Equity lender base and limits to arbitrage: Position-level evidence from mutual funds

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Abstract

We provide the first comprehensive analysis on equity lender base utilizing newly available fund-stock level lending data. We find that short sellers predominantly borrow from a small set of repeated lenders whose composition differs across stocks. We argue that this lender base structure indicates inelastic lending supply, which limits arbitrage. When existing lenders exit, short sellers struggle to find replacement lenders, even though conventional lending supply measures appear slack. Consequently, lending fees surge, exacerbating mispricing in the equity market. Ex ante, risks implied by lender concentration are priced. Our results suggest that lending-side frictions are an important source of market inefficiency.

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Short selling is instrumental for an efficient financial market. It allows investors to sell stocks they do not own, thus enabling the incorporation of negative information into stock prices (Miller, 1977; Diamond and Verrecchia, 1987; Hong and Stein, 2003) and feeding back to firms' real decision-making (Goldstein and Guembel, 2008; Bond, Edmans, and Goldstein, 2012; Edmans, Goldstein, and Jiang, 2012). Furthermore, short selling has shown to be profitable, even after adjusting for the associated risks and borrowing fees.[1] Despite its role in market efficiency and the demonstrated profitability, short selling remains intriguingly limited, which raises the question: Why do we observe overpricing in some stocks, often over extended periods, while short sellers remain on the sidelines? What constrains them?

In this paper, we delve into one central aspect of this issue by dissecting the constraints on short selling emanating from the securities lending market. To short sell, an investor needs to borrow shares from shareholders who, for various reasons, may not be willing to lend. Even after short sellers successfully borrow the securities, loaned shares can be recalled by lenders at any moment. Therefore, the availability and stability of securities lending supply critically determine the degree of short-sale constraints, and, in turn, contribute to the limits-to-arbitrage.

Conventionally, to measure short-sale constraints, researchers and practitioners rely on the number of "lendable shares" (relative to total outstanding shares) at the stock level, which is provided by data vendors (most notably, IHS Markit) who survey major custodian banks and prime brokers (Saffi and Sigurdsson, 2011). More lendable shares indicate higher lending supply, which relaxes short-sale constraints. However, this commonly used database does not identify actual lenders, which presents two challenges. First, not all lendable shares are equally lendable, even when their owners reported them as "lendable" to the data aggregator. In a comment letter to the proposed SEC rule requiring the disclosure of "available to loan" data, data provider IHS Markit argues that "[t]he available to loan data would be difficult to interpret because of the intricacies of the lending program parameters between

[1]For evidence, see Asquith, Pathak, and Ritter (2005); Diether, Lee, and Werner (2009); Drechsler and Drechsler (2015); Engelberg, Evans, Leonard, Reed, and Ringgenberg (2022).

the lender and the beneficial owner. There are many restrictions around markets, counterparties, collateral types, concentration limits, etc. that would make the data misleading to market participants."[2] In other words, two asset owners may both designate their shares as "lendable", but one of them might require a high fee and stringent conditions for lending to the effect that it never actually lends the shares out. In addition, we do not observe recalls of loaned shares by equity lenders. These recalls are particularly difficult for short sellers to deal with, as they have to find replacement lenders in short notice (D'Avolio, 2002).

Thanks to the SEC's *Investment Company Reporting Modernization Rules*, which became effective on February 27, 2019, we assemble a novel dataset that allows us to identify actual lenders of shares. The new Form N-PORTs filed by mutual funds to the SEC contain fund-position-level information on whether a mutual fund lends out a particular stock at quarterly reporting dates. The granular nature of the data enables us to compare the lending decision of a mutual fund relative to other funds holding the same stock at the same time. Such a within–stock–quarter approach enables us to isolate individual mutual funds' securities lending decisions from the shorting demand of a stock and gain insights on funds' relative willingness to lend shares as compared to peer funds. To the best of our knowledge, our paper is the first to utilize this systematic and mandatory disclosure to study the securities lending market.[3] We show that lendable shares alone are far from a sufficient statistic for short-sale constraints, and that short-sale constraints may be binding even though lendable shares typically appear abundant. We examine the impact of share recalls on securities lending outcomes as well as the pricing and efficiency measures of underlying stocks.

One stark pattern that emerges from our position-level lending data is that short sellers borrow shares from a small set of repeated equity lenders. Consider the following statistics: The median stock in the U.S. market has six mutual fund lenders (out of 107 mutual funds

[2]The provision of disclosing "available to loan" data is subsequently removed from the SEC final rule.

[3]Prior to the reform, researchers have made attempt to gather securities lending information from Form N-Qs. However, there is no compulsory mandate for funds to disclose lending positions on N-Qs, and lending is only reported on the extensive margin. Outside of the U.S. market, Greppmair, Jank, Saffi, and Sturgess (2024) studies the lending positions of German mutual funds.

owners). While the probability of a mutual fund lending out a given position is fairly low at 6.95% unconditionally, if a mutual fund lent out a position this quarter, the probability for the fund lending out the same stock next quarter jumps up to 62.79%.[4] Even when we account for each fund's average lending propensity and each stock's shorting demand by inserting fund–by–quarter fixed effects and stock–by–quarter fixed effects, fund–stock pairs that engage in lending in the previous quarter still have a lending probability that is 40 percentage points higher relative to other positions. Consequently, for each dollar of securities lent out by all mutual funds, more than two thirds are contributed by funds that lent out the same shares in previous quarters. These patterns suggest that the lending supply that short sellers can actually tap into is far more constrained than conventional statistics indicate and relies on a small subset of owners. Shares from other owners, though appearing lendable, are not as readily accessible for lending.

Our tests help shed light on the determinants of cross-fund differences in equity lending by ruling in several factors considered in extant literature, while ruling out some other factors. Collectively, we find existing factors are far from fully explaining the heterogeneous lending propensities at the fund–stock level. First, mutual funds with longer expected holding horizons seem to lend more, consistent with Porras Prado, Saffi, and Sturgess (2016). Relatedly, ETFs are more willing to engage in securities lending, while passive and active traditional mutual funds have similar tendencies to lend. Second, poorly performing funds appear more likely to lend stocks, perhaps as a means to supplement their returns. Third, funds holding a larger stake in a given stock seem to be no less likely to engage in lending relative to funds with smaller stakes, suggesting that mutual funds are undeterred by the potential price impact of securities lending. Fourth, fund families and lending agents play some roles.

The persistent and fragmented lending at the fund–stock pair level suggests that securities

[4]Securities lending agreements are generally open-ended without a fixed maturity. Both borrower and lender can terminate the contract. The median length of securities lending in Markit database is 48 days. Choi, Park, Pearson, and Sandy (2020) reports a median length of 25 days for hedge funds' short trades. Hence, same lending deals spanning across quarters likely only explain a small part of the persistence.

lending supply is fairly inelastic and disparate across funds. We discussed these observations with several major prime brokers and custodian banks. Overall, their perspectives suggest that there are myriads of institutional and organizational frictions that generate fund–stock level limits to securities lending. These limits are attributable to all players in the lending market including lenders (mutual funds), prime brokers, custodian banks, and borrowers (short sellers). We also overview several theoretical arguments that may explain this persistent and fragmented lender base structure. The idiosyncratic nature of these limits explains why few characteristics, if any, systematically explain the persistent and fragmented lending at the fund–stock pair level.

From a market-efficiency perspective, it is important to understand whether this lending market structure impacts the pricing of assets. In particular, what happens when some current lenders cease to lend their shares? If the equity lender base that we observe is resulted from the inelastic supply of non-lending funds, removing current lenders would squeeze lending supply and push up lending fees for the affected stocks.

Consistent with our hypothesis, we find substantial disruptions in the securities lending market when existing mutual fund lenders sell off their positions, hence removing a significant chunk of *actual* lendable shares from the market. For example, when more than 5 percent of shorted shares are recalled and sold by their mutual fund lenders, the lending fee of these affected stocks raised by 30.0 basis points. Short interest drops by 0.2 percentage point of the total shares outstanding (the sample average short ratio is 3.3%). In contrast, position exits of non-lender mutual funds do not affect lending fees nor short ratios, even though they reduce the lendable shares measure. The increase in lending fees and the drop in short interest associated with lender exits suggest that the elimination of existing security lenders shifts inward the effective lending supply curve, which other institutional shareholders are unable to fully replenish quickly. Moreover, the changes in security lending quantities and prices are significant even after controlling for changes in conventional lending supply measures and in the subsample of low-utilization stocks. This suggests that short-sale constraints indicated by

conventional lending supply statistics may understate the actual constrainedness of security lending.[5] The disruption of lending market is attenuated, however, when existing lenders who did not exit their position have enough un-utilized holdings to replace the exiting lenders.

Prior studies and our conversations with practitioners suggest that mutual funds' decisions to sell their shares are often independent of the (expected) conditions in the securities lending market.[6] However, an alternative story is that mutual funds' portfolio decision is influenced by the private information about future stock fundamentals. Nevertheless, to the extent that short sellers are equally informed, bad news about a stock should associated with an increase in shorting demand, which should drive up, not down, short ratios. Therefore, our results are more consistent with an inward shift in lending supply. To further isolate the supply-side effect on lending fees when some existing security lenders withdraw from the lending market, we consider a setting where the selling of security lenders are more likely to be liquidity-motivated. Extant studies suggest that mutual funds on average scale up and down their holdings based on fund flows. Such flow-driven trades tend to be uninformative (Coval and Stafford, 2007; Frazzini and Lamont, 2008; Lou, 2012). Building on this literature, we argue that if security lenders exit their positions following a period of severe outflows, such removal of lending supply is less likely to correlate with the conditions in the securities lending market. Empirically, we use lender fund flows as a proxy for lenders' selling decisions. We find a substantial increase in lending fees and reduction in short ratios when a stock's existing security lenders face large redemptions.

In the final part of the paper, we examine the financial market consequences of the lender base structure. We argue that, given the lender structure, a contraction of the true lending supply would impede effective short selling as short sellers struggle to find quality replacement lenders in the short term and, in turn, affect equity returns and price effi-

[5]To provide some perspective, even for stocks that on special (lending fee greater than 100 bps), only 30% of the "lendable" shares are utilized. This suggests that a sizable share of the supply that appears to be available for short sellers has never been utilized and perhaps cannot be actually borrowed.

[6]For example, D'Avolio (2002) argues that asset managers' equity lending desks are often run separately from portfolio allocation teams. Chen, Kaniel, and Opp (2023) argue theoretically that the lending market is fragmented because a small number of lenders can commit to not using borrowing clients' information.

ciency. Indeed, for stocks that experience a period of significant lender exits, we observe a significantly positive stock return during the quarter when the lenders exit and the three months immediately afterwards. This suggests that the disruption in securities lending market squeezes short sellers and exacerbates limits to arbitrage. The fact that lender-exit stocks earn a positive short-term abnormal return also suggests that lenders who liquidated their positions are unlikely to be informed, as they would have achieved a better return had they not sold their holdings and kept lending. At a longer horizon, returns of these stocks reverse. This slow reversal is further consistent with a limits-to-arbitrage interpretation where it is hard to quickly find other lenders that are persistent and reliable.

In addition, using the mispricing measures based on the 100 anomalies from Dong, Li, Rapach, and Zhou (2022) and the 11 anomalies from Stambaugh, Yu, and Yuan (2012), respectively, we find that stocks are more likely to be subject to overpricing during the two quarters following large exits of existing equity lenders. Further corroborating our claim of overpricing, we present evidence that firms capitalize on the mispricing by issuing new shares after lender exits. Similarly, corporate insiders sell a larger share of their holdings following an episode of securities lending contraction.

An increase in short-sale constraints is often associated with reduced stock price efficiency (Saffi and Sigurdsson, 2011). We document that a stock's return volatility and idiosyncratic volatility, which represents a form of arbitrage risk (Porras Prado, Saffi, and Sturgess, 2016), increase significantly following exits of the stock's existing equity lenders. Using the price delay measure of Hou and Moskowitz (2005), we find that the price of these stocks suffering from severe limits-to-arbitrage are significantly slower in incorporating information.

Finally, we examine whether short sellers take into account the risks of potential lender exits and price such risks in the stock market *ex ante*. Our results suggest that the reliable, persistent lenders for each stock are difficult to replace. Thus, when shorting a stock, arbitrageurs should perceive a stock with very few past lenders as riskier than another similar stock with a more diffused set of lenders. To compensate for such risks, short sellers may

only short a stock with high lender concentration only if its overvaluation is more severe. Using a lender concentration measure from Markit and a longer time series of return data, we find that stocks with a higher lender concentration tend to underperform stocks with a more dispersed lender structure, controlling for the relation between stocks' short interest and returns.

Our paper contributes to several strands of literature. First, as discussed in Reed (2015), researchers face challenges in empirically measuring truly supply-side effect in the securities lending market. The amount of lendable shares is jointly determined by the demand of borrowing, price for borrowing, and the quantity borrowed. In the absence of controlled experimental settings (e.g., Kaplan, Moskowitz, and Sensoy, 2013; Chang, Cheng, and Yu, 2007), past studies use variations in news sentiment, short-term momentum, and discretionary accruals as plausible instruments for shorting demand and tease out the supply effect through estimating simultaneous equations (e.g., Kolasinski, Reed, and Ringgenberg, 2013; Aggarwal, Saffi, and Sturgess, 2015).[7] Our paper constructs a novel lending supply measure, leveraging on position-level securities lending data. While conventional lending constraint measures rely on *indicated* lending supply, our measure is constructed based on the identities of *actual lenders*. Our analyses suggest that the lender-base measure of lending supply shocks engenders shorting market disruptions and price inefficiencies that conventional measures fail to pick up.

Engelberg, Reed, and Ringgenberg (2018) suggests that short sellers face significant risks that stock loans might become expensive or get recalled. Our account of lending market disruption caused by lender exits provides a micro-foundation for such short-selling risk. Conditional on the level of short interest, a more concentrated lender structure predicts lower future stock returns, reflecting a large risk premium demanded by short sellers.

[7] Cohen, Diether, and Malloy (2007) uses the combination of ex post changes in shorting fees and quantities to identify supply shifts.

1 Data sources and descriptive statistics

1.1 Position-level mutual fund securities lending data

The primary data source of this paper is mutual funds' N-PORT filings as newly mandated by the SEC. As part of the *Investment Company Reporting Modernization Rules*, on February 27, 2019, the SEC adopted the final rule on N-PORT filing, which replaces previous N-Q reports. The N-PORT filings reports position-level holdings of registered investment companies at the quarterly frequency. Most important for our study, for each position, the N-PORT filings include the question "Is any portion of this investment on loan by the Fund?" If the answer is yes, the N-PORT filings further provide information on the value of position that is on loan.

We download all N-PORT filings of U.S. domestic equity funds. We define domestic equity funds as funds from the CRSP mutual fund database with a CRSP objective code that starts with "ED". We link CRSP mutual fund database to the downloaded N-PORT filings through the series CIK of each fund. Our sample period starts in 2019Q3, which is the first quarter that mutual funds start to file N-PORT. The sample period ends in 2022Q2. Table 1 reports, quarter by quarter, the number of funds in our sample. Except for 2019Q3, when some smaller investment companies are still exempt from adopting the new reporting rule, we have on average around 4,000 mutual funds filing N-PORT each quarter.

Table 1 further reports the number of mutual funds that engage in securities lending each quarter. A fund is considered as engaging in securities lending if any of its positions is on loan in a given quarter. Throughout the sample period, around 42% of all domestic equity funds have securities on loan, similarly to the fraction reported by Evans, Ferreira, and Porras Prado (2017) towards the end of their sample period (2008). The total dollar value on loan is relatively stable around $100 billion. As a point of comparison, the total value on loan for U.S. common equities at various points in time during our sample period is between $500 to $650 billion. This is consistent with Office of Financial Research (OFR)'s

estimate that mutual funds account for 18% of securities lending.[8]

Conditional on a position being lent out, the average (median) fraction of value on loan is 62.0% (78.8%) of the position value. Figure 2a shows that the modal mutual fund lends out close to 100% of its holding value conditional on lending out a position. In terms of a mutual fund's total value on loan as a fraction of its total net assets (TNA), Figure 2b displays the distribution. Conditional on some securities lending activities, the fraction of TNA on loan for the average (median) mutual fund is 3.87% (1.54%).[9]

In addition to mutual fund securities lending positions, we also collect the identities of the lending agents employed by each mutual fund and whether the lending agent is affiliated with the mutual fund. This piece of information is obtained from mutual funds' annual N-CEN filings.

