In Short Supply: Short-Sellers and Stock Returns

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Abstract

We use detailed security lending data to examine the relation between short sale constraints and equity prices. Our results show that the *supply* of lendable shares is frequently binding, and the constraint is related to firms' accounting characteristics. Specifically, we find: (1) when the lendable supply is binding (non-binding), short-sale supply (demand) is the main predictor of future stock returns, (2) abnormal returns to the short-side of nine well-known market anomalies are attributable solely to "special" stocks, (3) controlling for expected borrowing costs, a stock's supply of lendable shares varies over time as a function of accounting variables associated with the pricing anomalies, so shares are least available when they are most attractive to short sellers. Overall, our results highlight the central role played by the *supply* of lendable shares in both equity price formation and returns prediction.

JEL classification: G14; G17; M4.
Keywords: Short Selling, Security Lending, Arbitrage Costs, Overvaluation, Market Efficiency

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1. Introduction

One aspect of equity markets that has received increased academic attention in recent years is the informational role played by short sellers. Prior studies have consistently demonstrated that, as a group, short-sellers are sophisticated investors with superior information processing capabilities (e.g., Dechow et al. 2001; Desai et al. 2002; Drake et al. 2011; and Engelberg et al. 2012). At the intraday level, short-sale flows improve the informational efficiency of intraday prices (Boehmer and Wu 2013). Globally, the introduction of short-selling in international markets is associated with a lowering of country-level costs-of-capital, an increase in market liquidity, and an improvement in overall pricing efficiency (Daouk et al. 2006; Bris et al. 2007). At the same time, a number of studies show short sale constraints can affect the pricing of underlying stocks.[1] Even temporary short-selling bans appear to impede pricing efficiency in the banned stocks (Battalio and Schultz 2010; Boehmer et al. 2012).

While the importance of short-sellers as information intermediaries is clear, far less is known about the nature of the real-time constraints they face, and how these constraints shape future returns. A key impediment to progress on this front is the opaque nature of the equity loan market. Although average daily open short interest in the U.S. now exceeds 1.0 trillion dollars, equity loan transactions are still conducted in an archaic over-the-counter (OTC) market.[2] In this market, borrowers (typically hedge funds) must first contact their prime brokers, who in turn "locate" (i.e. check on the availability of) the requisite shares, often by consulting multiple end lenders. Absent a centralized quote system and a consolidated market clearing mechanism, it is difficult for participants in the equity loan market to secure an overarching view of real-time conditions. Similar difficulties confront researchers wishing to evaluate how current loan market conditions impact future stock returns.

In this study, we examine the informational role of short-selling activities in equity price formation with a particular focus on the role played by the supply of lendable shares. Researchers have long recognized the potential importance of supply constraints. In studying market pricing anomalies, some prior studies used institutional ownership as a proxy for the availability of short-sell supply (e.g.,

[1] For theoretical arguments, see Miller 1977, Diamond and Verrechia 1987, Gallmeyer and Hollifield 2008, and Blocher et al. 2013. Empirical support can be found in Geczy et al. 2002, Asquith et al. 2005, Jones and Lamont 2005; and Boehmer et al. 2009, among others.

[2] Total open short interest is reported monthly by NYSE and twice per month by NASDAQ. See D'Avolio 2002, Fabozzi 2004, and Kolasinski et al. 2013 for good summaries of institutional details on equity loan markets.

Chen, Hong and Stein (2002), Asquith, Parthak and Ritter (2005), Nagel (2005) and Hirshleifer, Teoh and Yu (2011)); other studies use short-selling data from a single lender (e.g., D'Avolio 2002; Geczy, Musto, and Reed 2002; and Boehme, Danielson, and Sorescu 2006). But without consolidated data that can provide a market-level view of supply conditions, it is extremely difficult to assess the full magnitude of this problem across a wide cross-section of stocks.

In this paper, we exploit a rich equity lending data set from Markit Data Explorer (DXL) to examine the role of loan market supply constraints in equity price formation. We also evaluate the role of accounting characteristics in establishing borrow costs and loan supply. Our work builds on recent studies that have greatly illuminated the linkages between the equity market and the market for equity loans. In particular, Blocher, Reed, and Van Wesep (2013) formalize the role of lendable supply in a joint equilibrium model linking the equity and stock lending markets. Their work highlights the pivotal role supply plays when constraints bind. Related empirical work using detailed security lending data provides support for this model in that: supply shocks matter for returns among constrained stocks (Blocher, Reed, and Van Wesep 2013), and demand shocks have little effect on loan fees when a stock is unconstrained by limited supply (Kolasinski et al 2013). The emerging picture from these studies is that the supply of lendable shares is crucial in explaining the relation between short-sell demand shocks and lending fees, as well as the relation between short-selling and subsequent equity returns. However, even these recent papers have limited data on the pool of lendable supply available at a given point in time.[3] Moreover, none of these studies link pricing and availability in the equity loan market to firms' accounting characteristics.

Our study uses an extensive dataset from a consortium of over 100 institutional lenders to provide an aggregated view of the supply of easily lendable shares across many stocks. This data allow us to conduct a market-level analysis of the supply of easily lendable shares. Using this data, we examine both the consequences and the determinants of short supply, and evaluate how they are related to firms' accounting characteristics. In particular, we show:

On the level of lendable shares in the cross section:

[3] For example, Blocher et al (2013) use dividend record dates to identify when shares are likely to leave and reenter lendable supply. Kolasinski et al (2013) use demand for share loans and loan fee data to infer a supply schedule, but the schedule reflects quantity supplied at various loan fee levels, not the pool of lendable shares.

- The typical stock has less than 20 percent of its outstanding shares in readily lendable form, and the supply of lendable shares varies substantially across stocks (Table 2).
- Constrained stocks typically have less than 10 percent of shares available (Table 2).
- When supply constraints based on DXL data are binding, borrowing costs rise sharply (Table 2). This suggests that even though DXL participants do not represent the entire equity loan market, the DXL supply measure is a good indication of market-wide scarcity.

On the consequences of the level of lendable shares:

- Lendable supply is more important than demand in explaining the cross section of borrowing constraints (Table 2); Indeed, some high-demand stocks will appear to have low observed demand *because of* low supply (Table 3);
- When predicting stock returns, it is important to distinguish between firms facing binding and firms facing non-binding supply constraints. Among unconstrained stocks, the short-interest ratio (*SIR*) remains an important predictor of future returns (Table 3).
- Among constrained stocks, lendable supply helps explain the informational efficiency of prices (Tables 4 and 5); specifically, when supply is binding, lower supply and higher borrowing costs portend more negative returns, but when supply is not binding, lower demand is the main predictor of higher returns.
- Limited supply contributes to the apparent overvaluation associated with a number of pricing anomalies that are based on accounting characteristics (Table 6).

On the determinants of lendable supply:

- We develop a two-stage estimation procedure to evaluate the cross-sectional determinants of firms' borrowing costs as well as lendable supply (Tables 7 and 8).
- Our findings confirm prior evidence that borrow costs are higher for smaller, lower-priced, and more volatile firms with lower institutional ownership, higher share turnover, and more negative recent stock returns.
- More importantly, after controlling for these firm characteristics, we find that both borrow costs and the supply of lendable shares, are impacted by the accounting characteristics associated with pricing anomalies. In general, borrow costs are higher when these characteristics indicate the firm is overvalued.

- Strikingly, after controlling for expected borrowing costs, we find that the supply of lendable shares also varies over time as a function of these accounting characteristics, such that shares are least available when they are most likely to be attractive to short sellers.

In sum, we not only provide descriptive evidence on the supply of lendable shares in the equity lending market, we also examine the consequences and the determinants of short supply. The fact that firms' specialness portends lower future returns is well known. We build on this insight by demonstrating the importance of supply and demand variables, *after* conditioning on specialness. In addition, we document an inextricable link between accounting characteristics associated with equity market pricing anomalies, and short-selling activities. Specifically, we find that these accounting characteristics increase borrowing costs and reduce the supply of available shares for lending, in the direction predicted by theories of constrained arbitrage.

Our analysis is conducted using a comprehensive dataset from Markit Data Explorer (DXL) spanning 114 months (July 2004 to December 2013). DXL's data are collected from a consortium of more than 100 institutional lenders, who collectively represent the largest pool of loanable equity inventory in the world. DXL coverage is also expansive, as the universe of firms with lending data represents 90 percent of the market capitalization of CRSP firms. For each stock in the database, DXL provides daily measures of the total shares borrowed from DXL lenders (a demand measure), and the total lendable inventory available from them (a supply measure). In addition, DXL computes a Daily Cost of Borrowing Score (DCBS), a measure of the *relative* cost of borrowing for each stock, ranging from 1 (low cost) to 10 (high cost). For a subset of stocks, DXL also reports the average loan fees and rebate rates charged by the lenders. Taken together, DXL data provide a highly granular view of daily loan pricing and availability information for a broad cross-section of individual equity securities.

As a first step, we use pricing information in the DXL data to develop a simple measure of "supply slack". Specifically, using the subset of observations with loan fee data, we show that DCBS values of 1 and 2 correspond to stocks that are easy to borrow as defined in prior research (annualized loan fees below 100 basis points). Following this logic, we define a *Special* (hard-to-borrow) stock as one with a DCBS of 3 or larger. By this definition, 14.3 percent of our firm-month observations are categorized as *Special* and 85.7 percent as *General Collateral* (*GC*; easy-to-borrow).

For the typical firm the supply of readily lendable inventory is only a small fraction of total shares outstanding. On average, general collateral stocks have less than 20 percent of their outstanding

shares in the form of readily lendable supply. For special stocks, the available supply is even worse: on average, less than 10 percent of the outstanding shares are readily available for lending. Thus, while high borrowing costs are associated with high demand, constrained stocks also experience low supply. In fact, the supply of lendable shares explains more of the cross-sectional variation in borrowing costs than does demand. In particular, demand explains 1 percent of the variation in *DCBS*, while lendable supply explains over 13 percent. This highlights the substantial role of the level of supply in shaping short-selling constraints.

Low levels of lendable supply suggest that a short-interest ratio (*SIR*) as low as 5 or 10 percent could already reflect full utilization of lendable inventory. Indeed, consistent with D'Avolio (2002) we document a nonlinear (U-shaped) relation between *SIR* and a stock's "special" status– i.e., both extremely high *SIR* firms and extremely low SIR firms have a greater probability of being on special.[4] Lendable supply is also lowest among low *SIR* firms. Thus, some firms have low observed demand yet high borrowing costs because of low supply. In such cases, low observed short interest reflects unsatisfied demand rather than a lack of desire to sell the stock short. This highlights the problems inherent in using *SIR* as a measure of either investor pessimism or short-sale cost constraints.

We then conduct a series of tests to sharpen the role of supply in returns prediction, after conditioning on specialness. Our results show the supply of available shares is correlated with future returns only when lendable supply is a binding constraint. In univariate regressions, the supply variable is uncorrelated with future returns. In multivariate regressions, supply does not predict returns for GC stocks, but strongly predicts returns for special stocks – i.e., lower supply is associated with stronger negative returns among special stocks. And even though special status is itself a strong indication of overvaluation, we find that among special stocks, those with *low* supply underperform the most. The conclusion seems clear: limited supply constrains the negative views impounded in price, leading to delayed stock price declines.

We next turn to the effect of supply-side constraints on returns to the short side of nine asset-pricing anomalies documented in prior work. If the apparent overvaluation identified by these trading strategies persists because of short sale constraints, returns to the short side should be concentrated in special stocks. Our results support this prediction. In particular, although not all stocks on the short side

[4] This is also consistent with Kolasinski et al. (2013, Figure 3, page 578), who plot specialness against their measure of relative demand (standardized loan quantity).

of these strategies are constrained, the negative short side returns are concentrated in only special stocks; general collateral stocks do not underperform. Consistent with prior studies, returns to the short side are stronger for months following high investor sentiment periods (e.g., Baker and Wurgler 2006; Stambaugh , Yu and Yuan 2012). But even in these periods, short-side returns are largely confined to the subsample of special stocks.

Interestingly, for the stocks on the short-side of these strategies, we find no difference between the GC and special subsamples in terms of the level of their short-seller demand. Yet we find a dramatic difference in terms of their level of available supply: GCs have much larger supplies of lendable inventory than Specials. These results show supply rather than demand is the key difference between special and general collateral status among stocks included on the short-side of these strategies. Once again, the evidence strongly points to limits in the supply of available shares in the security lending market as the source of the lower returns on the short-side of these anomalies.

Finally, we conduct a cross-sectional analysis of the determinants of firms' supply of lendable shares. Theory predicts that the supply of lendable shares will be positively related to the cost of borrowing, and the two are endogenously determined in conjunction with demand. Thus, we use a two-stage estimation technique. In the first stage, we fit a model for the expected cost-of-borrowing, taking into account various firm-level characteristics. In the second stage, we use the predicted cost-of-borrowing as an instrument in examining factors that affect the supply variable. Consistent with prior literature (e.g., D'Avolio 2002 and Mashruwala et al. 2006), we find that borrowing costs are higher for low priced, volatile stocks, with lower institutional ownership. Interestingly, borrowing costs are also higher for firms in financial distress, which is consistent with the notion that such firms face higher arbitrage costs (Avramov et al. 2013). In addition, borrowing costs are generally higher for firms that are on the short-side of the nine pricing anomalies, suggesting that these firms are already being targeted by short sellers (Drake et al. 2011). These results are quite robust to various perturbations in estimation model and choice of dependent variable.

We then regress the inventory of lendable shares on fitted borrowing costs and other firm characteristics. Our results show that even after controlling for expected borrowing costs, the supply of lendable shares is lower for low priced, volatile stocks with lower institutional ownership. More importantly, we find that the supply available for lending is lower for firms that appear on the short-side of most of the nine pricing anomaly variables. This suggests stock lenders want to avoid holding the stocks identified by the short-side of these strategies. As a result, these stocks appear to be least

available for borrowing when they are most attractive to short sellers. Once again, the evidence points to a potential supply shortage problem in the securities lending market.

Collectively, our findings show that even in the most liquid equity market in the world, the pool of readily borrowable shares can be a frequently binding constraint to informational arbitrage. These results should interest researchers, investors, and regulators. For researchers, our results confirm Miller's (1977) prediction that stocks without constraints do not experience significant negative future returns. In addition, we find that short-side returns to various anomalies are largely associated with firms with high short-selling constraints, suggesting a cost-based explanation for these returns. Our findings also bear on the investment value of many accounting characteristics related to strategies proposed in prior literature. Our findings suggest both short-sellers and the pool of institutional lenders represented in the DXL database pay attention to these characteristics. These findings lend credence to the view that the underlying characteristics are related to market mispricing. At the same time, our evidence suggests that the magnitude of returns documented in prior studies may overstate the mispricing that can be profitably exploited after transaction costs.

More broadly, our findings point to a shortage in the supply of lendable shares as a key impediment to pricing efficiency in capital markets. We show that a surprisingly small proportion of the shares outstanding is available for lending at any time, even in a market as liquid as the U.S. Moreover, when the shortage in supply is binding, equilibrium prices in the equity market are too high. This finding should be of interest to market regulators interested in reducing the likelihood and magnitude of overvaluation in equity markets. To the extent that the supply of lendable shares is influenced by rules and regulations governing the equity loan market, our findings will have implications for policy makers.

We believe these findings should also be of interest to investors. Our analyses show that real-time security lending data can be valuable in predicting future returns. In this context, we demonstrate the importance of conditioning on whether the supply constraint is binding. When supply is binding, future returns are mainly associated with the supply variable and with borrow costs. Conversely, when supply is not binding, *SIR* and other demand proxies are useful predictors of future returns. At the same time, our evidence on the time-varying nature of the supply of loanable inventory should sound a cautionary note to those interested in exploiting the short side of various investment strategies.

The remainder of the paper is organized as follows. In Section 2, discuss our empirical framework, including related literature. In Section 3, we detail our sample as well as key institutional

features of the equity loan market, and in Section 4 we discuss our empirical findings. We provide concluding remarks in Section 5.

