Ownership Structure, Limits to Arbitrage, and Stock Returns: Evidence from Equity Lending Markets*

MELISSA PORRAS PRADO† PEDRO A. C. SAFFI‡
JASON STURGESS§

December 9th, 2013

ABSTRACT

We examine how institutional ownership structure gives rise to limits to arbitrage through its impact on short-sale constraints. Stocks with lower, more concentrated, and less passive ownership exhibit lower lending supply, higher costs of shorting, and higher arbitrage risk. These constraints limit the ability of arbitrageurs to take short positions and delay the correction of mispricing. A positive shorting demand shock is associated with an additional negative abnormal return of -0.42% for stocks in the following week for stocks in the top quartile of ownership concentration.

Keywords: Limits to arbitrage, short-sale constraints, institutional investors, arbitrage risk, equity lending.

JEL classification: G10, G11, G14, G18, G28, G32.

*We are immensely grateful to Dataexplorers (now part of Markit) for providing the equity lending data. We thank Patrick Kelly, Marcelo Medeiros, Gilberto Loureiro and seminar participants at Georgetown University, IESE Business School, Queen Mary University, Universitat Pompeu Fabra, the 4th Lubrafin meeting in Évora, the XVIII Foro de Finanzas in Elche for helpful comments, and the Liquidity & Arbitrage Trading conference at the GFRI in Geneva. We also acknowledge support from the Spanish Ministry of Science and Innovation under the ECO2008-05155 grant at the Public-Private Sector Research Center at IESE Business School. All errors are ours.

†Nova School of Business and Economics. Email: melissa.prado@novasbe.pt

‡Judge Business School, University of Cambridge. Email: psaffi@jbs.cam.ac.uk

§Driehaus College of Business, DePaul University. Email: jsturge2@depaul.edu

I. Introduction

What causes short-sale constraints? Short-sale constraints collectively describe the market frictions that constrain investors from freely selling short a stock that they do not own. Constraints include liquidity concerns about whether the stock is available to borrow and the fee paid to a broker for the loan, both at the time of the transaction and in the future.

Prior literature has argued that short-sale constraints increase limits to arbitrage, reduce market efficiency and increase mispricing and market anomalies.[1] However, much less is known about the sources of these constraints. Aggregate cross-country evidence shows that they vary due to different regulatory environments and levels of financial development (see Bris, Goetzmann, and Zhu (2007), Charoenrook and Daouk (2009)), but there are few studies on how short-sale constraints vary at the stock-level.[2]

Our goal is to understand how the composition of institutional ownership increases short sale constraints and creates limits to arbitrage through the market for borrowing stock. In doing so, we are also able to shed light on whether equity lending supply matters for stock prices. We use data on equity lending supply and loans from over 125 custodians and 32 prime brokers to better understand the determinants of lending supply, loan fees and how they affect arbitrage risk. Next, we combine this data with the methodology developed by Cohen, Diether, and Malloy (2007) to identify shocks to shorting demand and study the impact of equity lending supply and ownership in the cross-section of stock returns.

We hypothesize that the decision to lend depends on institutional investor ownership characteristics beyond total ownership (e.g. Nagel (2005)). Specifically, investors should be less willing to lend stock in which they hold large positions and active investors should be less

[1] See Miller (1977), Diamond and Verrecchia (1987), De Long, Shleifer, Summers, and Waldmann (1990), Shleifer and Vishny (1997), Stein and Hong (1999) and Chen, Hong, and Stein (2002) among others.

[2] Exceptions are Saffi and Sigurdsson (2011) who examine the equity lending market of an international sample of stocks and Kolasinski, Reed, and Ringgenberg (2013), who study the loan supply schedule using data from twelve lenders and document that the presence of search frictions at the stock level result in higher short sale constraints through higher fees.

willing to lend than passive ones. Thus, differences in investor composition can affect equity lending supply of the stock, thereby tighten short-sale constraints and increase arbitrage risk, which in turn can affect the returns to shorting stocks.

For each of the 4,713 U.S. stocks in our sample, we compute total institutional ownership, ownership concentration, and the fraction held by passive institutional investors. We then examine the effect that institutional ownership structure has on the equity lending supply and a variety of short-sale constraints measures.

Our main findings are as follows. First, stocks with lower levels of passive ownership and more concentrated institutional ownership have lower lending supply, greater borrowing costs and higher recall risk.[3] Second, lower lending supply is associated with higher levels of idiosyncratic volatility of returns, a measure of arbitrage risk, but only through the fraction explained by ownership structure. Third, the abnormal returns following shocks to shorting demand found by Cohen, Diether, and Malloy (2007) are restricted to firms with high ownership concentration. Stocks in the top quartile of ownership concentration have average abnormal returns after an outward demand shock of -0.42% per week relative to stocks with a dispersed ownership facing a similar shock. This effect is unrelated to the level of total institutional ownership.[4] Our findings are robust to firm and calendar fixed-effects, to a propensity-score matched sample, to differences in investor sentiment, the inclusion of liquidity and visibility variables, and to abnormal returns based on the four-factor model using calendar portfolio regressions.

Tighter short-sale constraints limit the ability of arbitrageurs to take short positions and exploit inefficiencies (Saffi and Sigurdsson (2011) and Boehmer and Wu (2013)), leading to both higher prices and delays in incorporating pessimistic investors' opinions. If a stock is fairly

[3]We use the term "lending supply" to refer to the "potential supply" since most of these shares are not actually lent, and hence not actually supplied.

[4]This difference is large but it does not account for transaction costs. Cohen, Diether, and Malloy (2007) estimates that the excess return is reduced by 80% once transaction costs are accounted for. We find similar values.

valued, short sale constraints should not impact the price because there would be no demand to short it. However, as a stock becomes overvalued the demand for shorting it increases. In the absence of short sale constraints investors will borrow the stock, short it, and prices will quickly adjust to their fair value. When short-sales constraints are in place, investors might not be willing or able to immediately borrow shares and short them, due to factors like borrowing costs, or higher arbitrage risk. It is only if and when the overpricing becomes sufficiently high to compensate investors that investors will short. Thus, the price adjustment associated with short-selling a constrained stock might take longer to happen, generating the predictability found by previous articles. If concentrated ownership restricts the borrowing of stock to sell short, then lending supply should affect stock prices, and we should observe more negative returns to short selling demand shocks for stocks with more concentrated ownership compared with stocks with dispersed ownership.

Our results relate to the findings of Cohen, Diether, and Malloy (2007), who identify short selling demand as driving the relation between shorting indicators and subsequent stock returns. They find little evidence that lending supply matters for asset prices. Our results highlight an important role for the composition of lending supply, as abnormal returns following shocks to shorting demand are concentrated among firms with high ownership concentration. Nagel (2005) uses institutional ownership as a proxy for short-sale constraints to explain cross-sectional stock return anomalies. Our results suggest a link between institutional ownership concentration, limits to arbitrage and the cross-section of stock returns, which to the best of our knowledge has not been previously explored.

This paper also contributes to the literature on how to measure short sales constraints (D'Avolio (2002) and Nagel (2005)). We show that institutional ownership is not a sufficient statistic to proxy for lending supply constraint as is often assumed in the literature (see Asquith, Pathak, and Ritter (2005), Lamont (2004), Nagel (2005), Akbas, Boehmer, Erturk, and Sorescu (2008), and Kolasinski, Reed, and Ringgenberg (2013), among others). Instead,

both total institutional ownership and the composition of institutional ownership should be taken into consideration. Boehmer and Kelley (2009) discuss the impact of institutional holdings on price efficiency and our results are evidence that the equity lending market is a channel through which this happens.

II. Literature Review

Trading strategies designed to correct mispricing can be both risky and costly. Psychological biases, institutional frictions, and transaction costs can render the correction of mispricing unattractive to arbitrageurs. De Long, Shleifer, Summers, and Waldmann (1990) introduced the notion of noise trader risk, i.e. the possibility that mispricing worsens in the short run due to the presence of noise traders. Shleifer and Vishny (1997) further argue that financial institutions are constrained by agency frictions: if mispricing worsens and generates negative returns this may lead the principal owner of the underlying invested capital to close his positions. Another important limit to arbitrage is implementation costs.

In classical asset-pricing models it is assumed that market participants can buy, sell and short sell securities at no cost. In practice, restrictions such as the cost of borrowing can make shorting a stock not as straightforward as standard buy and sell orders. To establish a short position an arbitrageur needs to post collateral to borrow shares. The interest rate earned on the cash is below the market interest rate. These rebate rates can even be negative (i.e., loan fees in excess of the risk-free rate) and therefore be an important source of arbitrage costs.

Moreover, to borrow a share an arbitrageur needs to locate it first. At the time a short position is initiated, the short seller has three days to locate, borrow and deliver the shares to the buyer. The supply of shares available for borrowing is an important determinant of whether a stock is easy to locate and cheap to borrow. D'Avolio (2002) shows that institutional investors are the main suppliers of stock loans. Kolasinski, Reed, and Ringgenberg (2013) document that the presence of search frictions benefits lenders such that they can charge higher fees.

Autore, Boulton, and Braga-Alves (2010) and Blocher, Reed, and Van Wesep (2013) show that hard-to-borrow stocks that reach thresholds of failures become highly overvalued. These costs or limitations faced by arbitrageurs can prevent them from eliminating mispricing. In line with this, Stambaugh, Yu, and Yuan (2012) and Avramov, Chordia, Jostova, and Philipov (2013) find that profits from anomaly-based strategies reside mostly on the short side of the trade.

Institutional investors choose both to participate in equity lending and, if they lend, the amounts to make available and for which stocks. Different institutional investors likely have different preferences regarding their willingness to participate in the market for lending shares. Evans, Ferreira, and Prado (2012) show that the decision to lend out shares by mutual funds is taken consciously. Certain investors, like index funds, are much more likely to engage in securities lending as they face no negative impact on performance due to the lack of manager discretion over the fund's asset allocation. Aggarwal, Saffi, and Sturgess (2013) study the supply of shares in the equity lending market around shareholder meeting record dates and show that institutional investors vary in their preference for making supply available to borrow.

There is ample empirical evidence that the demand to borrow stock, and hence short selling, impacts stock prices.[5] However, there is much less evidence on whether similar effects arise from the lending supply channel.[6] Examining an increase in loan demand and fee suffers from the usual identification problem. It is not clear if there is an increase in the demand to short and/or if there is a decrease in the supply of stock to borrow. A couple of papers have attempted to overcome this challenge. Cohen, Diether, and Malloy (2007) show that while demand shifts are linked to future stock returns, shifts in supply are not. Kaplan, Moskowitz, and Sensoy (2013) study a lender-specific shock to the supply of lendable shares and find that

[5] See, for example, Asquith, Pathak, and Ritter (2005), Lamont (2004), Nagel (2005), Akbas, Boehmer, Erturk, and Sorescu (2008), and Kolasinski, Reed, and Ringgenberg (2013) among others)

[6] A contemporaneous study by Chuprinin and Massa (2012) uses similar data to examine the effects of lending supply on asset prices.

lending supply impacts short sale constraints such as fees, but do not find any impact on stock returns. However, this may not be surprising if there is sufficient slack supply, as shown in our paper and by Kolasinski, Reed, and Ringgenberg (2013), who study the loan supply schedule using data from twelve lenders. They argue that the loan supply schedule is nonmonotonic, with a downward slope at low short demand quantity levels, a relatively flat slope for moderate ones, and an upward slope at high quantity levels.

We stress that the ownership composition other than the level of institutional ownership is also important in explaining short-sale constraints. The ownership structure can affect equity lending supply, and in turn induce short-sale constraints and limits to arbitrage. The type of institutional investor holding a stock and whether these institutions are passive or active investors can determine the desirability of the lender and, besides increasing costs, also raises the risk faced by short sellers. When borrowing shares from an active institutional investor the risk of a recall of the loan is more prevalent as this investor might sell his position and ask for his lent shares back. Additionally, the more concentrated the ownership is, the more bargaining power the lender has in setting the fee (e.g., Kolasinski, Reed, and Ringgenberg (2013)).

III. The Market for Borrowing Stock

We use a proprietary dataset of equity lending supply and loans from Markit (who acquired Dataexplorers), which collects this information from a significant number of the largest custodians and prime brokers in the securities lending industry.[7] The data comprise security-level daily information from August 1st, 2006 to December 31st, 2010. As of December 2010, there are $5.7 trillion in stocks available to borrow, out of which $387 billion are actually lent out.

[7]The information is currently collected daily from 125 custodians and 32 prime brokers. Markit estimates that the data represent 85% of global equity lending. See Saffi and Sigurdsson (2011) for a detailed description.

This corresponds to an utilization level (i.e., amount lent out divided by amount available to borrow) of around 15%.[8]

Equity supply postings contain the dollar value of shares available for borrowing on a given day. We define lending supply as supply relative to a firm's market capitalization. Similarly, loan quantity is the dollar value of shares on loan on a given day relative to market capitalization. Loan fees are set in two different ways depending on the type of collateral placed by the borrower. If borrowers use cash - the dominant form in the U.S. - then the loan fee is defined as the difference between the risk-free interest rate and the rebate rate. The rebate rate is the portion of the interest rate on the collateral which the borrower receives back. If instead the transaction uses other securities as collateral, like U.S. Treasuries, the fee is directly negotiated between the borrower and the lender. The contract type variable examines whether equity loan transactions are open-term or fixed-term. Open-term loans are renegotiated every day. Fixed-term ones have predefined clauses and maturities. The overnight risk-free rate of the collateral's currency is used for open-term loans. Because the ownership data is reported at a quarterly frequency, we compute quarterly averages of daily equity lending variables for each firm. Variables are winsorized at the 1%-level to reduce the impact of outliers.

