Inefficiencies in the Securities Lending Market*

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Abstract

In contrast with a general trend of declining trading frictions, over the last several decades the cost of borrowing securities for short-selling has increased dramatically. Using a portfolio approach, we show that as the borrow costs have increased so has the mispricing associated with portfolios of high-borrow-cost names. This decline in market efficiency has resulted from a lack of competition in the intermediation chain that links share lenders with borrowers, and a growing and rational unwillingness among institutional investors to hold and lend high-borrow-cost names. Since 2020, we estimate that the social welfare costs associated with these frictions have exceeded $300 Million/day.

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1 Introduction

By many measures, financial markets have become more efficient over time. For example, as a result of improved technology, new entrants, and competition in the financial services sector, the costs of acquiring information and the transaction costs associated with buying and selling US common stocks have fallen dramatically (see e.g., Jones, 2002) and, at least by some measures, market efficiency has increased (Bai, Philippon, and Savov, 2016).[1]

In this paper we examine the securities lending market, and show that a variety of factors have instead led to the securities-lending market becoming far less efficient. Specifically, far more securities are now hard-to-borrow now. Those that are have borrow costs that are much higher than ever before, resulting in far greater inefficiencies.

We begin with some data on borrow costs from D'Avolio (2002), which was among the earliest papers to directly examine borrow costs in the modern era.[2] D'Avolio obtained data from "a large financial institution" on lending fees for US common stocks at a daily frequency for the period from April 2000 through September 2001. He found that:

1. Most stocks could be borrowed: specifically, "...at most 16% (1,267 of 7,879) of the stocks found in the monthly CRSP file [were] potentially impossible to short," but that these issues accounted for "...less than 1% of the market by value (1,093 of these are in the bottom size decile and 719 are under $5)"

2. The vast majority of stock loans were at the general-collateral (GC) rate of 25 bps/year.

3. "Only 9% of stocks (about 206 stocks per day) have loan fees above 1% per annum. These "specials" (stocks with high lending fees) have a mean fee of 4.3% per annum."

4. "Fewer than 1% of stocks (roughly seven per month) on loan become extremely special, demanding negative rebate rates (i.e., loan fees in excess of the risk-free rate)."

[1] See however Asness (2024) for an alternative perspective.

[2] Jones and Lamont (2002) examine borrow costs recorded at the share lending desk at the NYSE in the 1930s. See also Jones (2012).

With regard to the final point, D'Avolio reports the most extreme negative rebate stocks in his Table 2. Across all the (firm-day) observations in his sample, the highest annualized fee ever observed is 79%. In D'Avolio's sample, only eight firms ever have an annualized fee greater than 35%.

Table 1: Highest borrow costs for US securities as of Thursday, 8 May 2025. This table is constructed using borrow-cost data reported by Markit for common stocks with CRSP share codes of 10 or 11 and exchange codes of 1, 2, or 3, on Thu, May 9 2025. The table reports the annualized indicative fee (in %, from Markit), the market value of the shares available for borrowing (the Lendable Value in $MM, from Markit) as well as the market capitalization (from CRSP, in $MM).

Tick	Name	Fee (%)	Avail.	MktCap
NAOV	NANOVIBRONIX INC	924.87	0.548	2.701
ZCAR	ZOOMCAR HOLDINGS INC	899.90	0.652	3.557
FOXX	FOXX DEVELOPMENT HOLDINGS INC	791.90	0.282	34.876
KTTA	PASITHEA THERAPEUTICS CORP	724.82	0.969	1.812
AREB	AMERICAN REBEL HOLDINGS INC	672.39	2.314	0.803
HCTI	HEALTHCARE TRIANGLE INC	665.22	1.003	2.485
UPXI	UPEXI INC	593.13	1.966	2.761
GPUS	HYPERSCALE DATA INC	580.14	3.418	2.810
SBEV	SPLASH BEVERAGE GROUP INC	522.01	0.466	2.167
MRIN	MARIN SOFTWARE INC	504.10	0.963	4.243
TIVC	TIVIC HEALTH SYSTEMS INC	488.25	0.248	1.569
OSRH	OSR HOLDINGS INC	423.72	0.278	35.820
JAGX	JAGUAR HEALTH INC	414.13	0.666	3.108
ANNA	ALEANNA INC	404.95	0.101	501.159
SXTP	60 DEGREES PHARMACEUTICALS INC	396.42	0.353	2.710
APVO	APTEVO THERAPEUTICS INC	389.85	0.477	1.691
NAYA	NAYA BIOSCIENCES INC	378.40	0.402	1.332
ICCT	ICORECONNECT INC	363.57	0.673	6.937
PSTV	PLUS THERAPEUTICS INC	339.37	1.234	5.602
ENSC	ENSYSCE BIOSCIENCES INC	320.77	0.310	3.471
ZVSA	ZYVERSA THERAPEUTICS INC	318.51	0.558	1.577
WORX	SCWORX CORP	310.09	0.208	1.265
JNVR	JANOVER INC	291.68	3.768	7.065
ACON	ACLARION INC	281.26	0.678	6.286
VERO	VENUS CONCEPT INC	264.33	0.260	1.841
OBLG	OBLONG INC	249.13	0.250	3.744
CTOR	CITIUS ONCOLOGY INC	231.39	0.321	66.543
PHIO	PHIO PHARMACEUTICALS CORP	231.24	1.171	1.372
CELU	CELULARITY INC	221.09	2.030	38.897
REBN	REBORN COFFEE INC	218.33	0.861	13.553

Today the picture is much different. Table 1 presents a snapshot as of May 8, of the borrow costs for the 30 US common stocks listed on majoy US exchanges that were most expensive to borrow on that date. The dramatic change in extreme borrow costs over the last 25 years is clear. Note that there is one security, NAOV, for which the annualized fee is 924%, or, put differently, for which the daily cost of borrow is above 3.5%. For each of these 30 securities, the annualized borrow cost is greater than 200%. On this date, 105 common

stocks had a borrow cost above 100%/year.

Like D'Avolio, we find that the majority of common stocks have a borrow cost that is at (or close to) the GC rate. In the Markit data used to construct Table 1, 71.3% of the 3,700 securities had an annualized fee lower than 1%. However, the distribution of extreme fees is far different: D'Avolio found that "...at most 9% of all stocks ...[had] loan fees above 1% per annum", and that "...these 'specials' ...[had] a mean fee of 4.3% per annum." Consistent with D'Avolio's findings, at the start of our sample in 2003, roughly 10% of stocks in our sample have an annualized borrow cost greater than 1%. However, at one point in 2022, 42% have borrow costs greater than 1%. Over this same time period, the fraction of firms that have borrow costs above 10% increases from a handful of issues in 2003 to just under 20% of the sample in 2023.

In Section 5 we take a new approach to estimating this relationship between borrow costs and returns. We form portfolios on the basis of lagged borrow costs as reported by Markit.[3] We find that there is close to a one-to-one relationship between the borrow costs reported by Markit and the negative alpha of the security.

For our high-borrow-cost portfolio, formed based on one-day lagged borrow costs (as reported by Markit and available to Markit subscribers) the portfolio earned an annualized CAPM alpha of -78%.[4] Thus, an investor in this portfolio who did not lend out the securities would have earned a risk-adjusted return of -78%.

Given the large negative alpha earned by this portfolio, one might think a short position in this portfolio would have earned a high *positive* alpha of 78%. However, the *ex-post* cost of borrowing the shares over this period was approximately 80%, so net of the borrow cost the return to shorting this portfolio was an annualized -2%, based on the daily Indicative Fee reported by Markit data.

[3]As we discuss in Section 2, other papers in the literature employ the Markit share lending data to estimate the returns net of borrow costs to portfolios formed on the basis of other characteristics (see, e.g., Drechsler and Drechsler (2014))

[4]Note that we are forming the portfolios on the basis of the indicative fee as reported by Markit. However, we are calculating the raw portfolio returns using only CRSP data.

A net-of-borrow-cost alpha of zero is consistent with a market in which short-sellers are rational, informed, and competitive.[5] The net return for our high-borrow-cost portfolio is statistically indistinguishable from zero, but for portfolios with moderate annualized borrow costs between 0.5% and 50%, short-sellers would have earned *positive* alphas over our 2010:01–2025:03 sample period.[6]

As discussed above, we are also interested in the returns to investors who go long these high-borrow-cost stocks. For investors who choose not to lend their shares, the alphas to the portfolios we examine are negative and highly statistically significant. And, because any borrowed shares are always sold short, the number of shares which are not lent out and are not earning a lending fee is equal to the number of shares outstanding at all points in time.

Another important question, though, is the alpha that would be earned by a sophisticated investor who chose to and did lend out all of the shares in these portfolios. If the fee earned by the lender of the shares was equal to the fee paid by the borrower, then the alpha from going long these portfolios would equal -1 times the alpha from going short. However, there are necessarily transaction costs—i.e., losses in the intermediation chain connecting lenders with borrowers—which will result in the lending fee being lower than the borrow cost.

We estimate the efficiency of the intermediation chain between short sellers who borrow shares, and the funds that are the primary lenders of these shares. The N-PORT and N-CEN filings that the SEC has required since 2019 provide, for each fund that files these forms, snapshots of the exact security lending done by the fund, and that fund's income from share-lending over the year. By combining these data with the Markit data, we can estimate on a fund level basis what the eventual borrowers of the shares paid to borrow those shares. By comparing this borrow cost with the revenue received by the fund, we estimate that the intermediation costs are about 40% of the fees. This means that a fund lending it's shares receives only 60% of every dollar that a short-seller pays to borrow its

[5]Short sellers may face other costs other than the explicit borrow costs we consider here; see, e.g., Engelberg, Reed, and Ringgenberg (2018).

[6]One caveat is that this return was exclusively earned in 2021 and 2022, while throughout the rest of the sample, the alpha roughly equals the lending fees. See Section 5.2.

shares. Thus, once one accounts for the spread between the cost paid by the share borrowers (as reported by Markit), and the fee received by the lenders, the alpha from a strategy of holding and lending out a portfolio of high-borrow-cost names are strongly negative and highly statistically significant.

We argue that the increase in lending fees we document results at least in part from the structure of the share-lending markets, combined with an increased demand from short sellers and a lack of competition in the intermediation chain that links share lenders with borrowers. Specifically, we argue that the increase in borrow costs is consistent with a model in which, as some agents receive negative information about a security, these agents compete to short that security, driving up borrow costs. The result of this is that, as the negative information becomes apparent in the borrow costs of these securities, the funds holding these securities decide to sell rather than lend these securities . They sell rather than hold because the frictions in the intermediation chain mean that the lenders receive less than the borrow cost. As discussed above, our empirical estimates suggest that, if they received the full borrow cost, they would earn an alpha ≤ 0. They, given the intermediation costs, they have learned that they are far better off selling rather than holding and lending the high-borrow-cost securities. So they sell, and generally sell to individual investors who choose not to lend the securities, leading to a decrease in supply, and a large increase in the borrow costs (Evans, Ferreira, and Porras-Prado, 2017).

We investigate this hypothesis using data from the N-PORT filings. We show that in recent years even index funds underweight firms with higher borrow costs.

Our evidence, we present here, combined with much other evidence in the academic literature, suggests that there is substantial disagreement across market participants: optimists express this optimism through purchasing securities, and pessimists express their pessimism through short selling the same securities. A recent literature has attempted to explore the beliefs of investors by examining analyst forecasts (see, e.g., Bordalo, Gennaioli, La Porta, and Shleifer (2024)). An interesting question, given our evidence here, is whether the views

of analyst better reflect the views of the optimists or of the pessimists. We examine this question by exploring the extent to which analyst forecast errors and forecast revisions can be predicted using borrow costs reported by Markit in advance of the time the forecast is made. If these forecasts are rational with respect to borrow costs, in the sense that the forecasts fully incorporate all information embedded in the reported borrow costs, then both forecast errors and revisions should be orthogonal to this information. Instead, we find that forecast-errors and revisions can be forecast with the information in *ex-ante* borrow costs at high levels of statistical significance.

Finally we estimate both the social-welfare losses associated with the frictions in the share lending market, and the total fees payed to borrow securities. We estimate that, since 2020, both of these quantities have totaled more than $300 Million per day.

2 Related Literature

Miller (1977) and Harrison and Kreps (1978) argue that asset prices can become inflated as a result of both heterogeneous expectations and constraints on short selling. Diamond and Verrecchia (1987) show that private information can be supressed by short-selling constraints. Duffie, Garleanu, and Pedersen (2002) develop a dynamic model of securities lending, shorting, and pricing. Their work demonstrates how search frictions in the lending market create impediments to short selling that can lead to overpricing of securities, consistent with Miller (1977) and Harrison and Kreps (1978).

D'Avolio (2002) and Geczy, Musto, and Reed (2002) provide empirical evidence about the equity lending market's structure and functioning. Their analysis reveals that many stocks are "special" in the lending market, with significant variation in borrow costs and availability across securities. This heterogeneity in lending conditions creates differential arbitrage constraints that vary systematically across stocks, providing a mechanism through which anomalies can persist in some securities while being arbitraged away in others. Cohen,

Diether, and Malloy (2007) attempt to identify supply and demand shifts in the shorting market, and demonstrate that changes in short-selling constraints have predictable effects on stock prices, with tightening constraints leading to price increases and loosening constraints enabling price decreases.