2. Empirical Framework

2.1 Related literature

The theoretical literature on short selling makes a clear prediction: constraints in the market for equity lending will have direct consequences for equity pricing. Miller (1977) predicts that, given divergence of opinion, tighter short selling constraints will result in more overvaluation. Duffie (1996) makes a similar argument in the context of US Treasuries, which can be borrowed for shorting purposes through a reverse repo. In both settings, tighter short-sell constraints lead to overvaluation by preventing the negative views of some traders from being impounded into price.

Although the theoretical prediction is clear, researchers over the last four decades have wrestled with the difficulty of empirically identifying when a stock is constrained. Many prior studies in the anomalies literature, for example, used the short interest ratio (SIR) to proxy for short-seller demand. However, as discussed earlier, SIR can be a poor proxy for the amount of negative information excluded from the stock market: a firm's short interest ratio can be low either because demand is low, or because supply is limited.[5] More recent studies have sought to incorporate supply in their analysis. For example Chen, Hong and Stein (2002) nominate that breadth of ownership, measured by the percentage of institutions owning the stock, as a measure of the ease with which shares can be borrowed. Other studies use percentage institutional holdings as a proxy for the availability of supply. Among these, Asquith, Parthak and Ritter (2005) conclude that short sales constraints are not binding for most stocks; Nagel (2005) and Hirshleifer, Teoh and Yu (2011) suggest that negative future returns are related to the existence of short selling constraints; and Cohen, Diether, and Malloy (2007) suggest that negative returns following increases in demand exceed transaction costs.

As detailed stock lending data have become more available, researchers have been able to measure short sell constraints with greater precision. Among the first studies to investigate detailed

[5] For example, Chen, Hong and Stein (2002, 172) suggest that "a stock with a low or zero value of short interest may simply be one that is difficult or costly to short, which could potentially translate into more, rather than less, negative information being held off the market."

equity lending data is D'Avolio (2002). D'Avolio uses data from a major equity lender for an 18-month period between April 2000 and September 2001 and views special stocks as costly to borrow when they have loan fees in excess of 100 basis points. He shows that firms in the highest decile of short interest have the highest percentage of special stocks. Even among high short interest stocks, however, only approximately 30 percent are special. Thus, he argues, the majority of even highly shorted stocks remains unconstrained and are easy to borrow. D'Avolio (2002) does not link short sale constraints to pricing and returns in the equity market.

A number of recent studies argue that the market for equity and the market for security lending should be studied jointly (Geczy, Musto, and Reed 2002; Blocher et al. 2013; Engelberg et al. 2013; and Kolasinski et al. 2013). Using data from one large institutional lender from November of 1998 to October of 1999, Geczy, Musto, and Reed (2002) document underperformance for easy-to-borrow, unconstrained IPO, dotcom, high growth, and low momentum stocks. Their use of actual stock lending data lends credibility to the idea that even stocks facing minimal short-sell constraints can generate negative abnormal returns. On a related note, Boehme, Danielson, and Sorescu (2006) obtain rebate data from a major broker-dealer for the 21-month period between March 2001 and December 2002. They use loan fee data for a limited sample to estimate constraints for a broader sample, and find, once again, that constrained stocks underperform.

More recently Blocher et al. (2013) develop a framework for analyzing equilibrium in the security lending market jointly with equilibrium in the stock market. A key insight from this paper is that the extent to which a stock is constrained, or hard to borrow, is a primary driver of equity prices and the information impounded into prices. Using a tax-driven supply shock, the authors show when supply is reduced around dividend record dates, prices of hard-to-borrow stocks increase while prices of easy-to-borrow stocks are unaffected. In a related study, Kolasinski et al. (2013) examine the impact of demand shocks on lending fees. This study shows that at high demand levels, further increases in demand lead to significantly higher fees, but that at moderate demand levels fees are largely insensitive to demand shocks. Most recently, Engelberg et al. (2013) examine the market pricing of short-selling risk, defined as the likelihood that a stock loan becomes expensive or is recalled. They show that stocks with more short selling risk earn lower returns, exhibit lower pricing efficiency, and have less short-selling, suggesting short selling risk is a further constraint to arbitrage

Although these recent studies have advanced our understanding of short-sell constraints, their main focus is on the effect of supply and demand shocks on loan prices. In terms of implications for

future stock returns, the central finding from these studies is that when stocks are hard-to-borrow, future returns will be lower. Although this is an important finding, it provides limited insight into the predictive role of supply and demand variables, after conditioning on specialness. None of these studies focus on implications of supply-side (inventory) constraints on equity market pricing anomalies. At the same time, these studies do not attempt to link borrowing costs and the supply of lendable inventory to accounting characteristics.

We build on these studies by providing a consolidated market-level view of short-sell supply. This more comprehensive view of loan market conditions allows us to shed light on the profitability of a number of pricing anomalies reported in the equity market. Our work focuses not only on the implications of specialness, but also on the marginal effect of the supply and demand variables after conditioning on specialness. In addition, by matching this equity loan data to firm characteristics, we are able to report on the role of accounting characteristics in the formation of borrow costs as well as the supply of lendable shares. To our knowledge this is the first study to document the importance of accounting characteristics to pricing and availability in the short-sale market.

The precision with which we can distinguish binding and non-binding conditions allows us to evaluate an important prediction of Blocher et al. (2013). Their model predicts that the supply of shares affects equity prices only when borrowing is costly – when the negative views of short sellers are prevented from being priced. We show that among constrained stocks, there is indeed a positive correlation between the level of supply and future stock returns. However, as predicted by their model, this relation does not hold across the entire universe of stocks; in particular, it does not hold among easy-to-borrow (GC) stocks. These findings directly support the view that limited supply constrains negative views and affects future security prices only when binding conditions hold.

Prior research shows that a number of firm characteristics are correlated with subsequent returns.[6] All of these studies examine either hedge portfolios or the spread in returns across extreme

[6] We examine 13 such variables, include nine that are based solely on firms' accounting characteristics: (1) firm size (MVE), following evidence in, among others, Fama and French (1992); (2) the book-to-price ratio (BTM), following evidence in Fama and French (1992) and Haugen and Baker (1996); (3) price momentum (Momentum), following evidence in Jegadeesh and Titman (1993) that past 3 to 12 month returns tend to continue in the subsequent year; (4) the difference between earnings and cash flows from operations (Accruals), following Sloan (1996); (5) Financial distress (Stambaugh, Yu, and Yuan 2012, employing a financial distress measure based on Ohlson 1980); (6) Net stock issuances (Ritter 1991; Loughran and Ritter 1995; Daniel and Titman 2006); (7) Net operating assets (Hirshleifer, Hou, Teoh, and Zhang 2004); (8) Gross profit (Novy-Marx 2010); (9) Asset growth (Cooper, Gulen, and

portfolios of firms sorted on the firm characteristic. A common finding is that over half of the returns to the strategies is derived from the short side. Some prior work suggests that the returns documented on the short side may exceed the costs of short selling (e.g., Jones and Lamont (2002), Geczy, Musto, and Reed (2002), Nagel (2005) and Hirshleifer, Teoh and Yu (2011)). The higher resolution of our data allows us to revisit these findings in the context of borrow costs at the time each strategy was implemented.

Finally, our data allow us to conduct a detailed analysis of the determinants of borrowing costs, as well as the sensitivity of loan supply to various market pricing variables. D'Avolio (2002) uses a simple model for estimating firm borrowing costs. We extend his model by including a large number of equity market characteristics, as well as the nine pricing anomaly variables. Our results show that borrowing costs are sensitive to many of these anomaly metrics. Perhaps even more importantly, we show that even after controlling for the expected cost of borrowing, the supply of available shares for borrowing is also a function of these pricing anomaly variables. These results suggest the supply of lendable shares is perhaps a more serious constraint than prior studies suggest.

3. Equity lending data

3.1 Sample

Our analysis requires us to intersect financial statement and open short interest data from COMPUSTAT, stock prices from CRSP, and short sellers' trading information from Markit Data Explorer. Data Explorer (hereafter DXL) is one of the largest suppliers of equity lending information worldwide. DXL aggregates and reports information on the amount of equity on loan (demand), available equity inventory (supply), utilization (the ratio of demand to supply) as well as rebates and fees.[7] Although DXL began reporting *DCBS* in October of 2003, supply and demand data are not available until June of 2004. We have access to this data through December 2013. Because we predict one-month-ahead returns, we

Schill 2008); (10) Quarterly ROA (Fama and French 2006; Chen, Novy-Marx, and Zhang 2010; Wang and Yu 2010); (11) Investment to assets (Titman, Wei, and Xie 2004; Xing 2008); (12) MScore (Beneish, Lee, and Nichols 2013); and (13) the short interest ratio (SIR) following evidence in Asquith and Meulbroek (1995), Dechow et al. (2001), Desai, Ramesh, Thiagarajan, Balachandran (2002), and Drake et al. (2011) that firms with high short interest ratios subsequently earn lower returns. Most of these anomalies were also examined in Stambaugh, Yu, and Yuan (2012). They document that the short side returns vary with market-wide investor sentiment.

[7] We refer the reader to the Appendix for a detailed description of all the variables used in the paper's analysis.

use DXL and COMPUSTAT data from June 2004 to November 2013.[8] Our initial sample excludes ADRs, firms listed on exchanges other than NYSE, AMEX, and NASDAQ, and shares with multiple classes.

Table 1, Panel A reports the number of firms available in the COMPUSTAT Security Monthly file (our source of short interest data), CRSP (our source of size-adjusted return, or SAR, data), and DXL in each year of the sample period. This panel allows us to assess the extent of the DXL coverage for COMPUSTAT and CRSP sample firms. Not surprisingly, most firms in CRSP are also in COMPUSTAT's Security Monthly file. On average there are 4843 firms each month with returns from CRSP (range from 4240 to 5385), and 4827 firms with *SIR* from COMPUSTAT (range from 4235 to 5337 firms). The DXL coverage for these firms varies depending on the variable in question. In the case of the DXL proxy for the relative cost of borrowing (*DCBS*), an average of 3634 firms are covered each month (range from 2441 to 4013), representing 76.1% of the total COMPUSTAT firms and 91.7% of the total market capitalization.

We note that although DXL covers a vast majority of the tradable equities in the NYSE, AMEX, and NASDAQ (between 78.3 and 96.9% by market cap), DXL stocks tend to be larger than those not covered. This sample bias has the potential to limit our ability to generalize results to the stocks not covered by DXL, particularly for the early years in our sample: In 2004-2006 as the DXL data covers between 45% and 65% of the firms in the CRSP universe; subsequently DXL coverage increases from 75% in 2007 to over 90% in 2012 and 2013. If the supply constraint is binding more often among smaller stocks (a likely scenario), our findings on the importance of supply constraints would be understated.[9] From the observations in Panel A, we eliminate observations with missing short interest and DXL data, as well as observations in the financial services and utilities industries.[10] Our final sample includes 299,535 firm-month observations.

[8] In some of our tests, we use the Baker and Wurgler (2006) sentiment measure, which ends in December of 2010. For this analysis, our sample spans June, 2004 to December, 2010 with one-month-ahead returns from July 2004 to January 2011.

[9] In addition, if short selling demand is higher among smaller stocks, or if the tails of many anomalies documented in prior work relate to small firms, it is possible that we will understate the profitability of trading on the these strategies. For these reasons, in unreported analysis we examine returns to *SIR* and the various anomalies using the whole sample from CRSP and COMPUSTAT. Magnitudes of the returns were similar between the full CRSP/COMPUSTAT sample and our restricted sample requiring DXL data.

[10] We follow prior studies in excluding financial institutions and utilities, because the regulatory environment and financial statement characteristics of these firms have a direct impact on their rankings in accounting-based anomalies.

Panel B of Table 1 reports descriptive statistics for returns and our short-selling variables. The average firm has a short interest ratio (*SIR*) of 5.2 percent of shares outstanding, with a maximum of 91.8 percent. For comparison, DXL provides two measures of demand for borrowing in the equity lending market: Beneficial Owner on Loan Quantity (*BOLQ*) and Total Demand Quantity (*TDQ*). We express both measures as a percentage of shares outstanding. *BOLQ* represents shares borrowed by DXL borrowers *from DXL lenders*. *TDQ* adds to *BOLQ* shares borrowed by DXL participating borrowers from *non-DXL lenders*, as well as shares loaned by DXL lenders to *non-DXL borrowers*. Thus, *TDQ* is the most expansive measure of borrowing provided by DXL. *TDQ* averages 4.3 percent of outstanding shares, whereas *BOLQ* averages 3.4 percent. DXL also provides a measure of supply, Beneficial Owner Inventory Quantity (*BOIQ*), which we express as a percentage of shares outstanding. *BOIQ* reflects the total pool of shares held by DXL lenders and made available for borrowing. In our sample, *the mean (median) BOIQ* equals 17.4 (16.1) percent of shares outstanding.

A key issue for our analysis is whether the DXL supply measure (*BOIQ*) captures market-wide borrowing constraints for the sample stocks. Several facts suggest *BOIQ* is indeed a good proxy. First, the DXL consortium includes over 100 of the largest lenders in the world. As an indication of its footprint in the overall market, DXL's total demand quantity (*TDQ*) is 70% of the open short interest as reported by COMPUSTAT (see Table 2, *TDQ/SIR*). Second, we find that the supply by DXL lenders (*BOIQ*) is sufficient to cover total demand in 92.2% (or 276,317) of our observations. Thus it appears the majority of DXL borrowings are sourced from the lendable DXL inventory.

Third, we find that the median ratio of *BOLQ* to *SIR* is 55 percent (untabulated). In other words, over half of total borrowing for a typical firm is sourced from DXL inventory. Because *BOLQ* only reflects shares borrowed by DXL borrowers from DXL lenders, it is a lower bound on the shares borrowed from DXL inventory. The fact that 55 percent of all short borrowings come from an inventory representing 17 percent of total shares outstanding suggests that DXL lenders are a top choice borrowing source, and that shares are likely more difficult to locate and borrow outside the consortium.[11] For this reason, we often refer to *BOIQ* as the supply of *easily-lendable* shares. Finally, as we show later, when supply constraints based on DXL data are binding, borrowing costs rise sharply (Table 2). This suggests that

[11] If shares were just as easy to locate and borrow outside the consortium, we would expect only 17 percent of market-wide borrowings to be sourced from DXL lenders.

even though DXL participants may not represent the entire equity loan market, the DXL supply measure is a good indication of market-wide scarcity.

Similarly, DXL's cost of borrowing (DCBS) and utilization ratios (Utilization=BOLQ/BOIQ) are likely good proxies for the entire lending market. If utilization of inventory outside the consortium rises relative to DXL utilization, then costs of borrowing through these other lenders should rise relative to DXL borrowing costs. Further borrowing should then take place through the DXL consortium until DXL costs and utilization reach parity with costs and utilization outside the consortium. Therefore, a stock's *DCBS* is likely a lower bound on the relative cost of borrowing shares through sources other than the DXL consortium. We discuss DCBS and utilization ratios in greater detail in Table 2.

In Table 1 Panel C, several correlation coefficients are noteworthy. Corroborating the notion that *SIR* captures short-seller demand, the correlation between *SIR* and *TDQ* equals 0.861 and the correlation between *SIR* and *BOLQ* equals 0.830. On the other hand, the correlation coefficients of *SIR* with the cost of borrowing (*DCBS*) and with supply (*BOIQ*) are lower at 0.197 and 0.366. On the cost of borrowing side, the highest correlations with *DCBS* occur for measures of supply (-0.323) and utilization (0.539). This is consistent with the notion that special stocks have lower supply and higher utilization than general collateral stocks. It suggests that level of supply for lending and utilization are more likely to capture short selling constraints.

