Short-selling Profitability, Stock Lending Fees, and Asset Pricing Anomalies *

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February 18, 2025

Abstract

We measure a stock's short-selling profitability (SSP) as its price sensitivity to short-selling activities over recent periods. Our findings show that short-selling strongly and negatively predicts future returns, particularly among high-SSP stocks. Furthermore, we identify SSP as a novel determinant of stock lending fees in the cross-section. While the profitability of anomalies decreases when accounting for short-selling fees, they remain exploitable among high-SSP stocks. These results support the presence of a stock lending market in which lenders allow short sellers to retain a portion of arbitrage profits. This suggests that short-selling constraints alone do not fully explain the persistence of anomalies, especially among high-SSP stocks.

***Keywords*:** Short-selling fees, Stock lending market, Short Interest, Anomalies
***JEL Classifications*:** G12, G23

*We are grateful to Spencer Andrews , Yong Chen, Yongqiang Chu, Peter Dixon, Dayong Huang, Gady Jacoby, Luca Lin, Christian Opp, Adam Reed, Matthew Ringgenberg, Paul Schultz, Jianfeng Yu, and Guofu Zhou.

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1. Introduction

Anomalies in financial market often reflect instances of asset mispricing, which, under the assumption of market efficiency, should be corrected over time. The existing literature largely attributes the persistence of these anomalies to the high costs of short-selling.[1] When short sellers target overvalued stocks, their profits are shared with stock lenders, who charge lending fees, leaving short sellers with the remaining return after accounting for these costs. In typical capital markets, short-selling can be costly, which limits arbitrageurs' ability to exploit anomalies and correct mispricing. As a result, high short-sale fees play an important role in sustaining anomalous asset prices (Saffi and Sigurdsson, 2011; Beneish, Lee, and Nichols, 2015; Muravyev, Pearson, and Pollet, 2024; Schultz, 2024). To better understand asset pricing dynamics, it is necessary to examine the determinants of short-selling fees (Geczy, Musto, and Reed, 2002). In this paper, we explore a stock lending market where lenders hold market power and extract a portion of short-selling profits through fees.[2] Within this context, we propose a novel determinant of short-selling fees: stock-level short-selling profitability.

A typical short-sale transaction involves two participants: a stock lender, who supplies shares, and a short seller, who borrows these shares to profit from expected price declines. The lender charges a fee for lending shares, while the short seller aims to generate returns net of this fee. At the expiration of the stock loan, the short seller's profit is determined by the difference between the stock's price change and the short-selling fee. Building on the insights of Chen, Kaniel, and Opp (2023), we examine the dynamics of the stock lending market, where short sellers face frictions in securing stock shares. This market structure

[1]Prior studies include, but are not limited to, Jones and Lamont (2002), Scheinkman and Xiong (2003), Lamont (2004), Nagel (2005), Beneish, Lee, and Nichols (2015), Ljungqvist and Qian (2016), Schultz (2023), and Engelberg, Evans, Leonard, Reed, and Ringgenberg (2024).

[2]Theoretical models examining stock lending fees in the equity market under different frameworks include Duffie, Garleanu, and Pedersen (2002) and Atmaz, Basak, and Ruan (2024). Blocher, Reed, and Van Wesep (2013) document distinct price patterns for hard-to-borrow stocks, connecting the security lending market to stock market behavior. Kolasinski, Reed, and Ringgenberg (2013) empirically test the predictions of Duffie, Garleanu, and Pedersen (2002).

grants stock lenders pricing power, allowing them to extract a portion of the profits from short-selling. Specifically, lenders leverage their market power to set fees based on the pre-fee profitability of short sales, exploiting short sellers' information advantages regarding expected price declines.

Short-selling profitability, before accounting for fees, depends on the sensitivity of stock prices to short-selling activity. We propose that stock-level lending fees are negatively associated with the sensitivity of expected stock returns to short-selling activity—termed short-selling profitability (SSP)—reflecting stock lenders' strategic use of their market power to extract value from short sellers..

To estimate SSP, we use 36-month rolling window regressions, requiring stocks to have at least 24 monthly observations for each estimate.[3] We regress stock returns on lagged abnormal short interest at the stock level using the following equations:

$$ExRet_{it} = \alpha_{it} + \delta_{it}\ abnSIR_{it-1} + \varepsilon_{it}, \tag{1}$$

$$SSP_{it} = -\delta_{it}, \tag{2}$$

where $ExRet_{it}$ represents the excess return of stock i in month t, and $abnSIR_{it-1}$ denotes the abnormal short interest of stock i in month *t-1*. Following Karpoff and Lou (2010) and Chen, Da, and Huang (2022), abnormal SIR is calculated as the difference between a stock's short interest ratio (SIR) at month *t-1* and its 12-month average. This adjustment accounts for short sellers' tendency to increase short-sale positions in response to negative information. We posit that short sellers initiate stock loans based on adverse expectations regarding future stock prices. Thus, we control for short interest over the preceding year. The lead-lag regression coefficient δ_{it} captures the sensitivity of stock returns to changes in short interest while mitigating forward-looking bias. SSP is then computed as -δ_{it}.

We find that stocks with certain characteristics—such as small market capitalization,

[3] The main empirical results remain robust when using 48- and 60-month rolling windows or when controlling for the market factor in the estimation of SSP.

high book-to-market ratios, weak past performance, high disagreement, low liquidity, high idiosyncratic volatility, lottery-like features, and young age—tend to exhibit high SSP. These stocks typically experience significant price declines following short-selling, making them highly profitable for short sellers before accounting for fees.

To establish SSP as a novel determinant of short-sale fees, we make three assumptions. First, short-selling activities negatively predict expected stock returns due to short sellers' information advantage. The existing literature documents a negative relationship between short interest and stock returns in the cross-section. For example, Rapach, Ringgenberg, and Zhou (2016) find that short interest strongly predicts lower market returns both in-sample and out-of-sample. Similarly, Engelberg, Reed, and Ringgenberg (2012) provide evidence that short sellers are skilled in processing information, enabling them to forecast the future underperformance of equities. Chen, Da, and Huang (2022) further examine short-selling efficiency at the market level, confirming a negative relationship between short interest and future returns.[4] Second, we assume that stock lenders possess market power, enabling them to set short-selling fees. This assumption is supported by Chen, Kaniel, and Opp (2023) which documents that the two largest stock lenders dominate the market, collectively holding substantial shares ranging from 50% to 85%. Third, stock-level SSP exhibits persistence over time. This persistence is necessary, as stock lenders set lending fees, which will be returned at the maturity of the stock loan, based on SSP estimated from past stock returns. Section 4.2 provides empirical evidence showing the out-of-sample persistence of SSP. Given these assumptions, supported by theoretical literature and empirical evidence, we argue that when the return of a stock is highly and negatively sensitive to short-selling activity, short sellers can generate substantial profits. Thus, stock lenders charge high short-selling fees to extract a portion of these profits, increasing borrowing costs for short sellers.

[4]Studies that examine the relationship between stock-level short interest and asset prices also include: Brent, Morse, and Stice (1990); D'avolio (2002); Chen and Singal (2003); Lamont and Stein (2004); Asquith, Pathak, and Ritter (2005); Boehmer, Huszar, and Jordan (2010); Drechsler and Drechsler (2014); Ben-David, Drake, and Roulstone (2015) and Beneish, Lee, and Nichols (2015). Studies documenting the information advantage of short sellers also include: Sun and Yin (2017); Purnanandam and Seyhun (2018) and Boehmer, Jones, Wu, and Zhang (2020).

Using stock-level short-selling cost data from FIS Securities Finance Market, we employ the monthly value-weighted average short-selling fee as our primary measure of short-selling costs. Our results indicate a strong positive relationship between SSP and monthly short-selling fees, even after controlling for firm-level characteristics that influence short-selling costs. Employing panel regressions with multiple fixed effects, we obtain consistent results across different methodologies. To further validate our analysis, we incorporate two alternative measures of short-selling fees: the Daily Cost of Borrowing Score (DCBS) from IHS Markit and the option-implied short-selling fee. Our baseline findings remain robust when using these alternative proxies providing strong empirical evidence support for our hypothesis that stock lenders with market power set short-selling fees based on SSP.

To further investigate the relationship, we divide the full sample into two subsamples based on the level of market power associated with each stock: high-market power stocks and low-market power stocks. Since the pricing of short-selling fees based on SSP captures a stock lender's ability to leverage market power, we hypothesize that the relationship between SSP and short-selling fees is more pronounced for stocks with high market power than those with low market power. We proxy stock lender market power using lender concentration, measured as the total market share of the two largest stock lenders at the stock level. Our results confirm a significant positive relationship between SSP and short-selling fees for stocks with high market power, while this relationship is weaker for stocks with low market power. This asymmetry supports our hypothesis that stock lenders exploit their market power when setting short-selling fees.

Given that SSP captures the information advantage of short sellers and affects short-selling fees, we examine the asset pricing implications of this relationship for stock market anomalies. Muravyev, Pearson, and Pollet (2024) demonstrate that when accounting for short-selling fees, the aggregate return spread across anomalies becomes statistically insignificant. Their findings indicate that anomaly profitability is largely concentrated in short-leg stocks when short-selling fees are excluded. We hypothesize that stock market anomalies are more pronounced among high-SSP stocks, where short sellers have a stronger information advantage and short-selling is both efficient and profitable. The after-fee performance of anomalies reflects the profit retained by short sellers from their information advantage, after stock lenders have extracted a portion of the gains. If stock lenders possess market power that allows them to trade against short sellers' information advantage, the aggregate return spread from anomalies becomes insignificant after accounting for short-selling fees, as observed by Muravyev, Pearson, and Pollet (2024). However, stock lenders might charge short-selling fees while still leaving a portion of profits for short sellers in high-SSP stocks, given short sellers are more informed about future stock prices. Therefore, anomalies should remain significant among high-SSP stocks even after accounting for short-selling costs.

Building on Muravyev, Pearson, and Pollet (2024), we analyze and compare the before-fee and after-fee performances of 151 stock market anomalies. Our results illustrate that short-selling fees substantially reduce the profitability of arbitraging these anomalies by approximately 38.59%. However, while short-selling fees take partial profits, they do not fully explain anomaly performance in high-SSP stocks. Notably, exploiting anomalies is profitable before fees and remains significantly profitable in high-SSP stocks even after accounting for short-selling costs. Our findings suggest while stock lenders have market power, they do not entirely eliminate arbitrage opportunities, and short-selling costs are not the sole driver of cross-sectional stock market anomalies.

We conduct two additional analyses to ensure the robustness of our findings. First, we apply a Bayesian shrinkage factor (Frazzini and Pedersen, 2014; Liu, Stambaugh, and Yuan, 2018) to refine the SSP estimates. Second, our findings show that SSP is negatively related to both the average tenure of stock loans and the lendable rate, while positively associated with lender concentration.

Our study contributes to two strands of literature by improving the understanding of the stock lending market. First, we introduce SSP as a novel mechanism through which institutional investors determine stock-level short-selling fees.[5] Previous research has identified several factor affecting short-selling fees, including analyst disagreement (D'avolio, 2002; Atmaz, Basak, and Ruan, 2024), search costs (Duffie, Garleanu, and Pedersen, 2002), liquidity premium (Diether and Werner, 2011; Saffi and Sigurdsson, 2011; Porras Prado, Saffi, and Sturgess, 2016), short interest ratio (Beneish, Lee, and Nichols, 2015), matching costs (Gârleanu, Panageas, and Zheng, 2021), and institutional ownership (Diether and Werner, 2011; Beneish, Lee, and Nichols, 2015; Porras Prado, Saffi, and Sturgess, 2016; Honkanen, 2020; Sikorskaya, 2023; Palia and Sokolinski, 2024). Duffie, Garleanu, and Pedersen (2002) suggest that stock lending fees increase with the difference of opinion between optimists and pessimists, as well as with the bargaining power of lenders. Our study extends this literature by demonstrating that short-selling fees are higher for stocks expected to have significant negative returns because of short-selling activity. Specifically, SSP remains a strong determinant of short-selling fees even after controlling for most of the identified factors.

Second, our study contributes to the literature by providing additional evidence on the role of short-selling costs in explaining stock market anomalies, focusing on the market power of stock lenders. Prior research has explored various explanations for stock market anomalies, with short-selling costs being an important factor. For example, Nagel (2005) shows that several anomalies are more pronounced in stocks with significant short-sale constraints. Similarly, Stambaugh, Yu, and Yuan (2012) argue that short positions are more profitable than long positions for stock anomalies, partly due to short-selling costs. Chu, Hirshleifer, and Ma (2020) examine 11 anomalies using the causal impact of the SHO program and find that these anomalies are weaker in stocks without short-selling constraints. Consistent with Muravyev, Pearson, and Pollet (2024), our results confirm that stock market anomalies generally become insignificant after accounting for short-selling fees. However, among stocks where short-selling is likely profitable (i.e., high-SSP stocks), the aggregate return spread

[5] The literature on the joint determinants of short selling fees includes, but is not limited to, D'avolio (2002), Beneish, Lee, and Nichols (2015), Edelen, Ince, and Kadlec (2016), Gârleanu, Panageas, and Zheng (2021), and Atmaz, Basak, and Ruan (2024).

across anomalies remains statistically significant. This indicates that stock lenders do not extract all profits from short sellers, enabling them to retain gains due to their information advantage. Moreover, while short-selling costs substantially affect anomaly profitability among high-SSP stocks, they are not the sole factor driving this pattern.