[Insert Figure 1 HERE]

In Figure 1 we show lending supply and loaned shares as a fraction of market capitalization (left-axis) and the average loan fee (right-axis). The average loan fee in December 2010 is around 116 basis points a year (bps), similar to the figures reported by D'Avolio (2002), and Kolasinski, Reed, and Ringgenberg (2013). Lending supply has been around 20-25% for most of the period, but we can see the noticeable reduction in shares available to borrow that takes place after the financial crisis on October 2008.

[8]Note that equity loans are not an perfect measure of short selling activity, since stock loans might be used as part of tax-arbitrage strategies (see for example Christoffersen, Geczy, Musto, and Reed (2005)).

[Insert Figure 2 HERE]

In Figure 2 we plot the total lending supply and total loaned shares in billions of dollars (right-axis) and the average utilization (left-axis) in a given quarter. After 2008 utilization rates fell from 24% in September 2008 to 14.6% in December 2010 due to deleveraging that takes place after the financial crisis.

IV. Research Design

A. Hypotheses

We test four hypotheses on how the equity lending market is affected by the structure of institutional ownership and on how returns following shorting demand shocks are affected by ownership structure.

Recent literature has shown that short selling is associated with higher price efficiency and that it places downward pressure on stock prices (Bris, Goetzmann, and Zhu (2007)). Furthermore, it has been argued that lending supply increases with institutional ownership and subsequently that it leads to an increase in price efficiency as short sales constraints are relaxed. The main reasoning behind these arguments is that large institutional owners are willing to lend stock that they hold as a way to generate extra returns through lending income (e.g. D'Avolio (2002), Nagel (2005), and Evans, Ferreira, and Prado (2012)).

However, where institutional ownership is more concentrated this may not necessarily hold true. A more concentrated ownership structure, or a structure including larger single institutional investors, results in shareholders having greater influence in the equity lending market vis-à-vis a highly dispersed ownership structure. If shareholders prefer higher valuations, and short sale constraints allow stocks to be overpriced, shareholders should act to impede short-selling by limiting equity lending supply.

The following example illustrates how ownership structure effects in the equity lending market might hinder arbitrage opportunities. In the summer of 2007 Reuters was acquired by the Canadian family-controlled Thomson Corp. The newly-formed group became a dual-listed company, with siamese-twin stocks with claims to almost identical dividend streams trading in London and Toronto. However, the Thomson family continued to own 55% of shares on the Toronto exchange. Following the conclusion of the deal in April 2008, the London listing has traded on average at a 15 per cent discount to the Toronto quote. The Financial Times reported "One factor was that the high concentration of the Thomson family's stake in Canada limited liquidity in Toronto, benefiting the price by restricting opportunities for borrowing stock to sell short", and that despite the twins arbitrage strategy of shorting Toronto-listed stocks and buying London-listed stocks, "6 per cent of the London line was on loan as of Friday, according to Markit, compared to 5.4 per cent in Toronto".[9]

Larger and more concentrated owners may prefer not to lend stock and either to retain control of voting rights (e.g. Aggarwal, Saffi, and Sturgess (2013)), that would otherwise pass to the borrower or just to impede shorting. Evans, Ferreira, and Prado (2012) show that passive institutional investors, like index funds, are much more likely to engage in securities lending as a way to gain lending income and lower expenses. Moreover, index funds face no negative impact on performance due to the lack of manager discretion over the fund's asset allocation. This suggests that stocks held by passive investors are much more likely to be available to short sellers to borrow from. Using the N-SAR form's answers to the question of whether a fund is an index fund (question 69) we classify funds as passive funds and aggregate their holdings to calculate the fraction of passive ownership in each specific stock.

Hypothesis 1 *Lending supply is decreasing in the concentration of institutional ownership and increasing in passive ownership.*

[9] "How parochialism hampered Thomson Reuters", Financial Times, June 24 2009, and "Concern over Thomson Reuters' UK listing", Financial Times, January 9 2009.

While the effect of ownership structure on lending supply is interesting, the important issue is whether there are economic pricing implications due to changes in short sales constraints. Short selling carries various costs and risks, such as the expense and difficulty of shorting and the risk that the short position will have to be involuntarily closed due to recall of the borrowed shares. It can also be that these constraints deter arbitrage activity, increase idiosyncratic risk, leading to our second and third hypothesis:

Hypothesis 2 *Short sales constraints are increasing in the concentration of institutional ownership and decreasing in passive ownership.*

Hypothesis 3 *Arbitrage risk, measured by the idiosyncratic volatility of returns, is increasing in the concentration of institutional ownership and decreasing in passive ownership.*

Hypothesis 2 examines the effects of institutional ownership structure on the fee for borrowing stock. More concentrated ownership and less passive ownership are likely associated with higher fee due to a reduction on the the supply of lendable shares. In Hypothesis 3 we examine the effect of ownership structure on arbitrage risk. Following Wurgler and Zhuravskaya (2002), we define arbitrage risk as the standard deviation of the residuals based on the Carhart (1997) 4-factor model of returns. It measures the volatility of the portion of returns that cannot be hedged by standard risk factors. Thus, firms with a higher volatility of residuals present riskier opportunities to arbitrageurs as hedging becomes less perfect.

Hypothesis 4 *The returns associated with an outward demand shift are more negative for firms facing tighter short sale constraints owing to high ownership concentration effects on lending supply.*

Hypotheses 1-3 described the effects of ownership structure on equity lending supply, loan fees and arbitrage risk. Hypothesis 4 focuses on the returns associated with arbitrage trading

strategies. If ownership concentration results in higher short sale constraints and increases arbitrage risk, arbitrageurs face greater limits to arbitrage. Thus, mispricing builds up and the subsequent returns to short-selling will be more negative as prices take longer to adjust. Another possibility, described in Cohen, Diether, and Malloy (2007), is that shorting stocks is riskier for investors "betting" on negative price information because of the higher borrowing costs and arbitrage risks, requiring more negative returns in compensation. Regardless of the explanation, we should observe more negative returns following increases in the demand for short selling for stocks with more concentrated ownership relative to stocks with dispersed ownership.

We employ the methodology proposed by Cohen, Diether, and Malloy (2007) and test its sensitivity to ownership concentration levels in the previous quarter. The identification strategy consists of constructing price-quantity "pairs" from the equity lending market to isolate clear shifts in supply and demand. For example, an increase in the loan fee (i.e., price) coupled with an increase in the percentage of shares on loan (i.e., quantity) corresponds to an increase in shorting demand, as would be the case for any increase in price coupled with an increase in quantity.

We define DOUT and DIN in the following way:

$$\text{DOUT}_{i,t-1} = \begin{cases} 1 & \text{if Fee Score}_{t-1} - \text{Fee Score}_{t-2} > 0 \text{ and Loan}_{t-1} - \text{Loan}_{t-2} > 0 \\ 0 & \text{otherwise} \end{cases} \tag{1}$$

$$\text{DIN}_{i,t-1} = \begin{cases} 1 & \text{if Fee Score}_{t-1} - \text{Fee Score}_{t-2} < 0 \text{ and Loan}_{t-1} - \text{Loan}_{t-2} < 0 \\ 0 & \text{otherwise} \end{cases} \tag{2}$$

where *i* stands for stock, *t* for week, and *Fee Score* is a measure of loan fees that ranges from 1 (cheapest to borrow) to 10 (hardest to borrow).

Each of the shifts has an economic interpretation. *DOUT* captures the case in which there is an increase in both the cost of shorting (i.e., loan fee) and the amount that investors are willing to short at this higher cost. Effectively, more capital is betting that the price will decrease, despite the higher explicit cost of betting. *DIN* captures the case in which both shorting costs and the amount that investors borrow at this lower price decrease. The effect of DIN on returns is likely to be smaller than the one from *DOUT* because if investors have positive expectations about the stock they can purchase it in the spot market.

However, this strategy does not uniquely identify an outward demand shift. Instead, a shift of price and quantity into this quadrant implies that at least an outward demand shift has occurred. Stocks that have experienced at least an outward demand shift (*DOUT*) have seen both their loan fees and their loan amounts rise; and stocks that experienced at least an inward demand shift (*DIN*) have seen both their loan fee and loan quantity fall.

Cohen, Diether, and Malloy (2007) show that *DOUT* is a strong predictor of negative abnormal returns in the following week. Our hypothesis is that this effect is related to ownership concentration because of its impact on equity lending supply and short sales constraints. Conditional on an outward demand shock (i.e. *DOUT*=1), we compute the 75th percentile of ownership concentration in the previous quarter for all stocks. Then, we define a dummy variable (*Top(HHI)*) equal to one if a stock's ownership concentration is above the 75th percentile and test if its interaction with *DOUT* is negative and statistically significant. Note that the definition of *DOUT* makes it invariant to the magnitude of loan demand and the fee score as long as they are jointly larger than zero.

If the supply curve was always upward sloping, DOUT would always capture shifts in the demand curve. However, Kolasinski, Reed, and Ringgenberg (2013) show that the supply curve is mostly flat and only has a significantly positive slope for high levels of demand. The top graph of Figure 3 shows that the supply curve of stocks with concentrated ownership becomes positively sloped for much lower levels of loan demand. Within the lowest supply

quartile (bottom graph) the supply curve is generally steeper for stocks regardless of concentration levels but those in the top quartile are more expensive to borrow throughout.

B. Data

The main explanatory variables in our study are measures of the structure of ownership held by institutional investors. The ownership data come from the Thomson Reuters CDA/Spectrum database on SEC 13F filings. Form 13F is filed on a quarterly basis by institutional investment managers who exercise investment discretion over accounts holding at least $100 million in eligible equity securities. These managers report the total long positions in each eligible security, aggregated across all accounts over which they exercise investment discretion.[10] The data is available from August 1st, 2006 until December 31st, 2010 for approximately 5,000 stocks. For each stock we calculate the ownership by each institution and total institutional ownership, both as a percentage of market capitalization. We additionally compute several characteristics of the ownership structure: *HHI* is the concentration of institutions' holdings using the Hirschman-Herfindahl Index, normalized to be between zero and one; and Δ*(Breadth)* is the quarterly percentage increase in the number of institutional investors as used by Chen, Hong, and Stein (2002), *Top5 / Total* is the percentage of institutional ownership held by the largest five institutions, and *% Passive* is the fraction of shares outstanding held by passive institutional investors as in Evans, Ferreira, and Prado (2012).

We match firms in the equity lending database with those available on CRSP. The final sample has 59,316 firm-quarter observations with lending data available. From CRSP data, we compute market capitalization, turnover, share price, cumulative quarterly returns, the standard deviation of daily returns, cumulative abnormal returns based on the Daniel, Grinblatt, Titman, and Wermers (1997) characteristics-matched factor, and the market beta using

[10]We thank Stewart Mayhew for detailed advice on 13F holdings.

the CRSP value-weighted market index as the benchmark. Throughout, we only use common shares with prices larger than $1.[11]

C. Descriptive Statistics

Table I presents descriptive statistics for the main variables used in this paper. The average firm has 19.9% of its market capitalization available to lend. On average, 4.7% of its capitalization is on loan, with the shares costing 70.6 basis points per year to be borrowed. In our sample, 14.4% of firm-quarter observations are "on special", i.e. have lending fees above 100 basis points. Average total institutional ownership is 58%, with 140 institutions being shareholders of the average firm.

[Insert Table I HERE]

Given our focus on lending supply, in Table II we report the sample's main characteristics sorted by lending supply quintiles. In Panel A, we find that the difference in lending supply between the lowest and highest quintiles corresponds to about 36% of market capitalization. The number of shares loaned out (as a percentage of total shares outstanding) increases with lending supply. As expected, loan fees are decreasing in supply. Firms with low supply are about seven times more expensive to borrow (199 basis points per year) than those in the highest lending supply quintile (26 basis points per year). These numbers are similar to those reported by D'Avolio (2002), though shares in our database are slightly more expensive and are lent much more often, which reflects the growth in the equity lending market in recent years and the fact that our data cover a much bigger number of data providers.

Examining institutional ownership variables in Panel B, we find that total ownership grows with lending supply, consistent with its use as a proxy for lending supply as in Nagel (2005).

[11] Our results are also robust to the following additional filters: (i) stocks with prices above $5, (ii) only include firms with more than 10 institutional investors and (iii) excluding stocks in the smallest market capitalization decile.

We also observe that the average size of institutional holdings decreases with lending supply. Further, lending supply is positively related to the size of the long-term investor base, but not to the short-term investor base. Our measure of investor's ownership concentration, *HHI* decreases with lending supply. In Panel C, we find that firms with higher supply tend to be larger, have higher stock turnover and analyst coverage, but lower arbitrage risk.

[Insert Table II HERE]

In Figure 3, we plot the lending supply curve of stocks in the top and bottom concentration quartiles as a function of loan demand. For stocks in the bottom quartile, the supply curve is essentially flat across the various lending supply deciles. Stocks in the top quartile not only are considerably more expensive than those with low ownership concentration but have supply curves that slope up at much lower levels of loan demand. In the bottom graph of Figure 3 we focus on those stocks with low lending supply and sort them on ownership concentration. While here the supply curve slopes up much sooner regardless of ownership concentration, firms in the top quartile of concentration still exhibit higher borrowing costs.