1.2 Other data sources

Lending market outcomes, including short interest, lendable shares, lending fee, and utilization ratio, are obtained from Markit. We aggregate daily data from Markit to the stock-month or stock-quarter level and match Markit data to mutual fund equity lending data by stock CUSIPs. We define short ratio as number of shares on loan divided by total shares outstanding. Lending supply is defined as number of lendable shares divided by total shares outstanding. Utilization ratio is defined as number of shares on loan divided by lendable shares.

We obtain stock returns, return volatilities, turnovers, and bid-ask spreads from the CRSP. Other firm characteristics information is sourced from the Compustat and IBES. Mutual fund characteristics, such as TNA, expense ratio, portfolio turnover, index fund and ETF designations, fund flows, and past fund returns are obtained from the CRSP Mutual Fund Database.

[8] See Figure 9 of OFR's report at `https://financialresearch.gov/reports/files/ofr_asset_management_and_financial_stability.pdf`.

[9] SEC regulations require that funds may not have on loan at any time securities representing more than one-third of the fund's total value.

2 Empirical findings

2.1 The structure of equity lender base

We start by providing some descriptive statistics on the structure of stocks' equity lender base. We make the observation that securities lending is fairly "persistent" at the fund–stock pair level. For example, Figure 1 shows that the unconditional probability for a mutual fund to lend out a particular position is 6.95%. If a mutual fund lent out the same position in previous quarter, the corresponding probability for lending out this quarter jumps up to 62.79%. In stark contrast, if a mutual fund held a given position but did not lend out the shares in the previous quarter, the probability of lending out this position in the current quarter is only 2.72%.

Consequently, a stock's security lending is typically provided by a small set of repeated lenders. Figure 3 shows that more than two-thirds of a stock's loaned securities are lent by shareholders who engaged in lending of the same stock during the last quarter. Of these repeated lenders, more than half of them have been lending their shares for two or more quarters. The equity lender base of a stock is fairly small: among stocks with at least one mutual fund lender, the median stock has six mutual fund lenders (out of 107 mutual funds holding the stock).

A large body of literature has linked a number of ownership characteristics with institution's propensity of making holdings available for lending. For example, long-term, passive investors are often associated with higher lending supply (Porras Prado et al., 2016; Palia and Sokolinski, 2021). Being able to observe securities lending at the position level allows us to disentangle a stock-selection effect from mutual funds' true willingness to lend. Under the stock-selection story, certain mutual funds lend more shares than other funds because these funds happen to hold stocks that command a high shorting demand. With our granular position-level data, we can use a within–stock–quarter empirical design to tease out the differential lending propensity across funds for the same stock, effectively holding the shorting

demand invariant.

Given the fragmented and concentrated lender base we observe from mutual funds' lending positions, an important determinant of securities lending that we include in our empirical analyses is a fund's past history of lending the same stock. In our regression analysis, we are able to control for high-dimensional fixed effects to examine whether the lender base structure reflects variations in mutual funds' willingness of lending a particular stock.

We estimate the following equation at the fund–stock–quarter level:

$$\mathbb{1}_{s,f,t}^{\text{OnLoan}} = \alpha_{s,t} + \beta \mathbb{1}_{s,f,t-1}^{\text{OnLoan}} + \gamma X_{s,f,t} + \epsilon_{s,f,t}, \tag{1}$$

where $\mathbb{1}_{s,f,t}^{\text{OnLoan}}$ is an indicator variable that is set to one if fund f lends out (a positive amount of) its holdings in stock s at quarter t. The high-dimensional stock–quarter fixed effects $\alpha_{s,t}$ absorb the differences in shorting demand across stocks and compare the lending outcomes of different funds on the same stock at the same time. Additional fund(–stock) characteristics $X_{s,f,t}$ include portfolio weight of stock s in fund f, fund past returns, fund TNA, fund family TNA, fund expense ratio, fund portfolio turnover ratio, and indicators for whether fund f is an index fund or an ETF. The standard errors are double-clustered at the fund and the stock level.[10]

Table 3 displays the results. As column (1) shows, accounting for stock–by–quarter fixed effects, relative to a fund that newly establishes a position in a stock, a fund's propensity to lend this particular stock is 46.3 percentage points higher if the fund lent out the same position in the previous quarter-end. In contrast, a fund is 1.89 percentage point less likely to lend the stock if the same fund held the stock in the previous quarter but did not lend. These represent economically large effects as the unconditional probability for lending a particular stock position is 6.92% (see summary statistics in Table 2). A small part of the incremental lending propensity by previous mutual fund lenders is attributable to lending arrangements

[10]Our results are robust to double-clustering at the fund and the quarter level and double-clustering at the stock and the quarter level.

that span across multiple quarters. In the Markit database, the median length of securities lending in is 48 days for U.S. equities. Less than 20 percent of stock–months has securities lending with an *average* length of one quarter or more.[11]

In column (2) of Table 3, we further include an explanatory variable indicating that a fund lent out the same stock two quarters before. Conditional on a fund's lending decision at quarter $t-1$, lending out a particular stock at quarter $t-2$ further increases a fund's propensity to lend the same stock at quarter t by 17.0 percentage points. This implies a combined increase in lending propensity of 55.9 percentage points $(17.1 + 38.8)$ conditional on lending over the past two consecutive quarters relative to new shareholders. This result is unlikely attributable to long-term lending arrangements, as they seldom last for more than two quarters.

Is this difference in lending propensity driven by fund-level policies, or does it depend on considerations specific to a fund–stock pair? Presumably, if some funds always lend all of their holdings, while others never lend, we would estimate a positive β on lagged lending indicator but the positive β would go away when fund–time fixed effects are included. However, this is not the case in the data. In column (3) of Table 3, we further use fund–by–quarter fixed effects to absorb differences in the average lending propensity across funds. Effectively, we are comparing two different stocks held by the same fund — one being lent out in the previous quarter, while the other was not lent out. The estimated coefficient on $\mathbb{1}^{\text{OnLoan}}_{s,f,t-1}$ is 39.4 percentage points, similar to the estimate in column (2), where fund–by–quarter fixed effects are unaccounted for. This finding suggests that there is stark and persistent difference in lending propensity at the fund–stock pair level. The matching between stocks and lending funds indicates that there exists some degree of specialization in the supply of securities lending. In our data, for mutual funds that engage in securities lending in a given quarter, the median fund lends out five stocks, while the fund at the 75th percentile lends out 17

[11] If we assume that 20 percent of securities lending agreements that mutual funds have at previous quarter-ends have a remaining length of a quarter or more, this conservative assumption suggests that being a security lender in the previous quarter is associated with 37.5% $(46.9\% * (1 - 20\%))$ higher probability for a fund to lend the same stock to a different short seller this quarter.

stocks. Therefore, the set of willing equity lenders differs from stock to stock.

Some equity lending decisions are made at the fund-family level (Rizova, 2011; Evans et al., 2017). To account for family-level lending policies and a fund family's stock-specific considerations, in column (4) of Table 3, we additionally control for an indicator that equals one if any other fund in the same family lent out the stock in the previous quarter. We also acknowledge the possibility that the segmentation of the equity lending market is partially determined by the relatively small number of lending agents.[12] To evaluate whether the specialization of lending agents explains the persistent relation between mutual fund lenders and loaned stocks, we further include an indicator that equals one if a stock is previously lent by any other fund that utilizes the same lending agent as the focal fund. The coefficient estimates in column (4) show that the identity of both fund families and lending agents help explain the a fund's securities lending. For example, if other same-family funds lent out a stock last quarter, the focal fund is 3.0 percentage point more likely to put the same stock on loan. Similarly, past lending by funds associated with the same lending agent increases focal fund's lending probability by 3.7 percentage points. However, comparing the estimates in columns (1) and (4), we find that a fund's propensity to lend this particular stock is still 42.1 percentage points higher if the focal fund lent out the same position in the previous quarter-end. Therefore, family- and lending agent-related factors are insufficient in explaining the observed lending relation at the fund–stock level.

Can the observed concentration in equity lender base possibly be explained by the inattention of some mutual funds (who do not lend) to the securities lending market? In the last column of Table 3, we focus on the subsample of stocks that have a lending fee greater than 100 basis points (i.e., on special). For these stocks, it is reasonably to expect fund managers to be aware of securities lending opportunities. However, the coefficient estimates in column (5) show that, even among special stocks, securities lending activities in the previous quarter

[12]Each fund (family) typically uses one lending agent. In our data, the top three lending agents (BlackRock, State Street, and Goldman Sachs) account for 54.6% of mutual fund securities lending. The top ten lending agents account for 96.5% of the businesses.

still predict a higher probability to lend in this quarter by more than 34.9 percentage points. Moreover, relative to the omitted group of mutual funds that newly acquire the stock during the quarter, mutual funds that held the stock but did not lend in the previous quarter has a 12.7 percentage point *lower* probability to lend their holdings this quarter. In other words, the fact the some funds held shares without lending is more consistent with a deliberate choice than a result of inattention.[13]

The coefficients on other fund characteristics shown in Table 3 are also highly informative. Some of the estimates challenge the literature's received wisdom about securities lending supply, while others confirm past findings. First, a number of past studies (e.g., Porras Prado et al., 2016) make the assumption that long-term investors are more likely to lend securities than short-term investors (or that long-term investors are more preferred by short sellers as lenders). Our analysis finds inconclusive evidence for this claim. Controlling for stock–quarter fixed effects, funds' turnover ratio, which is an inverse proxy for investment horizon, is uncorrelated with equity lending (columns 1 and 2). Another proxy we use for measuring the expected holding horizon at the fund–stock level is the distance between a fund's average investment style and a stock's style.[14] We argue that funds tend to have a longer holding horizon for stocks that are close to the fund's core investment style (Evans, Ferreira, and Porras Prado, 2017). We hypothesize that, the closer a stock is to the fund's core investment style, the more likely that the fund lends the stock's shares. As reported in columns (1) to (3) of Table 3, we indeed find a negative coefficient the style distance of a stock. However, the economic magnitude of the coefficient is modest. For example, in column (1), a one standard deviation decrease in a stock's style distance (1.36) is only associated with an increase in lending probability of 0.25 percentage point ($-0.00188 * 1.36$).

Another view associated with investment horizon is that passive funds are more willing

[13] In Appendix Table A1, we use the fraction share of a position that is lent out as the outcome variable and repeat the analyses. We find consistent result that prior lenders tend to have a larger fraction share of the same position on loan in the current quarter.

[14] A stock's style is defined by its size and book-to-market deciles in the cross-section. A fund's average style is the average size and book-to-market deciles across its holdings. We then calculate the Euclidean distance for each stock–fund pair.

to supply shares for securities lending (e.g., Honkanen, 2020; Palia and Sokolinski, 2021). Our results show that this claim is true only for ETFs, but not for traditional index funds. As compared to active funds, ETFs are 1.19 percentage point more likely to lend the same stock relative to traditional active funds (column 1), while non-ETF index funds do not show a differential lending propensity.[15] This finding suggests that the reason why past studies find passive funds to lend more than active funds is a stock selection effect: Passive funds tend to hold stocks with strong shorting demand, which active funds tend to avoid these stocks. The difference between ETFs and both passive and active funds may arise from the fact that ETFs is less affected flow shocks.

Second, mutual funds' lending propensity is negatively correlated with their recent performance. This is consistent with the idea that poor-performing funds use securities lending income to supplement their investment returns. This finding is compatible with Evans, Ferreira, and Porras Prado (2017), which finds negative relation between securities lending and fund performance at the fund level. Our within-stock result suggests that the negative relation between fund performance and securities lending is not entirely driven by poor stock selection, but also a reverse causality: Poorly performing funds may be simply more willing to lend their holdings to generate additional revenues.

Third, we find that the relation between the ownership ratio (a fund's holdings of a stock relative to the stock's shares outstanding) is either positive (columns 1 and 2) or insignificant (column 3). This finding indicates that mutual fund lenders are not concerned about the price impact externalities from making their shares lendable. This is consistent with the discussion in Rizova (2011) and Kaplan, Moskowitz, and Sensoy (2013), but inconsistent with the arguments of several other studies.

Fourth, several studies (e.g., D'Avolio, 2002; Geczy, Musto, and Reed, 2002) emphasize the important role of lending agents in the securities lending market. Lending agents are

[15] If we remove all regressors except for the passive fund dummy and the ETF dummy, we still find that passive funds are no more likely to lend its holdings relative to active funds, controlling for stock-by-time fixed effects.

custodian banks or broker dealers who intermediate between short sellers and equity lenders in a market characterized by high search friction (Duffie, Garleanu, and Pedersen, 2002). We are especially interested in funds with affiliated lending agents. Past studies suggest that funds might be more motivated to lend securities when their management company is able to generate additional revenue through affiliated lending agents (Adams, Mansi, and Nishikawa, 2014; Johnson and Weitzner, 2023). Consistent with this hypothesis, column (1) of Table 3 shows that funds with an affiliated lending agent is 1.71 percentage points more likely to lend shares than funds that use un-affiliated lending agents.

2.2 Persistent and fragmented lender base: some discussion

Our analyses in the last section suggest that equity lender base is persistent, concentrated, and also fragmented. To shed more light on this observed lending market structure, we contacted seven major prime brokers (Goldman Sachs, JPMorgan Chase, Morgan Stanley, Credit Suisse, Bank of America Merrill Lynch, Citigroup, and Barclays) and the largest custodian bank State Street. We discussed with the employees of those entities to collect their views on what determines some stocks of a fund are persistently lent out while other stocks are usually not. In addition, we consider a number of economic and finance theories that are not specific built for the lending market, but may potentially explain the patterns we document.

2.2.1 Insights from practitioners

Asset managers: Usually, asset managers that lend shares are called beneficiary owners (BO) in the lending market. BOs only put a portion of their holdings as lendable inventory. They choose which stocks to lend by setting terms in their contracts with custodian banks. They are likely to lend out the stocks that they expect to benefit from lending. Therefore some fund-stock level characteristics might explain persistent lending of a stock such as expected holding horizon and whether a stock is considered core asset or not.

However, many other reasons are idiosyncratic at the fund-stock level. They include: (1) General relationship concerns: Some funds want to make sure the stocks they lend to their potential clients will not be sold soon, necessitating recalls. They do not wish to be conceived as an unstable lender for a particular stock. (2) Counterparty risk: Lending securities might involve counterparty risks from the borrower. Some funds screen on the creditworthiness of the borrowers.[16] (3) Insider or restricted stock: A stock in a fund might be classified as insider or restricted stock, making it subject to limitations that prevent or discourage lending. (4) Liquidity management and redemption policies: Securities that are lent out, when recalled, need settlement time. If a fund expects higher redemptions or has certain liquidity management strategy, it might refrain from securities lending to preserve liquidity. (5) Tax considerations: The tax implications of lending a particular stock might differ, given that dividends paid by shares on loan might be taxed differently. (6) Corporate governance considerations: Mutual funds do not have the right to vote on securities while they are on loan. Different funds may have different policies regarding lending securities prior to proxy voting events. (7) ESG considerations: Some funds have specific considerations on ESG (Environmental, Social, and Governance) principles, and they might impose restrictions on lending stocks with certain ESG profiles.

Broker and custodian banks: Prime brokers and custodian banks also face some constraints that significantly affect fund-stock level lending outcomes. These constraints center around relationship, reputation, regulatory, compliance, risk management, and conflict of interest. In situations where a broker has a business relationship through investment banking services, underwriting, or advisory businesses with a particular company, they may choose not to lend the shares of that company to short sellers or other borrowers. This can be due to the broker's desire to maintain a positive relationship with the company, avoid conflicts

[16] As an example, in the prospectus of AB Small Cap Value Portfolio, it states "In determining whether to lend securities to a particular borrower, the Adviser (subject to oversight by the Boards) will consider all relevant facts and circumstances, including the creditworthiness of the borrower. The loans will be made only to borrowers deemed by the Adviser to be creditworthy, and when, in the judgment of the Adviser, the consideration that can be earned at that time from securities loans justifies the attendant risk."

of interest and regulatory or legal investigations pertaining to insider trading, maintain a trustworthy reputation, or prevent any negative implications for their broader businesses. The decision is highly firm-specific, and different prime brokers may have different private internal lists restricting their lending desk to lend some stocks.

