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

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ABFER, May 2024

Motivation

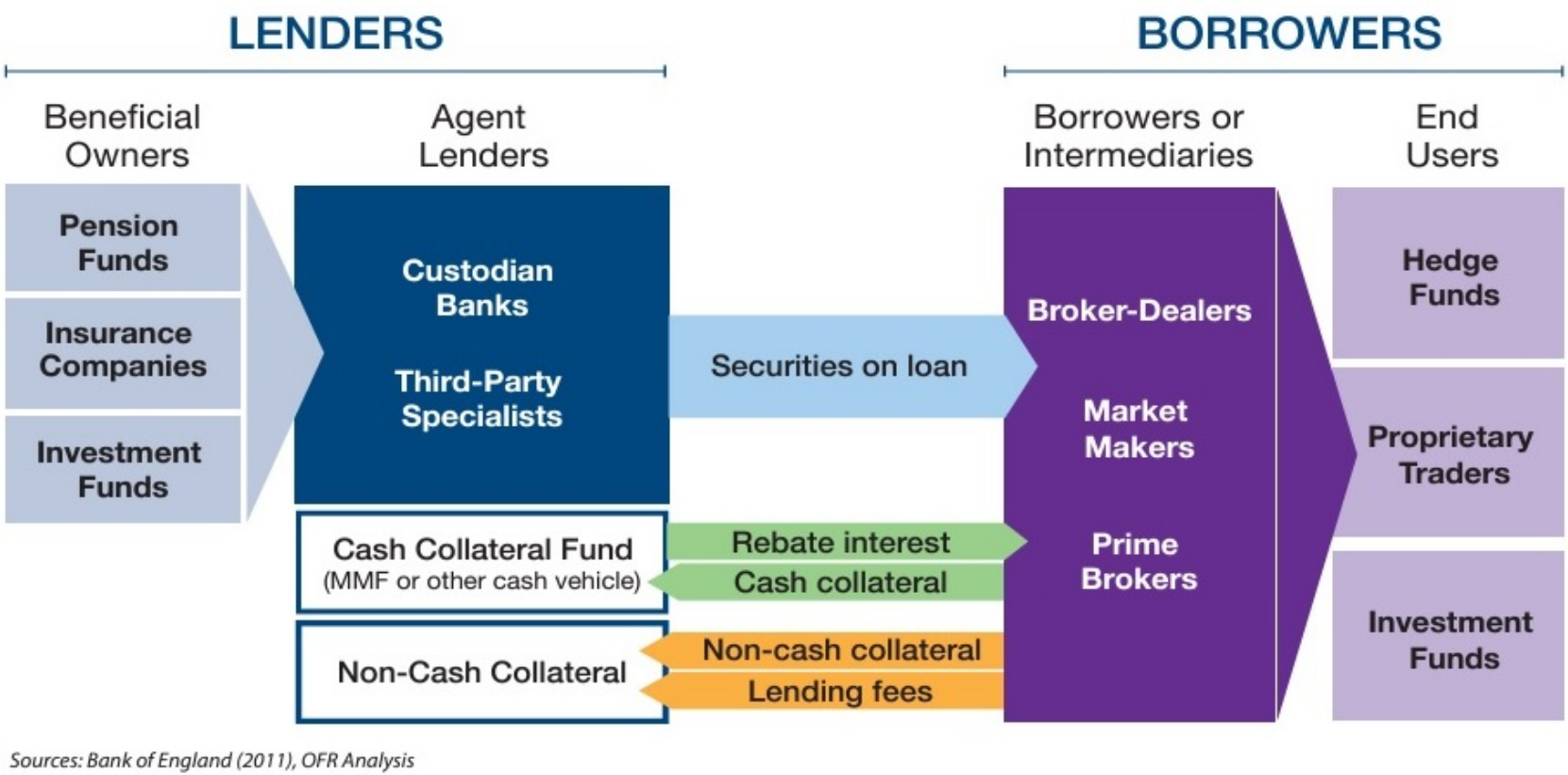
- Short selling is critical to an efficient stock market.
  - By allowing investors to sell stocks they do not own, it enables more effectively incorporation of negative information into stock prices (Miller 1977, Hong and Stein 2003)
  - Avoiding overpricing also means avoiding wasting capital/social resources on hyped businesses
  - Feed back to firms' real decision-making (Goldstein and Guembel, 2008; Bond, Edmans, and Goldstein, 2012; Edmans, Goldstein, and Jiang, 2012).
- Short selling strategies are profitable!
  - Short selling predicts negative returns (Asquith, Pathak, and Ritter 2005; Diether, Lee, and Werner 2009; Drechsler and Drechsler 2018).

Research question

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?**
  - We delve into one central aspect of this issue by dissecting the constraints on short selling emanating **from the securities lending market**.

Motivation



- Not all asset owners are willing to lend their shares.
- There are lending fees associated with shorting.
- Even loaned shares are subject to recall!

The availability and stability of securities lending supply critically determine the degree of short-sale constraints.

Dong and Zhu (2023)

Motivation

How do we know if a stock is short-sale constrained?

- The most common measure is stock-level total supply—"lendable shares"—provided by data vendor such as IHS Markit.
  - It surveys major custodian banks and prime brokers for the "number of shares available for securities lending".
  - Widely used by academic research and practitioners: Saffi and Sigurdsson (2011); Blocher, Reed, Van Wesep (2013); Prado, Saffi, and Sturgess (2016), etc.
- However, not all lendable shares are equally lendable.
  - IHS Markit: "[t]he available to loan data would be difficult to interpret because of the intricacies of the lending program parameters between 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."
  - Shares that are made "lendable" by investors but not yet utilized may only be available at a higher fee or with additional strings attached.