[Insert Figure 3 HERE]

In Table III we show the average supply, loan quantity and fee for concentration and supply quartiles. Panel A shows that supply is decreasing in the level of concentration across all supply quartiles but this effect is strongest when there is limited supply. Similarly for loan quantity stocks that belong to the lowest supply quartile and highest concentration quartile, they have only 0.43% on loan. In Panel C we observe a monotonically increasing pattern of lending fee across the concentration quartiles, even for stocks in the highest supply quartile. Firms in the highest quartile of supply and in the top quartile of ownership concentration have fees that are almost as high (101.24bps) as those found for stocks in the lowest supply and ownership concentration quartile, providing evidence that the ownership structure is an important driver of cross-sectional differences in lending fees.

[Insert Table III HERE]

V. Empirical Results

A. *How does institutional ownership structure affect equity lending supply?*

We apply multivariate regression analysis to study the impact of ownership structure on lending supply by using pooled OLS regressions with quarterly data. All models include year-quarter dummy variables and standard errors are double clustered at the firm and year-quarter levels using the procedure described in Petersen (2009). In each quarter we standardize all variables to have zero mean and unit standard deviation. We apply this transformation to allow for an easier comparison of each variable's impact on supply, with estimated coefficients denoting the impact of a one standard deviation change in the explanatory variable.[12] We include Δ(Breadth), Size, a price below \$5 indicator variable, turnover, book-to-market ratio, S&P500 stock member indicator, the natural log of 1 plus the the number of analysts following the stock, Amihud illiquidity, and the cumulative return in the previous two quarters as control variables. All standard errors are double-clustered by firm and time as suggested by Petersen (2009) since it is likely that errors are simultaneously correlated across firms and time.

Table IV presents evidence on lending supply and ownership structure. We first examine how total institutional ownership influences lending supply in column 1. The coefficient for total ownership, *Total*, on equity lending supply is positive and statistically significant. A one standard deviation increase in total ownership is associated with lending supply 0.781 standard deviations higher, equivalent to a 50.8% ($= \frac{0.781*0.1294}{0.1990}$) increase relative to the mean lending supply. In column 2, we examine how institutional ownership concentration, measured as the Hirschman-Herfindahl Index of institutional holdings. The coefficient of ownership concentration, *HHI*, on equity lending supply is negative and statistically significant. A one standard

[12] Our results are unchanged if we use raw values instead.

deviation increase in ownership concentration decreases lending supply by 0.170 standard deviations, equivalent to a 11.0% ($= \frac{-0.170*0.129}{0.199}$) decrease relative to the mean lending supply). Throughout, we include Δ*(Breadth)*, the change in the number of institutional investors, as a control variable for investor sentiment, as in Chen, Hong, and Stein (2002). Equity lending supply is greater for stocks with larger Δ*(Breadth)*, but this effect is explained by ownership concentration in column 2. We also find that firms with low turnover, low book-to-market ratios and prices below $5 have smaller lending supply. Our results show that ownership concentration is also relevant in explaining the availability of stocks to borrow, with an impact above an beyond the one due to total ownership (e.g. D'Avolio (2002)).

[Insert Table IV HERE]

In column 3 we use an alternative measure of ownership concentration, $Top5/Total$, which measures the fraction of total institutional ownership held by the institutions with the largest five holdings in column 3. The results mirror those in column 2. While higher institutional ownership is associated with higher lending supply, concentrated institutional ownership has the opposite effect. Both measures of institutional concentration, HHI and $Top5/Total$, capture the effects of concentration and institutional influence alike. Larger institutional investors are more likely to able to hold court with the firm's management, which in itself may determine whether an institutional owner is willing to lend shares.[13]. Our results suggest that concentrated and influential ownership structures both reduce equity lending supply.

Finally, in column 4 we examine how a passive investor base influences lending supply. Using the N-SAR form response to the question of whether a fund is an index fund we classify funds as passive funds and calculate the fraction of passive ownership of the specific stock. In line with Evans, Ferreira, and Prado (2012)'s findings that index funds are more likely

[13]The decision to lobby or lend shares is similar to the decision to lobby or walk, which has been studied by Admati and Pfleiderer (2009), Edmans (2009) and Edmans and Manso (2011). Prior literature has used measures of investor influence to show that firms with more influential institutional investors have higher CEO pay for performance and lower compensation Hartzell and Starks (2003)

to engage in security lending, we find that passive ownership is positively related to lending supply. In summary, these results support Hypothesis 1: stocks with concentrated ownership and an active investor base with a higher portfolio turnover have lower lending supply.

In columns 5-8 we include stock fixed-effects to control for firm-level heterogeneity. There might be time-invariant unobserved characteristics of the firm that are related to ownership structure and also to short sales constraints, potentially biasing our estimates. We see that our results for ownership concentration are robust to the inclusion of fixed-effects. For a given firm, as concentration increases we find that lending supply decreases.

B. How does institutional ownership structure affect short sale constraints?

An important issue in analyzing the effects of ownership on equity lending is measuring to what extent ownership affects short sale constraints. While ownership effects may be large for lending supply, they may be irrelevant if they do not have consequences for the pricing of borrowing stock, which in turn constrain short sales and affect asset prices. We investigate the relation between institutional ownership structure and short sale constraints by focusing on the cost of borrowing stock, and arbitrage risk.[14] Both characteristics may constrain short sales by increasing costs or the risk of short selling.

Loan fees reflect the cost of borrowing stock and are the most direct form of short-sale constraint. If the profits from a short-sale trade are smaller than the loan fee, investors face limits to arbitrage and anomalies may persist over time. The results in Table V present evidence that loan fees are higher where institutional ownership is more concentrated or investors have short investment horizons. Once again we employ pooled OLS regressions with time effects and double clustering of standard errors at the stock and time levels. In all regressions shown in Table V we include the same set of control variables used in Table IV. In the first two

[14]Table A.1 in the Appendix shows results for loan tenure and an alternative measure of borrowing costs.

columns we test for the effects of total ownership and ownership concentration on loan fees. If lower equity lending supply - as determined by ownership structure - has consequences for loan fees, then we expect that larger total institutional ownership should have a negative impact on fees while a higher ownership concentration should increase loan fees. We find this to be true.

From column 2, a one standard deviation increase in total ownership is associated with a decrease in fee of 28 basis points, while a one standard deviation increase in ownership concentration is associated with an increase in fee of 12 basis points, both economically significant when compared to the mean lending fee of 71 basis points. The impact of ownership concentration on fees is almost half as big as the one due to total ownership levels.

In column 3 we examine if the alternate measures of ownership composition explain lending fee. The results show that concentration, measured as the fraction of total institutional ownership held by the institutions with the largest five holdings, is positively associated with the cost of borrowing. In column 4 we show that stocks with a passive investor base do not necessarily exhibit lower lower fees and thus short sale constraints, as coefficients are not statistically significant. While passive ownership is associated with higher lending supply, its effects do not seem to affect borrowing costs. These results are also robust after the inclusion of stock fixed effects in columns 5-8.

[Insert Table V HERE]

In Table VI we investigate the effect of ownership on arbitrage risk. Arbitrage risk is measured as the standard deviation of daily stock returns' residuals from the Carhart (1997) 4-factor model (as in Wurgler and Zhuravskaya (2002)). Firms with a higher variability of the portion of returns that cannot be explained by the benchmark model are riskier for arbitrageurs trying to correct for mispricing. As argued by Shleifer and Vishny (1997), idiosyncratic risk poses a limit to arbitrage that deters short-selling simply because a large amount of stocks'

volatility cannot be hedged. For our sample, arbitrage risk has a mean of 3.00% and a standard deviation of 2.67%. Ownership structure can have a direct effect on arbitrage risk or through tighter short-sales constraints. We find that total ownership decreases arbitrage risk and that ownership concentration increases arbitrage risk. The coefficient on HHI (0.059) has an opposite impact on arbitrage risk than total ownership (-0.082), illustrating that ownership concentration should be taken into account by investors concerned with arbitrage risk. The same results are found when we use $Top5/Total$ to measure ownership concentration. In column 4 we find that more passive ownership is associated with lower arbitrage risk but these results do not hold once we include firm fixed-effects.

[Insert Table VI HERE]

A valid concern in interpreting these results is that, while ownership structure can clearly affect limits to arbitrage due to its effect on lending supply, there might be alternative channels through which ownership affects limits to arbitrage. For example, lending supply may affect limits to arbitrage independently of ownership structure, or it could be that ownership structure affects limits to arbitrage through channels other than equity lending supply. We address this concern in results presented in Table VII. We repeat the analysis presented in Tables V-VI but decompose lending supply into two components: (i) the portion explained by ownership characteristics (*Predicted Supply*) and (ii) the residuals that are, by construction, unrelated to them (*Residual Supply*).

[Insert Table VII HERE]

We employ total ownership and concentration to decompose supply (shown in Panel B) and use *Predicted Supply* and *Residual Supply* to explain arbitrage risk in columns 1-2 of Panel A. A higher lending supply is associated with lower arbitrage risk. In column 2 we find that

arbitrage risk is affected by supply only through the component explained by ownership structure. A one standard deviation in *Predicted Supply* using total ownership and concentration decreases arbitrage risk by -0.158 standard deviations. The unexplained component, *Residual Supply*, does not have explanatory power for arbitrage risk, indicating that the relation between idiosyncratic risk and lending supply stems from ownership characteristics.

We also examine this same decomposition for lending fees to test whether ownership structure affects the cost of shorting via lending supply. Higher fees deter short selling by increasing trading costs. Ownership structure can affect fees directly or via its effect on lending supply. In columns 3 and 4 we find that both the predicted and residual components of supply affect loan fees, although the economic magnitude is much larger for the *Predicted Supply* component.

In summary, limits to arbitrage vary with ownership characteristics and equity lending supply is an important channel through which this variability takes place. In particular, limits to arbitrage are higher for stocks with more concentrated ownership structures. This result arises because tightly-held ownership reduces equity lending supply, which in turn increases the cost of borrowing stock. Stocks with concentrated ownership also exhibit higher arbitrage risk which, in the spirit of Shleifer and Vishny (1997), hinders arbitrage activity. If these impediments prevent investors from shorting certain stocks they can lead to stocks becoming overpriced.

C. Propensity Score Matched Sample

One potential issue with our results is that stocks with high ownership concentration may be very different types of stocks from those with low ownership concentration. This might affect our inferences about equity lending variables and firm's ownership structure. We use propensity score matching to create a sample of low concentration firms (i.e. the control group) that are statistically similar to those in the high ownership concentration quartile (i.e.

the treatment group) along firm characteristics other than ownership concentration (i.e. the observed covariates). The matching attempts to mimic randomization by creating a sample of stocks that have high ownership concentration that is comparable on all observed covariates to a sample of stocks that are widely held.

The propensity scores are computed using the nearest neighbour without replacement based on the covariates and interactions, with a 0.4 caliper. Of the 13,038 treatment observations, we are able to find matches for 5,598. In total, the 11,196(=2*5,598) observations comprise the propensity-matched sample.

Based on the covariates, the 46,237 observations in the untreated sample have a very different probability of being in the top quartile of ownership concentration relative to those observations in the treated group. The propensity score is 0.085 for the untreated sample in the unmatched sample and 0.699 for the treated sample, with the difference being significant at the 1% level. However, importantly when we examine the propensity-matched sample, we find that both the treatment and control groups are equally likely to be in the top ownership concentration quartile. The matching algorithm results in a propensity equal to 0.408 for the control group and 0.409 for the treated group, with the difference not being statistically significant. This suggests that the match is doing a good job in finding similar type of stocks. In Table VIII we re-estimate the regressions shown in column 2 of Tables IV-VI using the propensity-matched sample. Even when compared to stocks that are very similar, ownership concentration still remains significantly negatively related to lending supply, and positively to loan fees and arbitrage risk.

[Insert Table VIII HERE]

D. Loan Demand Shocks, Stock Returns and the Role of Ownership Structure

D.1. Portfolio Analysis

Hypothesis 4 states that returns associated with an outward demand shift are decreasing in the concentration of institutional ownership. Short sale constraints allows mispricing to build up and the subsequent returns to short-selling will be more negative as prices take longer to adjust. We apply the methodology developed by Cohen, Diether, and Malloy (2007) to study the relation between lending supply and stock prices. Their approach identifies shocks to shorting demand and show that stocks exhibit lower abnormal returns in the following week. In particular, we will focus on those stocks with high ownership concentration following an outward demand shift. Cross-sectionally, we should observe that abnormal returns conditional on an outward demand shock are more negative for high concentration stocks. Note that we are agnostic about whether low levels of total ownership and high levels of ownership concentration affect stock returns. Instead, our hypothesis is that the tightening of short-sales constraints, in part due to ownership characteristics, can lead to asymmetric stock return reactions following shorting demand shocks.

Kolasinski, Reed, and Ringgenberg (2013) stress that the loan supply schedule is non-monotonic, being flat for most levels of shorting demand and only slopping up for high levels of demand. If short sales constraints due to ownership structure manifest themselves through a more positively-slopped equity loan supply curve, then outward demand shocks (i.e. *DOUT*) would pick up less extreme shifts in quantity for tighter shorting constraints. This happens because in the steeper part of the supply curve an increase in demand increase won't be as large due to the higher fees charged by equity lenders, possibly subduing stock price reactions. Thus, an alternative hypothesis could be that stocks facing tighter short sales constraints (such as those due to ownership concentration) exhibit a weaker association between *DOUT* and

subsequent negative abnormal returns. *Ex-ante*, it is unclear which of these effects is stronger and we let the data speak for itself.

