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The Response to Share Mispricing by Issuing Firms and Short Sellers

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Abstract

Short sale constrained stocks are overpriced on average. I show that firms exploit mispricing by selling shares when their stock is short sale constrained and repurchasing shares when their stock is easily shorted. Stocks underperform following seasoned equity offerings (SEOs) if and only if the stock is difficult to short. This suggests that some SEOs are motivated by mispricing, whereas others are not. Short selling costs make it difficult for investors to profit from the poor performance following SEOs. Short selling and SEOs are alternative ways to supply shares to investors, and firms become the low-cost share provider when short selling is costly.

I. Introduction

Firms transact in their own shares for a number of reasons. Firms issue equity to raise capital or to move to a less levered capital structure. Share repurchases reduce the amount of extra cash that a firm has on hand and thereby prevent managers from wasting it. A repurchase can also serve as a takeover defense if the supply curve for shares is upward sloping. Alternatively, firms may repurchase shares to move toward their optimal capital structure.

Firms may also buy or sell their own shares to exploit mispricing and enrich their shareholders. If shares are underpriced, the firm has an incentive to repurchase shares. If the firm buys shares that are worth \$20 million for \$15 million, the \$5 million gain is split among remaining shareholders. Selling shareholders are not hurt by the firm's repurchase. They would have sold anyway and likely at a lower price. It is the outside investors who do not purchase stock cheaply that are hurt. Similarly, if shares are overpriced, current shareholders can be made better off by issuing additional shares. If the firm sells \$10 million worth of stock for \$20 million, there is a \$10 million transfer from the purchasing shareholders to the original shareholders. Even if there are other motives for a repurchase or share offering, misvaluation can determine the timing of the firm's share transactions.

This article's first contribution is to test whether mispricing is an important motive for firms to transact in their own shares. I use three lending market variables

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as measures of short sale constraints and hence mispricing. The borrowing FEE (FEE) is the annualized amount that a short seller pays to borrow shares. IHS Markit calculates it as a value-weighted average of fees across all share loans. UTILIZATION is the proportion of shares available to lend that are on loan. Daily Cost of Borrowing Score (DCBS) is IHS Markit's proprietary measure of short selling costs. Measures of mispricing used here are cleaner than those have been used before. One reason these are good proxies for mispricing is that a stock is only costly or difficult to borrow to short if short sellers believe, at the time, that the stock is overpriced. A second reason these are good proxies is that these measures seem far less likely to be correlated with growth opportunities or risk than mispricing proxies like the book-to-market ratio or price-earnings ratio.

I obtain data on the share lending market for 2006–2019 from IHS Markit. I show that as short sale constraints increase and stocks become harder to borrow and hence more overpriced, firms become much more likely to file for or conduct a seasoned equity offering (SEO). This holds even after including fixed effects for the firm and month, and variables for the age of the firm, the firm's cash position, the book-to-market ratio of the stock, and recent share price run-ups. In contrast, repurchases are far more likely to occur when a stock is not hard to borrow at the beginning of the quarter and is therefore either fairly priced or underpriced. This finding holds after adjustment for cash holdings and after controlling for the firm identity with fixed effects. It is robust with respect to the measure of short sale constraints.

The poor performance of stocks after SEOs is often cited as evidence that firms issue stock when it is overpriced. For this to be true, we must also assume that it takes the market many, many months after an SEO to figure out that shares are overpriced. We must also assume that the market ignores the many academic studies showing poor performance after SEOs as the poor performance has continued for many years after their publication. Hence, to some researchers, mispricing seems to be an implausible or incomplete explanation for poor long-run performance following SEOs. An alternative explanation is that risk decreases after an offering and subsequent returns are lower because of the risk reduction. In this case, poor performance can occur after offerings even if the stock is not mispriced at the time of the SEO.

This article's second contribution is to show that only stocks that are short sale constrained, as measured by high FEE, high UTILIZATION, or high DCBS scores, perform poorly following SEOs. In contrast, underperformance following SEOs is minimal and insignificant for stocks that are not short sale constrained. This does not necessarily mean that only short sale constrained stocks underperformed after SEOs in earlier years. However, it has been 30 years since the original Ritter (1991) study showing that equity issuers perform poorly in the long run. This is one of the best-known anomalies among both academics and practitioners. Short sale constraints may help explain why equity issuers continue to perform badly after all this time. After incorporating borrowing fees, profits to shorting stocks with recent SEOs are eliminated. Only the firm, by issuing shares, can take advantage of the mispricing.

This article's third contribution is to characterize the competition between short sellers and firms as suppliers of shares. SEOs are expensive, and firms are

reluctant to conduct them to take advantage of mispricing unless the mispricing is significant. As short selling becomes more expensive and risky, firms become the low-cost suppliers of shares and conduct SEOs. Consistent with this, I find the firms with large SEO costs wait to issue shares until mispricing, as measured by FEE, UTILIZATION, and DCBS is especially large. Firms with smaller SEO costs issue when shares are less short sale constrained and hence less overpriced.

The rest of the article proceeds as follows: Section II reviews the literature on share repurchases and SEOs. Data are described in Section III. Section IV demonstrates that stocks that are hard to borrow earn poor returns or, put another way, are overpriced on average. Section V examines the connection between being hard to borrow and SEOs. Section VI shows that share repurchases are far less common when stocks are hard to borrow. Section VII concludes.

II. Share Offerings and Share Repurchases

Numerous studies suggest that firms issue stock when its price is high relative to past prices or accounting measures of value. DeAngelo, DeAngelo, and Stulz (2010) show that average returns are high in the 36 months prior to an offering and especially high in the 12 months before an offering. Alti and Sulaeman (2012) also note that SEOs tend to occur after stock price run-ups. Hovakimian, Opler, and Titman (2001) find that firms with stock prices that are high relative to earnings, book value, or past stock prices are more likely to issue equity. Dong, Hirshleifer, and Teoh (2012) estimate the intrinsic value of a stock using the stock's book value and analysts' forecasts of future years' return on equity. They find that firms whose market prices are high relative to the intrinsic value measure are far more likely to issue equity than firms with underpriced shares. High stock prices at the time of an SEO relative to past prices or book value could be consistent with firms issuing equity when it is overvalued. High stock prices could also, however, reflect investment opportunities or lowered risk. That is an advantage of using short sale constraints to measure mispricing. There is little connection between being hard to borrow and having investments to fund.

There is other evidence consistent with firms issuing stock when it is overpriced. Loughran and Ritter (1997) find that the operating performance of SEO firms decreases relative to other firms following the offering. Kim and Weisbach (2008) show that SEOs by high market-to-book firms include more secondary shares and lead to more stockpiling of cash than SEOs of low market-to-book firms. Frazzini and Lamont (2008) show that fund flows between mutual funds are "dumb money," and stocks held by funds that receive these sentiment-based flows underperform significantly afterward. Frazzini and Lamont show that stocks held by funds that receive flows issue more shares in the following year. If mutual fund flows are a sign of mispricing, as their results suggest, this is consistent with firms taking advantage of mispriced equity in their equity financing decisions.

To many, the strongest evidence that firms issue stock when it is overpriced is that stocks perform poorly after equity offerings. Ritter (1991) finds that stocks significantly underperform relative to matching stocks in the 3 years following their initial public offering (IPO). He notes that this is consistent with firms taking advantage of "windows of opportunity" to sell overpriced shares. Spiess and

Affleck-Graves (1995) show that seasoned equity offerings (SEOs) issued in 1975–1989 significantly underperform matched firms over the following 5 years. They say that this is consistent with managers taking advantage of overvaluation in their issuing decisions. Loughran and Ritter (1995) document that stocks of firms with SEOs earn mean buy-and-hold returns of 33.4% in the 5 years after the offering, far less than the 92.8% earned by matching firms. They observe that their findings are consistent "with a market in which companies announce stock issues when their shares are grossly overvalued." Lee (1997) examines 2,164 SEOs over 1976–1990 and shows that primary offerings significantly underperform benchmarks over the next 3 years. Baker, Stein, and Wurgler (2003) use an index of equity dependence derived by Kaplan and Zingales (1997) and show that equity issuance by equity-dependent firms is negatively related to future returns. Daniel and Titman (2006) estimate equity issuance using the difference between changes in the market value of equity and equity returns and show that it is inversely related to returns in future months. Baker and Wurgler (2000) calculate the annual aggregate equity share as the amount of money raised through equity offerings divided by the total raised by both debt and equity offerings. Using annual data from 1928 to 1996, they show that both value-weighted and equal-weighted annual CRSP index returns decline with the previous year's equity share. Baker and Stein (2004) show that equity share is negatively related to the next year's equal-weighted market returns over 1933–1999. A 1-standard-deviation increase in equity share decreases year-ahead expected returns by 9%.

The poor performance of stocks after equity issuance can only be due to firms exploiting mispricing if the market fails to incorporate the information that an offering has occurred. As Barclay, Fu, and Smith (2012) observe (p. 31), SEOs are announced prior to the offering and "rational investors will reassess the value of the firm's shares conditional on the SEO announcement." The poor performance after offerings suggests that it takes years for the market to reassess firm's values. Even now, 30 years after the first academic studies documented poor long-run performance of equity issuers, the market still cannot seem to get it right.

The seeming inability of the market to incorporate the information that a firm is selling stock into the price of its shares has led researchers to propose other explanations for the poor returns of firms after issuing equity. Schultz (2003) observes that if firms issue equity when prices are higher than in the past, offerings will cluster at market peaks and issuers will seem to time the market ex post. Butler, Cornaggia, Grullon, and Weston (BCGW) (2011) note several reasons besides market timing for stock returns to be lower following SEOs. One, from q-theory, says that a reduction in required returns leads to an increase in investment (which may be financed with SEOs). Another is that required returns decrease when a firm exercises real options by taking projects because the projects are less risky than the options to take them. These decreases in returns should occur regardless of how the firm finances their projects. On the other hand, market timing implies that firms issue equity when their stock is overvalued and debt at other times. Using data from 1971 to 2008, BCGW find that annual returns are lower following external financing, but the form of the financing has little impact. Lyandres, Sun, and Zhang (2008) also note that a negative relation between investment and expected returns is predicted by the q-theory of investment and real options theory. They construct

an investment factor as a long-short portfolio that buys stocks with the lowest 30% of investments to assets ratio and shorts the stocks with the highest 30% of investment to assets ratios. When this factor is included in regressions, the underperformance of SEOs is reduced by 75% and the underperformance of IPOs falls by 80%. Hou, Xue, and Zhang (2015) use the same investment factor to examine 80 anomalies. A model that uses their factors, along with size and the market return, does a better job of explaining the surviving anomalies than does the Fama and French (1993) or Carhart (1997) models.

Hertzel and Li (2010) compare rational explanations for poor performance following equity offerings, like q-theory, with the overpriced equity hypothesis. They observe that the real options and mispricing explanation for the poor long-run returns of equity issuers are not mutually exclusive. Hertzel and Li use an accounting multiples approach to extract stock mispricing and growth opportunities variables from market-to-book ratios. Firms with stock that are overvalued by this measure reduce debt and increase cash more than other firms in the 4 quarters following an SEO. Dong, Hirshleifer, Richardson, and Teoh (2006) also compare the misevaluation and q-theories using takeovers over the 1978–2000 period. Takeovers in which a target is bought with stock implicitly include a share offering. Dong et al. conclude that the evidence is consistent with both the q and misvaluation theories, with the evidence more supportive of the q-hypothesis in the 1980s, and the misvaluation hypothesis in the 1990s.

This article presents evidence that some firms do indeed issue shares when they are overpriced using cleaner measures of mispricing than past studies. This article also shows why stocks may perform poorly for many months after an SEO even when the poor performance of stocks following SEOs is widely known. Short sale constraints prevent short sellers from eliminating overpricing. At the same time, high lending fees mean that after an SEO, owners of shares can supplement their returns by loaning shares. This reduces their incentives to sell their holdings.

Share repurchases, like equity offerings, allow firms to take advantage of mispricing of their stock. Whereas overpricing may be a motive for SEOs, underpricing may be a reason for share repurchases. Furthermore, unlike SEOs, repurchases can be used to exploit mispricing without first informing the market as long as a firm has a repurchase program in place. Brav, Graham, Harvey, and Michaely (2005) survey 400 CFOs and find that 86% agree or strongly agree that "companies repurchase when their stock is a good value relative to its true value." When they asked CFOs of 82 firms that had not repurchased shares within the past 3 years what might get their company to seriously consider a repurchase in the future, 75.7% said "market undervaluation of our stock."