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Total supply ("Lendable shares") may understate a stock's true short-sale constraints.

- A share might be made "lendable" by its owner but never lent out!
- It ignores the dynamic aspects of short-sale constraints, i.e., recall risk and the difficulty to find quality replacement lenders.

This paper: Thanks to the SECâs Investment Company Reporting Modernization Rules, which became effective on February 27, 2019, we are the first to utilize this systematic and mandatory disclosure in the U.S. to study the securities lending market. .

- Data allow us to
  - see *who is actually providing securities lending* instead of just indicating shares lendable
  - compare the lending decision of a mutual fund relative to other funds holding the same stock at the same time (a within–stock–quarter approach to isolate individual mutual fund lending decisions from the shorting demand of a stock)

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This paper:

Equity lending is **persistent**, **fragmented** and **concentrated**.

- For a given stock, shares are borrowed from a small set of repeated lenders.

What does it mean for short-sale constraints?

- The lending supply that short sellers can actually tap into is **far more constrained** than conventional statistics indicate as it relies on a small subset of owners.
- Equity lending supply is far more fragile than conventional statistics suggest:
  - Lending could be easily disrupted and, in turn, market efficiency deteriorates significantly, with **just a few current lenders have to cease lending**

Central message: A new form of limits arbitrage, originated from the equity lending market.

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Main Findings: Lending market

When more than 5 percent of on-loan shares (from last quarter) are sold by their mutual fund holders:

- Lending fee of affected stocks increases by 30.0 basis points. Short ratio drops by 0.2 percentage points relative to TSO.
- The disruption in lending conditions is large even though "lendable shares" typically appear abundant
  - No quick replacements from non-lending institutional shareholders

Main Findings: Equity market efficiency

When the securities lenders of a stock exit their positions:

- We observe positive contemporaneous and short-term abnormal stock returns and negative long-term abnormal returns.
- Stock price efficiency measures deteriorate.
- Stock is more likely to be overvalued based on mispricing measures.
- Informed parties (companies and insiders) are more likely to trade against the overvaluation by issuing or selling the stock.

- The risk of lender exiting and recalling is priced in stock prices ex ante:
  - Stocks with more concentrated lendership tend to be more overpriced.

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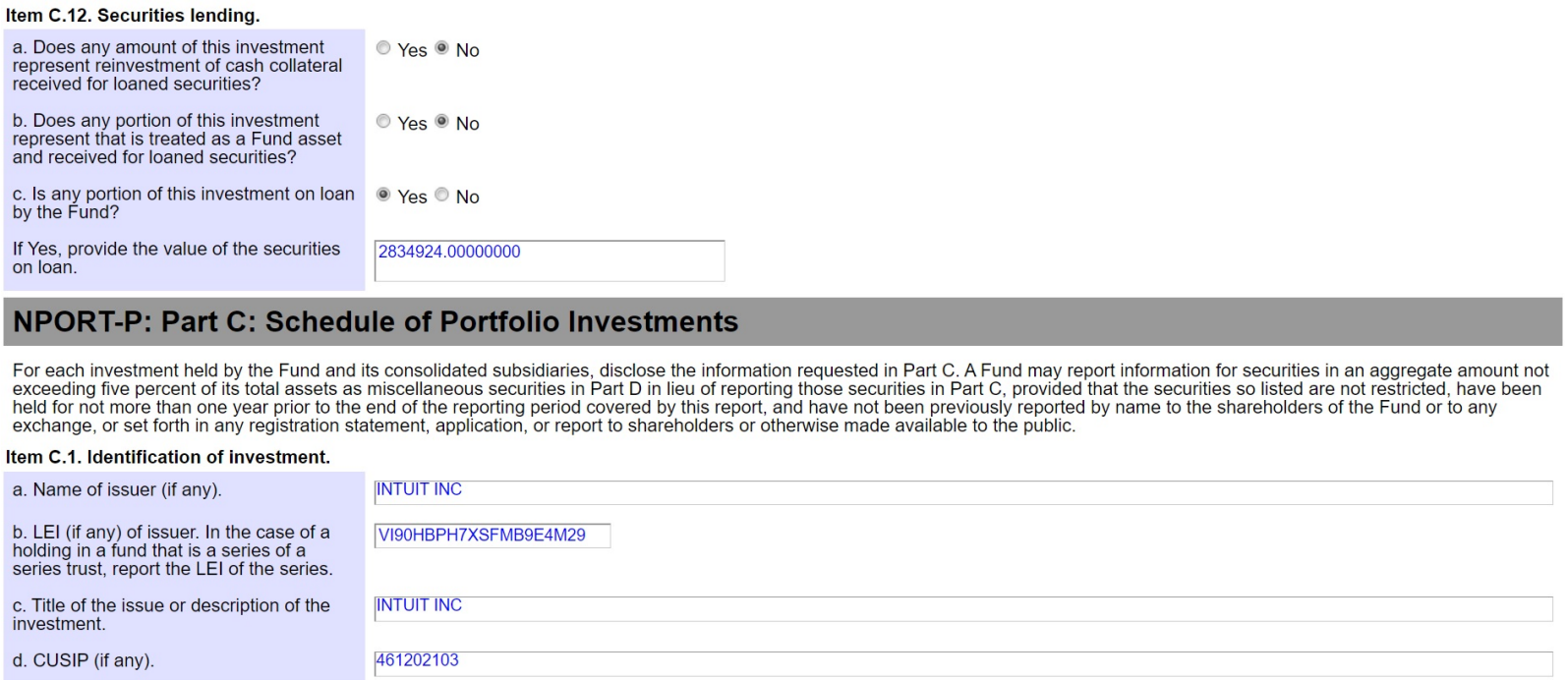
Roadmap