Our study also questions whether short-selling costs effectively measure short-sale constraints. Previous research often uses short-selling fees as a proxy for short-sale constraints (Asquith, Pathak, and Ritter, 2005), indicating that certain stocks are difficult to short-sell due to high borrowing costs. However, our findings suggest that short-selling profitability is a key driver of short-selling costs. Specifically, short sellers may target high-fee stocks due to their potential for high short-selling profits, meaning that high short-selling costs may not strictly reflect significant short-sale constraints. Instead, high stock borrowing costs may be offset by the expected profits from short-selling as the stock price declines. This insight highlights the need for further empirical research on the interaction between short-selling profitability and short-sale constraints.

The remainder of this paper is organized as follows: Section 2 develops the hypotheses. Section 3 describes the data and methodology. Section 4 presents the main empirical results, examining the relationships between short-selling profitability and stock lending fees, as well as short-selling profitability and stock returns and anomalies. Section 5 discusses additional empirical tests and Section 6 concludes.

2. Hypothesis Development

We test three hypotheses in this paper. The key variable of our study, SSP, captures the predictive power of short interest for future negative stock returns. Prior literature provides robust evidence that short interest predicts negative future stock returns. Stock lenders with market power extract a portion of short-selling profits if the stock-level SSP exhibits persistent out-of-sample predictability. Since stock loans are returned at maturity, lenders rely on SSP—estimated from historical stock prices—to forecast short-selling profits and set appropriate short-selling fees. For this intuition to hold, it is essential that short interest consistently predicts future stock returns out-of-sample. This reasoning leads to our first hypothesis:

Hypothesis 1 *Short interest negatively predicts stock returns in the cross-section, with stronger negative predictability for high-SSP stocks than for low-SSP stocks.*

Since SSP is related to potential short-selling profits, it should also impact short-selling fees when stock lenders extract a portion of those profits. Holding lender's market power constant, we expect a positive relationship between stock-level SSP and short-selling fees. Moreover, this relationship should be stronger for stocks where stock lenders have larger market power. However, in markets where short sellers have bargaining power over short-selling fees, lenders are less likely to extract profits according to SSP. This leads to our second hypothesis:

Hypothesis 2.1 *Stocks with high SSP incur high short-selling fees, whereas stocks with low SSP incur low short-selling fees.*

Hypothesis 2.2 *The positive relationship between SSP and short-selling fees is stronger for stocks where stock lenders have greater market power in the lending market.*

Finally, we examine the impact of SSP on asset prices at the cross-section. Our intuition suggests that stock lenders impose short-selling fees to capture a portion of the profits generated by short sellers. The existing literature shows that the profitability of stock market anomalies mainly arises from short-selling the short-leg stocks in anomaly portfolios (Stambaugh, Yu, and Yuan, 2015). Furthermore, Muravyev, Pearson, and Pollet (2024) show that most stock market anomalies become unprofitable after accounting for short-selling fees. Their findings have several important implications. First, the profitability of stock market anomalies is concentrated in short-leg stocks. Second, stock lenders extract a significant portion of arbitrage profits by exploiting their market power, leading the return spread of anomaly portfolios to be insignificant.[6] Third, anomalies persist over time mainly due to short-selling costs.

We hypothesize that stock market anomalies are statistically stronger in high-SSP stocks than in low-SSP stocks due to differences in short-selling profitability. Specifically, since short sellers are more (less) likely to gain an information advantage in high-SSP (low-SSP) stocks, we expect anomalies to be more pronounced among stocks that are highly sensitive to short-selling activity. Thus, we propose our third hypothesis:

Hypothesis 3.1 *Stock market anomalies become insignificant after accounting for short-selling fees, consistent with the existence of market power of stock lenders.*

Hypothesis 3.2 *After accounting for short-selling fees, stock market anomalies remain statistically significant for high-SSP stocks but become insignificant for low-SSP stocks.*

3. Data and Methodology

3.1. *Short Interest and Short-Selling Profitability*

We obtain monthly stock returns from CRSP and extract short interest and firm characteristics from Compustat. We exclude stocks in the utility sector (SIC codes 4001-4999) and the financial sector (SIC codes 6001-6999). Our sample includes only common stocks (CRSP share codes 10 and 11) listed on NYSE, NASDAQ, or AMEX. We remove stocks with a market capitalization below $15 million or a closing price below $1 in the previous month.

The short interest ratio (SIR), defined as the number of shares held short divided by total shares outstanding, is widely as a proxy for short-sale activity.[7] We exclude observations where SIR is negative or exceeds 100%, as these likely result from reporting errors, though such observations represent less than 1% of all stock-month data. Table 1 provides summary

[6] See Table 3 in Muravyev, Pearson, and Pollet (2024) for a detailed analysis of anomaly performance.

[7] The earliest short interest data dates back to January 1973. However, the earliest SSP estimation began in January 1977 to ensure sufficient observations. See Akbas, Boehmer, Erturk, and Sorescu (2017) and Bao, Kim, Mian, and Su (2019).

statistics for SIRs in the full sample.

Short-selling profitability (SSP), defined as the negative coefficient of δ_{it} in Equation (1), reflects the estimated profitability of short selling. To mitigate the impact of outliers, we winsorize SSP at the 1% level each month and normalize it using the monthly cross-sectional standard deviation. The full sample spans 504 months from 1980 to 2021, including 1,215,646 stock-month SSP estimates. However,our empirical analyses focus on short-selling fee observations from 2005 onward. Table 1 presents the summary statistics of SSP, which has a mean of -0.09 and a median of 0.00. The negative average SSP suggests that, on average, stocks tend to experience negative returns following an increase in short interest. This finding supports Hypothesis 1, which posits that short interest predicts negative stock returns, aligning with the existing literature.

[Insert Table 1 here]

Figure 1 plots the monthly average SSP across all stocks over time, with shaded areas indicating NBER recession periods. We observe that the market average SSP tends to decline during recessions, particularly in the periods from September 1982 to June 1986, August 1990 to December 1990, and November 2008 to October 2011, all of which follow economic recessions. We anecdotally observe that the market average SSP was low or even negative during the 2008 financial crisis. This pattern is expected, as the 2008 short-sale ban likely reduced short-selling efficiency, leading to a smaller or negative aggregate SSP across individual stocks. This finding is consistent with Andrews, Lundblad, and Reed (2024), which documents commonality in short-selling fees and suggests that the market-level short-sale costs were low and occasionally negative during the 2008-2009 financial crisis.

[Insert Figure 1 here]

3.2. *Short-selling Fee Measures and Other Data*

We consider three measure of short-selling fees: the FIS short-selling fee, the Markit DCBS, and option-implied short-selling fees. We obtain daily short-selling fees at the individual security level from the FIS Securities Finance Market Data. The dataset provides broad coverage of daily stock-level average lending fees and the market values of daily stock loans, spanning from January 2005 to December 2022. It has been widely used in recent studies, including Dixon, Fox, and Kelley (2021), Engelberg, Evans, Leonard, Reed, and Ringgenberg (2024), and Schultz (2024). The FIS dataset reports retail fees that stock lenders charge brokerages, with brokers requiring cash collateral for all stock loans. Following Dixon, Fox, and Kelley (2021) and Muravyev, Pearson, and Pollet (2022), we define the stock-level short-selling fee as the difference between the Federal Funds rate and the rebate rate paid on collateralized loans.[8] The FIS short-selling fee can serve as a cross-sectional approximation of short-selling costs.

Following the methodology of Muravyev, Pearson, and Pollet (2024), we assume that short-sellers pay 100% of the short-selling fee when borrowing short-leg stocks.[9] However, since stock lenders typically cannot lend all shares, long-leg stockholders usually receive less than the full short-selling fee. Consistent with their study, we assume that long-leg investors receive 70% of short-selling fee, reflecting the proportion of utilized stock loans. To address potential outlier problem, we include only observation that the FIS short-selling fee ranges between 0% and 100% in our empirical analyses.[10] Eventually, we obtain a final sample with 359,295 SSP-fee monthly observations.

The second measure of short-selling cost is the Daily Cost of Borrowing Score (DCBS), obtained from IHS Markit. DCBS, widely used in the literature (Beneish, Lee, and Nichols,

[8] We further exclude a small subset of cash collateralized loans with fixed rates and durations, as their costs remain unaffected by market conditions. Instead, we focus on overnight cash collateralized loans. However, our results remain robust even when all cash-collateralized loans are included.

[9] Our results are robust to a markup up to 15%, or when short-sellers pay up to 115% of the short-selling fee when borrowing short-leg stocks.

[10] In unreported analyses, we find that using stricter data filtration for outliers generates statistically more significant results.

2015; Schultz, 2023; Palia and Sokolinski, 2024), measures the expensiveness of short-selling and covers more than 90% of stocks. The DCBS score ranges from 1 to 10, with high values indicating greater borrowing costs. We calculate monthly short-selling fees as the mean of daily DCBS scores, requiring at least four daily observations per month. Our final sample includes 638,724 monthly DCBS observations from 2007 to 2021, merged with our SSP estimates.

We also consider a third measure of short-selling costs—the option-implied short-selling fee, proxied by put-call disparity—following Ofek, Richardson, and Whitelaw (2004) and Engelberg, Reed, and Ringgenberg (2018). For each stock, the short-selling cost is calculated as the difference between the synthetic stock price implied by options and the spot stock price. The synthetic stock price is computed as the difference between the call and put prices, adjusted for the discounted strike price.[11]

Additionally, we include specialness into our analysis, despite it not being a standard measure of short-selling fees (Beneish, Lee, and Nichols, 2015; Porras Prado, Saffi, and Sturgess, 2016; Palia and Sokolinski, 2024). This measure builds on D'avolio (2002) and aligns with the literature's classification of high lending fee or hard-to-borrow (special) stocks. A stock is classified as special if its monthly average DCBS score exceeds 4, in which case it is assigned a value of 1; otherwise, the specialness of the stock is assigned a value of 0.

Table 1 reports summary statistics for the FIS short-selling fees and the DCBS at the monthly frequency. As shown in column (3), the average FIS short-selling fee is 2.21% per year, and the fee is less than 1% for most stocks. The mean DCBS score of 1.50, consistent with the observation of the FIS short-selling fee that it is not expensive to borrow most stocks. Column (5) reports statistics for stock lenders' Market Power, defined as the total percentage of lendable shares supplied by the two largest stock lenders.

Table 2 presents the correlation coefficients among the various measures of short-selling

[11]Options written on individual stocks are typically American style, necessitating consideration of early exercise risk in estimating put-call disparity (Ofek, Richardson, and Whitelaw, 2004). To mitigate this issue, we restrict the sample to options with three-month maturities, as short-maturity options have lower expected dividends, reducing the likelihood of early exercise.

fees. The FIS short-selling fee, our primary measure in the baseline analysis, is strongly and positively correlated with the natural logarithm of the monthly DCBS, option-implied short-selling fees, and specialness. For instance, the correlation between the FIS fee and the logarithm of DCBS is 0.5234, which is highly significant (*p-value* = 0.00). The p-values reported below the correlation coefficients confirm that all measures are strongly correlated, indicating the consistency of our short-selling fee proxies. Moreover, we find that the average option-implied short-selling fee is around 0.34% per month, equivalent to 4.16% per annum, which is slightly higher than the FIS short-selling fee of 2.21% per annum. The difference between these two estimates likely reflects additional market friction of options trading.

[Insert Table 2 here]

To identify SSP as a novel determinant of short-selling fees, we control various firm characteristics that have been shown in the literature as affecting short-selling costs. We obtain firm characteristics, including beta, size, book-to-market ratio, momentum, and illiquidity, from the Open Source Asset Pricing website.[12] We measure disagreement as the dispersion of analysts' one-year EPS forecasts, following Diether, Malloy, and Scherbina (2002). Institutional ownership is defined as the total shares held by institutional investors scaled by the total shares outstanding. Table 1 provides summary statistics for these firm characteristics. Moreover, we obtain variables of anomalies, including idiosyncratic volatility (Ang, Hodrick, Xing, and Zhang, 2006), lottery demand (Bali, Brown, Murray, and Tang, 2017), coskewness risk (Ang, Chen, and Xing, 2006), and firm age (Barry and Brown, 1984). Appendix Table **??** provides the definitions of all variables unsed in this study.

[12] We thank Andrew Chen and Tom Zimmermann for generously sharing their data. Stock-level variables of anomalies are available at https://www.openassetpricing.com/data/.

4. Empirical Analysis

In this section, we present the main results of our study. First, we examine the relationship between SSP and firm characteristics. Second, we demonstrate that SSP is a persistent measure of short-selling profitability by showing that stocks with high abnormal short interest generate low returns only when SSP is high. Third, we examine the association between SSP and short-selling costs at the stock level, as well as the role of market power in shaping this relationship. Finally, we show that stock market anomalies remain statistically profitable in high-SSP stocks, even after accounting for short-selling fees, whereas anomalies become insignificant for low-SSP stocks when adjusted by short-selling fees.