Several studies provide evidence that firms repurchase shares when they are undervalued. Peyer and Vermaelen (2009) show that firms earn significant positive abnormal returns in the 48 months after announcing a share repurchase. Repurchases usually follow months of poor performance, and stocks that underperform the most before a repurchase announcement perform the best afterward. Peyer and Vermaelen conclude that the positive long-run performance of repurchasing stocks is not due to changes in risk or liquidity after repurchases, but to overreaction to bad news prior to the repurchase. Ben-Rephael, Oded, and Wahl

(2014) use 10-Q and 10-K filings to obtain monthly data on repurchases by 620 firms over 2004–2009. They find that firms are more likely to repurchase if returns have been low in the previous 2 months. Dittmar (2000) shows that there is a strong, negative relation between market-to-book ratios and repurchases. If low market-to-book ratios indicate underpricing, this is evidence that firms repurchase when their shares are undervalued. Cook, Krigman, and Leach (2004) use voluntarily disclosed data on 64 firms' repurchase programs from 1993 to 1994. They show that repurchases increase following price declines. Dittmar and Field (2016) find that repurchasers buy their stock at a discount to its average price over the next 1, 3, and 6 months. The discount is larger for companies that repurchase shares less frequently and for more volatile stocks.

There are other explanations for share repurchases and for positive returns after them. Grullon and Michaely (2004) suggest that a motive for repurchases is to reduce the total amount of free cash flow at management's disposal. They find that market reaction to repurchase announcements is stronger for firms that are most likely to overinvest and that firms that repurchase reduce their capital expenditures and R&D. Grullon and Michaely suggest that firms announce share repurchases when they no longer have growth opportunities. Consistent with this, they show that systematic risk, which is higher for investment opportunities than assets in place, declines following repurchases.

There has been a moderate amount of work linking short selling constraints with repurchases. Zheng (2021) obtains a sample of open market repurchase announcements from 1980 to 2016 from Securities Data Corporation (SDC). Short interest is from the Compustat Supplemental Short Interest File. Zheng shows that the reaction to repurchase announcements is inversely related to the amount of short selling before the announcement. Bargeron and Bonamie (2020) examine changes in short interest and repurchases. When there is disagreement and firms repurchase while short interest is increasing, firms are right on average. Abnormal returns are between 70 and 107 basis points over the next quarter.

The literature on stock mispricing, share offerings, and repurchases has grown large. Nevertheless, looking at share offerings and repurchases in conjunction with the share lending market offers new insights. One contribution of this article then is that it uses measures of mispricing from the share lending market that are arguably cleaner than other variables that are associated with equity offerings. Variables that are used as a proxy for mispricing (like market-to-book ratios) capture growth opportunities and risk as well as any mispricing. In contrast, a stock is *only* hard to borrow if short sellers believe it is overpriced and are willing to pay high borrowing costs. A second contribution of this article is to provide a reason why market prices do not fully react to the information in the announcement of an equity sale; in many cases, short sale constraints prevent short sellers from trading at SEO announcements.[1] Finally, this article notes that short selling and SEOs are alternative ways to supply shares to the market and explores when each is the low-cost way to provide shares.

[1]An additional reason that prices may not fully incorporate the information in an SEO announcement, as discussed in Stein (1996), is that irrational investors may not fully update their beliefs after the announcement.

III. Data

IHS Markit aggregates daily data on the stock lending market from lending agents, prime brokers, and other lending market participants. This study uses three of their measures of short selling constraints. The first is FEE. Most share loans are for 1 day, but the FEE is the annualized cost of borrowing shares. The second is IHS Markit's proprietary measure of the cost of borrowing shares (DCBS). This variable ranges from 1 to 10, with 1 indicating that shares are easy to borrow and 10 implying that the shares are among the hardest and costliest shares to borrow. The majority of stocks are ranked 1 on any given day. Stocks with a DCBS measure of 3 or greater are considered hard to borrow. The third measure, UTILIZATION, is the proportion of shares available to lend that are on loan. Most stocks are easily borrowed, and UTILIZATION is less than 10%. As UTILIZATION increases, it becomes harder to locate shares. Muravyev, Pearson, and Pollet (2019) use a UTILIZATION of more than 60% to define a stock as hard to borrow. Unlike FEE and DCBS, which are sticky and change slowly, UTILIZATION changes day-to-day and may therefore be more sensitive to changes in the share lending market. UTILIZATION is also a measure of the risk of short selling. If UTILIZATION is high, it is harder to locate new shares to borrow if a loan is recalled.

Table 1 provides summary statistics for FEE, UTILIZATION, and DCBS across all stocks. Panel A summarizes the distributions of these variables. The median FEE is 42.6 basis points per year. There is little variation in FEE over time and across easily borrowed stocks. The 5th percentile of FEE is 28.9 basis points, and the 25th percentile is 37.5 basis points. Although the majority of stocks can be borrowed cheaply, some stocks are very expensive to borrow during some months. The 75th percentile of FEE is 2.033%, and the 95th percentile is 13.44%. The distribution of UTILIZATION is described in the next row. The median UTILIZATION is 8.953%; therefore, for the median stock month, less than 9% of the shares that are available to borrow are actually lent out. The 95th percentile of UTILIZATION is 81.07. It may seem that shares can be borrowed when only 81% of the available shares are on loan, but the share lending market is fragmented. Short sellers typically borrow from a handful of prime brokers at most and may have difficulty in locating shares when most of the available shares are already lent out. The last row of Panel A provides the distribution of DCBS. The median is 1.0, so most stocks have the lowest possible DCBS score and are easy to borrow. The 75th percentile of DCBS is 2.0, and the 95th percentile is 6.6 out of a maximum of 10.

Panel B of Table 1 reports the correlations of the lending market variables. FEE, UTILIZATION, and DCBS are positively correlated with each other. The correlation between FEE and DCBS is particularly high at 0.7934.

Panels C–E of Table 1 provide transition matrices for monthly categories of FEE, UTILIZATION, and DCBS. Each month, I average the daily values of FEE, DCBS, and UTILIZATION for each stock. I categorize stocks by these measures and then compare categories in consecutive months. Panel C reveals that if a stock is in the low FEE category of 0.005 or less, there is a 95.5% chance it will be in the same category and a 3.9% chance it will be in the 0.005–0.01 category the next month. Similarly, Panel D shows that if a stock is in the lowest UTILIZATION

TABLE 1

Summary Statistics for the Short Sale Constraint Variables FEE, UTILIZATION, and DCBS

In Table 1, FEE is the borrowing FEE for shares expressed in annual terms. UTILIZATION is the proportion of shares that are available to lend that are actually on loan. Daily Cost of Borrowing Score (DCBS) is IHS Markit's proprietary measure of the cost of short selling. DCBS is 1 for the cheapest stocks to short and 10 for the most expensive stocks to short. The sample period is July 2006 to Dec. 2019.

Panel A. The Distribution of the Short Sale Constraint Measures

	5%	25%	Median	75%	95%	Mean	Std. Dev.
FEE	0.00289	0.00375	0.00426	0.02033	0.13435	0.0321	0.0914
UTILIZATION	0.268	2.452	8.953	26.564	81.070	19.695	25.041
DCBS	1.0	1.0	1.0	2.0	6.6	2.0	1.9

Panel B. Correlations of the Variables

	FEE	UTILIZATION	DCBS
FEE	1.0000		
UTILIZATION	0.3736	1.0000	
DCBS	0.7934	0.4870	1.0000

Panel C. Transition Matrix for FEEs

	FEE_t							
FEE_{t-1}	<.005	.005–.01	.01–.03	.03–.05	.05–.10	.10–.25	.25–.50	≥.50
<.005	0.955	0.039	0.005	0.001	0.000	0.000	0.000	0.000
.005–.01	0.263	0.600	0.118	0.011	0.006	0.001	0.000	0.000
.01–.03	0.041	0.161	0.658	0.101	0.033	0.005	0.001	0.000
.03–.05	0.014	0.030	0.232	0.557	0.149	0.015	0.002	0.001
.05–.10	0.005	0.011	0.051	0.129	0.711	0.085	0.005	0.002
.10–.25	0.002	0.002	0.011	0.012	0.124	0.782	0.058	0.009
.25–.50	0.001	0.001	0.003	0.003	0.008	0.165	0.740	0.079
≥.50	0.000	0.001	0.000	0.001	0.003	0.009	0.114	0.873

Panel D. Transition Matrix for UTILIZATION

	$UTILIZATION_t$					
$UTILIZATION_{t-1}$	<5	5–25	25–50	50–75	75–90	≥90
<5	0.906	0.089	0.003	0.001	0.000	0.001
5–25	0.093	0.849	0.054	0.003	0.001	0.000
25–50	0.007	0.142	0.769	0.075	0.005	0.002
50–75	0.003	0.015	0.167	0.712	0.093	0.010
75–90	0.003	0.007	0.023	0.256	0.609	0.102
≥90	0.015	0.010	0.019	0.062	0.232	0.662

Panel E. Transition Matrix for Monthly DCBS

	$DCBS_t$									
$DCBS_{t-1}$	1	1.1–2	2.1–3	3.1–4	4.1–5	5.1–6	6.1–7	7.1–8	8.1–9	9.1+
1	0.959	0.038	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000
1.1–2	0.263	0.604	0.104	0.018	0.007	0.002	0.001	0.000	0.000	0.000
2.1–3	0.028	0.235	0.564	0.130	0.027	0.009	0.004	0.001	0.000	0.001
3.1–4	0.012	0.056	0.228	0.531	0.132	0.023	0.011	0.004	0.002	0.002
4.1–5	0.009	0.028	0.049	0.210	0.538	0.119	0.028	0.010	0.005	0.004
5.1–6	0.004	0.010	0.020	0.044	0.198	0.537	0.142	0.025	0.012	0.007
6.1–7	0.002	0.010	0.010	0.013	0.033	0.188	0.592	0.107	0.031	0.014
7.1–8	0.001	0.002	0.007	0.004	0.015	0.038	0.237	0.501	0.134	0.060
8.1–9	0.002	0.000	0.004	0.003	0.007	0.008	0.043	0.198	0.585	0.151
>9	0.001	0.000	0.002	0.002	0.002	0.003	0.007	0.014	0.095	0.874

category in 1 month, there is a 90.6% chance it will be in the same category the next month. Panel E reveals that stocks in the lowest DCBS category in 1 month have a 95.9% chance of being in the lowest DCBS category the following month.

Of more interest is whether hard to borrow stocks remain hard to borrow for extended periods. In general, hard to borrow stocks become less hard to borrow over time. Nevertheless, a stock with a very high FEE of more than 50% has an 87.3% chance of having a FEE in excess of 50% the next month. There is a 98.7%

chance that the FEE will exceed 25% for the next month. Similarly, a stock in the highest DCBS category has an 87.4% chance of being in the highest DCBS category the next month and a 96.9% chance of being in one of the two highest DCBS categories. UTILIZATION is somewhat more fluid with just 66.2% of stocks with UTILIZATION over 90% having UTILIZATION that high in the following month.

IV. Short Selling and Misvaluation

In the empirical work to follow, I use measures that a stock is hard to borrow as indicators that the stock is overpriced. In this case, the friction that allows them to be overpriced is obvious – it is the costs and difficulty of short selling. Several articles show that hard to borrow stocks earn significantly lower raw returns and risk-adjusted returns than easily shorted stocks. Boehmer, Huszar, and Jordan (2010) calculate monthly short interest ratios over 1988–2005 for stocks by dividing short interest by shares outstanding. They find that portfolios of low short interest stocks earn significantly higher raw returns and 4-factor alphas than portfolios of high short interest stocks. Asquith, Pathak, and Ritter (2005) use short interest ratios as a proxy for the demand for shares to short and institutional ownership as a proxy for the supply of shares to borrow. They find that equal-weighted portfolios composed of stocks with the highest 1% of short interest and lowest one-third of institutional ownership underperform by 2.15% per month.

High short interest by itself does not necessarily mean that a stock is hard to borrow. Short interest can be high because it is easy-to-borrow shares or because there is a high demand to short. Therefore, recent articles have defined hard-to-borrow stocks using other variables. Cohen, Diether, and Malloy (2007) infer increases in the demand to short from contemporaneous increases in the FEE and the proportion of outstanding shares on loan. Increases in the demand to short are followed by significant negative abnormal returns the next month. Boehmer, Huszar, Wang, and Zhang (2018) analyze short selling across 38 countries over 2006–2014. They find that UTILIZATION and days-to-cover, defined as short interest divided by volume, are especially good at predicting returns. Engelberg, Evans, Leonard, Reed, and Ringgenberg (2020) find that FEE is a better predictor of returns than either days to cover or short interest. In fact, they find that long-short portfolios formed FEE outperforms every 1 of the 102 anomalies found in Green, Hand, and Zhang (2017).

