ROCK CENTER FOR CORPORATE GOVERNANCE STANFORD UNIVERSITY

ROCK CENTER *for* CORPORATE GOVERNANCE

WORKING PAPER SERIES NO. 165

In Short Supply: Equity Overvaluation and Short Selling

Messod Daniel Beneish
Indiana University Bloomington - Department of Accounting

Charles M.C. Lee
Stanford University - Graduate School of Business

Craig Nichols
Syracuse University

First Draft: 17 May 2013
This Draft: 15 November 2013

In short supply: Equity Overvaluation and Short Selling

M.D. Beneish[▽], C.M.C. Lee[+], D.C. Nichols[#]

First Draft: 17 May 2013
This Draft: 15 November 2013

Abstract

We use detailed security lending data to examine the relation between short sale constraints and equity overvaluation. We find that stocks' "special" status exhibits a non-linear (U-shaped) relation with their short interest ratio (SIR), and that a stock's special status, rather than its SIR, predicts negative returns. We show that short-sellers trade on a variety of firm characteristics and against high sentiment. Specifically, we find: (1) the abnormal returns to the short-side of nine market 'anomalies' identified in prior work are attributable to special stocks; and (2) future negative returns to special stocks are directly related to the lendable inventory in each stock rather than to its shares borrowed. Overall, our results suggest returns to the short side of documented 'anomalies' may not be obtainable without significant cost, and that the *supply* (available inventory) of lendable shares is the primary binding constraint to informational arbitrage in the case of equity overvaluation.

JEL classification: G14; G17; M4.
Keywords: Short Selling, Overvaluation, Market Efficiency

[▽] Beneish (dbeneish@indiana.edu) is Sam Frumer Professor of Accounting at Indiana University, [+]Lee (clee8@stanford.edu) is Joseph McDonald Professor of Accounting at Stanford University, and [#]Nichols (dcnichol@syr.edu) is Assistant Professor of Accounting at Syracuse University.

We would like to thank Joe Comprix, Dave Harris, Mike Hyman, and workshop participants at Syracuse University for helpful comments and suggestions.

In short supply: Equity Overvaluation and Short-Selling

1. Introduction

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 tended 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.

One aspect of equity market pricing that has received increasing academic attention is the role played by short sellers. Prior studies have consistently demonstrated that, as a group, short-sellers are sophisticated investors (e.g., Drake et al 2011). At the intraday level, short-sale flows improve the informational efficiency of intraday prices (Boehmer and Wu 2012). 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, even temporary short-selling bans can impede pricing efficiency for the equity options in the banned stocks (Battalio and Schultz 2011). In short, the evidence from prior studies consistently shows that short-sellers are key market intermediaries, whose actions help to incorporate a variety of information into equity prices.

What is less understood in the literature are the sources of the short-sellers' insights, the nature of the constraints they face, and the extent to which other market participants can benefit by mimicking their actions. On these issues, a number of puzzling regularities remain. For example, prior studies show that firms with higher (lower) "short sale ratios" consistently earn lower (higher) returns in subsequent

months, well after this information is publicly available. The 'bears' have left some scraps on the table, either because they face constraints or because short sellers (and the investors imitating them) underutilize publicly available information.

In this paper, we ask (1) What prevents short sellers and other market participants from fully eliminating the observed negative association between short interest and future returns?, and (2) To what extent are the negative returns to the short-leg of other market pricing anomalies due to frictions in the market for short-selling? We show that the *supply* of lendable shares is crucial in answering these questions. The total supply of lendable shares affects the size and volume of short positions that can be taken at low cost. When the supply of shares available for lending is a binding constraint, the extent to which the negative views of sellers can be impounded into price will be limited.

The primary variable used in prior studies to measure short-sale intensity, the "short-interest ratio" (SIR, defined as the ratio of total shares shorted to total shares outstanding), tends to mask the true importance of supply. The total shares shorted in the numerator is an equilibrium result that reflects both supply and demand. Thus, a firm's open short interest may be low either because (1) few investors have negative views, or (2) the supply of lendable shares is limited. The concerns with SIR are amplified by a denominator that implicitly assumes all outstanding shares are equally easy to borrow. However, the supply of lendable shares is often less than 100 percent of shares outstanding for a variety of reasons.[1] Indeed, our data show that stocks that are difficult to borrow have, on average, less than 10 percent of their outstanding shares in the form of lendable supply that is relatively easy to locate and borrow. Further, even for easy-to-borrow stocks the average number of easily lendable shares is typically only 20 percent of shares outstanding. In other words, a SIR of 10 percent could represent a

[1] For example, some institutional investors do not ever lend out their shares. Many retail shareholders do not have their holdings in margin accounts, and brokers generally cannot loan out shares held in cash accounts. Moreover, shares held in margin accounts are generally only available to lend by brokers if the retail shareholder has borrowed against the account. Also, there are public firms that for various reasons simply do not have as big a float in circulation (e.g., closely held firms, family-controlled firms, etc.).

'utilization' of up to 50 percent of the available supply for some stocks, or nearly 100 percent for others. This highlights the problems inherent in SIR as a measure of either pessimism or constraints.

We address our questions with a comprehensive dataset from Data Explorer Limited (DXL) spanning 88 months (July 2004 to October 2011). DXL's data are collected from a consortium of more than 100 institutional lenders, who collectively represent the largest security lender in the world. DXL coverage is 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 reports measures of the total shares borrowed from DXL lenders and the total lendable inventory available from them. DXL also provides a Daily Cost of Borrowing Score (DCBS), a proprietary measure ranging from 1 (low cost) to 10 (high cost).[2]

A stock's DCBS is positively correlated with SIR and with other DXL measures of demand, but negatively correlated with supply. DCBS exhibits its highest correlation with utilization (the ratio of its borrowed shares to its lendable inventory): the Pearson (Spearman) correlation coefficients equal 38.3% (53.0%). Moreover, for the subset of observations with loan fee data, we find that DCBS values of 1 and 2 correspond to stocks that are easy to borrow as defined in prior research (loan fees below 100 basis points). In short, when DCBS values are 1 or 2, the supply of shares available for lending is unlikely to be binding. Conversely, when DCBS values are 3 or larger, the loan fees suggest the supply constraint is likely to be binding. Following this logic, we define a *special* (hard-to-borrow) stock as one with a DCBS of 3 or larger. This definition classifies 13.7 percent of our observations as *special* and 86.3 percent as *general collateral* (easy-to-borrow).[3]

Our empirical results include the following. First, sorting firms by their short interest ratio, we show a nonlinear (U-shaped) relation between "special" status SIR – i.e., both extremely high SIR firms

[2] DCBS is a *relative* measure of borrowing cost that it is available for most stocks at any given moment in time.
[3] Although borrowers can obtain shares from lenders who do not participate with DXL, a stock that is easy to borrow (costly to borrow) from DXL lenders is likely easy to borrow (costly to borrow) in general. We discuss the data in more detail in Section 3.

and extremely low SIR firms have a greater probability of being on special. Moreover, it is a stock's specialness rather than its SIR that predicts negative returns. Among special stocks, SIR has marginally significant ability to predict returns. However, among general collateral stocks, those with low SIR experience consistently higher size-adjusted returns, averaging 0.9% per month, over firms with high SIR. When the constraints are not binding, high short interest ratios are not associated with future returns. This suggests that short-sale constraints play a crucial role in explaining the negative association between SIR and future returns.

Second, we isolate the effect of supply on returns to special stocks by employing a two-stage sort procedure that first sorts on utilization and then within each utilization decile, sorts on quintiles of supply. The end result is a set of portfolios that differ on the supply of lendable shares, but not on utilization. We find that future returns to low supply stocks are significantly more negative than the returns to high supply stocks. In fact, among special stocks holding utilization constant, we show that the lowest returns accrue to stocks with the lowest supply. Overall, we conclude that limited supply appears to be the primary driver of returns among constrained stocks.