In Table IX we examine average returns of portfolios formed using the demand shock classification defined in the discussion of Hypothesis 4 and split by institutional ownership concentration. We place all stocks into two demand shift portfolios: $DOUT = 1$ and $DOUT = 0$, and further sort on quartiles of HHI. Demand shift portfolios are formed in week $t - 1$, HHI quartiles are based on the prior quarter (the most recent data available) and the stocks are held in the portfolios during week *t* and rebalanced every week. We present results for raw returns and abnormal returns, measured as the difference between the weekly stock return and the return on a characteristics-matched benchmark portfolio sorted on market capitalization, book-to-market and momentum following Daniel, Grinblatt, Titman, and Wermers (1997).

Panel A examines raw returns and Panel B examines abnormal returns. Comparing the abnormal returns across $DOUT = 1$ and $DOUT = 0$ shows that an outward demand shift is associated with a negative future return, as documented by Cohen, Diether, and Malloy (2007). The average difference is statistically significant at 5% and equal to -0.122% per week (-0.488% per month). However, when we further sort returns by ownership concentration we find even lower future returns following outward demand shocks for stocks with concentrated ownership. The abnormal return for high concentration stocks that experience an outward demand shift (relative to those that experience no outward demand shock) is -0.439% in the following week, compared with the future abnormal return for low concentration stocks that experience and outward demand shift (relative to those that experience no outward demand shock) of -0.021% a week. The difference-in-difference abnormal return (across ownership structure and DOUT) is -0.419% a week and significant at the 1% level.

[Insert Table IX HERE]

In Panels C to H of Table IX we display characteristics of these portfolios. We present averages for total ownership, ownership concentration, lending supply, on loan amount, fee scores, and arbitrage risk. Firms in the top quartile of ownership concentration have lower total ownership, fees, and arbitrage risk, and smaller lending regardless of whether the stock has suffered an outward demand shock or not. Furthermore, the difference-in-difference is negative for total ownership and supply, and positive for concentration, on loan, and fees. These results provide evidence of asymmetric changes conditional on ownership concentration following outward demand shocks.

While these returns look extremely high, they do not take into account any transaction costs needed to rebalance the portfolio every week. Every week, the trade involves new short positions and reversing existing short positions. In our sample, 2.61% of stocks are estimated to have an outward demand shock in the last week (i.e. $DOUT = 1$) and no observed shock in the week prior to that (i.e. lagged $DOUT = 0$). Similarly, 2.63% of stocks have $DOUT = 0$ and lagged $DOUT = 1$. Thus, the estimated weekly turnover in the portfolio is around 5.24%. If we follow a conservative approach and take the average total trading costs shown in Keim and Madhavan (1998) for Nasdaq stocks in the middle quintile of firms ranked by market capitalization, we estimate weekly trading costs for the $DOUT = 1 - DOUT = 0$ portfolio to be equal to $2 * 0.524 * 0.92\% = 0.1\%$ per week.[15] This would reduce the estimated abnormal returns by almost a quarter, from 0.42% per week to 0.32% per week. Another source of costs are the lending fees paid to borrow shares required to implement short leg of the $DOUT = 1$ strategy. The average lending fee of the $DOUT = 1$ portfolio is 3.5% a year or 0.07% a week. This would reduce the weekly return of the $DOUT = 1 - DOUT = 0$ portfolio in column 1 by $0.07/2 = 0.035\%$, with average abnormal returns further decreasing

[15] Keim and Madhavan (1998) use trades by 21 institutions between January 1991 and March 1993. Given the reduction in transaction costs over time, the trading costs during our sample period are likely to be lower.

from -0.32% to -0.28% per week. Overall trading costs reduce the profitability of the strategy by approximately 30%.

D.2. Cross-Sectional Estimations

Next we determine the effect of ownership concentration on returns following outward demand shifts in a full multivariate regression setting, controlling for a wide array of variables. We estimate cross-sectional pooled regressions using weekly abnormal returns, including calendar month dummies, and cluster standard errors at the firm-level.[16] We interact demand shocks with raw (rather than the standardized values used in previous sections) total ownership and ownership concentration measured at end of the previous quarter. The baseline specification takes the form:

$$\begin{aligned} R_{i,t} &= \alpha + \theta_t + \beta_1 DOUT_{t-1} + \beta_2 Top(HHI_{i,q-1}) + \beta_3 Total_{i,q-1} \\ &\quad + \beta_4 DOUT_{t-1} * Top(HHI)_{i,q-1} + \beta_6 CTRLS_{i,t-2} + \epsilon_{i,t} \end{aligned} \tag{3}$$

where R_{it} is the abnormal return on stock i in week t, $DOUT_{t-1}$ is a dummy variable equal to one if there was an outward demand shift in the prior week, 0 otherwise; $Top(HHI)$ is a dummy variable equal to one if ownership concentration in the previous quarter (as measured by the Herfindahl index) is above the 75th percentile conditional on *DOUT*=1 and *Total* is institutional ownership.[17] Finally, $CTRLS$ denotes the set of additional controls used, which includes an indicator variable that equals one if the stock is part of the S&P500 and the number of analysts following the stock to control for visibility. Diether, Lee, and Werner (2009) show that short selling activity increases after higher returns in the previous week. It is possible that firms with high concentration are even more affected by over-reaction and our main result

[16] Results are robust to using standard errors clustered by time.

[17] This timing is used such that all variables are known to investors when forecasting returns.

could be caused by spurious correlation between lending demand shocks and reversals. Thus, we also include abnormal returns in the previous week to control for momentum effects.

We present the results in Table X. In column 1 we show that outward demand shifts convey negative information for returns, similar to the results presented by Cohen, Diether, and Malloy (2007). The coefficient on *DOUT* of -0.121 implies that an outward demand shock decreases abnormal returns by approximately 0.12% per week (0.48% per month). [18] None of the other coefficients is statistically significant.

[Insert Table X HERE]

If constraints on lending supply affect prices, then we should observe that the price adjustment associated with short-selling a stock with lower lending supply are larger, as tighter constraints result in delays in incorporating the beliefs of pessimistic investors. In column 2 of Table X we test this by estimating returns on $Bottom(Supply)$, a dummy variable equal to one if lending supply is in the bottom five per cent of firms in week $t-1$, and the interaction of $Bottom(Supply)$ with *DOUT*. We find that the negative returns found in column 1 for *DOUT* are concentrated in firms with low lending supply. The *DOUT* $*$ *Bottom(Supply)* parameter is equal to -0.683 and significant at the 10% level.

In column 3 we test whether returns following demand shocks are affected by arbitrage risk. We find that stocks in the top quartile of idiosyncratic risk ($Top(HHI)$) have an abnormal return of 0.068% per week, but following a shorting demand shock they exhibit a -0.424% abnormal return in the following week. This is consistent with Duan, Hu, and McLean (2010), who shows how idiosyncratic risk forecasts lower abnormal returns only for stocks with high short interest.

Next, in column 4, we starting investing the role of ownership structure. We define $Top(HHI)$ ($Bottom(Total)$) to be an indicator variable equal to one if, conditional on *DOUT=1*,

[18] Cohen, Diether, and Malloy (2007) find returns of 3.27% per month associated with outward demand shifts. However, once transaction costs are considered these reduce to 0.37% per month.

ownership concentration (total ownership) is in the top (bottom) quartile in the previous quarter. Then, we estimate the effect of institutional ownership structure on stock returns associated with an outward demand shift. If a more concentrated ownership structure poses greater limits to arbitrage, then we should expect more negative abnormal returns associated with outward demand shocks in firms with concentrated ownership than for other firms. This is precisely what we find. The coefficient on *DOUT* $*$ *Top(HHI)* is negative and significant, and implies that an outward demand shock decreases abnormal returns in more concentrated firms by approximately 0.416% per week (1.68% per month). While firms with low institutional ownership have lower returns (the -0.077 parameter is statistically significant at the 10% level), it doesn't affect returns conditional on *DOUT*=1 and the statistical significance of the interaction between ownership concentration and outward demand shocks.

In column 5 the coefficient on *DOUT* $*$ *Bottom(Supply)* is no longer significant when we add *DOUT* $*$ *Top(HHI)*. The impact of lending supply on returns following an outward demand shock (i.e. *DOUT*=1) is driven by ownership structure, in particular by firms with concentrated ownership. Combined, these results support Hypothesis 4. Outward demand shifts are associated with negative returns, but these negative returns are much larger for stocks with more concentrated ownership. The short sales constraints caused by concentrated ownership subject some stocks to higher limits to arbitrage and longer delays to incorporate information from demand shocks.

In column 6 we find that the negative coefficient of *DOUT* $*$ *Bottom(RMSE)* is still significant (-0.385% per week) after the inclusion of *Top(HHI)*. The impact of ownership concentration on the returns to short selling can occur through different channels. A direct one stems from higher costs of shorting. An indirect one also happens due to its effects on arbitrage risk. Pontiff (2006) argues that idiosyncratic risk is the largest cost face by arbitrageurs. We show that the impact of concentrated ownership following shorting demand shocks is not simply due to high concentration stocks having high arbitrage risk.

VI. Robustness Checks

A. Four-Factor Model Calendar-Time Regressions

As a robustness test we estimate time-series regressions of several portfolios using well-known risk factors rather than panel regressions with characteristic-adjusted returns. In Table XI we estimate regressions of weekly portfolio returns on the Fama-French factors and momentum, with each panel using a different portfolio formation rule. In Panel A, we form a portfolio that buys stocks without outward demand shocks and not in the top quartile of ownership concentration (i.e., DOUT=0 and Top(HHI)=0) while shorting those with demand shocks and in the top quartile of ownership concentration (i.e., DOUT=1 and Top(HHI)=1). In column 1 we see that the long-short difference is statistically significant at the 10% level (p-value is equal to 0.07) and equal to 0.46% per week, similar to our findings using cross-sectional regressions. In columns 2 to 4, this result in unaffected by controlling for the market (MKT), size (SMB), book-to-market (HML), and momentum (UMD) factors. The long-short portfolio has positive and significant loadings on the market and momentum factors.

In Panels B and C we split the impact of outward demand shocks according to ownership concentration looking at the difference between portfolios that buy DOUT=0 stocks and short DOUT=1 stocks split by Top(HHI). In Panel B, we do not find any statistical difference in returns between DOUT=0 and DOUT=1 for firms that are not in the top quartile of ownership concentration. Panel C shows that the abnormal returns only arise for those stocks with high ownership concentration. These results mirror our findings using the cross-sectional regressions.

[Insert Table XI HERE]

B. Short-term Liquidity, Lending Costs, and Breadth

Our final set of robustness tests are shown in Table Table A.2 in the Appendix. It is possible that concentrated ownership reflects stock liquidity, so we re-estimate regressions in Table X by adding the Fee Score and several indicator variables equal to 1 if firms are, respectively, in the top quartile of stock turnover, lending fee, bid-ask spread, Amihud's ILLIQ, and Breadth. As expected, stocks with high Fee Score, have lower returns throughout all specifications. Columns 2-6 show that none of the indicator variables affect the significance of the *DOUT*Top(HHI)* coefficient. In column 5, when we consider firm in the top quartile of firms ranked by Amihud's ILLIQ, the *DOUT*Top(HHI)* coefficient decrease to -0.320 (relative to the -0.416 found in column 3 of Table X). Our results for ownership concentration are not due to firms with high *HHI* capturing spurious correlation with turnover, liquidity, bid-ask spreads or loan fees.

[Insert Table A.2 HERE]

VII. Concluding Remarks

Arbitrageurs often use short selling as part of their trading strategies, borrowing securities they do not own to correct overvaluation. Short selling entails various costs and risks, such as locating shares to borrow, loan fees, and the risk that the short position has to closed due to recall by the lender of the borrowed shares. We argue that stocks with a more concentrated ownership structure and with a higher proportion of passive investors will hinder arbitrageurs' ability to engage in short selling.

The main objectives of this paper are: (i) to examine how the composition of institutional ownership affects the market for borrowing stock and (ii) if abnormal stock returns following increases in short selling demand are related to ownership structure through their effect on short sales constraints. Using a proprietary data set with information on equity lending supply,

loan transactions and loan fees we show that ownership structure is an important determinant of equity lending supply and short sale constraints. More specifically, we find that firms with low total ownership, high concentration of ownership, and fewer passive institutional shareholders to have lower lending supply, higher loan fees, and higher arbitrage risk. For example, firms in the low-ownership/high-concentration tercile have just 3.8% of their market capitalization available to borrow, against 26.9% for firms in the high-ownership/low-concentration tercile. We show that ownership concentration negatively impacts stock lending supply, even after controlling for total institutional ownership. We also examine loan fees and arbitrage risk and find that total ownership relieves constraints while ownership concentration increases the costs of borrowing equity and arbitrage risk. We find that that both higher loan fees and arbitrage risk are associated lower lending supply and most of the effect is due to the portion of lending supply explained by ownership characteristics.

If arbitrageurs face greater limits to arbitrage stemming from the short sale constraints then mispricing builds up and the subsequent returns to short-selling will be more negative. We examine the impact of changes on stock returns by identifying demand shifts using price-quantity pairs based on the methodology proposed by Cohen, Diether, and Malloy (2007) and find that outward demand shocks are more likely for stocks with less institutional ownership and higher ownership concentration. We show that abnormal returns are more negative following an outward demand shock for stock with more concentrated ownership, consistent with short sale constraints limiting negative information from being released in prices. We find that stocks in the top quartile of ownership concentration earn an average abnormal return following an outward demand shock of -0.42% per week, or -1.68% per month, compared to similar shocks on stocks with dispersed ownership. These results suggest a link between the limits to arbitrage and ownership structure, which to the best of our knowledge has not been explored previously. Our results are robust to several alternatives including liquidity, price reversals,

propensity score matching, time-series portfolio returns regressions, and changes in investor sentiment among others.