Miller (1977) provides one reason for the poor performance of hard to borrow stocks. If a stock is difficult to short, pessimistic investors are forced to the sidelines and the price of the stock will reflect the opinions of just the optimistic investors. Over time, the price of the stock will decline as the overly optimistic investors who hold the shares are proved wrong.

Duffie, Gârleanu, and Pedersen (2002) construct a dynamic model of securities prices and the securities lending market when investors have different opinions about the value of a stock. In their model, the price of a stock incorporates both its intrinsic value and the expected income from loaning the shares. Because the price includes the income from loaning out the shares, it can exceed even the most optimistic investor's assessment of the stock's intrinsic value. Stocks with higher

loan FEEs will appear more overpriced to observers who compare the stock's market price with its intrinsic value but ignore the income from lending out shares.

Another way to look at the poor performance of hard to borrow stocks is that short sellers, who are usually sophisticated investors, will short until the costs offset any expected gains from additional shorting. Stocks with high borrowing fees are expected to provide high returns to short sellers before paying fees (or short sellers would close their positions and fees would decline). Note that short sellers and share owners who lend stock can agree that the stock is overpriced if they disagree on how long it will take for the stock to reach its intrinsic value. The share owners may believe that the stock price will fall slowly and they will earn lending fees for a long time, whereas the short sellers may believe that the stock price will fall quickly and they will only pay borrowing fees for a brief period.

Before examining how short sale constraints affect the likelihood of equity offerings and share repurchases, I first show that hard to borrow stocks, as measured by FEE, UTILIZATION, and DCBS, are overpriced on average. Stock and market returns are obtained from CRSP. Fama–French factors are obtained from Ken French's website. For each month from Aug. 2006 to Dec. 2019, I calculate returns and Fama–French–Carhart 4-factor alphas for portfolios formed on FEE, UTILIZATION, and Markit's cost of borrowing score (DCBS) from the previous month. Returns and alphas are averaged across the months of the sample period, and *t*-statistics that test whether the mean alpha is different from 0 are calculated. Panel A of Table 2 reports results for portfolios formed using FEE.

Most stocks are easily borrowed. In an average month, there are 2,411 stocks with an annual FEE of less than 50 basis points. Equal-weighted portfolios formed from these stocks earn average returns of 1.06% and alphas of 0.21% the next month. Value-weighted portfolios of these low FEE stocks earn average returns of 0.89% and alphas of 0.04% the next month. Both the equal-weighted and value-weighted alphas are significantly greater than 0. I use 6 FEE categories. As FEE increases, both raw returns and alphas decrease. The highest FEE category includes stocks with an annual borrowing FEE of 10% or more. On average, there are 182 stocks in this category in a month. Equal-weighted portfolios of these stocks earn mean returns of −1.16% per month and alphas of −2.22% per month. The mean alpha is significantly less than 0 with a *t*-statistic of −5.61. Value-weighted portfolios of high FEE stocks underperform even more. The mean return for the value-weighted portfolio is −1.95% per month, and the mean alpha is −2.98% with a *t*-statistic of −7.30. Returns to short selling increase with FEE. This is consistent with entry and exit of short sellers ensuring that returns to short selling are large enough to compensate them for the fees.

Panel B of Table 2 reports returns and alphas for portfolios formed using DCBS. As with FEE, stocks are categorized by the average of their daily values from the previous month. By the DCBS measure, as with FEE, most stocks are easy to borrow. The easiest-to-borrow category has 2,645 stocks on average for a month. For both the equal-weighted and value-weighted portfolios, the mean return and alpha are positive and almost exactly the same as the mean return and alpha of the low FEE portfolio. As we move to DCBS categories with harder to borrow stocks, the returns and alphas for both equal-weighted and value-weighted portfolios become smaller. For equal-weighted portfolios, mean returns are negative for

TABLE 2

Returns and Fama–French–Carhart 4-Factor Abnormal Returns for Stocks Sorted on Short Selling Variables

In Table 2, stocks are sorted on the prior month's borrowing FEE, Daily Cost of Borrowing Score (DCBS), and UTILIZATION. The sample period is Aug. 2006 to Dec. 2019.

		Equal-Weighted Portfolios		Value-Weighted Portfolios	
	Mean Obs.	Return	Alpha	Return	Alpha
Panel A. Returns of Portfolios Formed on FEE					
$FEE_{t-1} < 0.005$	2,410.8	0.0106	0.0021 (3.16)	0.0089	0.0004 (4.20)
$0.005 \leq FEE_{t-1} < 0.01$	374.7	0.0106	0.0020 (1.01)	0.0070	−0.0027 (−1.34)
$0.01 \leq FEE_{t-1} < 0.03$	275.0	0.0099	0.0014 (0.57)	0.0080	−0.0026 (−1.05)
$0.03 \leq FEE_{t-1} < 0.05$	129.5	0.0069	−0.0025 (−0.73)	0.0043	−0.0057 (−1.68)
$0.05 \leq FEE_{t-1} < 0.10$	167.8	0.0047	−0.0040 (−1.27)	−0.0008	−0.0110 (−3.66)
$0.10 \leq FEE_{t-1}$	182.4	−0.0116	−0.0222 (−5.61)	−0.0195	−0.0298 (−7.30)
Panel B. Returns of Portfolios Formed with IHS Markit's Cost of Borrowing Score DCBS					
Cheapest to borrow	2,644.6	0.0105	0.0019 (2.72)	0.0089	0.0003 (4.65)
>1, ≤2	332.0	0.0111	0.0027 (1.24)	0.0086	−0.0013 (−0.61)
>2, ≤3	170.2	0.0058	−0.0030 (−1.11)	0.0082	−0.0022 (−0.68)
>3, ≤4	109.4	0.0078	−0.0013 (−0.36)	0.0015	−0.0082 (−2.17)
>4, ≤5	81.3	0.0045	−0.0037 (−1.05)	−0.0024	−0.0119 (−3.12)
>5, ≤6	54.9	−0.0039	−0.0136 (−3.99)	−0.0055	−0.0173 (−3.93)
>6, ≤7	49.1	−0.0054	−0.0162 (−2.98)	−0.0069	−0.0162 (−2.40)
>7, ≤8	27.0	−0.0072	−0.0182 (−2.99)	−0.0160	−0.0267 (−3.49)
>8, ≤9	24.6	−0.0123	−0.0246 (−3.92)	−0.0261	−0.0383 (−4.89)
Most expensive	47.0	−0.0295	−0.0419 (−5.02)	−0.0350	−0.0447 (−4.36)
Panel C. Returns of Portfolios Formed on UTILIZATION					
$UTIL_{t-1} < 5\%$	1,334.7	0.0114	0.0038 (2.91)	0.0090	0.0007 (1.79)
$5\% \leq UTIL_{t-1} < 25\%$	1,321.7	0.0097	0.0009 (1.24)	0.0085	−0.0003 (−0.48)
$25\% \leq UTIL_{t-1} < 50\%$	513.4	0.0073	−0.0022 (−1.72)	0.0089	−0.0008 (−0.84)
$50\% \leq UTIL_{t-1} < 75\%$	240.0	0.0006	−0.0099 (−4.43)	0.0048	−0.0051 (−2.19)
$75\% \leq UTIL_{t-1}$	130.4	−0.0102	−0.0204 (−6.13)	−0.0050	−0.0153 (−4.49)

DCBS greater than 5. For the second hardest-to-borrow category, the mean return of the equal-weighted portfolio is −1.23% per month and the mean alpha is −2.46% per month with a *t*-statistic of −3.92. For the hardest-to-borrow category, the mean return of the equal-weighted portfolio is −2.95% and the mean alpha is −4.19% per

month with a *t*-statistic of −5.02. Returns and alphas for value-weighted portfolios of hard to borrow stocks are even lower. For DCBS greater than 8 and less than or equal to 9, the mean return of the value-weighted portfolio is −2.61% and the mean alpha is −3.83% with a *t*-statistic of −4.89. For the value-weighted portfolio of stocks with the highest DCBS measures, the mean return is −3.50% per month and the mean alpha is −4.47% per month with a *t*-statistic of −4.36.

Panel C of Table 2 provides returns and alphas for portfolios formed on the basis of UTILIZATION. UTILIZATION is not a direct measure of the costs of shorting, but it is highly correlated with FEE and is an important determinant of the risk of short selling. In both equal-weighted and value-weighted portfolios, returns decrease as UTILIZATION increases. Four-factor abnormal returns are positive and significant for equal-weighted portfolios of firms with UTILIZATION less than 5%. For equal-weighted portfolios of stocks with UTILIZATION of 75% or more, the abnormal return is −2.04% per month with a *t*-statistic of −6.13. For value-weighted portfolios of stocks with UTILIZATION of at least 75%, the abnormal return is −1.53% per month with a *t*-statistic of −4.49.

Table 2 shows returns and abnormal returns for just 1 month after measuring a stock's FEE, UTILIZATION, or DCBS. Hard-to-borrow stocks continue to underperform by economically and statistically significant amounts for several months. This is true whether FEE, DCBS, or UTILIZATION is used to define hard to borrow stocks.

Table 2 shows that stocks that are hard to borrow are overpriced. Note that these were not measures of mispricing that were developed after the fact from tests on historical data. Stocks are hard to borrow because they are shorted in large quantities by sophisticated investors who believe that they are overpriced at the time. These short sellers are usually right. Managers with the same information as the short sellers, or who are aware of the level of short selling, should also be aware that their stock is overpriced in real time.

V. Mispricing and Seasoned Equity Offerings

A. Short Selling Constraints and the Likelihood of SEOs

I download the filing and offering dates for all SEOs by U.S. firms from July 2006 to Dec. 2019 from SDC. I omit offerings by firms with SIC codes 6000–6999 (financial firms) and SIC codes 4900–4949 (utilities). I merge the equity offerings with the monthly short selling data by CUSIP number. I then sort monthly observations by the level of short selling measures the previous month and calculate the proportion of observations with filings and the proportion of observations with offerings for levels of each measure. The results are shown in Table 3.

Panel A of Table 3 provides the proportion of stock months with filings and offerings for different DCBS levels. There are 307,945 stock-month observations with a DCBS of 1. The proportion of those observations with SEO filings is 0.540%, and the proportion with offerings is 0.676%. As DCBS increases, the proportion of observations with SEO filings or offerings increases. When the DCBS is greater than 1 and less than or equal to 2, the proportion of stock months with filings increases to 0.770% and the proportion with offerings increases to 0.936%.

TABLE 3

The Probability of an SEO Filing or Offering During a Month Based on the Previous Month's DCBS, FEE, or UTILIZATION

The sample period in Table 3 is Aug. 2006 to Dec. 2019. Dates of seasoned equity offering (SEO) filings and offerings for CRSP stocks are obtained from Securities Data Corporation. Share lending market variables are from IHS Markit. DCBS is the Daily Cost of Borrowing Score. It is 1 for the most easily borrowed shares and 10 for the most difficult shares to borrow. FEE is the annualized FEE to borrow shares. UTILIZATION is the proportion of shares available to lend that are on loan. The cost of SEO underwritings (UFEE) is the mean underwriting fees as a percentage of offering proceeds for offerings in that DCBS, FEE, or UTILIZATION category. Financial firms and utilities are omitted.

	Observations	Proportion Filings	Proportion Offerings	UFEE
Panel A. DCBS and SEOs				
DCBS = 1	307,945	0.540%	0.676%	4.12%
1 < DCBS ≤ 2	45,837	0.770%	0.936%	5.21%
2 < DCBS ≤ 3	21,660	0.896%	1.011%	5.71%
3 < DCBS ≤ 4	14,064	0.903%	0.910%	5.46%
4 < DCBS ≤ 5	10,216	0.998%	1.224%	5.92%
5 < DCBS ≤ 6	7,046	1.490%	1.476%	5.80%
6 < DCBS ≤ 7	6,457	0.883%	1.223%	6.04%
7 < DCBS ≤ 8	3,593	1.308%	1.364%	5.63%
8 < DCBS ≤ 9	3,330	1.291%	1.622%	6.16%
9 < DCBS	5,981	1.605%	1.956%	6.41%
Panel B. Stock Borrowing FEEs (FEE) and SEOs				
FEE < 0.5%	292,076	0.497%	0.640%	4.05%
0.5% ≤ FEE < 1%	38,828	0.953%	1.079%	5.02%
1% ≤ FEE < 3%	34,573	0.865%	0.995%	5.39%
3% ≤ FEE < 5%	16,068	0.915%	0.934%	5.50%
5% ≤ FEE < 10%	21,053	1.021%	1.159%	5.78%
10% ≤ FEE < 25%	14,559	1.133%	1.326%	5.93%
25% ≤ FEE < 50%	5,201	1.442%	1.865%	6.01%
50% ≤ FEE	3,791	1.662%	1.846%	6.55%
Panel C. UTILIZATION and SEOs				
UTILIZATION < 5%	155,325	0.357%	0.437%	3.81%
5% < UTILIZATION < 25%	158,406	0.677%	0.837%	4.58%
25% ≤ UTILIZATION < 50%	64,135	0.959%	1.135%	4.92%
50% ≤ UTILIZATION < 75%	30,975	0.981%	1.156%	5.33%
75% ≤ UTILIZATION < 90%	11,847	1.275%	1.646%	5.54%
90% ≤ UTILIZATION	5,576	1.578%	1.811%	6.03%

When DCBS is greater than 9, the proportion of observations with SEO filings jumps to 1.605% and the proportion with SEO offerings reaches 1.956%. SEOs are most common for the stocks that are most likely to be overpriced. Panel B reports the proportion of stock months with filings and offerings for different FEE levels. When FEEs are less than 0.5%, 0.497% of stock months have an SEO filing and 0.640% have an offering. These proportions increase with FEE. When FEE is between 10% and 25%, there are SEO filings in 1.133% of the stock months and offerings in 1.326%. When FEE is greater than 50%, 1.662% of stock months have SEO filings and 1.846% have offerings. Panel C contains the proportion of stock months with filings and offerings for different levels of UTILIZATION. Both proportions increase monotonically with UTILIZATION. At very high levels, when UTILIZATION exceeds 90%, the proportion with SEO filings reaches 1.578% and the proportion with offerings is 1.811%.