Third, we further examine the roles of demand and supply on future equity returns among general collateral stocks. Boehmer et al. (2010) find 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 their strategy generates positive returns from long positions. We show that the 'good news in short interest' exists among general collateral stocks, but not special stocks. Further, holding constant a firm's utilization ratio, we show low demand stocks outperform high demand stocks. These findings show that the 'good news' in low SIR is primarily related to the low short-interest demand among general collateral stocks, not the existence of unsatisfied demand.

Our findings to this point indicate that negative returns are localized to constrained stocks. Our final analysis examines whether this effect extends to the short side of nine asset-pricing anomalies documented in prior work. If the apparent overvaluation identified by these strategies persists because of short sale constraints, the returns to the short side should be concentrated in special stocks. Our results support this prediction. In particular, negative short side returns are concentrated in the special stocks but the general collateral stocks do not underperform their risk benchmark.[4] In addition, supply rather than demand seems to be the key difference between special and general collateral status among short side stocks. These findings strongly point 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.

Our 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 in the literature can be explained by short selling constraints, which should interest researchers who study market efficiency. Our findings also suggest that short sellers appear to trade on a variety of firm characteristics, are not subject to market-wide sentiment, and seem to trade against high sentiment. These results should interest researchers examining the trading behavior and information used by short sellers. Similarly, our finding that negative returns following high sentiment periods are concentrated in constrained stocks should matter to researchers studying the effects of investor sentiment. Our findings also bear on the investment value of many of the trading strategies proposed in prior literature. In particular, our results suggest the short side returns are not obtainable without significant cost, if at all.

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

[4] In an even stronger test, we find similar results following months of high investor sentiment (Baker and Wurgler 2006; Stambaugh et al. 2012).

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 can be influenced by the rules and regulations governing the market for short-sales, our findings will have implications for policy makers.

We discuss prior literature in section 2. We detail our sample in section 3, and discuss our results in section 4. We provide concluding remarks in section 5.

2. Related literature

The theoretical literature on short selling makes a clear prediction: constraints in the market for equity lending matter for equity pricing. Miller (1977) predicts that, given divergence of opinion, stronger short selling constraints result in more overvaluation. This occurs because constraints prevent the negative views of some traders from being impounded into price. Indeed, Blocher et al. (2013) formalize Miller's intuition, and develop a framework for analyzing equilibrium in the security lending market jointly with equilibrium in the stock market. The key insight from their model is that the extent to which a stock is constrained, or hard to borrow, is the primary driver of prices and the information impounded into prices.

Although the prior empirical research is generally consistent with this prediction, researchers over the last four decades have faced a common problem: the difficulty of empirically identifying when a stock is constrained. Short sale constraints are a function of demand and supply in the equity lending market, and many empirical studies on the role of constraints on equity pricing have used proxies for demand *or* supply to measure short selling constraints. In terms of short seller's demand, the most common measure used in academic research is the short interest ratio, defined as open short interest

divided by shares outstanding. Early papers that take a demand-only perspective provide mixed evidence that stocks with high short interest experience negative future abnormal returns. For example, Figlewski (1981) found that the short interest ratio forecasted negative returns over one sub-period but not over another, whereas Figlewski and Webb (1993) and Woolridge and Dickinson (1994) find little or no relation between short interest and returns.

One possible reason for these weak results is the ambiguity in the short interest ratio as a proxy for short sales constraints. For example, Chen, Hong and Stein (2002) argue that short interest is a poor proxy for the amount of negative information excluded from the market because the level of short interest is the resultant of supply and demand in the equity lending market such that differences in the level of short interest could reflect transactions costs of shorting due to limited supply. That is, the short interest ratio can be low because limited supply restricts short selling, or the short interest ratio can be high yet unconstrained if supply is abundant.[5]

More recent studies have sought to incorporate supply in their analysis. For example Chen, Hong and Stein (2002) suggest that breadth of ownership, measured by the percentage of institutions owning the stock, captures the extent to which opinions diverge among investors and also the ease with which shares can be borrowed by short sellers. They argue and find that reduction in breadth forecasts lower returns. Other studies use 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 consistent with the existence of short selling constraints; and Cohen, Deither, and Malloy (2007) suggest that negative returns following increases in demand exceed transaction costs.

[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."

Although the short interest ratio, breadth of ownership, and institutional holdings are correlated with demand and supply, they do not clearly distinguish constrained from unconstrained stocks. Thus, these papers suggest that relatively more constrained stocks have relatively more underperformance, but they cannot determine whether underperformance is localized to constrained stocks or whether unconstrained stocks underperform as well. The answer to this question bears not only on the predictions of theory but also on the sophistication and potential under-utilization of information by short sellers. Moreover, short interest, breadth of ownership and institutional holdings reflect not only constraints but also characteristics such as demand, quality of the information environment, and investor sophistication. Thus, the results from studies based on these measures are subject to alternative explanations.

Consequently, another stream of papers use detailed stock lending data to measure constraints. A stock becomes constrained when supply is not sufficient to satisfy demand at a reasonably low loan fee. As a market determined price, loan fees reflect the relation between supply and demand, and therefore several studies use loan fees to measure constraints. Among the first studies to investigate detailed equity lending data are D'Avolio (2002) and Geczy, Musto, and Reed (2002) to identify stocks with significant short sale constraints. 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 stocks in the lowest decile of short interest have relatively high numbers of special stocks. This confirms that some stocks have low short interest merely because of limited supply. On the other hand, he also shows that the highest decile of short interest has 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 remain unconstrained and easy to borrow. D'Avolio (2001) does not examine pricing and returns in the equity market, however.

Geczy, Musto, and Reed (2002) use data from an institutional lender from November of 1998 to October of 1999, and observe underperformance for easy-to-borrow, unconstrained IPO, dotcom, high growth, and low momentum stocks. Their use of actual stock lending data instead of a proxy based on institutional ownership lends credibility to the idea that low-constraint stocks can generate negative abnormal returns. Similarly, Boehme, Danielson, and Sorescu (2006) obtain rebate data from a major broker-dealer and study the 21-month period between March 2001 to December 2002. They use loan fee data for a limited sample to estimate constraints for a broader sample, and show that constrained stocks underperform.

Like these studies we recognize the problems in identifying constrained stocks. We extend these studies with equity lending data collected from a consortium of security lenders over a long horizon spaning an 88 month period subsequent to the period examined by these authors. In addition, we are able to augment cost of borrowing data with measures of demand, supply, and utilization. Because of the scope of the lending market captured by our data, we are better able to examine the forces of supply and demand in setting the equilibrium cost of borrowing. In particular, we are able to estimate the amount of easily lendable supply for the typical stock, and demonstrate how constrained and unconstrained stocks differ in supply. In addition, our detailed data for a lengthy time series enables us to gain insights into the role of constraints in equity pricing that were not available from past research designs.

Because detailed equity loan market data is not widely available, the short interest ratio remains a prominent fixture in the empirical research on short selling activity and market efficiency. The rationale for using the short interest ratio in capital markets research is the assumption that all of the shares outstanding are available to borrow (or alternatively, the supply of shares is proportional to the number of shares outstanding for all publicly traded companies). Our data allows us to examine the

validity of this assumption, and to examine the consequences when the assumption is violated. In particular, we are able to demonstrate that the negative association between short interest and future returns is attributable to constraints. Moreover, the positive returns to lightly shorted stocks documented by Boehmer et al. (2007) only applies to unconstrained stocks. Thus, although a number of papers allude to the problems with the short interest ratio as function of supply and demand, we are able to clearly disentangle the constraint effect (negative returns to highly shorted stocks) and the demand effect (positive returns to lightly shorted stocks). We can also examine differences in supply and demand between constrained and unconstrained stocks, assessing whether demand or supply matters more for a stock's specialness.