Short sellers: Finally, short sellers as share borrowers may choose a fixed set of lenders for a particular stocks based on the attractiveness of the terms attached with each stock by each fund. As a result, different stocks may always get lent out through a particular set of lenders. Additionally, different funds might have different preferences or requirements for collateral in securities lending transactions. Short sellers may also have to meet certain creditworthiness eligibility before borrowing from certain lenders.

2.2.2 Academic theories

We also consider several economic and finance theories that may shed light on our findings.

Preferred habitat: The concept of preferred habitat, while originating in the context of bonds and the term structure of interest rates, can be applied more broadly to understanding investor behavior in various markets, including securities lending. The underlying principle is that investors have specific preferences based on their risk tolerance, expected returns, investment horizons, liquidity needs, familiarity, regulatory and tax, and other rational or irrational factors, which influence their choice of assets. Our conversation with practitioners in the previous section suggests that lenders indeed have heterogeneous preferences in the stocks they prefer to lend.

Tacit collusion: Tacit collusion refers to a situation where multiple parties indirectly coordinate their actions not through any explicit agreements or communication but through mutual understanding that leads to higher prices, segmented market, restricted output, or reduced direct competition. In markets where parties interact repeatedly over time,

the opportunity for tacit collusion increases because players can punish deviations from collusive outcomes through future competitive actions. Bryzgalova, Pavlova, and Sikorskaya (2023) develop a model in which arbitrageurs act strategically by choosing to specialize in some markets so that all arbitrageurs combined generate the highest profits. The authors also show empirical support from the options market where, to avoid direct competition, different arbitrageurs choose to exploit different individual options, while also leaving many other almost identical options unexploited. Similar strategic considerations can apply to the lending market, where mutual funds each choose to specialize in lending a specific set of stocks to avoid direct competition. Tacit collusion is notoriously hard to detect from market outcomes.[17]

Information secrecy: Chen et al. (2023) model a monopolistic custodian bank who makes lending decisions. The key element of their model is that informed short sellers' concerns about information leakages through the stock borrowing process. As a result, "borrowers prefer interacting with an intermediary lender that is committed to facilitating secrecy, but also that a lender's commitment itself is supported by both market concentration and non-competitive fees." In their model the market power derives from a monopolistic custodian lender who rations the shares for lending across funds. To the extent that securities lenders potentially have access to information contained in short-sale trades, this intuition may have some effect on fund-stock level lender-borrower concentration.[18]

Overall, both the insights from practitioners and theories from other financial markets suggest that there could be a number of incentives and institutional constraints that generate idiosyncratic fund-stock level limits to securities lending. Since as econometricians we cannot

[17]The authors argue that "financial markets with entry costs and natural economies of scale, intermediated by a limited number of players, may present other applications of our model, as strategic interactions cannot be ruled out in such markets. More opaque and concentrated markets, for example, over-the-counter markets, may also present suitable applications, as repeated game considerations are more likely to arise in those environments." The lending market naturally satisfies these conditions.

[18]Different from our primary focus, this theory does not consider whether the exit of a lender restricts arbitrage opportunities, as the custodian can replace the exiting lender with another.

directly observe those considerations, it is difficult to pinpoint the exact micro-level reasons for lender-stock level lending outcomes. However, the most economically important consequence of this lender base structure is at the aggregate level: when a current lenders for a stock exit, the effectiveness of the lending market for the stock may significantly deteriorate. We provide such evidence in subsequent sections.

2.3 Securities lender exits as shocks to lending supply

Mutual funds that lent out shares in the equity lending market tend to continue to make the same stock's shares available for lending in the future. These past lenders are economically important in supplying short sellers with shares. As Figure 3 shows, 68.1% of the lending value of a given stock is borrowed from mutual funds that lent out the same stock in the previous quarter. One interpretation of why securities lending is provided by such a small set of repeated lenders is that there are heterogeneous reasons to supply shares in the securities lending market. However, one caveat is that our data do not allow us to observe shareholders who make their shares available to lend but do not end up lending. Therefore, an alternative possibility is that short sellers have some non-pecuniary preferences (e.g., business relationships) for borrowing from a specific set of mutual funds. To distinguish these two alternative explanations, in this section we examine the responses to some existing securities lenders exiting their positions. If the observed lender base structure is driven by investors' limited lending supply, then when existing security lenders exit their position and recall loaned share, the supply in securities lending market should drop significantly, causing an increase of lending fees and a reduction in the short ratio. In contrast, if it is borrowers' preference that limits the equity lender base, it means that non-lending mutual funds are equally willing to make their shares available and can step in once current securities lenders exit their positions. From a broader perspective, the two alternative narratives have very different implications for market efficiency and price formation.

To empirically evaluate these two competing hypotheses, we construct a measure that

tracks position exits of existing securities lenders. Specifically, for each stock–quarter, we are interested in mutual funds that lend their shares at the end of quarter $t-1$ and completely sell off their holdings of the stock between quarters $t-1$ and t. Absence of position exits, these prior mutual fund lenders have a high propensity to make their shares available for lending in quarter t. As they sell off their holdings, these mutual funds lender are no longer able to supply securities lending and have to recall their shares if their loans are still outstanding. To capture its economic impact on the securities lending market, our measure of lender position exits ($LenderExits$) scales the number of shares (measured at quarter $t-1$) lent by mutual funds who exit their position by the total number of shares on loan (measured at quarter $t-1$):

$$LenderExits_{i,t} = \frac{\sum_{j \in Owners_{i,t-1}} (\mathbb{1}_{i,j,t}^{\text{Position Exit}} \cdot Shares\ Lent_{i,j,t-1})}{Total\ \#\ Shares\ on\ Loan_{i,t-1}}, \tag{2}$$

where i indexes stocks, j indexes mutual funds that are shareholders of i, and t indexes quarters. The binary variable $\mathbb{1}_{i,j,t}^{\text{Position Exit}}$ indicates that fund j completely sells off its holdings of i during quarter t. We focus on complete portfolio exits because a fund is unable to lend the shares after such exits, and we can abstract away from funds' lending decisions after partial exits.[19] We scale the variable by lagged *Total # Shares on Loan* such that if $LenderExit = 5\%$, the interpretation is that five percent of short sellers need to find replacement source of lending if all short sellers want to keep their short trades open.

The variable $LenderExits$ has a very skewed distribution. About 71% of the stock–quarters have $LenderExits = 0$, indicating either no mutual fund lenders observed from the previous quarter or no lender exiting.[20] To ease economic interpretation, in most of our analyses, we use an indicator variable for $LenderExits \geq 5\%$, which accounts for about seven percent of the observations. Most of our results are robust to using alternative thresholds such as $LenderExits \geq 10\%$ or $LenderExits > 0\%$.

We first use an event-study framework to examine the impact on securities lending fees

[19] In untabulated tests, we confirm that all our results go through if we consider the overall change in lending from all previous-quarter lenders: $LenderReduction_{i,t} = \frac{\sum_{j \in Owners_{i,t-1}} (Shares\ Lent_{i,j,t} - Shares\ Lent_{i,j,t-1})}{Total\ \#\ Shares\ on\ Loan_{i,t-1}}$.

[20] For stock–quarters with positive $LenderExits$, the histogram is shown in Figure A1.

when a significant fraction of existing lenders liquidate their positions. To this end, we select the set of stock–quarters where $LenderExits \geq 5\%$ and trace their changes in lending fees surrounding the quarter when existing lenders exit their positions. To account for time trends in equity lending fees, we adjust lending fees by the sample-average equity lending fee in each month. We control for stock fixed effects in the regression:

$$LendingFee_{i,t} = \alpha_i + \sum_{k=-3}^{9} \beta_k \cdot \mathbb{1}^{k \text{ month from lender exit events}} + \epsilon_{i,t}. \tag{3}$$

Figure 4 shows the evolution of lending fees before and after the lender exit events. Before the quarter when more than 5% of existing lenders exit their positions, the level of lending fees is relatively stable. During the 3 months when lenders sell their positions and cease to provide lending supply, the level of lending fees begin to rise significantly. Lending fees are about 60 basis points higher in the first month after the sell-off, and remain significantly elevated at 25-27 basis points for Month 2 and Month 3. This relatively prolonged disruption of about one quarter is consistent with the recall risk as discussed in D'Avolio (2002).

To further examine in a multivariate setting the effect of the exit of existing lenders on the securities lending market, we estimate panel regressions on the quarter-to-quarter changes of securities lending outcomes, mainly lending fees and short ratios:

$$\Delta Y_{i,t} = \alpha_t + \beta_1 LenderExits_{i,t} + \beta_2 NonLenderExits_{i,t} + \gamma \Delta LendingSupply_{i,t} + \eta Y_{i,t-1} + \lambda X_{i,t-1} + \epsilon_{i,t}, \tag{4}$$

where $LenderExits$ is measured between quarters $t-1$ and t. The variable $NonLenderExits$ is defined as the number of shares sold by non-lending mutual funds that terminate their positions between quarters $t-1$ and t, scaled by total number of shares held by non-lending mutual funds at quarter $t-1$. This variable accounts for the general selling of shares by mutual funds unrelated to securities lending considerations. Later we contrast the coefficient estimates on $LenderExits$ and $NonLenderExits$. We control for $\Delta LendingSupply$ in regressions to highlight that, when existing lenders cease to make their shares available for

lending, the conventional measure for lendable shares does not capture the full magnitude of the shock of lending supply. The vector X represents stock-level characteristics such as mutual fund ownership, book-to-market ratio, gross profitability, past stock return, stock turnover ratio, and bid-ask spread. We include quarter fixed effects and cluster standard errors at the stock level.

Panel A of Table 4 shows the results. In column (1), we first confirm that both the exit of security-lending mutual funds and the exit of non-lenders are associated with a decrease in lendable shares as indicated by the *Markit* database. When the security lenders who exit their positions represent more than five percent of shares on loan, the associated drop in lendable shares is 1.77 percent of shares outstanding. The exits of non-lending mutual funds are similarly associated with a reduction in lendable shares, suggesting that some of these non-lenders have ostensibly indicated the availability for lending of their shares to the data vendor Markit.[21] In column (2), we find that the short ratio of stocks affected by lender exits drops by about 0.19 percentage point. Given that the sample average short ratio is 3.3%, the observed reduction in short ratio is economically meaningful. Importantly, $NonLenderExits$ is not associated with changes the volume of shorting or $DCBS$ score. Given that the median stock in our sample has six mutual fund lenders out of 107 fund owners, it is notable that idiosyncratic selling decisions of a small set of funds (i.e., the lenders) have outsized effects on lending outcomes.

Columns (3) and (4) of Table 4 display results on lending fees. During the quarter when more than 5% of existing lenders sell their shares, the $DCBS$ lending fee score, which ranges from one to ten, increases by 0.131 unit, while the indicative lending fee increases by 30.0 basis points. Both increases are statistically significant. The magnitude of lending fee increase is comparable to the increase found in the event study around month $t+3$, as shown in Figure 4.

Finally, in column (5), we restrict the sample to stocks whose utilization ratio was below

[21] Note that $NonLenderExits$ is a continuous variable. Therefore, one cannot directly compare the magnitude of its coefficient with the coefficient of $LenderExits \geq 5\%$.

10% at the end of the previous quarter. Such a low level of utilization ratio indicates that there should be ample "available" shares that are presumably lendable from alternative lenders. However, even within this set of stocks, exits of existing lenders still raise the lending fee significantly by 13.3 basis points. This result is consistent with Aggarwal, Saffi, and Sturgess (2015), who find that, in the context of voting-induced recalls, supply shifts have a significant impact on lending fees even at relatively low levels of utilization.

The joint observation of an increase in lending fees and a reduction in short selling volume (as measured by short ratios) suggests an inward shift in securities lending supplies (Cohen, Diether, and Malloy, 2007). In other words, when prior security-lending mutual funds exit their positions and remove their shares from the supply of lendable shares, other institutional investors fail to step in and provide lending supply at a similar level of fee. This set of findings suggest that the equity lender base observed in our data is likely attributable to some mutual funds being more willing to lend certain stocks at borrower-friendly terms than other mutual funds.

In Appendix Table A2, we repeat the analyses using the continuous variable $LenderExits$. Consistent with our main results, $LenderExits$ is negatively associated with changes in lendable shares and short ratios, and positively associated with changes in lending fees. In Panel B of Appendix Table A2, we scale $LenderExits$ by a stock' number of shares outstanding. When regressing this re-scaled $LenderExits$ on changes in short ratio, we find a coefficient of -0.164 (column 2). This indicates that, when existing lenders cease to lend shares, about 16% of borrowers are unable to find replacement lenders and presumably have to cover their shorts. The rest of the borrowers are able to find lendable shares, but presumably at higher lending fees.

While it is difficult for short sellers who face lender exits to borrow from asset owners who did not engage in securities lending, a more accessible source of replacement lending is from past lenders who did not exit their positions. To the extent that these non-exiting lenders still have un-utilized shares, they are most likely to step in the securities lending gap

caused by lender exits. This generates a sharp prediction for our inelastic lending supply story: the impact of lender exits on securities lending outcomes should be attenuated by the available lending capacity of non-exiting lenders.

To test this hypothesis, we first calculate the lending capacity of the non-exiting lenders of a stock. For each stock-quarter, we sum up the shares of holding that are were not lent out across all lenders as measured in Quarter t-1, excluding the lenders that liquidate their position in Quarter t. We then scale the un-utilized shares from non-exiting lenders by the total shorting volume of the stock in Quarter t-1.

$$LenderCapacity_{i,t} = \frac{\sum_j (\#\ Shares\ Held_{i,j,t-1} - \#\ Shares\ Lent_{i,j,t-1})}{Total\ \#\ Shares\ on\ Loan_{i,t-1}}, \tag{5}$$

where the summation j is over all past-quarter lenders who do not exit their positions between quarter $t-1$ and quarter t. One may interpret the $LenderCapacity$ variable has the fraction of total securities lending short sellers can replace if all non-exiting lenders put all of their un-used shares on loan.

We then sort all stocks in each quarter into low lender capacity and high lender capacity based on the cross-sectional median value of $LenderCapacity$. We then repeat the analyses of Equation 4 in each of the two subsamples. Panel B of Table 4 shows that the disruption in securities lending outcomes brought about by lender exits is much more pronounced for the subsample of stocks where the lending capacity of non-exiting lenders is relatively low.[22] Most notably, short selling quantities ($\Delta ShortRatio$) only drop following lender exit events if non-exiting lenders' capacity is relatively low. When the capacity is high, non-exiting lenders seem to be able to fully replace exiting lenders and the effect of lender exits on $\Delta ShortRatio$ is close to zero. The effect of lender exits on lending fees is also much larger in the subsample where $LenderCapacity$ is low. Taken together, this set of results corroborate our claim that there are considerable frictions in the securities lending market such that outside of existing

[22]In the low-capacity subsample, the median value of $LenderCapacity$ is 0.03. This means if all non-exiting lenders incrementally lend out all of their un-utilized shares, it only accounts for 3% of the prevailing shorting volume.

lenders, securities lending supply is fairly inelastic and responds rather mutedly to change in lending fees.

2.4 Fund flows as a proxy for lender exits

Past studies suggest that a mutual fund's decision to sell a stock holding is plausibly not influenced by the stock's condition in the securities lending market. According to D'Avolio (2002), "short-run [equity loan] supply is essentially vertical" because equity lending desks are often run separately from portfolio allocation desks. However, we also acknowledge the possibility that security-lending mutual funds are informed about future changes of loaned stocks' fundamentals and adjust their portfolios based on such information. While we examine the contemporaneous and future stock returns in the next section, which does not support the explanation of short-term trading gains, in this section we mitigate the endogeneity concern by studying a setting where the trades made by mutual funds are less likely to be driven by information.