Table 3 shows clearly that SEOs become far more common as stocks become harder to borrow. SEOs occur 3–4 times as often for stocks in the highest short sale constraint categories as they do for easily shorted stocks. Overpricing appears to be a motive for SEOs. The great majority of stocks, however, are easy to borrow, so most SEOs are from these companies (e.g., 61.5% of SEOs are from companies

with an average DCBS of less than 1.5 in the previous month). Similarly, 67.6% of SEOs were from companies with a FEE of 1% or less and 59% were from companies with UTILIZATION of less than 25%. The increase in the proportion of stocks with SEOs as stocks become harder to borrow is consistent with firms choosing to issue stock when it is overpriced. Most SEOs, however, appear to be issued for more innocent reasons.

B. Short Sale Constraints and Other Determinants of SEOs

We have shown that SEOs become more common as stocks become harder to borrow and more likely to be overpriced. The statistics in Table 3 should, however, be interpreted with caution. Ease of short selling is correlated with a number of other variables, like firm size or institutional holdings, which may be associated with the likelihood of an equity offering. To adjust for firm-specific factors that may affect the probability of an SEO, I regress dummy variables for an SEO filing or offer during a month on lending market variables that are associated with overpricing, including the mean borrowing FEE, UTILIZATION, and DCBS in the previous month. I also include fixed effects for the stock and the month. DeAngelo et al. (2010) show that firms are less likely to conduct SEOs as they age and that many firms that sell stock would run out of cash in a few months without the equity infusion. Therefore, in some of the regressions, I include the log of the number of months since the firm first appeared in the CRSP data (ln(AGE)) and the ratio of cash to assets in the last quarterly report before the month (CASH/ASSETS_{t-1}). Both DeAngelo et al. (2010) and Alti and Sulaeman (2012) show that firms are more likely to issue stock after recent stock price run-ups. Short selling also tends to increase after stock price run-ups, so I include the return on the stock over the previous 3 or 6 months ($\text{RET}_{t-3,\,t-1}$, $\text{RET}_{t-6,\,t-1}$) in some of the regressions. The results are reported in Table 4.

Panel A of Table 4 shows regression results when the dummy variable for an SEO filing during the month is the dependent variable. When it is regressed on the mean FEE the previous month, the coefficient is 0.0131 with a *t*-statistic of 7.11. After adjusting for the stock and the month with fixed effects, the greater is FEE the more likely is an SEO filing. The standard deviation of FEE is 0.0914, so for a specific stock, a 1-standard-deviation increase in FEE increases the likelihood of filing for an SEO in a month by $0.0914 \times 0.0131 = 0.0012$. For comparison, the unconditional likelihood of filing for an SEO during a month is 0.0077.

Regression 2 includes both the previous month's average FEE and the book-to-market ratio (BOOK/MARKET_{t-1}) as explanatory variables. BOOK/MARKET_{t-1} can be thought of as a measure of mispricing, with low book-to-market stocks more likely to be overpriced than high book-to-market stocks. It is also, however, a measure of growth opportunities with low BOOK/MARKET_{t-1} stocks having more potential investments than high BOOK/MARKET_{t-1} stocks. I calculate BOOK/MARKET_{t-1} as of the previous month using the book value per share from Compustat from the last annual report and the market value on the last day of the month. The coefficient on BOOK/MARKET_{t-1} is -0.0019 with a *t*-statistic of -8.09. This is consistent with firms being more likely to issue stock when there is a low book-to-market ratio because it signals either overpricing or investment

opportunities. For our purposes though, what is important is that the coefficient on the previous month's FEE does not decrease and in fact increases from 0.0131 to 0.0156. With a somewhat smaller number of observations, the *t*-statistic for the FEE in 2 is the same as in regression 1, 7.11. Any correlation between FEE and investment opportunities, as represented by BOOK/MARKET$_{t-1}$, appears to be small.

TABLE 4

Regressions of Dummy Variables for a Seasoned Equity Offering on Short Sale Constraints

In Table 4, FEE$_{t-1}$ is the average of daily borrowing FEEs over the previous month. UTILIZATION$_{t-1}$ is the average of the daily ratio of shares on loan to shares available to lend over the previous month. DCBS$_{t-1}$ is the average of the daily DCBS scores over the previous month. AGE is the number of months since the stock first appeared on CRSP. CASH, ASSETS, and book value (BOOK) are from the last quarterly report before month *t*. Market value (MARKET) is from the previous month. Regressions include fixed effects for the stock and the month. Financial firms and utilities are omitted.

	1	2	3	4	5	6	7
Panel A. Dependent Variable is a Dummy That Equals 1 if the Firm Filed for an Offering That Month							
INTERCEPT	0.0062	0.0080	0.0076	0.0071	0.0075	0.0755	0.0652
	(3.99)	(4.91)	(4.67)	(4.32)	(4.63)	(24.76)	(19.46)
FEE$_{t-1}$	0.0131	0.0156			0.0128	0.0130	0.0098
	(7.11)	(7.11)			(5.53)	(5.45)	(4.07)
UTILIZATION$_{t-1}$			0.000055		0.000040	0.000026	0.000020
			(6.09)		(4.24)	(2.72)	(2.06)
DCBS$_{t-1}$				0.00084			
				(6.37)			
BOOK/MARKET$_{t-1}$		−0.0019	−0.0020	−0.0020	−0.0020	−0.0007	−0.0007
		(−8.09)	(−8.27)	(−8.23)	(−8.28)	(−2.96)	(−2.80)
ln(AGE)						−0.0122	−0.0104
						(−27.11)	(−20.14)
CASH/ASSETS$_{t-1}$						−0.0119	−0.0126
						(−8.62)	(−9.10)
RET$_{t-3,\ t-1}$						0.0107	
						(22.95)	
RET$_{t-6,\ t-1}$							0.0064
							(21.50)
No. of obs.	426,149	391,643	390,422	391,643	390,364	379,715	365,766
Adj. R^2	0.0213	0.0225	0.0226	0.0225	0.0227	0.0286	0.0267
Panel B. Dependent Variable is a Dummy that Equals 1 if There Was a Seasoned Offering That Month							
INTERCEPT	0.0075	0.0097	0.0091	0.0086	0.0090	0.0685	0.0624
	(4.41)	(5.43)	(5.04)	(4.74)	(4.99)	(20.26)	(16.66)
FEE$_{t-1}$	0.0166	0.0190			0.0142	0.0144	0.0107
	(8.21)	(7.84)			(5.54)	(5.43)	(3.97)
UTILIZATION$_{t-1}$			0.000083		0.000067	0.000053	0.000053
			(8.41)		(6.45)	(4.96)	(4.81)
DCBS$_{t-1}$				0.00107			
				(7.34)			
BOOK/MARKET$_{t-1}$		−0.0028	−0.0029	−0.0028	−0.0029	−0.0018	−0.0016
		(−10.61)	(−10.85)	(−10.77)	(−10.86)	(−6.50)	(−5.59)
ln(AGE)						−0.0105	−0.0095
						(−21.06)	(−16.46)
CASH/ASSETS$_{t-1}$						−0.0210	−0.0222
						(−13.74)	(−14.38)
RET$_{t-3,\ t-1}$						0.0120	
						(23.12)	
RET$_{t-6,\ t-1}$							0.0086
							(26.18)
No. of obs.	426,149	391,643	390,422	391,643	390,364	379,715	365,766
Adj. R^2	0.0278	0.0296	0.0297	0.0296	0.0298	0.0351	0.0351

(continued on next page)

TABLE 4 (continued)

Regressions of Dummy Variables for a Seasoned Equity Offering on Short Sale Constraints

Panel C. Dependent Variable is a Dummy Variable for a Bond Offering That Month

	1	2	3	4	5	6
INTERCEPT	0.0065 (3.51)	0.0065 (3.51)	0.0067 (3.60)	0.0105 (3.34)	0.0092 (2.56)	0.0098 (3.11)
FEE_{t-1}	−0.0023 (−1.08)			−0.0023 (−1.05)	−0.0022 (−0.97)	−0.0026 (−1.16)
$UTILIZATION_{t-1}$		−0.000006 (−0.66)				
$DCBS_{t-1}$			−0.00018 (−1.30)			
ln(AGE)				−0.0006 (−1.47)	−0.0005 (−0.84)	−0.0005 (−1.23)
$CASH/ASSETS_{t-1}$				−0.0020 (−1.74)	−0.0018 (−1.52)	−0.0018 (−1.58)
$RET_{t-3,\ t-1}$				−0.0000 (−0.56)		−0.0000 (−0.60)
$RET_{t-6,\ t-1}$					0.0000 (0.73)	
$EQUITY\_OFFER_t$						0.0152 (8.91)
No. of obs.	426,322	426,322	426,322	415,333	399,344	415,333
Adj. R^2	0.0464	0.0464	0.0464	0.0467	0.0469	0.0469

In the third regression, the dummy variable for an SEO filing is regressed on the mean UTILIZATION the previous month, $BOOK/MARKET_{t-1}$, and stock and month fixed effects. Again, the likelihood of an SEO filing increases with the probability that a stock is overpriced as measured by UTILIZATION. The fourth regression in Panel A of Table 4 has DCBS in the previous month as the measure of overpricing. The coefficient on DCBS is 0.00084 with a *t*-statistic of 6.37. Regression 5 includes both the mean FEE and mean UTILIZATION from the previous month as explanatory variables. DCBS is not included as it is highly correlated with FEEs. The coefficients on both FEE and UTILIZATION are positive and highly significant. When stocks are hard to borrow, and hence overpriced, they are more likely to file for an SEO.

DeAngelo et al. (2010) find that a firm's life cycle is an important determinant of equity sales. Firms that have been public less than 5 years account for about 55% of all SEOs. They also show that the need for cash is an important motive for equity offerings. Hence, regression 6 includes ln(AGE), $CASH/ASSETS_{t-1}$, and $RET_{t-3,\ t-1}$ as explanatory variables. The coefficient on ln(AGE) is −0.0122 with a *t*-statistic of −27.11. This is consistent with the finding of DeAngelo et al. (2010) that equity offerings are more common for recently listed stocks. The coefficient on $CASH/ASSETS_{t-1}$ is −0.0119 with a *t*-statistic of −8.62. This is consistent with the result in DeAngelo et al. that an important motivation for equity offerings is to keep firms from running out of cash. The coefficient on $RET_{t-3,\ t-1}$ is 0.0107 with a *t*-statistic of 22.95. As in Alti and Sulaeman (2012), firms are more likely to issue shares after price increases.

However, even with all these other variables and with month and stock fixed effects, the coefficient of lagged FEE is 0.0130 with a *t*-statistic of 5.45 and the coefficient on lagged UTILIZATION is 0.000026 with a *t*-statistic of 2.72.

Firms are more likely to sell stock when short selling variables indicate it is overpriced. Finally, regression 7 includes $RET_{t-6,\ t-1}$ rather than $RET_{t-3,\ t-1}$. Using returns over the previous 6 months rather than the previous 3 months has little effect on the other regression coefficients.