- **Data Sources**
- The structure of equity lender base
- What happens when securities lenders exit the market?
- Asset pricing implications

Data sources

- We collect position-by-position data on mutual funds' securities lending between 2019Q3 and 2022Q2 from SEC EDGAR.
  - The reporting of form N-PORT is part of the SEC Investment Company Reporting Modernization rule, which went into effect in early 2019.



Item C.12. Securities lending.

a. Does any amount of this investment represent reinvestment of cash collateral received for loaned securities?	○ Yes ◉ No
b. Does any portion of this investment represent that is treated as a Fund asset and received for loaned securities?	○ Yes ◉ No
c. Is any portion of this investment on loan by the Fund?	◉ Yes ○ No
If Yes, provide the value of the securities on loan.	2834924.00000000

NPORT-P: Part C: Schedule of Portfolio Investments

For each investment held by the Fund and its consolidated subsidiaries, disclose the information requested in Part C. A Fund may report information for securities in an aggregate amount not exceeding five percent of its total assets as miscellaneous securities in Part D in lieu of reporting those securities in Part C, provided that the securities so listed are not restricted, have been held for not more than one year prior to the end of the reporting period covered by this report, and have not been previously reported by name to the shareholders of the Fund or to any exchange, or set forth in any registration statement, application, or report to shareholders or otherwise made available to the public.

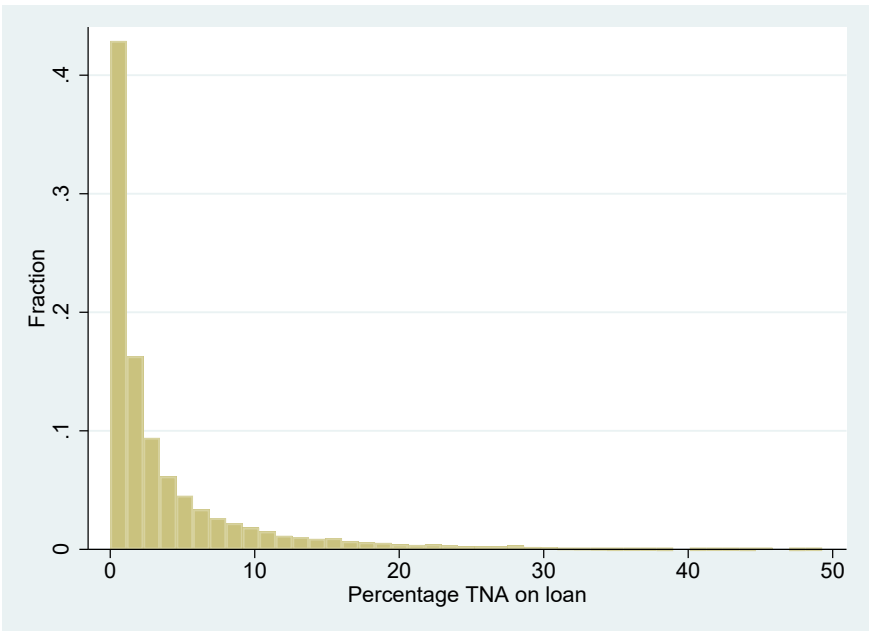
Item C.1. Identification of investment.

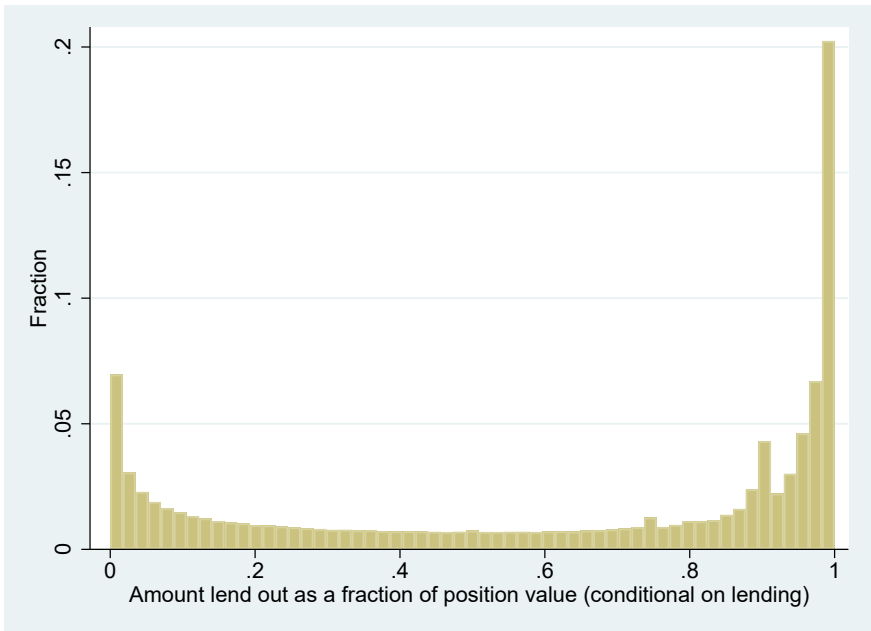
a. Name of issuer (if any).	INTUIT INC
b. LEI (if any) of issuer. In the case of a holding in a fund that is a series of a series trust, report the LEI of the series.	VI90HBPH7XSFMB9E4M29
c. Title of the issue or description of the investment.	INTUIT INC
d. CUSIP (if any).	461202103

- Stock-month level lending market variables, including short ratios, lending fees, and lendable shares are obtained from IHS Markit.