Stambaugh, Yu, and Yuan (2015) examine the link between short-selling constraints and asset pricing anomalies. They demonstrate that arbitrage asymmetry—the differential ease of going long versus short—can explain the persistence of various market anomalies. Their theoretical model shows that when short selling is constrained, overpriced securities cannot be efficiently arbitraged, leading to persistent anomalies. Importantly, they show that this asymmetry can also explain the idiosyncratic volatility puzzle, demonstrating the broad explanatory power of short-selling constraints for multiple market phenomena. Drechsler and Drechsler (2014) provide additional theoretical support for this relationship by developing a model where a "shorting premium"—the additional return required to compensate for short-selling costs and risks—helps explain various asset pricing anomalies. Their framework suggests that many documented anomalies may actually reflect compensation for the costs and risks associated with implementing arbitrage strategies, particularly those requiring short positions.

Engelberg, Evans, Leonard, Reed, and Ringgenberg (2022) examine the role of borrow costs in explaining cross-sectional return patterns. They examine 102 asset pricing anomalies and found that borrow costs are the best predictor of cross-sectional returns, with the "loan fee anomaly" exhibiting the highest monthly long-short return (1.17%) and Sharpe ratio (0.40). Their analysis reveals that 72% of the loan fee anomaly's performance is due to unique information possessed by short sellers, suggesting that short sellers' willingness to pay high fees reveals their private information about future returns.

This finding is complemented by Muravyev, Pearson, and Pollet (2022), who examine the relationship between anomalies and short-sale costs across 162 documented anomalies. Their analysis shows that anomalies are concentrated in stocks that are expensive to short, and

once stock borrow fees are accounted for, the alpha from anomaly strategies is eliminated. This result provides strong evidence that many documented anomalies may be "explained" by the limits to arbitrage imposed by high short-selling costs

A number of other papers have explored determinants of borrow costs. Sikorskaya (2024) shows that benchmark-driven institutional demand inflates prices and raises borrowing fees, a mechanism closely related to our focus on institutional frictions. Chen, Kaniel, and Opp (2025) document market power in securities lending, with concentrated custodians extracting non-competitive fees. Cookson, Fos, and Niessner (2025) find that disagreement facilitates informed trading by activists and short sellers, especially when borrow costs are high. Banerjee and Smith (2025) show that loan fees spike around information events, depending on disagreement.

In this paper, we generally examine just the Markit indicative fee as a measure of borrow costs. There are a few caveats raised by the literature. First, Kolasinski, Reed, and Ringgenberg (2013) use panel data examining how borrow costs charged by 12 distinct lenders change in response to demand shocks. They demonstrate significant dispersion in the fees charged by the different lenders, consistent with a model in which search costs drive lending fees in a competitve share lending market. As discussed below, we argue that the share lending is better characterized by a model with market power (consistent with Chen et al., 2025).

We use the borrow-cost as a proxy for the all-in cost to short-selling. Engelberg, Reed, and Ringgenberg (2018) point out that there are significant risks to short selling that make the effective cost for some short-sellers far higher than the simple borrow cost.

Daniel, Klos, and Rottke (2023) focuses on the behavioral and information-theoretic foundations of short-selling patterns. They develop a dynamic model of disagreement that explains how differences of opinion about security values evolve over time and interact with short-selling constraints. This model demonstrates that disagreement creates natural demand for short selling from pessimistic investors, but when this demand is constrained, it leads to persistent overpricing.

Reed (2013) and, more recently, Daniel, Klos, and Rottke (2024) provide reviews of the literature on securities lending and short-selling, with different emphasis.

3 The Structure of the Securities Lending Market

Here we provide a summary of the institutional features around short selling. Good summaries of the structure of the market for security lending are given in Duffie, Garleanu, and Pedersen (2002), Reed (2013), and Kolasinski, Reed, and Ringgenberg (2013). We summarize the institutional restrictions and features for the United States, but the basic structure is similar in other countries.

US security market regulations specify that for most traders, in order to take a short position in a US common stock, they must first borrow that stock, which means that they must first *locate* a willing lender. However, this doesn't mean that you must identify specific shares, but rather that the borrower, or the borrower's broker, has a high probability of being able to borrow or otherwise locate share certificates by the settlement date.

Settlement used to be $T + 2$ in the US, but $T + 1$ settlement was implemented on May 28, 2024. $T + 2$ settlement means that if I sell shares of stock X today, I have to come back and deliver the shares by market close 2 trading days in the future. At that point, the buyer is also required to deliver cash. The clearing agent will ensure that the seller gets their cash, and the buyer gets their shares at this point, unless the trade fails.

In the US, all shares held in *margin accounts* are held in *street name*, and can be lent by the brokerage firm for the purpose of short selling. Shares held in non-margin accounts are typically not in street-name, and hence cannot be lent by the brokerage firm.

The loan of a security for the purpose of short-selling mirrors closely a repurchase transaction: most loans are open term, which means that either the borrowing or the lending party can cancel the loan effectively overnight. This means that the lender can demand return of the shares. If it does so, the lender is required to return the shares the next day.

Securities lent can be rehypothecated (i.e., lent again by the party that purchased the lent shares). Thus, there is no limit on short-interest, which can and does sometimes exceed 100% of the number of shares outstanding for common stocks. However it is also important to note that, given the US restriction that share can only be borrowed for the purpose of short-selling, at any point in time 100% of the shares outstanding will not be lent out. This is important in that, if there are large fees associated with lending shares, it will always be the case that 100% of the shares outstanding will not be earning these fees.

However, all short-sellers face *buy-in risk*, the possibility that their stock loan will be recalled, and that they will be forced to "buy-to-cover," that is buy shares on the open market to repay the shares that have been borrowed.

A typical stock loan occurs within a brokerage firm, between a margin account that holds the shares, and another margin account that is undertaking (or extending) a short sale. According to SEC Regulation T, the short-seller is required to post collateral equal to 50% of the value of the shares shorted, where the value is the market value as of the time at which the short position is initiated, and is also required to keep the short-sale proceeds (the cash received from the sale of the borrowed shares) in the brokerage firm.

Historically, most brokerage firms paid no interest on the short sale proceeds for small individual investors. More recently, brokerage firms have started offering some fraction of the fee revenue they receive from lending out shares to the owners of the lent shares.

We note that if a share has been lent, any dividends paid by that share must be paid by the borrower to the lender. However, there is a caveat that if the share dividends are qualified, then the holder of the share would pay taxes on those dividends at a lower rate than the ordinary income rate. If the share has been lent, then payment from the borrower in lieu of dividends would be taxed at the ordinary income rate, not at the qualified dividend rate.

3.1 Restrictions on Share Lending

3.1.1 Mutual Funds

A 2011 Investment Company Institute report, Hadley, Salmon, and Smith (2011), states that:

> Since 1972, the SEC has set out conditions governing mutual fund's securities lending programs. For example, as noted in a recent Government Accountability Office report on securities lending in retirement plans, mutual funds may not have on loan at any time securities representing more than one-third of the fund's total value. A fund must receive from the borrower at least 100 percent collateral in exchange for loaned securities. (In practice, funds require 102 percent collateral for domestic securities and 105 percent for international securities.) Loaned securities must be available for recall on short notice, in case the fund needs to sell the securities or cast votes on proxy proposals. So the assets used for collateral must be highly liquid—typically, cash, government securities, or bank letters of credit. In addition, the borrower must add to the collateral on a daily basis if the value of the securities on loan increases.

In addition, an SEC report (SEC, Division of Investment Management, 2014) states:

> Securities lending by funds implicates a number of provisions of the Investment Company Act of 1940 (the "1940 Act"). For example, the transfer of a fund's portfolio securities to a borrower implicates section 17(f) of the 1940 Act, which generally requires that a fund's portfolio securities be held by an eligible custodian. A fund's obligation to return collateral at the termination of a loan implicates section 18 of the 1940 Act, which governs the extent to which a fund may incur indebtedness.
>
> Notwithstanding these (and other) 1940 Act provisions, funds engage in securities

lending, in large part in reliance on the following staff no-action letters [see the website for links to the no-action letters.]

3.2 The process of short selling

The SEC was granted authority to regulate short sales of securities under section 10(a) of the Securities Exchange Act of 1934. There are a number of SEC rules that govern short selling, most of which are under Regulation SHO.[7]

Per SEC Reg SHO Rule 200(g), all sell orders of any equity security must be marked as either a long sell (ie., selling a position you already hold), a short exempt sell, which is exempt from the up-tick rule and the locate rule), or as a standard short sale, which is subject to the modified up-tick rule and requires a locate. Market maker trades in particular are short-exempt, meaning that they are not required to perform a locate prior to (short) selling, and that they are not subject to the up-tick rule, and that they may continue to short sell after the price of a security has fallen by more than 10% in a given day.

A final restriction concerns the short-selling of threshold stocks. A threshold stock is one that has had a significant number of fails for more than five days in a row. Reg SHO specifies enhanced Close-out Requirements, locate requirements and more limited market-maker exemptions for threshold stocks. most importantly, brokers are required to pre-borrow (not just locate) those stocks before new shorts are executed for all of their customers. [8]

3.3 Sale of a stock that has been lent

$T + 2$ settlement means that if I sell shares of stock X today, I have to come back a deliver the shares by market close 2 trading days in the future. At that point, the buyer is also required to deliver cash. The clearing agent will ensure that the seller gets their cash, and

[7] See Mackintosh (2022) for a summary of the rules around share lending and short selling, and SEC, Division of Trading and Markets (2015) for specific guidance on SEC rule SHO.

[8] Exchanges publish a list of threshold stocks. See NYSE (2025) and Nasdaq Trader (2025) for the NYSE and NASDAQ list of threshold stocks.

the buyer gets their shares at this point, unless the trade fails.

It is generally the case that stock loan contracts specify that, once a stock loan is recalled, the borrower must return the shares to the lender by 3pm the next day (i.e., prior to close). This means that a trader can sell shares that have been lent out, and then recall the loans by the end of day $T + 1$. This will mean that the trade can settle on day $T + 2$.

- To take a short position in a US common stock, you must first borrow that stock.
- In the US
  - Almost all stock loans are open term. which means that either the borrowing or the lending party can cancel the loan effectively overnight. This means that the lender can demand return of the shares. If it does so, the borrower is required to deliver the shares.
  - Shares lent can be rehypothecated.
- Shares held in *non-margin* accounts are not available for lending.
- Within a brokerage firm, the broker can lend from one (margin) account to others.
  - Some brokerage firms now pay half of the lending-fee to lenders.
- Institutional investors generally lend out their shares.
  - This means that a combination of short interest and institutional ownership is generally a good indicator of whether a stock will be special (e.g., SIRIO in Drechsler and Drechsler, 2014)
- Share lending between institutions and hedge funds (for example) is not done via a centralized clearinghouse/exchange.
  - See, however, Jones and Lamont (2002), who discuss the NYSE lending post which ceased operation in the 1930s.

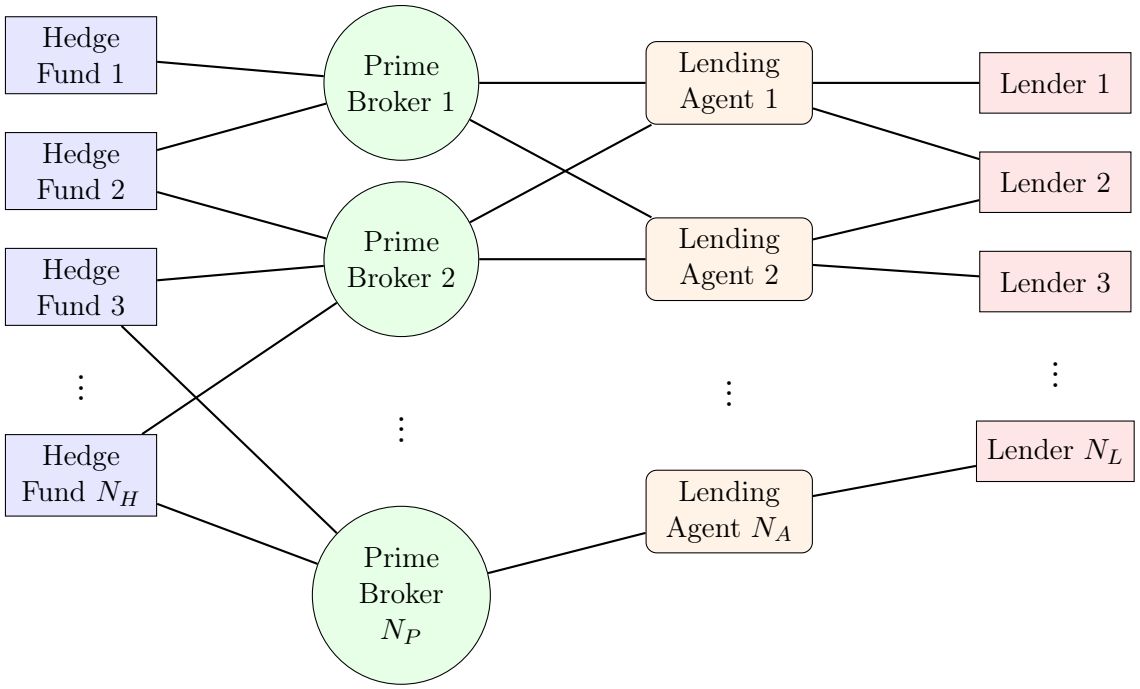


Figure 1: The Securities Lending Market

- Generally, prime brokers serve as intermediaries between share lenders and borrowers.
  - They determine the rate that paid to lenders, and charged to borrowers.
- Historically, this market was not particularly transparent.