Panel B of Table 4 replicates the regressions in Panel A but uses a dummy variable for an offering during the month as the dependent variable rather than a dummy variable for a filing for a seasoned offering. The results are similar to those in Panel A, but a bit stronger. As in Panel A, regressions contain fixed effects for stocks and months. In addition, as in Panel A, inclusion of $BOOK/MARKET_{t-1}$ has little effect on the coefficient or *t*-statistic of the previous month's FEE. The probability of a seasoned offering in a month increases with $RET_{t-3,\ t-1}$ and decreases with ln(AGE) and $CASH/ASSETS_{t-1}$. Coefficients for lagged FEE, lagged UTILIZATION, and DCBS are positive and highly significant in each regression. The coefficients and *t*-statistics for these variables are larger than the coefficients in Panel A when the dependent variable equaled 1 if there was a filing for an SEO. Possible mispricing of a stock appears to be more important in determining whether to actually sell shares during a month than whether to file for an offering.

Even after including firm and month fixed effects, and after adjusting for ln(AGE), $CASH/ASSETS_{t-1}$, and $BOOK/MARKET_{t-1}$, companies with hard to borrow stock are more likely to file for and conduct SEOs. Hard-to-borrow stocks, as categorized by FEE, UTILIZATION, or DCBS, are overpriced on average. This suggests that firms are more likely to take advantage of market timing opportunities and issue stock when it is overpriced.

An alternative explanation for the poor performance of stocks after SEOs is that it is the result of the low returns earned by firms taking advantage of investment opportunities. The low returns of firms taking investments could be because actual investments are less risky than options to take investments. Or, as *q*-theory explains, investment is greater when required returns are lower. An advantage of using measures of short selling to determine if stocks are overpriced is that stocks are only hard to borrow if short sellers believe that are overpriced. However, although it seems unlikely that firms with hard to borrow stock have more investments than other firms, there are plausible reasons why this could be true. Perhaps institutions that are a source of share loans avoid young growth firms and their shares are more difficult to borrow as a result. Perhaps disagreement about growth opportunities makes stocks hard to borrow. If measures of short sale restrictions are correlated with investment opportunities, we might see firms issuing more debt to finance investments when shares are more costly or difficult to borrow.

To test this, I download all nonconvertible debt offerings from 2006 to 2019 from SDC. I then match these offerings with measures of short sale constraints from IHS Markit. I estimate panel regressions with a dummy variable that equals 1 if the firm issued bonds that month. Regressions include fixed effects for the firm and each month from July 2006 to Dec. 2019. Regression estimates are presented in Panel C of Table 4. They are similar to the regressions in Panels A and B but have bond offerings as a dependent variable rather than equity offerings.

The first three regressions have, in addition to the firm and month fixed effects, the previous month's FEE, mean daily DCBS, and mean UTILIZATION as

explanatory variables. The coefficient on each variable is negative but insignificant. There is no evidence that firms are more likely to issue debt when shares are hard-to-borrow. The next two regressions include ln(AGE), CASH/ASSETS$_{t-1}$, and RET$_{t-3,\ t-1}$ or RET$_{t-6,\ t-1}$. The coefficient on the previous month's FEE remains negative and insignificant. The last regression includes a dummy variable that equals 1 if the firm has an SEO the same month (EQUITY_OFFER$_t$). The coefficient on that variable is positive and highly significant. A firm is more likely to issue bonds if it is also issuing equity that month. However, the coefficient on FEE remains negative if insignificant.

C. Mispricing and Other Motives for SEOs

Of course, not all firms sell shares in an SEO because they believe their shares are overpriced. For SEOs motivated by mispricing, shares could be expected to underperform after the offering. Poor long-run performance, however, need not follow other SEOs. To examine whether different motives for SEOs are associated with different long-run performance, I separate stocks that were hard to borrow at the time of their SEO from other stocks with SEOs. I then calculate the average difference between the return of hard to borrow stocks and the value-weighted market return and the average difference between the returns of other stocks and the market return for each of the 36 event months following the SEO. Stocks with prices of less than $5 2 months before are not included in portfolios to minimize the impact of bid–ask bounce and noise on returns. Figure 1 contains graphs of these return differences.

In Graph A of Figure 1, I define hard to borrow stocks as those with a FEE of 10% or more. For most of the 36 months after an SEO, the excess return, defined as the difference between the returns of the hard to borrow stocks and the return of the value-weighted market, is negative. This is especially true for the first 24 months following the SEO. In contrast, low FEE stocks, defined as those with fees of less than 2% at the offering, have excess returns that are usually positive and always close to 0 for the 36 months after the SEO. In Graph B, hard to borrow firms are defined as those with utilization of 75% or greater at the time of their SEO. With this definition of hard to borrow, excess returns are again negative in most of the 36 months after an SEO for hard to borrow stocks. For low UTILIZATION stocks, excess returns are generally small but positive in the 36 months after an SEO. In Graph C, hard to borrow stocks are defined as those with a DCBS score of 4 or more. As before, the average excess returns are negative for hard to borrow stocks for most of the 36 months following an SEO. For easily borrowed stocks with DCBS less than 2, excess returns are positive for about half of the months and always close to 0.

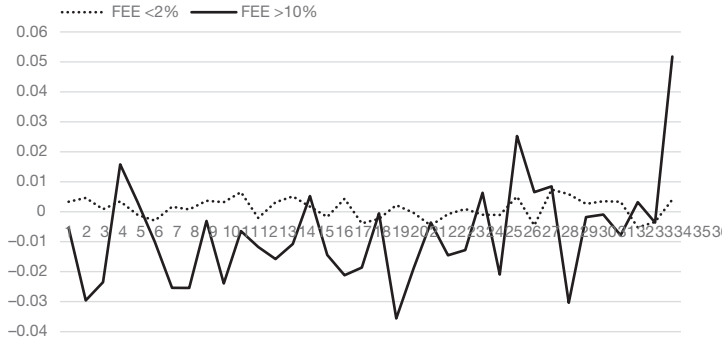
For each month over Aug. 2006-2020, I form an equal-weighted portfolio of hard to borrow stocks with SEOs in the previous 24 months, and a portfolio of stocks that were not hard to borrow but had an SEO in the previous 24 months. I do this using FEE, UTILIZATION, and DCBS as measures of the difficulty of borrowing shares. To minimize the impact of bid–ask bounce, I only include stocks with prices of $5 or more 2 months before. The returns of these portfolios are regressed on the Fama–French–Carhart 4 factors.

FIGURE 1

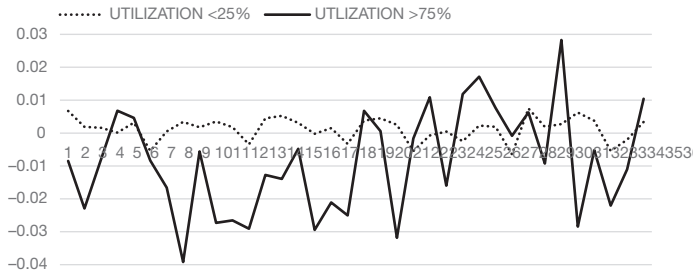
Excess Returns of Hard-to-Borrow Stocks and Others After SEOs

In Figure 1, differences between returns of stocks with recent seasoned equity offerings (SEOs) and value-weighted market returns are calculated for the 36 months after SEOs for hard-to-borrow stocks and other stocks.

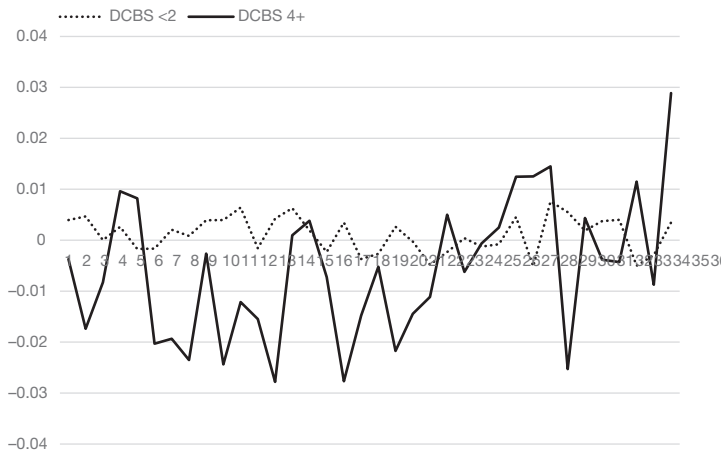
Graph A. Excess Returns Following SEOs for High and Low Fee Stocks



Graph B. Excess Returns After SEOs of High and Low Utilization Stocks



Graph C. Excess Returns After SEOs for High and Low DCBS Stocks



The first 3 rows of Panel A of Table 5 report regressions of portfolio returns on the 4 factors when a FEE of 10% or more defines hard to borrow stocks, whereas the other stocks have a FEE of less than 2%. The number of observations is small, just 152 monthly returns for the high FEE portfolio. Information on the stock lending market is only available for July 2006 to Dec. 2019. Portfolios are formed using stocks that had SEOs in the previous 24 months. For the beginning of the sample period, we can only determine if SEOs in a small number of earlier months had been hard to borrow. I omit early sample months with less than three hard to

TABLE 5

Calendar-Time Regressions of Returns of Portfolios of Hard-to-Borrow and Other Stocks on the Fama–French–Carhart 4 Factors

In Table 5, a stock is included in the portfolio for a calendar month if the company had a seasoned equity offering (SEO) within the previous 24 months. A stock is not included in the portfolio if its price 2 months before was less than $5. The sample period is 2007–2019. Stocks are classified as hard-to-borrow based on the lending market for the stock in the SEO month. Three different definitions of hard-to-borrow are used: a borrowing FEE of 10% or more, a UTILIZATION of 75% or more, or a DCBS of 4 or greater. RMKT is the return on the value-weighted market portfolio minus the risk-free rate. SMB is the return on small stocks minus the returns on big stocks. HML is the return on value (high market value to book value) stocks minus the return on growth stocks. UMD is the return on stocks with high returns (up) minus the return on stocks with low returns (down).

Panel A. Borrowing FEEs Are Not Included in Returns

	INT.	RMKT	SMB	HML	UMD	Obs.	Adj. R^2
FEE < 2%	−0.0014	1.2112	0.9332	−0.2638	−0.0337	167	0.9340
	(−0.99)	(35.59)	(14.75)	(−4.86)	(−0.98)		
FEE ≥ 10%	−0.0115	1.1123	1.0538	−0.2392	−0.4341	152	0.6404
	(−2.40)	(9.81)	(5.11)	(−1.36)	(−3.81)		
$FEE^{<2\%} - FEE^{>10\%}$	0.0101	0.0679	−0.0828	−0.0145	0.3826	152	0.0749
	(2.15)	(0.61)	(−0.41)	(−0.08)	(3.43)		
UTILIZATION < 25%	−0.0002	1.1871	0.8434	−0.2539	−0.0459	167	0.9242
	(−0.13)	(33.41)	(12.78)	(−4.49)	(−1.28)		
UTILIZATION ≥ 75%	−0.0150	1.2251	0.9769	−0.6488	−0.2775	165	0.6424
	(−3.50)	(12.03)	(5.17)	(−4.01)	(−2.69)		
$UTL.^{<25\%} - UTL.^{>75\%}$	0.0150	−0.0428	−0.1267	0.3951	0.2294	165	0.0306
	(3.52)	(−0.42)	(−0.67)	(2.45)	(2.23)		
DCBS < 2	−0.0014	1.2081	0.9203	−0.2654	−0.0337	167	0.9342
	(−0.97)	(35.75)	(14.65)	(−4.93)	(−0.99)		
DCBS ≥ 4	−0.0092	1.1311	1.0341	−0.3279	−0.4246	165	0.7007
	(−2.35)	(12.24)	(6.03)	(−2.23)	(−4.54)		
$DCBS^{<2} - DCBS^{>4}$	0.0079	0.0744	−0.1102	0.0629	0.3900	165	0.1319
	(2.15)	(0.88)	(−0.68)	(0.45)	(4.40)		

Panel B. Borrowing FEEs Are Included in Returns of Hard-to-Borrow Stocks

FEE < 2%	−0.0013	1.2182	0.9002	−0.2973	−0.0299	155	0.9298
	(−0.94)	(34.07)	(14.06)	(−5.15)	(−0.88)		
FEE ≥ 10%	−0.0008	1.1676	1.1170	−0.2891	−0.3997	140	0.6245
	(−0.17)	(9.42)	(5.17)	(−1.50)	(−3.43)		
$FEE^{<2\%} - FEE^{>10\%}$	−0.0004	0.0155	−0.1758	0.0048	0.3504	140	0.0700
	(−0.09)	(0.13)	(−0.83)	(0.03)	(3.07)		
UTILIZATION < 25%	0.0001	1.1822	0.8099	−0.3042	−0.0417	155	0.9194
	(0.07)	(32.02)	(12.25)	(−5.11)	(−1.18)		
UTILIZATION ≥ 75%	−0.0054	1.0957	1.2293	−0.4740	−0.3166	153	0.6518
	(−1.33)	(10.68)	(6.70)	(−2.87)	(−3.24)		
$UTL.^{<25\%} - UTL.^{>75\%}$	0.0057	0.0810	−0.4113	0.1693	0.2723	153	0.0606
	(1.43)	(0.80)	(−2.26)	(1.03)	(2.81)		
DCBS < 2	−0.0013	1.2105	0.8647	−0.2855	−0.0517	155	0.9372
	(−0.98)	(36.17)	(14.43)	(−5.29)	(−1.62)		
DCBS ≥ 4	0.0014	1.1270	1.1302	−0.3522	−0.4109	153	0.7179
	(0.39)	(12.30)	(6.90)	(−2.39)	(−4.71)		
$DCBS^{<2} - DCBS^{>4}$	−0.0025	0.0807	−0.2612	0.0668	0.3581	153	0.1321
	(−0.76)	(0.96)	(−1.73)	(0.49)	(4.45)		

borrow SEOs. Returns for the year 2020 are included, but I do not have short sale constraints for that year, so no SEOs from that year are included in the portfolios. For both the hard to borrow and easy-to-borrow SEO portfolios, the coefficient on SMB (small stocks minus big stocks) is positive and significant. The firms that conduct SEOs are small firms. The coefficients on HML (value stocks minus growth stocks) and UMD (high past return minus low past return stocks) are negative. Our main interest is the intercept. It is −0.0014 for low FEE stocks. Therefore, stocks that are not very difficult to borrow earn alphas of −14 basis points per month following SEOs. For the high FEE portfolio, the intercept is −0.0115 with a *t*-statistic of −2.40. These stocks underperform by 1.15% per month. The third row has the coefficient for a portfolio formed by going long the low FEE stocks and short the high FEE stocks. The intercept coefficient is 0.0101, or 1.01% per month with a *t*-statistic of 2.15.