3.2 A measure of the cost of borrowing

DXL provides a proprietary index of the costs to borrow, the Daily Cost of Borrow Score (*DCBS*) that ranges from 1 (cheap) to 10 (expensive). DXL assigns a *DCBS* for each stock based on the lending fees for the last seven days. *DCBS* is important because, as Table 2 illustrates, only about 36 percent of DXL observations have explicit loan fee data. Thus, we are not able to use loan fees and rebates directly in our analysis. Nevertheless, to establish the validity of *DCBS* as a measure of borrowing costs we report in Table 2 rebates and loan fees, where available, by *DCBS* category.[12]

[12] Lenders receive loan fees on the value of the stocks they lend. Prior research (e.g., D'Avolio 2002) classifies stocks with loan fees exceeding 100bp as 'special', indicating that they are difficult and costly to borrow. Borrowers receive interest on the value of the collateral they put up to secure the loan. Collateral requirements are generally met with proceeds from the sale of the security. The difference between loan fees and interest on collateral is called the rebate rate, and represents the net amount received (if positive) or paid (if negative) by the borrower.

In Figure 1, we plot the percentage of observations in each DCBS category, along with the average loan fee (when available). Shares are easy to borrow for the vast majority of stocks, but borrowing costs rise quickly for a select set of observations. Stocks with *DCBS* equal to 1 are clearly easy to borrow: their fees average less than 34 basis points per year. For *DCBS* equal to 2, the average (median) loan fee rises to 145 (122) basis points. Average rebates turn negative at *DCBS* equal to 2, and we establish that DCBS=2 also contains firms with loan fees below 100 basis points. The average loan fee for *DCBS* equal to 3 is over 270 basis points, and quickly rises as *DCBS* increases: by the time *DCBS* equal to 7, the average loan fee exceeds 1000 basis points and for *DCBS* equal to 10, the average loan fee exceeds 4800 basis points. In economic terms, for a short seller to hold the position for a year, they must pay a loan fee of over 48% of the value of the stock at the time of the borrowing transaction. We thus use *DCBS* to distinguish easy to borrow stocks (general collateral) from stocks that are costly and difficult to borrow (special). In the spirit of D'Avolio (2002) who classified stocks as easy (costly) to borrow depending on whether the loan fee was less (more) than 100 basis points, we label observations with *DCBS*>2 as *Special* stocks and treat observations with *DCBS* equal to 1 or 2 as *General Collateral* (*GC*) stocks.

Several features of Table 2, Panel A are noteworthy. First, the ratio of *TDQ* to *SIR* captures the percentage of the total market for borrowing stock captured by DXL (*SIR* is total market and *TDQ* is DXL demand). The ratio of *TDQ* to *SIR* averages approximately 70 percent and is remarkably consistent across *DCBS* categories. Thus, DXL covers the majority of stock lending transactions, and DCBS is not biased toward or against stocks based on DXL's coverage of them. Second, as *DCBS* rises, the measures of demand (e.g., *SIR* and *BOLQ*) increase slightly whereas supply (*BOIQ*) falls at a faster rate. We depict this in Figure 2. As a result, *Utilization*, which captures the percentage of lendable shares that are actually on loan (calculated as the ratio of *BOLQ* to *BOIQ*), also increases. In fact, as depicted in Figure 3, *Utilization* has a nearly monotonic relation with values of DCBS. This suggests that (1) *Utilization* is a reasonable alternative measure of borrowing costs, and (2) that the costs of borrowing are largely driven by the level of supply.

We find that for general collateral stocks utilization rates average approximately 20%, whereas special stocks average approximately 50%. The most costly stocks to borrow, those with *DCBS* equal to 10, have utilization averaging 78.1% and a staggering median loan fee of 46% per year. Evidently among the most difficult to borrow stocks, extremely high borrowing fees are sufficient to dampen demand and prevent utilization from reaching 100%. Recall risk is another reason total utilization may not reach

100%. In Panel B, we report share turnover for the month (share volume divided by shares outstanding). *DCBS* is positively associated with share turnover, and among special stocks share turnover is almost monotonically increasing from *DCBS* 3 to 10. Note that the more active stocks face a higher likelihood of being recalled (Engleberg et al. 2013). Evidently these stocks are also more costly to borrow in general.[13]

Panel B of Table 2 also reports next month size-adjusted returns,[14] end of month market value of equity, end of month share price, size adjusted returns over the prior six months, and the book to market ratio as of the end of the month for each *DCBS* category. *DCBS* of 1 and 2 are associated with positive size adjusted returns of 0.4% and 0.2%, respectively.[15] Observations with *DCBS* of 3 and above have significant negative returns. The magnitude of returns increases as *DCBS* progresses from 3 to 10. One-month-ahead returns for stocks with *DCBS* of 10 average -4.5 percent, or 54% annualized. Although this may seem impressive, notice that the median loan fee for this group is 46% per year, leaving a mere 8% after borrowing costs. This further illustrates the importance of accounting for short-sell cost when analyzing future equity returns.

Panel B also provides a profile for hard to borrow stocks. Observations with high *DCBS* scores tend to be smaller, low price stocks with higher share turnover. In addition, costly to borrow stocks tend to be past losers with glamour characteristics (i.e., lower book to market). Because momentum and book-to-market predict returns, in unreported analyses we verify that our return prediction results continue to hold after controlling for these characteristics. In later analyses, we use this profile along with accounting characteristics that are associated with future returns to develop a model that explains cross-sectional differences in the cost of borrowing.

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[13] In unreported analysis we also find that within each *DCBS* category, unused inventory (*BOIQ* – *BOLQ*) is positively associated with share turnover. Thus, holding the cost of borrowing constant, more active stocks are associated with more slack in supply relative to total borrowed.

[14] We compute size-adjusted returns following a slightly modified version of the procedures outlined in Lyon, Barber, and Tsai (1999). To form reference portfolios, we first identify decile portfolio breakpoints based on all NYSE firms. We then assign all NYSE, AMEX, and Nasdaq firms to portfolios based on those breakpoints. The smallest portfolio has a disproportionately large number of stocks, so we further sort those stocks into five portfolios based on market cap. The end result is 14 size-based portfolios. If a firm delists, we include returns to the delist date as well as any delisting return reported by CRSP. If a delist return is missing, we estimate it using the procedures outlined in Beaver, McNichols, and Price (2007). To compute size-adjusted returns, we use the stock's market cap at the end of the month prior portfolio formation to identify its reference portfolio. We then subtract the return for the reference portfolio from the return for the firm.

[15] Although we report our analyses using size-adjusted returns, results are similar based on alphas from time-series regressions using the Fama-French three factors (MKT, SMB, HML), or the three factors augmented with a momentum factor (WML).

As shown in Panel A, borrowing costs are increasing in demand but decreasing in supply. For example, high DCBS firms have 50 percent more demand than low DCBS firms, whereas high DCBS firms have a third of the supply of low DCBS firms. We evaluate the relative contribution of demand and supply to borrowing costs in Panel C of Table 2. In particular, each month we regress DCBS on BOIQ and BOLQ, and report the averages of the monthly coefficients. Not surprisingly, DCBS is negatively related to supply and positively related to demand. More importantly, supply exhibits much more explanatory power for DCBS than does demand. In particular, the univariate regression of DCBS on BOIQ has an average adjusted R-square of 13.1 percent, whereas the BOLQ explains 1 percent of the variation in DCBS. The difference in adjusted R-squares is statistically significant. Specifically, the mean adjusted R-square for the BOIQ regressions is statistically significantly greater than the mean adjusted R-square for the BOLQ regression with a t-statistic of 28.33 (untabulated). Thus, not only is the supply of lendable shares important in shaping borrowing costs, it appears to be much *more* important than demand. In later analyses, we more fully explore the determinants of both borrowing costs and lendable supply.

4. Results

4.1 Returns to short interest ratio deciles for special and general collateral stocks

In Table 3, we report returns to *SIR* deciles, where stocks are further divided into special and general collateral categories. Particularly interesting patterns emerge in the extreme *SIR* deciles. As expected, the percentage of stocks that are special is highest in the highest *SIR* decile. However, even in the highest *SIR* decile, less than 30 percent of the stocks are special. Thus, the majority of high *SIR* stocks are in fact easy to borrow, despite high demand. More broadly, we find that the percentage of special stocks forms a U-shaped pattern across *SIR* deciles, such that the lowest *SIR* deciles also have a relatively high proportion of special stocks. This pattern is consistent with D'Avolio (2002) and confirms the noise in *SIR* as a proxy for investor pessimism (e.g., Chen et al. 2002).

Another salient finding pertains to stocks in the lowest *SIR* decile. Notice that *BOIQ* (the supply of lendable shares) is lowest for stocks with low *SIR*, and that it increases monotonically over the *SIR* deciles (see Figure 4). This shows that some low *SIR* stocks are in that category simply because they are in short supply. A key finding from Boehmer et al. (2010) is that low *SIR* stocks (the "good new" firms) earn positive returns. Note however, that this result does not hold among low *SIR* stocks that are supply constrained. In fact, even among the lowest SIR deciles, special stocks earn negative, not positive, size-

adjusted returns -- the average returns to special stocks in two of the lowest three SIR portfolios are statistically and economically significant (-0.9% and -1.5%).

More broadly, a stock's specialness predicts returns within every *SIR* decile. Consistent with prior studies, the low SIR portfolio generates a positive abnormal return of 0.6 percent per month, while the high SIR portfolio return averages -0.5 percent per month. More importantly, within each *SIR*, there are negative returns concentrated among stocks on special and positive returns among general collateral stocks. The spread between GC and special stocks is greater than 1% in all *SIR* deciles. Among special stocks, the highest *SIR* stocks have an average significant return of -1.8 percent, while returns to the lowest *SIR* stocks (-0.5 percent) are not distinguishable from zero. The spread is statistically distinguishable from zero and economically large (1.3 percent).

Finally, we show that *SIR* is a useful predictor of returns for GC firms. Specifically, we find lower *SIR* firms earning higher future returns, with a statistically significant low-high return differential of 0.8% per month. This result is consistent with the "good news in short interest" finding in Boehmer et al. 2010, but may at first blush appear to be at odds with Blocher et al 2013. Blocher et al. (2013; Table 7), show that a *SIR* measure has no significant predictive power for returns after controlling for specialness. In contrast, we find *SIR* remains a robust predictor among GC stocks. Interpreted in the context of supply constraints, our result shows when stocks are divided into binding and non-binding subsamples, *SIR* continues to be a good proxy for short-seller demand in the non-binding group (i.e. among GC stocks). However, if the sample was not subdivided, as in Blocher et al. (2013), SIR would be dominated by specialness.

To assess the economic magnitude of the associations between our short selling variables and returns in a multivariate setting, we estimated monthly cross sectional regressions of one-month-ahead size adjusted returns on scaled decile ranks of *SIR*, *DCBS*, *TDQ*, *BOLQ*, *BOIQ*, and *Utilization*. Most of the results conform to expectations. In Table 4 Panel A, high *SIR* firms underperform low short interest firms by 0.9 percent each month, while high *TDQ* firms and high *BOLQ* firms underperform their low demand counterparts by 0.9 percent and 0.8 percent, respectively. The highest *DCBS* stocks earn 3.7 percent per month lower returns than the lowest *DCBS* stocks; note however, these are also the stocks with the highest loan fees. Strikingly, on a stand-alone basis the supply variable, *BOIQ*, does not predict returns for the full sample. We revisit this result later in the paper. In the final regression of Panel A, we include both *SIR* (demand as a percentage of shares outstanding) and *Utilization* (demand as a percentage of available supply). We find that *SIR* is not significant (0.1 percent per month) but

Utilization continues to be a strong and significant predictor of future returns (-1.4 percent per month). Thus, the combination of demand and supply results in a more powerful predictor of future returns.

In Table 4, Panel B we investigate how a stock's special status influences the relation between short selling characteristics and future returns. Our results show much of the association between *SIR* and future return derives from stocks that are on special: high *SIR* stocks on special underperform low *SIR* stocks on special by 2.3 percent, while high *SIR* general collateral stocks only underperform their low *SIR* counterparts by 0.4 percent. The results are practically identical in the next two regressions when we use *TDQ* and *BOLQ* as alternative measures of demand. The fifth regression examines the relation between future returns and supply (*BOIQ*). For general collateral stocks, once again we find no relation between *BOIQ* and returns. However, the coefficient on the interaction term between special and *BOIQ* is strongly negative, showing that among special stocks, higher supply is associated with more negative future returns. This coefficient is difficult to interpret because when the supply constraint is binding, total demand and total supply are strongly positively correlated. For this reason, we investigate in Panel C the combined effect of both supply and demand in predicting future returns. The results are similar for the three measures of demand we consider: we find that high demand special stocks underperform low demand special stocks by 2.9 to 3.3 percent.

Strikingly, after controlling for demand, the coefficient for supply among special stocks turns reliably positive: high supply special stocks outperform low supply special stocks by 2.1 to 3.0 percent per month. The last regression in Panel C sums up our findings well. Controlling for supply, lower demand (*BOLQ*) is always "good news" for future returns (the coefficient on *BOLQ* is reliably positive for both GC and special stocks), although the effect is stronger among special stocks. Supply (BOIQ) is irrelevant for GC stocks (it is non-informative when the constraint is not binding), but is positively associated with future returns for special stocks (i.e. for special stocks, more supply is a sign of greater inventory slack, which portends more positive returns).

Overall, these results demonstrate the importance of both demand and supply for returns prediction. For GC stocks, returns are decreasing in demand. For special stocks the demand and supply variables are positively correlated, and both play a role. In the next analysis, we confirm the role of demand on GC stocks and further disentangle the roles of supply and demand for special stocks.

4.2 Returns to general collateral and special stocks by demand and supply

In this section, we first explore the role of demand on GC stocks, and then examine the role of supply for special stocks. Boehmer et al. (2010) show that lightly shorted stocks experience positive future returns after controlling for risk. Their results are difficult to reconcile with transaction costs or short sale constraints because the returns are generated from long positions. Our Table 3 results show that this "good news in short interest" exists among GC stocks, but not among special stocks. We now further parse the source of the "good news" in short selling among GC and special stocks.

Table 5, Panel A reports results for GC stocks from a first stage sort on utilization and a second stage sort on demand (*BOLQ*). In the first stage, we use the *Utilization* ratio to sort firms into deciles. In the second stage, we further sort firms into quintiles by demand (*BOLQ*) within each *Utilization* decile. We then form the lowest *BOLQ* portfolio by combining low *BOLQ* firms from each of these second-stage sorts, and follow a similar procedure for the other quintiles. In this way, we collapse the 50 portfolios after the second stage sort into five, with roughly similar constraints (as measured by *Utilization*). Our goal is to evaluate the role of demand on future returns when stocks have similar utilizations (i.e. when short-sell constraints are neutralized).

Panel A shows that among GC stocks, holding *Utilization* constant, low demand stocks earn higher returns. Low *BOLQ* firms enjoy abnormal returns of 0.5 percent, while high *BOLQ* firms earn insignificant returns, with the return difference being statistically significant. Recall from Table 4, Panel B that supply (*BOIQ*) has no correlation with returns among GC stocks. The results in Table 5, Panel A confirm the role of demand in predicting returns among GC stocks, even after controlling for any residual effects due to differences in *Utilization*.

Table 5 Panel B examines the constrained case (special stocks). In the constrained case, we expect limited supply to have a direct effect on the censoring of negative views among traders. The greater the supply of lendable shares, the more fully negative views can be impounded into price before the supply constraint is reached. Thus, among special stocks, we expect low supply to portend lower future returns. To help isolate the effect of supply, we again apply a two-stage sort procedure, sorting first by *Utilization* ratio, and then by supply (*BOIQ*) quintiles within each utilization decile. The spread in *Utilization* across our five *BOIQ* quintiles confirms that our design is successful, as *utilization* does not differ significantly across portfolios. As predicted, we find low supply stocks underperform high supply stocks. The lowest quintile generates returns of -1.6 percent per month whereas the highest quintile

generates -0.8 percent per month, consistent with special stocks that have less supply underperforming their higher supply counterparts. Moreover, the patterns in demand (measured as *BOLQ* or *SIR*) help to rule out a demand explanation for these returns. If returns among special stocks are driven by short sale demand, higher *BOLQ* should be associated with lower future returns. In fact, Panel B shows the opposite -- i.e., for special stocks, both *BOLQ* and *SIR* are lowest in the low supply quintile, where future returns are most negative.