A vast literature has shown that mutual funds' portfolio purchases and sales are largely driven by fund flows (e.g., Pollet and Wilson, 2008; Lou, 2012). When faced with redemption requests, fund managers tend to proportionally scale down their holdings, and the associated selling decisions are likely uninformative and often associated with price reversals (Coval and Stafford, 2007; Frazzini and Lamont, 2008; Edmans et al., 2012; Lou, 2012). Motivated by this literature, we use the fund flows (during quarter t) to a stock's current security lenders (measured at $t-1$) as an instrument for these security lenders' position exits between quarters $t-1$ and t. In particular, for stock i at quarter t:

$$LenderFlow_{i,t} = \frac{\sum_{j \in Owners_{i,t-1}} (FundFlow_{j,t} \cdot Shares\ Lent\ by\ Fund_{i,j,t-1})}{Total\ \#\ Shares\ on\ Loan_{i,t-1}}, \tag{6}$$

where $FundFlow_{j,t}$ is the fractional flow for fund j during quarter t. When existing lenders suffer from large outflows (signified by a negative $LenderFlow$), we posit that these lenders

are more likely to sell their shares, hence restricting the supply in the securities lending market.

When $LenderFlow$ is negative, one may interpret the variable as the fraction of loaned shares that would be recalled by existing lenders if all lender funds trade their portfolio holdings proportionally in response to redemption requests. The construction of this variable is similar to Edmans, Goldstein, and Jiang (2012) and avoids using actual trading decisions made by lender funds, as recent studies show that there is informational content in mutual fund fire sales (Huang, Ringgenberg, and Zhang, 2023). In Appendix Table A3, we verify that $LenderFlow$ is negatively associated with actual lender exits, validating the relevance condition.

We estimate the effects of lender fund flows to outcomes in the securities lending market. The outcome variable Y includes lending fees and short ratios:

$$\Delta Y_{i,t} = \alpha_t + \beta_1 LenderFlow_{i,t} + \beta_2 NonLenderFlow_{i,t} + \eta Y_{i,t-1} + \gamma X_{i,t-1} + \epsilon_{i,t}, \quad (7)$$

the variable $NonLenderFlow$ is defined as the holding-weighted flows to funds that held stock i but did not lend the shares in quarter $t-1$. We control for the average flow to non-lender funds to account for confounding factors that affect flows to certain fund investment styles. The vector X represents a set of stock characteristics.

Table 5 shows the effects of $LenderFlow$ on securities lending outcomes. In column (1), we find that flows to securities lenders are positively associated with changes in lendable shares, indicating that an outflow (negative flow) to existing lenders is correlated with a reduction in lending supply. In column (2), we find that an outflow from existing lenders is associated with a reduction in short ratio.

In columns (3) and (4), we find that $LenderFlow$ is significantly negatively associated with lending fee score ($DCBS$) and indicative lending fee. These coefficient estimates suggest that, when mutual funds that previously lent out the shares suffer from a severe outflow,

stocks' lending fee tend to increase, reflecting a contraction in securities lending supply.[23]

We also note that in columns (2) to (4) of Table 5, flows to a stock's non-lending mutual fund owners are uncorrelated with securities lending outcomes of the stock. To the extent that these non-lending mutual funds follow similar investment styles with the mutual funds that engage in securities lending and that flows of non-lending funds are similarly (un)informative as compared to flows of lending funds, it further strengthens our contention that the changes in the quantity and price of securities lending are not driven by factors associated with stocks' fundamentals.

We want to caveat that, our identification strategy notwithstanding, fund flows may still contain information about future fundamentals of a fund's portfolio stocks. However, to the extent that outflows are associated with negative information about stock fundamentals, what we show in the next section is that stocks affected by lender exits do *not* exhibit negative abnormal returns for a number of months. Therefore, the possibility that changes in lending decisions may contain information does not overturn our central message that lender exits constrain short selling and reduce price efficiency. Indeed, even if some lenders' sales are information-driven, such information appears to be not timely incorporated in stock prices. Therefore, our evidence seems to be more consistent with limits-to-arbitrage, which arises from the contraction of true lending supply that impede effective short selling as short sellers struggle to find quality replacement lenders in the short term. Put it differently, rebalancing from a lent stock into another stock too early contradicts an information-based explanation. As the period of holding a stock without information extends, the total holding costs—namely, the variance of the compounded returns plus the lost lending fees—effectively dilute any gain that lenders might have from selling the lent stock (Pontiff, 1996).

[23] In Appendix Table A3, we conduct two-stage-least-squares (2SLS) regressions using $LenderFlow$ as an instrument for $LenderExits$. We find consistent results that the instrumented $LenderExits$ is negatively associated with the changes in lending supply and short ratio, and positively associated with lending fees.

3 Asset pricing implications

In this section, we gauge the economic importance of position exits by security lenders through the lens of their impact on stock prices. We argue that a sudden contraction in equity lending supply exacerbates the limits to arbitrage in the equity market, hence moving the stock price and adversely affecting stock price efficiency.

3.1 Stock returns

We first study the return predictability of lender position exits. To this end, we investigate what happens to stock returns during and after lenders exit their positions by estimating a monthly cross-sectional regression of the following form:

$$Ret_{i,t,t+n} = \alpha + \beta_1 LenderExits_{i,t} + \beta_2 \Delta MFHoldings_{i,t} + \gamma X_{i,t-1} + \epsilon_{i,t}, \tag{8}$$

where we transform the quarterly $LenderExits$ dummy into monthly frequency by assigning the same dummy value to all months of the same quarter. We examine stock returns Ret at the contemporaneous months $Ret_{i,t-2,t}$ (the quarter when lenders exit) and subsequent months including $Ret_{i,t+1,t+3}$, $Ret_{i,t+4,t+6}$,$Ret_{i,t+7,t+12}$, and $Ret_{i,t+13,t+18}$. To ensure a fair comparison across horizons, we keep a stock-month observation if return outcome variables across all horizons are non-missing. We control for the general effect of mutual holding changes on returns using $\Delta MFHoldings_{i,t}$, as prior literature has shown the price impact of aggregate mutual fund trading (e.g., Lou, 2012). The vector X represents a set of stock characteristics that are shown to be important cross-sectional return determinants in the Fama-French four factor model including the log of market cap, book to market ratio, and momentum. We use time (month) fixed effects in the regression to ensure we focus on the cross-sectional return predictability. Standard errors are double-clustered at the firm and month levels.

Table 6 shows that $LenderExits$ in the current quarter is slightly positively related to

the contemporaneous stock return (column (1)). The cumulative abnormal return during the quarter is about 1.7%. This result suggests that, at the time of lender exiting from a stock, there is no obvious sign that there is bad news for the underlying stock. Instead, the exit of securities lenders possibly force some short sellers to cover their positions and generate positive stock returns. In the next three months following lenders' exit (column (2)), stock returns continue to be abnormally positive (4.2% and t=2.457), suggesting that a sudden contraction in equity lending market may generate economically meaningful short-sale constraints in the stock market, preventing negative information from being incorporated into stock prices. The return of stocks affected by lender exits seems to plateau during months t+4 to t+6 and months t+7 to t+12. Finally, we observe significant reversal of stock returns averaging about 4.4% during months t+13 to t+18 (column (5)). This is consistent with the lending supply of these stocks eventually becoming normalized and overvaluation being corrected.

Throughout our tests, we control for the overall changes in mutual fund holdings, which are negatively correlated to the stock return over multiple horizons. The negative relation is consistent with the pattern documented in Dasgupta, Prat, and Verardo (2011) and Lou (2012), which argue that mutual fund trading exerts temporary price pressure that will revert in the long term. We also control for the change in lendable shares from Quarter t-1 to Quarter t. In further robustness test as shown in Appendix Table A4, we additionally control for the level of stock lending fee prior to lender exits. The predictive power of *LenderExits* is virtually unchanged.[24]

These results offer evidence that stocks may experience significant overpricing following lender exits. They also strengthen our argument that exited lenders are unlikely to have been driven by private information about loaned-out stocks: Had they not exited their positions, they would have earned more from both increased lending fees and higher stock prices.

[24]Our return results are also robust to controlling for the change in the number of mutual fund owners of a stock, which by itself is not significantly related to current or future returns.

3.2 Price efficiency

In this section, we examine how securities lender exits affect equity market price efficiency. Extant studies suggest that increased limits-to-arbitrage is associated with less efficient stock prices (Bris, Goetzmann, and Zhu, 2007; Saffi and Sigurdsson, 2011; Boehmer and Wu, 2013). To investigate this relation, we estimate the following equation:

$$Inefficiency_{i,t,t+6} = \alpha + \beta_1 LenderExits_{i,t} + \beta_2 \Delta MFHoldings_{i,t} + \gamma X_{i,t-1} + \epsilon_{i,t}, \quad (9)$$

where the dependent variable is price (in)efficiency proxies measured over month t+1 to t+6 after the quarter where $LenderExits$ is greater than or equal to 5%.

In Table 7, we use mispricing scores as the price (in)efficiency measure. To construct the level of mispricing of a stock, we follow the existing literature by aggregating each stock's ranking of a number of anomalies that are widely used in the literature. Specifically, we proceed in three steps. First, every month, we rank stocks into deciles according to next month's return as predicted by each anomaly, from 1 (most undervalued) to 10 (most overvalued). Second, for each stock and month, we compute the average of these anomaly-specific ranks, and then sort stocks into deciles according to this averaged rank. We refer to this decile ranking as the composite mispricing score with a higher score again indicating higher likelihood of overpricing. For robustness, we utilize two sets of anomalies when generating this score. The first score $MISP^{DLRZ}$ is based on the 100 anomalies studies in Dong et al. (2022). The second score $MISP^{SYY}$ is based on the 11 anomalies used in Stambaugh et al. (2012). Both studies show that their anomaly sets are related to mispricing, dominated by the overpricing in terms of persistence and magnitude, respectively, in the short legs of the anomalies considered. Dong, Li, Li, Rapach, and Zhou (2024) further argues that their anomalies perform well in capturing systematically important overpricing in the sense that the overpricing within the short-leg segment of the market is informative about the overpricing in the aggregate market. The mispricing (decile) score has an average around

5.4 and a standard deviation of around 2.8, as shown in Panel C of Table 2.

Columns (1) and (2) of Table 7 show that $LenderExits$ is statistically significantly associated with more overpricing at the 1% level across all specifications. The relation is also economically important. Using $MISP^{DLRZ}$ as an example, since the score is a decile ranking measure, the coefficient estimate on the $LenderExits \geq 5\%$ dummy in column (1) suggests that a stock's overpricing ranking moves up by about 18.5 percentiles on average during the six months following lender exists. This move equals to 70% of the standard deviation of the mispricing score, which is substantial. Similarly, based on the SYY mispricing measure, stocks that experienced lender exits becomes more overvalued by about 11.2 percentiles (column 2). This is consistent with our conjecture that stocks experiencing a reduction in lending supply and an increase in short-sale constraint are more likely to be overpriced.

Limits-to-arbitrage slows the incorporation of new information into stock prices. In columns (3) to (6) of Table 7, we consider other alternative price (in)efficiency measures as the dependent variable in Equation 10. We compute measures of the inverse of price efficiency ($Delay$) using the $Delay3$ measure in Hou and Moskowitz (2005). Higher values of $Delay$ indicate more price delay, which indicates worse price efficiency. Return volatility measures ($Volatility$ and $IdioVol$) are computed using daily returns following Ang, Hodrick, Xing, and Zhang (2006). The extreme positive return measure ($MaxRet$) is computed as the maximum daily return during a month following Bali, Cakici, and Whitelaw (2011). Theoretical work of Abreu and Brunnermeier (2002, 2003); Scheinkman and Xiong (2003) shows that short sales constraints is a direct cause of, or at least a necessary condition for, excessive volatility. Empirically, higher return volatility or idiosyncratic volatility is shown to be associated with informationally inefficient prices (Lau, Ng, and Zhang, 2012), especially overpricing (see, e.g., Stambaugh, Yu, and Yuan, 2015). The extreme positive return measure ($MaxRet$) is computed as the maximum daily return during a month following Bali, Cakici, and Whitelaw (2011). To the extent that extreme movements may be driven by overoptimism or speculative trading, more severe short-sale constraints prevent bearish bets

from counterbalancing such extreme price movements. Consequently, the $MaxRet$ measure could capture price inefficiencies. To ease interpretation, all the price efficiency measures are standardized to have a mean of zero and a unit standard deviation.

Table 7 shows that $LenderExits$ is significantly positively associated with higher price inefficiency across all measures. During Month t+1 to t+6, $LenderExits$ is associated with 13% higher price delay, 33% higher return volatility, 31% higher idiosyncratic volatility, and 24% higher $MaxRet$ on average relative to these variables' standard deviation. These results suggest that limits to arbitrage induced by reduced lending supply prevent short sellers from impounding their information into security prices. As a result, stocks prices are less informational efficient and more susceptible to overpricing.

Overall, our results in this section provide robust and economically important evidence that lender exits are associated with inefficient prices and particularly overpricing. Lender exits are associated with a small reduction in supply relative to the total supply level (comparing the coefficient of 1.77% on $LenderExists$ in Table 4 with the level of total lendable shares averaged at 26.7%, as shown in Table 1). Yet, they are very consequential for returns, mispricing, and pricing inefficiency. In contrast, changes in the traditional lending supply measure (ΔLendable shares) are insignificantly (at the 5% level) related to returns, mispricing, and price efficiency measures in all tests in both Table 6 and Table 7. Therefore, our results highlight that our lender-based measure of lending supply changes is more apt at identifying overpricing and pricing inefficiencies.

3.3 Trading by informed investors

If stocks are overpriced, informed traders might trade against the overvaluation by selling the shares. Therefore, to provide more convincing evidence that the stocks experiencing lender exits are overpriced, we examine whether informed investors trade against it. However, short sellers are constrained from lending the shares in the event of lender exits. As our return-related evidence in Table 6 suggests, the overpricing associated with lender exists

are only partially corrected after more than one year, consistent with equity lender base being fragmented with very few persistent lenders for each stock and arbitrageurs being constrained by this lender base. Nevertheless, two sets of informed investors are less subject to short-sale constraints: companies themselves, who can issue new shares, and company insiders, who have already owned company stocks. There is a long literature that indicates firms' issuance and repurchase behaviors are informative (e.g., Pontiff and Woodgate, 2008; Daniel and Titman, 2006). Similarly, trades made by corporate insiders, such as executives and directors, are shown to be predictive of future stock returns (Lakonishok and Lee, 2001).

We capture firms' trading using two measures. The first measure is used in Da, Dong, Wu, and Zhou (2022), *Net Firm Trading* (NFT), computed as the change in the split-adjusted shares outstanding over a month relative to its past 12-month average, scaled by the 12-month average. The measure essentially captures the abnormal net share issuance over a month. The second measure for firms' issuance, based on Daniel and Titman (2006), is *Composite Equity Issuance* (CEI), which is defined as the amount of equity a firm issues (or retires) in exchange for cash or services (i.e., percentage change in market equity value minus the return over the same period). Under this measure, seasoned issues and share-based acquisitions increase the issuance measure, while repurchases, dividends, and other actions that take cash out of the firm reduce this issuance measure.

To capture the trading by firm insiders, we consider the *Net Insider Sales* (NIS) measure in Da et al. (2022), computed as the negative change in the insider holdings over a month relative to insiders' past 12-month average holdings, scaled by the 12-month average. The measure again captures the abnormal net insider sales over a month. We estimate the following equation:

$$Firm(Insider)\ Trading_{i,t,t+6} = \alpha + \beta_1 LenderExits_{i,t} + \beta_2 \Delta MFHoldings_{i,t} + \gamma X_{i,t-1} + \epsilon_{i,t}, \tag{10}$$

where the dependent variable is firm (or insider) trading measured over month t+1 to t+6 af-

ter the quarter where $LenderExits$ is greater than or equal to 5%. To ease the interpretation of economic magnitude, we again standardize the outcome variables.