The next 3 rows provide regression coefficients for portfolios formed on the basis of UTILIZATION at the time of their SEO. UTILIZATION of 75% or more is used to define hard to borrow stocks. Other stocks have UTILIZATIONs of 25% or less. The regression intercept is −0.0002, or − 2 basis points per month for stocks that are not hard to borrow. For stocks with UTILIZATION of 75% or more, the intercept is −0.0150 or − 1.5% per month. The *t*-statistic of −3.50 shows that stocks that are hard to borrow, as measured by UTILIZATION, underperform relative to the 4-factor model. The following row shows coefficients for the portfolio that goes long SEO stocks with low UTILIZATION and short SEO stocks with UTILIZATION of 75% or more. The intercept is 0.0150 with a *t*-statistic of 3.52.

The last 3 rows report regressions when a DCBS of 4 or more defines a hard-to-borrow stock. As with the other definitions, stocks that are easily borrowed underperform far less after an SEO than stocks that are costly to borrow. The regression intercept for the portfolio of stocks with a DCBS of less than 2 is −0.0014, whereas the regression intercept for portfolios of stocks with a DCBS of 4 or more is −0.0092 with a *t*-statistic of −2.35. The portfolio that goes long stocks with a DCBS of less than 2 and short the stocks with a DCBS of 4 or greater has an intercept of 0.0079 with a *t*-statistic of 2.15. Hence, the alpha of the long-short portfolio is significantly different from 0 at the 5% level.[2]

If the shares are not hard to borrow at the time of the offering, stocks, on average, underperform by small and insignificant amounts. This is consistent with most firms selling shares because they need capital. Stocks that are hard to borrow do underperform significantly following an SEO. These firms appear to be trying to exploit mispricing by selling overvalued equity.

Firms may be able to profitably exploit overpricing of their shares by issuing equity. Short sellers, however, must pay borrowing fees, and these costs may eliminate any profits from the short selling. To see if the poor performance of recent

[2]As Figure 1 shows, underperformance by hard-to-borrow stocks is concentrated in the first 24 months after the SEO. Results are weaker when the calendar-time regressions use stocks that have had SEOs in the previous 36 months. The intercept coefficient changes from −0.0115 to −0.0084 (*t*-stat of −1.85) for high FEE stocks, from −0.0150 to −0.0110 (*t*-stat of −2.64) for high UTILIZATION stocks, and from −0.0092 to −0.0060 (*t*-stat of −1.68) for high DCBS stocks.

issuers presents a profit opportunity for short sellers, I add back the FEE for each stock each month to the returns of hard to borrow stocks.[3] Therefore, for example, if a stock returns −1% during a month before including FEE, it appears that a short seller could earn a 1% return that month. If the short seller has to pay a FEE of 0.5% that month, adding the FEE to the stock return gives a net return of −0.5%. The short seller could expect a return of 0.5% after paying the FEE.

Returns including FEE are regressed on the Fama–French–Carhart factors. Regression results are presented in Panel B of Table 5.[4] When FEE is included, the regression intercepts, or abnormal returns, are not statistically different from 0 for the hard to borrow stocks. In Panel A, when hard to borrow is defined as a FEE of 10% or more, the regression intercept, or monthly abnormal return, is −1.15%. When FEE is included in the returns in Panel B, the abnormal return for the hard to borrow stocks is just −0.08%. When hard to borrow is defined as UTILIZATION of 75% or more, abnormal returns are −1.50% before including FEE, and −0.54% after incorporating FEE. For DCBS of 4 or more, abnormal returns are −0.92% without FEE in Panel A and 0.14% with FEE in Panel B. After including FEE, shorting hard to borrow stocks after SEOs does not appear to be profitable.

By the same token, it may not be foolish to continue to hold stocks after an SEO. Stocks that are not hard to borrow do not appear to underperform. Stocks that are hard to borrow do not appear to underperform *if the owner lends the shares.* Of course, every share must be owned by somebody, so some investors who hold shares in hard to borrow stocks with recent SEOs will lose money.

Panel B of Table 5 also shows the abnormal returns to a strategy of going long the recent SEOs of easily sorted stocks and short the SEOs of hard to borrow stocks when short sellers pay the FEE. Regardless of whether hard to borrow is defined by FEE, UTILIZATION, or DCBS, the abnormal returns of the long-short portfolio strategy are never significantly different from 0.[5]

To summarize, overpricing appears to be an important determinant of when firms issue equity in SEOs. Stocks are expensive or difficult to borrow only if short sellers believe the stock is significantly overpriced and are willing to pay high fees to short it. Firms are much more likely to conduct SEOs when their shares are hard to borrow and overpriced than when they are easily borrowed. Stocks that are hard to borrow at the time of their SEO do earn poor returns afterward. Short sellers do not appear to profit from shorting these stocks after paying the FEE. Firms, on the other hand, can profit from the mispricing by selling shares.

[3]FEE is annualized, so I use the 12th root of the annualized FEE here.

[4]Panel A regressions include 2020 returns. I do not have FEEs for 2020, so regressions in Panel B go through 2019 and thus have fewer observations.

[5]I only include FEE in calculating returns to the short side of the long-short strategy. In theory, the long position in the easily borrowed stock could generate lending fees. I ignore this for three reasons. First, utilization rates are low for easily borrowed stocks. Every short seller has to pay the FEE to borrow shares, but the great majority of investors in easily borrowed stocks will not find a borrower even if they want to lend. Second, FEE is low for these stocks anyway. Finally, after paying intermediaries, the lending fees received by most share lenders are only 75%–80% of the already low FEE.

D. Short Selling and SEOs as Alternative Ways to Supply Shares to the Market

One way to think of short selling is that it is a market response to a shortage of outstanding shares. When a short seller borrows shares and sells them, the lender retains his equity stake in the company and the buyer of the shorted shares gets a new equity position. There are more shares available for investors who want long positions and the demand for shares is satisfied. Underwriting fees and other costs associated with an SEO are significant, so when borrowing costs are low, short sellers may be able to supply shares at a lower cost than firms.

When, however, there is a heavy demand for shares but there are few shares available to borrow, the cost of borrowing will be high. Short sellers can only meet demand by paying these high borrowing costs. In this situation, the low-cost provider of shares is the firm itself. Selling shares may also be less risky for the firm than for short sellers. For hard to borrow stocks, the risk that a short seller will be forced to close a short position because a loan is recalled is high (see Schultz (2020)). Risks to the firm from selling shares, on the other hand, are small. If the firm is right and sells shares at a price above intrinsic value, managers have made the survival of the firm more likely. If they are wrong, and sell underpriced equity, they have presided over a rising share price and selling shares along the way is likely to be overlooked.

Therefore, when FEE is low, short sellers are the lower-cost suppliers of shares and SEOs will be less common (ignoring the need to sell equity to make investments). When borrowing costs are high, firms will be the lower cost suppliers of shares and SEOs will be more common. The costs of SEOs will vary across firms and over time, however, and firms with low costs of SEOs will become the suppliers of shares when FEE is lower. Firms with high costs for SEOs will not become low-cost supplier of shares until FEE is high. Therefore, SEOs completed when FEE and other measures of short selling constraints are high will tend to have higher issuing costs.

The last column of Panel A of Table 3 reports the mean underwriting fee (UFEE) as a percentage of the offering proceeds for offerings that took place for stocks in different DCBS categories. There are of course other costs of an SEO, including management time and the possibility of revealing valuable information to competitors, but UFEE is a major part of the cost of issuing equity. The mean UFEE is lowest, at 4.12%, for SEOs that took place when stocks were easily borrowed. The mean UFEE increases with DCBS and reaches 6.41% for DCBS greater than 9. Firms that face high SEO costs become the low-cost supplier of shares only when DCBS is high. Panel B reports the mean UFEE for offerings that took place when FEE is at various levels. UFEE increases monotonically with FEE. Again, firms with high SEO costs only become the low-cost supplier of shares when FEE is high. Or, put another way, shares have to be overpriced by a lot before firms with high issuing costs conduct SEOs. Finally, Panel C shows that UFEE increases monotonically with UTILIZATION.

It is difficult to compare the costs of an SEO with the costs of supplying shares through short sales. FEE and UFEE are not directly comparable. UFEE is a one-time cost expressed as a percentage of the amount of money raised in the

underwriting. FEE is the annualized stock borrowing fee and depends on the length of time that the short position is held open. There are also fixed costs of an SEO which may mean that short sales are the cheapest way to supply a small number of shares while SEOs may be a cheaper source of large numbers of shares. In addition, there are intangible costs of SEOs that are difficult to quantify. SEOs consume management time and can reveal information to competitors. Short selling, on the other hand, presents risks for the short seller like changing levels of FEE or short squeezes that are not present for an issuing firm. These factors make it difficult to determine exactly when additional shares are cheapest to create through SEOs or short sales, and indeed if short selling is ever cheapest. Nevertheless, the evidence presented here suggests that SEOs and short sales are alternative ways of supplying shares and that advantages of SEOs grow with the costs and difficulty of short selling.

There are two reasons to expect short selling constraints to ease following an SEO. First, it is likely that some of the newly issued shares will be made available for lending. Second, shares supplied by SEOs substitute for shares supplied by short sales. With a downward sloping demand curve for shares, an increase in the supply of shares from an SEO will lower stock prices, make shorting less profitable, and reduce the number of shares borrowed. To test whether short selling constraints are relaxed following SEOs, I form a portfolio of equity issuers and calculate the average changes in DCBS, FEE, and UTILIZATION for up to 60 days past the offering date. These measures tend to revert to their means over time, so for each SEO, I construct a matching portfolio of stocks with the same DCBS on the offer date or FEE or UTILIZATION within 1% of the SEO firm's on the offer date. Therefore, for example, if FEE is 1%, matching firms would have FEE between 0.99% and 1.01% on the same day. Up to 10 firms are placed in a matching portfolio. The average change in the lending variable for stocks in the matching portfolio is subtracted from the change in the lending variable for the SEO stocks to get an excess change in the lending variable that can be attributed to the SEO.

The results are shown in Table 6. Panel A reports changes in DCBS after SEO offer dates. Following the offering date, DCBS initially increases slightly, by 0.0224 on day 3 and then falls. The change in DCBS is −0.0250 with a *t*-statistic of −2.58 on day +5, −0.1033 (*t*-stat of −8.58) on day 10, and reaches −0.2238 (*t*-stat of −13.48) 60 days after the offering. For comparison, the average value of DCBS on offering dates is 2.22.

The change in DCBS for stocks with DCBS greater than 3 is shown next. For these stocks, DCBS declines immediately after the offering date, perhaps as a result of mean reversion. The decline in DCBS accelerates 5 days after the offering and reaches −0.6355 (*t*-stat of −12.20) 10 days after and − 1.1638 (*t*-stat of −16.18) 60 days following the offering.