Our contribution is also methodological in nature. We show that institutional ownership is not a sufficient statistic to proxy for lending supply as is often assumed in the literature (see Asquith, Pathak, and Ritter (2005), Lamont (2004), Nagel (2005), Akbas, Boehmer, Erturk, and Sorescu (2008), and Kolasinski, Reed, and Ringgenberg (2013) among others). For example, a one standard deviation shock to ownership concentration has an impact that is similar in magnitude to a one standard deviation shock to total institutional ownership. Instead, both institutional ownership levels and the structure of institutional ownership should be taken into consideration.

These results are important in showing how ownership structure can generate limits to arbitrage through their impact on the equity lending market. Furthermore, they can be used by practitioners to pin down the set of firms for which abnormal returns following increases in short selling demand can be found.

References

Admati, Anat R., and Paul Pfleiderer, 2009, The "Wall Street Walk" and Shareholder Activism: Exit as a Form of Voice, *Review of Financial Studies* 22, 2445–2485.

Aggarwal, Reena, Pedro A.C. Saffi, and Jason Sturgess, 2013, The Role of Institutional Investors in Voting: Evidence from the Securities Lending Market, *Working paper*.

Akbas, Ferhat, Ekkehart Boehmer, Bilal Erturk, and Sorin M. Sorescu, 2008, Why Do Short Interest Levels Predict Stock Returns?, *Working Paper*.

Asquith, Paul, Parag A. Pathak, and Jay R. Ritter, 2005, Short Interest, Institutional Ownership and Stock Returns, *Journal of Financial Economics* 78, 243–276.

Autore, Don M., Thomas J. Boulton, and Marcus V. Braga-Alves, 2010, Failures to Deliver, Short Sale Constraints, and Stock Overvaluation, *Working paper*.

Avramov, Doron, Tarun Chordia, Gergana Jostova, and Alexander Philipov, 2013, Anomalies and financial distress, *Journal of Financial Economics* 108, 139–159.

Blocher, Jesse, Adam V. Reed, and Edward D. Van Wesep, 2013, Connecting two markets: An equilibrium framework for shorts, longs, and stock loans, *Journal of Financial Economics* 108, 302–322.

Boehmer, Ekkehart, and Eric Kelley, 2009, Institutional investors and the informational efficiency of prices, *Review of Financial Studies* 22, 3563–3594.

Boehmer, Ekkehart, and Juan (Julie) Wu, 2013, Short Selling and the Price Discovery Process, *Review of Financial Studies* 26, 287–322.

Bris, Arturo, William N. Goetzmann, and Ning Zhu, 2007, Efficiency and the Bear: Short Sales and Markets Around the World, *Journal of Finance* 62, 1029–1079.

Carhart, Mark M., 1997, On Persistence in Mutual Fund Performance, *Journal of Finance* 52, 57–82.

Charoenrook, Anchada, and Hazem Daouk, 2009, A Study of Market-wide Short-selling Restrictions, *Working Paper*.

Chen, Joseph, Harrison Hong, and Jeremy C. Stein, 2002, Breadth of ownership and stock returns, *Journal of Financial Economics* 66, 171–205.

Chen, Xia, Jarrad Harford, and Kai Li, 2007, Monitoring: Which Institutions Matter?, *Journal of Financial Economics.* 86, 279–305.

Christoffersen, Susan E.K., Christopher C. Geczy, David K. Musto, and Adam V. Reed, 2005, Crossborder dividend taxation and the preferences of taxable and nontaxable investors: Evidence from Canada, *Journal of Financial Economics* 78, 121–144.

Chuprinin, Oleg, and Massimo Massa, 2012, To Lend or not to Lend: The Effect of Equity Lenders' Preferences on the Shorting Market and Asset Prices, *INSEAD Working Paper*.

Cohen, Lauren, Karl B. Diether, and Christopher J. Malloy, 2007, Supply and Demand Shifts in the Shorting Market, *Journal of Finance* 62, 2061–2096.

Daniel, Kent, Mark Grinblatt, Sheridan Titman, and Russ Wermers, 1997, Measuring Mutual Fund Performance with Characteristic-Based Benchmarks, *Journal of Finance* 52, 1035–58.

D'Avolio, Gene, 2002, The Market for Borrowing Stock, *Journal of Financial Economics* 66, 271–306.

De Long, J. Bradford, Andrei Shleifer, Lawrence H. Summers, and Robert J. Waldmann, 1990, Noise trader risk in financial markets, *Journal of Political Economy* 98, 703–38.

Diamond, Douglas W., and Robert E. Verrecchia, 1987, Constraints on short-selling and asset price adjustment to private information, *Journal of Financial Economics* 18, 277–311.

Diether, Karl B., Kuan-Hui Lee, and Ingrid M. Werner, 2009, Short-Sale Strategies and Return Predictability, *Review of Financial Studies* 22, 575–607.

Duan, Ying, Gang Hu, and R. David McLean, 2010, Costly arbitrage and idiosyncratic risk: Evidence from short sellers, *Journal of Financial Intermediation* 19, 564–579.

Edmans, Alex, 2009, Blockholder Trading, Market Efficiency, and Managerial Myopia, *Journal of Finance* 64, 2481–2513.

Edmans, Alex, and Gustavo Manso, 2011, Governance Through Trading and Intervention: A Theory of Multiple Blockholders, *Review of Financial Studies* 24, 2395–2428.

Evans, Richard, Miguel A. Ferreira, and Melissa Porras Prado, 2012, Equity Lending, Investment Restrictions and Fund Performance, *Working paper*.

Hartzell, Jay C., and Laura T. Starks, 2003, Institutional Investors and Executive Compensation, *Journal of Finance* 58, 2351–2374.

Kaplan, Steven N., Tobias J. Moskowitz, and Berk A. Sensoy, 2013, The Effects of Stock Lending on Security Prices: An Experiment, *The Journal of Finance* 68, 1891–1936.

Keim, Donald B., and Ananth Madhavan, 1998, The Cost of Institutional Equity Trades, *Financial Analysts Journal* 54, 50–69.

Kolasinski, Adam C., Adam V. Reed, and Matthew C. Ringgenberg, 2013, A Multiple Lender Approach to Understanding Supply and Search in the Equity Lending Market, *Journal of Finance* 68, 559–595.

Lamont, Owen, 2004, Go Down Fighting: Short Sellers vs. Firms, *NBER Working Paper No. 10659*.

Miller, Edward M., 1977, Risk, Uncertainty, and Divergence of Opinion, *Journal of Finance* 32, 1151–68.

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

Petersen, Mitchell A., 2009, Estimating Standard Errors in Finance Panel Data Sets: Comparing Approaches, *Review of Financial Studies* 22, 435–480.

Pontiff, Jeffrey, 2006, Costly arbitrage and the myth of idiosyncratic risk, *Journal of Accounting and Economics* 42, 35–52.

Saffi, Pedro A. C., and Kari Sigurdsson, 2011, Price Efficiency and Short-selling, *Review of Financial Studies* 24, 821–852.

Shleifer, Andrei, and Robert W. Vishny, 1997, The Limits of Arbitrage, *Journal of Finance* 52, 35–55.

Stambaugh, Rob, Jianfeng Yu, and Yu Yuan, 2012, The Short of It: Investor Sentiment and Anomalies, *Journal of Financial Economics* 104, 288–302.

Stein, Jeremy C., and Harrison Hong, 1999, A Unified Theory of Underreaction, Momentum Trading and Overreaction in Asset Markets, *Journal of Finance* 54, 2143–2184.

Wurgler, Jeffrey, and Ekaterina Zhuravskaya, 2002, Does Arbitrage Flatten Demand Curves for Stocks?, *Journal of Business* 75, 583–608.

Figure 1. Loan Fees and Equity Lending Quantities scaled by Market Capitalization

The figure shows average lending supply and the average shares on loan as a fraction of firm capitalization, and average value-weighted annualized loan fee for each quarter between August 2006 and December 2010.

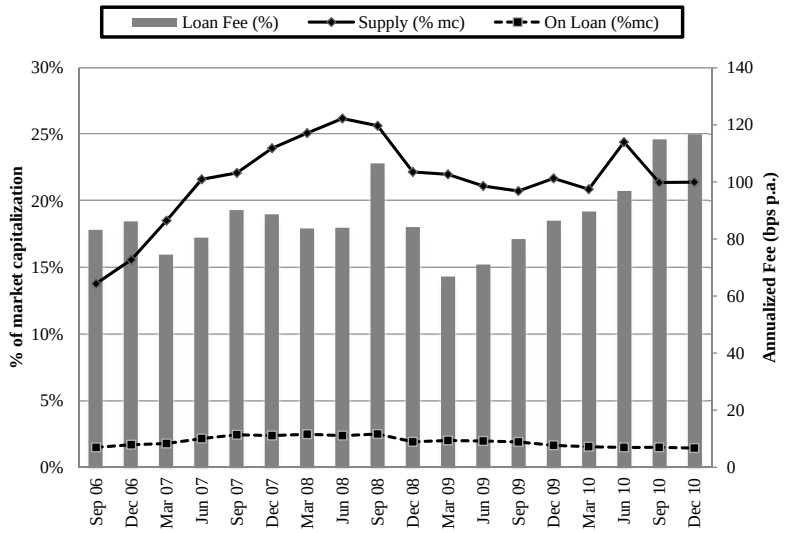


Figure 2. Equity Lending Market - Total Size and Utilization

The figure shows average utilization, lending supply, and the average shares on loan as a fraction of firm capitalization, for each quarter between August 2006 and December 2010.

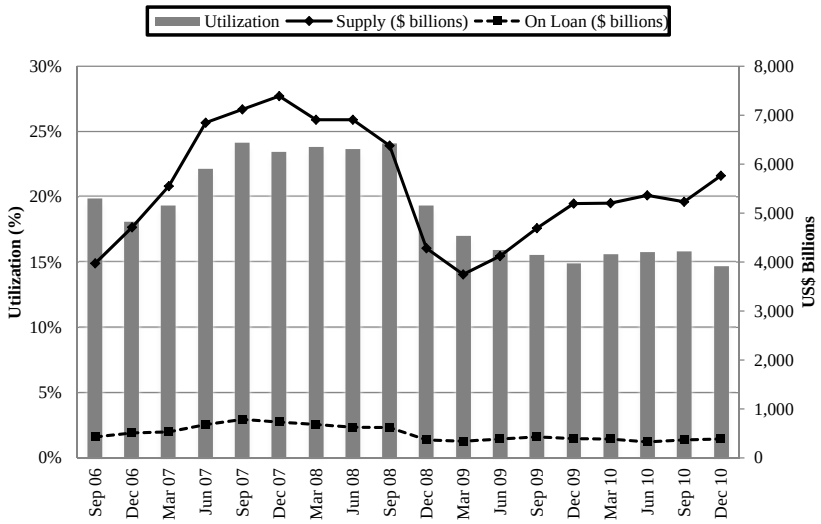
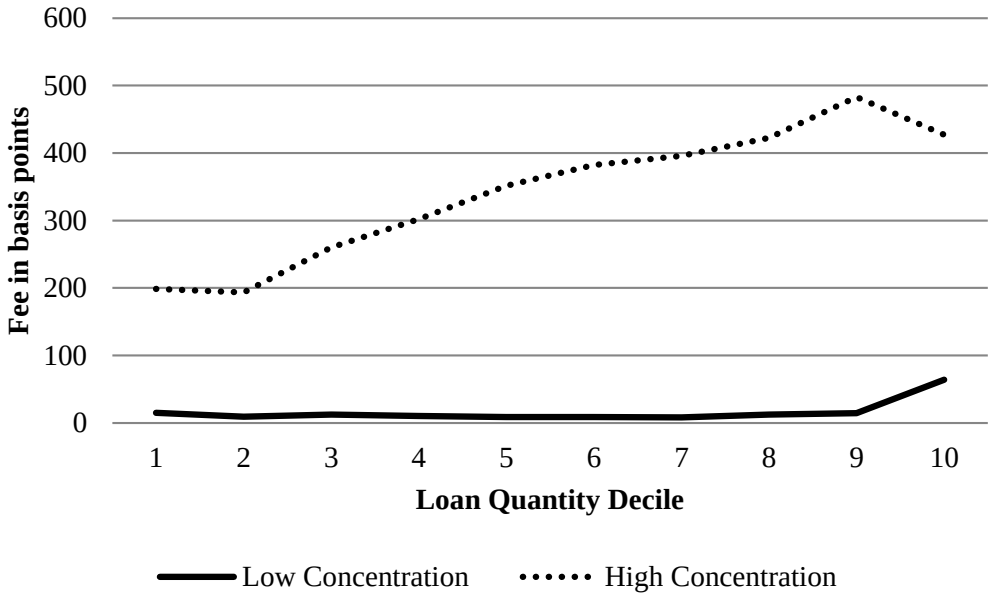


Figure 3. Loan Supply Curve

The top figure shows the loan supply curve across loan demand deciles of stocks in the highest and lowest quartiles ranked by institutional ownership concentration. The sample comprises quarterly U.S. stocks between August 2006 and December 2010. The bottom figure further restricts the sample to only include stocks in lowest quartile of lending supply and then rank stocks by institutional ownership concentration. Lending supply is defined as the fraction of market capitalization available to lend and fee is the average value-weighted annualized loan fee in basis points. Ownership concentration is defines as the Hirschman-Herfindahl index.