We also examine the association between supply and future returns for constrained (i.e., special) stocks. This is important because it more directly tests how limited supply constrains negative views and affects security prices. Within constrained stocks, we expect a positive relation between supply and returns. For high supply stocks many short positions can be taken before the supply constraint is reached. This allows the negative views of short sellers to be impounded into price, and these stocks should have less adverse future returns. However, when a stock is in short supply relatively few short positions can be taken before supply becomes constrained. The negative views of short sellers are prevented from being priced, and these stocks should experience future negative returns. This is consistent with the model in Blocher et al. (2013), which predicts that the supply of shares affects equity prices only when borrowing is costly.

Finally, our data allow us to examine the role of short selling constraints on the existence of short side returns to trading strategies. Prior research shows that a number of characteristics are correlated with subsequent returns: (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 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) M-Score (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, and Balachandran (2002) Drake et al. (2011) that firms with high short interest ratios subsequently earn lower returns.[6]

All of these studies examine either hedge portfolios or the spread in returns across extreme portfolios of firms sorted on the firm characteristic. A common finding is that over half of the returns to the strategies derive from the short side. Some evidence in prior work suggests that the returns documented on the short side likely exceed the costs of short selling. For example, Jones and Lamont (2002) examine a sample of "loan crowd" stocks from 1926 to 1933 with loan fees published in the Wall Street Journal. They find that the negative returns to these stocks exceed the loan fee even among stocks that are costly to borrow, suggesting that short selling does not eliminate mispricing, even after transaction costs. Similar results are reported by Geczy, Musto, and Reed (2002), Nagel (2005) and Hirshleifer, Teoh and Yu (2011) who find negative returns among easy to borrow stocks for the

[6] 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.

anomalies they examine. These results suggest that short sellers, while sophisticated, do not completely utilize public information in their trades.

Although our data do not allow us to measure direct and indirect costs of short selling, and thus comment on the trading profits that remain net of costs, we can examine returns to constrained and unconstrained stocks on the short side of various trading strategies. This sheds light on the use of information by short sellers and the likelihood of returns that can be enjoyed by shorting easy-to-borrow stocks. For example, if we find negative returns among easy to borrow stocks, one possibility is that short sellers do not fully use available information. As rational actions by short sellers are among the last lines of defense for market efficiency, evidence that short sellers underutilize information would have important implications for the frequency and magnitude of departures of price from value that are possible in capital markets. Alternatively, if we find that negative returns to the short side of trading strategies are localized in constrained stocks, the abnormal returns documented in prior studies are likely to be real yet unexploitable by individual (and perhaps institutional) investors.

3. Equity lending data

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 Data Explorers. Data Explorers (thereafter 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, BOIQ and BOLQ are not available until June of 2004. We have

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

access to this data through October, 2011. Because we predict one month ahead returns, our returns data span July, 2004 to October, 2011.[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 such firms available in COMPUSTAT Security Monthly file (our source of open short interest data), CRSP, and DXL in each year of the sample period. This allows us to assess the extent of coverage given that we are using a relatively new and unfamiliar data source. It is not surprising that coverage is nearly identical in CRSP and COMPUSTAT's Security Monthly file. On average there are 5007 firms every month with returns from CRSP (range from 4467 to 5386), and 4987 firms with SIR from COMPUSTAT (range from 4463 and 5337 firms). On the other hand, DXL coverage in terms of their proprietary proxy for the costs of borrowing (DCBS) averages 3548 firms (range from 2441 to 3907) which represents 70.8% in terms of number of firms and 90.1% in terms of market capitalization.

By market capitalization, DXL covers the majority of the tradable equities in the NYSE, AMEX, and NASDAQ and our results can thus provide insights into an economically significant segment of the capital markets. However, the stocks that we examine are the larger stocks in the market and this has the potential to limit our ability to generalize to the stocks not covered by DXL. If short selling demand is more frequent 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 various predictors previously discussed. 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.

[8] For some of our trading strategy 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.

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. Our final sample includes 227,083 firm-month observations. 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 5.4 percent of shares outstanding, with a maximum of 91.8 percent. For comparison, DXL provides two measures of borrowing, Total Demand Quantity (TDQ) and Beneficial Owner on Loan Quantity BOLQ). We express both measures as a percentage of shares outstanding. BOLQ represents shares borrowed by participating institutions *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 4.5 percent of outstanding shares, whereas BOLQ averages 3.6 percent.

DXL 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 to borrow. BOIQ averages 17.2 percent of shares outstanding for our sample firms. DXL participants include over 100 of the largest institutions in the world and collectively the consortium represents the largest share lender in the world. Although we do not have the entire inventory of lendable shares, the cost of borrowing and utilization from DXL are likely good proxies for the entire lending market. Our reasoning is based on parity arguments. 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. Additional borrowing is thus likely to be through the DXL consortium until DXL costs and utilization reach parity with costs and utilization outside the consortium.

The ratio of TDQ to SIR averages 70 percent (untabulated), suggesting that DXL captures 70 percent of all shorts. The ratio of the BOLQ to TDQ averages 75 percent across stocks, whereas the ratio

of BOLQ to SIR equals 55 percent for the typical stock (both untabulated). Thus, borrowing by DXL borrowers from DXL lenders accounts for 75 percent of all lending activity captured by DXL, and amounts to 55 percent of all short selling activity. Moreover, the average BOIQ amounts to 17 percent of shares outstanding. Consequently, for the typical firm, between 55 percent (BOLQ/SIR) and 70 percent (TDQ/SIR) of borrowed shares are sourced from a pool of inventory representing 17 percent of shares outstanding.[9] This suggests that DXL lenders are a top choice to source the borrow, and is consistent with shares being relatively more difficult to locate and borrow 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.

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. Stocks with no lending transactions in the last seven days are not assigned a DCBS, and this explains why some observations have BOIQ and BOLQ but do not have DCBS. As we describe below, we use DCBS to distinguish easy to borrow stocks (general collateral) from stocks that are costly and difficult to borrow (special).

To establish the validity of DCBS as a measure of borrowing costs, Table 2 reports rebates and loan fees, where available, by DCBS category. Lenders receive loan fees on the value of the stocks they lend. Prior research (e.g., D'Avolio 2002) classify 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

[9] The difference between TDQ and BOLQ could represent shares borrowed from the DXL pool of inventory. If none of those shares are borrowed from the DXL pool (i.e., DXL participating borrowers borrowing from non-DXL lenders), then the DXL pool of inventory is the source of 55 percent of all borrowing (BOLQ/SIR). If all of the difference between TDQ and BOLQ is borrowed from the DXL pool (non-DXL borrowers borrowing shares from DXL lenders), then the DXL pool of inventory is the source of 70 percent of all borrowing (TDQ/SIR).

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.

As the table illustrates, less than 30 percent of DXL observations have explicit loan fee data; thus, we are not able to use loan fees and rebates directly in our analysis. 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 loan fee rises to 125 basis points. However, the median loan fee for DCBS equal to 2 is 95bp suggesting that the majority of DCBS=2 observations have loan fees less than 100bp. Thus, consistent with prior work which classifies stocks with a loan fee less (greater) than 100bp as easy to borrow (costly to borrow), we label observations with DCBS>2 as special stocks and treat observations with DCBS equal to 1 or 2 as general collateral stocks. The average loan fee for DCBS equal to 3 is over 200 basis points, and quickly rises as DCBS increases. Average rebates turn negative at DCBS equal to 3, and average loan fee exceeds 1000 basis points at DCBS equal to 7. For DCBS equal to 10, the average loan fee exceeds 4400 basis points. In economic terms, for a short seller to hold the position for a year, they must pay a loan fee of over 44% of the value of the stock at the time of the borrowing transaction.

