t-statistic	***3.93***	***4.66***	***4.14***

This table reports evidence of variation in sell-side analyst optimism across new issuer portfolios formed based on *DO Score* and offering size. Panel A reports mean portfolio values of sell-side analyst consensus stock recommendations across all analysts and separately for affiliated analysts, i.e., sell-side analysts employed by the investment banks of the underwriter syndicate, and all other analysts. Panel B reports mean portfolio values of the percentage deviation of the consensus target price from the offer price across all analysts and separately for affiliated analysts and all other analysts. We obtain individual analyst stock recommendations and target prices from IBES' detail files as of ten trading days prior to the IPO lockup expiration. Our sample includes 709 IPOs over the period from 2007 to 2015. Appendix 2 provides detailed variable definitions.

Table 5
IPO Short-Sales Constraints: Variation in Stock Loan Fees

Panel A: Portfolio Results

DO Score	All IPOs	*Offering Size*		
		Small	*Medium*	*Large*
0 (*Low*)	1.31%	1.40%	1.64%	0.83%
t-statistic	*6.97*	*3.58*	*4.03*	*6.16*
0.33	2.99%	3.44%	2.02%	4.22%
t-statistic	*3.97*	*3.67*	*3.13*	*1.82*
0.66	5.15%	10.67%	3.78%	1.98%
t-statistic	*5.35*	*4.26*	*2.97*	*3.61*
1 (*High*)	8.81%	15.08%	4.92%	8.83%
t-statistic	*6.34*	*4.95*	*3.84*	*1.95*
High − Low	7.50%	13.68%	3.29%	8.00%
t-statistic	*5.33*	*4.45*	*2.45*	*1.77*

Panel B: Top and Bottom Portfolio Regression Results.

	Average Stock Loan Fee
Low DO Score & Large Offer	0.83%
t-statistic	*6.16*
High DO Score & Small Offer	15.08%
t-statistic	*4.95*
Spread	**14.26%**
t-statistic	*4.67*

Panel C: Full Sample Regression Results.

	Dependent Variable = $Stock\ Loan\ Fee$		
	(1)	(2)	(3)
$Intercept$	0.009	0.015	0.048
	0.26	*0.40*	*1.01*
$\boldsymbol{DO\ Score}$	**0.083**	**0.050**	**0.047**
	4.65	***4.21***	***5.27***
$Small\ Offer$	.	-0.020	-0.015
		-1.46	*-1.55*
$\boldsymbol{DO\ Score \times Small\ Offer}$	.	**0.112**	**0.108**
		2.85	***2.83***
$Prestigious\ Underwriter$	.	.	-0.002
			-0.19
$Big\ Four\ Audit\ Firm$	.	.	-0.003
			-0.25
$Prestigious\ Law\ Firm$	.	.	-0.006
			-1.19
$log(IPO\ Value)$	.	.	-0.002
			-0.21
$NASDAQ$	.	.	-0.002
			-0.14
$log(Age)$	.	.	-0.004
			-0.80
$Selling\ Shareholders\ \%$	.	.	-0.024
			-2.52
$Market\ Return$	.	.	0.107
			1.21
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Adjusted R^2	9.2%	13.0%	12.5%

This table reports evidence of variation in stock loan fees with pre-IPO characteristics. We measure stock loan fees as the average daily stock loan fees over the window from ten trading days before to ten trading days after the lockup expiration. Panel A reports portfolio mean values of stock loan fees across partitions formed based on *DO Score* and *Offering Size*. Panel B reports the spread of stock loan fees between the portfolio with a combination of low *DO Score* and large offering size and the portfolio with a combination of high *DO Score* and small offering size. Panel C reports results from OLS regressions of stock loan fees on *DO Score*, the indicator for small offering size (*Small Offer*), and their interaction, along with other new issuer characteristics, as well as year and industry fixed effects. Industry fixed effects are based on Fama and French's (1997) 12-industry classification. The t-statistics are based on standard errors clustered by year. Our sample includes 709 IPOs over the period from 2007 to 2015. Appendix 2 provides detailed variable definitions.