4.3 Returns, demand, and inventory for the short side of trading strategies

The prior section reveals the role of lendable supply among special stocks. In particular, negative returns are most severe for special stocks with the lowest supply. In this section, we examine whether the short-side returns to a variety of trading strategies are evident among GC, easy to borrow stocks, or whether these returns concentrate in special and difficult to borrow stocks. To better understand the role that lendable supply plays on short-side returns, we also examine demand and lendable supply for firms on the short side of these strategies. The strategies that we examine include:

(1) ***GrossProfit***, following Novy-Marx (2010) who proposes the ratio of gross profit-to-assets as a good proxy for true economic profitability, and show that a sort based on this ratio is positively associated with future abnormal returns.

(2) ***AssetGrowth***, following Cooper et al. (2008) who argue investors overreact to the implications of asset growth. We measure asset growth as total assets for the most recent quarter divided by total assets four quarters ago.

(3) ***Investment/Assets***, following Titman et al. (2004) and Xing (2008) who suggest investors underreact to overinvestment by managers. This variable is the sum of capital expenditures and the change in inventory over the most recent four quarters divided by assets four quarters ago.

(4) ***NOA****, or Net operating assets*, following Hirshleifer, Hou, Teoh, and Zhang (2004), who suggest investors fail to recognize the negative implications of high NOA for future performance. We measure *NOA* as the sum of debt and equity divided by total assets for the most recent quarter.

(5) ***Accruals***, following Sloan (1996). He suggests that investors fixate on earnings and ignore the differential implications of earnings components. We measure total accruals as net income less cash from operations for the most recent four quarters divided by total assets for the most recent quarter.

(6) ***Payout%***, is measured as clean surplus dividends over the most recent four quarters divided by market value of equity four quarters ago. Clean surplus dividends are calculated as net income (comprehensive income when available) less the increase in the equity balance over the most recent four quarters. Ritter (1991), Loughran and Ritter (1995), and Daniel and Titman (2006) find firms that issue equity underperform. This variable is in the same spirit but employs an accounting-based metric.

(7) ***QuarterlyEarnings***, following Chen et al. (2010), who find that more profitable firms have higher future returns. We measure quarterly earnings as net income for the most recent quarter divided by assets for the most recent quarter.

(8) ***OhlsonScore***, following Stambaugh et al. (2012) who find underperformance by firms with high financial distress. We measure financial distress using the bankruptcy prediction model from Ohlson (1980).

(9) ***MScore***, following Beneish, Lee, and Nichols (2013). They find that high probability of fraud based on Beneish (1999) is associated with low future returns. They suggest that investors do not fully recognize the consequences of firm characteristics associated with high probability of fraud.

We use quarterly COMPUSTAT to obtain the financial statement variables. With the exception of the quarterly earnings strategy, we use trailing twelve months for income statement and cash flow statement variables, and balance sheet data from the most recent quarter (or four quarters before when taking lags). We allow a three-month lag between the end of the quarter and portfolio formation to ensure the financial information is publicly available. Because not all firms have the same quarter end, we rank firms into deciles based on the distribution of the characteristic from all observations with quarters ending in the most recent three months. Once a firm is assigned to a decile, the assignment continues for a three-month period.

Table 6, Panel A reports average size-adjusted returns to the nine strategies across the 114 months in our sample. Although all the short side returns are numerically negative, only three (*AssetGrowth*, *Investment/Assets*, *Accruals*) have returns that are significantly negative.[16] However, when we split the short side into special and general collateral, we find that all the short side returns are

[16] In time-series regressions using the Fama-French three factor model or three factors plus momentum, 7 of the 9 strategies generate significantly negative alphas for the full sample period of 114 months.

significantly negative for the special stocks. Moreover, the returns are not significant for the stocks that are easy to borrow.

To provide a stronger test, we focus on the months in our sample period that follow high investor sentiment. Stambaugh et al. (2012) argue there are potentially more overpriced investments following periods of high sentiment. In Panel B, we conduct a similar test to Stambaugh et al. (2012) using Baker and Wurgler (2006)'s sentiment index and defining high sentiment as a values of the index greater than 0. Consistent with Stambaugh et al. (2012), we find short side returns are stronger following high sentiment periods -- seven of the nine strategies produce significantly negative returns following high sentiment periods. However, consistent with our earlier findings, the negative returns are concentrated among the special stocks. Seven of the nine strategies generate significant returns among special stocks. Moreover, the returns to special stocks are generally more than twice the returns to GC stocks.

To evaluate the effect of supply and demand among special and GC stocks, we also examine these statistics for stocks identified by the short-side of each strategy following high sentiment months. Panel C reports the supply of shares outstanding that are available to borrow (*BOIQ*). This panel shows a striking difference in inventory quantity between the special and GC stocks. *Special* stocks have significantly lower inventory for all nine of the strategies, and the differences range from 6 percent to over 10 percent of total shares outstanding. Thus, a key difference between special and GC stocks is the supply of lendable shares. GC stocks have sufficient supply to satisfy demand at reasonable cost; special stocks do not.

Panel D reports the percentage of shares outstanding actually borrowed (*BOLQ*) for special and GC stocks included on the short side of each strategy. Surprisingly, we find little differences in the level of demand between special and GC firms. For all the strategies, the difference in loan quantity demanded is 1 percent or less of total shares outstanding. For four of the nine strategies, GC stocks actually have significantly greater loan quantity than special stocks. Loan quantity is significantly greater for special stocks in only three of the strategies. Taken together, results in Panels C and D point to the supply of lendable shares as a key constraint in informational arbitrage on the short-side of these strategies. At the same time, our results suggest that the short-side returns documented in prior studies are likely unavailable without incurring significant borrowing costs. This reduces the *attainable* profitability of strategies appearing in the literature.

4.4 Determinants of the cost of borrowing and the supply of lendable shares

In previous analyses, we show that the inventory of readily lendable shares is substantially less than total shares outstanding for the typical firm. Indeed, as reported in Table 2, even GC stocks have an average inventory representing less than 20 percent of outstanding shares. In this final analysis we seek to better understand the forces that shape the available inventory of lendable shares. We approach the problem in two stages. In the first stage, we model the determinants of the cost of borrowing. In the second stage, we examine the determinants of the supply of lendable shares, after controlling for expected borrowing costs.

Theory and prior empirical research suggest three categories of factors that could impact the available supply of lendable shares: cost of borrowing, equity market characteristics, and accounting characteristics that are associated with institutional investing and with recall risk.[17]

Cost of Borrowing. The greater the cost of borrowing shares, the higher the incentive to place one's shares in the lendable inventory. Cost of borrowing represents a benefit to share lenders, so higher borrowing costs should attract more shares to lendable inventory. This suggests a positive association between borrowing costs and lendable inventory. On the other hand, lendable inventory also affects the cost of borrowing. When shares are in short supply, it becomes difficult and costly to locate and borrow additional shares, and lower demand is required to trigger special status. This effect suggests a negative relation between borrowing costs and lendable inventory. To address the endogenous relation between cost of borrowing and lendable inventory, we follow an instrumental variables approach, discussed in more detail in the next section.

Equity Market Characteristics. Although prior literature has not modeled the cross-sectional determinants of lendable supply, a number of variables have been identified that affect borrowing costs (see for example D'Avolio 2002). Among these, many should also impact lendable supply, and are thus included in our model. First, because larger firms are more liquid and more widely held, we expect a

[17] The inventory of lendable shares is associated with, but not the same as, shares supplied to short sellers. For example, prime brokers need some reserve inventory on hand to cover sell orders by beneficial owners. The inventory of lendable shares will include the shares actually on loan to short sellers plus the reserve inventory that the broker is willing to lend, should they get a sufficiently attractive deal (e.g., cost of borrowing rises enough to compensate the broker for recall risk). Thus, although we predict the cost of borrowing will be important, we expect other characteristics will shape the inventory of lendable shares as well.

positive association between *BOIQ* and ***lnMVE***. Share turnover reflects how actively the shares are traded. More active trading increases the likelihood a beneficial owner will opt to sell, thus increasing recall risk. We therefore expect a negative association between *BOIQ* and ***ShareTO***. Many institutions favor stocks with positive price momentum, so we expect a positive relation between *BOIQ* and ***Momentum***. At the same time, institutional lenders tend to shun low priced stocks (e.g., less than $5 per share), so we expect a negative association between *BOIQ* and ***LoPrice***. Many institutions are drawn to value stocks, so we predict a positive association between *BOIQ* and ***BTM***. Similarly, if firms with higher idiosyncratic return volatility are more difficult to arbitrage because they have higher recall risk, they are less likely to be placed in lendable inventory. This leads us to expect a negative relation between *BOIQ* and ***RetVol***. Finally, if institutions are the main lender of shares, the more shares held by institutions, the more shares that should be available in lendable inventory. Thus, we expect a positive relation between *BOIQ* and ***InstOwn***.

Accounting Characteristics. Accounting characteristics include characteristics that relate to the strength of the company's fundamentals and/or the likelihood of overvaluation. Accounting fundamentals should matter to the extent security lenders prefer to hold stocks with strong fundamentals. Characteristics of overvalued equity should matter to the extent security lenders prefer to avoid overvalued equities in their portfolios which serves as the source of lendable shares. We use the same accounting characteristics from Table 6, but we re-rank firms into decile portfolios such that firms with weak fundamentals and/or signs of overvaluation receive high ranks. Thus, we expect a negative association between *BOIQ* and the portfolio assignments for our accounting characteristics. We rescale the portfolio assignments to range between 0 and 1. See Appendix A.1 for a detailed description of the variables.

4.4.1 First stage model of borrowing costs

The cost of borrowing depends on the demand for shares as well as the inventory of lendable shares. To address the endogenous relation between cost of borrowing and lendable inventory, we develop a two-stage least squares estimation. In the first stage, we model borrowing costs (*DCBS*) as a function of demand (*BOLQ*) and the predetermined variables from the second-stage *BOIQ* equation. In the second stage, we model *BOIQ* as a function of the predetermined variables as well as an instrumental variable for the expected borrowing costs from the first stage model.

The cost of borrowing should increase as more shares are loaned out (*BOLQ*), but should decrease as more shares enter inventory and are available to lend (*BOIQ*). This reflects the negative effect of inventory on the cost of borrowing mentioned above. Because we predict *BOIQ* to depend on market characteristics and accounting characteristics, *DCBS* should be an indirect function of these same determinants. Thus, we regress *DCBS* on *BOLQ* (demand) and the determinants of *BOIQ* using OLS. The fitted value is the instrumental variable from this regression:

(1) $$DCBS\ (or\ Special) = \beta_0 + \beta_1 BOLQ + \beta_2 lnMVE + \beta_3 ShareTO + \beta_4 Momentum + \beta_5 LoPrice + \beta_6 BTM + \beta_7 RetVol + \beta_8 InstOwn + \beta_9 GrossProfit + \beta_{10} AssetGrowth + \beta_{11} Accruals + \beta_{12} OhslonScore + \beta_{13} MScore + \beta_{14} QuarterlyEarnings + \beta_{15} NOA + \beta_{16} Payout\% + \beta_{17} Investment/assets + \varepsilon$$

We report our main results in model 1 of Table 7. Generally, these results are consistent with Table 2, Panel B. As expected *DCBS* is strongly positively associated with demand (*BOLQ*). *DCBS* is also negatively related to ln*MVE*, *Momentum*, *BTM*, and *InstOwn*, but positively related to *ShareTO, LoPrice,* and *RetVol*. Interestingly, accounting characteristics also affect borrowing costs. Specifically, borrowing costs are higher when gross profit is low, asset growth is high, financial distress is high, probability of earnings manipulation is high, quarterly earnings are weak, balance sheet bloat is high, and investment intensity is heavy. These results suggest that hard-to-borrow stocks have weak fundamentals and characteristics of overvalued equity. In contrast, high payout and low accruals, typically associated with stable, high quality firms, are associated with higher borrowing costs.

For robustness, we vary our first stage estimation procedure and our measure of borrowing costs. Although our interest is in a continuous measure of the costs of borrowing, we only observe *DCBS*, a rough categorical proxy for unobserved borrowing costs. This motivates our use of ordered logit to estimate our first stage model. For each observation, the ordered logistic estimation produces an individual probability for each level of the dependent variable (*DCBS* from 1 to 10). For the instrumental variable in our second stage model, we select the *DCBS* level with the highest probability for that observation. *DCBS* is only one measure of borrowing cost. An alternative measure common in the literature and used in earlier analysis simply sorts stocks into low cost (*GC*) and high cost (*Special*) categories. Consequently, we also model the probability of *Special* status as a function of *BOLQ*, market characteristics, and accounting characteristics as in model (1) using probit regression. We use the estimated probability of special status from this model as final instrumental variable.

The results from our ordered logit and probit models in Table 6 show the OLS findings are not sensitive to choice of estimation procedure or to perturbations in the measurement of borrowing costs. Generally, the signs and significance of the coefficient estimates are similar across all three estimations. The only exception is *Payout%*, which flips sign. *Payout%* is not significantly related to *DCBS* in the OLS specification, but positively related to *DCBS* and *Special* in the ordered logit and probit models. Overall, these results confirm that accounting characteristics influence borrowing costs even after controlling for demand.

4.4.2 Second stage model of lendable inventory

In our second-stage estimation, we model the supply of lendable inventory, *BOIQ*, as a function of expected borrowing costs, market characteristics, and accounting characteristics:

(2) $$BOIQ = \beta_0 + \beta_1 CostProxy + \beta_2 lnMVE + \beta_3 ShareTO + \beta_4 Momentum + \beta_5 LoPrice + \beta_6 BTM + \beta_7 RetVol + \beta_8 InstOwn + \beta_9 GrossProfit + \beta_{10} AssetGrowth + \beta_{11} Accruals + \beta_{12} OhslonScore + \beta_{13} MScore + \beta_{14} QuarterlyEarnings + \beta_{15} NOA + \beta_{16} Payout\% + \beta_{17} Investment/assets + \varepsilon$$

where *CostProxy* denotes *DCBS*, *DCBS_OLS*, *DCBS_OrdLog*, *Special*, or *PrSpecial*. *DCBS_OLS* denotes the fitted value from the *DCBS* OLS regression in Table 7. *DCBS_OrdLog* denotes the *DCBS* level with the highest individual probability from the *DCBS* ordered logit model in Table 7. *PrSpecial* denotes the probability that the stock is on special from the probit specification in Table 7. All other independent variables are the same as Table 7, and described in detail in Appendix A.1.

We estimate the models monthly, and we report the average coefficients and t-statistics from the distribution of monthly estimates in Table 7. Models 1 and 4 do not use the instrumental variable approach and we find that the proxies for the cost of borrowing *DCBS* (model 1) and special (model 4) load with negative coefficients. This reflects the effect of inventory on the cost of borrowing: when shares are in short supply, the cost of borrowing is high. In contrast, we predict a positive coefficient for the effect that the cost of borrowing has on *BOIQ*. That is, when cost of borrowing is high, more shares should become available to lend. Thus, the results in models 1 and 4 reflect the simultaneity bias that motivates our two-stage least squares approach.

Model 2 reports our main results, and addresses the simultaneity bias by replacing *DCBS* with the expected value of *DCBS* estimated from the first stage OLS model in Table 6. The instrumental

variable loads with a positive coefficient. Thus, controlling for their simultaneous nature allows us to isolate the effect of borrowing costs on lendable inventory. The positive coefficient on *DCBS _OLS* confirms that higher cost of borrowing is associated with *more* shares in inventory. All the equity market characteristics load with their predicted sign. The results profile a firm with deep inventory of lendable shares: a large firm, with a price greater than $5, glamour characteristics, positive momentum, low turnover and return volatility, and heavy institutional ownership. For the variables in common with D'Avolio (2002), the results are generally consistent with his Table 2.