SIR captures total demand for borrowed shares, whereas TDQ reflects borrowing associated with DXL. The ratio of TDQ to SIR thus provides the percentage of the total market for borrowing stock captured by DXL. The ratio of TDQ to SIR averages approximately 70 percent and is surprisingly consistent across DCBS categories. Thus, DXL covers the majority of stock lending transactions. This also suggests that our cost of borrowing measure is not biased toward or against stocks based on DXLs coverage of them.

Table 2 also shows that as DCBS rises, the measures of demand (SIR, TDQ, and BOLQ) increase whereas supply (BOIQ) falls. As a result, utilization, which captures the percentage of lendable shares that are actually on loan and is calculated as the ratio of BOLQ to BOIQ, also increases. Indeed, 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 77.8%. Although this suggests ample remaining inventory, lenders need a cushion of reserve inventory. The lenders are the prime brokers who hold the shares for the beneficial owners. The problem from the lender's perspective is ensuring shares are available if the ultimate owner of the securities places a sell order. Even if an owner's shares have been lent out by the broker, the broker can replace those shares from another owner's account as a simple matter of internal bookkeeping. So the broker needs to have *some* inventory on hand. We expect the amount of reserve inventory should be increasing with the activity in the stock.

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. In other words, the more active the stock (and thus more likely the owner is to place a sell order), the costlier it is to borrow the stock. 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 borrowed shares.

Panel B of Table 2 also reports next month size-adjusted returns, 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 0.3%, respectively. 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 -4.9 percent.

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 Table 3, several correlation coefficients are noteworthy. Corroborating the notion that SIR captures short-seller demand, the correlation between SIR and TDQ equals 0.845 and the correlation between SIR and BOLQ equals 0.814. On the other hand, the correlation coefficients of SIR with the cost of borrowing (DCBS) and with supply (BOIQ) are lower at 0.212 and 0.374. On the cost of borrowing side, the highest correlations with DCBS occur for measures of supply (-0.294) and utilization (0.530). 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.

In Table 2, we found that high DCBS stocks have high short interest and other measure of demand, low inventory, and high utilization, in addition to experiencing low future returns. This pattern in returns and short selling characteristics motivates our analysis in Panel B of Table 3. To assess economic magnitude of the associations between our short selling variables and returns, 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. Our measures of demand yield similar results; high short interest firms underperform low short interest firms by 1.0 percent each month, whereas high TDQ firms and high BOLQ firms underperform their low demand counterparts by 1.0 percent and .9 percent, respectively. The highest DCBS stocks underperform the lowest DCBS stocks by 3.8 percent per month; however, DCBS is not sorted into equal sized portfolios but is based on the raw DCBS score (scaled to

range from 0 to 1). Thus, the select few stocks that are most constrained underperform the large number of least constrained stocks by 3.8 percent each month. On average, special stocks underperform general collateral stocks by 1.5 percent per month. Similarly, highly utilized stocks underperform lightly utilized stocks by 1.4 percent each month. BOIQ does not predict returns for the full sample. We revisit this result later in the paper.

SIR is demand as a percentage of shares outstanding, whereas utilization is demand as a percentage of available supply. When we include both measures, SIR is not significant (-0.2 percent per month) but utilization continues to be a strong and significant predictor of future returns (-1.3 percent per month). Thus, combining demand and supply generates a powerful predictor of future returns.

4. Results

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

In Table 4, we examine the returns to short interest ratio deciles by special and general collateral stocks. For this analysis, we use the full 88 months with available data for both returns and DXL data. We sort firms into portfolios based on the short interest at the end of the previous month. Within short interest deciles, we further sort into special and general collateral based on DCBS in the previous month.

As expected, the percentage of stocks that are special is highest in the highest short interest decile. However, less than 30 percent of the high short interest stocks are classified as special. Thus, the majority of these stocks remain easy to borrow, despite the high short interest. The percentage of special stocks forms a U-shaped pattern across deciles, such that low short interest deciles also have a relatively high number of special stocks. This pattern is consistent with D'Avolio (2002) and with criticisms of the short interest ratio as a noisy proxy for borrowing costs (e.g., Chen et al. 2002). The

lowest two SIR deciles have roughly 14 percent special stocks each. This implies that some stocks likely have low open interest because they are in short supply. Although Boehmer et al. (2007) find that lightly shorted stocks have positive returns, we do not expect this to extend to lightly shorted stocks with low supply. Boehmer et al. (2007) expect the "good news" in low short interest to reflect the absence of demand, whereas low short interest coupled with low supply suggests unsatisfied demand. We expect lightly shorted yet special stocks have unsatisfied demand and thus to experience worse future returns following Miller (1977)'s prediction.

Returns decrease almost monotonically across short interest deciles. The low short interest portfolio generates a significant abnormal return of 0.6 percent per month, whereas the high short interest portfolio return averages -0.5 percent per month. The hedge portfolio averages 1.1 percent per month, and is statistically significant. Among special stocks, the highest short interest decile generates significant returns of -1.9 percent, but the returns in the lowest short interest decile (-0.6 percent) are not distinguishable from zero. Thus, the good news in low short interest of Boehmer et al. (2007) does not extend to stocks that have low short interest because of low supply. Although the spread is economically large (1.3 percent), the significance is marginal. The short interest ratio does predict returns among the general collateral stocks. Low short interest, general collateral stocks generate a significant return of 0.8 percent per month. High short interest stocks that remain easy to borrow generate an insignificant return of -0.1 percent per month. The spread in returns is 0.9 percent per month, and is statistically significant.

4.2 Returns to special stocks by supply

In this section, we explore the role of supply constraints on future equity returns. Stocks become special when supply is not sufficient to cover demand at a low cost. Short sales allow the negative views of traders to be impounded into price. The greater the supply of lendable shares, the

more negative views can be impounded into price before the supply constraint is reached. Thus, among special stocks, we expect those with less supply to underperform stocks with higher supply, as short supply prevents more negative views from being priced.

To help isolate the effect of supply, we follow a two-stage sort procedure. In the first stage, we use either the short interest ratio or the utilization ratio as alternative proxies for short sale constraints. In the second stage, we sort into quintiles by inventory quantity within each constraint decile. We then form the lowest inventory quantity portfolio by collecting the lowest stocks by inventory quantity 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, and these five portfolios are roughly similar in terms of constraints. The purpose is to hold demand relative to supply constant across quintiles, but to have quintiles that exhibit substantial differences in supply.

We report the results in Table 5. In Panel A, with a first stage sort based on SIR we find that the low supply portfolio generates a significantly negative return of 2.3 percent, whereas the high supply portfolio generates an insignificant return. The spread in returns is 1.8 percent. However, the SIR sort is ineffective at controlling for utilization; the lowest BOIQ portfolio has utilization of 61.0 percent whereas the highest BOIQ portfolio has utilization of 39.1 percent and the spread is statistically significant. This is consistent with the notion that the short interest ratio is a noisy measure of constraints because although the numerator reflects demand, the denominator does not reflect supply. Thus, although we sort on BOIQ, the ineffective first stage sort reveals a spread in utilization that could also explain pattern of returns we observe; higher utilization stocks likely have lower returns than low utilization stocks, as the regressions in Table 3 reveal a statistically significant negative relation between utilization and future returns.