Table 6
IPO Short-Sales Constraints: Variation in Active Supply Utilization

Panel A: Portfolio Results

DO Score	All IPOs	*Offering Size*		
		Small	*Medium*	*Large*
0 (*Low*)	26.32%	27.57%	27.11%	24.61%
t-statistic	*13.62*	*5.91*	*9.61*	*7.56*
0.33	38.11%	48.70%	34.98%	34.04%
t-statistic	*16.09*	*9.38*	*10.60*	*8.10*
0.66	49.65%	62.79%	48.20%	37.84%
t-statistic	*19.56*	*11.47*	*14.27*	*8.49*
1 (*High*)	63.55%	76.30%	59.83%	42.93%
t-statistic	*25.29*	*22.41*	*17.85*	*4.89*
High − Low	37.23%	48.73%	32.72%	18.31%
t-statistic	*11.74*	*8.44*	*7.47*	*1.96*

Panel B: Top and Bottom Portfolio Regression Results.

	Average Utilization
Low DO Score & Large Offer	24.61%
t-statistic	*7.56*
High DO Score & Small Offer	76.30%
t-statistic	*22.41*
Spread	**51.69%**
t-statistic	*10.97*

Panel C: Full Sample Regression Results.

	Dependent Variable = $Utilization$		
	(1)	(2)	(3)
$Intercept$	0.478	0.470	0.358
	4.82	*4.74*	*2.40*
$\boldsymbol{DO\ Score}$	**0.398**	**0.344**	**0.329**
	10.97	***7.92***	***7.68***
$Small\ Offer$	.	0.035	0.016
		0.67	*0.29*
$\boldsymbol{DO\ Score \times Small\ Offer}$	.	**0.164**	**0.170**
		2.93	***3.02***
$Prestigious\ Underwriter$	.	.	0.010
			0.69
$Big\ Four\ Audit\ Firm$	.	.	-0.051
			-1.54
$Prestigious\ Law\ Firm$	.	.	-0.011
			-0.46
$log(IPO\ Value)$	.	.	0.021
			2.48
$NASDAQ$	.	.	0.050
			1.82
$log(Age)$	.	.	0.005
			0.58
$Selling\ Shareholders\ \%$	.	.	-0.079
			-1.21
$Market\ Return$	.	.	-0.307
			-0.57
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Adjusted R^2	22.7%	25.2%	25.6%

This table reports evidence of variation in active supply utilization with pre-IPO characteristics. We measure utilization as the current inventory on loan from beneficial owners divided by the current inventory of lendable shares available from beneficial owners net of shares temporarily restricted from lending. We take the average daily utilization over the window from ten trading days before to ten trading days after the lockup expiration. Panel A reports portfolio mean values of active supply utilization across partitions formed based on *DO Score* and *Offering Size*. Panel B reports the spread of active supply utilization between the portfolio with a combination of low *DO Score* and large offering size and the portfolio with a combination of high *DO Score* and small offering size. Panel C reports results from OLS regressions of active supply utilization on *DO Score*, the indicator for small offering size (*Small Offer*), and their interaction, along with other new issuer characteristics, as well as year and industry fixed effects. Industry fixed effects are based on Fama and French's (1997) 12-industry classification. The t-statistics are based on standard errors clustered by year. Our sample includes 709 IPOs over the period from 2007 to 2015. Appendix 2 provides detailed variable definitions.

Table 7

Short Selling IPO Lockups: A Risky Business

Panel A: Sharpe Ratios from Short Selling IPO Lockups.

	Portfolio Payoffs			
	# of Days	*Mean*	*Std. Dev.*	*Sharpe Ratio*
Low DO Score & Large Offer	2,251	-0.06%	2.73%	-0.36
High DO Score & Small Offer	2,251	0.55%	3.49%	2.51
All IPOs	2,251	0.10%	1.99%	0.76
Stock Market	2,251	0.03%	1.37%	0.33

Panel B: Variation in Short-Selling Risk.