Table 8 shows that $LenderExits$ is significantly associated with higher firm share issuance for both firm trading measures. Taking NFT as an example, the coefficient estimate of 0.21 on $LenderExits$ in column (1) implies that abnormal net firm issuance is about 21% higher relative to its standard deviation. The estimate on CEI is almost identical. These results suggest that companies exploit the overpricing in stock experiencing lender exists by issuing more shares. This finding corroborates a recent study by Schultz (2021), who documents that some seasoned equity offerings (SEOs) are motivated by short-sale constraints. Similarly, insider sales are also 13% higher relative to NIS's standard deviation during the subsequent 6 months after the lender exits. These findings are consistent with our interpretation that firms are on average more overvalued when their short-sale constraints bind after lender exits.

3.4 Are risks associated with lender structure priced ex ante?

The analyses so far focus on the *ex post* asset pricing effects of lenders' exits. Our results suggest that lending fees subsequently spike and short sellers get partially squeezed out of the shorting market. From short sellers' perspective, such lender exit events impose considerable risks on their shorting strategies as they cannot find other reliable lenders to borrow shares at attractive terms for a period of time. The loss of such lenders is critical for arbitrageurs as arbitrage trades often take a long term to generate profits (e.g., Shleifer and Vishny, 1997). Such short-selling risks should be priced in the stock market *ex ante*.[25] In this section, we examine the relationship between lender structure and future stock returns.

Specifically, we argue that the concentration of equity lenders is a source of short-selling risks that short sellers should consider. Compare two stocks with similar levels of short interest but different lender concentration: The lending condition of the stock with a con-

[25] Engelberg et al. (2018) argue that short fee risk should be priced *ex ante*. Our argument is based on the same theoretical consideration, but we differ by introducing a micro-founded risk consideration.

centrated lender structure is more subject to the idiosyncratic shocks that force a few of their lenders to exit their positions, as compared to the stock with a more dispersed lender base. At the first glance, losing a few lenders may not seem significant. However, as our earlier evidence suggests, active lenders are usually persistent and thus reliable to short sellers. Consequently, unexpectedly losing even just a few of them could pose a significant risk to the continuation of a short-selling thesis. Taking this dynamic consideration into account, we expect stocks with a more concentrated lender base to be more short-sale constrained and to have lower average future returns than stocks whose lendership is more dispersed. The return spread is to compensate for the risks borne by short sellers. Put differently, for a stock with very few active lenders, arbitrageurs would only short it if the stock is extremely overvalued.

To empirically examine this relationship between lender concentration and stock returns, we use a longer time series (April 2006 to December 2022) and utilize the *LenderConcentration* measure provided by Markit. The variable *LenderConcentration* is a Herfindahl-Index-like measure at the stock level that describes the concentration of lenders. It takes the value between $(0, 1]$ where a very small number indicates a large number of lenders with low value on loan and 1 indicates a single lender with all the value on loan. Since there is a negative correlation between a stock's *LenderConcentration* and its short interest,[26] it is important that we control for stock short ratio when examining the return predictability of lender concentration.

To this end, we conduct dependent double sorts of stock on short ratios and lender concentration. Each month, we form portfolios by first sorting stocks into quintiles using the previous month's average daily short ratio and then sorting into terciles using the previous three months' average lender concentration (Markit's *LenderConcentration*). Panels A and B of Table 9 report average returns and Fama-French four-factor alphas for these portfolios. Conditional on the level of short interest in each row, the last column presents the portfolio

[26]Consider a stock with only one share being shorted, naturally all the on-loan share is provided by a single lender.

returns to a strategy that buys firms with the highest lender concentration and shorts firms with the lowest lender concentration.

For both average portfolio returns (Panel A) and the Fama-French four-factor alphas (Panel B), we find that stocks with a more concentrated lender structure underperform stocks whose lender base is more dispersed, when the level of short interest is within intermediate range (short interest quintiles 2, 3, and 4). The monthly underperformance of high-lender-concentration stocks ranges from 24 to 34 basis points per month. This is consistent with our hypothesis that lender concentration heightens short-selling risk and makes it more likely that short sellers need to replace key lenders in the future. Ex ante, short sellers require a higher level of compensation to short such stocks.

It also makes sense that stocks with high lender concentration only underperform when short interest is modest: For highest-short-interest stocks (quintile 5), the sorting on lender concentration generates a large-enough spread in the level of short interest within the quintile. In untabulated test we find that, within Quintile 5 of high-short-interest stocks, stocks with high lender concentration have a short ratio that is almost four percentage points lower than stocks with low lender concentration. Given it is well known that a high short interest itself predicts lower future stock return (e.g., Boehmer, Jones, and Zhang, 2008), the predictive power of short interest and the predictive power of lender concentration offset each other in the high-short-interest quintile.

In the last row of each panel, we average across the five short interest-sorted groups and calculate the average return difference between stock with high lender concentration and stocks with low lender concentration. The high-minus-low portfolio generates a monthly return of -24 basis points and a four-factor alpha of -16 basis points, both of which are statistically significant. Therefore, controlling for the predictability of short interest on average, lender concentration provides significant information about future returns.

4 Conclusions

In this paper, we use novel position-level equity lending data from mutual funds to uncover several new, stylized facts about securities lending activities. Shares are lent out repeatedly by a small set of mutual fund shareholders, suggesting heterogeneity at the lender-stock level in supply the securities to short sellers. When a significant portion of current lenders exit their holdings, the lending market experiences a contraction in the supply of shares and a spike in lending fees. These findings suggest that short sellers might be more constrained than conventional statistics suggest: even when the aggregate lendable shares seem abundant, potential lenders do not appear to step in under similar terms to provide lending supply when existing lenders are no longer able to lend shares. Consequently, short sellers are exposed to the risk of recalled shares and spiking lending fees.

Constrained lending supply caused by lender exits also has the potential to distort equity prices. We find that stocks experiencing lender exits generate abnormally high returns in the months following the lender exits before reversing later. Various price efficiency measures suggest that the price of affected stocks becomes less efficient. Finally, informed parties seem to trade against such mispricing induced by limits-to-arbitrage. In particular, after the contraction of equity lending market, affected companies take advantage of the favorable valuation to issue more shares. Overall, our findings suggest that lending-side frictions, previously understudied, significantly hamper market efficiency.

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Figure 1. Probability of a stock position lent out by a mutual fund

This figure shows the probability that a mutual fund stock holding is lent out in a given quarter. In addition to the unconditional probability, we also tabulate the lending probability for a position that is (i) held and lent out by the same fund in the previous quarter, (ii) held and not lent out by the same fund in the previous quarter, and (iii) not held by the fund in the previous quarter.

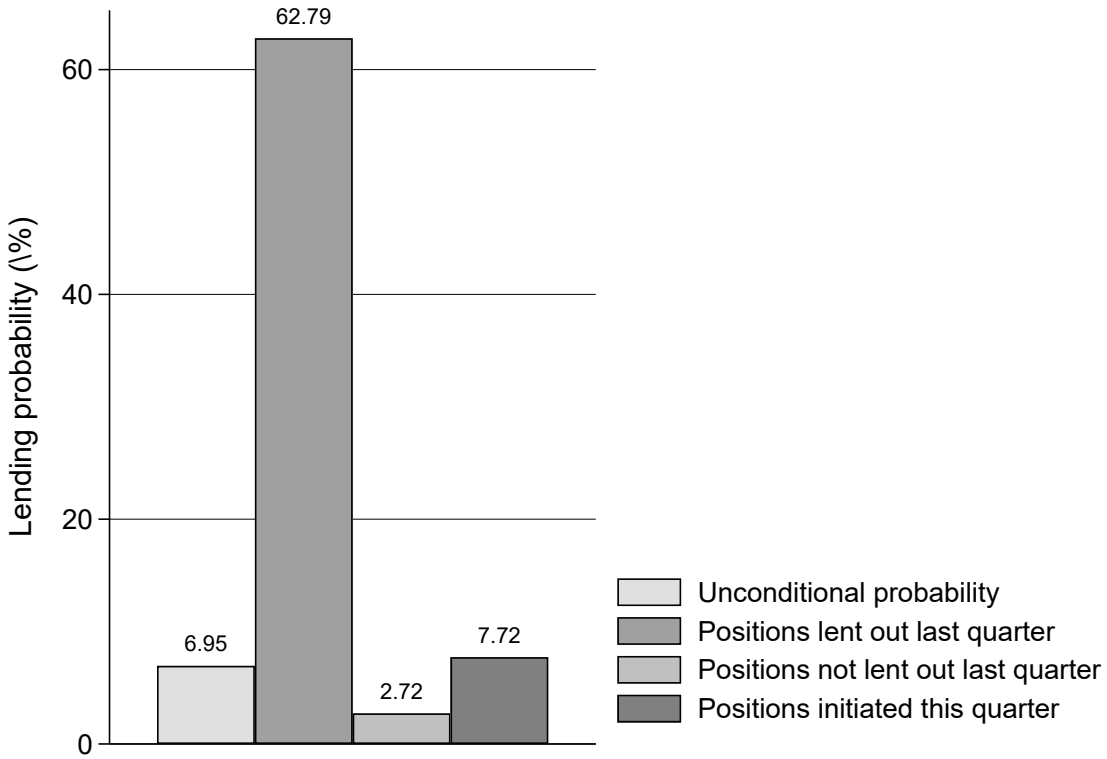
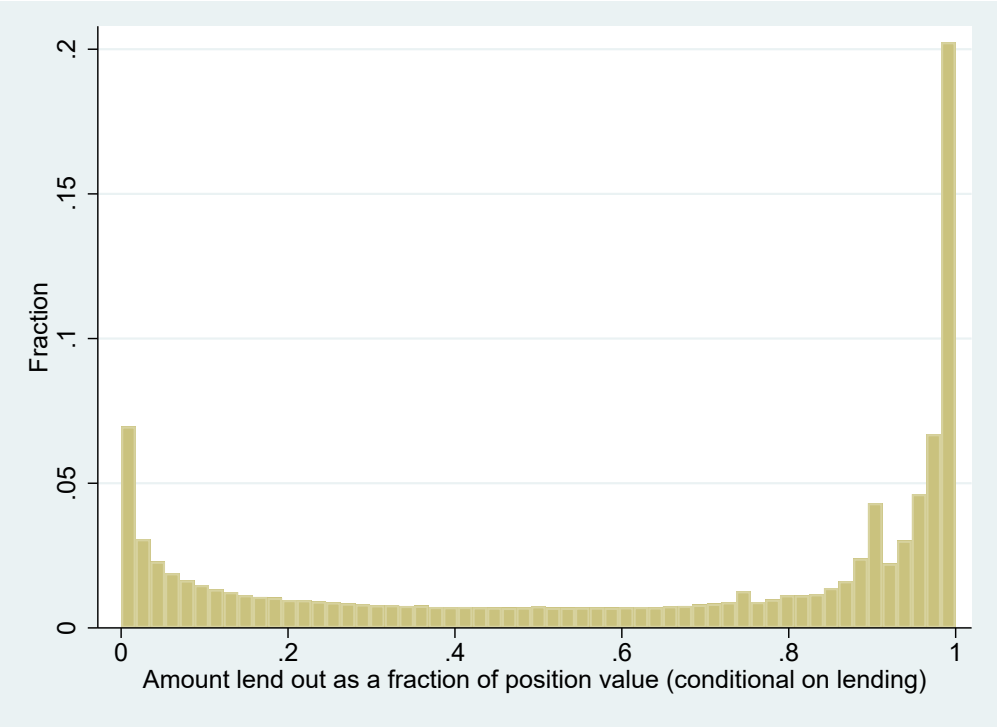
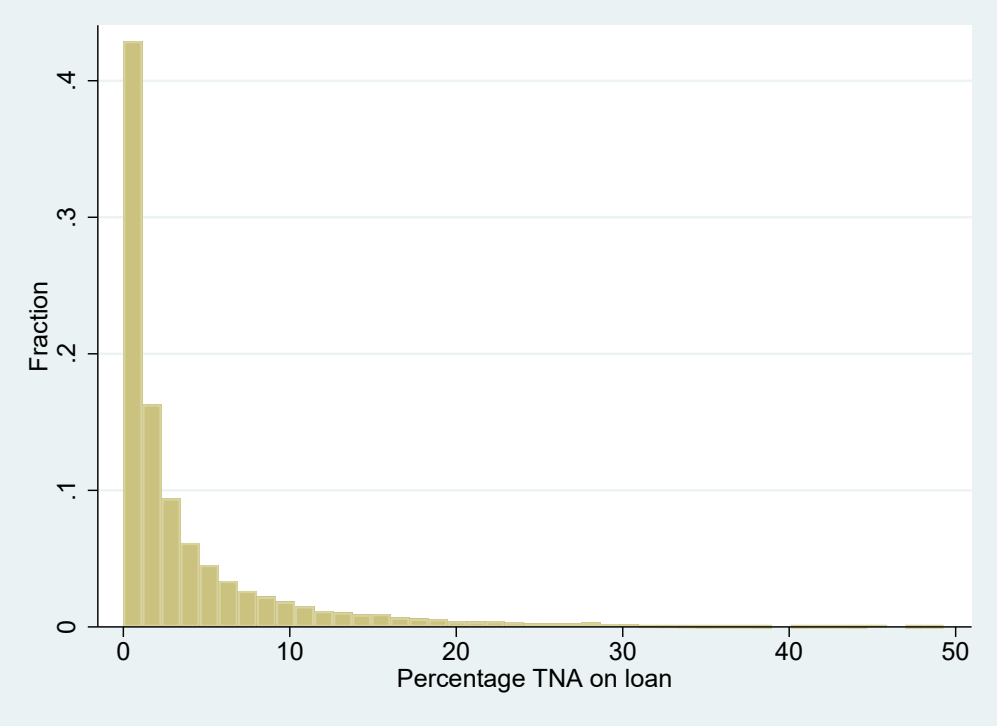


Figure 2. Distribution of mutual fund securities lending (conditional on lending)

These figures show the fractions of assets loaned out conditional on securities lending. Panel (a) shows the fraction of value on loan for a given security holding, conditional on the said security holding being loaned out. Panel (b) shows that fraction of TNA on loan for a given fund–quarter, conditional on the fund engages in a positive amount of securities lending.



(a) Fraction of value loaned out for a given stock holding



(b) Fraction of TNA loaned out for a given fund

Figure 3. Shares of securities lending by different set of mutual funds

This figure shows the share of securities lending done by different set of mutual funds relative to the total dollar value lent out by all mutual funds for the same stock. Past lenders refer to mutual funds that lent out the same stock in the previous quarter-end. Non-lenders refer to mutual funds that held the stock last quarter but did not lend out its shares. New investors refer to mutual funds that did not hold shares of the stock last quarter and only purchased the stock this quarter.