3.4 Short-position and share-lending reporting

The SEC's reporting requirements for short positions and securities of US equities by institutional investors have evolved significantly over the past several decades. Prior to the 1980s and the introduction of the N-SAR reporting requirements, institutional investment managers filing Form 13F were not required to report short positions. In addition, there were no specific, standardized disclosure requirements for securities lending activities.

The N-SAR form, introduced in the 1980s and used until 2018, required funds to report basic information about their securities lending programs on a semi-annual basis, including whether they engaged in securities lending and the revenue generated from such activities.

However, N-SAR provided limited granular detail about individual lending transactions.

SEC's form N-PORT, introduced in 2019, replaced N-SAR and significantly enhanced transparency requirements for fund portfolios. N-PORT requires funds to report detailed quarterly (third-month) information about their securities lending activities, including the identity and value of securities on loan, collateral received, and counterparty information. This detailed data is only public with a 60-day lag.

Complementing N-PORT, Form N-CEN (also introduced in 2018) requires funds to provide annual census-type information about their operations, including basic statistics about securities lending programs.

The SEC has subsequently adopted new Rules 10c-1a, intended to increase the transparency and efficiency of the securities lending market, and 13f-2, effective January 2, 2024. These requirements should expand transparency by requiring certain entities to report securities lending transactions to FINRA for public dissemination, and mandating institutional investment managers to disclose short position data.[9]

The SEC's final report on rule 10c-1a (U.S. Securities and Exchange Commission, 2023) states that:

> The securities lending market is opaque. There is a general lack of comprehensive information on current market conditions in the securities lending market.... The lack of public information and data gaps creates inefficiencies in the securities lending market [and] ... make it difficult for borrowers and lenders alike to know whether the terms they receive are consistent with market conditions....
>
> Private vendors have attempted to address the opacity in the securities lending market by offering systems that provide data to borrowers and lenders of securities, such as systems that are only available to those who voluntarily provide their transaction data to the data vendor. However, data gaps remain. (pp. 5–6)

In our analysis below, we make use of data from both the N-PORT and N-CEN filings, available on the SEC's website.

[9] From SEC (2023c). See also SEC (2023a) and SEC (2023b).

4 Data

For our analysis of the returns of portfolios of hard-to-borrow securities, we use daily and monthly returns, market capitalizations, and trading volumes from the Center for Research in Security Prices (CRSP). Our sample consists of all common ordinary NYSE, AMEX, and NASDAQ stocks.[10]

Short interest comes from two sources: from April 1980 to May 1988 and after June 2003, we get short-interest data at the security level from Compustat. From June 1988 through June 2003, our short-interest data come directly from the exchanges (NYSE, AMEX and NASDAQ). However, prior to June 2003, if short-interest data from an exchange is missing for a given firm-month, we use short interest as reported by Compustat if that is available. After June 2003, if Compustat short-interest data is missing for a given firm-month, we use data from the exchanges if available.[11]

Aggregated institutional ownership data is constructed using Thomson-Reuters Institutional 13-F filings through June 2013, and on WRDS-collected SEC data after June 2013.[12]

Our data on stock borrow costs comes from IHS Markit. Prior to August 2004, Markit data frequency is monthly. From August 2004 until July 2006, Markit data frequency is weekly; daily coverage begins in July 2006. We use both the *indicative fee* (a proxy for marginal costs) and *simple average fee* (equal-weighted average of all contracts for a particular security) in our analyses.

Most of our analysis which utilizes the Markit stock loan database begins in January 2010. While the Markit data is available starting in 2002, coverage is poor prior to 2010. Figure 2 shows a number of statistis on the coverage based on the Markit borrow cost data,

[10]Specifically, we only consider stocks with exchange code 1, 2, or 3, and share code 10 or 11. Returns are adjusted for delisting (Shumway, 1997) using the CRSP delisting return, where available. Where the delisting return is missing, we follow Scherbina and Schlusche (2015) and assume a delisting return of -100%, or, if the delisting code is 500, 520, 551-573, 574, 580, or 584, we assume a delisting return of -30%.

[11]See the data section in Daniel, Klos, and Rottke (2023) for more details on our calculation of short interest.

[12]See note issued by WRDS in May 2017. We do substantial cleaning of these data, as described in the data section in Daniel, Klos, and Rottke (2023).

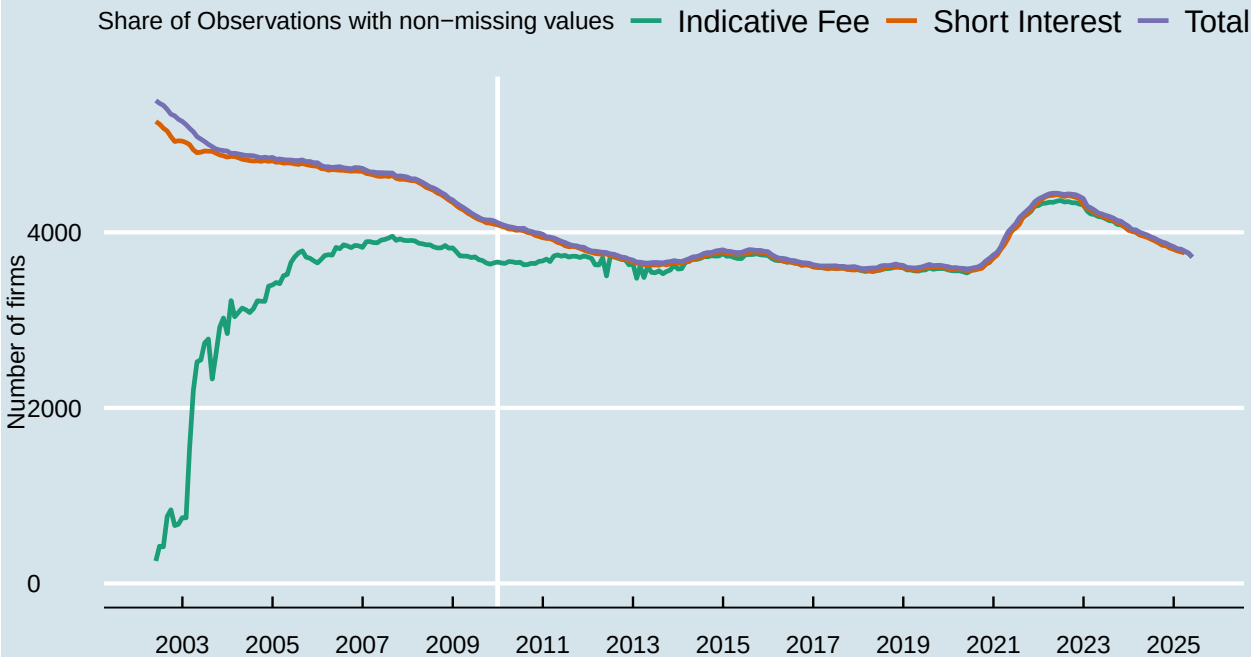


Figure 2: Markit Coverage, May 2002 through May 2025
This figure presents statistics on data coverage over the period from 2002:05–2025:05. The baseline universe consists of all stocks in CRSP with a valid market cap, share code 10 or 11 and exchange code 1, 2, or 3, and the line labeled "Total" plots the total number of stocks in that baseline universe. The line labeled "Short Interest" is the number of stocks in the universe for which we have non-missing short interest data (from Compustat, NYSE, Amex or NASDAQ). The line labeled "IndicativeFee" is the number of stocks in the universe for which Markit reports a valid indicative fee.

short-interest, and other variables.

Analyst forecasts of quarterly and fiscal-year-end earnings comes from IBES. We use the summary file unadjusted for stock splits, to avoid the bias induced by ex-post split adjustment, as pointed out by Diether, Malloy, and Scherbina (2002).

We accessed N-NPORT and N-CEN data from the SEC Edgar website to do the analysis of individual fund holdings used in the analysis below. The first date at which N-PORT filings are available from the SEC as structured data is 2019:q4.[13] Compliance dates differed among smaller and larger fund families. All funds should be included by 2020:q2.[14]

[13] See https://www.sec.gov/data-research/sec-markets-data/form-n-port-data-sets.
[14] See https://www.sec.gov/about/divisions-offices/division-investment-management/accounting-disclosure-information/investment-company-reporting-modernization-frequently-asked-questions for further details.

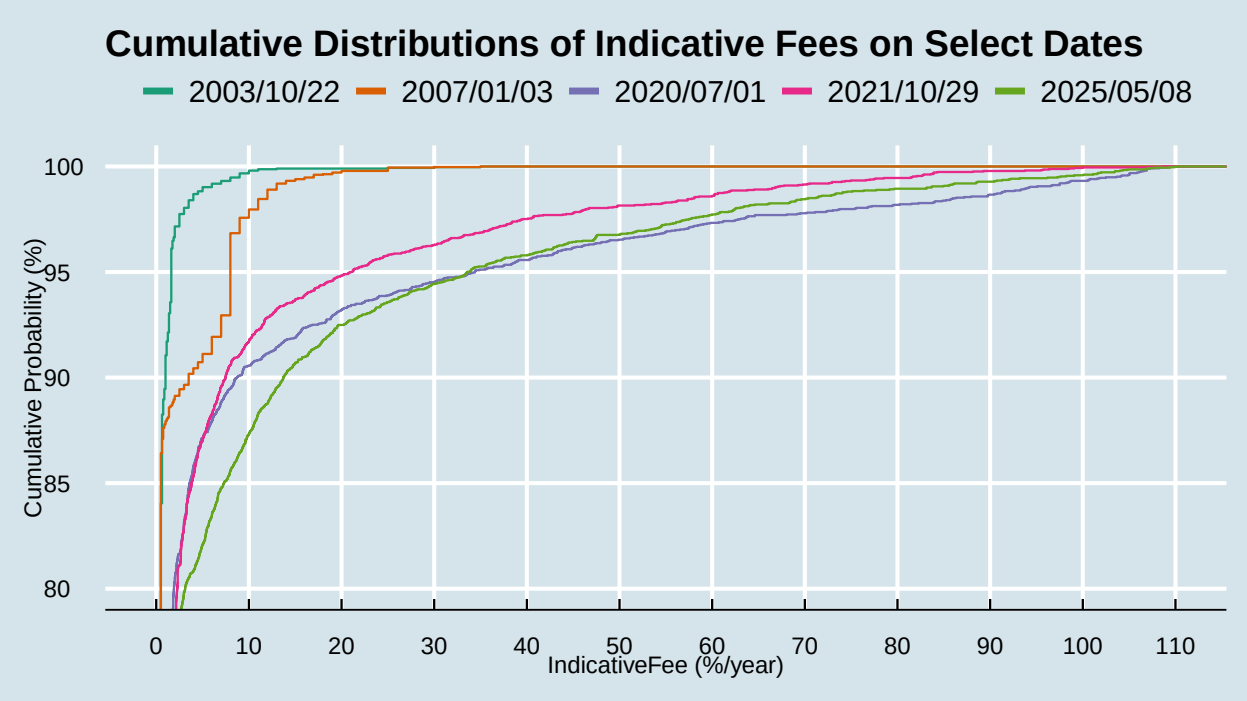


Figure 3: CDFs of *Markit* Indicative Fees for US common stocks

Finally the source for the US (equity) market returns, Fama-French indstry returns, and the monthly risk-free rate is Ken French's data library.

5 Empirical Findings

5.1 Changes in Borrow Costs and Short Interest over time

In this section we examine how borrow costs have changed for US common equities in the last several decades. Figure 3 present empirical cumulative distribution functions (CDFs) for *Markit* Indicative Fees for US common stocks listed on the major US exchanges on four selected dates. The earliest CDF, using early Markit data, shows that as of 2003/10/22, 99% of US common stocks have borrow costs of 5% or less (annualized). For both 2003/10/22 and 2007/01/03, 35% is the maximum fee observed in the data. Already by 2007, the fees have started to increase.

For the last three dates at which cumulative distribution functions are calculated, the

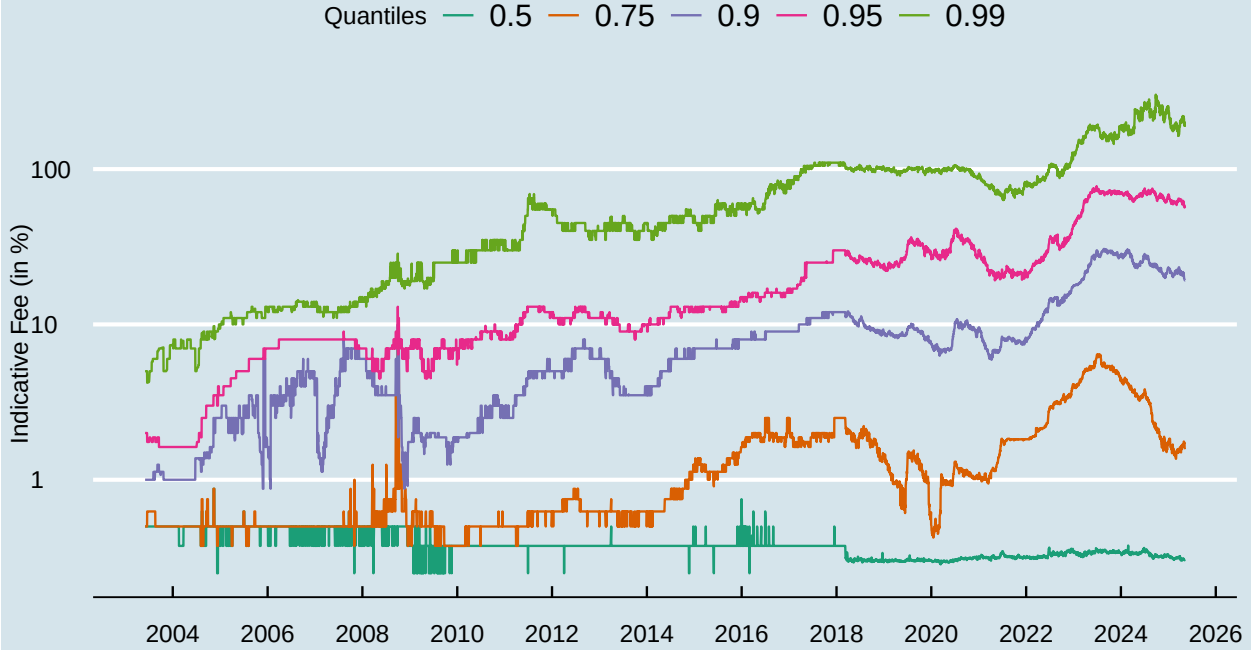


Figure 4: Indicative fee quantiles over time

picture is far different. The 99th percentile cut off is above 105%, 72% and 192% annualized fee, respectively.