	Portfolio standard deviation around lockups		
	# of IPOs/firms	*Stock loan fee*	*Stock return*
Low DO Score & Large Offer	72	0.22%	2.84%
High DO Score & Small Offer	52	2.56%	3.74%
All IPOs	709	0.76%	3.32%

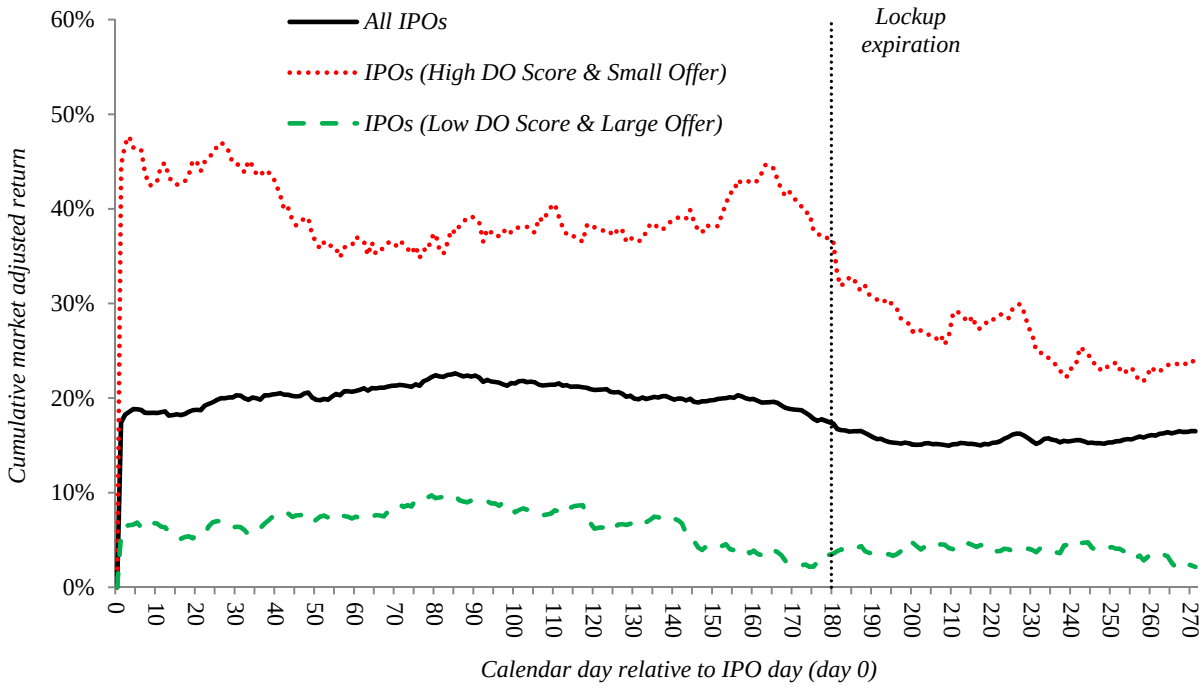
Panel C: Portfolio Diversification Restrictions.

	# of IPOs on any given trading day							
	0	1	2	3	4	5	> 5	> 20
Low DO Score & Large Offer	59%	25%	8%	4%	2%	1%	0%	0%
High DO Score & Small Offer	68%	20%	10%	2%	0%	0%	0%	0%
All IPOs	10%	8%	14%	6%	5%	7%	51%	2%

This table examines the payoffs to short sellers from targeting IPO lockups over the window from ten trading days before to ten trading days after the lockup expiration. Panel A reports the mean, standard deviation, and annualized Sharpe ratio from a trading strategy financed by borrowing at the risk free rate that takes a long position in the stock market index and a short position in IPO lockups. We measure the payoff to this trading strategy at daily frequency as the stock loan rebate rate minus the market adjusted stock return minus the risk free rate. On trading days with multiple overlapping lockup expiration windows, we measure the equal-weighted payoff across the overlapping IPO lockups. On trading days that are not overlapping with any IPO lockup windows, we set the payoff equal to zero. We proxy for the stock market portfolio using the CRSP value-weighted index including distributions. We proxy for the daily risk free rate using the one-month T-bill rate. We implement the strategy across the portfolio of new issuers with a combination of low *DO Score* and large offering size and the portfolio of new issuers with a combination of high *DO Score* and small offering size. For comparison purposes, we report the mean and standard deviation of the daily stock market index return in excess of the risk free rate along with the corresponding annualized Sharpe ratio. We measure the annualized Sharpe ratio as the ratio of the mean