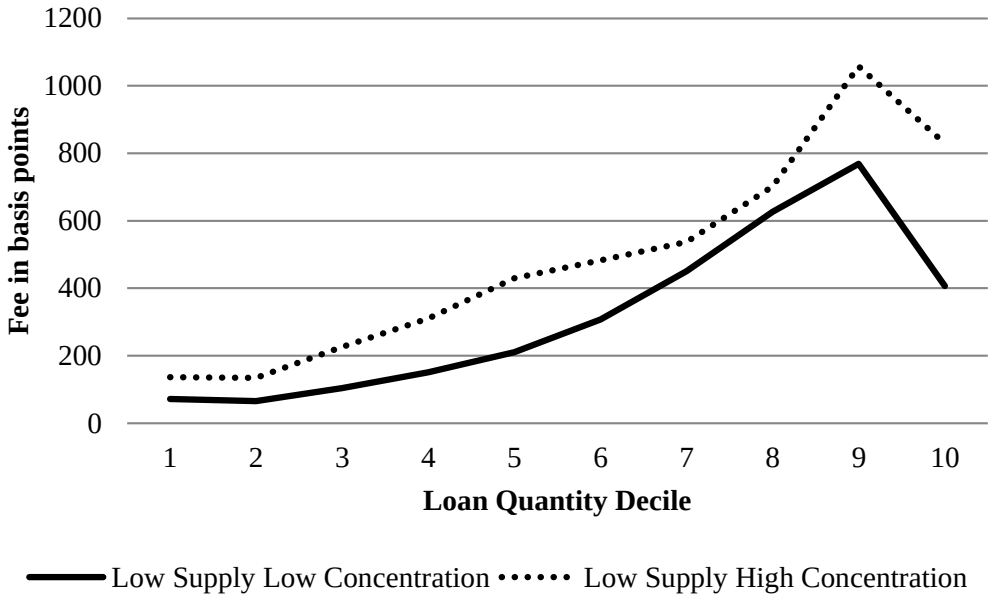


Table I
Descriptive Statics

The table shows quarterly descriptive statistics between August 2006 and December 2010 of the main variables used in the paper. Equity lending data are provided by Markit, price data are from CRSP, ownership data from SEC's 13F holdings, and accounting data from Compustat. Obs is the number of firm-quarter observations available. The variable definitions are in the appendix.

Variable	Obs	Mean	Median	St. Dev	Min	Max	Skewness	Kurtosis
Equity Lending								
Supply	59,674	19.90	20.01	12.94	0.00	53.69	0.30	2.39
On Loan	59,674	4.66%	2.47%	5.77%	0.00%	27.81%	1.87	6.52
Fee (bps p.a.)	59,281	70.61	13.36	184.92	-6.83	1,301.18	4.52	25.86
Fee Score	58,751	1.50	1.00	1.23	1.00	10.00	3.56	17.36
Specialness	59,674	14.43%	0.00%	35.14%	0.00%	100.00%	2.02	5.10
Utilization	59,674	19.12	11.68	20.49	0.00	84.61	1.35	4.12
Institutional Ownership								
Total	59,674	58.01%	63.42%	30.55%	0.00%	100%	4.67	60.56
HHI	59,674	12.35%	6.61%	14.38%	1.27%	100%	1.68	37.88
Top5	59,674	3.08%	3.19%	1.86%	0.00%	59.9%	1.68	37.88
Top5-ST	59,674	2.27%	2.31%	2.05%	0.00%	59.9%	1.18	19.80
Top5-LT	59,674	0.82%	0.00%	1.72%	0.00%	50.5%	2.74	25.09
Breadth	59,674	140.21	89.00	179.65	1.00	1,683	1.55	11.79
Δ(Breadth)	59,674	0.98%	0.00%	3.06%	-4.29%	18.57%	3.38	18.71
% Passive	59,674	5.37%	2.86%	6.45%	0.00%	71.02%	1.78	8.02
Pricing & Other Variables								
Price	59,674	22.67	15.32	40.27	0.04	2,432.34	22.87	901.39
Mkt. Cap (bi)	59,674	3,662	397	16,260	0.31	513,362	12.55	228.38
μ(Ret)	59,674	2.43%	0.53%	34.12%	-94.23%	1833.18%	8.68	273.57
σ(Ret)	59,674	3.53%	2.84%	2.82%	0.15%	244.79%	14.64	962.63
Arb. Risk (RMSE)	59,669	3.00	2.35	2.67	0.15	230.90	15.23	967.37
Turnover	59,674	0.90	0.64	1.03	0.00	33.72	-0.33	1.84
Amihud	59,674	2.84	0.01	13.34	0.00	112.15	1.18	19.80
$\beta_{mkt}(FF3)$	59,669	0.85	0.89	0.73	-1.54	2.82	2.86	12.89
B/M	59,674	0.76	0.58	0.70	-0.05	4.39	8.44	104.50
S&P500	59,674	1.43%	0%	11.89%	0%	100%	8.17	67.73
Number of Analysts	59,674	1.18	1.10	0.98	0.00	3.81	0.21	1.85

Table II
Descriptive Statics - Lending Supply Quintiles

The table shows quarterly descriptive statistics of U.S. stocks between August 2006 and December 2010 sorted by equity lending supply quintiles. Equity lending data are provided by Markit, price data are from CRSP, ownership data from SEC's 13F holdings, and accounting data from Compustat. Panel A reports equity lending characteristics: Obs_{Supply} is the number of firm-quarter observations for which lending supply data is available. Panel B reports institutional ownership characteristics. Panel C price data. The variable definitions are in the appendix.

Panel A: Equity Lending

Quintile	Obs_{Supply}	Supply	On Loan	Specialness	Util.	Fee	Fee Score
1	10,294	2.16%	0.50%	0.46	13.44%	199.32	2.34
2	11,635	9.70%	2.30%	0.193	19.47%	93.44	1.75
3	12,322	18.73%	4.50%	0.063	20.50%	39.90	1.31
4	12,717	26.50%	5.90%	0.032	18.87%	23.71	1.16
5	12,706	38.12%	9.80%	0.034	22.31%	26.08	1.18
Overall	59,674	19.90%	4.80%	0.144	19.12%	70.61	1.50

Panel B: Institutional Ownership

Quintile	Total	HHI	Mean	Top5	Top5 - LT	Top5 - ST	Breadth
1	15.3%	33.1%	1.1%	0.8%	0.5%	0.3%	17.46
2	38.2%	15.1%	1.0%	2.3%	1.6%	0.7%	66.10
3	62.1%	7.7%	0.7%	3.4%	2.5%	0.9%	180.07
4	77.3%	5.2%	0.6%	3.9%	2.9%	1.0%	230.64
5	87.5%	4.7%	0.7%	4.6%	3.5%	1.1%	178.35
Overall	58.0%	12.3%	0.8%	3.1%	2.3%	0.8%	140.21

Panel C: Price Data

Quintile	Price	Mkt. Cap. (bi)	μ(Ret)	σ(Ret)	Arb. Risk	Turnover	β_{mkt}
1	9.60	199.95	6.3%	4.7%	4.59%	0.31%	0.32
2	17.11	2140.09	5.5%	3.8%	3.45%	0.53%	0.70
3	24.87	6572.75	5.3%	3.2%	2.56%	0.91%	0.98
4	31.27	6225.06	3.7%	2.9%	2.23%	1.18%	1.06
5	27.64	2473.60	-7.5%	3.3%	2.51%	1.42%	1.08
Overall	22.67	3662.25	2.4%	3.5%	3.00%	0.90%	0.85

Table III
Descriptive Statistics - Lending Supply and Ownership Concentration Quartiles

The table shows the average Supply (Panel A), On Loan Quantity (Panel B) and Fee (Panel C). We first sort stocks into quartiles by ownership concentration and then, within each quartile, sort stocks in lending supply quartiles. Equity lending data are provided by Markit. The variable definitions are in the appendix.

Panel A: Supply

Quartiles	Supply			
HHI	1	2	3	4
1	5.30	15.30	24.17	36.56
2	5.16	14.51	23.74	36.32
3	4.48	12.89	22.79	35.61
4	2.57	11.19	22.39	35.87

Panel B: On Loan

Quartiles	Supply			
HHI	1	2	3	4
1	2.88%	3.85%	4.77%	8.35%
2	2.47%	4.76%	6.39%	8.82%
3	1.34%	3.26%	4.92%	7.95%
4	0.43%	1.70%	2.93%	5.67%

Panel C: Fee

Quartiles	Supply			
HHI	1	2	3	4
1	105.74	27.79	16.57	17.96
2	210.12	57.50	29.28	26.10
3	176.84	75.43	41.21	52.04
4	183.94	91.74	62.06	101.24

Table IV: Lending Supply & Ownership Structure

The table displays regressions of equity lending supply as a function of corporate ownership measures, with quarterly stock data between August 2006 and December 2010 of U.S. firms. All explanatory variables are standardized each quarter such that they have zero mean and unit standard deviation. All regressions include year-quarter dummies and standard errors are double-clustered at the stock and quarterly level. The variable definitions are in the appendix. We report standard errors in brackets and significance levels are indicated as follows: ***=statistical significance at the 1% level, **=significant at the 5% percent level.

	Lending Supply							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total	0.781***	0.729***	0.621***	0.746***	0.446***	0.440***	0.411***	0.443***
	[0.012]	[0.013]	[0.013]	[0.014]	[0.027]	[0.027]	[0.027]	[0.027]
HHI		-0.170***				-0.041***		
		[0.017]				[0.008]		
Top 5 Ownership			-0.393***				-0.134***	
			[0.023]				[0.015]	
Percentage Indexheld				0.130***				0.027***
				[0.016]				[0.005]
Δ(Breadth)	0.025**	0.011	0.002	0.019*	-0.007	-0.006	-0.003	-0.008
	[0.010]	[0.009]	[0.009]	[0.010]	[0.007]	[0.007]	[0.007]	[0.008]
Mkt. cap	0.060***	0.005	-0.122***	0.027	0.376***	0.361***	0.306***	0.371***
	[0.018]	[0.020]	[0.022]	[0.018]	[0.051]	[0.051]	[0.052]	[0.051]
$D_{P<5}$	-0.118***	-0.107***	-0.092***	-0.119***	-0.045*	-0.043*	-0.040	-0.044*
	[0.024]	[0.023]	[0.022]	[0.023]	[0.025]	[0.025]	[0.025]	[0.025]
S&P 500 membership	-0.025	0.001	0.046	-0.036	0.020	0.025	0.068	0.021
	[0.051]	[0.046]	[0.041]	[0.049]	[0.446]	[0.446]	[0.452]	[0.452]
Number of Analysts	0.018**	0.011*	-0.008	0.017**	0.015***	0.015***	0.013***	0.015***
	[0.008]	[0.007]	[0.007]	[0.007]	[0.005]	[0.005]	[0.004]	[0.004]
Amihud Illiquidity	-0.030***	0.005	-0.004	-0.029***	-0.001	-0.000	-0.002	-0.001
	[0.007]	[0.005]	[0.005]	[0.007]	[0.002]	[0.002]	[0.002]	[0.002]
Turnover	0.039***	0.034***	0.013	0.039***	0.029***	0.028***	0.021**	0.030***
	[0.011]	[0.011]	[0.011]	[0.011]	[0.008]	[0.008]	[0.008]	[0.008]
B/M	0.110***	0.107***	0.117***	0.106***	0.181***	0.181***	0.182***	0.180***
	[0.012]	[0.012]	[0.012]	[0.012]	[0.015]	[0.015]	[0.015]	[0.015]
Momentum	-0.005	-0.004	-0.005	-0.001	-0.001	-0.001	-0.000	-0.000
	[0.009]	[0.009]	[0.008]	[0.008]	[0.005]	[0.005]	[0.005]	[0.005]
Constant	0.040***	0.033***	0.029***	-0.127***				
	[0.005]	[0.005]	[0.005]	[0.020]				
Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
Observations	59,674	59,674	59,674	59,674	59,459	59,459	59,459	59,459
Adj. R^2	0.713	0.725	0.746	0.722	0.117	0.118	0.125	0.119
Firms	4,483	4,483	4,483	4,483	4,275	4,275	4,275	4,275

Table V: Loan Fee & Ownership Structure

The table displays a regression of loan fees as a function of ownership structure, with quarterly stock data between August 2006 and December 2010 of U.S. firms. All explanatory variables are standardized each quarter such that they have zero mean and unit standard deviation. The variable definitions are in the appendix. All regressions include year-quarter dummies and standard errors are double-clustered at the stock and quarterly level. We report standard errors in brackets and significance levels are indicated as follows: ***=statistical significance at the 1% level, **=significant at the 5% percent level. The variable definitions are in the appendix.