Almost all the accounting-based characteristics load, confirming that accounting characteristics are associated with the inventory of lendable shares. Although ***Accruals***, ***MScore*** and ***Payout%*** are not significantly related to lendable inventory, the signs of the accounting fundamentals are generally consistent with lower inventory when the stock has weak fundamentals or has potential to be overvalued. In particular, firms with low ***GrossProfit***, high ***AssetGrowth***, high financial distress (low ***OhlsonScore***), low ***QuarterlyEarnings***, high ***NOA***, and high ***Investment/Assets*** have lower lendable inventory. These findings strongly suggest that accounting characteristics associated with pricing anomalies impact pricing and availability in the equity loan market. In particular, they confirm the existence of a whipsaw effect: stocks with characteristics of overvalued equity have high shorting demand yet low inventory of lendable shares.

We report models 3 and 5 as robustness. Model 3 replaces *DCBS* with the level of *DCBS* that has the highest probability from the first stage ordered logistic regression (*DCBS _OrdLog*). Model 5 replaces *Special* status with the estimated probability of special status from the first stage probit model (*PrSpecial*). In both specifications, the instrumental variable loads with a positive coefficient, confirming the prediction that higher cost of borrowing is associated with more shares in inventory. The sign and significance of the equity market characteristics in models 3 and 5 resemble our main results in model 2, with the exception of share turnover and momentum. Among the accounting characteristics, the results for gross profit and accruals appear to be sensitive to specification: they change signs in model 3 and lose significance in model 5. However, ***AssetGrowth***, ***OhlsonScore***, ***MScore***, ***QuarterlyEarnings***, ***NOA*** and ***Investment/Assets*** are all negatively associated with lendable inventory. This suggests that accounting characteristics of overvalued equity generally reduce the supply of lendable shares.

5. Conclusion

The informational efficiency of stock markets has been a central theme in financial economic research in the past 50 years. Over this period, the focus of academic research has gradually shifted from the general to the more specific. While earlier studies tend to view the matter as a yes/no debate, many recent studies now acknowledge the impossibility of fully efficient markets, and have focused instead on analyses of factors that could materially affect the timely incorporation of information into prices. At the same time, increasing attention is being paid to regulatory and market design issues that could either impede or enhance pricing efficiency.

In this study, we use detailed equity lending data to examine the role of constraints on equity prices. We find that constrained stocks underperform, the short interest ratio has a nonlinear association with constraints, constrained stocks have negative returns regardless of short interest ratio, high short interest yet unconstrained stocks do not underperform, yet low short interest unconstrained stocks outperform. Moreover, we show that limited supply is a key feature distinguishing constrained and unconstrained stocks, and that among constrained stocks, those with the lowest supply have the strongest negative returns. Our findings confirm that supply varies across firms (in contrast to SIR, which assumes supply is 100 percent of outstanding shares for all stocks) and short supply in the equity lending market has implications for the informational efficiency of equity prices.

Because our data spans a wide cross section of stocks over a 114 month period, we are able to examine the role of constraints and lending supply on various trading strategies proposed in the literature. We find that the short side returns to these strategies exist in the constrained, hard to borrow, special stocks only; we do not observe significant negative returns among stocks that remain easy to borrow. Moreover, special stock have much lower supply yet have similar levels of demand relative to general collateral stocks. Thus, equity lending constraints appear to render the short side returns in prior literature suspect, and short supply seems to be the primary constraint.

Our conclusions are subject to several limitations. Our tests of the role of constraints on equity pricing involve the joint hypothesis that our measure of constraints is valid. Although the strong results from our tests suggest this assumption holds, to the extent we measure constraints with error, our ability to detect the pricing implications of constraints is weakened. Moreover, our study focuses on the consequences of limited supply. Thus, we take supply as given, but acknowledge that a better

understanding of supply is warranted. Indeed, our results highlight the importance of additional research into the determinants of supply in the securities lending market.

Collectively, our results show that a proper appreciation for the underlying economics in the equity loan market is crucial in assessing the implications of short-sell data for stock return prediction. These findings should interest regulators, researchers, and investors, among others. For regulators, our findings suggest that improving supply can lead to improved market efficiency. For researchers, our findings improve understanding of the existence and longevity of short side returns to various trading strategies. For investors, our results suggest the predictive power of short-selling variables can be greatly enhanced by conditioning on the level of a stock's "supply slack". At the same time, our findings suggest caution is warranted in implementing short-based strategies: the stocks that remain easily available to short for the typical marginal investor are likely not mispriced.

Appendix

Sample construction

We construct our sample from the intersection of quarterly Compustat, CRSP, and Markit, formerly Data Explorers (DXL). Data Explorers represents the most significant constraint on our sample. DXL reports demand and supply data beginning in June of 2004 and extending to December 2013. Thus, our returns span the period from July, 2004 to October 2011 for a total of 88 months. We use the Baker and Wurgler (2006) sentiment measure in some of our tests. Their data is available through December, 2010. Consequently, for those tests our last returns are for January, 2011, for a total of 79 months. Our primary sample excludes observations with missing DCBS, utilization, or SIRatio. We also eliminate observations if TDQ, BOLQ, BOIQ, or SIRatio exceed one because these are likely to reflect data errors.

Ranking procedures

In various analyses, we rank observations into portfolios based on various firm characteristics. When ranking on short selling variables, sorts are based on the distribution of the variable as of the same month. In contrast, when we rank on financial statement variables (as in our trading strategy analyses), we perform our rankings using a rolling window to capture the distribution of the variable over the three months ending with the month of the firm's fiscal quarter end. Because all firms will have a fiscal quarter ending in any given three month window, this procedure ensures a firm's ranking is based on the entire distribution of firms.

Information available to the market

In the DXL data, each firm has multiple observations in a month. We take the last observation in month t-1 for ranking firms and predicting returns in month t. For our trading strategy analysis, we allow a three month lag between the end of the fiscal quarter (when a firm's rank is assigned) and when the firm enters a portfolio to ensure information is available for ranking and portfolio assignment.

Size-adjusted returns

We compute size-adjusted returns following a slightly modified version of the procedures outlined in Lyon, Barber, and Tsai (1999). To form reference portfolios, we first identify decile portfolio breakpoints based on all NYSE firms. We then assign all NYSE, AMEX, and Nasdaq firms to portfolios based on those breakpoints. The smallest portfolio has a disproportionately large number of stocks, so

we further sort those stocks into five portfolios based on market cap. The end result is 14 size-based portfolios. If a firm delists, we include returns to the delist date as well as any delisting return reported by CRSP. If a delist return is missing, we estimate it using the procedures outlined in Beaver, McNichols, and Price (2007). As in Lyon, Barber, and Tsai (1999), from the month following delisting to the end of the holding period, we assume the proceeds from delisting, if any, were invested in the CRSP size-based portfolio to which the firm belongs.

Table A.1 Variable Construction and Definitions

Equity lending variables	These variables are measured using the last available observation in month t. All the equity lending variables except one were obtained from Markit formerly Data Explorers (DXL). The exception, SIR, is from COMPUSTAT.
BOIQ	Beneficial Owner Inventory Quantity (*BOIQ*)—Quantity of shares in inventory available from beneficial owners, divided by shares outstanding. This is the supply of shares available from lenders in the DXL consortium.
BOLQ	Beneficial Owner on Loan Quantity (*BOLQ*)—Quantity of shares on loan from beneficial owners, divided by shares outstanding. This measure of demand represents shares borrowed by DXL borrowers from DXL lenders.
DCBS	Daily Cost of Borrow Score – a relative measure of borrow cost, constructed by DXL. It ranges from 1 (cheap to borrow) to 10 (expensive to borrow).
Loan Fee	Simple average loan fee expressed as an annual rate in basis points. This variable reflects the direct cost the lender charges the borrower for lending the stock.
Rebate	Simple average rebate in basis points, calculated as the interest on cash collateral put up by the borrower less the loan fee charged by the lender. This is the net amount received by the borrower as a result of the lending transaction.
SIR	Open short interest divided by shares outstanding, from COMPUSTAT. A measure of total market demand for borrowing widely use in prior short selling research.

TDQ	Total Demand Quantity (*TDQ*). Quantity in shares on loan by DXL borrowers, divided by shares outstanding. *TDQ* is the most expansive measure of total borrowing provided by DXL. It differs from *BOLQ* as follows: in addition to shares borrowed by DXL borrowers *from DXL lenders*, *TDQ* also includes shares borrowed by DXL borrowers from *non-DXL lenders*, as well as shares loaned by DXL lenders to *non-DXL borrowers*.
Utilization	BOLQ divided by BOIQ—The ratio of DXL demand for borrowing and supply for lending. This is a measure of the constraint slack in the equity loan market based solely on DXL demand and supply (abstracting from recall risk).
Equity market variables	
SAR	Monthly size-adjusted return. Market capitalization benchmark portfolio returns are subtracted from firm returns to calculate buy and hold size adjusted returns. Benchmark portfolio returns are based on NYSE capitalization decile cutoffs at portfolio formation. The lowest NYSE capitalization decile is further sorted into five portfolios on market capitalization, for a total of 14 size-based benchmark portfolios.
Market capitalization	Price per share multiplied by shares outstanding as of the end of the month.
Price	Price per share as of the end of the month.
Share turnover	Trading volume for the month divided by shares outstanding.
Book to market	Book value of equity for the most recent quarter divided by market value of equity
Trading strategy variables	All income statement and cash flow statement variables are trailing four quarters. Balance sheet variables are most recent quarter. Lagged (i.e., t-4) income statement variables are for quarters t-7 to t-4. Lagged balance sheet variables are for quarter t-4.
Gross profit	$(Sales_t - CGS_t)/Assets_t$
Asset growth	$Assets_t/Assets_{t-4}$
Investment/Assets	$(CAPEX_t + Increase\ in\ inventory_t)/Assets_{t-4}$
NOA	$(Debt\ in\ current\ liabilities_t + Long\text{-}term\ debt_t + Total\ equity_t)/Assets_t$

Accruals	(Net income$_t$ - Cash from operations$_t$)/Assets$_t$
Payout%	CSR Payout$_t$/MVE $_{t-4}$
Quarterly earnings	Income before extraordinary items$_t$/Assets$_t$
Ohlson score	-.407*size+6.03*tlta-1.43*wcta+.0757*clca-2.37*nita-1.83*futl+.285*intwo-1.72*oeneg-.521*chin-1.32 where size = natural log of Total assets$_t$ tlta = Total liabilities$_t$/Total assets$_t$ wcta = (Current assets$_t$ - Current liabilities$_t$)/Assets$_t$ clca = Current liabilities$_t$/Current assets$_t$ nita = Net income$_t$/Assets$_t$ futl = Cash from operations$_t$/Total liabilities$_t$ chin = [Net income$_t$ - Net income$_{t-4}$]/[Abs(Net income$_t$)+Abs(Net income $_{t-4}$)] oeneg = 1 if Total equity$_t$ is negative; 0 otherwise intwo = 1 if net income is negative in both of the last two years; 0 otherwise
MScore	-4.84+.92*dsri+.528*gmi+.404*aqi+.892*sgi+.115*depi-.172*sgai+4.679*tata-.327*levi Where dsri = (Receivables$_t$/Sales$_t$)/(Receivables $_{t-4}$/Sales $_{t-4}$) gmi = Gross Margint-1/ Gross Margin$_t$, where Gross Margin is 1 minus Costs of Goods Sold / Sales depi = [1-(PPE$_t$+CA$_t$)/TA$_t$] /[1-(PPE $_{t-4}$+CA $_{t-4}$)/TA $_{t-4}$], where PPE is net, CA are Current Assets and TA are Total Assets sgi = Sales$_t$/Sales $_{t-4}$ depi = Depreciation Ratet-1/ Depreciation Rate$_t$, where depreciation rate equals Depreciation /(Depreciation+PPE) sgai = (SGA$_t$/Sales$_t$)/(SGA $_{t-4}$/Salest-1) tata = (Income Before Extraordinary Items$_t$ - Cash from Operations$_t$)/ Total Assets$_t$ lvgi = Leverage$_t$ /Leverage $_{t-4}$ where Leverage is calculated as debt to assets

References

Asquith, P. and L. Meulbroek. 1995. An empirical investigation of short interest, unpublished M.I.T. working paper.

Asquith, P., Pathak, P. A., & Ritter, J. R. 2005. Short interest, institutional ownership, and stock returns. *Journal of Financial Economics*, *78*(2), 243-276.

Avramov, D., T. Chordia, G. Jostova, and A. Philipov. 2013. Anomalies and financial distress. *Journal of Financial Economics* 108, 139-159.

Baker, M., and J. Wurgler. 2006. Investor sentiment and the cross-section of stock returns. *Journal of Finance* 61, 1645-1680.

Battalio, R., and P. Schultz. 2010. Regulatory uncertainty and market liquidity: the 2008 short sale ban's impact on equity option markets. *Journal of Finance* 66 (6), 2013-2053.

Beaver, W., M. McNichols, and R. Price. 2007. Delisting returns and their effect on accounting-based market anomalies. *Journal of Accounting and Economics* 43(2-3): 341-368.

Beneish, M.D. 1999. The detection of earnings manipulation. *Financial Analysts Journal* (September/October): 24-36.

Beneish, M., Lee, C., & Nichols, D. C. .2013. Earnings Manipulation and Expected Returns. *Financial Analysts Journal*, *69*(2).

Blocher, J., A. V. Reed, and E. D. Van Wesep. 2013. Connecting two markets: An equilibrium framework for shorts, longs, and stock loans. *Journal of Financial Economics* 108, 302-322.

Boehme, R.D., B. R. Danielsen, and S. M. Sorescu. 2006. Short-sale constraints, differences of opinion, and overvaluation. *Journal of Financial and Quantitative Analysis* 41, 455-487.

Boehmer, E., Z. R. Huszar, and B. D. Jordan. 2010. The good news in short interest. *Journal of Financial Economics*

Boehmer, E., C. M. Jones, and X. Zhang. 2012. Shackling the short sellers: The 2008 shorting ban, Working paper, Singapore Management University, Columbia Business School, and Purdue University.

Boehmer, E., and Wu, J. J. 2013. Short selling and the price discovery process. *Review of Financial Studies*, *26*(2), 287-322.

Bris, A., W. N. Goetzmann, and N. Zhu, 2007. Efficiency and the Bear: Short sales and markets around the world, *Journal of Finance* 62(3), 1029-1079.

Chen, J., H. Hong and J. Stein. 2002. Breadth of ownership and stock returns. *Journal of Financial Economics* 66, 171-205.

Chen, J., R. Novy-Marx, and L. Zhang. 2010. An alternative three-factor model. Unpublished working paper. University of Rochester.

Cohen, L., K. B. Diether, and C. J. Malloy. 2007. Supply and Demand Shifts in the Shorting Market, *Journal of Finance,* 62 (5), 2061-2096.

Cooper, M., H. Gulen, and M. Schill. 2008. Asset growth and the cross-section of stock returns. *Journal of Finance* 63, 1609-1652.

Daniel, K. and S. Titman. 2006. Market reactions to tangible and intangible information. *Journal of Finance* 61, 1605-1643.

Daouk, H., C. M. C. Lee, and D. Ng. 2006. Capital market governance: how do security laws affect market performance? *Journal of Corporate Finance* 12, 560-593.

D'Avolio, G. 2002. The market for borrowing stock. *Journal of Financial Economics* 66, 271-306.

Dechow, P. M., A. P. Hutton, L. Meulbroek, and R. G. Sloan. 2001. Short-sellers, fundamental analysis, and stock returns. *Journal of Financial Economics* 61 (1), 77–106.

Desai, H., K. Ramesh, S. R. Thiagarajan, and B. V. Balachandran. 2002. An investigation of the informational role of short interest in the NASDAQ market. *The Journal of Finance* 57 (5), 2263–2287.