To rule out this possibility, we next report results with a first stage sort on utilization. Utilization explicitly measures demand relative to supply. The spread in utilization confirms that our design is successful, as utilization does not significantly differ across portfolios. As we predicted, low supply stocks underperform high supply stocks. The lowest quintile generates returns of -1.5 percent per month, which is statistically significant. In contrast, the highest quintile generates a statistically insignificant -.4 percent per month. The spread is 1.1 percent, and is significant.

Moreover, the patterns in demand, and importantly the SIR, help to rule out a demand explanation for the returns. For the pattern in returns to be consistent with more negative returns being associated with greater short seller demand, BOLQ and the SIR must be highest where returns are most adverse. However, this is inconsistent with the evidence in Panel B. In particular, both BOLQ and SIR are lowest in the low supply quintile, where returns are most negative.

Overall, these results clarify the role of lending supply in equity returns. In particular, as supply increases, more negative views can be priced before supply constraints bind, resulting in more efficient prices and less adverse future returns. When stocks are in extremely short supply, constraints bind quickly and negative future returns are large.

4.3 Returns to general collateral stocks by demand

In this section, we explore the role of demand on future equity returns among general collateral stocks when demand is unconstrained. Boehmer et al. (2007) 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 their strategy generates returns with long positions. The results in Table 4 show that this 'good news in short interest' exists among general collateral stocks, but not among special stocks. Because demand is positively correlated with constraints and constraints

are negatively correlated with returns, our aim is to more carefully examine the relation between demand and returns.[10]

Table 6, Panel A reports results from a first stage sort on BOIQ and a second stage sort on BOLQ. This analysis controls for the supply effect we document in Table 5, Panel B. The low demand portfolio has significant abnormal returns of .5 percent, whereas the abnormal returns for the high demand portfolio (0 percent) are not significant. The spread (-.5 percent) is significantly different from 0, suggesting that demand does indeed predict returns among general collateral stocks holding supply constant. However, the results also reveal a significant spread in utilization across extreme quintiles; low (high) demand stocks have low (high) utilization. As noted previously, utilization is significantly negatively related to returns. Thus, in Panel B, we sort firms first by utilization then by demand.

We find significant spread in returns to our second stage sort on demand. Low demand stocks enjoy abnormal returns of .5 percent, whereas high demand stocks have insignificant returns. The spread in returns is -.5 percent and statistically significant. Because low (high) demand stocks also have low (high) supply, the pattern in returns cannot be explained by the supply effect we observed in Table 5. Finally, note the similarity in patterns of BOLQ and SIR across portfolios: the spreads for both variables across extreme deciles are approximately 5 percent. This is not surprising as both measure demand relative to the number of shares outstanding, and the correlation between these variables exceeds 80 percent.

4.4 Short side returns to trading strategies

[10] Although constraints are expected to play a lesser role among general collateral stocks, to the extent even easy to borrow stocks can be sorted on relative borrowing costs constraints can still have equity pricing effects. Thus, we control for constraints to highlight the role of demand among easy to borrow stocks.

In this section, we examine whether the short side returns to a variety of trading strategies are experienced by general collateral, easy to borrow stocks or whether the returns concentrate in those stocks that are special and difficult to borrow. The strategies that we examine include:

(1) Gross Profit following Novy-Marx (2010) who propose 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) Asset growth, 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-to-assets, following Titman et al. (2004) and Xing (2008) who suggest investors underreact to overinvestment by managers. We measure Investment-to-assets as the sum of capital expenditures and the change in inventory over the most recent four quarters divided by assets four quarters ago.

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

(5)Total 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 percentage, 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 that firms that issue equity underperform.

(7) Quarterly earnings, following Chen et al. (2010). They 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) Financial distress, following Stambaugh et al. (2012) who find underperformance by firms with high financial distress. We measure financial distress using the bankruptcy prediction model of Ohlson (1980).

(9) M-Score, 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 follow Beneish et al. (2013) in measuring the M-Score.

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.

We report size-adjusted returns for our portfolio-based tests. 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.

Table 7 reports average size-adjusted returns to the nine strategies across the 79 months in our sample.[11] Although all the short side returns are numerically negative, only three (Asset Growth, NOA, M-Score) have returns that are significantly negative. However, when we split the short side into special and general collateral, we find that all the short side returns are significantly negative for the special stocks except for accruals. 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) show that short side returns are stronger following high sentiment periods. We use the Baker and Wurgler (2006) sentiment index, and define high sentiment as a value of the sentiment index greater than 0. We report the results in Panel B. Seven of the nine strategies produce significantly negative returns following high sentiment periods, confirming the Stambaugh et al. (2012) result. 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 general collateral stocks.

Overall, these results suggest that easy to borrow stocks do not share in the underperformance documented in prior research, and the short side returns are concentrated in the special stocks. These results also extend Stambaugh et al. (2012) and Baker and Wurgler (2006). Those papers predict negative returns following high sentiment among stocks that are difficult to arbitrage. Our evidence supports this prediction, and shows that short sellers appear to recognize overvaluation associated with investor sentiment, and seem to trade against it.

[11] For this analysis, we restrict our sample to the period with sentiment data from Baker and Wurgler (2006). Thus, our sample spans June 2004 (beginning of our DXL data) to December 2010 (end of the sentiment data), with observations of one month ahead returns spanning July 2004 to January 2011.

4.5 Supply and demand for special and GC stocks on the short side of trading strategies

In Table 7, we showed that the negative returns to trading strategies following high sentiment months were concentrated in special stocks. One possible explanation for our results is that special status is correlated with higher demand, and the underperformance associated with special stocks merely reflects a stronger signal of overvaluation once we focus on short side stocks with strong borrowing demand. We therefore examine differences in supply and demand among special and general collateral stocks in Table 8.

Panel A reports the percentage of shares outstanding that are available to borrow. We find strong differences in inventory quantity between special and general collateral stocks. Special stocks have significantly lower inventory quantity for all nine of the strategies, and the differences range from 6 percent to over 10 percent. Thus, a key difference between special and general collateral stocks is the supply of lendable shares. General collateral stocks have sufficient supply to satisfy demand at reasonable cost; special stocks are in short supply.

Table 8, Panel B reports the percentage of shares outstanding actually borrowed for special and general collateral stocks for each the short side of each of the trading strategies, again following high sentiment months. Surprisingly, we find little differences in the percentage of borrowed shares between special and general collateral firms. For all the strategies, the difference in loan quantity is 1 percent or less of shares outstanding. Moreover, general collateral stocks have significantly greater loan quantity than special stocks for four of the nine strategies. Loan quantity is significantly greater for special stocks than for general collateral stocks in only three of the strategies.

Overall, the results in Tables 7 and 8 reveal that short side returns reside in special stocks, and short supply appears to be the primary difference between special and general collateral stocks. This confirms the role of supply – an element of mechanical efficiency – on evidence that stock prices are not

fully efficient with respect to public information. Moreover, our results suggest that short side returns documented in prior studies are likely unavailable. This reduces the *attainable* profitability of strategies appearing in the literature. However, our results do not address the profitability of the long side returns.

4.6 Fama-French alphas

We use monthly size-adjusted returns in our main analysis. In this section, we report results from rerunning our tests controlling for risk using the four factor model from Fama and French (1992, 1993) augmented with the momentum factor from Carhart (1997). In particular, each month we sort firms into portfolios based on the characteristic under consideration (e.g., the short interest ratio in Table 4, the short side decile in Table 7, etc.). We calculate the equal-weighted portfolio return for the month and subtract the return on the 30 day T-Bill to create the monthly portfolio excess returns. Finally, we regress the time series of monthly portfolio excess returns on the asset pricing factors. The factor loadings capture the portfolio's exposure to risk, whereas the alphas (intercepts) reflect average returns to the portfolio that cannot be explained by risk.