Figure 4 plots quantiles of the distribution of Indicative Fees over time. While the median is at a low level and even falls slightly, the other quantiles show a remarkable upward trend over time. The 99th percentile used to be at a 5% annualized fee in 2003, and has risen to over 192% by the end of the sample. Note that Markit has changed their algorithm in 2018 to produce a smooth distribution of Indicative Fees, whereas before that date, fees were reported in coarse buckets, such as 37.5 bps, which is reflected in the lines jumping between these predefined coarse buckets pre-2018.

Figure 5 shows the evolution of fees in a different way. Here, we plot the fraction of stocks with indicative fees above one percent and above 10% over the period from January 2010 (where data coverage is better - see Figure 2) through May 2025. The fraction of stocks with a fee above 1% has increased from 11% in 2010 to over 40% in 2022, and, as of May 2025, has come down slightly, to 29% in May 2025. In 2010, only 3% of stocks had a fee >10%. That number was up to just under 20% in 2023 and is about 15% in May 2025.

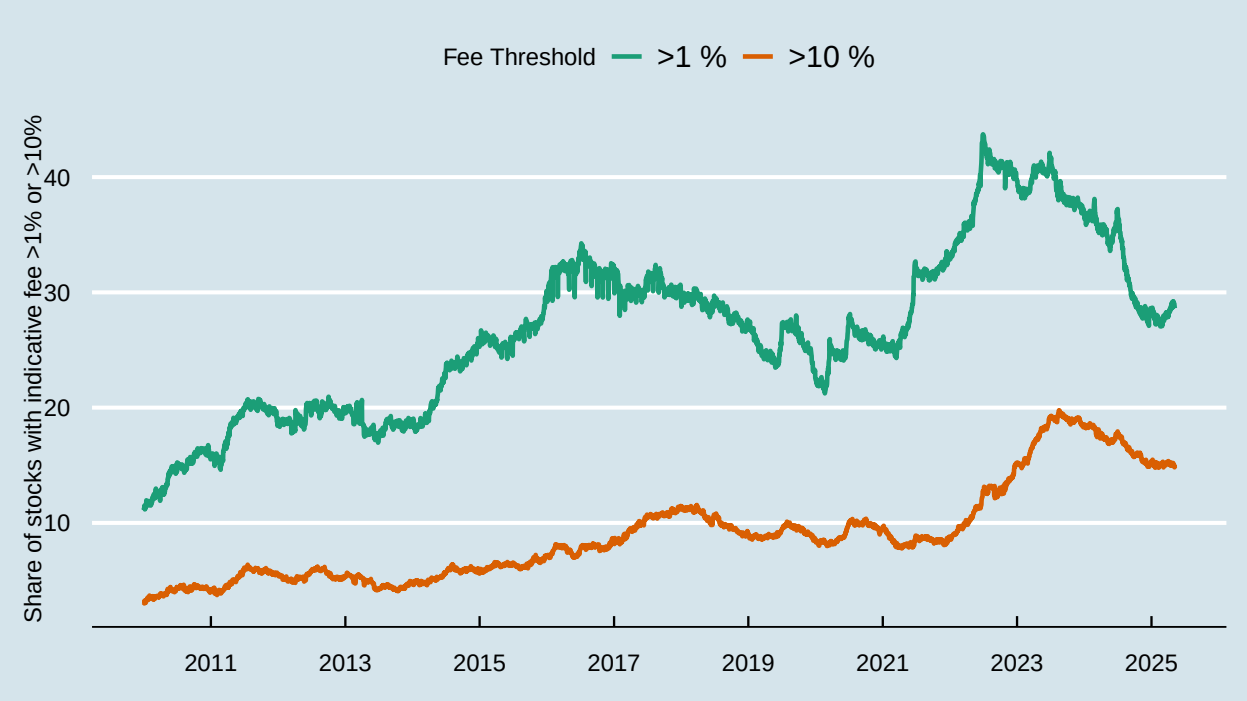


Figure 5: Share of stocks with indicative fee above 1% and 10% over time

In the following, we first sort all US common stocks on each date into ten groups, using NYSE breakpoints. That is, the bottom decile portfolio contains all US common stocks, traded on any of the three major exchanges, for which the equity market capitalization is less than the market capitalization of the 10th percentile NYSE firm. Figure 6 gives an overview of the proportion of these buckets. As a result of using NYSE breakpoints, there are far more firms in the bottom decile portfolio than in any other bucket. In fact, decile 1 makes up around 40% of names in the universe. The large stocks (decile 10) only account for roughly 5% of all names. In the following, we put deciles 4 to 9 together to simplify the exposition.

Figures 7 and 8 perform the same analysis as Figure 5, for one percent and 10% fee cutoffs, only now this is done within our size sorted universes. The figures show that among bottom decile market capitalization firms, the fraction of firms for which the fee is greater than one percent has risen from about 15% to above 75%, and the fraction for which fees are above ten percent has risen from just over 5% in 2010 to well over 40% in 2023. It has come

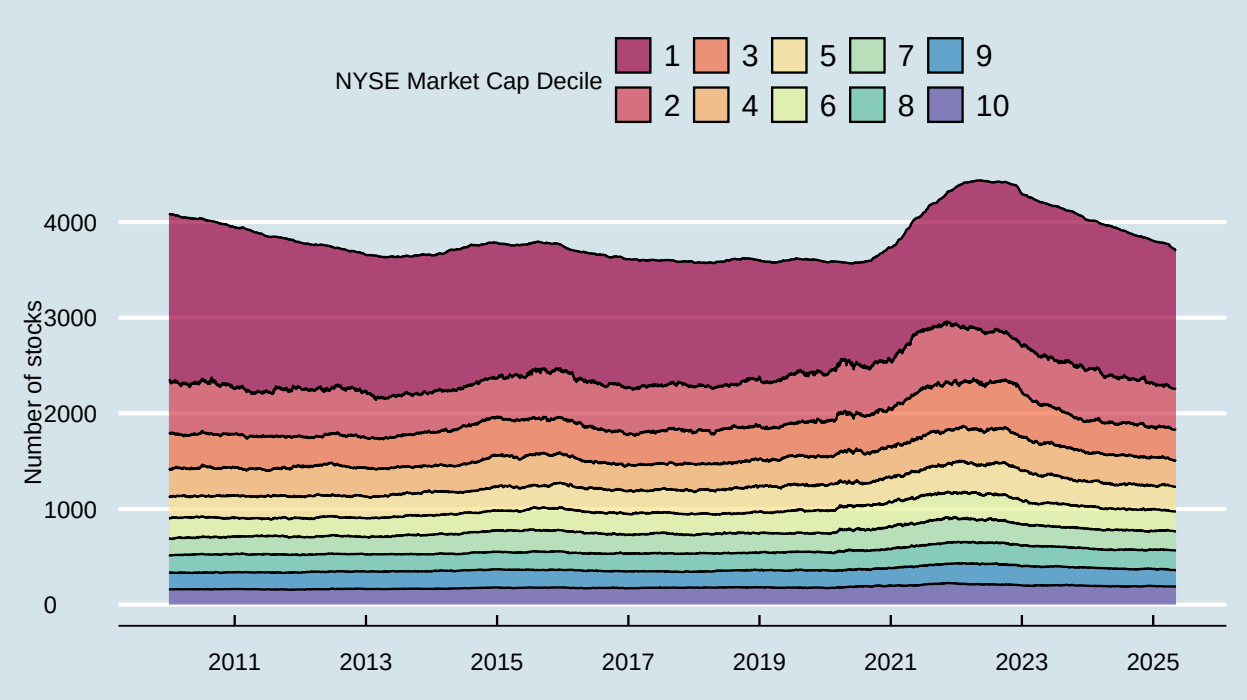


Figure 6: Number of stocks in NYSE market capitalization deciles

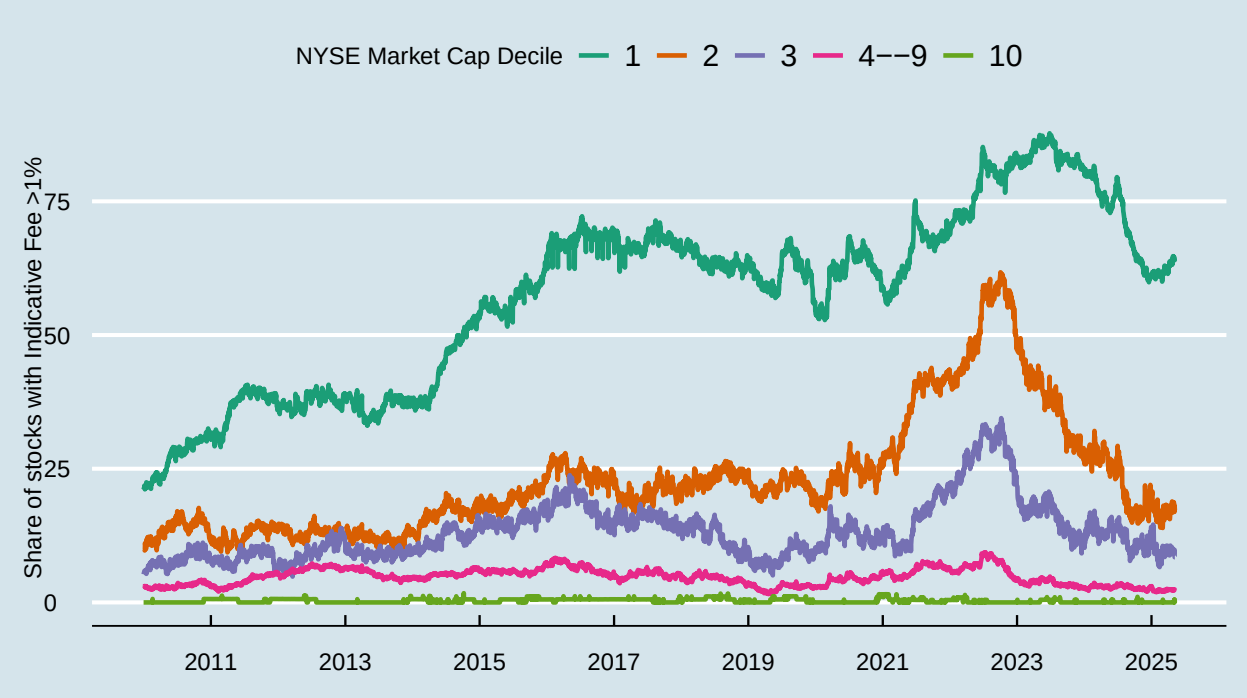


Figure 7: Fraction of US common stocks with an inidicative fee $> 1\%$, by ME quintile