Diamond, D.W. and R.E. Verrecchia. 1987. Constraints on short-selling and asset price adjustment to private information. *Journal of Financial Economics* 18 (2), 277-311.

Drake, M. S., L. Rees, and E. P. Swanson. 2011. Should investors follow the prophets or the bears? Evidence on the use of public information by analysts and short sellers. *The Accounting Review* 86 (1), 101-130.

Duffie, D. 1996. Special repo rates. *Journal of Finance* 51, 493-526.

Engelberg, J. E., A. V. Reed, and M. C. Ringgenberg. 2012. How are shorts informed? Short sellers, news, and information processing, *Journal of Financial Economics* 105, 260-278.

_____, 2013. Short selling risk. Working paper. Rady School of Management, UCSD, Kenan-Flagler Business School, UNC, and Olin Business School, WUST, August 19.

Fabozzi, F. J., Editor. 2004. *Short selling: strategies, risks, and rewards.* Wiley and Sons: Hoboken, NJ.

Fama, E. F., and K. R. French. 1992. The cross-section of expected stock returns. *The Journal of Finance* 47, 427–465.

Fama, E. F., and K. R. French. 1993. Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics* 33 (1), 3–56.

Fama, E., and K. French. 2006. Profitability, investment, and average returns. *Journal of Financial Economics* 82, 491-518.

Gallmeyer, M. and B. Hollifield. 2008. An Examination of Heterogeneous Beliefs with Short-Sale Constraint in a Dynamic Economy. *Review of Finance* 12 (2), 323-364.

Geczy, C. C., Musto, D. K., & Reed, A. V. 2002. Stocks are special too: An analysis of the equity lending market. *Journal of Financial Economics*, *66*(2), 241-269.

Haugen, R. A., & Baker, N. L. 1996. Commonality in the determinants of expected stock returns. *Journal of Financial Economics*, *41*(3), 401-439.

Hirshleifer, D., K. Hou, S. Teoh, and Y. Zhang. 2004. Do investors overvalue firms with bloated balance sheets. *Journal of Accounting and Economics* 38, 297-331.

Hirshleifer, D., Teoh, S. H., & Yu, J. J. 2011. Short arbitrage, return asymmetry, and the accrual anomaly. *Review of Financial Studies*, *24*(7), 2429-2461.

Jegadeesh, N. and S. Titman. 1993. Returns to buying winners and selling losers: implications for market efficiency. *Journal of Finance* 48, 65-91.

Jones, C.M., and Lamont, O., 2002. Short-sale constraints and stock returns. *Journal of Financial Economics* 66, 207–239.

Kolasinski, A., A. Reed, and Riggenberg, O. 2013. A Multiple Lender Approach to Understanding Search and Supply in the Equity Lending Market. *Journal of Finance* 68, 559-595.

Loughran, T. and J. Ritter. 1995. The new issues puzzle. *Journal of Finance* 50, 23-51.

Lyon, J. D., Barber, B. M., & Tsai, C. L. 1999. Improved methods for tests of long-run abnormal stock returns. *The Journal of Finance*, *54*(1), 165-201.

Mashruwala, C., S. Rajgopal, and T. Shevlin. 2006. Why is the accrual anomaly not arbitraged away? The role of idiosyncratic risk and transaction costs, *Journal of Accounting and Economics* 42, 3-33.

Miller, E. M., 1977. Risk, uncertainty and divergence of opinion. *Journal of Finance* 32, 1151–1168.

Nagel, S., 2005. Short sales, institutional investors and the cross-section of stock returns. *Journal of Financial Economics* 78, 277–309.

Novy-Marx, R. 2010. The other side of value: good growth and the gross profitability premium. Unpublished working paper. University of Chicago.

Ohlson, J. 1980. Financial ratios and the probabilistic prediction of bankruptcy. *Journal of Accounting Research*18, 109-131.

Ritter, J. 1991. The long-run performance of initial public offerings. *Journal of Finance* 46, 3-27.

Sloan, R. 1996. Do stock prices fully reflect information in accruals and cash flows about future earnings? *Accounting Review* 71, 289-315.

Stambaugh, R. F., J. Yu, and Y. Yuan, 2012. The short of it: Investor sentiment and anomalies, *Journal of Financial Economics*, forthcoming.

Titman, S., K. Wei, and F. Xie. 2004. Capital investments and stock returns. *Journal of Financial and Quantitative Analysis* 39, 677-700.

Wang, H. and J. Yu. 2010. Dissecting the profitability premium. Unpublished working paper. University of Minnesota.

Xing, Y. 2008. Interpreting the value effect through the Q-theory: an empirical investigation. *Review of Financial Studies* 21, 1767-1795.

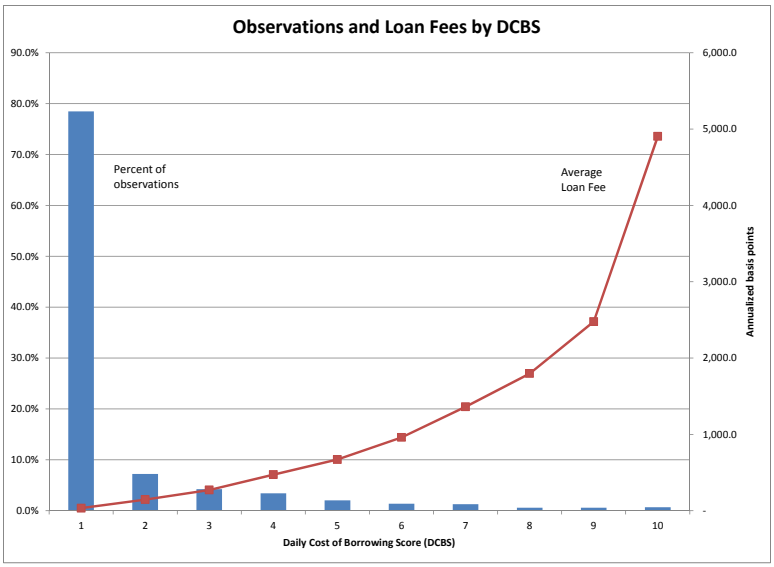

Figure 1. For each DCBS category, this figure charts the percentage of firm-month observations (left axis) and the average loan fees (right axis). Sample includes 299,535 firm-month observations from June 2004 to November 2013.

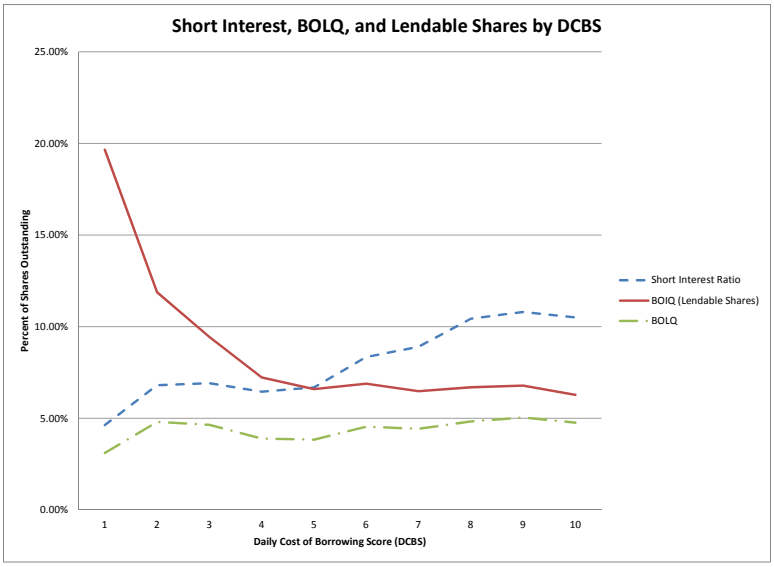

Figure 2. For each DCBS category, this figure charts the average values of two measures of demand (short interest and BOLQ) and average values of lendable supply (BOIQ). Sample includes 299,535 firm-month observations from June 2004 to November 2013.

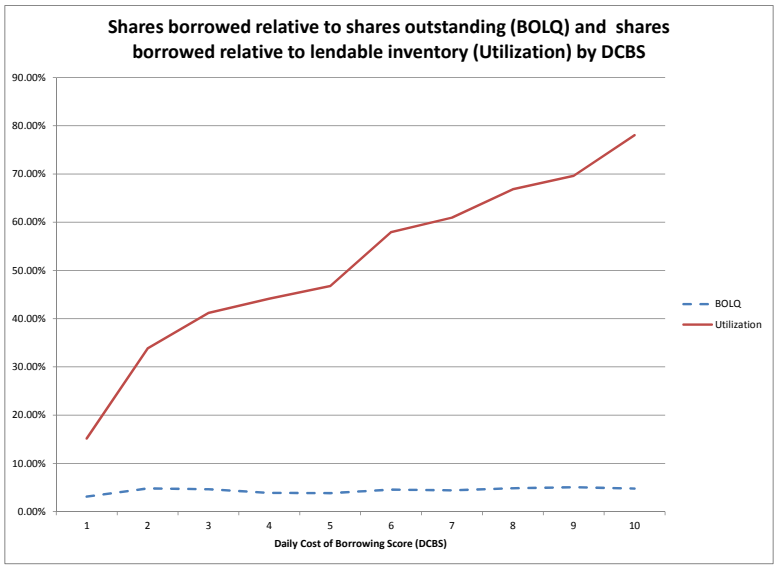

Figure 3. For each DCBS category, this figure charts shares borrowed as a percentage of shares outstanding (BOLQ) and as a percentage of shares in lendable inventory (Utilization). Sample includes 299,535 firm-month observations from June 2004 to November 2013.

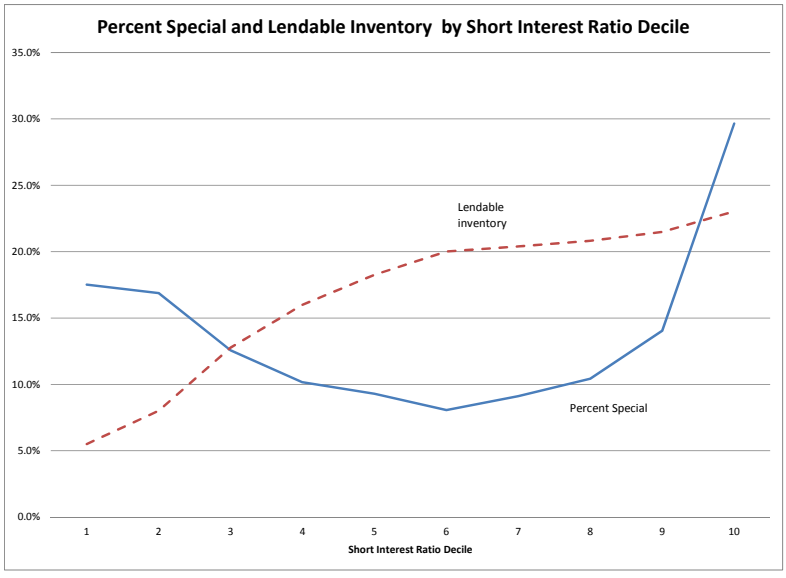

Figure 4. For each Short Interest Ratio decile, this figure charts the percentage of stocks that are Special and the lendable inventory as a percentage of shares outstanding (BOIQ). Sample includes 299,535 firm-month observations from June 2004 to November 2013.

Table 1. Sample description

This table describes our sample and key variables. Sample firms consists of NYSE, AMEX, and Nasdaq stocks from a merged CRSP and Compustat data set spanning 2004 to 2013. The unit of observation is firm-month. ***SAR*** is size-adjusted returns in month t+1. All other variables are based on the last available observation for each firm in each month (month t). ***SIR***, the short-interest ratio, is the open short interest divided by total shares outstanding, from the Compustat Security Monthly file. *DCBS*, *BOIQ*, *BOLQ*, and *TDQ* are short-interest variables from the Data Explorer (DXL) database. ***DCBS*** is Data Explorer's Daily Cost of Borrow Score, a measure of the relative cost of borrowing ranging from 1 (lowest cost, easiest to borrow) to 10 (highest cost, most difficult to borrow). ***BOLQ***, the beneficial owner loan quantity, and is the number of shares borrowed by DXL borrowers from DXL lenders, divided by total shares outstanding. ***TDQ*** is total demand quantity and represents all shares borrowed by DXL lenders, divided by total shares outstanding. ***BOIQ*** (beneficial owner inventory quantity) is the shares held and made available to lend by DXL lenders divided by total shares outstanding. ***Utilization*** (the ratio of shares borrowed to shares made available by DXL participants) is *BOLQ* divided by *BOIQ*. Panel A reports the average number of observations in each month. The last two columns report the percentage of sample firms for which we have *DCBS* data. Panel B reports simple descriptive statistics for the key variables. Panel C reports pairwise correlations.

Panel A. Average monthly observations for Returns, SIR and key Data Explorer variables

		Average Number of Observations Each Month						*DCBS* Coverage	
Year	Months	*SAR*	*SIR*	*DCBS*	*BOIQ*	*BOLQ*	*TDQ*	By MVE	By Firm
2004	7	5385	5332	2441	1710	1429	1625	85.30%	45.34%
2005	12	5376	5335	3260	3779	3285	3552	88.40%	60.64%
2006	12	5300	5273	3444	4268	3733	4026	78.26%	65.02%
2007	12	5217	5196	3897	4425	4125	4368	89.22%	74.72%
2008	12	5039	5030	3777	4375	4059	4355	93.92%	74.96%
2009	12	4715	4706	3611	4156	3818	4122	94.03%	76.61%
2010	12	4563	4557	3662	4033	3744	4058	95.09%	80.27%
2011	12	4447	4444	3901	4032	3804	4114	96.88%	87.73%
2012	12	4325	4323	4013	3942	3771	4025	97.13%	92.77%
2013	11	4240	4235	3859	3893	3686	3952	96.71%	91.01%

Panel B. Descriptive Statistics for Key Variables

Variable	Mean	Std Dev	Median	Minimum	Maximum
SIR	0.052	0.059	0.034	0.000	0.918
TDQ	0.043	0.057	0.021	0.000	0.958
BOLQ	0.034	0.047	0.016	0.000	0.552
BOIQ	0.174	0.121	0.166	0.000	0.993
DCBS	1.642	1.588	1.000	1.000	10.000
Utilization	0.215	0.237	0.120	0.000	1.000
SAR	0.1%	15.3%	-0.5%	-128.4%	1332.3%

N = 299,535

(Table 1, continued)

Panel C. Pearson (Spearman) correlations above (below) the diagonal

	SIRatio	*DCBS*	*Special*	*TDQ*	*BOLQ*	*BOIQ*	*Utilization*	*SAR*
SIRatio		**0.197**	**0.165**	**0.861**	**0.830**	**0.366**	**0.600**	**-0.019**
DCBS	**0.058**		**0.859**	**0.147**	**0.091**	**-0.323**	**0.539**	**-0.042**
Special	**0.046**	**0.844**		**0.132**	**0.082**	**-0.329**	**0.493**	**-0.037**
TDQ	**0.896**	**0.086**	**0.069**		**0.969**	**0.433**	**0.627**	**-0.017**
BOLQ	**0.866**	**0.039**	**0.024**	**0.967**		**0.488**	**0.585**	**-0.014**
BOIQ	**0.477**	**-0.387**	**-0.348**	**0.506**	**0.570**		**-0.117**	**0.007**
Utilization	**0.682**	**0.383**	**0.344**	**0.777**	**0.760**	**-0.006**		**-0.037**
SAR	-0.003	**-0.068**	**-0.066**	**-0.007**	-0.002	**0.044**	**-0.042**	

N = 299,535

Table 2. Short selling variables and other firm characteristics

This table reports average short selling variables and other firm characteristics for each firm-month observation, sorted by Daily Cost of Borrow Score (*DCBS*). ***DCBS*** is a daily measure of the relative cost of borrowing, ranging from 1 (lowest cost, easiest to borrow) to 10 (highest cost, most difficult to borrow). ***Rebate*** is the cash interest on collateral received by the short seller, net of the loan fee (expressed in basis points per year). ***Loan fee*** is the amount the short seller must pay to borrow the stock (expressed in basis points per year). ***SIR*** is open short interest as a percentage of shares outstanding. ***TDQ*** is total demand quantity and represents all shares borrowed by DXL lenders as a percentage of shares outstanding. ***TDQ/SIR*** is the total shares borrowed by DXL lenders as a percentage of total open short interest reported by Compustat. ***BOLQ*** is the number of shares borrowed by DXL borrowers from DXL lenders as a percentage of shares outstanding. ***BOIQ*** is the shares held and made available to lend by DXL lenders as a percentage of shares outstanding. ***Utilization*** is *BOLQ* divided by *BOIQ*. ***SAR*** denotes size adjusted return in the following month (t+1). ***MVE*** denotes market value of equity at the end of month t. ***Price*** denotes price per share at the end of month t. ***ShareTO*** is trading volume for month t divided by shares outstanding. ***Momentum*** is the cumulative size-adjusted return over the past six months (a measure of price momentum). BTM, or Book-To-Market, is book value of equity for the most recent quarter divided by market value of equity at the end of month t. Sample spans June, 2004 to November, 2013.