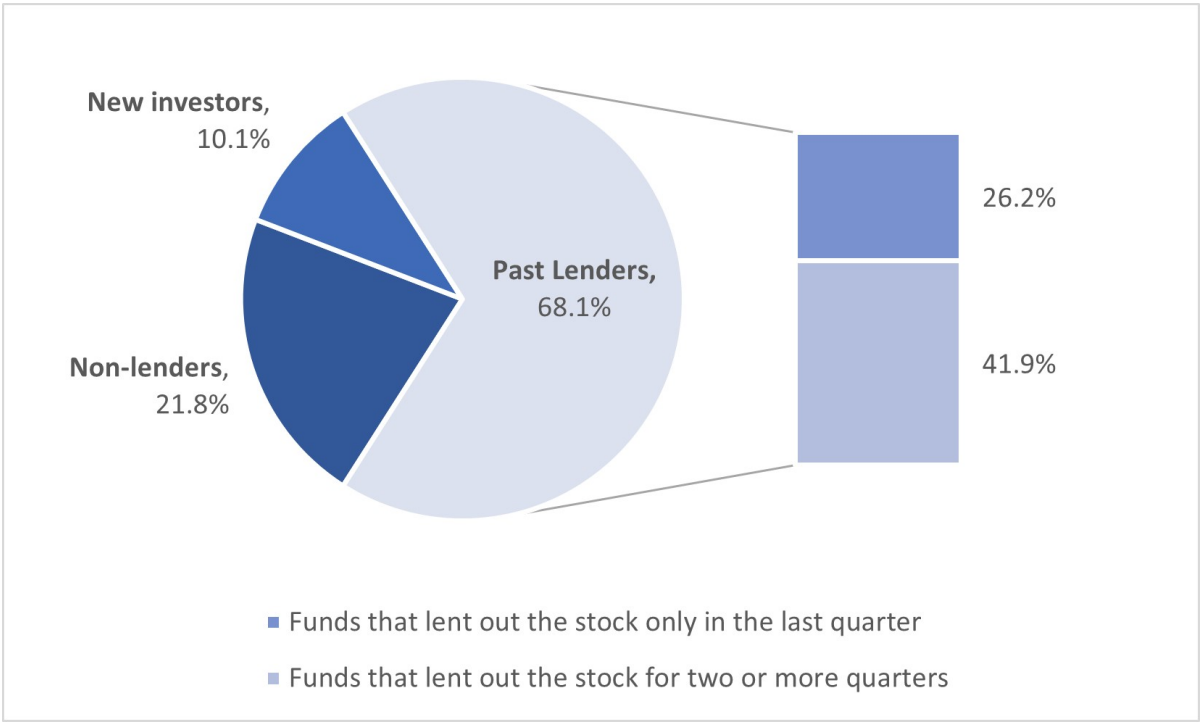


Figure 4. The effect of position exits by existing security lenders on lending fees

This figure shows the dynamic impact on securities lending fee surrounding a significant lender exit events, defined as stock–quarters where a stock's $LenderExits \geq 5\%$. The lending fee is adjusted by the cross-sectional median lending fee. Each point and range represents the β_k estimates and the associated 95% confidence intervals from the following equation:

$$LendingFee_{i,t} = \alpha_i + \sum_{k=-3}^{9} \beta_k \cdot \mathbb{1}^{k \text{ month from lender exit events}} + \epsilon_{i,t},$$

where the standard errors are clustered at the stock level.

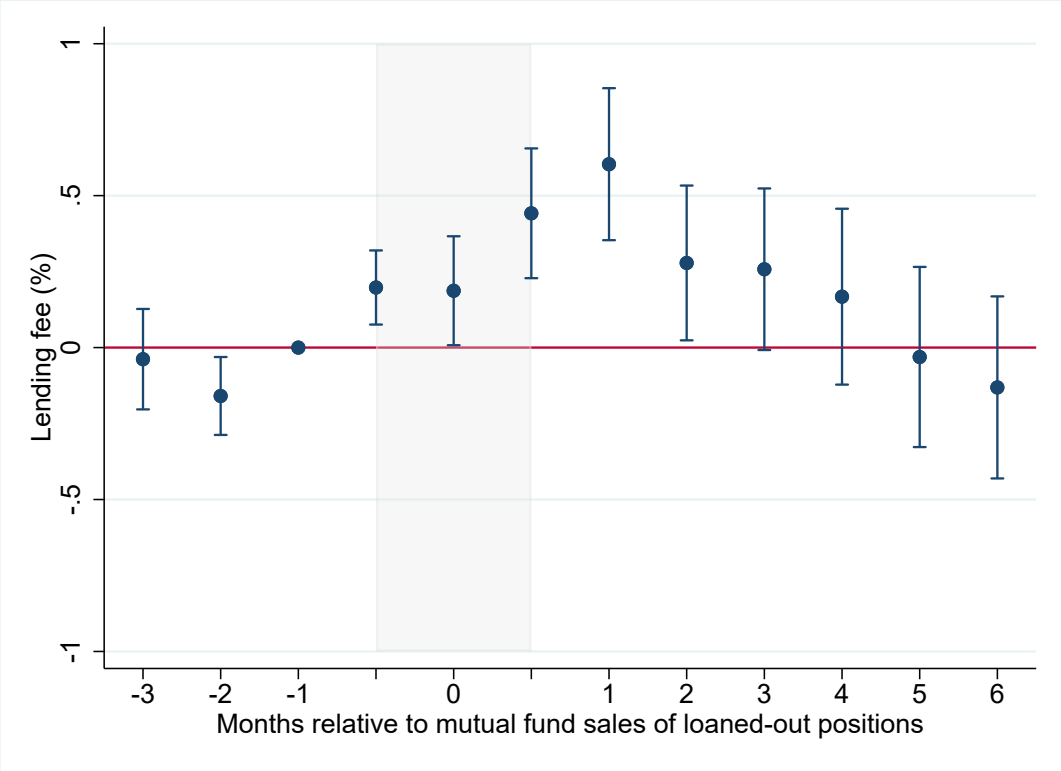


Table 1. Sample of funds by year

This table shows the number of sample funds, the number of sample funds with positive securities lending, the percentage of security-lending funds in the cross section, and the total value of securities on loan in each quarter of our sample.

Quarter	Number of funds	Number of funds with securities on loan	% of funds with securities on loan	Total value ($bil) of securities on loan
2019q3	2,089	883	42.26	68.90
2019q4	3,505	1,654	47.18	114.23
2020q1	3,850	1,737	45.11	101.17
2020q2	3,688	1,584	42.95	106.27
2020q3	3,932	1,693	43.05	93.93
2020q4	3,894	1,670	42.88	96.26
2021q1	4,040	1,647	40.76	98.12
2021q2	4,013	1,712	42.66	109.80
2021q3	4,006	1,724	43.03	110.02
2021q4	3,979	1,704	42.82	105.16
2022q1	4,169	1,752	42.02	114.74
2022q2	4,135	1,741	42.10	107.54

Table 2. Summary statistics

This table shows the summary statistics of the dependent variables and independent variables used in the paper.

Panel A: Fund–stock–quarter level variables	N	Average	Std Dev	P25	Median	P75
Position is on loan this quarter	6,818,772	0.070	0.254	0.000	0.000	0.000
Same fund lent out the stock last quarter	6,818,772	0.057	0.232	0.000	0.000	0.000
Same fund held the stock but not lent last quarter	6,818,772	0.775	0.418	1.000	1.000	1.000
Same fund lent out the stock two quarters ago	6,818,772	0.047	0.212	0.000	0.000	0.000
Same-family funds lent out the stock last quarter	6,818,772	0.176	0.381	0.000	0.000	0.000
Same-lending-agent funds lent out the stock last quarter	6,818,772	0.224	0.417	0.000	0.000	0.000
Stock's weight in fund portfolio (%)	6,818,772	0.427	0.885	0.026	0.106	0.422
Percentage ownership fund holds in the company	6,818,772	0.141	0.468	0.003	0.015	0.071
Stock's style distance to fund average style	6,818,772	2.896	1.360	1.928	2.897	3.698
Past 12-month fund return	6,818,772	0.186	0.197	0.041	0.175	0.332
Ln(Fund TNA)	6,818,772	6.534	2.238	5.229	6.597	8.018
Ln(Fund family TNA)	6,818,772	10.928	3.623	8.301	11.651	13.634
Fund expense ratio	6,818,772	0.006	0.004	0.002	0.006	0.009
Fund portfolio turnover	6,818,772	0.511	0.517	0.180	0.470	0.648
D(Affiliated lending agent)	6,818,772	0.237	0.425	0.000	0.000	0.000
D(Fund is an index fund (non-ETF))	6,818,772	0.278	0.448	0.000	0.000	1.000
D(Fund is an ETF)	6,818,772	0.266	0.442	0.000	0.000	1.000
Panel B: Stock–quarter level variables	**N**	**Average**	**Std Dev**	**P25**	**Median**	**P75**
Δ Lendable shares (%)	36,045	0.219	3.652	-0.606	0.262	1.363
Δ Short ratio (%)	36,045	-0.022	1.982	-0.586	-0.011	0.523
Δ DCBS fee score	36,045	-0.010	0.886	0.000	0.000	0.000
Δ Lending fee	36,045	-0.147	3.403	-0.046	-0.001	0.036
Lagged lendable shares (%)	36,045	26.692	15.373	12.902	27.901	39.457
Lagged short ratio (%)	36,045	3.297	4.938	0.403	1.421	4.140
Lagged DCBS fee score	36,045	1.639	1.818	1.000	1.000	1.000
Lagged Lending fee	36,045	2.758	11.084	0.279	0.301	0.451
$LenderExits$	36,045	0.015	0.068	0.000	0.000	0.002
$LenderExits \geq 5\%$	36,045	0.068	0.252	0.000	0.000	0.000
Fund flows to securities lenders	36,045	-0.001	0.006	-0.003	-0.000	0.000
$NonLenderExits$	36,045	0.057	0.149	0.002	0.014	0.041
Flows to non-lending mutual fund owners	36,045	-0.005	0.036	-0.017	-0.007	0.004
Mutual fund ownership	36,045	0.234	0.162	0.091	0.223	0.361
Ownership by index funds	36,045	0.022	0.016	0.008	0.020	0.035
Ownership by ETFs	36,045	0.103	0.072	0.042	0.093	0.153
Log(Market Cap)	36,045	7.033	2.102	5.495	7.038	8.453
Book-to-market ratio	36,045	0.667	0.706	0.212	0.464	0.880
Gross profitability	36,045	0.187	0.245	0.039	0.172	0.319
Past 6-month return	36,045	0.099	0.446	-0.142	0.073	0.294
Monthly stock turnover	36,045	0.266	0.390	0.093	0.157	0.274
Bid-ask spread	36,045	0.004	0.009	0.000	0.001	0.004

Table 2. Summary statistics (continued)

Panel C: Stock–month level variables	N	Average	Std Dev	P25	Median	P75
MISP DLRZ	43,499	5.31	2.62	3.17	5.17	7.50
MISP SYY	43,499	5.32	2.70	3.00	5.33	7.67
Delay	64,140	10.84	0.18	10.80	10.90	10.95
Volatility	64,994	10.96	0.02	10.96	10.97	10.98
Idio Vol	64,987	8.29	2.00	7.64	8.84	9.57
MaxRet	64,994	10.92	0.07	10.90	10.93	10.96
NFT	87,143	0.06	0.16	0.00	0.00	0.04
CEI	87,098	0.19	0.70	-0.03	0.00	0.08
NIS	83,471	0.17	0.67	0.00	0.02	0.16

Table 3. Determinants of position-level securities lending

This table shows the determinants of whether a (fraction of) fund–stock holding is on loan. The observations are at the fund–stock–quarter level. The sample contains all domestic equity funds' stock holdings between 2019Q3 and 2022Q2. The dependent variable, D(Position on loan), is set of one if a positive amount of fund–stock holding is on loan, and zero otherwise. In column (5), only stocks with a lending fee greater than 100 basis points are included. The first five explanatory variables are binary indicators. Standard errors are double-clustered at the stock level and the fund level, and are shown in parentheses. ***, **, and * represent result significant at 1%, 5%, and 10% level, respectively.

Dependent variable: D(Position on loan)					
Sample	Full sample				Fee >100bps
	(1)	(2)	(3)	(4)	(5)
Same fund lent out the stock last quarter	0.463***	0.389***	0.394***	0.421***	0.349***
	(0.009)	(0.006)	(0.008)	(0.008)	(0.014)
Same fund held the stock but not lent last quarter	-0.0189***	-0.0224***	-0.0133***	-0.0339***	-0.127***
	(0.002)	(0.002)	(0.001)	(0.002)	(0.013)
Same fund lent out the stock two quarters ago		0.170***			
		(0.005)			
Same-family funds lent out the stock last quarter				0.0300***	
				(0.004)	
Same-lending-agent funds lent out the stock last quarter				0.0371***	
				(0.003)	
Stock's weight in fund portfolio (%)	0.000305	0.000355	0.00131***	0.000941	0.0119*
	(0.001)	(0.001)	(0.000)	(0.001)	(0.007)
Percentage ownership fund holds in the company	0.0125*	0.0107*	-0.000256	0.0142**	0.0180***
	(0.006)	(0.006)	(0.002)	(0.006)	(0.007)
Stock's style distance to fund average style	-0.00188***	-0.00169***	-0.000687*	-0.00179***	-0.00401
	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)
Past 12-month fund return	-0.0814***	-0.0694***		-0.0788***	-0.263***
	(0.017)	(0.015)		(0.016)	(0.078)
Ln(Fund TNA)	0.00479***	0.00420***		0.00423***	0.0229***
	(0.001)	(0.001)		(0.001)	(0.006)
Ln(Fund family TNA)	-0.00333***	-0.00304***		-0.00238***	-0.00614*
	(0.001)	(0.001)		(0.001)	(0.003)
Fund expense ratio	-1.524**	-1.375**		-1.319**	-3.272
	(0.701)	(0.633)		(0.661)	(3.438)
Fund portfolio turnover	-0.00167	-0.00103		-0.00146	0.0150
	(0.002)	(0.002)		(0.002)	(0.016)
D(Affiliated lending agent)	0.0171***	0.0151***		0.0123***	0.0515***
	(0.004)	(0.003)		(0.003)	(0.019)
D(Fund is an index fund (non-ETF))	-0.00728	-0.00719		-0.00840*	0.0125
	(0.005)	(0.005)		(0.005)	(0.023)
D(Fund is an ETF)	0.0120*	0.0112*		0.0122**	0.0482*
	(0.006)	(0.006)		(0.006)	(0.028)
Observations	6,818,772	6,818,772	6,818,772	6,818,772	280,168
Adjusted R^2	0.414	0.427	0.464	0.419	0.436
Stock-by-quarter FE	Y	Y	Y	Y	Y
Fund style-by-quarter FE	Y	Y	NA	Y	Y
Fund-by-quarter FE	N	N	Y	N	N

Table 4. The effect of loan termination on securities lending market

This table estimates the effect of the position exits of a stock's equity lenders on securities lending outcomes. The observations are at the stock–quarter level. The sample period spans 2019Q4 and 2022Q2. The variable $LenderExits \geq 5\%$ is a binary indicator. The variable $LenderExits$ is defined as the the number of shares lent out (measured at quarter $t-1$) by mutual funds that exit its position between quarters $t-1$ and t, scaled by the stock's total number of shares on loan in quarter $t-1$. All outcome variables are measured as changes between quarters $t-1$ and t. Control variables (except $LenderExits$ and $NonLenderExits$) are measured at quarter $t-1$. In column (5), only stock–quarters with lagged utilization ratio below 10% are included. Standard errors are clustered at the stock level, and are shown in parentheses. ***, **, and * represent result significant at 1%, 5%, and 10% level, respectively.