4.1. *Short-selling Profitability and Firm Characteristics*

We begin by analyzing the firm characteristics of stocks with SSP to identify which stocks are associated with higher or lower short-selling costs. Understanding the relationship between SSP and return-predicting firm characteristics is important for two reasons. First, this analysis advances our understanding of SSP's role in predicting short-selling fees and helps identify stocks likely to incur higher borrowing costs. Second, a significant relationship between SSP and these firm characteristics suggests that short-selling fees may provide insight into anomalies driven by these variables, as highlighted by Muravyev, Pearson, and Pollet (2024). Therefore, establishing a statistical relationship between SSP and anomaly-based firm variables helps relate asset prices to SSP.

We perform stock-level Fama and MacBeth (1973) regressions, conducting univariate regressions of SSP on various firm characteristics. We report time-series averages of regression coefficients along with Newey-West adjusted t-statistics Newey and West (1987). Table 3 summarizes the results for eleven important characteristics. Column 1 shows a significant positive relationship between SSP and market beta ($t-stat = 12.44$), suggesting that high-beta stocks are more likely to generate negative returns following abnormal increases in short interest. This result indicates that short-selling high-beta stocks is more profitable than short-selling low-beta stocks, consistent with the literature that high-beta stocks are more likely to be mispriced (Baker, Bradley, and Wurgler, 2011; Hong and Sraer, 2016; Ramachandran and Tayal, 2021).

Column 2 presents a significant negative relationship between SSP and firm size ($t-stat$=-18.47), indicating that smaller stocks are more prone to negative short-sale activity than larger stocks. This result is consistent with prior findings that smaller stocks are costlier to borrow in the stock lending market (Beneish, Lee, and Nichols, 2015; Porras Prado, Saffi, and Sturgess, 2016). Columns 3 and 4 show that stocks with high book-to-market ratios and poor past performance exhibit lower returns following increases in short interest, consistent with previous studies (Beneish, Lee, and Nichols, 2015).

Column 5 demonstrates a positive relationship between SSP and disagreement, indicating that short-selling fees respond positively to disagreement. This finding supports the first proposition of Atmaz, Basak, and Ruan (2024) and is consistent with the empirical evidence of D'avolio (2002). Column 6 examines the relationship between SSP and stock liquidity, using Amihud (2002)'s illiquidity measure as a proxy. The positive coefficient indicates that illiquid stocks are associated with higher SSP, implying that illiquidity increases short-selling costs. Column 7 demonstrates a significant positive relationship between SSP and idiosyncratic volatility ($t-stat$=14.30), suggesting that stocks with higher idiosyncratic volatility are more prone to short interest changes. This finding is also consistent with the first proposition of Atmaz, Basak, and Ruan (2024).

Column 8 shows that SSP is positively associated with lottery demand (MAX) (Bali, Brown, Murray, and Tang, 2017), implying that stock lenders require higher short-selling fees for stocks with extreme daily returns. Column 9 shows a negative relationship between SSP and downside risk (co-skewness), suggesting that short-selling is more profitable for stocks with greater downside risk. Column 10 shows that SSP is lower for mature stocks than for young stocks. Lastly, Column 11 reports a negative relation between SSP and short interest at the stock level, indicating that lower SSP stocks likely have higher short interest. This result suggests that a short squeeze may drive stocks to realize positive returns following increased short-selling activity, leading to negative SSP values. Since retail investors and short sellers bet against each other on future asset prices, short interest may increase even as stock prices rise, resulting in negative SSPs.

[Insert Table 3 here]

4.2. *Persistence in Short-selling Profitability*

This section examines the persistence of SSP at the stock level, a question of importance for two reasons. First, stock lenders intuitively set short-selling fees based on expected short-selling profitability, capturing a portion of the gains realized by short sellers. If SSP is to be estimated using historical data, it must exhibit out-of-sample persistence. Second, the statistical persistence of SSP indicates that stock lenders consistently impose high short-selling fees on certain stocks, making these stocks persistently expensive to borrow. This persistence may help explain asset pricing anomalies through the lens of SSP.

To explore SSP's persistence, we examine the out-of-sample performance of abnormal short interest in predicting future stock returns. Previous literature has shown that short interest negatively predicts stock returns at the cross-section (Engelberg, Reed, and Ringgenberg, 2012 ; Rapach, Ringgenberg, and Zhou, 2016; Chen, Da, and Huang, 2022). To ensure that the predictive relationship between abnormal short interest and stock returns remains robust after accounting for short-selling fees, we follow the methodology of Muravyev, Pearson, and Pollet (2024), adjusting stock returns by applying a markup to short-leg stocks. In quintile portfolio analysis, stocks in the highest abnSI quintile, which typically deliver lower expected returns, are categorized as short-leg stocks. Conversely, stocks in the remaining abnSI quintiles, representing approximately 80% of the sample, are classified as long-leg stocks. Since long-leg stockholders are unlikely to lend out their entire holdings, we adjust long-leg stock returns by adding a 70% markup on the short-selling fee to account for unutilized stock loans (Muravyev, Pearson, and Pollet, 2024). Similarly, for short-leg stocks, we adjust returns by adding 100% of the short-selling fee, reflecting the compensation received by investors who lend their shares to brokerages, as recorded by the FIS.[13]

Panel A of Table 4 reports the results of the portfolio analysis, where stocks are sorted into quintile portfolios based on their lagged abnormal short interest from the previous month using NYSE breakpoints. Columns (1) and (2) present average abnormal short interest and equal-weighted portfolio returns after accounting for short-selling fees for the full sample. Column (1) shows that lagged abnormal short interest rises from -0.0401 in the lowest quintile to 0.0406 in the highest quintile. Column (2) indicates that after-fee portfolio returns decrease from 1.5536% per month in the lowest quintile to 1.2901% in the highest quintile, generating a statistically significant long-short monthly return of 0.2636% ($t-stat = 1.98$). The rows labeled CAPM Alpha, FF3 Alpha, FF5 Alpha, and FF6 Alpha report risk-adjusted returns under various factor models, including the CAPM, Fama and French (1993) three-factor, Fama and French (2015) five-factor, and Fama and French (2018) six-factor models. The negative relationship between abnormal short interest and returns remains robust across all models. For example, the Fama and French (1993) 3-factor model generates a long-short monthly return of 0.2498%, which is statistically significant at the 5% level. Overall, the quintile portfolio analysis confirms the findings of prior studies (Asquith, Pathak, and Ritter, 2005; Boehmer, Huszar, and Jordan, 2010; Engelberg, Reed, and Ringgenberg, 2012; Rapach, Ringgenberg, and Zhou, 2016; Chen, Da, and Huang, 2022).

Next, we examine whether SSP affects the relationship between abnormal short interest and stock returns. Since SSP is defined as the negative coefficient from regressing stock returns on abnormal short interest, we expect that the predictability of short interest on future stock returns is stronger for high-SSP stocks if SSP is persistent (Hypothesis 1). To test this, we divide the full sample into high-SSP and low-SSP groups using SSP estimates

[13] Muravyev, Pearson, and Pollet (2024) classify stocks in the top eight deciles as long-leg stocks and those in the bottom two deciles as short-leg stocks. However, there is no universally agreed definition of which decile or quintile stock portfolios should be considered long- or short-leg stocks. Our findings remain consistent across different specifications.

from the prior month. Stocks with SSP above the cross-sectional median are classified as high-SSP, while those below the median are categorized as low-SSP. We then conduct a portfolio analysis to examine the relationship between expected return and abnormal short interest within each group. Specifically, we sort stocks within each group into quintiles based on abnormal short interest and report portfolio returns separately for high-SSP and low-SSP stocks. Column (4) of Panel A shows that for high-SSP stocks, monthly returns decline from 1.6405% in the lowest abnormal short interest quintile to 1.2395% in the highest quintile, resulting in a return spread of 0.4010%, which is statistically significant ($t-stat$=3.37). Moreover, this long-short portfolio return remains robust after adjusting for common risk factors. The Fama and French (1993) 3-factor model reports a risk-adjusted monthly return of 0.4162%, statistically significant at the 1% level ($t-stat$=4.41). In contrast, low-SSP stocks do not exhibit a significant relationship between abnormal short interest and expected returns. As shown in column (6) of Panel A, both the long-short portfolio return spread and the risk-adjusted alphas for low-SSP stocks are statistically insignificant.

For robustness, Panel B of Table 4 employs an independent double-sort methodology when sorting stocks into quintiles by abnormal short interest. A comparison of columns (4) and (6) in Panel B shows that the negative relationship between short interest and stock returns is significant only for high-SSP stocks. Specifically, the monthly return spread between the lowest quintile and the highest quintile is 0.3555% and statistically significant ($t-stat$=2.21) for high-SSP stocks, while it decreases to 0.1178% and becomes insignificant ($t-stat$=0.65) for low-SSP stocks. These findings support Hypothesis 1.

Panel C of Table 4 presents the results of the portfolio analysis without incorporating short-selling fees, refinforcing Hypothesis 1. Specifically, by comparing Panel C with Panel A, we find that arbitrage profits are higher before accounting for these costs. For instance, the before-fee Fama and French (1993) 3-factor alpha is 0.4987% ($t-stat$=5.70) in column 4 of Panel C, whereas the after-fee alpha in Panel A is 0.4162%. Given the observed impact of short-selling costs on long-short portfolio returns, Panel D of Table 4 reports the average short-selling fees at the portfolio level across quintiles. Column (1) shows that for the full sample, stocks in the quintile with the highest abnormal short interest have the highest average short-selling fee of 0.1716% per month, indicating that higher short-sale volumes are associated with increased short-selling costs.

Panel E of Table 4 presents the DGTW characteristics-adjusted portfolio returns (Daniel, Grinblatt, Titman, and Wermers, 1997). The results confirm that for the full sample, abnormal short interest continues to predict negative stock returns at the stock level, even after controlling for size, B/M ratio, and momentum. However, this relationship remains significant only for high-SSP stocks, consistent with the findings in Panel A. Among low-SSP stocks, the predictive power of abnormal short interest is insignificant. These results suggest that SSP is persistent at the stock level, supporting our Hypothesis 1. Specifically, stock lenders can predict SSP using historical data and set short-selling fees accordingly to extract a portion of short-selling profits. These results also imply that SSP is a determinant of short-selling fees at the individual stock level.

[Insert Table 4 here]

4.3. ***Short-selling Profitability and Short-selling Fees***

This section first examines the relationship between SSP and short-selling costs (Hypothesis 2.1). Next, we investigate whether stock lenders' market power influences this relationship (Hypothesis 2.2).

4.3.1. Using Measures of Short-selling Costs

We examine the relationship between SSP and short-selling fees using three well-known measures of short-selling costs: the FIS short-selling fee, the Markit DCBS, and option-implied short-selling fees. We derive the monthly stock-level FIS short-selling fee by computing the value-weighted average of the daily short-selling fees over the month. The Markit

DCBS is a score-based measure of short-selling costs, where higher scores indicate a greater short-selling expense. We calculate the monthly DCBS score as the average daily score within a given month (Beneish, Lee, and Nichols, 2015). The option-implied short-selling fee, also referred to as put-call disparity (Ofek, Richardson, and Whitelaw, 2004; Evans, Geczy, Musto, and Reed, 2009; Engelberg, Reed, and Ringgenberg, 2018; Weitzner, 2023; Jacoby, Li, Lin, and Yang, 2024), reflects the notion that when short-selling is constrained, arbitrageurs may synthetically create short positions. This constraint results in increased ask prices for put options and depressed bid prices for call options (Ofek, Richardson, and Whitelaw, 2004; Evans, Geczy, Musto, and Reed, 2009).

We conduct panel regressions of SSP and the aforementioned short-selling fee measures, including firm-, time-, and industry-fixed effects. First, we analyze monthly FIS short-selling.[14] Since we posit that SSP is a novel determinant of short-selling fees, we control for all variables that are shown to affect short-selling fees in the literature. These variables include beta, size (Diether and Werner, 2011; Saffi and Sigurdsson, 2011; Beneish, Lee, and Nichols, 2015; Porras Prado, Saffi, and Sturgess, 2016), book-to-market ratio (Saffi and Sigurdsson, 2011; Beneish, Lee, and Nichols, 2015), momentum (Diether and Werner, 2011; Beneish, Lee, and Nichols, 2015), disagreement (Diether and Werner, 2011; Atmaz, Basak, and Ruan, 2024), firm age, illiquidity (Diether and Werner, 2011; Saffi and Sigurdsson, 2011; Porras Prado, Saffi, and Sturgess, 2016), short interest ratio (Beneish, Lee, and Nichols, 2015), idiosyncratic volatility (Beneish, Lee, and Nichols, 2015), and institutional ownership (Diether and Werner, 2011; Beneish, Lee, and Nichols, 2015; Sikorskaya, 2023; Palia and Sokolinski, 2024).[15] Appendix Table **??** provides the definitions of all these variables.