Descriptive statistics

Most funds lend out a modest fraction of the asset under management.
Conditional on lending, funds lend out most of their holdings of a stock.





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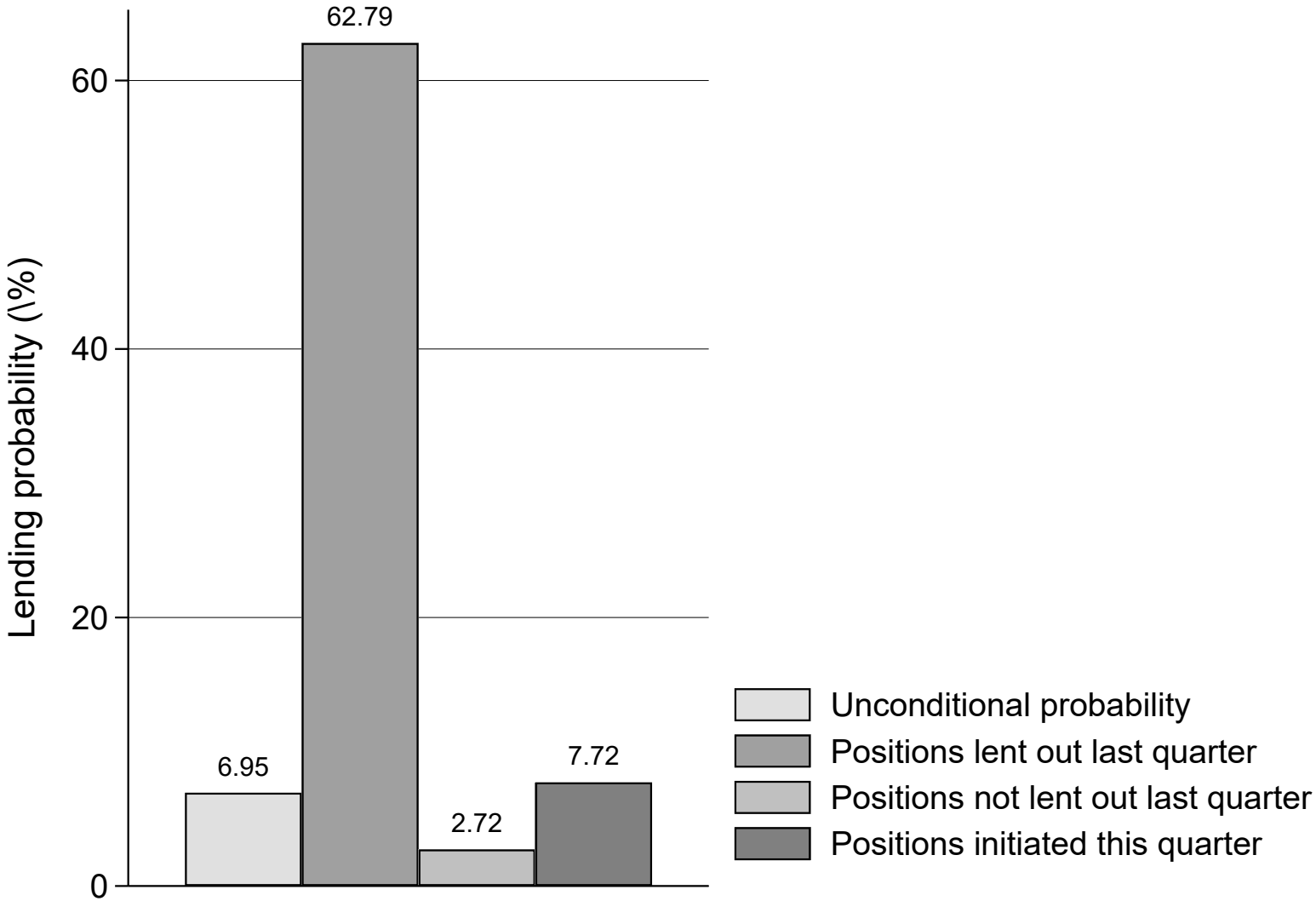
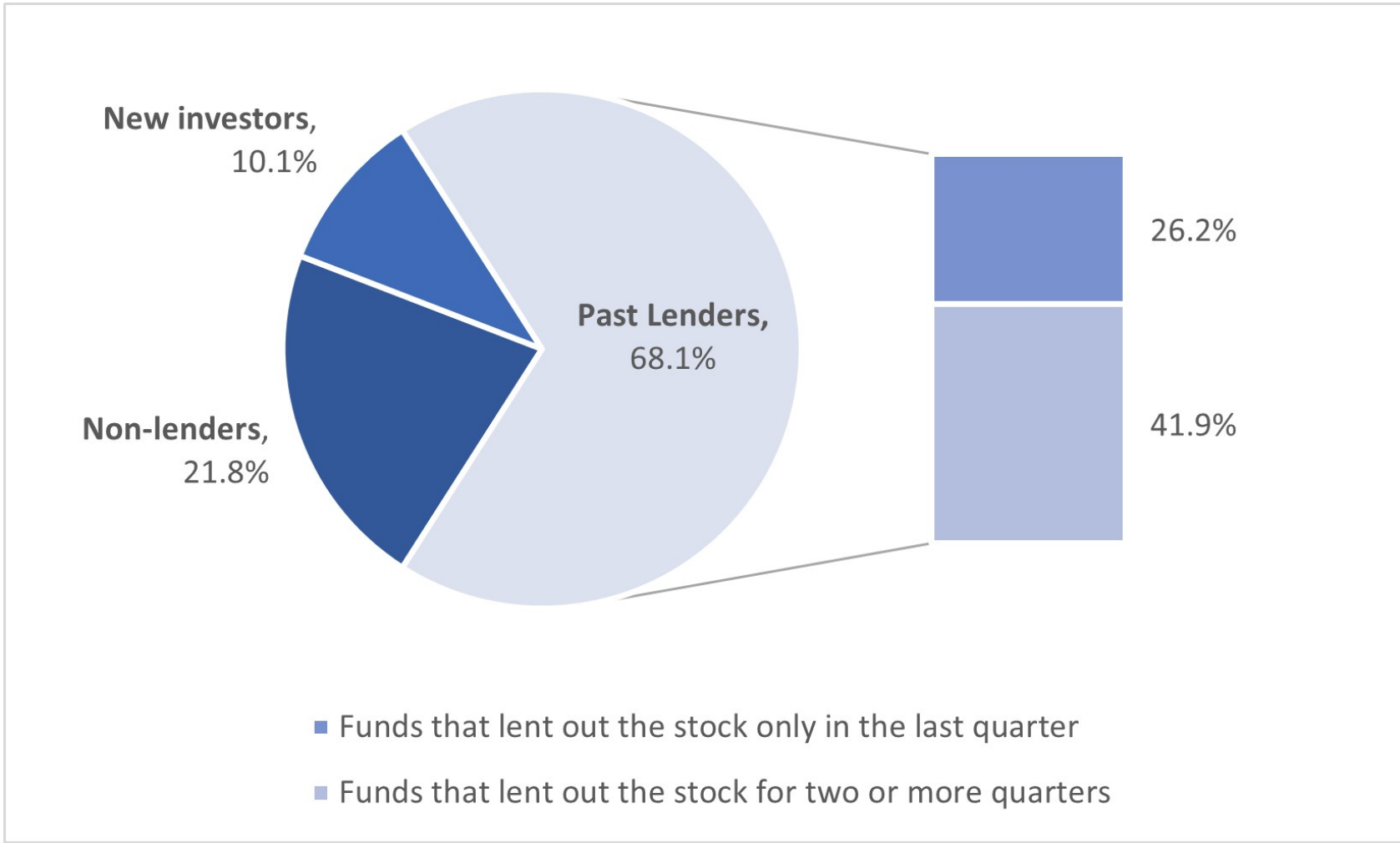
Equity lender base is persistent, fragmented and concentrated