The results based on alphas are qualitatively similar to the results reported in earlier sections. Before splitting on special status, low short interest stocks generate positive abnormal returns, high short interest stocks generate negative abnormal returns, and low short interest stocks significantly outperform high short interest stocks. The positive returns to low short interest exist among general collateral stocks only, and the negative returns to high short interest are concentrated in the special stocks. However, the high short interest decile for general collateral stocks generates significant negative returns (t-statistic = -2.00), although the economic effect is only 27bp per month. In contrast to Table 4, the low SIR portfolio does not outperform the high SIR portfolio for special stocks. Low SIR stocks do outperform high SIR stocks for general collateral status.

The alphas confirm the results in Tables 5, 6, and 7. Among special stocks (holding utilization constant), those with low supply generate negative abnormal returns and underperform those with high supply. High supply stocks do not generate significant abnormal returns. Among general collateral stocks (holding utilization constant), low demand stocks generate positive abnormal returns and outperform high demand stocks. High demand stocks do not generate significant abnormal returns. For our trading strategy tests, negative returns continue to be concentrated in special stocks.

5. Conclusion

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 an 88 month period, we 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 make the short side returns in prior literature unavailable, 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 joint hypothesis 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 indicate that supply of lendable shares matters, and thus motivate additional research into the determinants of supply in the securities lending market.

Our findings should interest regulators, researchers, and traders, among others. For regulators, our findings suggest that improving supply can lead to improved market efficiency. For researchers, our findings help better understand the existence and longevity of short side returns to various trading strategies. We also demonstrate the forces that shape the short interest ratio, which remains a central variable of interest in capital markets research in the area of short selling. For traders, our results suggest caution in attempting to use the short interest ratio and other firm characteristics in forming a short position; 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 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 September 2011. 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	The variables are measured at portfolio formation, which is the end of the third month following the end of the fiscal quarter
SIR	Open short interest divided by shares outstanding
DCBS	Daily Cost of Borrow Score, constructed by DXL that takes a value from 1 (cheap to borrow) to 10 (expensive to borrow)
utilization	BOLQ divided by BOIQ
boiq	Quantity in shares of current inventory available from beneficial owners, divided by shares outstanding
bolq	Quantity in shares of current inventory on loan from beneficial owners, divided by shares outstanding
Rebate	Simple average rebate in basis points, calculated as the interest on cash collateral put up by the borrower less the stock loan fee charged by the lender. This variable reflects the net amount received by the security borrower as a result of the lending transaction.
Loan Fee	Simple average loan fee in basis points. This variable reflects the direct cost the lender charges the borrower for lending the stock. Prior research generally classifies stocks with a loan fee of 100bp or less as general collateral and those with a loan fee greater than 100bp as special.
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	$(CAPEX_t + \text{Increase in inventory}_t)/Assets_{t-4}$
NOA	$(\text{Debt in current liabilities}_t + \text{Long-term debt}_t + \text{Total equity}_t)/Assets_t$
Accruals	$(\text{Net income}_t - \text{Cash from operations}_t)/Assets_t$
Payout%	$\text{CSR Payout}_t/MVE_{t-4}$
Quarterly earnings	$\text{Income before extraordinary items}_t/Assets_t$
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 = $\text{Total liabilities}_t/\text{Total assets}_t$ wcta = $(\text{Current assets}_t - \text{Current liabilities}_t)/Assets_t$ clca = $\text{Current liabilities}_t/\text{Current assets}_t$ nita = $\text{Net income}_t/Assets_t$ futl = $\text{Cash from operations}_t/\text{Total liabilities}_t$ chin = $[\text{Net income}_t - \text{Net income}_{t-4}]/[Abs(\text{Net income}_t)+Abs(\text{Net income}_{t-4})]$ 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

M-score	-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.

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., & 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.

Carhart, M. M. 1997. On persistence in mutual fund performance. *The Journal of finance*, *52*(1), 57-82.

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.

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.

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.

Figlewski, S., 1981. The informational effects of restrictions on short sales: some empirical evidence. *Journal of Financial and Quantitative Analysis* 16, 463–476.

Figlewski, S., & Webb, G. P. 1993. Options, short sales, and market completeness. *The Journal of Finance*, *48*(2), 761-777.

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.

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.

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.

Wooldridge, J. R., & Dickinson, A. 1994. Short selling and common stock prices. *Financial Analysts Journal*, 20-28.

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

Table 1. Sample description

This table describes our sample and key variables. Returns are drawn from CRSP and include only observations from NYSE, AMEX, and Nasdaq. The SIR is drawn from the Compustat Security Monthly file. DCBS, BOIQ, BOLQ, and TDQ are collected from Data Explorer. Returns are measured in month 0. All other variables are measured in month -1. SIR is open short interest as a percentage of total shares outstanding. DCBS is Data Explorer's Daily Cost of Borrow Score. 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. Panel A reports the average number of observations in each month for returns, SIR, DCBS, BOIQ, BOLQ, and TDQ. The final columns in panel A indicate the percentage of the total market capitalization of the returns sample with data for the SIR and DCBS. Panel B reports simple descriptive statistics.

Panel A. Average monthly observations for returns, SIR and DXL variables, before data requirements

			Average obs each month					As % of Mkt Cap	
Year	Months	Returns	SIRatio	DCBS	BOIQ	BOLQ	TDQ	SIRatio	DCBS
2004	7	5386	5333	2441	1709	1428	1625	99.84%	85.26%
2005	12	5378	5337	3260	3779	3283	3551	99.87%	88.23%
2006	12	5303	5275	3448	4271	3737	4029	99.84%	78.50%
2007	12	5220	5198	3899	4427	4126	4369	99.86%	88.72%
2008	12	5042	5033	3779	4376	4061	4358	99.94%	93.93%
2009	12	4718	4709	3613	4158	3820	4124	99.95%	94.03%
2010	12	4567	4561	3664	4036	3746	4059	99.99%	95.07%
2011	9	4467	4463	3907	4044	3806	4124	99.99%	96.83%
	88								

Panel B. Descriptive statistics for key variables, analysis sample

Variable	Mean	Std Dev	Median	Minimum	Maximum
SIR	0.054	0.059	0.036	0.000	0.918
DCBS	1.591	1.475	1.000	1.000	10.000
TDQ	0.045	0.058	0.023	0.000	0.958
BOLQ	0.036	0.049	0.017	0.000	0.552
BOIQ	0.172	0.122	0.160	0.000	0.993
Utilization	0.224	0.237	0.134	0.000	1.000
SAR	0.1%	15.6%	-0.5%	-128.4%	1332.2%

N = 227,083

Table 2. Short selling variables and other firm characteristics by DCBS

This table reports average short selling variables by Daily Cost of Borrow Score (DCBS). Rebate is the cash interest on collateral received by the short seller, net of the loan fee. Loan fee is the amount the short seller must pay to borrow the stock. 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. 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. 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. SAR denotes size adjusted return. MVE denotes market value of equity at the end of the month. Price denotes price per share at the end of the month. Share turnover is trading volume for the month divided by shares outstanding. Book to market is book value of equity for the most recent quarter divided by market value of equity.