Panel A of Table 5 reports the results. We find a significant and positive relationship between the monthly FIS short-selling fee and SSP in the cross-section. Specifically, as shown

[14]To mitigate the potential impact of outliers in the FIS fee data sample, we re-examine the relationship between SSP and short-selling costs using a winsorized FIS short-selling fee at the 1% level in each tail. Our conclusions remain robust.

[15]Saffi and Sigurdsson (2011) suggest that the stock loan utilization rate may affect the cost of short-selling. However, the FIS dataset does not include utilization rates.

in the first row of column (1) in Panel A, the coefficient of SSP is 0.0505, with a t-stat of 2.13. This finding indicates that stocks with higher SSP tend to have higher short-selling costs. Columns (2) to (4) confirm the robustness of this positive relationship after controlling for idiosyncratic volatility, institutional ownership, and utilization rate, with the coefficient of SSP increasing to 0.0647 in column (4) ($t-stat$=2.59). Furthermore, columns (5) through (8) demonstrate that this relationship persists even after excluding the industry-fixed effect while keeping firm- and time-fixed effects. The signs of the control variables are consistent with the literature. Overall, these results support Hypothesis 2.1.

Panel B of Table 5 presents panel regression results replacing the FIS short-selling fee with the logarithm of the monthly average DCBS. The set of control variables remains unchanged from Panel A of Table 5 but includes the utilization rate of stock loans, as this data is available in the Markit database. The result, reported in the first rows of columns (1) to (8), indicates a consistent and positive correlation between SSP and short-selling fees, even after controlling for multiple variables. For example, in column (4), the average coefficient of SSP is 0.0206, which is statistically significant at the 1% level ($t-stat$=2.65) when all control variables are included.

Panel C of Table 5 examines the third measure for short-selling costs: the option-implied short-selling fee. Though using option data reduces the number of observations relative to the baseline analysis, the results remain unchanged. Panel regressions with firm-, time-, and industry-fixed effects show statistically significant coefficients in the first rows of columns (1) to (3). To further investigate whether the robustness of these findings, we use an alternative methodology. Following Beneish, Lee, and Nichols (2015), Porras Prado, Saffi, and Sturgess (2016), and Palia and Sokolinski (2024), we employ a dummy variable, specialness, to identify stocks that are expensive to borrow. A stock is defined as "special" if its monthly average DCBS score exceeds 4, assigned a value of 1; otherwise, the specialness of a stock is assigned a value of 0. We conduct Probit regressions of SSP on this dummy variable. The results, as shown in columns (4) to (6), demonstrate that the coefficients of SSP remain positively significant, consistent with Hypothesis 2.1.

[Insert Table 5 here]

In summary, we use various methodologies and several short-selling cost measures to examine the relationship between SSP and short-selling fees. We consistently find a positive relationship between SSP and short-selling fees with various control variables. Overall, our empirical findings provide strong evidence supporting Hypothesis 2.1 and confirm that SSP is a novel determinant of short-selling costs.

4.3.2. The Role of Stock Lenders' Market Power

This section examines whether stock lenders' market power impacts the relationship between SSP and short-selling fees. The effect of SSP on short-selling fees results from stock lenders extracting a portion of short sellers' profits by exploiting their market power. It is thus reasonable to expect an asymmetrical relationship between SSP and short-selling fees, as illustrated in Hypothesis 2.2. Specifically, this relationship should be stronger for stocks where a small number of stock lenders dominate the supply of lendable shares, as indicated by higher lender concentration. To test this hypothesis, we divide the sample into two groups based on lender concentration, a proxy for market power. Lender concentration measures the degree to which a small number of stock lenders control the provision of lendable shares, with higher values representing greater market power.[16] We anticipate that the relationship between SSP and short-selling fees is stronger for stocks with higher lender concentration than those with lower lender concentration.

To empirically test this prediction, we rerun the baseline panel regressions from Section 4.3.1 separately for each subsample: stocks with high market power, defined as those with lender concentration above the cross-sectional median, and stocks with low market power,

[16]The Markit database defines this variable as "a value between 0 and 1 to measure the distribution of lender value on loan. A very small number indicates a large number of lenders with low value on loan and 1 indicates a single lender with all the value on loan. 0 means no value on loan."

characterized by lender concentration below the median. The results are shown in Panel A of Table 6. Columns (1) to (4) show that SSP is strongly and positively related to short-selling fees for stocks with high lender concentration. For instance, in column (4), the coefficient of SSP is 0.1393 and is statistically significant ($t-stat$=2.56) when all control variables are included. In contrast, columns (5) to (8) show that while the coefficients of SSP remain positive for stocks with low lender concentration, they are not statistically significant.

To further examine the robustness of these findings, we replace the dependent variable with the natural logarithm of the monthly DCBS and use the same methodology. We have consistent results in Panel B of Table 6, showing that the positive relation between SSP and short-selling fees is still prevalent among stocks with high lender concentration, but remains insignificant for stocks with low lender concentration. Overall, these results are consistent with our expectation that SSP prominently determines short-selling fees when stock lenders have market power, providing empirical support for Hypothesis 2.2.

[Insert Table 6 here]

4.4. *The Role of Short-selling Profitability in Anomaly Performance*

In this section, we extend the analysis of Muravyev, Pearson, and Pollet (2024) to test whether stock lenders' market power influences the relationship between SSP and the performance of a comprehensive set of stock market anomalies, as described in Hypothesis 3.1. If stock lenders have significant market power, they are expected to extract most, if not all, of the profits generated by short sellers, thereby making stock anomalies statistically insignificant after accounting for short-selling fees. On the contrary, if stock anomalies remain significantly exploitable even after accounting for short-selling fees, they leave a portion of the profits to short sellers. Hypothesis 3.1 formalizes this conjecture.

We test this hypothesis following Muravyev, Pearson, and Pollet (2024). We obtain anomaly data from the Open Source Asset Pricing website, provided by Chen and Zimmermann (2021). To account for short-selling expenses, we use the FIS short-selling fees. Following Muravyev, Pearson, and Pollet (2024), we exclude anomalies with insufficient monthly observations after sorting stocks into decile portfolios, as such anomalies often rely on discrete values. This leaves us with 151 anomalies for analysis. We adjust stock returns by adding short-selling fees, sort stocks into decile portfolios based on anomaly variables from the previous month, and calculate equal-weighted portfolio returns for each decile. Consistent with the methodology in Table 4, we add a markup to the FIS short-selling fee for short-leg stocks. Particularly, stocks in the first two deciles, accounting for approximately 20% stocks, are classified as short-leg stocks, while the remaining stocks are categorized as long-leg stocks. Short-leg stocks are added a 100% markup on the short-selling fee to capture the commission paid to intermediaries, whereas long-leg stocks are added a 70% markup to represent the full fee received by lenders. This methodology follows the approach used in Muravyev, Pearson, and Pollet (2024). The results are reported in Table 7.

Panel A of Table 7 reports the equal-weighted portfolio returns before adjusting for short-selling fees. In the full sample, monthly portfolio returns exhibit a monotonic increase from 1.0611% for short-leg stocks to 1.3111% for long-leg stocks. The aggregate return spread between short-leg and long-leg portfolios is 0.2499% per month, statistically significant at the 1% level ($t - stat$=7.06). For stocks with available short-selling fee data, monthly returns range from 1.3318% for short-leg stocks to 1.4840% for long-leg stocks, with the difference remaining strongly significant ($t - stat$=3.30). These findings suggest that before accounting for fees, the 151 anomalies generate significant returns, allowing arbitrageurs to profitably exploit these stock market anomalies. Panel A of Table 7 also reports the average short-selling fees across portfolios. Short-leg stocks have an average monthly short-selling fee of 0.1789%, slightly higher than 0.1652% for long-leg stocks. After adjusting portfolio returns for short-selling costs, the returns increase from 1.5155% per month for short-leg stocks to 1.5948% per month for long-leg stocks. However, the aggregate return spread declines to 0.0793%, which is insignificant. This finding aligns closely with the results in Table

3 of Muravyev, Pearson, and Pollet (2024) that stock market anomalies become nearly untradable after accounting for short-selling costs, suggesting that stock lenders capture a substantial portion of the profits from short sellers. This result is also consistent with the existence of the stock lenders' market power (Chen, Kaniel, and Opp, 2023). We show that the after-fee return retained by short sellers is 0.0793%, compared to the pre-fee return of 0.1104%. This implies that stock lenders extract approximately 44.31% of the arbitrage profit by exploiting their market power, leaving short sellers with the remaining 55.68%.[17] This finding is not surprising considering that SSP captures short sellers' information advantage at the individual stock level.

Section 2 documents that SSP at the individual stock level serves proxies for short sellers' information advantage, leading to more pronounced anomalies in high-SSP stocks compared to low-SSP stocks, as stated in Hypothesis 3.2. To test this hypothesis, we replicate the regression from Panel A of Table 7 separately for high-SSP and low-SSP stocks. Panels B and C of Table 7 report the equal-weighted portfolio returns before and after adjusting for short-selling fees in the respective subsamples. Panel B demonstrates that for high-SSP stocks, both the before-fee and the after-fee return spreads of anomalies are statistically significant. The before-fee portfolio returns increase from 1.4061% per month in the lowest decile to 1.5848% in the highest decile, generating a return spread of 10.7878%, which is significant at the 1% level ($t-stat$=3.77). The after-fee portfolio returns increase from 1.5969% to 1.7071%, with a return spread of 0.1079% that remains significant at the 5% level ($t-stat$=2.21). In contrast, Panel C shows that for low-SSP stocks, while the before-fee spread of portfolio returns is 0.1086% per month and statistically significant ($t-stat$=2.18), the after-fee return spread is reduced to 0.0531% and becomes statistically insignificant at the 5% level ($t-stat$=0.96). A comparison of the results in Panels B and C strengthens Hypothesis 3.2, demonstrating that short-selling costs alone do not fully explain the aggregate performance of stock market anomalies.

[17] Chen, Kaniel, and Opp (2023) estimate that short-selling costs reduce about 60% of short sellers' profits.

[Insert Table 7 here]

To evaluate the robustness of our results, we repeat all analyses using only the subset of clear anomalies, as identified by Chen and Zimmermann (2021). Using the same methodology, we filter a sample of 119 clear anomalies and report the results in Table 8. Panel A indicates that for stocks with available short-selling fee data, the after-fee return spread is 0.1521% per month, which is statistically significant at the 1% level ($t-stat$=3.13). However, after accounting for short-selling fees, the return spread becomes statistically insignificant ($t-stat$=1.65). Notably, Panel B demonstrates a statistically significant return spread of 0.1324% per month remains among high-SSP stocks after adjusting for short-selling fees ($t-stat$=2.35). In contrast, Panel C shows that for low-SSP stocks, the after-fee return spread is 0.0466% per month and statistically insignificant ($t-stat$=0.74). These findings confirm the robustness of the results reported in Table 7.

[Insert Table 8 here]

We also consider a scenario where short sellers hedge short-sale constraints by simultaneously taking a long put, a short call, and a long risk-free bond position. The approach allows arbitrageurs to use options to mitigate short-sale constraints in the stock lending market. We adjust anomaly returns using the option-implied short-selling fee, calculated as the percentage difference between the synthetic short position cost and the spot stock price. The results presented in Table 9 are consistent with those in Tables 7 and 8, confirming that the after-fee return spread is statistically significant only for high-SSP stocks.

[Insert Table 9 here]

In summary, the results in Tables 7-9 provide compelling evidence that stock lenders share partial profits with short sellers in high-SSP stocks when arbitraging anomalies, supporting the idea that SSP captures short sellers' information advantage. The findings confirm Hypothesis 3.2 and suggest that short-selling costs alone do not fully explain stock market anomalies. The residual profitability left to short sellers highlights their information advantage, sustaining profitability despite high short-selling fees.

5. Additional Analysis

5.1. *Time-series Persistence of SSP Estimates – Bayesian Shrinkage Factor*

This section provides a further analysis of the persistence of SSP over time. To stabilize and examine the time-series variance of SSP estimates, we employ the Bayesian shrinkage factor (Frazzini and Pedersen, 2014; Liu, Stambaugh, and Yuan, 2018). SSP is estimated through time-series regressions using monthly data, and these estimates are adjusted as follows:

$$SSP_{i,t} = \omega_{i,t}(\hat{SSP}_{i,t}^{TS}) + (1 - \omega_{i,t})(\hat{SSP}_{t}^{XT}), \tag{3}$$

$$\omega_{i,t} = \frac{\sigma^2_{t,XT}}{\sigma^2_{i,TS} + \sigma^2_{t,XT}}, \tag{4}$$

where $\hat{SSP}_{i,t}^{TS}$ represents the empirical estimate of SSP using regression (1) and $\hat{SSP}_{t}^{XT}$ denotes the monthly average of SSP estimates. $\sigma^2_{i,TS}$ is the time-series variance of stock i's SSP estimates across all months, and $\sigma^2_{t,XT}$ is the cross-sectional variance of SSP estimates in month t across all stocks.