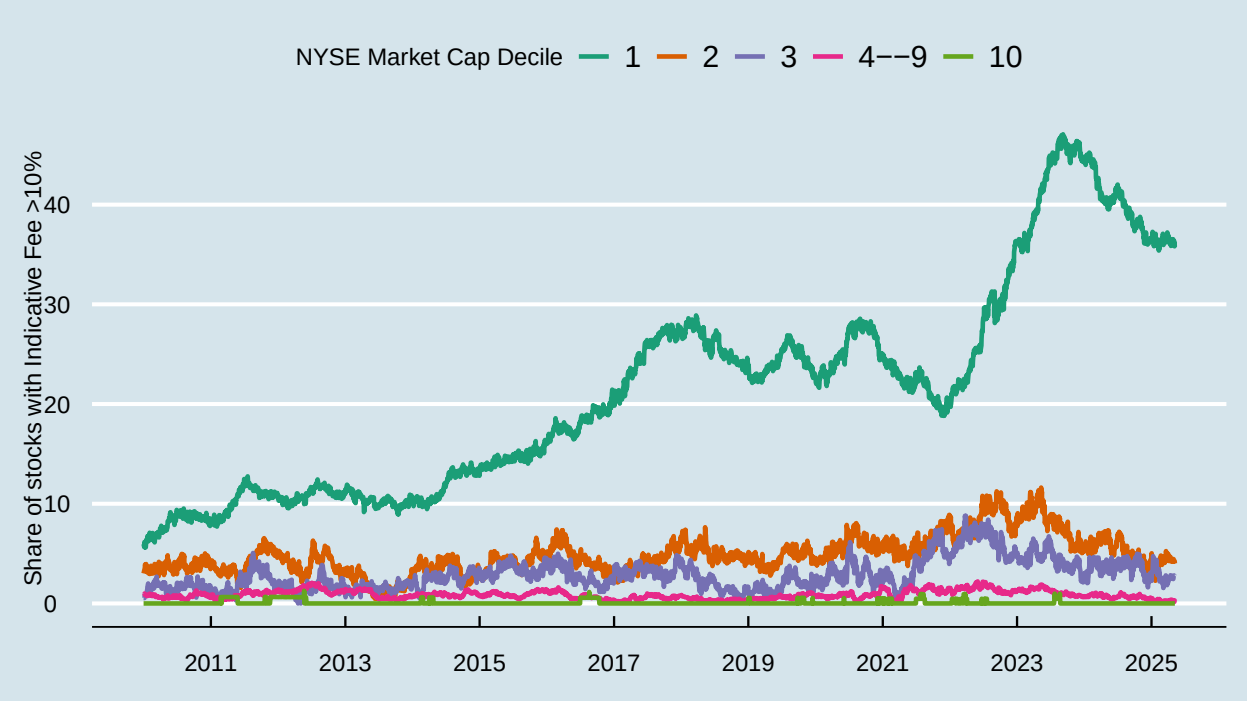


Figure 8: Fraction of US common stocks with an inidicative fee IF $>10\%$, by ME quintile

down slightly to around 36% in May 2025. Even for deciles 2 and 3, the share of stocks that are commonly referred to as special (i.e. a fee >1%) rose above 50% and 30%, respectively, in 2022. These have since come down but are still much higher than they used to be in 2010 (17% vs. 10% and 8% vs. 6%). For the share of stocks with lending fees >10% in deciles 2 and 3, it is also higher in 2025 compared to 2010 (4% vs. 3% and 3% vs. 1%)

Figure 9 presents the final snapshot of how fees have evolved in the US market for share lending. The most striking finding here is that the average fee for stocks in the bottom NYSE size decile increased by about a factor of 10: it has moved from just above 2% in early 2010 to above 20% today. For deciles 2 and 3, the average fee has also increased substantially (3.3% vs. 1.5% and 0.9% vs. 0.6%).

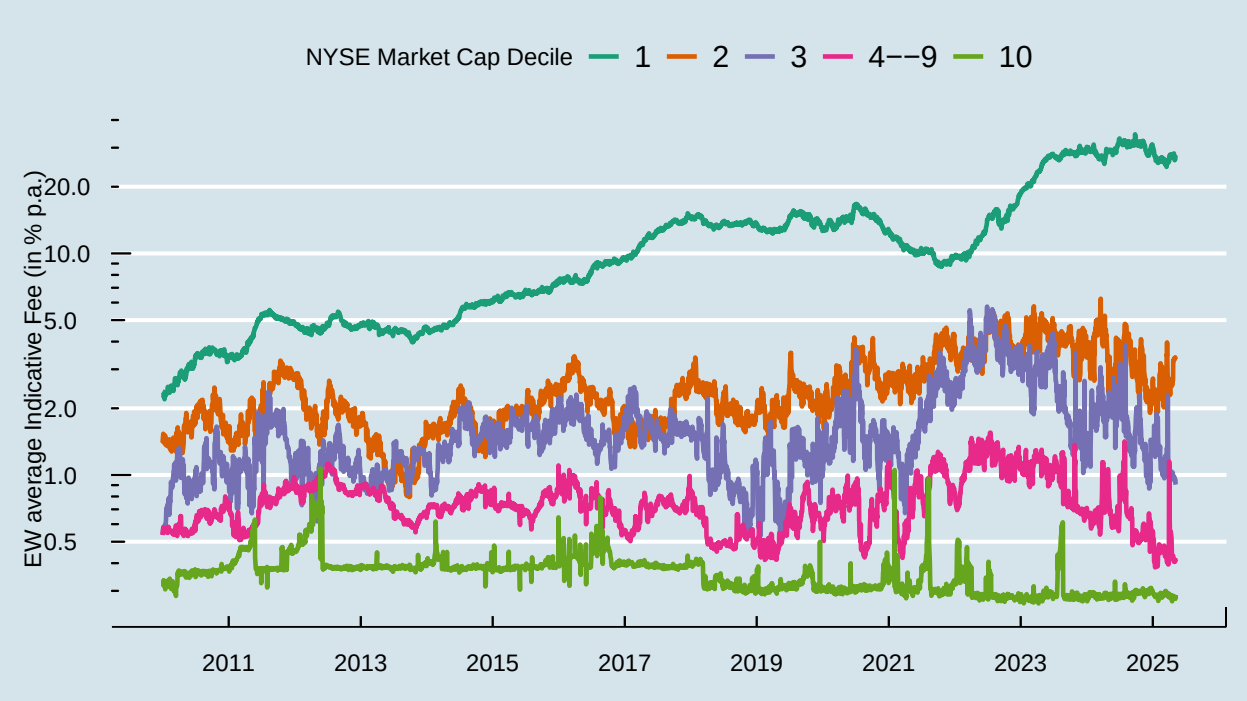


Figure 9: Average borrow cost, by size decile
This figure presents the equal weighted average of the indicative fees for all firms in each NYSE-sorted market cap decile. That is, market capitalization decile 1 contains all firms, listed on any of the three major US exchanges and with share code 10 or 11, which have a market capitalization, which is less than the 10th percentile NYSE firm by market cap. The sample period is 2010:01–2025:04.

5.2 Abnormal Returns for long- and short-investors in special stocks

In this section we examine the returns earned by by special securities, and how these returns have evolved over time as fees have changed. Specifically, we estimate the relation between the indicative fee reported by Markit on a given stock, and the subsequent return to that stock. As discussed in earlier sections, the Markit data comes pretty close to having full coverage starting in about January of 2010. Therefore, we start our examination in January of 2010.

We use the CRSP return data merged with the Markit share lending data as described in Section 4. Our sample is all US common equities traded on major exchanges. Specifically, we require that the CRSP exchange code be 1, 2, or 3, and the CRSP sharecode be 10 or 11. We also require that the stock have a valid indicative fee in the Markit data.

On each day from January 3, 2010 to March 31, 2025, we form portfolios based on the indicative fee provided by Markit for that stock. We form eight portfolios, using indicative fee breakpoints of 0.5, 1, 2.5, 5, 10, 20, and 50 % (annualized indicative fee). That is, portfolio 1 (the lowest fee portfolio) on January 4, 2010 contains all stocks that, as of January 3, 2010, had an annualized indicative fee of less than 0.5%. Portfolio 2 contains all stocks that, as of January 3, 2010, had an annualized indicative fee between 0.5% and 1%, and so on. The high fee portfolio contains all stocks that had an annualized indicative fee on January 3, 2010 that was above 50%.

The stocks in each portfolio are value weighted, and the returns and borrow costs for the portfolios over the next trading day are calculated. To calculate the borrow cost for the portfolio, we assume that the indicative fee on each stock is paid from close on the trading day on which it appears in the Markit database, to the close of the following trading day. We calculate the daily borrow cost by dividing the annualized indicative fee by 252.

We then regress these daily returns, in excess of the risk-free rate, on the excess market return to get CAPM alphas for each of these eight portfolios.[15]

Figure 10 provides a scatterplot. The orange dots in the plot represent, on the y-axis, the annualized CAPM alpha for these portfolios over the sample period, and on the x-axis the annualized borrow cost. Note that these orange dots represent the "gross" returns, and the lines represent the ± 1.96 standard errors.[16] That is, these are the average annualized return for these portfolio, which make no adjustment for borrowing cost.

Thus, for the high fee portfolio, the average borrow cost over this time was a bit more than 80% (annualized), and the alpha was about -75% (also annualized).

To generate the returns "net" of borrow costs (the orange dots) we add the individual stocks's daily borrow cost to it daily return to get the stock's net return. To get the portfolio's net return we just multiply by the portfolio weights (ie., the stock's market capitalization, since the portfolio is value-weighted), and sum for each day. To make the chart easier to

[15] Both the excess market return and the daily risk-free rate are taken from Ken French's database.
[16] Based on Newey and West (1987, 1994) standard errors with automatic lag selection.

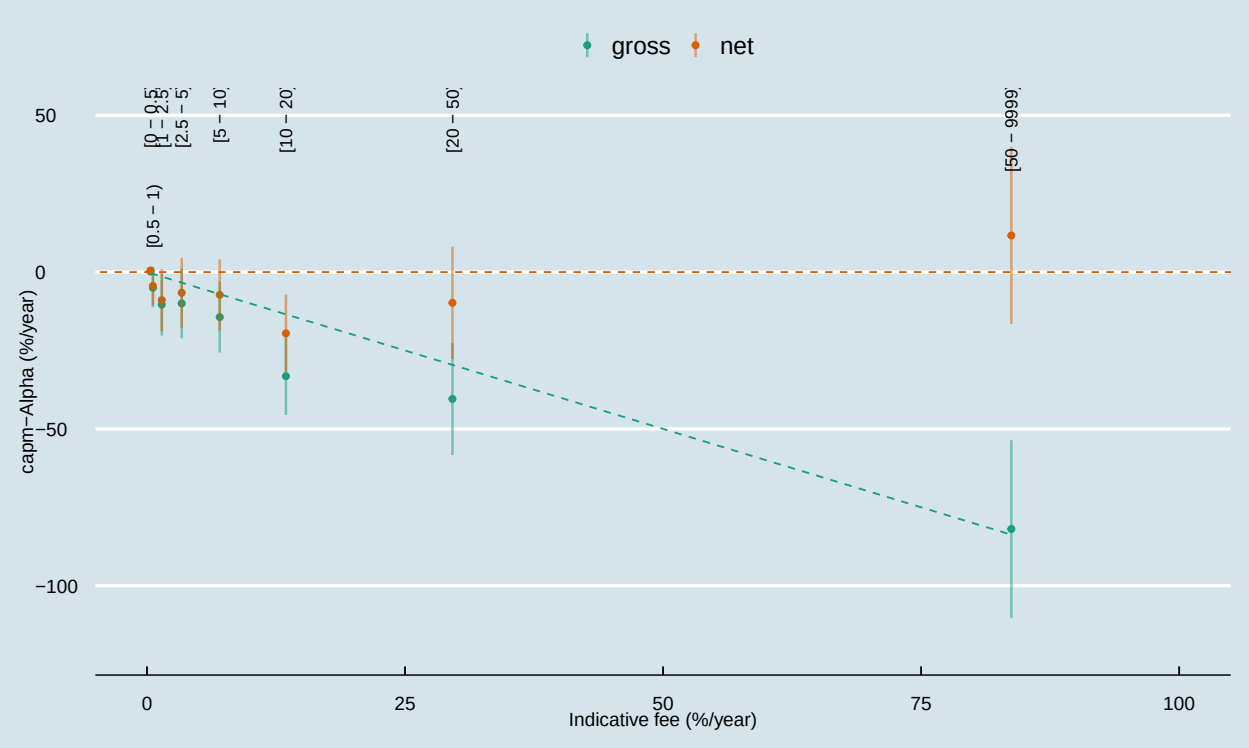


Figure 10: Performance of borrow-cost sorted portfolios – Daily formation
The green dots in this scatterplot represent, on the y-axis, the annualized CAPM alpha for the portfolios over the sample period, and on the x-axis the annualized borrow cost based on the indicative fee reported by Markit. Note that these orange dots represent the "gross" returns, and the green whiskers represent the ±1.96 standard errors, based on Newey and West (1987, 1994) standard errors with automatic lag selection. The net returns — represented by the orange dots—are calculated by adding to each stock's daily return the daily borrow cost for that security. The CAPM alpha for each portfolio is calculated by running a time series regression of the return, net of the risk-free rate on the excess market return.

read, we have added an orange dashed line at $y = 0$, and a green dashed line with a slope of -1 and an intercept of zero.

There are several interesting regularities evident in the Figure:

1. The average alpha is approximately the negative of the fee, meaning that the high-fee portfolios suffer dramatic and consistent losses: the value-weighted portfolio of the high-fee stocks underperforms by 75%/year. This is somewhat shocking, because of course 100% of the shares outstanding in these firms are not lent out. (Recall that, for every share that is lent and sold, it has to eventually be bought by an entity who holds it without lending). So the investors who are holding these shares are losing a remarkable amount of money.

2. Historically, shorting moderate fee stocks was a good bet. For example, the 5th portfolio had an average fee of about 13%, but lost about 33% (on average over this entire period). So you would have made an alpha of 20%/year had you shorted these stocks. This of course means that, if you had gone long these stocks and lent them out, AND captured the full fee, you would have lost 20%/year. Based on our estimate that you would have captured only 50% of the fee, you would have lost 26.5%/year.

3. Based on conversations with an individual involved in share lending at at a major asset management firm, it appears that this firm and some others have begun monitoring fees, and if they get at all high, they just sell the stock rather than lend it out. This is a hypothesis we explore formally in Section5.5.

4. For the very highest fee stocks, it looks like the short sellers are paying too much. This suggests that there are a set of overly-aggressive individuals with margin accounts who are willing to pay massive fees to short sell some securities. Related to this, two decades ago the highest fees were always on the order of 20-30%. Now, there are over a hundred securities with fees $>$ 100% (annualized).