Panel A. Short selling variables by *DCBS*

DCBS	Obs	Obs with Rebates and Loan fees	*Rebate*	Mean *Loan Fee*	Median *Loan Fee*	*SIR*	*TDQ*	*TDQ/SIR*	*BOLQ*	*BOIQ*	*Utilization*
1	235,044	92,902	21.60	33.20	27.50	4.63%	3.78%	64.40%	3.10%	19.66%	15.15%
2	21,653	6,266	-40.90	145.60	121.60	6.80%	6.07%	69.91%	4.80%	11.88%	33.81%
3	12,702	3,086	-154.30	271.80	277.60	6.91%	6.13%	70.59%	4.64%	9.44%	41.18%
4	10,303	1,901	-385.60	473.20	489.00	6.45%	5.39%	67.99%	3.89%	7.23%	44.15%
5	6,125	1,176	-579.90	671.80	701.30	6.68%	5.39%	66.06%	3.83%	6.59%	46.76%
6	4,156	994	-895.90	960.80	962.50	8.34%	6.56%	70.85%	4.54%	6.89%	57.94%
7	3,888	900	-1317.00	1362.20	1370.60	8.90%	6.76%	70.09%	4.42%	6.48%	60.95%
8	1,785	440	-1754.00	1796.80	1808.50	10.43%	7.43%	70.46%	4.83%	6.69%	66.83%
9	1,777	417	-2445.00	2478.30	2515.00	10.80%	7.60%	71.78%	5.04%	6.78%	69.64%
10	2,102	515	-4886.00	4903.60	4615.00	10.50%	7.32%	71.06%	4.76%	6.28%	78.06%
Total	299,535	108,597									

(Table 2, continued)

Panel B. Returns and other firm characteristics by *DCBS*

		Next mo.		*MVE* (000)		*Share Price*		*ShareTO*		*Momentum* (n=293,230)		*BTM* (n=298,854)	
DCBS	Obs	*SAR*	t-stat	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
1	235,044	0.4%	13.39	$4,751,998	$713,895	$26.53	$18.41	1.97	1.46	3.2%	-0.7%	0.57	0.44
2	21,653	0.2%	1.62	$2,632,862	$267,592	$14.79	$8.30	2.25	1.34	-0.9%	-7.5%	0.60	0.40
3	12,702	-0.8%	-4.53	$1,378,493	$178,726	$11.44	$6.03	2.28	1.22	-1.7%	-9.4%	0.50	0.39
4	10,303	-0.6%	-3.02	$526,787	$125,331	$9.16	$4.37	2.21	1.09	-3.7%	-12.4%	0.48	0.36
5	6,125	-1.1%	-3.00	$292,601	$93,345	$7.41	$3.60	2.51	1.01	-1.9%	-12.8%	0.50	0.36
6	4,156	-2.0%	-5.67	$338,153	$106,983	$7.91	$3.64	2.71	1.30	-0.5%	-15.0%	0.54	0.30
7	3,888	-1.8%	-5.09	$334,510	$97,284	$7.99	$3.24	2.93	1.29	-7.8%	-18.7%	0.52	0.32
8	1,785	-2.1%	-3.50	$419,969	$106,437	$8.50	$3.36	3.22	1.57	-4.6%	-21.5%	0.54	0.28
9	1,777	-2.1%	-3.37	$344,447	$119,974	$7.87	$3.47	3.73	1.60	-3.7%	-19.3%	0.54	0.25
10	2,102	-4.5%	-8.41	$250,672	$95,046	$6.10	$2.95	4.64	2.04	-2.6%	-22.2%	-0.07	0.31
Total	299,535												

Panel C. Cross sectional regressions of daily cost of borrowing (*DCBS*) on demand (*BOLQ*) and supply of lendable shares (*BOIQ*)

Variable	Estimate	t-statistic	Estimate	t-statistic	Estimate	t-statistic
Intercept	2.489	52.81	1.521	74.46	2.459	53.73
BOIQ	-5.397	-40.57			-7.584	-44.49
BOLQ			4.552	8.56	13.207	19.61
Adj. R-square	13.1%		1.0%		20.9%	
n = 114 months						

Table 3. Returns to short interest ratio (SIR) Deciles for *Special* and General Collateral stocks

This table reports the average Daily Cost of Borrowing Score (*DCBS*) and one-month-ahead size-adjusted returns (*SAR*) for firms sorted by their short interest ratio (*SIR*). ***SIR*** denotes open short interest divided by shares outstanding as reported by Compusat in the month prior to the returns accumulation period. To construct this table, firms are sorted into SIR deciles at the end of the previous month (month t). Table values represent the average for each decile portfolio. ***DCBS*** is Data Explorer's Daily Cost of Borrow Score (we use the last available observation in month t for each firm). ***SAR*** is size-adjusted returns for month t+1. We also separately report results for *Special* (hard-to-borrow) and General Collateral, or GC (easy-to-borrow) firms. ***Special*** denotes firms with *DCBS* greater than 2 in month t. ***GC*** denotes firms with *DCBS* less than or equal to 2. Sample consists of all firm-month observations with available data for the period from June, 2004 to November, 2013. ***, **, * denote statistical significance at the 1 percent, 5 percent, and 10 percent levels, respectively.

SIR				Percent				*Special*		*GC*	
Portfolio	Obs	*SIR*	*DCBS*	*Special*	*BOIQ*	*SAR*	t-stat	*SAR*	t-stat	*SAR*	t-stat
1	29,902	0.2%	1.7	17.5%	5.5%	0.6%	3.79	-0.5%	-1.16	0.8%	4.88
2	29,961	0.6%	1.7	16.9%	8.0%	0.3%	2.15	-0.9%	-2.02	0.6%	4.00
3	29,969	1.4%	1.5	12.6%	12.8%	0.2%	1.29	-1.5%	-3.34	0.4%	3.43
4	29,957	2.2%	1.4	10.2%	16.0%	0.3%	1.77	0.5%	0.50	0.3%	2.41
5	29,949	3.0%	1.4	9.3%	18.3%	0.3%	2.27	-1.6%	-2.87	0.4%	3.87
6	29,986	4.0%	1.4	8.1%	20.0%	0.2%	1.29	-1.1%	-1.77	0.3%	2.20
7	29,967	5.2%	1.4	9.1%	20.4%	0.0%	0.28	-1.4%	-2.63	0.2%	1.45
8	29,959	6.9%	1.5	10.4%	20.8%	0.0%	-0.06	-1.4%	-2.75	0.2%	1.25
9	29,971	9.8%	1.7	14.0%	21.5%	-0.4%	-2.17	-2.3%	-4.41	-0.1%	-0.57
10	29,914	18.4%	2.4	29.6%	23.0%	-0.5%	-2.13	-1.8%	-4.17	0.0%	0.19
Total	299,535										
Spread (Low - High)						1.1%***		1.3%**		0.8%***	
Spread conditional on special (Low *GC* - High *Special*)						2.6%***					

Table 4. Multivariate Regressions of Future Returns

This table reports the time-series averages of monthly cross sectional Fama-MacBeth regressions. The dependent variable is one-month-ahead (month t+1) size-adjusted returns. The independent variables are firm characteristics based on the last available observation in month t. ***SIR***, the short-interest ratio, is open short interest divided by total shares outstanding, from the Compustat Security Monthly file. *DCBS*, *Special*, *TDQ*, *BOLQ*, *BOIQ*, and Utilization are short-sale metrics extracted from the Data Explorer (DXL) database. ***DCBS*** is Data Explorer's Daily Cost of Borrow Score ranging from 1 (lowest cost, easiest to borrow) to 10 (highest cost, most difficult to borrow). ***Special*** equals 1 if *DCBS* is greater than 2 and 0 otherwise. ***BOLQ*** denotes beneficial owner loan quantity, and is the number of shares borrowed by DXL borrowers from DXL lenders as a percentage of shares outstanding. ***TDQ*** is total demand quantity and represents all shares borrowed by DXL lenders as a percentage of shares outstanding. ***BOIQ*** denotes beneficial owner inventory quantity and is the shares held and made available to lend by DXL lenders as a percentage of shares outstanding. ***Utilization*** is *BOLQ* divided by *BOIQ*. In Panel B, ***SP*** denotes *Special*. Sample consists of 114 months (299,535 firm-months) spanning June, 2004 to November, 2011.

Panel A. Fama-MacBeth cross sectional regressions of one-month-ahead size-adjusted-returns on short-selling variables

	Intercept	*SIR*	*DCBS*	*Special*	*TDQ*	*BOLQ*	*BOIQ*	*Utilization*	Adj R-Sq
Mean	0.5%	-0.9%							0.30%
(t-stat)	(4.41)	(-3.58)							
Mean	0.3%		-3.7%						0.53%
(t-stat)	(4.19)		(-6.84)						
Mean	0.3%			-1.6%					0.40%
(t-stat)	(3.72)			(-7.16)					
Mean	0.6%				-0.9%				0.26%
(t-stat)	(4.79)				(-4.03)				
Mean	0.5%					-0.8%			0.23%
(t-stat)	(4.21)					(-3.61)			
Mean	0.0%						0.2%		0.16%
(t-stat)	(-0.06)						(1.05)		
Mean	0.8%							-1.4%	0.37%
(t-stat)	(8.51)							(-6.12)	
Mean	0.8%	0.1%						-1.4%	0.51%
(t-stat)	(6.76)	(0.25)						(-5.50)	

(Table 4, continued)

Panel B. Fama-MacBeth cross sectional regressions of one-month-ahead size-adjusted returns when demand or supply variables are interacted with stocks' *Special* status

	Intercept	*SIR*	*SP* SIR*	*TDQ*	*SP* TDQ*	*BOLQ*	*SP* BOLQ*	*BOIQ*	*SP* BOIQ*	Adj R-sq
Mean	0.5%	-0.9%								0.30%
(t-stat)	(4.41)	(-3.58)								
Mean	0.5%	-0.4%	-2.3%							0.66%
(t-stat)	(3.92)	(-1.93)	(-7.03)							
Mean	0.5%			-0.5%	-2.3%					0.61%
(t-stat)	(4.35)			(-2.36)	(-7.17)					
Mean	0.5%					-0.5%	-2.3%			0.58%
(t-stat)	(3.96)					(-2.13)	(-6.45)			
Mean	0.1%							0.2%	-3.2%	0.35%
(t-stat)	(0.63)							(0.84)	(-5.36)	

Panel C. Fama-MacBeth cross sectional regressions of one-month-ahead size-adjusted returns when demand and supply variables are interacted with stocks' *Special* status

	Intercept	*SIR*	*SP* SIR*	*TDQ*	*SP* TDQ*	*BOLQ*	*SP* BOLQ*	*BOIQ*	*SP* BOIQ*	Adj R-sq
Mean	0.5%	-0.5%	-2.9%					0.1%	2.1%	0.84%
(t-stat)	(3.02)	(-1.96)	(-6.89)					(0.24)	(3.11)	
Mean	0.5%			-0.6%	-3.1%			0.1%	2.6%	0.80%
(t-stat)	(3.44)			(-2.56)	(-6.72)			(0.27)	(3.58)	
Mean	0.5%					-0.6%	-3.3%	0.1%	3.0%	0.74%
(t-stat)	(3.06)					(-2.53)	(-6.68)	(0.55)	(4.10)	

Table 5. Returns to general collateral and special stocks by measures of supply and demand

This table reports returns to general collateral and special stocks based on nested sorts. For general collateral (special) stocks, observations are first sorted on *Utilization*, then sorted on *BOLQ* (*BOIQ*) within each *Utilization* portfolio. This procedure holds *Utilization* relatively constant while generating variation in the second characteristic. ***BOIQ*** denotes beneficial owner inventory quantity and is the shares held and made available to lend by DXL lenders. ***SAR*** denotes one-month-ahead size-adjusted returns. ***BOLQ*** denotes beneficial owner loan quantity, and is the number of shares borrowed by DXL borrowers from DXL lenders as a percentage of shares outstanding. ***Utilization*** is *BOLQ* divided by *BOIQ*. ***SIR*** denotes open short interest divided by shares outstanding in the month prior to the returns. Sample consists of 114 months (299,535 firm-months) spanning June, 2004 to November, 2013.

Panel A. General collateral stocks sorted by *Utilization* then by *BOLQ* (Demand)

	Obs	*SAR*	t-stat	*BOIQ*	*BOLQ*	*Utilization*	*SIR*
Lowest	50,800	0.4%	2.45	4.9%	0.8%	16.8%	1.9%
2	51,604	0.5%	4.39	13.2%	2.1%	16.1%	3.8%
3	51,850	0.4%	4.07	19.3%	3.1%	16.0%	5.0%
4	51,407	0.2%	2.59	23.9%	4.1%	16.6%	5.9%
Highest	51,036	0.0%	0.24	30.2%	5.6%	17.6%	7.4%
	256,697						
Spread		-0.4%		25.4%	4.8%	0.8%	5.5%
t-stat		-2.11		28.00	21.15	1.48	39.09

Panel B. *Special* stocks sorted by *Utilization* then by *BOIQ* (Supply)

	Obs	*SAR*	t-stat	*BOIQ*	*BOLQ*	*Utilization*	*SIR*
Lowest	8,101	-1.6%	-4.17	0.7%	0.4%	50.2%	2.2%
2	8,811	-1.2%	-2.74	2.5%	1.5%	50.4%	4.4%
3	8,782	-1.5%	-4.02	5.0%	2.9%	50.6%	6.5%
4	8,811	-1.1%	-2.68	8.8%	5.1%	50.4%	9.9%
Highest	8,333	-0.8%	-2.59	17.3%	9.9%	51.1%	15.8%
	42,838						
Spread		0.8%		16.5%	9.5%	1.0%	13.6%
t-stat		1.74		29.37	29.22	0.97	54.61

Table 6. Returns, Inventory, and Demand on the Short-side of pricing anomalies (n = 114 months)

This table reports short-side returns to nine anomalies identified by prior studies (see Table A.1 for detailed construction and references). ***GrossProfit*** denotes sales minus cost of goods sold divided by total assets. ***AssetGrowth*** denotes total assets divided by total assets in the prior year. ***Investment/assets*** denotes capital expenditures plus the change in inventory divided by total assets. ***NOA*** denotes net-operating-assets, defined as debt plus equity divided by beginning of period market value of equity. ***Accruals*** denotes net income minus operating cash flow divided by total assets. ***Payout%*** denotes clean surplus dividends, measured as beginning equity plus net income (comprehensive income when available) minus ending equity, all divided by beginning of period market value of equity***.*** ***QuarterlyEarnings*** denotes net income divided by total assets. ***OhlsonScore*** denotes the bankruptcy prediction score as in Ohlson (1980). ***MScore*** denotes the probability of manipulation score as in Beneish, Lee, and Nichols (2013). Except for quarterly earnings, all income statement and cash flow statement variables are summed over the most recent four quarters. Sorts are based on the distribution of the variable over the most recent three months, and a three month lag is imposed before the return window to ensure accounting information is publicly available. ***SAR*** denotes one-month-ahead size-adjusted returns. ***Special*** denotes stocks with a *DCBS* greater than 2. **GC** denotes general collateral stocks, those with a *DCBS* less than or equal to 2. Sample period is from June, 2004 to November, 2013. Panels B, C, and D include only periods following high sentiment months. We use the Baker and Wurgler (2006) sentiment index, and define high sentiment as months with sentiment greater than 0.