The Bayesian-adjusted estimate of SSP assigns greater weight to the time-series estimates when they have smaller variance and less weight when their variance is higher. If an SSP estimate fluctuates significantly over time, the Bayesian-adjusted SSP converges to the cross-sectional average SSP estimate for the same month. Figure 2 plots a histogram of the Bayesian adjustment weight ($\omega_{i,t}$) for the full sample, demonstrating that the Bayesian adjustment weights for most stocks are close to one. This indicates that a relatively small time-series variance in SSP estimates.

Table 10 presents summary statistics. The median value of the Bayesian shrinkage factor is approximately 96%, suggesting that adjustments to SSP estimates are negligible for most stocks. Additionally, the average monthly correlation between SSP estimates and their Bayesian-adjusted counterparts is approximately 93%.

[Insert Figure 2 here]

[Insert Table 10 here]

5.2. *SSP and Other Stock Lending Market Variables*

This section examines the relationships between SSP and various stock lending market variables beyond short-selling fees. We focus on three critical dimensions: the average tenure of stock loans (Kolasinski, Reed, and Ringgenberg, 2013), the lendable rate (D'avolio, 2002; Saffi and Sigurdsson, 2011), and lender concentration (Chen, Kaniel, and Opp, 2023). These variables provide a comprehensive view of how SSP interacts with different aspects of the stock lending market, providing insights into the behavior of short sellers and stock lenders.

First, short sellers, who realize different profitability across stocks, may borrow shares in different durations depending on SSP. We hypothesize a negative relationship between SSP and the average tenure of stock loans, as short sellers are likely to borrow shares for shorter periods from stocks that are more sensitive to short-selling, and vice versa. Our analysis uses stock-level Fama and MacBeth (1973) regressions to test this hypothesis, with results reported in Table 11. Column (1) demonstrates a significantly negative relationship between SSP and the average tenure of stock loans. The regression coefficient for the full sample is -0.1136, statistically significant at the 1% level ($t - stat =$ -4.22). This finding confirms that short sellers prefer shorter borrowing durations when dealing with high-SSP stocks, aligning with our hypothesis.

Second, we analyze the lendable rate, defined as the ratio of lendable shares to total shares outstanding, which reflects the willingness of stock lenders to supply shares for short-selling. We hypothesize that stock lenders may be less inclined to supply loans of high SSP stocks.

As discussed in Section 4.3.2, stock lenders have a market power but do not extract all profits from short-selling. Thus, stock lenders may restrict the supply of loans for high-SSP stocks, as the short-selling fee that they charge cannot fully compensate for negative stock return in their loan. Column (2) of Table 11 shows a negative relationship between SSP and the lendable rate, supporting our conjecture. The results indicate that high-SSP stocks have a lower lendable rate, implying that stock lenders are more selective in supplying these stocks for short-selling.

[Insert Table 11 here]

Finally, we examine lender concentration, which measures the degree that a few lenders dominates stock loans. High lender concentration may limit short sellers' access to stock loans, potentially making short-selling more efficient due to reduced competition among lenders. We hypothesize a positive relationship between SSP and lender concentration, as the limited availability of stock loans could lead to increased short-selling profitability. Column (3) of Table 11 displays a significantly positive relationship between SSP and lender concentration. This finding implies that stocks with higher lender concentration tend to be more profitable for short sellers. The increased profitability in these stocks may be due to the reduced competition among lenders, allowing short sellers to obtain more profits.

6. Conclusion

This paper examines a stock lending market in which stock lenders have market power. In this market, lenders supply stock loans to short sellers and exploit their market power to extract a fraction of the profits generated from short-selling activities. The intuition of this study is consistent with the findings of existing literature, including Chen, Da, and Huang (2022), Chen, Kaniel, and Opp (2023), and Atmaz, Basak, and Ruan (2024). The total profitability of short-selling is determined by the negative sensitivity of stock returns to abnormal short interest, and the profit is shared between short sellers and stock lenders.

Stock lenders leverage their market power to extract partial short-selling profit. Therefore, stock lenders leverage their market power by imposing higher short-selling fees on stocks with high sensitivity to short-sale activities while requiring lower fees from stocks with lower sensitivity.

We empirically estimate stock-level short-selling profitability (SSP) and examine its asset pricing implications. Our results show a significant relationship between SSP and multiple proxies for short-selling fees. We demonstrate that SSP is persistent in out-of-sample, as abnormal short interest predicts stock returns stronger for high-SSP than for low-SSP stocks. Consistent with Muravyev, Pearson, and Pollet (2024), a comprehensive set of anomalies is not profitably exploitable after accounting for short-selling fees. However, our result show that stock market anomalies remain statically significant after accounting for short-selling fees in high-SSP stocks, but become insignificant in low-SSP stocks. These findings indicate that short-selling costs alone do not fully explain stock market anomalies, highlighting the role of market structure and lender behavior in shaping short-selling dynamics.

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Figure 1. Monthly Average Short-selling Profitability (SSP) of Stocks

This figure plots the time-series of the simple average SSP across all months from 1980 to 2021. The shaded areas denote the NBER recession periods.

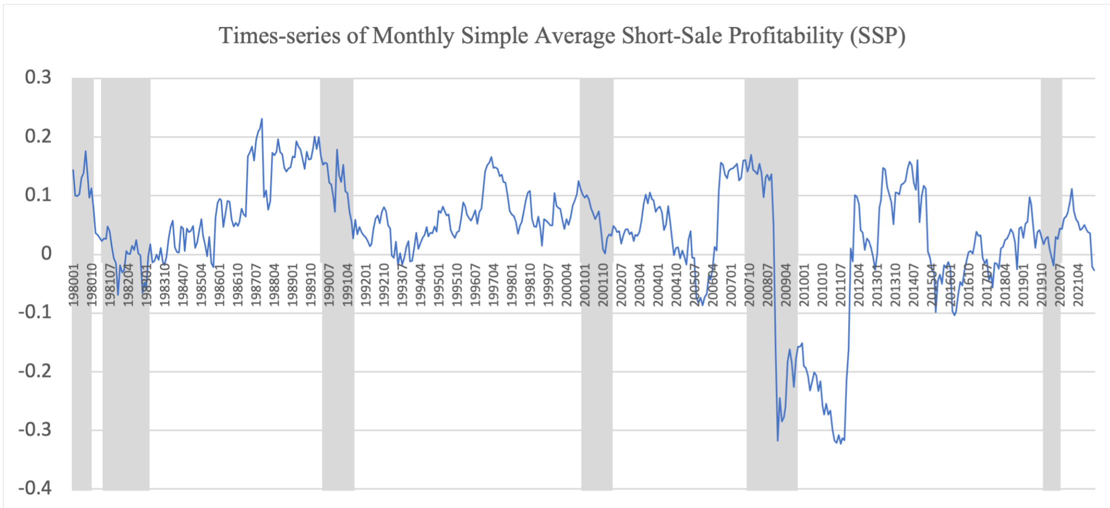

Figure 2. The Distribution of SSP's Bayesian Shrinkage Factor Adjustment Weights

This figure plots a histogram of the Bayesian shrinkage factor adjustment weights for the full sample, as defined in Section 5.1.

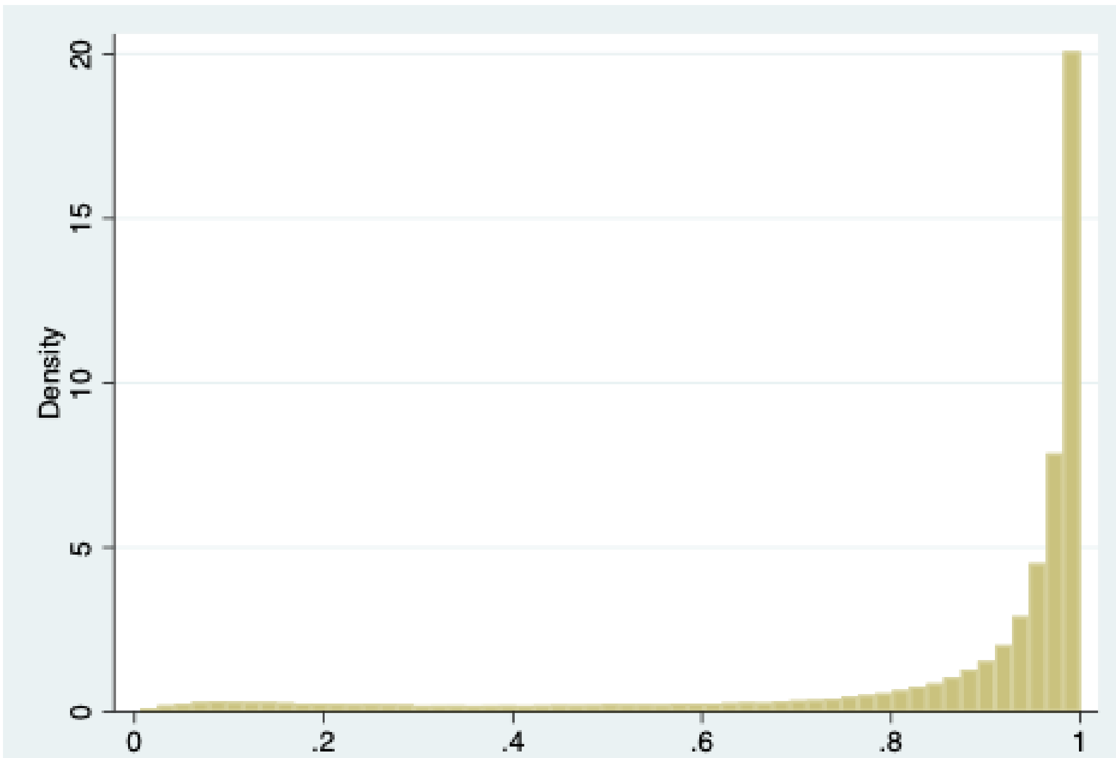

Table 1. Summary Statistics

This table provides summary statistics for short-selling profitability (SSP) and other stock-level variables. The detailed definitions of these variables could be found in Appendix Table **??**. For each variable, this table reports the median, mean, standard deviation, skewness, kurtosis, number of observations, and full-sample statistical breakpoints.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	SSP	SIR	FIS Fee	DCBS	Market Power	ME	B/M	Mom	Disp	IO
Min.	-7.98	0.00	0	1.00	21.36	0.09	0.00	-1.00	0.00	0.00
1%	-5.39	0.00	0.05	1.00	37.22	7.04	0.04	-0.80	0.00	0.00
5%	-1.09	0.00	0.15	1.00	44.15	23.48	0.12	-0.56	0.01	0.02
Median	0.00	0.01	0.56	1.00	67.36	567.91	0.57	0.07	0.04	0.53
95%	0.72	0.15	6.97	4.80	100.00	18,693.01	1.75	0.97	0.60	1.00
99%	3.04	0.33	29.41	9.74	100.00	76,292.79	3.55	2.22	2.71	1.18
Max.	7.17	70.13	100	10.00	100.00	2,902,368	57.08	98.57	356.00	2,889.65
Mean	-0.09	0.04	2.21	1.50	69.18	4,841.45	0.74	0.14	0.21	0.56
Std. Dev.	1.00	0.27	12.05	1.52	16.72	25,095.04	1.34	0.72	1.59	8.50
Skewness	-2.74	135.55	16.05	3.81	0.22	32.65	437.17	25.85	63.86	311.69
Kurtosis	26.12	27,120.16	318.88	18.00	2.19	2,128.36	312,148.70	2,320.39	7,928.01	99,387.44
Obs.	1,215,646	1,282,054	360,407	359,999	343,053	1,282,054	854,449	974,348	594,965	1,209,147

Table 2. Correlation Matrix of Short-selling Cost Measures

This table presents the correlations among proxies for short-selling costs: the FIS short-selling fee, the natural logarithm of the monthly average DCBS, the option-implied short-selling fee, and specialness. Detailed definitions of these variables are provided in Appendix Table **??**. The corresponding p-values are reported in parentheses below the correlation coefficients. Statistical significance is denoted by ***, **, and * at the 1%, 5%, and 10% levels, respectively.