Panel A

Sample	Full sample				Utilization <10%
Dependent variable Δy	ΔSupply	ΔShortRatio	ΔDCBS	ΔFee	ΔFee
	(1)	(2)	(3)	(4)	(5)
$LenderExits \geq 5\%$	-1.770***	-0.190***	0.131***	0.300***	0.133**
	(0.115)	(0.056)	(0.025)	(0.082)	(0.056)
$NonLenderExits$	-6.807***	0.105	-0.00907	0.550***	0.0227
	(0.343)	(0.100)	(0.057)	(0.199)	(0.111)
Mutual fund ownership	5.392***	-0.462***	-0.133***	-0.120	-0.166***
	(0.474)	(0.113)	(0.034)	(0.105)	(0.045)
Ownership by index funds	-10.93***	-0.0368	1.448***	1.803	-1.030
	(3.166)	(1.341)	(0.463)	(1.687)	(0.640)
Ownership by ETFs	7.797***	-0.261	-0.753***	-1.026**	-0.448***
	(0.914)	(0.330)	(0.119)	(0.424)	(0.172)
Log(Market Cap)	0.285***	-0.000390	-0.0375***	-0.0590***	-0.0280***
	(0.017)	(0.005)	(0.003)	(0.011)	(0.006)
Book-to-market ratio	-0.0269	-0.0249	-0.00428	0.0788*	0.0201
	(0.033)	(0.016)	(0.010)	(0.046)	(0.023)
Gross profitability	0.128*	0.0280	-0.0591***	-0.0472	0.0514
	(0.077)	(0.039)	(0.023)	(0.081)	(0.048)
Past 6-month return	0.178***	-0.0868***	-0.197***	-0.519***	-0.0625**
	(0.056)	(0.033)	(0.018)	(0.073)	(0.030)
Monthly stock turnover	0.194***	-0.129***	0.185***	0.334***	0.254**
	(0.065)	(0.045)	(0.027)	(0.123)	(0.114)
Bid-ask spread	-22.22***	-1.347	6.798***	24.59***	13.74***
	(1.991)	(0.871)	(1.177)	(4.112)	(2.372)
Change in lendable shares		0.145***	0.00741***	0.00837	0.00474**
		(0.007)	(0.002)	(0.006)	(0.002)
Observations	36077	36077	36077	36077	21968
Adjusted R^2	0.163	0.091	0.121	0.221	0.169
Control for lagged y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y

Table 4. The effect of loan termination on securities lending market (continued)

Panel B

Sample:	Low capacity from non-exiting lenders			High capacity from non-exiting lenders		
Dependent variable Δy	ΔShortRatio	ΔDCBS	ΔFee	ΔShortRatio	ΔDCBS	ΔFee
	(1)	(2)	(3)	(4)	(5)	(6)
$LenderExits \geq 5\%$	-0.441***	0.216***	0.526***	-0.0174	0.0780***	0.157**
	(0.094)	(0.047)	(0.167)	(0.066)	(0.026)	(0.076)
$NonLenderExits$	0.246**	-0.0666	0.479**	-0.152	0.118	0.517
	(0.114)	(0.062)	(0.234)	(0.187)	(0.154)	(0.440)
Mutual fund ownership	-0.497***	-0.172***	-0.241	-0.584***	-0.0699*	0.0749
	(0.184)	(0.055)	(0.171)	(0.166)	(0.039)	(0.108)
Ownership by index funds	-2.667	3.348***	5.415**	2.883	-0.502	-1.629
	(2.100)	(0.715)	(2.595)	(1.919)	(0.623)	(1.817)
Ownership by ETFs	0.645	-1.259***	-1.790***	-1.359***	-0.226	-0.252
	(0.505)	(0.193)	(0.684)	(0.476)	(0.144)	(0.439)
Log(Market Cap)	0.0160**	-0.0531***	-0.0852***	-0.00368	-0.0249***	-0.0366**
	(0.007)	(0.005)	(0.017)	(0.008)	(0.004)	(0.016)
Book-to-market ratio	-0.00330	-0.0247	0.0624	-0.0361	0.0103	0.0846
	(0.025)	(0.015)	(0.067)	(0.024)	(0.015)	(0.059)
Gross profitability	-0.0647	-0.104**	-0.114	0.113**	-0.0304	-0.0113
	(0.073)	(0.042)	(0.144)	(0.053)	(0.027)	(0.089)
Past 6-month return	-0.0349	-0.288***	-0.860***	-0.168***	-0.0929***	-0.148**
	(0.053)	(0.031)	(0.129)	(0.042)	(0.020)	(0.072)
Monthly stock turnover	-0.205***	0.227***	0.463***	0.146*	0.0480	-0.0719
	(0.059)	(0.035)	(0.161)	(0.083)	(0.045)	(0.183)
Bid-ask spread	3.432**	8.917***	32.26***	-5.204***	4.698***	17.30***
	(1.415)	(1.764)	(6.211)	(1.132)	(1.420)	(5.087)
Change in lendable shares	0.140***	0.0126***	0.0177*	0.149***	0.00132	-0.00171
	(0.009)	(0.002)	(0.010)	(0.010)	(0.002)	(0.006)
Observations	17840	17840	17840	18237	18237	18237
Adjusted R^2	0.093	0.131	0.231	0.094	0.129	0.219
Control for lagged y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y

Table 5. Effects of fund flows to existing lenders on securities lending market

This table estimates the effect of fund flows to a stock's existing equity lenders on securities lending outcomes. The observations are at the stock–quarter level. The sample period spans 2019Q4 and 2022Q2. The variable $LenderFlow$ is measured as weighted-average quarterly fractional flows to all mutual funds that lent their holdings of stock i, where the weight is each fund's on-loan shares. $NonLenderFlow$ is the weighted-average quarterly flow to all mutual funds that held stock i but did not lend, where the weight is each fund's holdings. All outcome variables are measured as changes between quarters $t-1$ and t. Control variables (except $LenderFlow$ and $NonLenderFlow$) are measured at quarter $t-1$. Standard errors are clustered at the stock level, and are shown in parentheses. ***, **, and * represent result significant at 1%, 5%, and 10% level, respectively.

Dependent variable Δy	ΔSupply	ΔShortRatio	ΔDCBS	ΔFee
	(1)	(2)	(3)	(4)
Fund flows to securities lenders	18.86***	4.219**	-2.749***	-8.311***
	(3.106)	(2.105)	(0.749)	(2.369)
Flows to non-lending mutual fund owners	1.690***	0.119	-0.0343	-0.296
	(0.537)	(0.353)	(0.148)	(0.596)
Mutual fund ownership	5.590***	-0.283**	-0.139***	-0.202*
	(0.475)	(0.119)	(0.035)	(0.108)
Ownership by index funds	-14.21***	-2.979**	1.287***	2.064
	(3.296)	(1.369)	(0.457)	(1.679)
Ownership by ETFs	8.309***	-0.308	-0.744***	-1.184***
	(0.939)	(0.339)	(0.118)	(0.434)
Log(Market Cap)	0.299***	0.0163***	-0.0380***	-0.0606***
	(0.017)	(0.005)	(0.003)	(0.011)
Book-to-market ratio	-0.0662*	-0.0574***	-0.00796	0.0767*
	(0.036)	(0.017)	(0.010)	(0.047)
Gross profitability	0.179**	0.0122	-0.0658***	-0.0588
	(0.081)	(0.041)	(0.022)	(0.081)
Past 6-month return	0.501***	-0.00990	-0.204***	-0.559***
	(0.057)	(0.036)	(0.018)	(0.073)
Monthly stock turnover	-0.268***	-0.174***	0.192***	0.397***
	(0.065)	(0.048)	(0.026)	(0.123)
Bid-ask spread	-9.695***	-0.526	6.549***	23.40***
	(1.880)	(0.913)	(1.176)	(4.102)
Observations	36332	36332	36332	36332
Adjusted R^2	0.064	0.020	0.120	0.220
Control for lagged y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y

Table 6. Lender exits and stock returns

This table estimates the effect of the position exits of a stock's equity lenders on stock returns. The observations are at the stock–month level. The sample period spans 2019Q4 and 2022Q2. The variable $LenderExits \geq 5\%$ is a binary indicator. The variable $LenderExits$ for each month t is defined as the the number of shares lent out (measured at the last quarter) by mutual funds that exit its position between the current quarter and the last quarter, scaled by the stock's total number of shares on loan at the end of last quarter. Control variables are measured at the same month as $LenderExits$. Standard errors are double-clustered at the stock and the month level, and are shown in parentheses. ***, **, and * represent result significant at 1%, 5%, and 10% level, respectively.

Cumulative return over months:	$Ret_{t-2,t}$	$Ret_{t+1,t+3}$	$Ret_{t+4,t+6}$	$Ret_{t+7,t+12}$	$Ret_{t+13,t+18}$
	(1)	(2)	(3)	(4)	(5)
LenderExits $\geq 5\%$	0.0170**	0.0421**	0.0206	-0.0154	-0.0441***
	(0.007)	(0.017)	(0.024)	(0.023)	(0.014)
ΔMutual Fund Holdings	0.00783	-0.0248*	-0.0658***	-0.127***	-0.119***
	(0.009)	(0.013)	(0.013)	(0.023)	(0.019)
ΔLendable shares	-0.0225	-0.0722*	-0.0400	-0.0951	-0.0194
	(0.028)	(0.037)	(0.038)	(0.062)	(0.016)
Log(Market Cap)	-0.00189	-0.0110**	-0.00530	0.00320	0.0261***
	(0.002)	(0.005)	(0.005)	(0.008)	(0.003)
Book-to-market ratio	0.00508*	0.000417	0.00837	0.0373**	0.0414***
	(0.003)	(0.005)	(0.005)	(0.013)	(0.009)
Past 6-month return	0.0274***	-0.00414*	-0.00485	-0.0207***	-0.0127**
	(0.007)	(0.002)	(0.004)	(0.004)	(0.006)
Observations	64,776	64,776	64,776	64,776	64,776
Adjusted R2	0.198	0.191	0.174	0.316	0.126
Time FE	Y	Y	Y	Y	Y

Table 7. How do lender exits affect stock mispricing and price efficiency?

This table estimates the effect of the position exits of a stock's equity lenders on stock mispricing scores and price (in)efficiency measures. The mispricing score is a decile ranking that ranges between 1 and 10 with 10 being most likely overpriced and 1 being least likely overpriced. $MISP^{DLRZ}$ is a mispricing score based on the 100 anomalies in Dong et al. (2022). $MISP^{SYY}$ is a mispricing score based on the 11 anomalies in Stambaugh et al. (2012). *Delay* is the inverse of price efficiency measure *Delay*3 in Hou and Moskowitz (2005). Return volatility measures (*Volatility* and *IdioVol*) are computed using daily returns following Ang et al. (2006). The extreme positive return measure (*MaxRet*) is computed as the maximum daily return during a month following Bali, Cakici, and Whitelaw (2011). All price (in)efficiency measures are standardized. The observations are at the stock–month level. The sample period spans 2019Q4 and 2022Q2. The variable $LenderExits \geq 5\%$ is a binary indicator. The variable *LenderExits* for each month t is defined as the the number of shares lent out (measured at the last quarter) by mutual funds that exit its position between the current quarter and the last quarter, scaled by the stock's total number of shares on loan at the end of last quarter. Control variables are measured at the same month as *LenderExits*. Standard errors are double-clustered at the stock and the month level, and are shown in parentheses. ***, **, and * represent result significant at 1%, 5%, and 10% level, respectively.

	$MISP^{DLRZ}_{t+1,t+6}$	$MISP^{SYY}_{t+1,t+6}$	$Delay_{t+1,t+6}$	$RetVol_{t+1,t+6}$	$IdioVol_{t+1,t+6}$	$MaxRet_{t+1,t+6}$
	(1)	(2)	(3)	(4)	(5)	(6)
LenderExits $\geq$ 5%	1.85***	1.12***	0.13***	0.33***	0.31***	0.24***
	(0.106)	(0.128)	(0.034)	(0.027)	(0.026)	(0.028)
Δ Mutual Fund Holdings	2.38***	2.34***	0.37***	0.25***	0.26***	0.15***
	(0.181)	(0.175)	(0.058)	(0.050)	(0.046)	(0.042)
ΔLendable shares	0.49*	0.46	0.050	-0.10	-0.12	-0.15
	(0.271)	(0.308)	(0.048)	(0.074)	(0.084)	(0.093)
Log (Market Cap)	0.0048	-0.41***	-0.16***	-0.22***	-0.25***	-0.21***
	(0.026)	(0.027)	(0.009)	(0.011)	(0.013)	(0.012)
Book-to-market ratio	-0.64***	-0.44***	-0.018	-0.048**	-0.066***	-0.048**
	(0.098)	(0.081)	(0.016)	(0.018)	(0.017)	(0.017)
Past 6-month return	0.30***	0.16***	0.096**	0.14***	0.13***	0.096***
	(0.056)	(0.037)	(0.039)	(0.019)	(0.021)	(0.017)
Observations	43,499	43,499	64,140	64,994	64,987	64,994
Adjusted R2	0.091	0.132	0.146	0.396	0.395	0.298
Time FE	Y	Y	Y	Y	Y	Y

Table 8. Lender exits, firm stock issuance, and insider sales

This table estimates the effect of the position exits of a stock's equity lenders on firm and insider trading. The first measure is used in Da et al. (2022), Net Firm Trading (NFT), computed as the change in the split-adjusted shares outstanding over a month relative to its past 12-month average, scaled by the 12-month average. The second measure is based on Daniel and Titman (2006), composite equity issuance (CEI), defined as the amount of equity a firm issues (or retires) in exchange for cash or services (i.e., percentage change in market equity value minus the return over the same period). The third measure is Net Insider Sale (NIS) used in Da et al. (2022), computed as the negative change in the insider holdings over a month relative to insiders' past 12-month average holdings, scaled by the 12-month average. All firm and insider trading measures are standardized to have mean of zero and standard deviation of one. The observations are at the stock–month level. The sample period spans 2019Q4 and 2022Q2. The variable $LenderExits \geq 5\%$ is a binary indicator. The variable $LenderExits$ for each month t is defined as the the number of shares lent out (measured at the last quarter) by mutual funds that exit its position between the current quarter and the last quarter, scaled by the stock's total number of shares on loan at the end of last quarter. Control variables are measured at the same month as $LenderExits$. Standard errors are double-clustered at the stock and the month level, and are shown in parentheses. ***, **, and * represent result significant at 1%, 5%, and 10% level, respectively.

	Firm Issuance		Insider Sales
	$NFT_{t+1,t+6}$	$CEI_{t+1,t+6}$	$NIS_{t+1,t+6}$
	(1)	(2)	(3)
LenderExits $\geq$ 5%	0.21***	0.21***	0.13***
	(0.037)	(0.039)	(0.035)
ΔMutual Fund Holdings	0.64***	0.88***	0.20***
	(0.075)	(0.099)	(0.039)
ΔLendable shares	-0.20	0.21	0.48**
	(0.126)	(0.126)	(0.210)
Log(Market Cap)	-0.13***	-0.097***	0.020***
	(0.009)	(0.009)	(0.006)
Book-to-market ratio	-0.082***	-0.065***	-0.092***
	(0.023)	(0.022)	(0.022)
Past 6-month return	0.021***	0.16***	0.068***
	(0.007)	(0.020)	(0.016)
Observations	87,143	87,098	83,471
Adjusted R2	0.138	0.179	0.031
Time FE	Y	Y	Y

Table 9. Monthly portfolio returns conditioning on lender concentration

This table presents monthly returns, alphas, and lagged short ratios for portfolios calculated over the period April 2006 through December 2022. The portfolios are formed by first sorting into quintiles using the previous month's average daily short ratio and then sorting into terciles using the previous three months' average lender concentration (Markit's *LenderConcentration*). All portfolios are equal weighted and are held for one month. The last column in each panel (High - Low) shows differences between the high-concentration portfolio and the low-concentration portfolio. Panel A presents results using raw returns of portfolios. Panel B presents results using Fama-French four-factor alphas that account for market, size, value, and momentum factors. *t*-statistics are shown in parentheses.

Panel A: Monthly portfolio returns (%)

	Low Lender Concentration	Mid Lender Concentration	High Lender Concentration	High - Low
Short Interest:				
1 (Low)	0.88	0.78	0.54	-0.34
	(2.71)	(2.56)	(2.17)	(-1.92)
2	0.82	0.82	0.49	-0.33
	(2.29)	(2.12)	(1.27)	(-2.14)
3	0.78	0.78	0.49	-0.30
	(2.05)	(1.90)	(1.20)	(-2.29)
4	0.59	0.58	0.28	-0.31
	(1.46)	(1.33)	(0.62)	(-2.67)
5 (High)	0.35	0.39	0.42	0.07
	(0.70)	(0.81)	(0.84)	(0.53)
Average across 1 to 5	0.69	0.67	0.44	-0.24
	(1.79)	(1.71)	(1.16)	(-2.70)

Panel B: Monthly portfolio Fama-French 4-factor alphas (%)

	Low Lender Concentration	Mid Lender Concentration	High Lender Concentration	High - Low
Short Interest:				
1 (Low)	0.29	0.33	0.20	-0.09
	(2.80)	(2.44)	(1.35)	(-0.63)
2	0.12	0.16	-0.13	-0.25
	(1.56)	(1.57)	(-0.82)	(-1.69)
3	0.06	0.09	-0.17	-0.24
	(0.98)	(1.19)	(-1.63)	(-2.01)
4	-0.15	-0.16	-0.46	-0.31
	(-2.07)	(-2.19)	(-4.65)	(-3.14)
5 (High)	-0.47	-0.39	-0.37	0.10
	(-3.09)	(-3.66)	(-2.94)	(0.74)
Average across 1 to 5	-0.03	0.01	-0.19	-0.16
	(-0.65)	(0.12)	(-2.16)	(-2.06)

Appendix

Figure A1. Distribution of *LenderExits* Conditional on Positive Value

This figure shows the distribution of *LenderExits* variable, conditional on $LenderExits > 0$. The variable *LenderExits* is defined as the the number of shares lent out (measured at quarter $t-1$) by mutual funds that exit its position between quarters $t-1$ and t, scaled by the stock's total number of shares on loan in quarter $t-1$.