Figure 11 is similar to Figure 10 above. Here though, instead of reforming the portfolio each day based on the preceding day's reported borrow cost, we form the portfolio at the start of each month, and keep the portfolio membership constant over the following month. Comparing Figures 11 and 10 shows that there is very little decline in either the realized indicative fee when we form the portfolio monthly, and only a small increase in the portfolio alphas. The reason for this is that the fees (and the alphas) are quite persistent. Thus, all of the qualitative findings described above hold with the monthly formed portfolios.[17]

Figure 12 plots the number of stocks in each fee portfolio over time. There is a clear upward trend in the number of stocks in the high-fee portfolios. The portfolio of stocks with fees $>$ 50% carries less than 10 stocks in 2010 and well over 200 stocks towards the end of the sample. Note that there is a bit of back-and-forth between the two lowest-fee portfolios in 2016, when the mode of the fee distribution sometimes increases to 50 bps and a large number of stocks gets allocated to the [0.5-1) portfolio temporarily. This probably relates to Markit calculating the Indicative Fee in a way that results in relatively coarse buckets of rounded fee levels (such as 37.5 bps and 50 bps) up until 2018.

[17]We have also calculated industry-adjusted alphas by also subtracting off the returns to a value-weighted portfolio of returns from the stocks in the same industry. The conclusions from this analysis are similar.

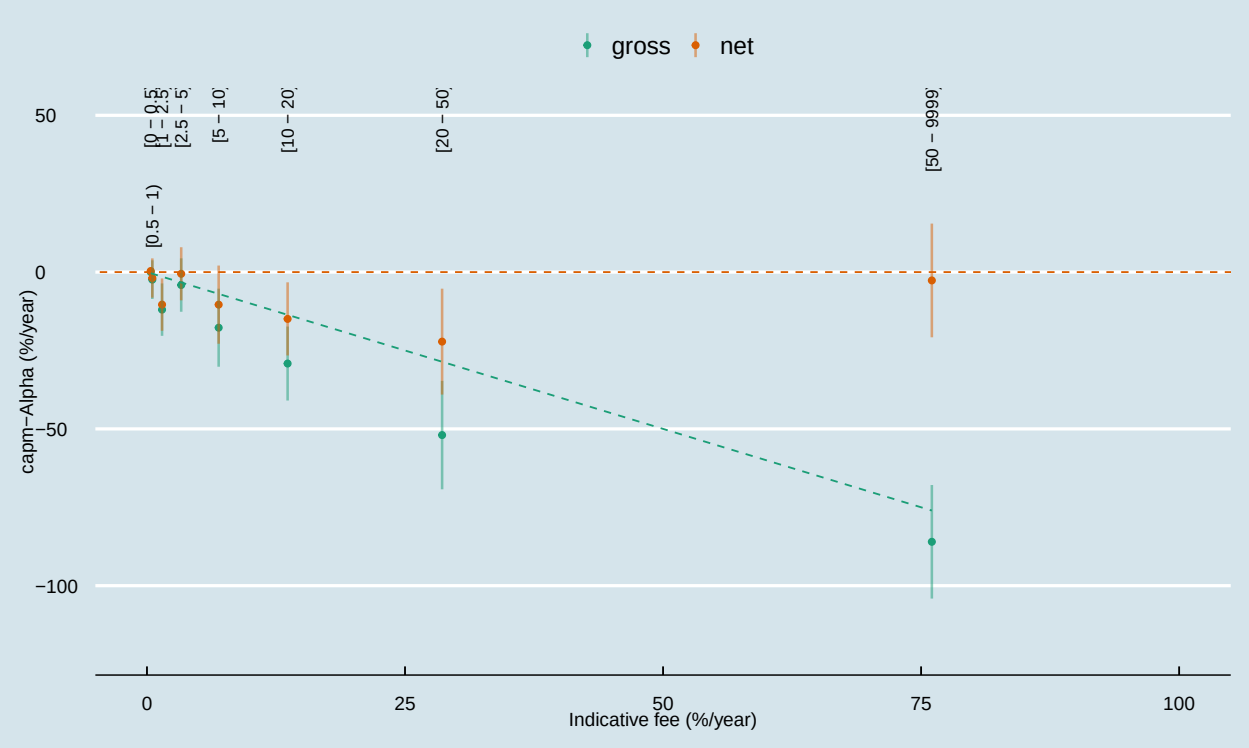


Figure 11: Performance of borrow-cost sorted portfolios – Monthly formation
Each month, we sort all US common stocks traded on major US exchanges into portfolios based on the Indicative fees reported by Markit on the last day of the preceding month, using cutoffs of breakpoints of 0.5, 1, 2.5, 5, 10, 20, and 50 % (annualized indicative fee) The green dots in this scatterplot represent, on the y-axis, the annualized CAPM alpha for the portfolios over the sample period, and on the x-axis the annualized borrow cost based on the indicative fee reported by Markit. The green dots represent the "gross" returns, and the orange whiskers represent the ±1.96 standard errors, based on Newey and West (1987, 1994) standard errors with automatic lag selection. The net returns —represented by the orange dots—are calculated by adding to each stock's return the daily borrow cost for that security, and cumulating to get the monthly return. The CAPM alphas for each portfolio is calculated by running a time series regression of the return, net of the risk-free rate on the excess market return.

Figure 13 plots the cumulative after-fee return to the daily-rebalanced portfolios long 1$ in stocks with fees between 0–50 bps, 50–5000 bps and more than 5000 bps and short a portfolio of stocks that mimics the industry composition of the respective long portfolios. The short proceeds earn the risk-free rate. The portfolios also earn the lending-fees of the long side and pays the borrowing fees of the industry-matched short side.

We can see that until about 2020, both the [0.5-50) and [50-9999) portfolios' negative

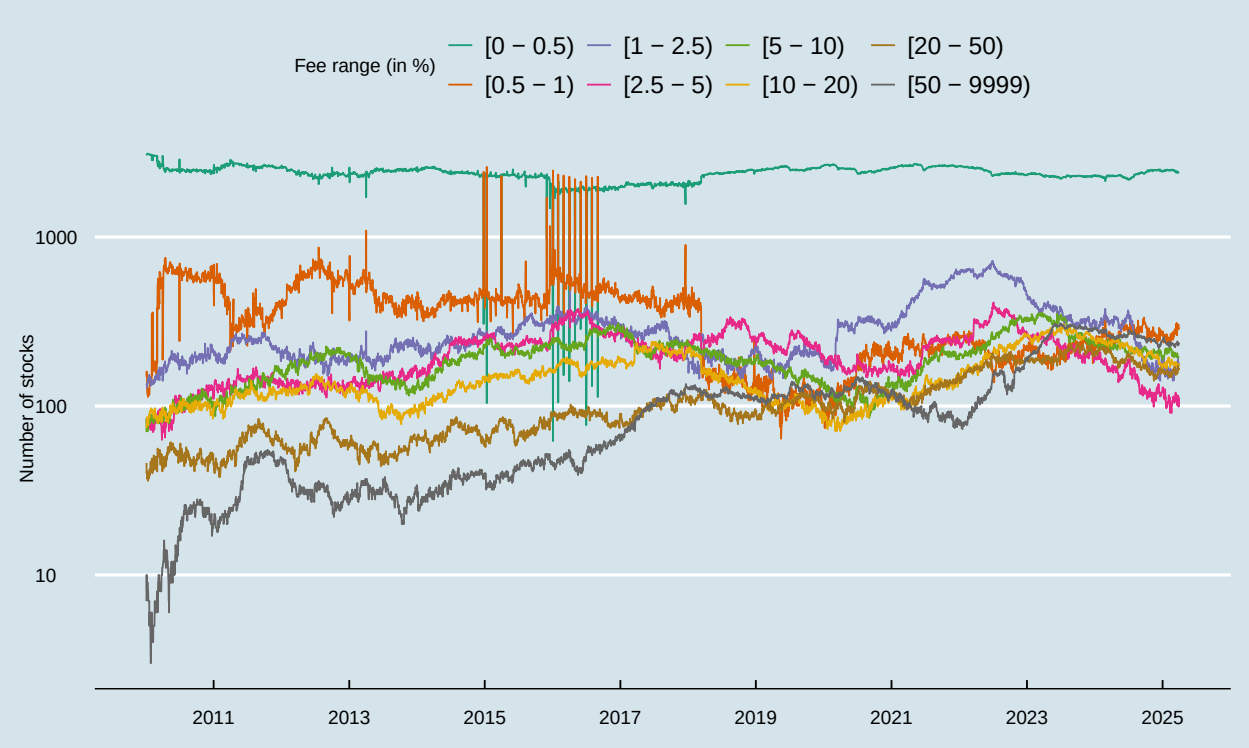


Figure 12: Number of stocks in fee-sorted portfolios over time

returns relative to their industry peers are roughly offset by their fees, rendering their cumulative after-fee return essentially flat. In 2021 and 2022 they earn strong negative after-fee returns. Starting 2023 the [0.5-50) portfolio is flat again. The [50-9999) portfolio starts gaining in value at the end of the sample, but is much more volatile over the whole time period.

5.3 Do analyst expectations reflect short seller beliefs?

The evidence presented in Section 5.2, combined with much other evidence in the academic literature, suggest that there is substantial disagreement across market participants: optimists express this optimism through purchasing securities, and pessimists express their pessimism through short selling securities. A recent literature has attempted to explore the beliefs of investors by examining analyst forecasts (see, e.g., Bordalo, Gennaioli, La Porta, and Shleifer (2024)). An interesting question given our evidence here is whether the views

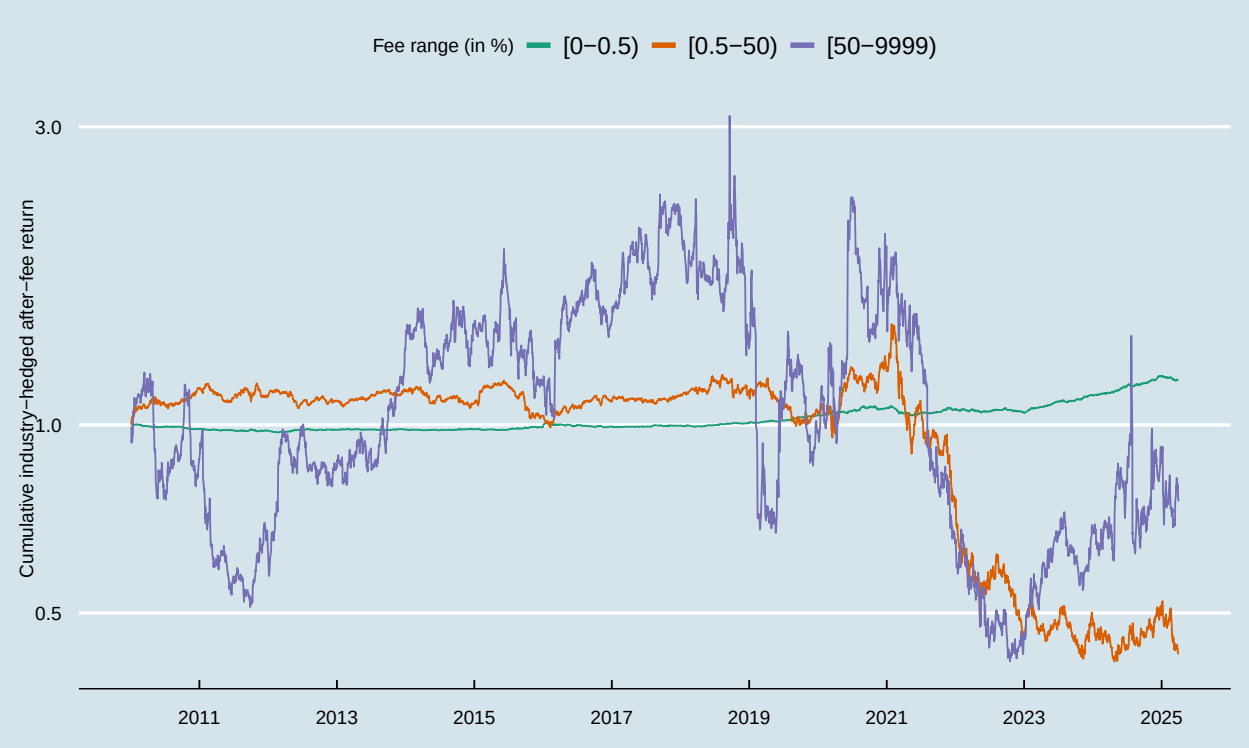


Figure 13: Cumulative return of fee-sorted portfolios

of analyst better reflect the views of the optimists or of the pessimists. We examine this question by exploring the extent to which analyst forecast errors and forecast revisions can be predicted using borrow costs reported by Markit in advance of the time the forecast is made. If these forecasts are rational with respect to borrow costs, in the sense that the forecasts fully incorporate all information embedded in the reported borrow costs, then both forecast errors and revisions should be orthogonal to this information.

Table 2 presents the results of panel regressions in which we regress analyst's 1-quarter-ahead consensus forecast errors on past consensus forecast errors and past lending fees over the period from 2010:01–2024:12. What this indicates is strong predictability, consistent with the information in *ex-ante* borrow costs not being reflected in the analysts' forecasts.

Table 3 presents the results of panel regressions in which we regress analyst's 1-quarter-ahead forecast revisions on lagged lending fees over the period from 2010:01–2024:12. This again indicates strong predictability for forecast revisions, consistent with the information in *ex-ante* borrow costs not being reflected in the forecasts.