- A median stock has **six lenders (out of 107 mutual funds owners).**



Equity lender base is persistent, fragmented and concentrated

- As a result of the persistent equity lending, over 2/3 of a stock's shares on loan are provided by past lenders.



Dong and Zhu (2023)

Determinants of mutual fund securities lending decisions

Our stylized facts show there is strong a **fund–stock specific** component in equity lending determination:

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

In other words, the best predictor for a fund lending out a position is whether the fund lent out the same stock in the previous quarter.

Mutual fund securities lending decisions

Dependent variable: D(Position on loan)			
	(1)	(2)	(3)
Same fund lent out the stock last quarter	0.463***	0.388***	0.394***
	(0.009)	(0.006)	(0.008)
Same fund held the stock but not lent last quarter	-0.0189***	-0.0224***	-0.0134***
	(0.002)	(0.002)	(0.001)
Same fund lent out the stock two quarters ago		0.170***	
		(0.005)	
Stock's weight in fund portfolio (%)	0.000309	0.000356	0.00131***
	(0.001)	(0.001)	(0.000)
Percentage ownership fund holds in the company	0.0125*	0.0107*	-0.000244
	(0.006)	(0.006)	(0.002)
Stock's style distance to fund average style	-0.00187***	-0.00168***	-0.000676*
	(0.000)	(0.000)	(0.000)
D(Affiliated lending agent)	0.0171***	0.0150***	
	(0.004)	(0.003)	
D(Fund is an index fund (non-ETF))	-0.00728	-0.00725	
	(0.005)	(0.005)	
D(Fund is an ETF)	0.0119*	0.0111*	
	(0.006)	(0.006)	
Additional controls	Y	Y	Y
Observations	6812594	6812594	6912999
Adjusted R^2	0.414	0.427	0.464
Stock-by-quarter FE	Y	Y	Y
Fund style-by-quarter FE	Y	Y	NA
Fund-by-quarter FE	N	N	Y

Dong and Zhu (2023)

The novel (and dominant) factor: Lending persistence

- Accounting for stock–by–quarter fixed effects, 46.3% higher lending propensity for existing lenders vs. 1.89% lower for new lenders vs. 6.92% unconditional probability
- Conditional on a fund's lending decision at quarter t–1, lending out a particular stock at quarter t–2 further increases propensity to lend by another 17%, implying a combined increase of 55.9% relative to new shareholders.
- Similar persistence using fund– by–quarter fixed effects to absorb differences in the average lending propensity across funds.