Panel A. Short selling variables by DCBS

DCBS	Obs	Obs with rebates and loan fees	Mean Rebate	Mean Loan Fee	Median Loan Fee	SIR	TDQ	TDQ/SIR	BOLQ	BOIQ	Utilization
1	178,954	53,349	54.43	33.49	28.82	4.77%	4.01%	65.94%	3.29%	19.23%	16.23%
2	17,084	3,909	37.46	124.69	95.00	6.98%	6.32%	71.50%	5.01%	12.69%	34.53%
3	10,139	1,906	-48.18	231.40	220.00	7.06%	6.37%	72.04%	4.82%	10.01%	42.22%
4	7,968	939	-218.07	384.69	399.17	6.72%	5.70%	69.52%	4.10%	7.67%	45.78%
5	4,202	523	-356.38	548.86	561.00	7.42%	6.09%	68.70%	4.31%	7.32%	50.28%
6	2,827	395	-649.26	795.31	819.00	8.99%	7.09%	72.15%	4.84%	7.15%	61.35%
7	2,532	369	-1058.70	1151.28	1250.00	9.99%	7.55%	70.61%	4.80%	6.76%	64.82%
8	1,223	200	-1440.40	1520.15	1611.13	11.35%	7.99%	70.02%	5.01%	6.69%	69.94%
9	1,131	177	-2002.96	2066.11	2153.25	12.25%	8.35%	71.19%	5.39%	7.02%	72.77%
10	1,023	204	-4395.46	4423.52	4059.50	11.33%	7.61%	68.71%	4.76%	6.42%	77.80%
Total	227,083	61,971									

Panel B. Returns and other firm characteristics by DCBS

		Next mo.		MVE (000)		Share Price		Share turnover		Prior 6 mo. SAR (n=222,472)		BTM (n=226,596)	
DCBS	Obs	SAR	t-stat	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
1	178954	0.4%	11.55	$4,425,816	$691,190	$25.27	$18.25	2.057	1.546	3.6%	-0.8%	0.569	0.435
2	17084	0.3%	1.97	$3,138,522	$294,458	$15.99	$9.39	2.353	1.466	0.5%	-6.4%	0.603	0.382
3	10139	-0.7%	-3.42	$1,593,474	$194,360	$12.19	$6.73	2.345	1.332	0.0%	-8.2%	0.498	0.367
4	7968	-0.7%	-2.85	$587,120	$137,373	$9.86	$5.00	2.330	1.206	-2.5%	-11.5%	0.482	0.334
5	4202	-1.3%	-2.79	$315,549	$111,597	$8.20	$4.09	2.913	1.211	0.7%	-11.6%	0.503	0.304
6	2827	-2.5%	-5.73	$355,735	$122,816	$8.55	$4.09	3.071	1.459	1.8%	-14.0%	0.536	0.278
7	2532	-1.9%	-4.18	$372,321	$124,872	$8.80	$4.10	3.327	1.545	-5.2%	-18.8%	0.519	0.273
8	1223	-2.1%	-3.09	$474,712	$123,125	$8.63	$3.89	3.662	1.764	-2.2%	-22.4%	0.541	0.263
9	1131	-1.9%	-2.56	$375,309	$149,594	$8.04	$4.07	4.107	1.862	-1.4%	-19.9%	0.540	0.243
10	1023	-4.9%	-6.05	$294,891	$138,729	$6.96	$3.67	4.919	2.220	3.8%	-21.9%	-0.071	0.245
Total	227,083												

Table 3 Correlations and Fama-MacBeth regressions for key variables

Panel A reports correlations for key variables. Panel B reports time-series average of monthly cross sectional regressions of one month ahead size adjusted returns on short selling variables. Returns are drawn from CRSP and include only observations from NYSE, AMEX, and Nasdaq. The SIR is drawn from the Compustat Security Monthly file. DCBS, BOIQ, BOLQ, and TDQ are collected from Data Explorer. Returns are measured in month 0. All other variables are measured in month -1. SIR is open short interest as a percentage of total 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). 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.

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

	SIR	DCBS	Special	TDQ	BOLQ	BOIQ	Utilization
SIR		**0.212**	**0.174**	**0.845**	**0.814**	**0.374**	**0.603**
DCBS	**0.080**		**0.858**	**0.153**	**0.091**	**-0.294**	**0.530**
Special	**0.064**	**0.833**		**0.136**	**0.081**	**-0.295**	**0.484**
TDQ	**0.887**	**0.107**	**0.086**		**0.966**	**0.463**	**0.630**
BOLQ	**0.853**	**0.056**	**0.035**	**0.963**		**0.524**	**0.582**
BOIQ	**0.471**	**-0.345**	**-0.315**	**0.524**	**0.601**		**-0.089**
Utilization	**0.685**	**0.383**	**0.342**	**0.777**	**0.755**	**0.018**	

N = 227,083

Panel B. Fama-MacBeth cross sectional regressions of one month ahead size adjusted returns on short selling variables (88 months; 227,083 firm-month observations)

	Intercept	SIR	DCBS	Special	TDQ	BOLQ	BOIQ	Utilization	Adj R-Sq
Mean	0.6%	-1.0%							0.3%
(FM t-stat)	(4.04)	(-3.34)							
(FM Z-stat)	(4.60)	(-4.47)							
Mean	0.3%		-3.8%						0.5%
(FM t-stat)	(3.35)		(-5.73)						
(FM Z-stat)	(3.17)		(-7.16)						
Mean	0.3%			-1.5%					0.4%
(FM t-stat)	(2.97)			(-5.95)					
(FM Z-stat)	(2.77)			(-6.80)					
Mean	0.6%				-1.0%				0.3%
(FM t-stat)	(4.31)				(-3.71)				
(FM Z-stat)	(4.83)				(-4.99)				
Mean	0.6%					-0.9%			0.3%
(FM t-stat)	(3.86)					(-3.39)			
(FM Z-stat)	(4.29)					(-4.66)			
Mean	0.1%						0.0%		0.2%
(FM t-stat)	(0.50)						(0.13)		
(FM Z-stat)	(0.03)						(0.40)		
Mean	0.8%							-1.4%	0.4%
(FM t-stat)	(7.33)							(-5.35)	
(FM Z-stat)	(7.92)							(-6.66)	
Mean	0.8%	-0.2%						-1.3%	0.5%
(FM t-stat)	(5.95)	(-0.42)						(-4.22)	
(FM Z-stat)	(6.71)	(-0.53)						(-5.75)	

Table 4. Returns to short interest ratio deciles for special and general collateral stocks

This table reports DXL short selling measures and returns to short interest ratio deciles from July, 2004 to October, 2011. SIR denotes open short interest divided by shares outstanding in the month prior to the returns. DCBS is Data Explorer's Daily Cost of Borrow Score. TDQ is total demand quantity and represents all shares borrowed by DXL lenders as a percentage of shares outstanding. 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. 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. Observations are sorted into deciles at the end of the previous month. SAR denotes size-adjusted returns. Special denotes DCBS greater than 2. GC denotes DCBS less than or equal to 2. ***, **, * denote statistical significance at the 1 percent, 5 percent, and 10 percent levels, respectively.