Changes in DCBS after subtracting DCBS changes for the matching portfolio are reported next. These results indicate that most of the reduction in DCBS occurs as a result of the SEO and not from mean reversion. For example, when all stocks are included, after 10 days, the change in DCBS is −0.1033 and the change in DCBS after taking out the change for matching stocks is −0.0874 (*t*-stat of −6.58). When only stocks with DCBS greater than 3 are included, the raw change in DCBS

TABLE 6

Changes in Short Selling Measures in the Days Following SEOs Filings and Offerings

In Table 6, mean changes in DCBS, FEEs, and UTILIZATION are calculated from seasoned equity offering (SEO) filing dates and offer dates from 1 to 60 days afterward. Matching firm portfolios are formed by finding stocks with the same DCBS on the filing or offering date or stock with FEEs or UTILIZATION that are within 1% of the FEEs or UTILIZATION of the SEO stock on the filing or offering date. Up to 10 stocks are placed in the matching portfolios. Changes in the lending FEE measures for the matching stocks are equal-weighted averages of the changes for the stocks in the matching portfolios. Financial firms and utilities are omitted.

Panel A. Changes in DCBS

	ΔDCBS		ΔDCBS ($DCBS_0 > 3$)		ΔDCBS − Match ΔDCBS		ΔDCBS − Match Δ DCBS ($DCBS_0 > 3$)	
	Obs.	ΔDCBS	Obs.	ΔDCBS	Obs.	Diff.	Obs.	Diff.
Offer Date to								
+1	4,416	0.0020 (0.34)	812	−0.0690 (−3.07)	3,735	0.0164 (2.34)	666	0.0218 (0.81)
+2	4,419	0.0081 (1.14)	812	−0.0788 (−2.78)	3,737	0.0262 (3.23)	666	0.0509 (1.59)
+3	4,414	0.0224 (2.80)	810	−0.0642 (−2.07)	3,733	0.0409 (4.36)	665	0.0907 (2.45)
+5	4,403	−0.0250 (−2.58)	805	−0.2658 (−6.59)	3,724	−0.0092 (−0.84)	662	−0.0761 (−1.63)
+10	4,395	−0.1033 (−8.58)	801	−0.6355 (−12.20)	3,720	−0.0874 (−6.58)	660	−0.3833 (−6.53)
+20	4,345	−0.1549 (−11.16)	784	−0.8355 (−13.76)	3,680	−0.1419 (−9.39)	654	−0.5500 (−7.96)
+60	4,290	−0.2238 (−13.48)	763	−1.1638 (−16.18)	3,596	−0.2053 (−11.42)	639	−0.6393 (−7.71)

Panel B. Changes in FEE

	ΔFEE		ΔFEE ($FEE_0 \geq 10\%$)		ΔFEE − ΔMatch FEE		ΔFEE − ΔMatch FEE ($FEE_0 > 10\%$)	
	Obs.	ΔFEE	Obs.	ΔFEE	Obs.	Diff.	Obs.	Diff.
Offer Date to								
+1	4,416	0.0003 (0.57)	498	−0.0013 (−0.30)	3,726	0.0007 (1.33)	401	0.0035 (0.76)
+2	4,419	0.0005 (0.91)	497	−0.0013 (−0.27)	3,728	0.0011 (1.89)	400	0.0067 (1.40)
+3	4,483	0.0014 (1.89)	495	0.0015 (0.27)	3,723	0.0023 (2.63)	398	0.0117 (1.80)
+5	4,403	−0.0021 (−2.22)	492	−0.0249 (−3.17)	3,724	−0.0007 (−0.69)	397	−0.0084 (−0.94)
+10	4,395	−0.0065 (−5.71)	490	−0.0581 (−6.06)	3,710	−0.0048 (−4.16)	396	−0.0381 (−3.71)
+20	4,345	−0.0090 (−7.56)	477	−0.0782 (−7.84)	3,680	−0.0067 (−5.92)	391	−0.0489 (−4.95)
+60	4,290	−0.0107 (−8.39)	464	−0.0928 (−8.82)	3,585	−0.0097 (−7.69)	378	−0.0591 (−5.39)

Panel C. Changes in UTILIZATION

	ΔUTILIZATION		ΔUTL. ($UTL_{-0} \geq 75\%$)		ΔUTL. − ΔMatch UTL.		ΔUTL. − ΔMatch UTL. ($UTL_{-0} > 75\%$)	
	Obs.	ΔUTL.	Obs.	ΔUTL.	Obs.	Diff.	Obs.	Diff.
Offer Date to								
+1	4,464	0.1095 (1.31)	437	−1.7817 (−3.85)	3,765	0.3118 (3.09)	378	0.4138 (0.74)
+2	4,465	0.1553 (1.35)	436	−4.4857 (−7.15)	3,766	0.5949 (4.50)	377	−0.1910 (−1.65)
+3	4,460	0.1126 (0.64)	436	−9.9309 (−11.43)	3,762	0.5975 (3.05)	377	−6.3294 (−6.51)
+5	4,459	−4.4069 (−20.02)	433	−19.861 (−17.33)	3,763	−3.7852 (−15.89)	375	−14.991 (−12.00)
+10	4,455	−6.1805 (−26.21)	433	−23.230 (−18.74)	3,760	−5.4126 (−21.53)	376	−15.837 (−11.73)
+20	4,417	−6.5088 (−26.64)	428	−24.594 (−19.14)	3,728	−5.1532 (−20.13)	372	−13.732 (−9.58)
+60	4,352	−5.1151 (−18.75)	420	−24.148 (−18.65)	3,637	−2.8528 (−9.92)	363	−5.438 (−3.53)

is −0.8355 after 20 days, whereas the difference in changes between SEO stocks and matching stocks is −0.5500 (*t*-stat of −7.96).

Panel B of Table 6 shows changes in FEE following SEOs. Results are similar to those in Panel A. FEE begins to decline about 5 days following the SEO and continues to decline afterward. Most of the decline in FEE continues after subtracting out the decline in FEE for matched firms, so most of the decline is associated with SEOs. Panel C shows changes in UTILIZATION after SEOs. Again, UTILIZATION starts to decrease about 5 days after the offering and continues to decrease for 60 days afterward. Most of the decline in UTILIZATION remains after subtracting out the change of matching firms.

Short sales and SEOs are two ways to provide additional shares to investors who want to take long positions. Table 6 shows that stocks become easier to borrow after SEOs. On the one hand, this could be because there is less demand to borrow shares because the new shares issued in an SEO are substitutes for the shares created by short selling. On the other hand, shares could become easier to borrow after an SEO because more shares are made available to lend.

For each stock with an SEO, I calculate the percentage change in shares available to borrow and the percentage change in shares on loan from the offering date to several later dates. We would expect the shares available to borrow to increase after an SEO as some of the SEO purchasers will offer their shares to lending agents. We might expect the shares on loan to increase following an SEO as a result of additional shares made available to borrow. On the other hand, if shares supplied in an SEO are substitutes for shares supplied by short sellers, the number of shares on loan could decrease. Changes in shares available to lend and shares on loan could also occur if FEE is high at the time of the SEO and more shareholders elected to lend shares. To account for this possibility, I select a matching firm for each SEO that has the same DCBS or UTILIZATION or FEE (within 1%) as the SEO firm's on the offer date. I then calculate the proportion of SEO firms with bigger changes in shares available to lend and shares on loan for dates after the SEO.[6]

Panel A of Table 7 shows the proportion of SEO stocks with larger percentage increases (or lower percentage decreases) in shares available to borrow than their matching stocks. Results are similar whether matching stocks are determined by FEE, DCBS, or UTILIZATION. About 53% of SEO stocks had a greater proportional increase in shares available to lend than their matches when the increase is measured from the offer date to the day after. After 5 days, about 80% of SEO stocks have had a greater proportional increase in shares available to lend than their matches. This proportion decreases somewhat by day $t + 60$, but even then more than 3 quarters of stocks had greater increases in shares available to lend than their matches. *Z*-statistics, shown in parentheses under the proportions, are calculated using a normal approximation to the binomial distribution and test whether the proportions differ from 50%. In each case, regardless of the number of days after the SEO offering and whether DCBS, FEE, or UTILIZATION determines the match,

[6]Both the percentage change in shares on loan and the percentage change in shares available to lend can take very large values if the denominator is small. Hence, I calculate the proportion with bigger changes to avoid the effects of outliers on average changes.

TABLE 7

The Proportion of Stocks with SEOs with Greater Increases in Shares Available to Lend and Shares on Loan than Stocks Matched on DCBS, UTILIZATION, or FEEs

In Table 7, for each stock with a seasoned equity offering (SEO), I calculate the percentage change in shares available to lend and percentage change in shares on loan from the offering date to several later dates. I select a matching firm with the same DCBS on the SEO date or UTILIZATION or FEES within 1% of the SEO's firms. I then compare the percentage change in available shares and shares on loan for the matching firm with the percentage change by the SEO firm. The proportion of SEO firms with bigger changes in shares available to lend and shares on loan is hence calculated for dates after the SEO. *Z*-statistics, shown in parentheses under the proportions, are calculated using a normal approximation to the binomial distribution and test whether the proportions differ from 50%.

	DCBS Match	UTILIZATION Match	FEE Match
Panel A. Proportion of SEO Stocks with Greater Increases in Shares Available to Loan After the Offering			
Day $t+1$	53.72% (4.36)	53.35% (4.04)	52.63% (3.08)
Day $t+2$	55.95% (6.94)	56.82% (8.21)	55.97% (6.97)
Day $t+3$	67.26% (20.09)	66.95% (20.41)	67.43% (20.31)
Day $t+5$	81.12% (36.15)	81.56% (37.96)	82.11% (37.38)
Day $t+10$	79.22% (33.75)	80.27% (36.29)	81.60% (36.57)
Day $t+20$	78.24% (32.04)	79.78% (35.40)	80.53% (34.94)
Day $t+60$	76.28% (28.69)	78.16% (32.60)	79.31% (32.65)
Observations $t+1$	3,425	3,642	3,418
Panel B. Proportion of SEO Stocks with Equal or Greater Increases in Shares on Loan After the Offering			
Day $t+1$	53.46% (3.87)	54.82% (5.81)	53.69% (4.19)
Day $t+2$	56.90% (7.69)	57.43% (8.95)	56.78% (7.68)
Day $t+3$	56.28% (6.99)	57.05% (8.48)	56.05% (6.86)
Day $t+5$	40.10% (−11.00)	42.03% (−9.57)	41.85% (−9.22)
Day $t+10$	36.22% (−15.24)	38.49% (−13.78)	37.42% (−14.17)
Day $t+20$	40.42% (−10.47)	43.01% (−8.30)	41.03% (−10.01)
Day $t+60$	48.50% (−1.59)	52.56% (2.96)	48.90% (−0.60)
Observations $t+1$	3,120	3,634	3,228

the *Z*-statistic indicates that the proportion is significantly different from 50%. SEO stocks have greater increases in shares available to lend than other stocks with the same borrowing market characteristics.

Panel B of Table 7 shows the proportion of SEO stocks with a percentage increase in shares on loan that is at least as large as the increase in shares on loan of its matching stock.[7] For the first 3 days after the SEO, 53%–57% of SEO stocks have a percentage increase in shares on loan that is at least as large as the percentage

[7]To be conservative, Panel B shows the proportion of matched pairs in which the SEO firm has a percentage increase in shares on loan that is the *same or greater* than the percentage of the matched firm. In contrast, in Panel A, I calculate the proportion of stocks with *strictly larger* increases in shares available to loan.

increase in shares on loan for their matching stocks. This changes though for 5–20 days after the SEO. For these days, the majority of SEO stocks have smaller increases in shares on loan than their matches. On day $t + 10$, for example, only 36.22% of firms have a percentage increase in shares on loan that is equal to or exceeds the increase in shares on loan of stocks matched by DCBS.

Therefore, following SEOs, stocks become easier to short. FEE, UTILIZATION, and DCBS all decline. Relative to matching stocks, shares available to loan increase following SEOs, whereas shares actually on loan decrease. This is consistent with SEOs and short selling, being alternative ways to supply shares to the market.

VI. Mispricing and Share Repurchases

Impediments to taking long positions in underpriced shares are minimal, but a firm can still exploit underpricing through repurchases if the managers have private information. Unlike share offerings that are publicly announced, firms can quietly repurchase shares without notifying other market participants. The market's reaction to repurchases may take place long after the firm has bought back shares.