Table 2: Forecasting forecast errors
Analyst 1-quarter-ahead forecast errors regressed on past forecast errors and past lending fees. 2010:01–2024:12

	1	2	3	4
Intercept	-0.00			
	(-1.11)			
fee	-0.02	-0.02		-0.02
	(-11.02)	(-11.01)		(-11.01)
error (t-1)			0.18	0.18
			(17.82)	(17.74)
R^2	0.0105	0.0169	0.0376	0.0451
Fixed Effects		qtr	qtr	qtr
Clustering	permno,qtr	permno,qtr	permno,qtr	permno,qtr
N	170,525	170,525	170,525	170,525

Table 3: Forecasting Revisions
Revision in analyst 1-quarter-ahead forecasts regressed on lagged lending fees, 2010:01–2024:12

	1	2	3	4	5
Intercept	-0.02	-0.02	-0.02	-0.02	
	(-233.55)	(-31.04)	(-26.03)	(-4.92)	
fee	-0.41	-0.41	-0.41	-0.41	-0.41
	(-100.87)	(-11.00)	(-10.84)	(-11.60)	(-12.11)
R^2	0.0020	0.0020	0.0020	0.0020	0.0088
Fixed Effects					year
Clustering		permno	permno, analys	permno, analys,yr	permno analys,yr
N	5,093,157	5,093,157	5,093,157	5,093,157	5,093,157

5.4 Inefficiency

Here we estimate the social-welfare losses associated with the frictions in the share lending market, and the total fees payed to borrow securities.

Figure 14 plots inefficiency as a function of time, where inefficiency is measured as:

$$\text{Ineff}_t = \sum_i \text{ME}_{i,t} \cdot \text{fee}_{i,t},$$

where $\text{ME}_{i,t}$ is the market-capitalization for firm i at time t in dollars, and $\text{fee}_{i,t}$ is the daily indicative fee for stock i on day t.

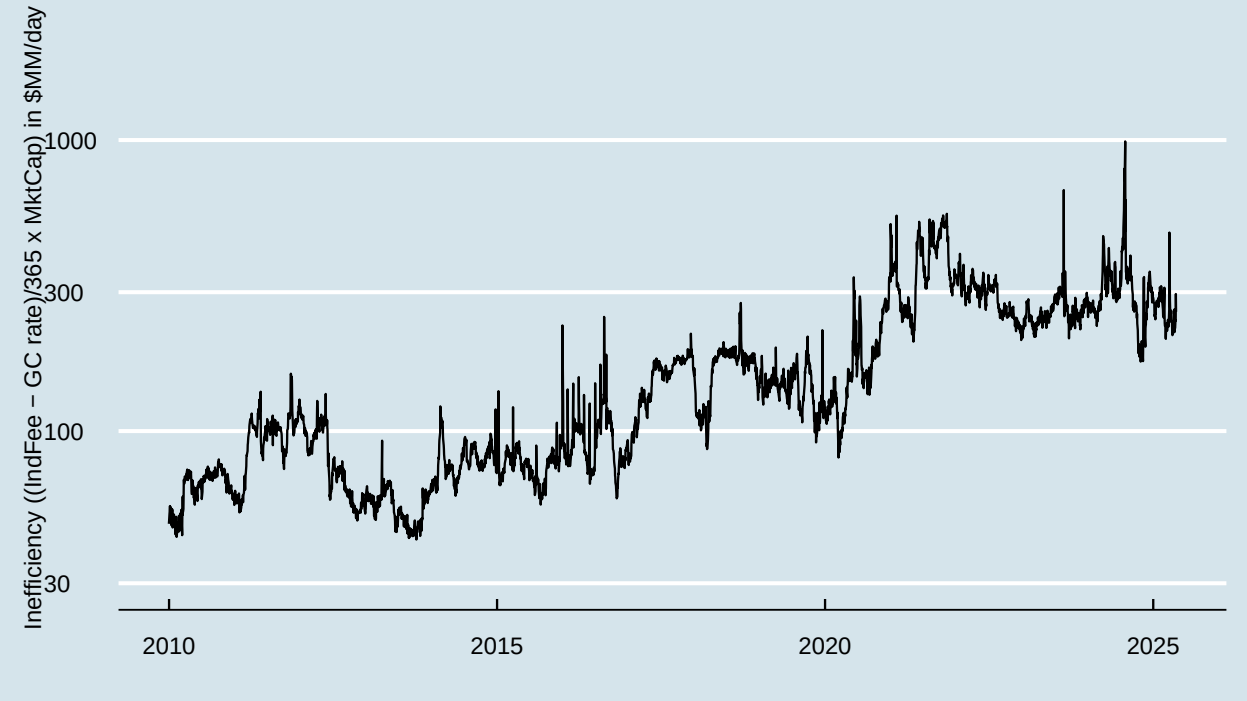


Figure 14: Inefficiency over time
The figure plots inefficiency as a function of time, where inefficiency is measured as: $\text{Ineff}_t = \sum_i \text{ME}_{i,t} \cdot \text{fee}_{i,t}$, where $\text{ME}_{i,t}$ is the market-capitalization for firm i at time t in dollars, and $\text{fee}_{i,t}$ is the daily indicative fee for stock i on day t.

Figure 15 plots the aggregate borrow costs as a function of time, where aggregate borrow costs are measured as:

$$\text{Costs}_t = \sum_i \text{SI}_{i,t} \cdot \text{P}_{i,t} \cdot \text{fee}_{i,t},$$

where $\text{SI}_{i,t}$ is the short-interest in shares for firm i at time t $\text{P}_{i,t}$ is the price in dollars per share, and $\text{fee}_{i,t}$ is the daily indicative fee for stock i on day t.

5.5 Why isn't there more lending?

A striking finding from the analysis in this paper is that, with the very high borrow costs we observe, there is not more lending of high fee names. In this section, we explore the holding of high-borrow-cost securities by institutional investors, and in particular, we examine how these holdings vary with the fees on the securities. Here as elsewhere in this paper, we restrict ourselves to US common equites, and in this section we utilize the data available

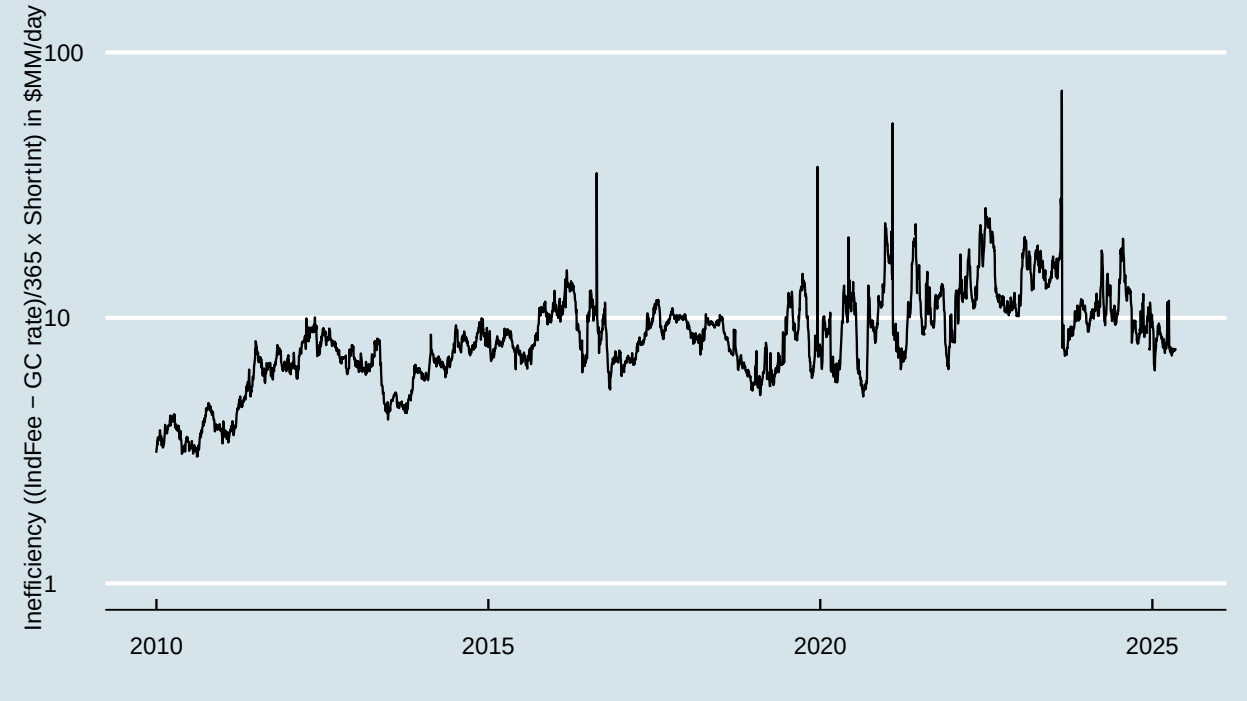


Figure 15: Aggregate borrow costs over time
The figure plots the aggregate borrow costs as a function of time, where aggregate borrow costs are measured as: $\text{Costs}_t = \sum_i \text{SI}_{i,t} \cdot \text{P}_{i,t} \cdot \text{fee}_{i,t}$, where $\text{SI}_{i,t}$ is the short-interest in shares for firm i at time t $\text{P}_{i,t}$ is the price in dollars per share, and $\text{fee}_{i,t}$ is the daily indicative fee for stock i on day t.

from the SEC's N-PORT filings from 2019:q4.

Table 4 reports the ten funds with the largest total dollar lending of securities as of 2024:q4. The table lists the dollar amount on loan, the total AUM of the fund, and finally the ratio of the amount lent to the AUM. At this point in time, the largest lender was the iShares Russell 2000 ETF, which at this point in time lent out 9% of its holdings. We note that this is far below the mandated upper limit on lending of 33%.

Table 5 reports, for the iShares Russell 2000 ETF as of 2024:q4, the holdings, the amount lent out of each holding in dollars, and the fraction lent for each holding for which the annualized indicative fee was greater than 20%. The table shows that 17 securities meet this 20% criterion. Interestingly, the fraction of these names lent is now, on average, close to 100%. This report also shows that there are a few problems with the filing, in that the amount reported lent for two names—Galectin Therapeutics and Beyond Meat—are greater

Table 4: Largest Lenders – 2024:q4
This table shows the largest lenders of shares as of the final quarter of 2024.

Fund Name	Lent($)	AUM($)	ratio
iShares Russell 2000 ETF	6,478,828,734	72,093,428,512	0.090
iShares Core S&P Small-Cap ETF	3,983,488,985	85,836,927,634	0.046
iShares Core S&P 500 ETF	3,575,614,374	584,398,561,119	0.006
Vanguard total stock mkt index fund	3,072,685,466	1,772,368,654,393	0.002
iShares Core MSCI Emerging Mkts ETF	2,808,831,783	80,072,853,241	0.035
Vanguard total intl stock index fund	2,797,110,492	437,351,714,892	0.006
iShares Core S&P Mid-Cap ETF	2,776,593,040	94,310,766,143	0.029
Vanguard developed mkts index fund	2,119,483,377	190,020,993,881	0.011
Fidelity Sml Cap Index Fund	2,110,345,840	26,820,629,983	0.079
Invesco S&P 500 EW ETF	1,999,590,011	65,616,385,655	0.030

than the dollar holdings reported, resulting in calculated fraction lent of $> 100\%$.

The largest holding reported in Table 5 is Humacyte, in which the iShares Russell 2000 ETF has holdings of $12.2 Million as of this reporting date. In Table 6, we report the largest 20 holders of Humacyte across all N-PORT 2024:q4 filings. The table shows that the fund with the largest position in Humacyte at this time was the SPDR S&P(R) Biotech ETF, with a position of $13.3 million. In the table we also report the dollar amount of this holding lent out as of the reporting date, the fraction lent, and finally the total dollar amount of securities lent by that fund as of 2024:q4.

Again in this table we see that, given the high borrow cost for Humacyte over the preceding quarter, a number of funds elect to lend out a large fraction of their holdings. Across all of the non-zero entries in this table, the lowest is 87%. Interestingly, there is one fund, the TIFF Multi-Asset Fund, that reports zero lending of Humacyte, despite doing a substantial amount of lending of its other holdings. In addition, there are four funds that do no lending of any securities.

We began this analysis by showing that borrow costs have increased over the last several decades. A key question is why the fees have increased so much. One hypothesis is that institutional owners who hold high-fee firms have come to appreciate that, when the borrow

Table 5: iShares R2000 ETF lending – fee > 20% – 2024:q4
This table shows holdings (in $), amount lent (in $), and the average annualized borrow cost over the preceding 90 days (labeled "fee") for all holdings of the iShares R2000 fund for which the fee was greater than 20%/year. The The borrow cost is calculated using the indicative fee as reported by Markit. The table entries are sorted by the average borrow cost over the preceding 90 days.