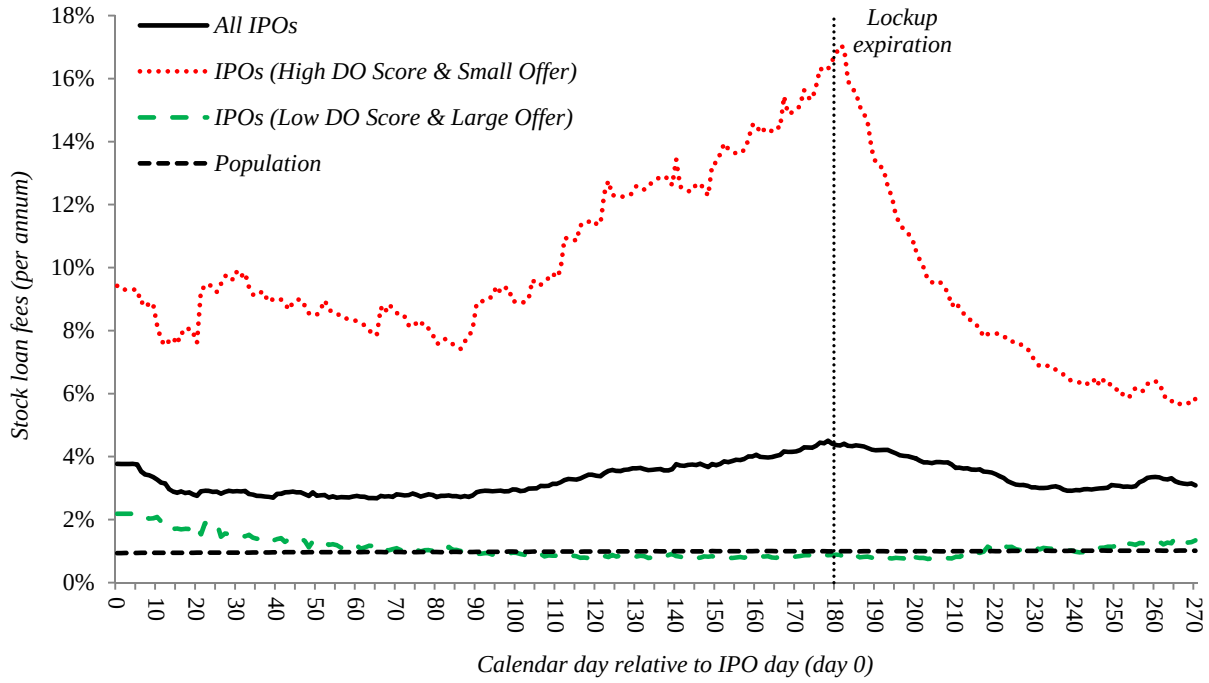
value of payoffs to the standard deviation of payoffs multiplied by the square root of 252, which corresponds to the number of trading days per year. Panel B reports the standard deviation of stock loan fees and daily stock returns measured around IPO lockup expiration windows. Panel C reports the average frequency distribution of the number of IPOs with overlapping lockup windows on any given trading day. Our sample includes 709 IPOs and 2,251 trading days over the period from 2007 to 2015.

Figure 1
Aftermarket Stock Returns



This figure reports mean cumulative market-adjusted stock returns from the IPO day (day zero) to 270 calendar days after for (i) all IPOs (solid black line), (ii) IPOs with a combination of high *DO Score* and small offering size (dotted red line), and (iii) IPOs with a combination of low *DO Score* and large offering size (dashed green line). We use the CRSP value-weighted index including distributions to proxy for the market portfolio. The day zero return is the market-adjusted return from the IPO offering price per share to the closing price per share on the first trading day. The vertical line indicates the lockup expiration on the 180th calendar day after the IPO day. Our sample includes 709 IPOs over the period from 2007 to 2015.

Figure 2
Stock Loan Fee Dynamics



This figure reports mean values of stock loan fees from the IPO day (day zero) to 270 calendar days after for (i) all IPOs (solid black line), (ii) IPOs with a combination of high *DO Score* and small offering size (dotted red line), (iii) IPOs with a combination of low *DO Score* and large offering size (dashed green line), and (iv) the population equal-weighted average stock loan fees (black dashed line). The vertical line indicates the IPO lockup expiration on the 180th calendar day after the IPO day. Our sample includes 709 IPOs over the period from 2007 to 2015.