There exists some degree of specialization in **persistently** supplying securities.

Previously-considered factors ruled in or ruled out

- Funds with longer expected holding horizons (proxied by turnover ratio or distance to fund average style) lend more (Porras Prado, Saffi, and Sturgess 2016)?
  - ETFs are more willing to engage in securities lending, while passive and active traditional mutual funds have similar tendencies to lend.
- Poorly performing funds more likely to lend stocks
- 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
- Having affiliated lending agent matters (e.g., D'Avolio, 2002; Geczy, Musto, and Reed, 2002)
- Fund families and lending agents play some roles by 3.0% and 3.7% respectively.

Collectively, we find existing factors are **far from** fully explaining the heterogeneous lending propensities at the fund-âstock level.

Fragmented lender base: Practitioner insights

Lending decisions are idiosyncratic at the fund-(family-custodian-broker-borrower)-stock level:

- Fund/Family-level considerations
  - E.g., securities lending policies; specialization strategies; how much a fund values securities lending income; expected holding period of the position; governance considerations (i.e., voting rights), liquidity/risk/legal, preference/beliefs.
- Lending agent/prime broker considerations
  - E.g., tradeoff of direct and indirect benefits with different clients such as relationship, business, and legal considerations.
- Short seller considerations
  - E.g., fees, collateral, duration.

Fragmented lender base: Theoretical insights

Lending decisions are idiosyncratic at the fund-(family-custodian-broker-borrower)-stock level:

- Preferred habit theories
  - Lenders indeed have heterogeneous preferences in the stocks they prefer to lend..
- Tacit collusion (e.g., Bryzgalova, Pavlova, and Sikorskaya (2023))
  - 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.
- Information secrecy (Chen, Kaniel, Opp (2023))
  - 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 noncompetitive fees.

Short-selling market consequences

Whether and how are persistent and segmented lending base economically consequential?

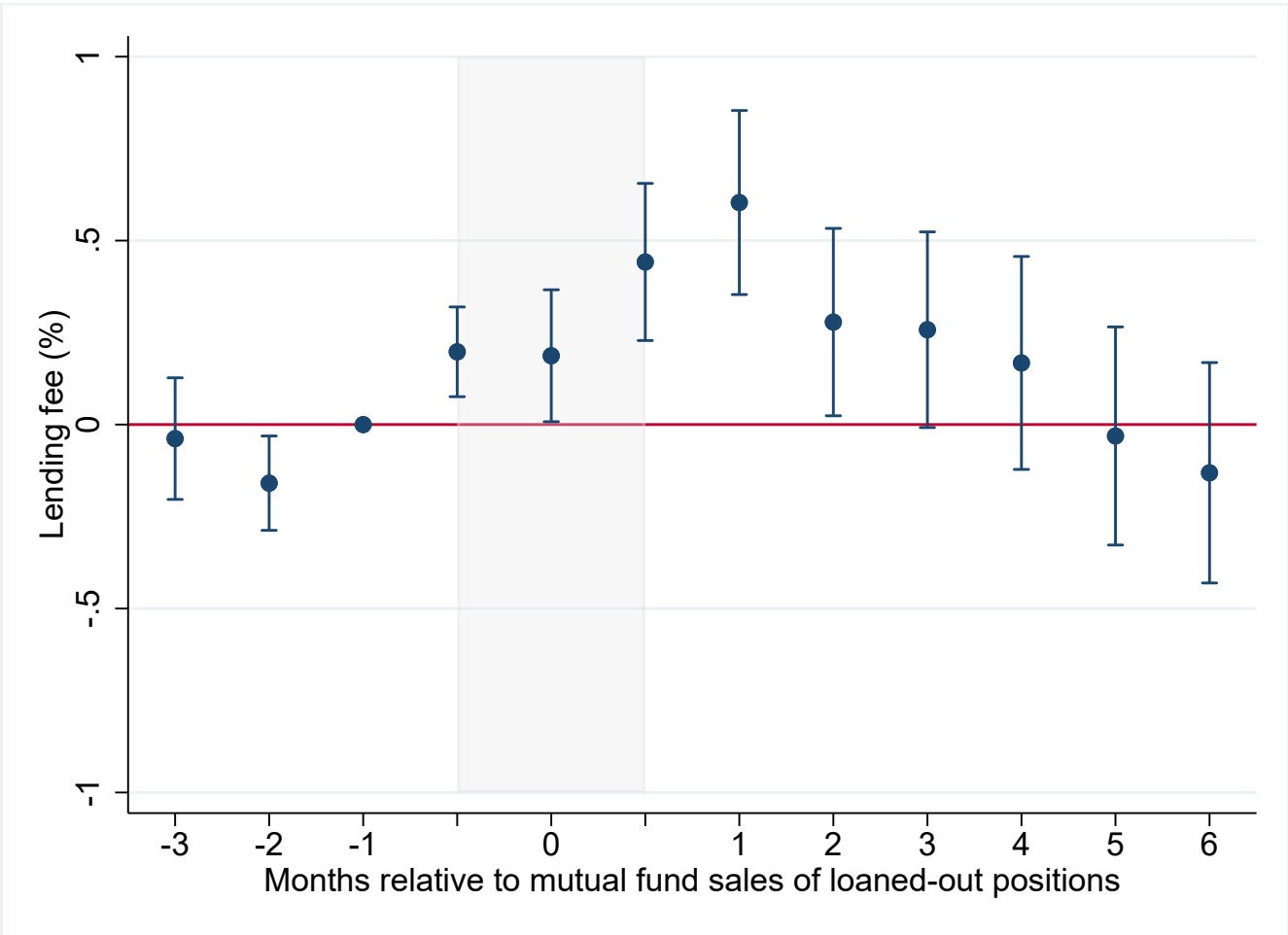
- When existing lenders exit their lending positions, do other shareholders fill in?
  - We examine the lending market responses after current lenders (measured at t-1) sell their shares and hence are unable to lend.