SIR				Percent			Special		GC	
Portfolio	Obs	SIR	DCBS	Special	SAR	t-stat	SAR	t-stat	SAR	t-stat
1	22,667	0.2%	1.5	14.2%	0.6%	3.32	-0.6%	-1.07	0.8%	4.11
2	22,713	0.7%	1.6	15.2%	0.4%	2.39	-0.6%	-0.97	0.6%	3.34
3	22,724	1.5%	1.5	12.1%	0.2%	1.42	-1.6%	-2.82	0.4%	3.27
4	22,713	2.3%	1.4	10.2%	0.3%	1.63	0.4%	0.29	0.4%	2.27
5	22,705	3.2%	1.4	9.7%	0.2%	1.58	-1.7%	-2.72	0.4%	2.94
6	22,727	4.3%	1.4	8.2%	0.2%	0.97	-0.8%	-1.11	0.3%	1.68
7	22,721	5.5%	1.4	8.9%	0.1%	0.39	-1.0%	-1.69	0.2%	1.13
8	22,716	7.1%	1.5	10.2%	0.0%	-0.02	-1.4%	-2.29	0.2%	1.09
9	22,721	9.9%	1.6	13.0%	-0.4%	-1.83	-2.3%	-3.63	-0.1%	-0.72
10	22,676	18.4%	2.3	28.7%	-0.5%	-2.12	-1.9%	-3.63	-0.1%	-0.34
Total	227,083									
Spread					1.1%***		1.3%*		0.9%***	
(Low - High)										
Spread conditional on special					2.7%***					
(Low GC - High special)										

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

This table reports returns to special stocks based on nested sorts. Observations are first sorted on the first listed characteristic, then sorted on second characteristic within each first-stage portfolio. This procedure holds the first characteristic 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 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.

SIRatio then BOIQ

	Obs	SAR	t-stat	BOIQ	BOLQ	Utilization	SIRatio
Lowest	5841	-2.3%	-5.00	2.3%	1.7%	61.0%	7.5%
2	6393	-1.3%	-2.90	4.3%	3.0%	58.2%	7.8%
3	6393	-1.0%	-2.24	6.2%	3.9%	52.6%	8.2%
4	6393	-0.8%	-1.77	8.4%	4.9%	47.0%	8.2%
Highest	6025	-0.6%	-1.44	14.1%	6.6%	39.1%	8.7%
	31045						
Spread		1.8%		11.8%	4.9%	-21.9%	1.2%
t-stat		2.92		19.97	16.59	-21.24	4.27

Utilization then BOIQ

	Obs	SAR	t-stat	BOIQ	BOLQ	Utilization	SIRatio
Lowest	5844	-1.5%	-3.27	0.8%	0.5%	51.0%	2.5%
2	6392	-1.3%	-2.54	2.7%	1.5%	51.2%	4.7%
3	6393	-1.4%	-3.21	5.2%	3.0%	51.5%	7.0%
4	6392	-1.3%	-2.55	9.0%	5.2%	51.2%	10.1%
Highest	6024	-0.4%	-1.08	17.7%	10.1%	52.2%	16.0%
	31045						
Spread		1.1%		16.8%	9.6%	1.2%	13.6%
t-stat		1.79		23.20	22.95	0.99	45.12

Table 6. Returns to general collateral stocks by measures of supply and demand

This table reports returns to general collateral stocks based on nested sorts. Observations are first sorted on the first listed characteristic, then sorted on second characteristic within each first-stage portfolio. This procedure holds the first characteristic 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 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.

BOIQ then BOLQ

	Obs	SAR	t-stat	BOIQ	BOLQ	Utilization	SIRatio
Lowest	38947	0.5%	4.89	17.5%	0.4%	1.8%	1.6%
2	39318	0.5%	4.56	17.7%	1.2%	5.8%	2.7%
3	39397	0.3%	2.95	17.7%	2.3%	12.1%	4.0%
4	39389	0.2%	1.25	17.8%	4.2%	22.6%	6.0%
Highest	38987	0.0%	-0.07	18.1%	8.3%	45.8%	10.3%
	196038						
Spread		-0.5%		0.6%	7.9%	44.0%	8.7%
t-stat		-2.57		0.55	21.55	55.56	59.55

Utilization then BOLQ

	Obs	SAR	t-stat	BOIQ	BOLQ	Utilization	SIRatio
Lowest	38672	0.5%	2.48	5.0%	0.8%	17.9%	2.0%
2	39538	0.5%	3.53	12.9%	2.2%	17.1%	4.0%
3	39700	0.4%	3.19	18.5%	3.3%	17.1%	5.1%
4	39235	0.2%	1.87	23.1%	4.2%	17.6%	6.0%
Highest	38893	0.0%	-0.40	29.4%	5.8%	18.6%	7.5%
	196038						
Spread		-0.5%		24.4%	5.0%	0.7%	5.4%
t-stat		-2.33		21.13	17.33	1.21	31.17

Table 7. Short side returns to anomalies, full sample

This table reports short side returns to nine anomalies from July, 2004 to January, 2011. Gross profit denotes sales minus cost of goods sold divided by total assets. Asset growth 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. Quarterly earnings denotes net income divided by total assets. Ohlson score denotes the bankruptcy prediction score as in Ohlson (1980). M-Score 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. SAR denotes monthly 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. Panel A reports the full sample period. Panel B reports returns 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. Full sample period

	All Obs		Special		GC	
	SAR	t-stat	SAR	t-stat	SAR	t-stat
Gross profit	-0.1%	-0.35	-1.4%	-2.64	0.3%	0.82
Asset growth	-0.5%	-1.97	-1.1%	-2.02	-0.3%	-1.37
Investment/assets	-0.2%	-0.55	-1.4%	-2.37	0.1%	0.30
NOA	-0.4%	-1.80	-1.2%	-2.42	-0.2%	-0.78
Accruals	-0.2%	-0.80	-0.7%	-1.33	0.0%	-0.16
Payout%	-0.3%	-0.85	-2.2%	-3.70	0.3%	0.97
Quarterly earnings	-0.3%	-0.71	-1.5%	-2.99	0.3%	0.73
Ohlson score	-0.4%	-0.83	-2.3%	-3.01	0.5%	1.16
M-Score	-0.4%	-1.70	-1.5%	-2.57	-0.2%	-0.67

Panel B. Short side returns following high sentiment months

	All Obs		Special		GC	
	SAR	t-stat	SAR	t-stat	SAR	t-stat
Gross profit	-0.7%	-2.06	-1.3%	-2.04	-0.6%	-1.80
Asset growth	-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
Quarterly earnings	-1.0%	-2.07	-1.3%	-1.86	-0.7%	-1.42
Ohlson score	-1.2%	-2.23	-2.6%	-2.11	-0.7%	-1.52
M-Score	-0.9%	-2.62	-1.4%	-1.97	-0.7%	-2.18

Table 8. Supply and demand for special and general collateral stocks on the short side of trading strategies

This table reports supply and demand for short side portfolios for nine anomalies following high sentiment months from July, 2004 to January, 2011. Gross profit denotes sales minus cost of goods sold divided by total assets. Asset growth 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. Quarterly earnings denotes net income divided by total assets. Ohlson score denotes the bankruptcy prediction score as in Ohlson (1980). M-Score 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. SAR denotes monthly 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. SIR is open short interest as a percentage of shares outstanding. 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. BOIQ denotes beneficial owner inventory quantity and is the shares held and made available to lend by DXL lenders. We use the Baker and Wurgler (2006) sentiment index, and define high sentiment as months with sentiment greater than 0.

Panel A. Supply (BOIQ)

			BOIQ		
	All obs	Special	GC	Spec - GC	t-stat
Gross Profit	12.7%	6.2%	16.2%	-10.1%	-14.22
Asset growth	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
Quarterly earnings	8.2%	5.4%	11.3%	-6.3%	-17.02
Ohlson Score	8.2%	5.1%	11.6%	-6.6%	-13.44
M-Score	13.1%	7.6%	15.5%	-8.5%	-15.13

Panel B. Demand (BOLQ)

			BOLQ		
	All obs	Special	GC	Spec - GC	t-stat
Gross Profit	3.3%	3.5%	3.3%	0.2%	2.15
Asset growth	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
Quarterly earnings	3.0%	3.0%	3.2%	-0.4%	-3.07
Ohlson Score	2.9%	2.8%	3.1%	-0.3%	-1.96
M-Score	4.5%	4.7%	4.5%	0.0%	0.11