	FIS Fee	Log DCBS	Optionimplied Fee	Specialness
FIS Fee	1.0000			
	(0.00)			
Log DCBS	0.5234***	1.0000		
	(0.00)	(0.00)		
Option-implied Fee	0.3374***	0.2678***	1.0000	
	(0.00)	(0.00)	(0.00)	
Specialness	0.6929***	0.5557***	0.2717***	1.0000
	(0.00)	(0.00)	(0.00)	(0.00)

Table 3. Correlation Matrix

This table reports the average coefficients from univariate regressions of stock-level short-selling profitability (SSP) on various firm characteristics. The firm characteristics include beta, the natural logarithm of firm size, the book-to-market ratio, momentum, the dispersion of analysts' forecasts, illiquidity (Illiq), realized idiosyncratic volatility (Idiovol), lottery demand (Max), Coskewness, firm age (Age), and short interest ratio (SIR). The analysis uses stock-level Fama and MacBeth (1973) regressions, with significance levels adjusted for autocorrelation using the method of Newey and West (1987). Statistical significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

	(1) Beta	(2) Size	(3) B/M	(4) Mom	(5) Disp	(6) Illiq	(7) Idiovol	(8) Max	(9) Coskewness	(10) Age	(11) SIR
Independent Variable: Stock-level SSP	0.0259***										
	(12.44)										
		-0.1822***									
		(-18.47)									
			0.0087***								
			(4.21)								
				-1.1741***							
				(-6.07)							
					0.0377***						
					(3.94)						
						0.3946***					
						(2.67)					
							0.0012***				
							(14.30)				
								0.0032***			
								(11.97)			
									-0.0045***		
									(-5.43)		
										-6.7343***	
										(-12.99)	
											-0.0027***
											(-12.86)
Obs.	561,143	561,143	541,198	561,143	341,607	561,143	561,140	561,143	561,143	561,142	561,143
Adj. R^2	0.0053	0.0129	0.0180	0.0036	0.0018	0.0149	0.0126	0.0087	0.0237	0.0022	0.18%

Table 4. The Role of SSP in the Predictability of Short Interest to Stock Returns

This table examines the time-series persistence of SSP estimates using out-of-sample portfolio analysis. Panel A reports equal-weighted portfolio returns when stocks are ranked by abnormal short interest. The reported returns are net of short-selling fees. The row labeled *Low-High* reports the return spread between the Lowest and Highest abnormal short interest portfolios. Subsequent rows present risk-adjusted returns (alphas) estimated under various factor models, including the CAPM, FF3, FF5, and FF5+UMD (FF6). Panel B reports equal-weighted portfolio returns net of short-selling fee using independent double sort. Panel C uses the same methodology as Panel A but reports portfolio results before accounting for short-selling fees. Panel D exhibits average short-selling fees at the portfolio level. Panel E shows returns in the dependent double sort portfolios adjusted for firm characteristics using the DGTW (Daniel, Grinblatt, Titman, and Wermers, 1997) methodology, where short-selling fees are also used to adjusted returns. Statistical significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

Panel A: Bivariate Portfolio Analysis – After Short-selling Fee using Dependent Double Sort

	Full Sample		High-SSP		Low-SSP	
	(1)	(2)	(3)	(4)	(5)	(6)
Quintiles	abnSI	Ret	abnSI	Ret	abnSI	Ret
1 (Low)	-0.0401	1.5536	-0.0375	1.6405	-0.0422	1.4984
2	-0.0079	1.4024	-0.0075	1.6365	-0.0085	1.2293
3	-0.0008	1.5775	-0.0004	1.5281	-0.0012	1.5737
4	0.0068	1.4542	0.0075	1.5329	0.0062	1.2671
5 (High)	0.0406	1.2901	0.0410	1.2395	0.0399	1.3769
Low-High		0.2636**		0.4010***		0.1215
		(1.98)		(3.37)		(0.63)
CAPM Alpha		0.2768**		0.4216***		0.1049
		(2.02)		(4.80)		(0.54)
FF3 Alpha		0.2498**		0.4162***		0.0683
		(1.99)		(4.41)		(0.35)
FF5 Alpha		0.2827**		0.4990***		0.0758
		(2.08)		(5.43)		(0.40)
FF6 Alpha		0.2689**		0.4696***		0.0753
		(2.01)		(3.81)		(0.38)

Panel B: Bivariate Portfolio Analysis – After Short-selling Fee using Independent Double Sort

	Full Sample		High-SSP		Low-SPP	
	(1)	(2)	(3)	(4)	(5)	(6)
Quintiles	abnSI	Ret	abnSI	Ret	abnSI	Ret
1 (Low)	-0.0401	1.5536	-0.0383	1.6194	-0.0414	1.4728
2	-0.0079	1.4024	-0.0079	1.5748	-0.0080	1.2463
3	-0.0008	1.5775	-0.0008	1.6009	-0.0008	1.5650
4	0.0068	1.4542	0.0068	1.5355	0.0068	1.3662
5 (High)	0.0406	1.2901	0.0399	1.2639	0.0412	1.3550
Low-High		0.2636**		0.3555**		0.1178
		(1.98)		(2.21)		(0.65)
CAPM Alpha		0.2768**		0.3718***		0.1130
		(2.02)		(2.99)		(0.72)
FF3 Alpha		0.2498*		0.3593***		0.0750
		(1.94)		(2.75)		(0.39)
FF5 Alpha		0.2827**		0.4266***		0.0901
		(2.08)		(4.00)		(0.51)
FF6 Alpha		0.2689**		0.3972***		0.0895
		(2.04)		(2.85)		(0.47)

Panel C: Bivariate Portfolio Analysis – Before Short-selling Fee using Dependent Double Sort

	Full Sample		High-SSP		Low-SSP	
	(1)	(2)	(3)	(4)	(5)	(6)
Quintiles	abnSI	Ret	abnSI	Ret	abnSI	Ret
1 (Low)	-0.0401	1.4605	-0.0375	1.5409	-0.0422	1.4119
2	-0.0079	1.3347	-0.0075	1.5624	-0.0085	1.1685
3	-0.0008	1.5068	-0.0004	1.4542	-0.0012	1.5070
4	0.0068	1.3847	0.0075	1.4568	0.0062	1.2035
5 (High)	0.0406	1.1184	0.0410	1.0586	0.0399	1.2161
Low-High		0.3420***		0.4824***		0.1958
		(2.22)		(3.88)		(1.04)
CAPM Alpha		0.3550**		0.5038***		0.1780
		(2.40)		(6.15)		(1.04)
FF3 Alpha		0.3283**		0.4987***		0.1418
		(2.07)		(5.70)		(0.70)
FF5 Alpha		0.3137**		0.4659***		0.1427
		(2.06)		(4.05)		(0.66)
FF6 Alpha		0.3473**		0.5531***		0.1478
		(2.09)		(4.77)		(0.75)

Panel D: Bivariate Portfolio Analysis – Average Short-selling Fee

	Full Sample	High-SSP	Low_SSP	
	(1)	(2)	(3)	(4)
Quintiles	Fee	Fee	Fee	H-L
1 (Low)	0.1331	0.1446	0.1223	0.0223***
				(6.19)
2	0.0968	0.1062	0.0874	0.0189***
				(7.45)
3	0.1010	0.1091	0.0929	0.0163***
				(6.87)
4	0.0993	0.1078	0.0905	0.0172***
				(6.04)
5 (High)	0.1716	0.1794	0.1645	0.0149***
				(3.56)
Low-High	0.0385***	0.0348***	0.0422***	
	(4.91)	(4.95)	(4.53)	

Panel E: DGTW Characteristics-adjusted Return

	Full Sample	High SSP	Low SSP
	(1)	(2)	(3)
Quintiles	Ret	Ret	Ret
1 (Low)	0.5496	0.6919	0.3938
2	0.5420	0.7292	0.3318
3	0.6942	0.8074	0.5652
4	0.5047	0.5822	0.4140
5 (High)	0.2507	0.3094	0.1790
Low-High	0.2989**	0.3825**	0.2148
	(2.44)	(2.39)	(1.19)

Table 5. SSP and Short-selling Costs at the Stock Level

This table examines the relationship between stock-level SSP and various proxies for short-selling fees. Panel A reports results from panel regressions with firm-, time-, and industry-fixed effects, regressing the FIS short-selling fee on SSP. Panel B reports panel regression results with firm-, time-, and industry-fixed effects using the month-end DCBS as a proxy for the monthly short-selling fee. Panel C uses the option-implied short-selling fee as a proxy for short-selling fee. It reports the results of panel regressions with firm-, time-, and industry-fixed effects. This panel then uses specialness as a alternative proxy. Specialness is a dummy variable, which equals 1 if the average DCBS exceeds 4, and 0 otherwise.In each regression, t-statistics using clustered standard errors are reported in parentheses below the regression coefficients. Control variables include beta, size, book-to-market ratio (B/M), momentum (Mom), disagreement (Disp), firm age (Age), illiquidity (Illiq), short interest ratio (SIR), idiosyncratic volatility (Idiovol), and institutional ownership (IO). The rows labeled *Obs.* and *Adj. R-sq.* report the numbers of observations and the adjusted R-squared values, respectively. Statistical significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

Panel A: SSP and Monthly FIS Short-selling Fees – Panel Regressions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dependent Variable: FIS Short-selling Fee							
SSP	0.0505**	0.0641***	0.0649***	0.0647**	0.0509**	0.0647***	0.0654***	0.0655***
	(2.13)	(2.72)	(2.77)	(2.59)	(2.15)	(2.74)	(2.79)	(2.62)
Beta	0.0089	0.0165	-0.0057	-0.0104	0.0080	0.0153	-0.0069	-0.0116
	(0.57)	(1.06)	(-0.36)	(-0.65)	(0.51)	(0.98)	(-0.44)	(-0.73)
Size	-0.4015***	-0.2520***	-0.2199***	-0.1325***	-0.3976***	-0.2485***	-0.2164***	-0.1290***
	(-24.59)	(-14.61)	(-12.40)	(-6.56)	(-24.42)	(-14.40)	(-12.19)	(-6.38)
B/M	-0.0661***	-0.0472***	-0.0446***	-0.0489***	-0.0663***	-0.0473***	-0.0447***	-0.0491***
	(-7.66)	(-5.52)	(-5.28)	(-5.76)	(-7.70)	(-5.54)	(-5.30)	(-5.79)
Mom	-0.0604***	-0.0461**	-0.0512***	-0.0671***	-0.0607***	-0.0463**	-0.0514***	-0.0673***
	(-3.34)	(-2.54)	(-2.82)	(-3.48)	(-3.35)	(-2.55)	(-2.82)	(-3.49)
Disp	0.0089	0.0079	0.0072	0.0079	0.0086	0.0076	0.0069	0.0076
	(1.25)	(1.12)	(1.02)	(1.12)	(1.22)	(1.09)	(0.99)	(1.08)
Age	-0.4998***	-0.4306***	-0.4348***	-0.3684***	-0.4954***	-0.4250***	-0.4294***	-0.3626***
	(-9.29)	(-7.81)	(-7.99)	(-6.71)	(-9.29)	(-7.74)	(-7.92)	(-6.63)
Illiq	-0.0036*	-0.0013	-0.0019	-0.0035	-0.0036*	-0.0013	-0.0018	-0.0034
	(-1.70)	(-0.55)	(-0.77)	(-1.55)	(-1.68)	(-0.53)	(-0.76)	(-1.53)
SIR		5.0451***	5.0199***	5.6346***		5.0516***	5.0262***	5.6417***
		(24.10)	(24.06)	(25.05)		(24.13)	(24.09)	(25.06)
Idiovol			7.4099***	7.1586***			7.4245***	7.1722***
			(10.27)	(10.02)			(10.29)	(10.04)
IO				-1.3513***				-1.3535***
				(-9.70)				(-9.71)
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	N	N	N	N
Obs.	201,609	201,609	201,609	201,192	201,609	201,609	201,609	201,192
Adj. R^2	0.4916	0.512	0.5134	0.5151	0.4914	0.5118	0.5133	0.5150

Panel B: SSP and Monthly Average DCBS – Panel Regressions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dependent Variable: Natural Logarithm of Monthly Average DCBS							
SSP	0.0192***	0.0194***	0.0198***	0.0206***	0.0193**	0.0195**	0.0200**	0.0208**
	(3.02)	(2.96)	(2.71)	(2.65)	(2.24)	(2.26)	(2.32)	(2.38)
Beta	0.0033	0.0006	-0.0002	-0.0011	0.0032	0.0005	-0.0003	-0.0012
	(0.55)	(0.10)	(-0.03)	(-0.19)	(0.45)	(0.07)	(-0.04)	(-0.18)
Size	-0.0514***	-0.0476***	-0.0375***	-0.0366***	-0.0508***	-0.0471***	-0.0371***	-0.0361***
	(-3.54)	(-3.31)	(-2.85)	(-2.88)	(-6.79)	(-6.34)	(-4.94)	(-4.83)
B/M	-0.0039	-0.0036	-0.0043	-0.0033	-0.0039	-0.0036	-0.0043	-0.0033
	(-0.90)	(-0.81)	(-0.95)	(-0.74)	(-1.03)	(-0.94)	(-1.13)	(-0.87)
Mom	-0.0001*	-0.0001*	-0.0001**	-0.0001**	-0.0001**	-0.0001**	-0.0001***	-0.0001***
	(-2.27)	(-2.30)	(-2.56)	(-2.61)	(-2.45)	(-2.57)	(-2.86)	(-2.94)
Disp	-0.0001	-0.0002	-0.0002	-0.0002	-0.0001	-0.0002	-0.0002	-0.0002
	(-0.14)	(-0.23)	(-0.18)	(-0.24)	(-0.23)	(-0.36)	(-0.29)	(-0.37)
Age	-0.0674***	-0.0676***	-0.0590**	-0.0563**	-0.0665***	-0.0667***	-0.0581***	-0.0553***
	(-2.71)	(-2.75)	(-2.55)	(-2.50)	(-3.18)	(-3.20)	(-2.76)	(-2.62)
Illiq	-0.0006	-0.0007	-0.0008	-0.0007	-0.0006	-0.0007	-0.0008*	-0.0007*
	(-1.21)	(-1.30)	(-1.50)	(-1.26)	(-1.51)	(-1.64)	(-1.95)	(-1.67)
SIR	0.7920***	0.7891***	0.8564***	0.8130***	0.7932***	0.7902***	0.8576***	0.8141***
	(6.72)	(6.78)	(6.87)	(6.45)	(7.02)	(7.05)	(6.64)	(6.28)
Idiovol		0.8747***	0.8717***	0.8453***		0.8762***	0.8731***	0.8466***
		(11.06)	(9.16)	(9.08)		(8.85)	(8.82)	(8.69)
IO			-0.1497***	-0.1616***			-0.1498***	-0.1617***
			(-3.03)	(-2.99)			(-3.09)	(-3.15)
Utilization				0.0105***				0.0105***
				(2.88)				(3.58)
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	N	N	N	N
Obs.	193,861	193,861	193,480	193,396	193,861	193,861	193,480	193,396
Adj. R^2	0.634	0.635	0.637	0.637	0.634	0.635	0.636	0.637