	Loan Fee							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total	-0.313***	-0.277***	-0.254***	-0.313***	-0.062**	-0.055*	-0.034	-0.063**
	[0.016]	[0.017]	[0.019]	[0.016]	[0.028]	[0.028]	[0.028]	[0.027]
HHI		0.121***				0.051**		
		[0.017]				[0.024]		
Top 5 Ownership			0.145***				0.109***	
			[0.021]				[0.022]	
Percentage Indexheld				-0.003				0.005
				[0.007]				[0.006]
Δ(Breadth)	-0.004	0.006	0.005	-0.003	-0.002	-0.003	-0.006	-0.002
	[0.010]	[0.010]	[0.010]	[0.010]	[0.013]	[0.012]	[0.012]	[0.013]
Mkt. cap	-0.090***	-0.052***	-0.023	-0.089***	-0.362***	-0.345***	-0.306***	-0.363***
	[0.018]	[0.018]	[0.019]	[0.018]	[0.057]	[0.057]	[0.058]	[0.058]
$D_{P<5}$	0.258***	0.251***	0.248***	0.258***	-0.028	-0.030	-0.032	-0.028
	[0.051]	[0.050]	[0.051]	[0.051]	[0.028]	[0.028]	[0.028]	[0.028]
S&P 500 membership	0.042	0.024	0.016	0.042	0.146*	0.139*	0.106	0.146*
	[0.075]	[0.070]	[0.068]	[0.075]	[0.076]	[0.078]	[0.102]	[0.076]
Number of Analysts	-0.008	-0.003	0.002	-0.008	0.008	0.008	0.010*	0.008
	[0.010]	[0.010]	[0.010]	[0.010]	[0.005]	[0.005]	[0.005]	[0.005]
Amihud Illiquidity	-0.029***	-0.054***	-0.039***	-0.029***	-0.016	-0.017*	-0.015	-0.016
	[0.010]	[0.010]	[0.011]	[0.010]	[0.010]	[0.010]	[0.010]	[0.010]
Turnover	0.206***	0.209***	0.216***	0.206***	0.112***	0.114***	0.119***	0.112***
	[0.013]	[0.013]	[0.013]	[0.013]	[0.014]	[0.014]	[0.014]	[0.014]
B/M	-0.067***	-0.065***	-0.069***	-0.067***	0.000	0.000	-0.000	-0.000
	[0.014]	[0.014]	[0.014]	[0.014]	[0.014]	[0.014]	[0.014]	[0.014]
Momentum	-0.032***	-0.032***	-0.031***	-0.032***	0.009	0.008	0.008	0.009
	[0.009]	[0.009]	[0.009]	[0.009]	[0.006]	[0.006]	[0.006]	[0.006]
Constant	-0.072***	-0.068***	-0.069***	-0.081***				
	[0.010]	[0.009]	[0.010]	[0.012]				
Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
Observations	59,316	59,316	59,316	59,316	59,096	59,096	59,096	59,096
Adj. R^2	0.165	0.172	0.170	0.165	0.027	0.028	0.029	0.027
Firms	4,480	4,480	4,480	4,480	4,267	4,267	4,267	4,267

Table VI: Arbitrage Risk & Ownership Structure

The table shows regressions of arbitrage risk as a function of ownership structure, with quarterly US stock data between August 2006 and December 2010. Arbitrage risk is defined as the mean squared error of residuals from Carhart (1997)'s 4-factor model. Other variable definitions are in the appendix. All regressions include year-quarter dummies and standard errors are double-clustered at the stock and quarterly level. We report standard errors in brackets and significance levels are indicated as follows: ***=statistical significance at the 1% level, **=significant at the 5% percent level.

	Arbitrage Risk							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total	-0.100***	-0.082***	-0.062***	-0.092***	-0.115***	-0.109***	-0.107***	-0.115***
	[0.011]	[0.011]	[0.012]	[0.011]	[0.018]	[0.018]	[0.018]	[0.018]
HHI		0.059***				0.044**		
		[0.011]				[0.020]		
Top 5 Ownership			0.092***				0.032**	
			[0.012]				[0.015]	
Percentage Indexheld				-0.030***				-0.003
				[0.008]				[0.011]
Δ(Breadth)	-0.089***	-0.084***	-0.084***	-0.088***	-0.019*	-0.020*	-0.020*	-0.019*
	[0.010]	[0.009]	[0.010]	[0.010]	[0.011]	[0.011]	[0.011]	[0.011]
Mkt. cap	-0.446***	-0.427***	-0.403***	-0.438***	-0.938***	-0.922***	-0.921***	-0.937***
	[0.017]	[0.017]	[0.018]	[0.018]	[0.051]	[0.055]	[0.053]	[0.051]
$D_{P<5}$	0.615***	0.611***	0.609***	0.615***	0.239***	0.237***	0.237***	0.238***
	[0.048]	[0.047]	[0.048]	[0.048]	[0.030]	[0.030]	[0.030]	[0.030]
S&P500 membership	0.043	0.034	0.027	0.046	0.130	0.124	0.119	0.130
	[0.030]	[0.030]	[0.029]	[0.030]	[0.172]	[0.170]	[0.165]	[0.171]
Number of Analysts	-0.002	0.000	0.004	-0.002	-0.011	-0.010	-0.010	-0.011
	[0.008]	[0.008]	[0.008]	[0.008]	[0.007]	[0.007]	[0.007]	[0.007]
Amihud Illiquidity	0.112***	0.100***	0.106***	0.112***	0.076***	0.075***	0.076***	0.076***
	[0.017]	[0.016]	[0.017]	[0.017]	[0.014]	[0.014]	[0.014]	[0.014]
Turnover	0.360***	0.361***	0.366***	0.359***	0.432***	0.434***	0.434***	0.432***
	[0.019]	[0.019]	[0.019]	[0.019]	[0.020]	[0.020]	[0.020]	[0.020]
B/M	-0.031**	-0.030**	-0.032**	-0.030**	-0.031**	-0.031**	-0.031**	-0.031**
	[0.015]	[0.015]	[0.015]	[0.014]	[0.013]	[0.013]	[0.013]	[0.013]
Momentum	-0.024*	-0.024*	-0.024*	-0.025**	0.002	0.002	0.002	0.002
	[0.012]	[0.012]	[0.012]	[0.012]	[0.008]	[0.008]	[0.008]	[0.008]
Constant	-0.175***	-0.174***	-0.174***	-0.134***				
	[0.010]	[0.010]	[0.010]	[0.010]				
Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
Observations	59,704	59,704	59,704	59,704	59,488	59,488	59,488	59,488
Adj. R^2	0.471	0.472	0.473	0.471	0.256	0.257	0.256	0.256
Firms	4,483	4,483	4,483	4,483	4,274	4,274	4,274	4,274

Table VII
Arbitrage Risk and Loan Fees as a Function of Lending Supply

Panel A shows regressions of arbitrage risk and fee as a function of lending supply, ownership concentration, and decompositions of supply using ownership variables. We use quarterly U.S. stock data between August 2006 and December 2010. Panel B shows the first-stage estimates of decomposing lending supply as a function of total ownership and HHI. All explanatory variables are standardized each quarter such that they have zero mean and unit standard deviation. Predicted Supply is the predicted component from the regression of Supply on institutional ownership (Total) and ownership concentration (HHI) shown in Panel B, while Residual Supply are the residuals of the same regression. All other variable definitions are in the appendix. All regressions include year-quarter dummies and robust standard errors. Regressions in Panel A also include stock fixed-effects. We report standard errors in brackets and significance levels are indicated as follows: ***=statistical significance at the 1% level, **=significant at the 5% percent level.

Panel A: Second-stage estimates of Short Sales Constraints

	Arb. Risk	Arb. Risk	Fee	Fee
Supply	-0.092***		-0.237***	
	[0.009]		[0.012]	
Residual Supply		0.003		-0.038***
		[0.019]		[0.014]
Predicted Supply		-0.158***		-0.119***
		[0.026]		[0.034]
Δ(Breadth)	-0.093***	-0.020*	-0.026***	-0.003
	[0.010]	[0.011]	[0.010]	[0.012]
Mkt. cap	-0.456***	-0.933***	-0.146***	-0.339***
	[0.017]	[0.056]	[0.016]	[0.058]
$D_{P<5}$	0.610***	0.237***	0.257***	-0.032
	[0.048]	[0.030]	[0.052]	[0.028]
S&P500 membership	0.048	0.127	0.067	0.144
	[0.030]	[0.170]	[0.063]	[0.088]
Number of Analysts	-0.005	-0.010	-0.031***	0.010*
	[0.008]	[0.006]	[0.011]	[0.005]
Amihud Illiquidity	0.112***	0.075***	-0.027***	-0.016
	[0.017]	[0.014]	[0.010]	[0.010]
Turnover	0.356***	0.433***	0.194***	0.117***
	[0.020]	[0.021]	[0.014]	[0.014]
B/M	-0.022	-0.035***	-0.046***	0.006
	[0.015]	[0.012]	[0.014]	[0.015]
Momentum	-0.023*	0.002	-0.028***	0.008
	[0.012]	[0.008]	[0.009]	[0.006]
Constant	-0.177***		-0.100***	
	[0.011]		[0.011]	
Instruments	None	Total	None	Total
Observations	59,669	59,453	59,281	59,061
FE	N	Y	N	Y

Panel B:First stage: Decomposition of Supply

Total	HHI	Constant	Observations	R^2
0.741***	-0.151***	-0.008	68,038	0.708

Table VIII
Propensity Score Matching

The table shows the impact of ownership structure on lending supply, loan fee and arbitrage risk on a propensity-score matched sample of US stocks between August 2006 and December 2010. The treatment variable is a dummy variable equal to 1 if firms are in the top quartile of ownership concentration (HHI) on a given quarter. The propensity scores are computed from a 1:1 matching without replacement based on the covariates and interactions, with a 0.4 caliper. Of the 13,038 treatment observations, we are able to find matches for 5,598. In total, the 11,196(=2*5,598) observations comprise the propensity-matched sample. All explanatory variables are standardized each quarter such that they have zero mean and unit standard deviation. The variable definitions are in the appendix. All regressions include year-quarter dummies and standard errors clustered at the stock level. We report standard errors in brackets and significance levels are indicated as follows: ***=statistical significance at the 1% level, **=significant at the 5% percent level.

	Supply	Fee	Arb. Risk
Total	0.479***	-0.481***	-0.041**
	[0.02]	[0.04]	[0.02]
HHI	-0.293***	0.151***	0.126***
	[0.02]	[0.03]	[0.02]
Δ(Breadth)	-0.005	-0.005	-0.034
	[0.01]	[0.02]	[0.03]
Mkt. cap	0.101***	0.124***	-0.474***
	[0.02]	[0.05]	[0.03]
$D_{P<5}$	-0.046***	0.400***	0.591***
	[0.02]	[0.05]	[0.03]
S&P500 membership	-0.382	1.355	0.037
	[0.40]	[0.82]	[0.06]
Number of Analysts	-0.020	-0.010	0.007
	[0.01]	[0.03]	[0.02]
Amihud Illiquidity	-0.049***	-0.072***	0.104***
	[0.02]	[0.02]	[0.02]
Turnover	0.056***	0.350***	0.612***
	[0.01]	[0.05]	[0.06]
B/M	0.091***	-0.074***	-0.031**
	[0.01]	[0.02]	[0.01]
Momentum	-0.015***	-0.052***	-0.030***
	[0.00]	[0.02]	[0.01]
Constant	-0.220***	-0.113***	-0.018
	[0.02]	[0.04]	[0.05]
Observations	11,196	11,196	11,196
Adj. R^2	0.487	0.167	0.435

Table IX
Portfolio Returns & Characteristics sorted on Shorting Demand Shocks and Ownership Concentration

The table shows returns and characteristics of portfolios sorted on outward demand shocks (DOUT) in the previous week and ownership concentration (Top HHI) in the previous quarter using U.S. stock data from August 2006 to December 2010. Panels A and B display return, with weekly abnormal returns computed as the difference in returns relative to a matched benchmark portfolio sorted on market capitalization, book-to-market and momentum as in Daniel, Grinblatt, Titman, and Wermers (1997). *DOUT* captures outward equity lending demand shocks, being equal to 1 if in the previous week there is an increase in the fee score and an increase in loaned amount, 0 otherwise. Ownership concentration is measured by the Hirschman-Herfindahl index of institutional ownership in the previous quarter. Top HHI is equal to 1 if concentration is in the top HHI quartile conditional on DOUT=1. Panel C shows total ownership, Panel D shows ownership concentration, Panel E displays lending supply as a fraction of market capitalization and Panel F the amount on loan as a fraction of market capitalization. Panel G displays the Fee Score, a measure of fee that ranges from 1 (cheapest to borrow) to 10 (hardest to borrow). Panel H shows arbitrage risk defined as the mean squared error of residuals from Carhart (1997)'s 4-factor model. Significance levels are indicated as follows: ***=statistical significance at the 1% level.