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

Lending fees after lender exits

We define a lender exit event when *LenderExits* $\geq 5\%$. In an event-study framework, we examine:

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



Lending market after the lenders exit

Quarter-to-quarter changes of securities lending outcomes in response to lender exits:

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

Sample	Full sample					Utilization <10%
Dependent variable	ΔSupply	ΔUtilization	ΔShortRatio	ΔDCBS	ΔFee	ΔFee
	(1)	(2)	(3)	(4)	(5)	(6)
LenderExits ≥ 5%	-1.583***	1.508**	-0.190***	0.188**	0.668***	0.300**
	(0.270)	(0.598)	(0.046)	(0.073)	(0.143)	(0.128)
NonLenderExits	-6.730***	-0.438	0.105	-0.0296	0.590	0.243
	(0.377)	(0.709)	(0.167)	(0.089)	(0.520)	(0.148)
Mutual fund ownership	0.617	-3.433***	-0.462**	0.0921	0.222	0.168
	(0.460)	(0.957)	(0.152)	(0.095)	(0.293)	(0.116)
Change in lendable shares		-0.0630	0.145***	0.00579***	0.00782	0.00693
		(0.049)	(0.013)	(0.002)	(0.010)	(0.006)
Observations	36077	36045	36077	36077	36077	23456
Adjusted R^2	0.115	0.024	0.091	0.032	0.052	0.016
Time FE	Y	Y	Y	Y	Y	Y

Additional controls: index fund ownership, Log(MarketCap), BM ratio, gross profitability, past stock return, stock turnover, and bid-ask spread.

The effect depends on remaining lenders' capacity

Sample:	Low capacity from non-exiting lenders			
Dependent variable Δy	ΔUtilization	ΔShortRatio	ΔDCBS	ΔFee
	(1)	(2)	(3)	(4)
LenderExits $\geq 5\%$	2.480***	-0.441***	0.216***	0.526***
	(0.753)	(0.094)	(0.047)	(0.167)
Observations	17817	17840	17840	17840
Adjusted R^2	0.169	0.093	0.131	0.231
Control variables	Y	Y	Y	Y
Time FE	Y	Y	Y	Y

Sample:	High capacity from non-exiting lenders			
Dependent variable Δy	ΔUtilization	ΔShortRatio	ΔDCBS	ΔFee
	(1)	(2)	(3)	(4)
LenderExits $\geq 5\%$	1.131*	-0.0174	0.0780***	0.157**
	(0.601)	(0.066)	(0.026)	(0.076)
Observations	18228	18237	18237	18237
Adjusted R^2	0.191	0.094	0.129	0.219
Control variables	Y	Y	Y	Y
Time FE	Y	Y	Y	Y

How exogenous are lender exits?

We are assuming that a mutual fund's decision to sell a stock holding is uncorrelated with the stock's (expected future) condition in the securities lending market.

- This is a plausible assumption.
- **Devil's advocate**: it is possible that fund managers sell their holdings in anticipation of future changes in firms' fundamentals.
- More on equity return later: lender funds would have made more money had they kept their shares and lent them out!

Fund flows as instruments for lender exits:

- To further mitigate endogeneity concerns, we use fund flows to existing fund lenders (of a stock) as instruments:

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

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Reduced-form results

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

Dependent variable	ΔSupply	ΔUtilization	ΔShortRatio	ΔDCBS	ΔFee
	(1)	(2)	(3)	(4)	(5)
Fund flows to securities lenders	18.86***	-48.73***	4.219**	-2.749***	-8.311***
	(3.106)	(14.934)	(2.105)	(0.749)	(2.369)
Flows to non-lending mutual fund owners	1.690***	4.292	0.119	-0.0343	-0.296
	(0.537)	(3.081)	(0.353)	(0.148)	(0.596)
Control variables	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y

- Following outflows of funds that lent out the stock, shorting fee ↑, short volumne ↓. 2SLS

Roadmap

- Data Sources
- The structure of equity lender base
- What happens when securities lenders exit the market?
- **Asset pricing implications**

Stock returns

When securities lenders exit, lending fee spikes and short selling goes down; does it further squeeze the stock price?