Compustat provides quarterly data on shares outstanding, treasury stock, and mean repurchase prices from July 2006 to 2019. For each stock each quarter, I set a dummy variable equal to 1 if there were repurchases in the quarter. Following Fama and French (2001) and Cho, Han, Kim, and Kim (2017), I identify a repurchase by an increase in treasury stock during the quarter. I also require a mean repurchase price in Compustat. A second dummy variable for large repurchases is 1 if the number of shares in treasury stock increased by at least 1% of shares outstanding and Compustat has a repurchase price for the quarter. I eliminate quarters in which the shares outstanding increase by 25% or more. This eliminates quarters in which splits could affect the number of treasury shares as well as quarters when firms are issuing stock and unlikely to repurchase shares. For each stock each quarter, I match the Compustat data with the IHS Markit data on the FEE, DCBS, and UTILIZATION.

I calculate the mean FEE, mean DCBS, and mean UTILIZATION using all daily observations in the month before the start of each quarter. Panel A of Table 8 reports the proportion of stock quarters with share repurchases for different levels of DCBS. When DCBS equals 1, as it does with most stocks, shares are repurchased in just under 19% of the stock quarters and large repurchases occur in 5.99% of stock quarters. If firms attempt to repurchase stock when it is underpriced, we would expect firms to become more and more reluctant to repurchase as DCBS increases. That is what we find. When DCBS in the month before the quarter goes from 1 to greater than 1 and less than or equal to 2, the proportion of stock quarters with repurchases falls from 18.99% to 6.86%. The proportion of quarters with large stock repurchases drops from 5.99% to 1.92%. As DCBS increases, the stock becomes harder to borrow and more likely to be overpriced, and the likelihood of a share repurchase continues to decline. The likelihood of a large share repurchase also decreases as DCBS increases, and the stock becomes harder to borrow. These results are consistent with firms repurchasing shares when they believe their shares are undervalued, or at the very least not overvalued.

TABLE 8

The Proportion of Stock Quarters with Share Repurchases

In Table 8, a stock is classified as having a repurchase during a quarter if the number of treasury shares increases, Compustat lists a mean repurchase price, and the number of shares outstanding does not increase by 25% or more. Large repurchases occur when treasury stock increases by 1% or more of shares outstanding during the quarter.

	Observations	$D_{REPURCHASE}$	$D_{REPURCHASE>1\%\_OUT}$
Panel A. Proportion of Stock Quarters with a Repurchase for Different Levels of DCBS the Month Before the Quarter			
$DCBS_{t-3} = 1$	237,477	0.1899	0.0599
$1 < DCBS_{t-3} \leq 2$	49,321	0.0686	0.0192
$2 < DCBS_{t-3} \leq 3$	25,736	0.0407	0.0105
$3 < DCBS_{t-3} \leq 4$	20,847	0.0323	0.0083
$4 < DCBS_{t-3} \leq 5$	14,987	0.0256	0.0077
$5 < DCBS_{t-3} \leq 6$	9,429	0.0218	0.0060
$6 < DCBS_{t-3} \leq 7$	8,809	0.0241	0.0062
$7 < DCBS_{t-3} \leq 8$	4,449	0.0202	0.0024
$8 < DCBS_{t-3}$	8,323	0.0208	0.0049
Panel B. Proportion of Stock Quarters with Repurchases Sorted by Borrowing FEEs (FEE) the Month Before the Quarter			
$FEE_{t-3} < 0.005$	227,559	0.1957	0.0619
$0.005 \leq FEE_{t-3} < 0.01$	32,914	0.0812	0.0234
$0.01 \leq FEE_{t-3} < 0.03$	38,993	0.0471	0.0119
$0.03 \leq FEE_{t-3} < 0.05$	21,305	0.0384	0.0108
$0.05 \leq FEE_{t-3} < 0.10$	30,969	0.0265	0.0069
$0.10 \leq FEE_{t-3}$	27,638	0.0214	0.0051
Panel C. Proportion of Stock Quarters with Repurchases by UTILIZATION the Month Before the Quarter			
$UTILIZATION_{t-3} < 5\%$	131,793	0.1804	0.0546
$5\% \leq UTILIZATION_{t-3} < 25\%$	126,995	0.1547	0.0492
$25\% \leq UTILIZATION_{t-3} < 50\%$	47,438	0.1101	0.0365
$50\% \leq UTILIZATION_{t-3} < 75\%$	22,267	0.0772	0.0229
$75\% \leq UTILIZATION_{t-3}$	20,708	0.0293	0.0076

Panel B of Table 8 provides the proportion of stock quarters with share repurchases by categories of FEE. Most stocks have a FEE that is less than 50 basis points per year. Repurchases are common for these stocks and occur in 19.57% of stock quarters. Large repurchases occur in 6.19% of stock quarters. As FEE increases and stocks become harder to borrow and more likely to be overpriced, the proportion of stock quarters with repurchases decreases monotonically. When FEE is greater than or equal to 10%, there are repurchases in only 2.14% of stock quarters. The proportion of stock quarters with large repurchases also falls monotonically with FEE. The results in Panel B tell the same story as the results in Panel A: Firms are much more likely to repurchase shares when their stock is unlikely to be overpriced.

Panel C of Table 8 shows the proportion of repurchases by UTILIZATION. High levels of UTILIZATION are correlated with a high FEE and a high DCBS score. UTILIZATION is, in addition, a measure of the risk of shorting. The results in Panel C clearly show that firms are far less likely to repurchase shares if UTILIZATION is high. Of the firms with UTILIZATION less than 5%, 18.04% repurchase shares. Only 2.93% of firms repurchase shares if UTILIZATION is above 75%.

Table 8 provides evidence that firms avoid repurchasing these hard to borrow shares. Differences in repurchasing frequency across FEE, DCBS, and UTILIZATION categories could, however, reflect differences between firms. Ben-Rephael et al. (2014) show, for example, that large firms repurchase shares more frequently. Large firms may also have shares that are easier to borrow. Similarly, a firm that is

TABLE 9

The Share Lending Market and the Decision to Repurchase Shares

In each regression in Table 9, the dependent variable is a dummy variable that equals 1 if there is a share repurchase during the quarter. A repurchase is defined as an increase in treasury stock during a quarter and a repurchase price in Compustat for the quarter. The FEE, UTILIZATION, and DCBS explanatory variables are mean daily variables for the month before the quarter. Panel regressions use only stock quarters in which all lending market variables are available. Month and firm fixed effects are included in each regression.

	$D_{REPURCHASE}$			
	1	2	3	4
Panel A. Dependent Variable is 1 if There is a Repurchase in the Quarter				
INTERCEPT	0.1690 (47.91)	0.1746 (45.59)	0.1697 (45.77)	0.1790 (45.62)
FEE_{t-3}	−0.0394 (−5.33)			0.0281 (2.47)
$UTILIZATION_{t-3}$		−0.00051 (−17.05)		−0.00047 (−14.80)
$DCBS_{t-3}$			−0.0041 (−9.73)	−0.0031 (−4.49)
$CASH_{t-3}/ASSETS_{t-3}$	0.0373 (7.46)	0.0428 (7.94)	0.0372 (7.44)	0.0424 (7.85)
No. of. obs. Adj. R^2	353,893 0.4350	335,909 0.4345	353,893 0.4351	335,107 0.4346
Panel B. Dependent Variable is 1 if the Firm Repurchased More Than 1% of Its Shares				
INTERCEPT	0.0158 (7.35)	0.0169 (8.19)	0.0175 (7.98)	0.0182 (8.21)
FEE_{t-3}	−0.0109 (−2.46)			0.0079 (1.24)
$UTILIZATION_{t-3}$		−0.00009 (−5.56)		−0.00008 (−4.25)
$DCBS_{t-3}$			−0.0012 (−4.58)	−0.0011 (−2.90)
$CASH_{t-3}/ASSETS_{t-3}$	0.0277 (9.09)	0.0276 (9.07)	0.0276 (9.07)	0.0276 (9.05)
No. of obs. Adj. R^2	335,107 0.1175	335,107 0.1175	335,107 0.1175	335,107 0.4346

low on cash may be unable to repurchase shares and may also be a target of short sellers.

In Table 9, I run regressions of a dummy variable for a repurchase during the quarter on firm fixed effects and month fixed effects, FEE, UTILIZATION. And DCBS in the month before the quarter. These regressions use only stock quarters when FEE, UTILIZATION, and DCBS are all available. Including firm fixed effects in the regressions allows us to see if individual firms' decisions to repurchase are affected by whether or not a stock is hard to borrow. I also include CASH/ASSETS at the end of the previous quarter as a measure of the firm's excess cash.

Panel A of Table 9 reports regressions with the dependent variable equal to 1 if there is a repurchase that quarter regardless of how many shares are repurchased. The first three regressions include one share lending market variable. In each regression, the coefficient on CASH/ASSETS is positive and significant. Firms are more likely to repurchase shares if they have excess cash. Even after adjusting for cash holdings, the coefficient on each of the three lending market variables is negative and highly significant, indicating that individual firms become more reluctant to repurchase shares as their stock becomes harder to borrow. The median

value of the DCBS measure is 1, and the 90th percentile value is 4. After adjustment for the firm and month, a change from the median to the 90th percentile of DCBS changes the likelihood of a repurchase by $-0.0041 \times 3 = -1.23\%$. The median FEE is 0.00405, and the 90th percentile is 0.0670. An increase in FEE from the median to the 90th percentile has a smaller impact on the probability of a repurchase, only $-0.0394 \times (0.0670 - 0.00405) = -0.25\%$. UTILIZATION seems a particularly strong predictor of repurchases. The median value of UTILIZATION used in the regressions in Panel B is 9.076, and the 90th percentile is 56.845. The coefficient in Panel B indicates that moving from the median UTILIZATION to the 90th percentile of UTILIZATION changes the likelihood of a repurchase in the quarter by $-0.00051 \times (56.845 - 9.076) = -2.44\%$. For comparison, the unconditional probability of a repurchase across all firm quarters is 13.5%. When all three variables are combined in the same regression, the coefficient on FEE flips from negative to positive. This is likely a result of multicollinearity as DCBS and FEE are highly correlated. Coefficients on UTILIZATION and DCBS remain negative and significant.

Panel B of Table 9 reports regressions with a dummy dependent variable that equals 1 if the firm repurchased 1% or more of its outstanding shares in the previous quarter. In each regression, the coefficient on the ratio of cash to assets is positive and highly significant. Firms are more likely to make large repurchases if they have a lot of cash. The likelihood of large repurchases falls significantly with increases in FEE, UTILIZATION, and DCBS. An increase from the median to the 90th percentile of DCBS decreases the probability of a large repurchase by $-0.0012 \times 3 = -0.36\%$. An increase from the median to the 90th percentile of UTILIZATION decreases the probability of a large repurchase by $-0.00009 \times (56.845 - 9.076) = -0.43\%$. For comparison, the probability of a large repurchase across all stock quarters is 4.2%.

After using firm fixed effects and adjusting for CASH/ASSETS, firms are more likely to repurchase shares if their stock is not short sale constrained and hence likely to be fairly priced or underpriced. Therefore, mispricing appears to be a factor in deciding whether to repurchase shares, just as it seems to be a factor in choosing to conduct SEOs. Firms with repurchase programs in place do not have to announce the actual repurchases. This allows them to exploit mispricing with repurchases just as short sale constraints allow them to exploit mispricing with equity offerings.

VII. Conclusions

Firms may transact in their own shares for a number of reasons. One is to exploit mispricing to transfer wealth from outsiders or selling shareholders to long-run shareholders. Even if this is not a motive for the transaction, it can affect the transaction's timing. Therefore, a firm that is planning on selling shares to raise capital may delay an offering if shares are underpriced or accelerate an offering if they believe their shares are overpriced. Similarly, a firm that is planning to repurchase shares may delay a repurchase to the next quarter if they believe their shares are overpriced, or may speed up a repurchase if they believe their stock is underpriced.

To test whether misevaluation is a motive for a firm' transactions in its shares, I use data on the cost of borrowing shares in the company stock. Short sellers are sophisticated, informed investors, and hard to borrow stocks have been determined by short sellers to be overpriced based on information available at the time. The short sellers are right on average. Stocks that are hard to borrow as measured by FEE, UTILIZATION, or DCBS earn significantly lower risk-adjusted returns than stocks that are not hard to borrow.

I find that firms are less likely to repurchase shares and more likely to conduct an SEO when shares are hard to borrow and overpriced. Stocks underperform following SEOs only if the stock was hard to borrow at the time of the offering. This suggests that overpricing is behind the decision to issue shares in some instances, but not always. It also suggests that the poor performance of stocks following SEOs does not represent a market inefficiency that investors can exploit. Only firms can profit from the overpricing of short sale constrained shares.

Some caution is called for in extrapolating the results of this article to earlier periods. This study uses a relatively short sample period of 14 years, and only starts in 2006 when comprehensive stock lending market data became available. By the beginning of this period, the poor performance of firms after SEOs was well documented and well known by both academics and practitioners. It is possible that in earlier years, SEOs of stocks that were not short sale constrained also underperformed.

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