Panel C: Robust to Option Implied Short-selling Fee and Specialness Treatment

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent Variable: Option Implied Short-selling Fee			Dependent Variable: Specialness		
SSP	0.0004**	0.0004**	0.0004**	0.0366**	0.0538***	0.0534***
	(2.23)	(2.20)	(2.51)	(2.04)	(2.93)	(2.88)
Beta	0.0004***	0.0005***	0.0002***	0.2083***	0.2018***	0.1771***
	(11.71)	(11.83)	(7.22)	(26.55)	(24.96)	(21.46)
Size	-0.0008***	-0.0008***	-0.0007***	-0.3391***	-0.4302***	-0.4064***
	(-34.56)	(-33.15)	(-29.49)	(-61.83)	(-68.07)	(-63.34)
B/M	-0.0001***	-0.0001***	-0.0001***	-0.1237***	-0.1190***	-0.1171***
	(-7.62)	(-7.27)	(-9.37)	(-21.20)	(-19.26)	(-18.87)
Mom	-0.0000***	-0.0000***	-0.0000***	0.0000	0.0001	0.0001
	(-6.35)	(-6.20)	(-6.56)	(-0.60)	(1.06)	(1.29)
Disp	0.0002***	0.0002***	0.0001***	0.0041	0.0015	0.0006
	(4.95)	(4.49)	(3.20)	(1.21)	(0.37)	(0.14)
Age	-0.0001**	0.0000	0.0000	-0.2634***	-0.2447***	-0.2355***
	(-2.49)	(-0.66)	(1.63)	(-28.45)	(-24.89)	(-23.84)
Illiq	0.1182***	0.1232***	0.1094***	0.0028**	0.0026**	0.0026**
	(11.74)	(11.73)	(11.16)	(2.32)	(2.15)	(2.13)
SIR		0.0017***	0.0013***		1.9888***	1.9423***
		(15.51)	(13.52)		(60.06)	(58.46)
Idiovol			0.0426***			4.3859***
			(17.89)			(18.97)
Obs.	72,942	72,942	72,942	193,930	193,930	193,930
Adj. R^2	0.311	0.319	0.345			
Pseudo R^2				0.178	0.248	0.255

Table 6. SSP and the Stock Lending Costs - the Role of Stock Lenders' Market Power

This table examines the relationship between SSP and short-selling fees, conditional on stock lenders' market power using subsamples.The market power, defined using lender concentration, is the total percentage of lendable shares offered by the two largest stock lenders. Panel A reports the results where FIS short-selling fee is dependent variable. Panel B shows results of similar method using the natural logarithm of monthly average DCBS as dependent variable for robustness. This table continues to use the same methodology as in the Table 5, where we use panel regressions and report t-statistics with clustered standard errors. The rows labeled *Obs.* and *Adj. R-sq.* report the numbers of observations and the adjusted R-squared values, respectively. Statistical significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

Panel A: Market Power Defined using Lender Concentration – FIS Short-selling Fee

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	High Market Power Stocks				Low Market Power Stocks			
	Dependent Variables: FIS Short-selling Fee							
SSP	0.1347**	0.1312**	0.1361**	0.1393**	-0.0341	-0.0341	-0.0072	-0.0099
	(2.48)	(2.41)	(2.50)	(2.56)	(-1.00)	(-1.00)	(-0.22)	(-0.29)
Beta	-0.0622***	-0.0613***	-0.0554***	-0.0844***	0.0921**	0.0921**	0.1101***	0.0699*
	(-3.22)	(-3.09)	(-2.76)	(-3.63)	(2.50)	(2.50)	(2.98)	(1.85)
Size	-0.3694***	-0.3669***	-0.3380***	-0.2994***	-0.6685***	-0.6685***	-0.3706***	-0.3125***
	(-14.19)	(-13.62)	(-12.36)	(-9.69)	(-14.11)	(-14.02)	(-7.91)	(-6.84)
B/M	-0.0335**	-0.0343**	-0.0250	-0.0210	-0.0799***	-0.0800***	-0.0598***	-0.0556***
	(-2.08)	(-2.11)	(-1.56)	(-1.34)	(-4.27)	(-4.28)	(-3.19)	(-2.96)
Mom	-0.0356	-0.0368	-0.0304	-0.0407	-0.0260	-0.0260	-0.0215	-0.0283
	(-1.50)	(-1.51)	(-1.18)	(-1.55)	(-0.37)	(-0.37)	(-0.30)	(-0.40)
Disp	0.0089	0.0090	0.0088	0.0087	0.0051	0.0051	0.0032	0.0014
	(0.77)	(0.77)	(0.77)	(0.75)	(0.87)	(0.87)	(0.56)	(0.25)
Age	-0.3647***	-0.3661***	-0.3666***	-0.3700***	-0.3797***	-0.3797***	-0.2167**	-0.2320***
	(-7.28)	(-7.27)	(-7.35)	(-7.21)	(-4.39)	(-4.39)	(-2.48)	(-2.69)
Illiq		0.0160	0.0165	0.0158		0.0013	0.1642	0.1411
		(0.52)	(0.54)	(0.52)		(0.01)	(0.65)	(0.57)
SIR			3.0859***	2.9944***			5.5267***	5.5031***
			(12.84)	(12.29)			(19.38)	(19.37)
Idiovol				9.1802***				12.7966***
				(2.99)				(6.68)
IO								
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y	Y	Y
Obs	97,330	97,330	97,330	97,330	119,603	119,603	119,603	119,603
adj. R^2	0.6264	0.6265	0.6283	0.6299	0.4331	0.4331	0.4512	0.4531

Panel B: Market Power Defined using Lender Concentration – Robustness to the Monthly DCBS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	High Market Power Stocks				Low Market Power Stocks			
	Dependent Variables: Natural Logarithm of Monthly Mean DCBS							
SSP	0.0263***	0.0265***	0.0252**	0.0255***	0.0095	0.0097	0.0112	0.0134*
	(3.75)	(3.69)	(3.30)	(3.40)	(1.65)	(1.56)	(1.72)	(1.93)
Beta	0.0039	0.0021	0.0019	-0.0022	0.0066	0.0033	0.0020	-0.0091
	(0.50)	(0.26)	(0.24)	(-0.27)	(0.96)	(0.49)	(0.29)	(-1.32)
Size	-0.0911***	-0.0892***	-0.0605***	-0.0575***	-0.0517***	-0.0464**	-0.0383**	-0.0216**
	(-5.95)	(-5.83)	(-5.97)	(-6.21)	(-3.56)	(-3.31)	(-2.77)	(-2.60)
B/M	-0.0048*	-0.0046*	-0.0056*	-0.0023	-0.0051	-0.0046	-0.0049	0.0063
	(-1.92)	(-1.88)	(-2.09)	(-0.90)	(-1.09)	(-0.99)	(-1.05)	(1.77)
Mom	0.0134*	0.0130*	0.0062	0.0066	-0.0112	-0.0121*	-0.0133*	-0.0087*
	(2.14)	(2.07)	(1.17)	(1.31)	(-1.76)	(-1.90)	(-2.05)	(-1.96)
Disp	-0.0006	-0.0006	-0.0007	-0.0007	0.0004	0.0003	0.0004	0.0000
	(-0.69)	(-0.67)	(-0.88)	(-0.92)	(0.52)	(0.33)	(0.42)	(-0.03)
Illiq	0.4488***	0.4295***	0.7561***	-0.1777*	0.8040***	0.8016***	0.8549***	0.2520***
	(2.77)	(2.63)	(6.16)	(-2.13)	(6.47)	(6.54)	(6.63)	(3.33)
SIR		0.5447***	0.4515***	0.3107**		1.1395***	1.1510***	0.7331***
		(4.69)	(4.98)	(3.26)		(8.80)	(7.75)	(5.91)
IO			-0.3546***	-0.2981***			-0.1429***	-0.2414***
			(-6.19)	(-5.97)			(-3.36)	(-3.20)
Utilization				0.0053***				0.0087***
				(15.93)				(12.41)
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y	Y	Y
Obs.	96,374	96,374	95,943	95,943	109,284	109,284	108,850	108,850
Adj. R^2	0.7571	0.7579	0.7656	0.7773	0.6164	0.6180	0.6191	0.6849

Table 7. The Role of SSP on Anomaly Performance

This table empirically tests whether stock lenders share profit with short sellers and the role of SSP on equity prices. Following Muravyev, Pearson, and Pollet (2024), we adjust stock returns in decile portfolios, formed based on 151 anomalies, by stock-level short-selling fees. The first row of Panel A reports aggregate equal-weight returns for decile portfolios, where stocks are sorted by anomaly variables across all 151 anomalies. The row labeled *Average Num. of Stocks* reports the average number of stocks in each decile portfolio across all anomalies. The row labeled *Average Fee* reports the average short-selling fees of the aggregate decile portfolios. The last column labeled *High-Low* reports the spreads of returns and short-selling fees between the two extreme portfolios. Panel B shows the aggregate return spread where only high-SSP stocks are included. Panel C shows results using low-SSP stocks only. Statistical significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

Panel A: Decile Portfolios Sorted by 151 Anomalies - Full Sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	High-Low
	With or Without FIS Short-selling Fee Observations										
Return before Fee	1.0611	1.1335	1.1239	1.1132	1.1263	1.1435	1.1653	1.1928	1.2125	1.3111	0.2499***
t	(59.79)	(90.77)	(124.73)	(139.60)	(146.35)	(128.90)	(132.30)	(127.00)	(109.87)	(49.52)	(7.06)
Average Num of Stocks	242.76	176.86	160.52	156.01	152.38	152.88	152.72	159.48	172.98	242.73	
	With FIS Short-selling Fee Observations										
Return before Fee	1.3318	1.2688	1.2256	1.2093	1.2259	1.2427	1.2651	1.3000	1.3441	1.4840	0.1424***
t	(47.04)	(69.22)	(105.95)	(98.85)	(104.71)	(109.19)	(108.75)	(89.50)	(77.83)	(44.83)	(3.30)
Average Fee	0.1789	0.1156	0.1030	0.0976	0.0956	0.0959	0.0968	0.1014	0.1117	0.1652	-0.0137
t											(-1.61)
Return after Fee	1.5155	1.3905	1.3034	1.2783	1.2914	1.3097	1.3275	1.3689	1.4160	1.5948	0.0793
t	(50.82)	(81.39)	(118.50)	(115.70)	(117.77)	(117.60)	(117.60)	(97.31)	(86.95)	(53.37)	(1.64)
Average Num of Stocks	185.60	142.80	130.92	127.61	124.56	124.77	124.48	129.81	139.13	186.03	

Panel B: Decile Portfolios Sorted by 151 Anomalies – High-SSP Stocks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	High-Low
Return before Fee	1.4061	1.3125	1.2561	1.2377	1.2684	1.2687	1.2935	1.3244	1.3795	1.5848	0.1787***
t	(49.41)	(63.27)	(95.69)	(96.39)	(89.50)	(94.45)	(87.64)	(82.68)	(77.32)	(50.35)	(3.77)
Average Fee	0.1907	0.1227	0.1088	0.1030	0.1010	0.1011	0.1020	0.1066	0.1172	0.1736	-0.0171*
t											(-1.93)
Return after Fee	1.5969	1.4366	1.3314	1.3112	1.3416	1.3430	1.3663	1.4014	1.4638	1.7071	0.1079**
t	(48.80)	(65.34)	(98.17)	(98.26)	(91.15)	(94.22)	(88.81)	(82.24)	(76.65)	(51.05)	(2.21)
Average Num of Stocks	93.97	72.21	66.21	64.52	62.98	63.10	62.97	65.71	70.47	94.68	