Holding Name	Holdings ($)	lent ($)	fraction	Ind. Fee
CervoMed	314,474.900	280,881.900	0.893	1.199
NANO Nuclear Energy	3,103,734.000	3,075,055.000	0.991	1.047
Galectin Therapeutics	503,772.100	507,756.900	1.008	0.731
FuelCell Energy	4,355,038.000	4,318,281.000	0.992	0.729
Airship AI Holdings	1,927,930.000	1,899,660.000	0.985	0.582
Roadzen	1,861,513.000	1,314,039.000	0.706	0.539
Tenaya Therapeutics	2,143,601.000	2,114,025.000	0.986	0.504
BioAge Labs	1,915,037.000	1,899,682.000	0.992	0.411
Critical Metals	1,259,117.000	794,484.300	0.631	0.404
B Riley Financial	2,915,600.000	2,598,266.000	0.891	0.363
SolarMax Technology	795,799.100	112,946.400	0.142	0.355
Beyond Meat	6,094,031.000	6,156,135.000	1.010	0.283
Humacyte	12,222,682.000	12,139,296.000	0.993	0.274
Candel Therapeutics	5,012,197.000	3,079,933.000	0.614	0.274
Luminar Technologies	3,196,699.000	1,422,800.000	0.445	0.264
IGM Biosciences	2,571,925.000	2,525,544.000	0.982	0.225
Verrica Pharmaceuticals	397,372.500	59,745.700	0.150	0.203
Cartesian Therapeutics	4,672,092.000	3,941,633.000	0.844	0.201

costs on these securities become large, they are far better off selling these holdings than lending them out (consistent with the findings in Evans, Ferreira, and Porras-Prado, 2017). If these holdings are sold by the funds/institutional investors to individual investors with non-margin accounts, then this will downward shift the supply curve of shares in the share lending market, resulting in an increase in fees, consistent with the increase documented in Section 5.2.

To investigate this hypothesis empirically we next examine, for a set of index-based ETFs, whether they deviate from market weights in a way that is consistent with this hypothesis. In Table 7, using the SEC's N-PORT filings merged with the Markit fee data, we examine whether index ETFs downweight high fee stocks. Of course, if index funds do indeed

Table 6: Humacyte (fee = 27.4%) – Top holdings 2024:q4

Fund	Holdings ($)	lend?	lent ($)	frac.	tot lent ($)
SPDR(R) S&P(R) Biotech ETF	13,291,115	Y	12,645,780	0.951	975,439,502
Vanguard Total Stock Mkt Index Fund	13,093,716	Y	12,291,483	0.939	3,072,685,466
iShares Russell 2000 ETF	12,222,682	Y	12,139,296	0.993	6,478,828,734
Vanguard extended mkt index fund	7,797,599	Y	6,784,170	0.870	1,451,145,428
iShares Russell 2000 Growth ETF	4,127,612	Y	3,964,704	0.961	1,634,287,005
iShares Biotechnology ETF	3,412,280	Y	3,100,084	0.909	441,983,984
iShares Micro-Cap ETF	1,016,676	Y	1,006,505	0.990	170,617,586
TIFF Multi-Asset Fund	836,502	N			32,760,076
Master Small Cap Index Series	761,413	Y	761,413	1	386,110,541
Putnam Dynamic Asset Alloc. Gr. Fnd	602,672	N			0
EQ/2000 Managed Volatility Portfolio	505,242	Y	458,318	0.907	196,855,125
Putnam Dynamic Asset Alloc. Bal. Fnd	417,316	N			0
CREF - Equity Index Account	386,224	Y	382,360	0.990	139,148,899
LVIP SSGA Small-Cap Index Fund	329,260	N			0
Fidelity Small Cap Growth Index Fund	270,437	Y	264,620	0.978	62,394,843
Vanguard balanced index fund	257,171	Y	254,520	0.990	39,085,903
Vanguard inst. tot stock mkt index fund	255,742	Y	253,005	0.989	14,689,272
Small Cap Index Fund (Northern Funds)	197,066	N			0
EQ/Small Company Index Portfolio	182,355	Y	165,419	0.907	75,613,837
State St. Sm/Mid Cap Eq Index Port	164,125	Y	155,994	0.950	386,521,077

downweight these high fee stocks, this will result in higher tracking error but, based on the results in Section 5.2, it will also result in an increased alpha relative to the index. If asset managers have concluded that it is optimal for them (and for their customers) to increase their alpha by getting out of the high fee names, at the cost of increased tracking error, this would be support for the hypothesis that this behavior is indirectly leading to lower lending supply, higher borrow costs, and decreased market efficiency.

The panel data regressions (2) and (3) are run using fund fixed effect, so the coefficient on the fee can be interpreted as the elasticity of the fund holding, relative to market weights, and of the holdings relative to changes in the borrow costs. The elasticity is highly statistically significant: when borrow costs for a security increase, on average a fund will drop their holdings of that security. Moreover, the estimated elasticity of -0.15 suggests that this effect is large.

Figure 16 illustrates the result by setting an example. We look at the Vanguard Total Stock Market Index Fund, the largest fund in the database and the lender with the second-

Table 7: Borrow Costs and Fund Weights – Index-ETFs
This table reports the results of a panel data regression used to assess the effect of fund fees on portfolio weights in index funds. The dependent variable is the log of the weight of asset i in fund j as of the reporting date. The independent variables are the log of the market weight for asset i in fund j, and the log of the average borrow cost for asset i over the preceding 90 calendar days. The market-weight for asset i of fund j is defined as $w^m_{i,j,t} = \frac{ME_{i,t}}{\sum_{k \in j(t)} ME_{k,t}}$, where $ME_{i,t}$ is stock i's equity market capitalization at time t. We run a pooled OLS, a regression with fund fixed effects and a regression with fund and quarter fixed effects. Standard errors are clustered at the fund and reporting quarter level. Fund holdings come from the quarterly N-PORT filings available from the SEC between 2019:q1 and 2024:q4. We restrict our sample to funds that self-report that they are both ETFs and index funds–taken from that fund's N-CEN filing from the same year. We merge the N-PORT data with indicative fee data from Markit, and with market capitalizations from CRSP. We require at least 15 valid fees in the preceding 90 days for each asset. We only look at positions worth at least half a million and require that a fund holds at least 10 positions larger than half a million.

	Dep. Var: log(port-wt)		
	(1)	(2)	(3)
log(mkt-wt)	0.938	0.746	0.745
	(37.2)	(22.8)	(22.7)
log(avg-fee$_{t-90,t-1}$)	−0.118	−0.151	−0.153
	(−4.2)	(−6.1)	(−6.2)
Constant	−0.939		
	(−6.2)		
Fund Fixed Effects	No	Yes	Yes
Quarter Fixed Effects	No	No	Yes
Observations	2,067,560	2,067,560	2,067,560
Adjusted R^2	0.828	0.898	0.898

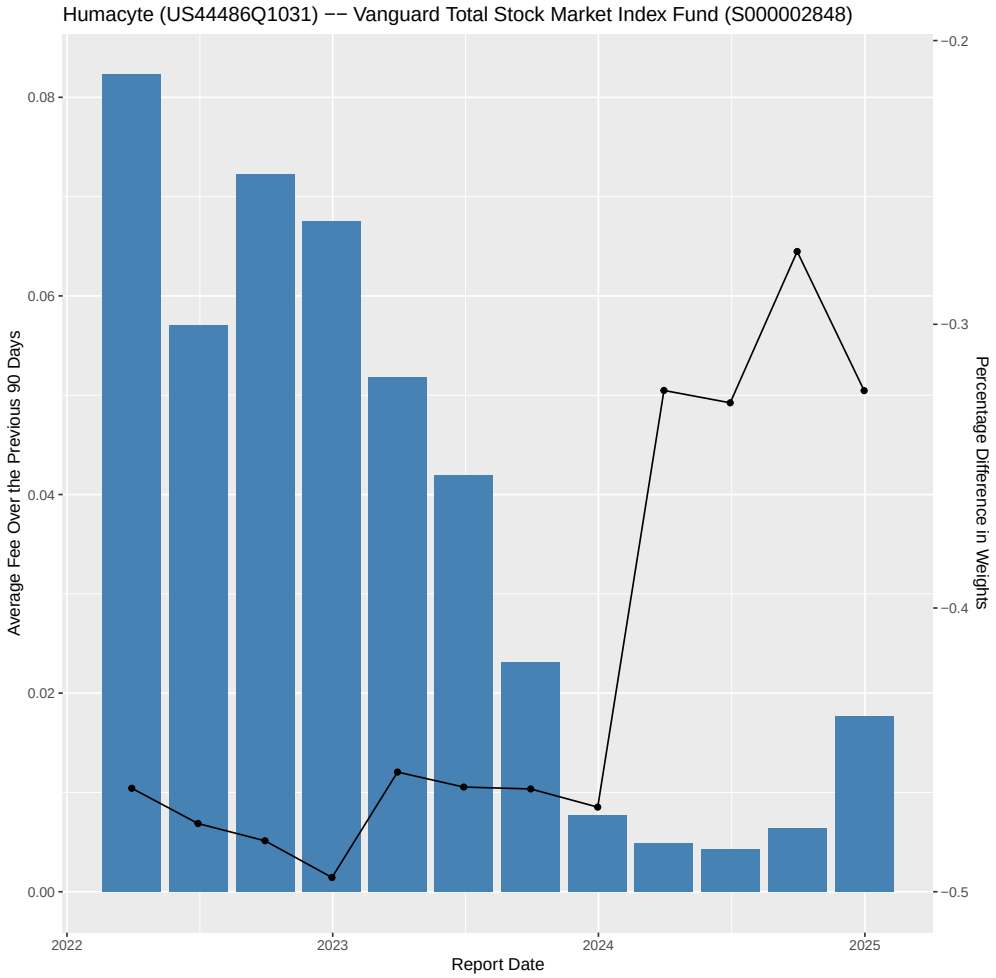


Figure 16: Example: Humacyte and the Vanguard Total Stock Mkt Index Fund The figure shows the average indicative fee over the previous 90 days for Humacyte as a bar chart. The figure further plots the average deviation of the Vanguard Total Stock Market Index Fund from Humacyte's market weight. This deviation, called percentage difference in weights in the graph, is compute as the difference between the fund's portfolio weight and their market weight divided by the market weight.

largest holding of Humacyte as of December 2024. The figure shows the percentage deviation of Vanguard's portfolio weight from the market weight (as defined in the caption of Table 7). This negative deviation suggests that Vanguard underweights Humacyte relative to their market capitalization. However, they underweight more strongly if fees were high over the previous 90 days.

We note that this specific test will have little power against the alternative hypothesis that funds completely sell out of holdings when the fees become large: we are only examining

whether they reduce their positions in these securities.

6 Conclusion

We document a marked deterioration in the efficiency of the securities lending market over the past several decades. While financial markets have generally become more efficient through technological advances and increased competition, the securities lending market represents a notable exception to this trend. The evidence we present shows that borrow costs have increased dramatically, with particularly pronounced effects in smaller capitalization stocks where the average fee has increased by approximately a factor of ten since 2010.

Our portfolio-based analysis demonstrates a strong relationship between borrow costs and subsequent negative returns, with the highest fee portfolio earning an annualized CAPM alpha of approximately -75% over our sample period. This near one-to-one correspondence between borrow costs and negative alpha represents a substantial departure from market efficiency and suggests significant losses to those who purchase these securities when the borrow costs are elevated.

Short sellers cannot profit from this inefficiency, as they have to pay the borrow costs. Even the investors in these hard-to-borrow securities who lend out the shares cannot benefit, as it appears that institutional investors who lend their securities only receive 50–60% of the borrow cost. Who benefits from the inefficiency in the share lending market? Investors who sell when the borrow cost is high, and the intermediaries in the share-lending intermediation chain, who capture a large fraction of the borrow costs. An interesting but open question is how much the frictions in the share lending market, and the resulting inefficiencies in the pricing of the equity of the hard-to-borrow firms leads to inefficient capital allocation to the underlying firms.

Since all shares outstanding are necessarily not lent, we can calculate the "cost" of this inefficiency as the product of the number of shares outstanding times the price times the fee

(which is also approximately equal to the negative alpha). Summing over all common stocks in the US market, we estimate that, since 2020, the cost has averaged about $300 million per day.

Our evidence suggests that analyst forecasts largely fail to incorporate information embedded in borrow costs. The strong predictability we document in both forecast errors and forecast revisions suggests that the high borrow costs we observe reflect genuine negative information about firms' prospects, yet this information is not being efficiently incorporated into consensus expectations or market prices. This represents a failure of one of the market's key information aggregation mechanisms and suggests that the impediments to short selling are preventing the market from efficiently processing negative information.

Our investigation into the supply side of the lending market reveals a potential explanation for the dramatic increase in borrow costs. Using newly available N-PORT data, we show that even passive index funds have begun systematically underweighting high-fee stocks relative to market weights. This behavior, while individually rational for fund managers seeking to avoid the negative alpha associated with holding high-fee securities reduces the supply of lendable shares precisely when demand from short sellers is highest. The resulting supply-demand imbalance drives borrow costs even higher, further incentivizing institutional holders to exit these positions rather than lend them out.

The social welfare implications of these findings are substantial. Our estimates suggest that the inefficiencies in the securities lending market impose significant costs on market participants and reduce the overall efficiency of capital allocation. The dramatic increase in aggregate borrow costs over our sample period represents a deadweight loss to the economy, as resources are being allocated to rent-seeking activities in the intermediation chain rather than productive uses. Furthermore, the failure of the market to efficiently process negative information likely leads to persistent overvaluation of some securities, potentially distorting investment decisions and capital allocation throughout the economy.

These findings have important implications for both market participants and policymak-

ers. For institutional investors, our results suggest that the traditional approach of lending out all available securities may no longer be optimal when borrow costs rise. The evidence that index funds are already adapting their behavior by underweighting high-fee stocks indicates that market participants are beginning to recognize and respond to these changed market conditions. For policymakers, our findings raise questions about the current regulatory framework governing securities lending and whether additional measures are needed to ensure that this critical market infrastructure continues to support efficient price discovery and market functioning.

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