Panel A: Raw Returns

	Top HHI		
DOUT	0	1	1-0
0	0.262	-0.150	-0.412***
1	-0.011	-0.545	-0.534***
1-0	-0.273***	-0.395***	-0.122**

Panel B: DGTW Abnormal Returns

	Top HHI		
DOUT	0	1	1-0
0	0.006	-0.015	-0.021
1	-0.014	-0.454	-0.439***
1-0	-0.020	-0.439***	-0.419***

Panel C: Total Ownership

	Top HHI		
DOUT	0	1	1-0
0	69.30%	30.55%	-38.75%***
1	54.45%	27.47%	-26.98%***
1-0	-14.85%***	-3.09%***	11.77%***

Panel D: HHI

	Top HHI		
DOUT	0	1	1-0
0	6.31%	27.11%	20.80%***
1	8.20%	24.55%	16.35%***
1-0	1.89%***	-2.56%***	-4.44%***

Panel E: Supply

	Top HHI		
DOUT	0	1	1-0
0	24.4%	7.4%	-17.0%***
1	17.2%	7.1%	-10.1%***
1-0	-7.2%***	-0.3%***	6.9%***

Panel F: On Loan

	Top HHI		
DOUT	0	1	1-0
0	5.95%	1.65%	-4.30%***
1	8.19%	3.40%	-4.79%***
1-0	2.23%***	1.75%***	-0.49%***

Panel G: Fee Score

	Top HHI		
DOUT	0	1	1-0
0	1.351	2.119	0.768***
1	2.125	2.757	0.632***
1-0	0.774	0.638***	-0.136***

Panel H: Arbitrage Risk

	Top HHI		
DOUT	0	1	1-0
0	2.58%	4.01%	1.43%***
1	3.30%	4.51%	1.20%***
1-0	0.72%***	0.50%***	-0.23%

Table X
Impact of Ownership Structure Stock Returns Following Shorting Demand Shocks

The table displays regressions of abnormal returns as a function of equity lending market shocks and lagged ownership characteristics using weekly U.S. stock data between August 2006 and December 2010. Abnormal returns are computed based on a characteristics-matched benchmark portfolio sorted on market capitalization, book-to-market and momentum as in Daniel, Grinblatt, Titman, and Wermers (1997). *DOUT* captures outward equity lending demand shocks, being equal to 1 if in the previous week there is an increase in the fee score and an increase in loaned amount, 0 otherwise. *DIN* equals 1 if there is a decrease in both fee scores and loaned amount. *Top(HHI)* is equal to 1 if the Hirschman-Herfindahl index in the previous quarter is in the top quartile conditional on DOUT=1. *Top(RMSE)* is equal to 1 if the firm is in the top quartile of idiosyncratic risk. Ownership characteristics are from the previous quarter. *Bottom(Total)* equals 1 if the stock is in the bottom quartile of institutional ownership conditional on DOUT=1 and *Bottom(Supply)* equals 1 if the firm belongs to the bottom five percent of firms ranked by lending supply as a fraction of market capitalization, conditional on DOUT=1. The remaining variable definitions are in the appendix. Regressions include calendar-month dummies and standard errors are clustered at the firm level. Significance levels are indicated as follows: ***=1% level, **=5% percent level, *=10% level.

	(1)	(2)	(3)	(4)	(5)	(6)
DOUT	-0.121*	-0.086	0.018	-0.038	-0.040	0.062
	[0.069]	[0.069]	[0.060]	[0.079]	[0.079]	[0.072]
DIN	-0.056	-0.055	-0.067	-0.047	-0.047	-0.058
	[0.062]	[0.062]	[0.062]	[0.062]	[0.062]	[0.062]
Bottom(Supply)		-0.058			-0.010	
		[0.071]			[0.078]	
DOUT*Bottom(Supply)		-0.683*			-0.601	
		[0.356]			[0.378]	
Top RMSE			0.068**			0.077**
			[0.031]			[0.031]
DOUT*Top(RMSE)			-0.424**			-0.385**
			[0.166]			[0.169]
Top(HHI)				0.000	0.001	-0.012
				[0.037]	[0.037]	[0.037]
DOUT*Top(HHI)				-0.416**	-0.357*	-0.351*
				[0.189]	[0.191]	[0.191]
Bottom(Total)				-0.077*	-0.076*	-0.085**
				[0.042]	[0.045]	[0.042]
DOUT*Bottom(Total)				0.107	0.180	0.148
				[0.190]	[0.196]	[0.189]
S&P500	-0.013	-0.013	-0.011	-0.013	-0.012	-0.010
	[0.035]	[0.035]	[0.035]	[0.035]	[0.035]	[0.035]
Abret_{w-1}	-0.041***	-0.041***	-0.041***	-0.041***	-0.041***	-0.041***
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Number of Analysts	0.005	0.002	0.010	-0.004	-0.004	0.001
	[0.009]	[0.009]	[0.009]	[0.009]	[0.009]	[0.009]
Constant	-0.005	-0.001	-0.019	0.010	0.010	-0.003
	[0.044]	[0.044]	[0.044]	[0.044]	[0.044]	[0.044]
Observations	672,221	672,221	672,221	672,221	672,221	672,221
Firms	4,584	4,584	4,584	4,584	4,584	4,584

Table XI
Four-Factor Model Time Series Regressions

The table displays time-series regressions of long-short portfolios of stocks sorted on outward equity lending demand shocks and institutional ownership concentration, using weekly U.S. stock data between August 2006 and December 2010. Each panel estimates regressions using a different criteria to create the long and short legs of a zero-cost equal-weighted stock portfolio. *DOUT* captures outward equity lending demand shocks, being equal to 1 if in the previous week there is an increase in the fee score and an increase in loaned amount, 0 otherwise. *Top(HHI)* is equal to 1 if the concentration of ownership measured by the Hirschman-Herfindahl index in the previous quarter is in the top quartile conditional on DOUT=1. The remaining variable definitions are in the appendix. Standard errors are clustered at the firm level. Significance levels are indicated as follows: ***=statistical significance at the 1% level, **=significant at the 5% percent level, *=significant at the 10% level.

Panel A – Long DOUT=0 & Top(HHI)=0; Short DOUT=1 & Top(HHI)=1

	(1)	(2)	(3)	(4)
α	0.460*	0.430*	0.411*	0.433*
	[0.244]	[0.242]	[0.244]	[0.241]
MKT		0.218**	0.295**	0.365***
		[0.097]	[0.123]	[0.117]
SMB			-0.261	-0.004
			[0.204]	[0.222]
HML				0.275***
				[0.100]
UMD			0.085	0.048
			[0.229]	[0.223]

Panel B – Top(HHI)=0 Firms Only: Long DOUT=0; Short DOUT=1

α	0.03	0.029	0.017	0.03
	[0.127]	[0.128]	[0.121]	[0.115]
MKT		-0.017	0.123**	0.163**
		[0.058]	[0.058]	[0.065]
SMB			-0.415***	-0.263**
			[0.110]	[0.130]
HML				0.163*
				[0.094]
UMD			-0.087	-0.108
			[0.102]	[0.104]

Panel C – Top(HHI)=1 Firms Only: Long DOUT=0, Short DOUT=1

α	0.392*	0.380*	0.368*	0.382*
	[0.218]	[0.219]	[0.220]	[0.219]
MKT		0.068	0.178*	0.223**
		[0.086]	[0.100]	[0.097]
SMB			-0.335*	-0.168
			[0.187]	[0.195]
HML				0.179*
				[0.091]
UMD			-0.04	-0.063
			[0.190]	[0.187]

Appendix: Variables Definition

Variable	Definition
Supply	Quarterly average fraction of market capitalization available to lend.
On Loan	Quarterly average fraction of market capitalization effectively lent out.
Fee	Value-weighted average loan fee in basis points.
Fee Score	A measure of fee computed by Markit that ranges from 1 (cheapest to borrow or General Collateral) to 10 (hardest to borrow).
Loan Tenure	Weighted average number of days from start date to present for all open transactions
Specialness	A dummy variable equal to one if the loan fee is above 100 basis points, zero otherwise.
Utilization	On Loan divided by Supply.
Total	Total institutional ownership.
HHI	Concentration of institutional ownership measured by the Hirschman-Herfindahl index.
Top5	Percentage held by the largest 5 shareholders.
Percentage Indexheld	Fraction of the stock held by passive funds taken from N-SAR form.
Breadth	Number of institutional investors as in Chen, Hong, and Stein (2002).
Δ(Breadth)	Percentage change of Breadth relative to the previous quarter.
Price	Average quarterly price.
Mkt. Cap.	Firm size in USD billions.
μ(Ret)	Average quarterly return.
σ(Ret)	Standard deviation of returns.
Arb. Risk (RMSE)	Mean squared error of residuals from Carhart (1997)'s 4-factor model.
$\beta_{mkt}(FF3)$	Market beta from the same regression above.
Turnover	Average daily stock turnover with a quarter (x100).
Amihud Illiquidity	Absolute return over dollar volume.
BM	Book-to-market ratio.
S&P500	Indicator variable of index membership.
Number of Analysts	Natural log of 1 plus the number of analyst estimates in IBES in that quarter. Missing values are set to zero.
$D_{P<5}$	Dummy variable equal to one if the quarterly average price is below five dollars, zero otherwise.
Momentum	Cumulative return in the previous two quarters (i.e. months *t-7* to *t-1*).
Abret$_{w-1}$	Lagged abnormal weekly stock returns. Abnormal returns are computed based on a characteristics-matched benchmark portfolio sorted on market capitalization, book-to-market and momentum as in Daniel, Grinblatt, Titman, and Wermers (1997).

Appendix: Table A.1
Short-Sale Constraints & Ownership Structure: Loan Tenure & Specialness

The table estimates loan tenure and fee specialness. Loan tenure is the average number of days from start date to present for all open transactions and specialness is a dummy variable equal to one if the lending fee is above 100bps, zero otherwise. We employ a firm-fixed effect regression for loan tenure and a logistic firm-fixed effects regression to estimate the probability that a stock is "on special". Quarterly U.S. stock data ranges between August 2006 and December 2010. All explanatory variables are standardized each quarter such that they have zero mean and unit standard deviation. The variable definitions are in the appendix. All regressions include year-quarter dummies, and fixed-effects' standard errors are clustered at the stock level. We report standard errors in brackets and significance levels are indicated as follows: ***=statistical significance at the 1% level, **=significant at the 5% percent level.

	Loan Tenure	Specialness
Total	0.055	-0.117
	[0.035]	[0.080]
HHI	0.057**	0.152***
	[0.023]	[0.038]
Δ(Breadth)	-0.000	0.019
	[0.019]	[0.055]
Mkt. cap	-0.262***	-2.007***
	[0.051]	[0.127]
$D_{P<5}$	0.003	-0.034
	[0.029]	[0.080]
S&P500 membership	0.077	
	[0.258]	
Number of Analysts	-0.044***	0.120***
	[0.010]	[0.042]
Amihud Illiquidity	-0.011	-0.028
	[0.010]	[0.018]
Turnover	-0.106***	0.599***
	[0.011]	[0.036]
B/M	-0.005	-0.001
	[0.013]	[0.031]
Momentum	-0.012*	0.051***
	[0.007]	[0.017]
Fixed Effects	Yes	Yes
Observations	59,096	19,151
Adj. R^2	0.015	0.120
Firms	4,267	1,347

Appendix: Table A.2
Stock Returns, Equity Lending Shocks & Ownership Structure: Extra Robustness

The table displays regressions of abnormal returns as a function of equity lending market shocks and lagged ownership characteristics using weekly U.S. stock data between August 2006 and December 2010. Abnormal returns are computed based on a characteristics-matched benchmark portfolio sorted on market capitalization, B/M and momentum as in Daniel, Grinblatt, Titman, and Wermers (1997). *DOUT* captures outward equity lending demand shocks, being equal to 1 if in the previous week there is an increase in the fee score and an increase in loaned amount, 0 otherwise. *Top(HHI)* equals 1 if the concentration of ownership measured by the Hirschman-Herfindahl index in the previous quarter is in the top quartile conditional on DOUT=1.*High Turnover* equals 1 if the stock belongs to the the top quartile of the average daily turnover; *High Fee* is equal to 1 if the fee score is above the 95th percentile, 0 otherwise; and *High Breadth* equals 1 if the stock belongs to the top quartile of the number of institutions holding stock between the previous two quarters as in Chen, Hong, and Stein (2002). *High Spread* equals 1 if the stock belongs to the top quartile of stocks with highest spread. *High Amihud* equals 1 if the stock belongs to the top quartile in terms of Amihud illiquidity. The remaining variable definitions are in the appendix. Regressions include calendar-month dummies and standard errors are clustered at the firm level. Significance levels are indicated as follows: ***=statistical significance at the 1% level, **=significant at the 5% percent level, *=significant at the 10% level.

	(1)	(2)	(3)	(4)	(5)	(6)
DOUT	0.015	0.046	-0.038	0.049	0.088	-0.027
	[0.075]	[0.084]	[0.088]	[0.070]	[0.072]	[0.094]
Top(HHI)	0.005	0.005	-0.009	0.166***	0.161***	0.005
	[0.033]	[0.033]	[0.037]	[0.035]	[0.035]	[0.033]
Total	-0.047	-0.050	-0.018	-0.269***	-0.304***	-0.047
	[0.036]	[0.037]	[0.038]	[0.038]	[0.038]	[0.036]
DOUT*Top(HHI)	-0.420**	-0.438**	-0.536**	-0.425**	-0.320*	-0.430**
	[0.175]	[0.179]	[0.223]	[0.186]	[0.188]	[0.175]
Fee Score$_{w-2}$	-0.058***	-0.059***	-0.124***	-0.055***	-0.060***	-0.058***
	[0.009]	[0.009]	[0.040]	[0.009]	[0.009]	[0.009]
High Turnover		0.009				
		[0.020]				
DOUT*High Turnover		-0.104				
		[0.167]				
High Fee			0.357			
			[0.227]			
DOUT*High Fee			0.173			
			[0.267]			
High Spread				-0.510***		
				[0.035]		
DOUT*High Spread				-0.171		
				[0.207]		
High Amihud					-0.523***	
					[0.032]	
DOUT*High Amihud					-0.430**	
					[0.204]	
High Breadth						-0.005
						[0.042]
DOUT*High Breadth						0.137
						[0.136]
Constant	0.109**	0.110**	0.158**	0.301***	0.338***	0.109**
	[0.050]	[0.050]	[0.062]	[0.051]	[0.051]	[0.050]
Observations	695,405	695,404	603,239	695,405	695,405	695,405
Firms	4,637	4,637	4,603	4,637	4,637	4,637