Panel C: Decile Portfolios Sorted by 151 Anomalies – Low-SSP Stocks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	High-Low
Return before Fee	1.2616	1.2349	1.2056	1.1818	1.1790	1.2086	1.2241	1.2702	1.2895	1.3702	0.1086**
t	(50.03)	(83.32)	(97.32)	(95.56)	(95.20)	(101.09)	(94.57)	(90.96)	(78.80)	(34.75)	(2.18)
Average Fee	0.1670	0.1085	0.0972	0.0921	0.0902	0.0906	0.0915	0.0962	0.1062	0.1567	-0.0102
t											(-1.25)
Return after Fee	1.4300	1.3440	1.2743	1.2454	1.2411	1.2739	1.2890	1.3372	1.3674	1.4831	0.0531
t	(49.06)	(86.28)	(97.60)	(97.86)	(97.67)	(101.23)	(96.83)	(90.63)	(79.99)	(37.01)	(0.96)
Average Num of Stocks	93.48	71.71	65.72	64.02	62.48	62.60	62.49	65.20	69.97	94.18	

Table 8. The Role of SSP in Anomaly Performance: Robustness to 119 Clear Anomalies

This table empirically tests Hypotheses 3.1 and 3.2 using the same methodology as in Table 7 but restricting the analysis to clear anomalies. Clear anomalies are those that can be directly identified using the Open Source Asset Pricing database, as provided by Chen and Zimmermann (2021). This sample includes 119 clear anomalies. The row labeled *Average Num of Stocks* reports the average number of stocks within the decile portfolio across all anomalies. The row labeled *Average Fee* reports the average short-selling fees of aggregate decile portfolios. Panel B reports the aggregate return spread for portfolios that include only high-SSP stocks. Panel C presents results based on portfolios that consist exclusively of low-SSP stocks. Statistical significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

Panel A: Decile Portfolios Sorted by 119 Anomalies - Full Sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	High-Low
	With or Without FIS Short-selling Fee Observations										
Return before Fee	1.0482	1.1241	1.1150	1.1120	1.1198	1.1485	1.1678	1.1970	1.2234	1.3222	0.2741***
t	(53.97)	(77.47)	(109.00)	(119.23)	(132.78)	(114.04)	(118.54)	(112.44)	(97.59)	(42.73)	(6.88)
Average Num of Stocks	245.95	179.08	162.42	157.82	154.57	155.37	155.05	161.98	175.81	244.65	
	With FIS Short-selling Fee Observations										
Return before Fee	1.3348	1.2739	1.2314	1.2097	1.2236	1.2399	1.2586	1.2968	1.3349	1.4772	0.1521***
t	(52.33)	(79.82)	(118.62)	(115.23)	(117.36)	(120.65)	(119.86)	(98.80)	(87.76)	(52.32)	(3.13)
Average Fee	0.1807	0.1167	0.1039	0.0985	0.0970	0.0971	0.0980	0.1029	0.1132	0.1670	-0.0137
t											(-1.46)
Return after Fee	1.5141	1.3864	1.2978	1.2787	1.2947	1.3135	1.3350	1.3733	1.4269	1.6031	0.0890
t	(45.67)	(70.91)	(106.19)	(99.52)	(104.95)	(106.90)	(106.90)	(88.29)	(77.59)	(46.31)	(1.65)
Average Num of Stocks	187.98	144.56	132.39	128.87	126.10	126.54	126.13	131.73	141.12	187.55	

Panel B: Decile Portfolios Sorted by 119 Anomalies – High-SSP Stocks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	High-Low
Return before Fee	1.4007	1.3033	1.2532	1.2336	1.2686	1.2718	1.2928	1.3283	1.3946	1.6044	0.2037***
t	(43.88)	(57.77)	(82.41)	(86.91)	(81.89)	(82.55)	(77.74)	(74.50)	(71.63)	(44.02)	(3.84)
Average Fee	0.1928	0.1240	0.1100	0.1042	0.1025	0.1022	0.1032	0.1083	0.1186	0.1754	-0.0174*
t											(-1.77)
Return after Fee	1.5958	1.4288	1.3284	1.3083	1.3433	1.3468	1.3666	1.4065	1.4797	1.7281	0.1324**
t	(49.03)	(67.35)	(95.72)	(100.04)	(93.72)	(93.64)	(88.84)	(83.87)	(80.22)	(50.76)	(2.35)
Average Num of Stocks	95.15	73.09	66.95	65.17	63.76	64.01	63.82	66.70	71.51	95.44	

Panel C: Decile Portfolios Sorted by 119 Anomalies – Low-SSP Stocks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	High-Low
Return before Fee	1.2617	1.2334	1.1971	1.1845	1.1836	1.2107	1.2374	1.2726	1.2937	1.3634	0.1017*
t	(45.46)	(73.00)	(88.58)	(84.64)	(82.37)	(91.08)	(95.17)	(80.41)	(68.09)	(28.12)	(1.73)
Average Fee	0.1685	0.1093	0.0977	0.0926	0.0914	0.0919	0.0927	0.0975	0.1077	0.1584	-0.0101
t											(-1.12)
Return after Fee	1.4314	1.3430	1.2664	1.2486	1.2463	1.2772	1.3035	1.3407	1.3743	1.4780	0.0466
t	(44.38)	(75.15)	(89.03)	(86.50)	(84.77)	(91.53)	(97.77)	(80.23)	(69.55)	(30.21)	(0.74)
Average Num of Stocks	94.66	72.59	66.46	64.67	63.27	63.51	63.35	66.18	71.00	94.95	

Table 9. The Role of SSP in Anomaly Performance: Robustness to Option-Implied Stock Lending Fees

This table empirically tests Hypotheses 3.1 and 3.2, using the option-implied stock lending fees. The first row of Panel A reports aggregate equal-weight returns for decile portfolios, where stocks are sorted by anomaly variables. This analysis contains a comprehensive set of 149 anomalies. Stock-level option-implied short-selling fees are estimated using discounted value of the spread between the ask price of puts and the bid price of calls, accounting for trading costs. Due to data limitations in options trading, the full sample in this analysis includes 149 anomalies. The row labeled *Average Option Implied Fee* reports the average short-selling fees across the aggregate decile portfolios. Panel B shows the aggregate return spread for portfolios that include only high-SSP stocks. Panel C shows results using low-SSP stocks only. Statistical significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

Panel A: Decile Portfolios Sorted by 149 Anomalies - Full Sample

	1 (Low)	2	3	4	5	6	7	8	9	10 (High)	High-Low
Return	0.8255	0.9191	0.8702	0.8509	0.8624	0.8586	0.8789	0.8646	0.8979	0.9749	0.1494***
t	(46.04)	(60.53)	(67.86)	(73.92)	(71.39)	(78.48)	(75.70)	(67.67)	(55.71)	(37.23)	(3.25)
Average Option	0.4568	0.3537	0.3171	0.3021	0.2962	0.2952	0.298	0.312	0.3388	0.4305	
Return after Fee	1.3224	1.2728	1.1873	1.153	1.1586	1.1538	1.1769	1.1766	1.2367	1.4054	0.0830*
t	(54.35)	(69.89)	(80.74)	(91.09)	(86.17)	(94.22)	(88.49)	(78.26)	(64.15)	(44.08)	(1.90)

Panel B: Decile Portfolios Sorted by 149 Anomalies – High SSP Stocks

	1 (Low)	2	3	4	5	6	7	8	9	10 (High)	High-Low
Average Option	0.4953	0.3801	0.3408	0.3227	0.316	0.3143	0.3187	0.3351	0.3651	0.4641	
Return after Fee	1.3914	1.325	1.2114	1.1919	1.1681	1.1881	1.2175	1.2104	1.2689	1.5066	0.1152**
t	(44.34)	(55.95)	(67.15)	(69.72)	(73.17)	(64.21)	(63.58)	(65.90)	(56.28)	(40.10)	(2.14)

Panel C: Decile Portfolios Sorted by 149 Anomalies – Low SSP Stocks

	1 (Low)	2	3	4	5	6	7	8	9	10 (High)	High-Low
Average Option	0.4200	0.3294	0.2971	0.2841	0.2785	0.2788	0.281	0.2923	0.3159	0.3996	
Return after Fee	1.2600	1.2215	1.1619	1.1414	1.1357	1.1379	1.1414	1.1414	1.1962	1.2686	0.0086
t	(50.71)	(63.12)	(78.01)	(58.70)	(79.44)	(81.32)	(67.47)	(59.98)	(54.93)	(45.70)	(0.22)

Table 10. Time-series Persistence of SSP Estimates: Bayesian Shrinkage Weights

This table describes summary statistics for the Bayesian shrinkage factor Weight. The reported statistics include statistical breakpoints, median values, mean values, standard deviations, skewness, kurtosis, and the number of observations. Stock-level SSP is estimated using the methodology detailed in Section 3.

	Bayesian Shrinkage Factor Weight
Min.	0.0138
1%	0.0645
5%	0.1910
Median	0.9603
95%	0.9989
99%	0.9998
Max.	0.9999
Mean	0.8251
Std. Dev.	0.2607
Skewness	-1.6320
Kurtosis	4.3100
Obs.	681,583

Table 11. SSP and Other Stock Lending Market Variables

This table examines the relationship between short-selling profitability (SSP) and stock-level variables in the stock lending market, excluding short-selling fees. The key variables of interest include the average tenure of stock loans, the lendable rate, and lender concentration. The rows labeled *Obs.* and *Adj. R-sq.* report the numbers of observations and adjusted R-squared values. Statistical significant levels at 1%, 5%, and 10% levels are denoted by ***, **, and *, respectively.

	(1)	(2)	(3)
	Average Tenure	Lendable Rate	Lender Concentration
SSP	-0.1136***	-0.0262***	0.0168***
	(-4.22)	(-6.76)	(2.98)
Beta	-0.0093	-0.0011*	-0.0096***
	(-1.46)	(-1.87)	(-11.81)
Size	-0.0643***	0.0139***	-0.0340***
	(-7.92)	(17.44)	(-43.41)
B/M	-0.0226***	0.0052***	0.0037***
	(-10.58)	(9.88)	(7.25)
Mom	-0.0015***	-0.0000***	0.0002***
	(-14.77)	(-3.06)	(9.77)
Disp	-0.0073**	-0.0066***	0.0010**
	(-2.05)	(-10.36)	(1.99)
Age	0.0080	0.0167***	0.0059***
	(1.61)	(13.06)	(9.32)
Illiq	-0.2181***	-0.0628***	0.0856***
	(-6.49)	(-7.14)	(6.53)
Obs.	193,897	193,930	193,930
Adj. R^2	0.0652	0.1570	0.2028

Table A1. Definitions of Variables

Variable	Definition
SSP	Short-selling profitability is defined as the coefficient for the lagged abnormal short interest ratio in Equation (2).
SIR	The short interest ratio, expressed as a percentage, is calculated as the number of shares held short divided by the total shares outstanding. The data is obtained from Compustat.
FIS fee	Short-selling fee at the individual security level is obtained from the FIS Securities Finance Market Data. It is calculated as the difference between the federal funds rate and the rebate rate paid on collateralized loans. We exclude a subset of cash-collateralized loans with fixed rates and durations, as these loans are less sensitive to market conditions. Instead, we focus on overnight cash-collateralized loans. Robustness checks confirm that our results remain consistent when including all cash-collateralized loans. Following Muravyev, Pearson, and Pollet (2024), we assume that short-sellers bear 100% of the short-selling fee when borrowing short-leg stocks, while long-leg investors receive 70% of the fee, reflecting the proportion of utilized stock loans.
DCBS	The Daily Cost of Borrowing Score (DCBS) is obtained from IHS Markit and ranges from 1 to 10, with higher values indicating greater borrowing costs. We calculate monthly short-selling fees as the mean of daily DCBS scores, requiring a minimum of four daily observations per month.
Option-implied fee	The option-implied short-selling fee is calculated as the difference between the synthetic stock price implied by options and the spot stock price, based on put-call parity.
Specialness	A stock is classified as 'special' if its monthly average DCBS score exceeds 4, in which case it is assigned a value of 1; otherwise, it is assigned a value of 0.
Market power	This measure is defined as the combined market share of the two largest stock lenders in the stock lending market.
ME	Firm size is defined as the market capitalization, calculated as the product of the stock price and the number of outstanding shares at the end of each month.
B/M	The book-to-market ratio is calculated as the book value of shareholders' equity at the end of the most recent June divided by the firm's current market capitalization.
Mom	Momentum is the cumulative return from month t-12 to t-2.
Disp	Investors' disagreement is measured as the standard deviation of financial analysts' forecast for one-year-ahead earnings per share.
IO	Institutional ownership is estimated as the number of shares held by institutional investors scaled by the total number of outstanding shares.
Illiq	Liquidity is measured using the Amihud illiquidity metric. (Amihud, 2002).

Variable	Definition
Idiovol	The realized idiosyncratic volatility is calculated following Ang, Hodrick, Xing, and Zhang (2006).
Max	Lottery demand is measured following Bali, Brown, Murray, and Tang (2017).
Coskewness	Coskewness risk is calculated following Ang, Chen, and Xing (2006).
Age	Firm age is measured following Barry and Brown (1984).
Beta	The market beta of an individual stock.
Utilization	The stock loan utilization rate is obtained from the IHS Markit dataset.
Tenure	The average tenure of stock loans is obtained from the IHS Markit dataset.
Lendable rate	The ratio of lendable shares to total shares outstanding is obtained from the IHS Markit dataset.
Lender concentration	The total market share of the two largest stock lenders for each stock is derived from the IHS Markit dataset.