Panel A. One-month-ahead size adjusted returns to the short side of various strategies, full sample (n=114 months)

	All Obs		*Special*		*GC*	
	SAR	t-stat	*SAR*	t-stat	*SAR*	t-stat
GrossProfit	-0.1%	-0.54	-1.5%	-3.44	0.3%	1.15
AssetGrowth	-0.5%	-2.68	-1.4%	-3.39	-0.3%	-1.38
Investment/assets	-0.6%	-2.07	-2.0%	-4.40	-0.2%	-0.74
NOA	-0.4%	-1.44	-1.7%	-3.84	-0.1%	-0.29
Accruals	-0.5%	-3.17	-1.6%	-4.05	-0.2%	-1.16
Payout%	-0.2%	-1.21	-1.0%	-2.59	0.0%	0.30
QuarterlyEarnings	-0.4%	-1.40	-2.1%	-4.58	0.2%	0.90
OhlsonScore	-0.4%	-1.22	-1.6%	-4.09	0.3%	0.82
MScore	-0.4%	-1.10	-2.1%	-3.74	0.5%	1.57

(Table 6, continued)

Panel B. One-month-ahead size adjusted returns to the short side of various strategies following high sentiment months (n=43 months)

	All Obs		*Special*		*GC*	
	SAR	t-stat	*SAR*	t-stat	*SAR*	t-stat
GrossProfit	-0.7%	-2.06	-1.3%	-2.04	-0.6%	-1.80
AssetGrowth	-0.9%	-2.82	-1.4%	-2.06	-0.8%	-2.33
Investment/assets	-0.9%	-1.72	-1.6%	-2.08	-0.6%	-1.23
NOA	-0.3%	-0.92	-0.7%	-1.19	-0.1%	-0.29
Accruals	-0.2%	-0.96	-0.5%	-0.74	-0.1%	-0.59
Payout%	-1.1%	-3.04	-2.8%	-3.78	-0.6%	-1.51
QuarterlyEarnings	-1.0%	-2.07	-1.3%	-1.86	-0.7%	-1.42
OhlsonScore	-1.2%	-2.23	-2.6%	-2.11	-0.7%	-1.52
MScore	-0.9%	-2.62	-1.4%	-1.97	-0.7%	-2.18

Panel C. Inventory of lendable shares (*BOIQ*) for the short side of various strategies following high sentiment months (n=43 months)

	All obs	*Special*	*GC*	*Special - GC*	t-stat
GrossProfit	12.7%	6.2%	16.2%	-10.1%	-14.22
AssetGrowth	13.6%	6.8%	15.9%	-9.7%	-14.74
Investment/assets	14.2%	8.5%	15.9%	-8.0%	-13.64
NOA	13.7%	7.2%	16.0%	-9.4%	-15.69
Accruals	13.6%	7.9%	15.3%	-7.7%	-15.01
Payout%	11.7%	5.8%	14.5%	-9.3%	-15.70
QuarterlyEarnings	8.2%	5.4%	11.3%	-6.3%	-17.02
OhlsonScore	8.2%	5.1%	11.6%	-6.6%	-13.44
MScore	13.1%	7.6%	15.5%	-8.5%	-15.13

Panel D. Shares borrowed (*BOLQ*) for the short side of various strategies following high sentiment months (n=43 months)

	All obs	*Special*	*GC*	*Special - GC*	t-stat
GrossProfit	3.3%	3.5%	3.3%	0.2%	2.15
AssetGrowth	4.8%	4.4%	5.0%	-0.8%	-4.90
Investment/assets	5.0%	5.8%	4.9%	0.7%	4.12
NOA	4.4%	4.4%	4.5%	-0.3%	-1.58
Accruals	4.2%	4.8%	4.0%	0.8%	5.02
Payout%	3.8%	3.3%	4.1%	-1.0%	-6.92
QuarterlyEarnings	3.0%	3.0%	3.2%	-0.4%	-3.07
OhlsonScore	2.9%	2.8%	3.1%	-0.3%	-1.96
MScore	4.5%	4.7%	4.5%	0.0%	0.11

Table 7. Determinants of Borrowing Costs (n = 114 months, 226,512 firm-month observations)

This table reports results from monthly OLS regressions of the Daily Cost of Borrowing Score (*DCBS*) or a firm's *Special* status (*Special*) on various firm-level equity market and accounting characteristics, as well as a measure of the firm's demand from short-sellers (*BOLQ*). ***DCBS*** is Data Explorer's Daily Cost of Borrow Score, ranging from 1 (lowest cost, easiest to borrow) to 10 (highest cost, most difficult to borrow). ***Special*** equals 1 if *DCBS* is greater than 2 and 0 otherwise. ***BOLQ*** denotes beneficial owner loan quantity, and is the number of shares borrowed by DXL borrowers from DXL lenders as a percentage of shares outstanding. ***lnMVE*** denotes the natural log of the market value of equity at month end. ***ShareTO*** denotes share turnover, measured as monthly trading volume (in shares) divided by average shares outstanding. ***Momentum*** denotes size-adjusted returns over the prior six months. ***LoPrice*** equals 1 if month-end share price is less than $5, 0 otherwise. ***BTM*** denotes book-to-market ratio, measured as stockholder equity from the most recent quarter divided by month-end market value of equity. ***RetVol*** denotes variance of residuals from a regression of excess returns on the excess CRSP value-weighted return, estimated over a minimum of the prior 12 months and a maximum of the prior 48 months. ***InstOwn*** denotes the percentage of shares held by institutions for the most recent quarter.

GrossProfit denotes sales minus cost of goods sold divided by total assets. ***AssetGrowth*** denotes total assets divided by total assets in the prior year. ***Investment/Assets*** denotes capital expenditures plus the change in inventory divided by total assets. ***NOA*** denotes debt plus equity divided by beginning of period market value of equity. ***Accruals*** denotes net income minus operating cash flow divided by total assets. ***Payout%*** denotes clean surplus dividends, measured as beginning equity plus net income (comprehensive income when available) minus ending equity divided by beginning of period market value of equity. ***QuarterlyEarnings*** denotes net income divided by total assets. ***OhlsonScore*** denotes the bankruptcy prediction score as in Ohlson (1980). ***MScore*** denotes the probability of manipulation score as in Beneish, Lee, and Nichols (2013). All pricing anomaly variables are measured in scaled decile ranks, such that high ranks are consistent with overvaluation, and each variable ranges from 0 to 1.

Except for quarterly earnings, all income statement and cash flow statement variables are summed over the most recent four quarters. Sorts are based on the distribution of the variable over the most recent three months, and a three month lag is imposed before the measurement of *BOLQ* and *DCBS*. Sample period is from June, 2004 to November, 2013.

(Table 7, continued)

		Model 1		**Model 2**		**Model 3**	
Dependent Variable		*DCBS*		*DCBS*		*Special*	
Estimation Method		OLS		Ordered Logit		Probit	
Variable type	**Variable**	**Estimate**	**t-stat**	**Estimate**	**t-stat**	**Estimate**	**t-stat**
Demand	*BOLQ*	4.158	14.79	17.521	10.17	7.924	14.74
Equity Market	*lnMVE*	-0.052	-11.09	-0.301	-14.73	-0.193	-19.90
Market	*ShareTO*	0.045	11.83	0.039	2.44	0.032	3.12
Characteristics	*Momentum*	-0.144	-11.54	-0.102	-3.85	-0.054	-3.35
	LoPrice	0.515	24.56	0.832	16.99	0.480	13.33
	BTM	-0.074	-4.95	-0.115	-3.99	-0.103	-5.73
	RetVol	0.036	19.18	0.056	14.36	0.031	15.69
	Inst Own	-0.899	-21.22	-2.205	-21.05	-1.259	-21.82
Accounting	*GrossProfit*	0.387	16.11	0.274	6.93	0.192	6.95
Characteristics	*AssetGrowth*	0.012	5.62	0.029	6.89	0.019	6.60
	Accruals	-0.078	-4.91	-0.109	-3.60	-0.047	-2.22
(Scaled decile ranks; high ranks correspond to overvaluation)	*OhlsonScore*	0.339	24.50	0.988	27.30	0.603	27.83
	MScore	0.107	7.28	0.178	4.28	0.118	4.93
	QuarterlyEarnings	0.044	2.04	0.275	5.88	0.107	3.92
	NOA	0.089	9.53	0.244	8.19	0.123	7.09
	Payout%	-0.015	-1.36	0.227	4.67	0.126	5.52
	Investment/assets	0.092	7.65	0.257	7.79	0.169	9.81
	Intercept	1.455	19.29			-0.055	-0.42
	Intercept_2			0.197	0.79		
	Intercept_3			-0.623	-2.46		
	Intercept_4			-1.232	-4.67		
	Intercept_5			-1.748	-7.06		
	Intercept_6			-2.214	-9.06		
	Intercept_7			-2.786	-10.99		
	Intercept_8			-3.472	-13.39		
	Intercept_9			-4.163	-14.69		
	Intercept_10			-4.533	-14.20		
	Adj. R-square	27.1%					
	Pseudo R-square			27.5%		21.6%	
	N = 114 months						

Table 8. Regression of the inventory of lendable shares (*BOLQ*) on borrowing costs, equity market characteristics, and accounting characteristics (n=114 months, 226,512 firm-month observations)

This table reports results from monthly OLS regressions of Beneficial Owner Inventory Quantity (*BOIQ*) on various firm-level equity market characteristics, and accounting characteristics, as well as the cost of borrowing (*DCBS*) from June, 2004 to December, 2010. ***BOLQ*** denotes beneficial owner loan quantity, and is the number of shares borrowed by DXL borrowers from DXL lenders as a percentage of shares outstanding. ***DCBS*** is Data Explorer's Daily Cost of Borrow Score, ranging from 1 (lowest cost, easiest to borrow) to 10 (highest cost, most difficult to borrow). ***DCBS_OLS*** denotes the predicted value of *DCBS* from the OLS regression in Table 8. ***DCBS_OrdLog*** denotes the predicted level of *DCBS* from the ordered logistic model in Table 8. ***Special*** equals 1 if *DCBS* is greater than 2 and 0 otherwise. ***PrSpecial*** is the predicted value of *Special* from the probit model in Table 6. ***lnMVE*** denotes the natural log of the market value of equity at month end. ***ShareTO*** denotes share turnover, measured as monthly trading volume (in shares) divided by average shares outstanding. ***Momentum*** denotes size-adjusted returns over the prior six months. ***LoPrice*** equals 1 if month-end share price is less than $5, 0 otherwise. ***BTM*** denotes book-to-market ratio, measured as stockholder equity from the most recent quarter divided by month-end market value of equity. ***RetVol*** denotes variance of residuals from a regression of excess returns on the excess CRSP value-weighted return, estimated over a minimum of the prior 12 months and a maximum of the prior 48 months. ***InstOwn*** denotes the percentage of shares held by institutions for the most recent quarter.

GrossProfit denotes sales minus cost of goods sold divided by total assets. ***AssetGrowth*** denotes total assets divided by total assets in the prior year. ***Investment/Assets*** denotes capital expenditures plus the change in inventory divided by total assets. ***NOA*** denotes debt plus equity divided by beginning of period market value of equity. ***Accruals*** denotes net income minus operating cash flow divided by total assets. ***Payout%*** denotes clean surplus dividends, measured as beginning equity plus net income (comprehensive income when available) minus ending equity divided by beginning of period market value of equity. ***QuarterlyEarnings*** denotes net income divided by total assets. ***OhlsonScore*** denotes the bankruptcy prediction score as in Ohlson (1980). ***MScore*** denotes the probability of manipulation score as in Beneish, Lee, and Nichols (2013). All pricing anomaly variables are measured in scaled decile ranks, such that high ranks are consistent with overvaluation, and each variable ranges from 0 to 1.

Except for quarterly earnings, all income statement and cash flow statement variables are summed over the most recent four quarters. Sorts are based on the distribution of the variable over the most recent three months, and a three month lag is imposed before the measurement of *BOLQ* and *DCBS*. Sample period is from June, 2004 to November, 2013.

(Table 8, continued)

		Model 1		Model 2		Model 3		Model 4		Model 5	
Variable type	**Variable**	**Estimate**	**t-stat**	**Estimate**	**t-stat**	**Estimate**	**t-stat**	**Estimate**	**t-stat**	**Estimate**	**t-stat**
	Intercept	0.1338	14.33	-0.4303	-4.20	0.1149	12.34	0.1265	13.77	0.1055	9.72
Proxy for cost of borrowing	*DCBS*	-0.0083	-18.84								
	DCBS _OLS			0.5075	3.37						
	DCBS _OrdLog					0.0124	13.14				
	Special							-0.0348	-22.32		
	PrSpecial									0.2163	16.28
Equity Market Characteristics	*lnMVE*	0.0011	2.26	0.0138	2.98	0.0016	3.07	0.0011	2.21	0.0034	5.42
	ShareTO	0.0077	14.87	-0.0327	-2.18	0.0066	12.80	0.0076	14.79	0.0044	8.96
	Momentum	-0.0131	-9.69	0.0847	2.63	-0.0099	-7.06	-0.0128	-9.49	-0.0039	-2.36
	LoPrice	-0.0455	-24.75	-0.2613	-4.56	-0.0506	-24.13	-0.0450	-24.69	-0.0723	-22.60
	BTM	0.0045	7.56	0.0440	2.61	0.0068	7.87	0.0046	7.50	0.0104	7.90
	RetVol	-0.0017	-13.14	-0.0186	-4.09	-0.0026	-12.64	-0.0018	-13.15	-0.0039	-11.80
	Inst Own	0.1214	16.97	0.4835	5.60	0.1328	17.85	0.1218	17.07	0.1734	19.12
Accounting Characteristics (Scaled decile ranks; higher ranks imply overvaluation)	*GrossProfit*	0.0188	12.17	-0.0791	-6.55	0.0114	7.35	0.0183	11.72	0.0008	0.43
	AssetGrowth	-0.0001	-0.90	-0.0046	-2.94	-0.0002	-1.86	-0.0001	-1.01	-0.0006	-3.58
	Accruals	-0.0054	-7.51	0.0690	1.63	-0.0039	-4.97	-0.0051	-7.18	-0.0012	-0.97
	OhlsonScore	-0.0226	-20.43	-0.2374	-3.21	-0.0274	-20.18	-0.0223	-20.14	-0.0476	-18.25
	MScore	-0.0045	-6.18	-0.0854	-1.61	-0.0064	-7.71	-0.0047	-6.28	-0.0116	-8.86
	QuarterlyEarnings	-0.0027	-2.76	-0.0645	-2.79	-0.0039	-3.58	-0.0032	-3.2	-0.0074	-4.17
	NOA	-0.0015	-2.15	-0.0544	-4.32	-0.0041	-6.18	-0.0014	-1.99	-0.0108	-10.78
	Payout%	0.0027	2.30	0.0043	0.82	0.0050	4.25	0.0028	2.43	0.0036	2.67
	Investment/assets	-0.0112	-11.73	-0.0373	-2.69	-0.0125	-11.98	-0.0115	-11.6	-0.0176	-12.83
	Adj. R-sq.	46.5%		56.7%		46.3%		46.5%		48.8%	
Includes instrumental variable?		**NO**		**YES**		**YES**		**NO**		**YES**	