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

	$Ret_{t-2,t}$ (1)	$Ret_{t+1,t+3}$ (2)	$Ret_{t+4,t+12}$ (3)	$Ret_{t+13,t+18}$ (4)
$LenderExits \geq 5\%$	0.0336***	0.0213**	-0.00393	-0.0622***
	(0.011)	(0.011)	(0.028)	(0.015)
Δ Mutual fund ownership	0.102***	-0.0227***	-0.111***	-0.0983***
	(0.010)	(0.008)	(0.030)	(0.013)
Δ Lendable shares	0.00488***	-0.000391	-0.00371**	0.00208***
	(0.001)	(0.001)	(0.002)	(0.001)
Ln(Market Cap)	-0.00270***	-0.00966***	-0.0232***	0.0131***
	(0.001)	(0.001)	(0.005)	(0.002)
Book-to-market ratio	-0.0367***	0.0201***	0.0853***	0.0441***
	(0.005)	(0.003)	(0.013)	(0.006)
Past 12-month return	-0.0499***	-0.0162***	-0.141***	-0.0482***
	(0.005)	(0.005)	(0.015)	(0.008)
Time FE	Y	Y	Y	Y
Observations	20169	20167	20167	20169
Adjusted R^2	0.381	0.383	0.267	0.193

Price efficiency and mispricing

Lender exits tighten short-sale constraints and exacerbate limit-to-arbitrage. Affected stocks are more likely to be subject to overvaluation.

- We examine several measures of price (in)efficiency: the *Delay* measure by Hou and Moskowitz (2005). Idiosyncratic volatility (*IdioVol*) of Ang, Hodrick, Xing, and Zhang (2006).
- We use mispricing measure of 11 anomalies from Stambaugh, Yu, and Yuan (2015) and 100 anomalies from Dong, Li, Rapach, and Zhou (2022) to measure mispricing. The higher the composite score, the more overvalued a stock is.

Price efficiency and mispricing

	$\text{Delay}_{t+1,t+6}$	$\textit{RetVol}_{t+1,t+6}$	$\textit{IdioVol}_{t+1,t+6}$	$\text{MISP}^{SYY}_{t+1,t+6}$	$\text{MISP}^{DLRZ}_{t+1,t+6}$
	(1)	(2)	(3)	(4)	(5)
LenderExits $\geq$ 5%	0.137***	0.341***	0.326***	1.26***	1.94***
	(3.700)	(12.07)	(11.98)	(8.34)	(16.77)
ΔMutual Fund Holdings	0.325***	0.216***	0.218***	2.04***	2.01***
	(7.162)	(5.236)	(5.792)	(13.62)	(12.50)
Log(Market Cap)	-0.164***	-0.221***	-0.253***	-0.41***	-0.0013
	(-17.48)	(-22.55)	(-19.91)	(-14.44)	(-0.05)
Book-to-market ratio	-0.0149	-0.0361*	-0.0542***	-0.35***	-0.52***
	(-1.014)	(-2.039)	(-3.374)	(-4.54)	(-5.10)
Past 6-month return	0.102**	0.117***	0.102***	0.22***	0.35***
	(2.318)	(4.580)	(3.807)	(4.49)	(5.44)
Time FE	Y	Y	Y	Y	Y

Do informed investors trade against this mispricing?

If reduction in securities lending supply induces overpricing, do informed investors trade against it?

- But by definition, a smart hedge fund would find it costly/difficult to short the stock.
- However, some insiders, for example the firm itself (or its managers), can trade against the mispricing by issuing (selling) shares.

	$NFT_{t+1,t+6}$ (1)	$CEI_{t+1,t+6}$ (2)	$NIS_{t+1,t+6}$ (3)
LenderExits $\geq$ 5%	0.213***	0.220***	0.125***
	(5.572)	(5.478)	(3.589)
ΔMutual Fund Holdings	0.636***	0.877***	0.205***
	(8.658)	(8.967)	(5.187)
ΔLendable shares	-0.227	0.196	0.478**
	(-1.637)	(1.538)	(2.284)
Log(Market Cap)	-0.127***	-0.0968***	0.0201***
	(-13.51)	(-10.29)	(3.358)
Book-to-market ratio	-0.0802***	-0.0634***	-0.0921***
	(-3.518)	(-2.938)	(-4.185)
Past 6-month return	0.0203***	0.160***	0.0675***
	(2.925)	(8.228)	(4.220)
Time FE	Y	Y	Y

Does market price in lender-exit risks?

- From short sellers' perspective, lender exits pose short selling risks.
- Does stock market price in such risks *ex ante*?
- We posit that lender concentration is positively associated with recall risks.

	Equal-Weighted 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)

Conclusions

- Securities lending market is highly persistent, fragmented, and concentrated.
- Total supply 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.
- Constrained lending supply caused by lender exits distorts equity prices and reduces price efficiency. The risk associated with such lender concentration is priced.

2SLS results

$$1_{i,t}^{LenderExits \geq 5\%} = \beta LenderFlow_{i,t} + \gamma X_{i,t-1} + \epsilon_{i,t}$$

$$\Delta Y_{i,t} = \alpha_t + \beta_1 \widehat{1}^{LenderExits \geq 5\%} + \beta_2 NonLenderFlow_{i,t} + \gamma X_{i,t-1} + \epsilon_{i,t},$$

Dependent variable	*LenderExits* $\geq$ 5%	ΔSupply	ΔUtilization	ΔShortRatio	ΔDCBS	ΔFee
	(1)	(2)	(3)	(4)	(5)	(6)
Fund flows to securities lenders	-3.072***					
	(0.303)					
LenderExits $\geq$ 5%		-5.528***	15.85***	-1.244*	1.305***	3.776***
		(1.068)	(5.356)	(0.685)	(0.284)	(0.896)
NonLenderExits	0.345***	-5.360***	-5.870***	-0.585**	-0.460***	-0.547
	(0.017)	(0.516)	(2.119)	(0.253)	(0.116)	(0.376)
Control variables	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y
Kleibergen-Paap Wald F statistic	102.8					

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