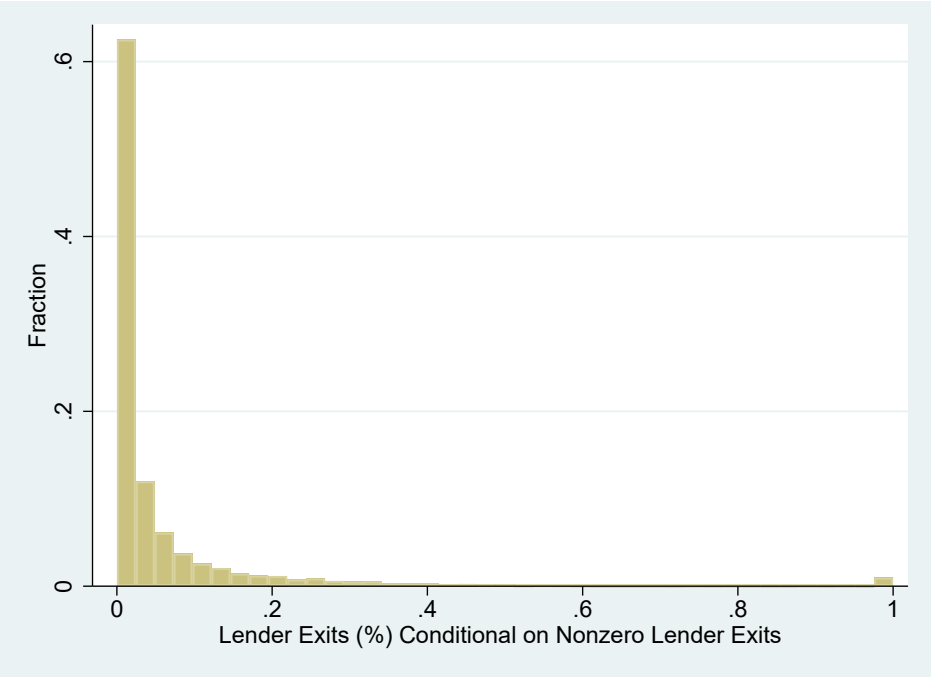


Table A1. Determinants of position-level securities lending

This table shows the determinants of the fraction of a mutual fund's stock holding that is on loan. If a position is not on loan, the dependent variable is set to zero. The observations are at the fund–stock–quarter level. The sample contains all domestic equity funds' stock holdings between 2019Q3 and 2022Q2. In column (4), only stocks with a lending fee greater than 100 basis points are included. In column (5), only stocks with a utilization ratio greater than 50 percent are included. The first three explanatory variables are binary indicators. Standard errors are double-clustered at the stock level and the fund level, and are shown in parentheses. ***, **, and * represent result significant at 1%, 5%, and 10% level, respectively.

Dependent variable: Fraction of position value on loan					
Sample	Full sample				Fee >100bps
	(1)	(2)	(3)	(4)	(5)
Same fund lent out the stock last quarter	0.267***	0.229***	0.238***	0.248***	0.248***
	(0.007)	(0.006)	(0.006)	(0.007)	(0.013)
Same fund held the stock but not lent last quarter	-0.0111***	-0.0129***	-0.00929***	-0.0180***	-0.0985***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.012)
Same fund lent out the stock two quarters ago		0.0871***			
		(0.004)			
Same-family funds lent out the stock last quarter				0.00922***	
				(0.003)	
Same-lending-agent funds lent out the stock last quarter				0.0204***	
				(0.002)	
Stock's weight in fund portfolio (%)	0.000254	0.000279	0.00134***	0.000486	0.00896
	(0.001)	(0.001)	(0.000)	(0.001)	(0.006)
Percentage ownership fund holds in the company	-0.0150***	-0.0159***	-0.0116***	-0.0142***	-0.0250***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.005)
Stock's style distance to fund average style	-0.000185	-0.0000882	-0.000307	-0.000148	0.000665
	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)
Past 12-month fund return	-0.0217**	-0.0155*		-0.0202**	-0.198***
	(0.009)	(0.008)		(0.009)	(0.065)
Ln(Fund TNA)	0.00146**	0.00116*		0.00128**	0.0134***
	(0.001)	(0.001)		(0.001)	(0.005)
Ln(Fund family TNA)	-0.00197***	-0.00183***		-0.00169***	-0.00567*
	(0.000)	(0.000)		(0.000)	(0.003)
Fund expense ratio	-0.824*	-0.747		-0.709	-3.632
	(0.497)	(0.467)		(0.476)	(2.910)
Fund portfolio turnover	-0.00124	-0.000919		-0.00115	0.00547
	(0.002)	(0.002)		(0.002)	(0.014)
D(Affiliated lending agent)	0.00571**	0.00470**		0.00441**	0.0217
	(0.002)	(0.002)		(0.002)	(0.016)
D(Fund is an index fund (non-ETF))	-0.000324	-0.000277		-0.000700	0.0216
	(0.004)	(0.004)		(0.004)	(0.020)
D(Fund is an ETF)	0.00106	0.000641		0.00106	-0.0125
	(0.004)	(0.004)		(0.004)	(0.022)
Observations	6812447	6812447	6912852	6812447	280153
Adjusted R^2	0.387	0.393	0.422	0.389	0.424
Stock-by-quarter FE	Y	Y	Y	Y	Y
Fund style-by-quarter FE	Y	Y	NA	Y	Y
Fund-by-quarter FE	N	N	Y	N	N

Table A2. The effect of loan termination on securities lending market: continuous *LenderExits*

This table estimates the effect of the position exits of equity lenders on securities lending outcomes. The observations are at the stock–quarter level. The sample period spans 2019Q4 and 2022Q2. The variable *LenderExits* is defined as the the number of shares lent out (measured at quarter $t-1$) by mutual funds that exit its position between quarters $t-1$ and t, scaled by the stock's total number of shares on loan in quarter $t-1$. All outcome variables, *LenderExits*, and *NonLenderExits* are measured at quarter t. Other control variables are measured at quarter $t-1$. Standard errors are clustered at the stock level, and are shown in parentheses. ***, **, and * represent result significant at 1%, 5%, and 10% level, respectively.

Panel A: *LenderExits* scaled by lagged total shares on loan

Dependent variable Δy	ΔSupply	ΔShortRatio	ΔDCBS	ΔFee
	(1)	(2)	(3)	(4)
LenderExits (scaled by shares on loan)	-5.242***	-0.387**	0.247**	0.745**
	(0.520)	(0.184)	(0.117)	(0.340)
NonLenderExits	-6.878***	0.0850	0.00661	0.569***
	(0.346)	(0.101)	(0.057)	(0.200)
Mutual fund ownership	5.325***	-0.468***	-0.131***	-0.113
	(0.473)	(0.114)	(0.034)	(0.104)
Ownership by index funds	-10.41***	-0.00632	1.436***	1.730
	(3.177)	(1.343)	(0.462)	(1.690)
Ownership by ETFs	7.708***	-0.254	-0.761***	-1.033**
	(0.914)	(0.331)	(0.119)	(0.425)
Log(Market Cap)	0.290***	0.000806	-0.0386***	-0.0607***
	(0.017)	(0.005)	(0.003)	(0.011)
Book-to-market ratio	-0.0198	-0.0240	-0.00512	0.0770*
	(0.033)	(0.016)	(0.010)	(0.046)
Gross profitability	0.146*	0.0311	-0.0617***	-0.0519
	(0.076)	(0.039)	(0.023)	(0.081)
Past 6-month return	0.222***	-0.0808**	-0.202***	-0.527***
	(0.056)	(0.033)	(0.018)	(0.073)
Monthly stock turnover	0.156**	-0.135***	0.190***	0.344***
	(0.065)	(0.045)	(0.027)	(0.122)
Bid-ask spread	-20.36***	-1.107	6.639***	24.27***
	(2.014)	(0.873)	(1.177)	(4.107)
Change in lendable shares		0.146***	0.00682***	0.00730
		(0.007)	(0.002)	(0.006)
Observations	36077	36077	36077	36077
Adjusted R^2	0.158	0.091	0.120	0.221
Control for lagged y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y

Table A2. The effect of loan termination on securities lending market: continuous *LenderExits* (continued)

Panel B: *LenderExits* scaled by lagged total shares outstanding

Dependent variable	ΔSupply (1)	ΔShortRatio (2)	ΔDCBS (3)	ΔFee (4)
LenderExits (scaled by shares outstanding)	-0.255***	-0.164**	0.0143***	0.0295
	(0.095)	(0.075)	(0.004)	(0.025)
NonLenderExits	-7.392***	0.0627	0.0281	0.635***
	(0.346)	(0.101)	(0.057)	(0.199)
Mutual fund ownership	5.233***	-0.450***	-0.132***	-0.114
	(0.472)	(0.114)	(0.034)	(0.104)
Ownership by index funds	-12.34***	-0.288	1.515***	1.955
	(3.206)	(1.340)	(0.463)	(1.685)
Ownership by ETFs	7.854***	-0.199	-0.780***	-1.087**
	(0.922)	(0.331)	(0.119)	(0.424)
Log(Market Cap)	0.304***	0.00272	-0.0395***	-0.0635***
	(0.017)	(0.005)	(0.003)	(0.011)
Book-to-market ratio	-0.0273	-0.0255	-0.00512	0.0770*
	(0.033)	(0.016)	(0.010)	(0.046)
Gross profitability	0.170**	0.0365	-0.0636***	-0.0571
	(0.077)	(0.039)	(0.023)	(0.080)
Past 6-month return	0.271***	-0.0774**	-0.204***	-0.533***
	(0.056)	(0.033)	(0.018)	(0.073)
Monthly stock turnover	0.133**	-0.126***	0.192***	0.351***
	(0.065)	(0.045)	(0.027)	(0.123)
Bid-ask spread	-18.48***	-0.858	6.571***	24.07***
	(1.960)	(0.877)	(1.179)	(4.110)
lag_lending_supply	-0.125***			
	(0.008)			
Change in lendable shares		0.146***	0.00646***	0.00617
		(0.007)	(0.002)	(0.006)
lag_DCBS			-0.190***	
			(0.008)	
lag_IndicativeFee				-0.150***
				(0.007)
Observations	36077	36077	36077	36077
Adjusted R^2	0.150	0.092	0.120	0.221
Time FE	Y	Y	Y	Y

Table A3. Effects of lender exits on securities lending: Two-stage-least-squares (2SLS) regressions

This table estimates two-stage-least-squares (2SLS) regressions, where $LenderFlow$ is used as an instrumental variable (IV) for the indicator variable $LenderExits \geq 5\%$. The variable $LenderExits$ is defined as the the number of shares lent out (measured at quarter $t-1$) by mutual funds that exit its position between quarters $t-1$ and t, scaled by the stock's total number of shares on loan in quarter $t-1$. The variable $LenderFlow$ is measured as weighted-average quarterly fractional flows to all mutual funds that lent their holdings of stock i, where the weight is each fund's on-loan shares. All outcome variables are measured as changes between quarters $t-1$ and t. Control variables (except $LenderFlow$, $LenderExits$ and $NonLenderExits$) are measured at quarter $t-1$. Standard errors are clustered at the stock level, and are shown in parentheses. ***, **, and * represent result significant at 1%, 5%, and 10% level, respectively.

Dependent variable Δy	$LenderExits \geq 5\%$	ΔSupply	ΔShortRatio	ΔDCBS	ΔFee
	(1)	(2)	(3)	(4)	(5)
Fund flows to securities lenders	-3.072***				
	(0.303)				
$LenderExits \geq 5\%$		-5.528***	-1.244*	1.305***	3.776***
		(1.068)	(0.685)	(0.284)	(0.896)
$NonLenderExits$	0.345***	-5.360***	-0.585**	-0.460***	-0.547
	(0.017)	(0.516)	(0.253)	(0.116)	(0.376)
Mutual fund ownership	0.0212	0.738***	-0.348***	0.0612*	0.131
	(0.016)	(0.215)	(0.117)	(0.034)	(0.120)
Ownership by index funds	0.464**	-18.15***	-2.545*	-0.336	-5.907***
	(0.217)	(2.773)	(1.408)	(0.522)	(1.910)
Ownership by ETFs	-0.125***	-1.728**	-0.548	0.110	2.737***
	(0.048)	(0.698)	(0.346)	(0.128)	(0.483)
Log(Market Cap)	-0.0131***	0.0216	-0.000700	0.0230***	0.134***
	(0.001)	(0.018)	(0.010)	(0.005)	(0.017)
Book-to-market ratio	-0.00506*	-0.202***	-0.0551***	0.0549***	0.282***
	(0.003)	(0.032)	(0.017)	(0.009)	(0.040)
Gross profitability	-0.0277***	-0.317***	-0.0246	0.0795***	0.407***
	(0.007)	(0.085)	(0.044)	(0.022)	(0.098)
Past 6-month return	-0.0520***	0.00453	-0.0994**	-0.115***	-0.396***
	(0.005)	(0.078)	(0.050)	(0.024)	(0.094)
Monthly stock turnover	0.0463***	0.338***	-0.0688	-0.199***	-1.529***
	(0.005)	(0.088)	(0.057)	(0.027)	(0.122)
Bid-ask spread	-1.770***	-15.26***	-4.008***	4.847***	15.36***
	(0.178)	(2.615)	(1.491)	(1.154)	(4.155)
Observations	36077	36077	36077	36077	36077
Adjusted R^2	0.094	0.048	0.018	-0.059	0.004
Control for lagged y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y
Kleibergen-Paap Wald F statistic	102.8				

Table A4. Lender exits and stock returns: Controlling for lending fee

This table estimates the effect of the position exits of a stock's equity lenders on stock returns. The observations are at the stock–month level. The sample period spans 2019Q4 and 2022Q2. The variable $LenderExits \geq 5\%$ is a binary indicator. The variable $LenderExits$ for each month t is defined as the the number of shares lent out (measured at the last quarter) by mutual funds that exit its position between the current quarter and the last quarter, scaled by the stock's total number of shares on loan at the end of last quarter. Control variables are measured at the same month as $LenderExits$. Standard errors are double-clustered at the stock and the month level, and are shown in parentheses. ***, **, and * represent result significant at 1%, 5%, and 10% level, respectively.

Cumulative return over months:	$Ret_{t-2,t}$	$Ret_{t+1,t+3}$	$Ret_{t+4,t+6}$	$Ret_{t+7,t+12}$	$Ret_{t+13,t+18}$
	(1)	(2)	(3)	(4)	(5)
LenderExits $\geq 5\%$	0.016**	0.042**	0.021	-0.015	-0.043***
	(0.007)	(0.017)	(0.024)	(0.023)	(0.014)
ΔMutual Fund Holdings	-0.0020	-0.022*	-0.064***	-0.120***	-0.100***
	(0.008)	(0.011)	(0.012)	(0.022)	(0.017)
ΔLendable shares	-0.013	-0.075*	-0.042	-0.100	-0.035*
	(0.027)	(0.037)	(0.039)	(0.066)	(0.017)
IndicativeFee	0.20***	-0.059	-0.046	-0.20***	-0.33***
	(0.037)	(0.042)	(0.047)	(0.042)	(0.036)
Log(Market Cap)	0.0027*	-0.012***	-0.0063	-0.0013	0.019***
	(0.001)	(0.004)	(0.005)	(0.007)	(0.003)
Book-to-market ratio	0.0075***	-0.00027	0.0078	0.035**	0.037***
	(0.002)	(0.005)	(0.005)	(0.013)	(0.010)
Past 6-month return	0.027***	-0.0039*	-0.0047	-0.020***	-0.012*
	(0.007)	(0.002)	(0.003)	(0.004)	(0.006)
Observations	64,776	64,776	64,776	64,776	64,776
Adjusted R2	0.227	0.192	0.174	0.320	0.142
Time FE	Y	Y	Y	Y	Y