Anomalies and Their Short-Sale Costs

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Abstract

Short-sale costs eliminate the abnormal returns on asset pricing anomaly portfolios. While many anomalies persist out-of-sample, they cannot be profitably exploited due to stock borrow fees. Using a comprehensive sample of 162 anomalies, the average long-short portfolio return is a significant 0.15% per month before short-sale costs, and the returns are due to the short leg. However, the average is −0.02% once returns are adjusted for borrow fees. The anomalies are not profitable even before accounting for fees if the high-fee observations, 12% of stock dates, are excluded from the analysis. Thus, short sale costs explain why many anomalies persist.

JEL Classification: G12, G13, G14

Keywords: anomalies, stock return predictability, stock borrow fee, stock lending fee, data mining

1. Introduction

The interpretation of apparent asset pricing anomalies has long been controversial. Fama (1991) suggested that much of the apparent return predictability documented in the asset pricing literature is due to data mining.[1] Recently, Harvey, Liu, and Zhu (2016), Linnainmaa and Roberts (2018), Green, Hand, and Zhang (2017), and Hou, Xue, and Zhang (2020) also question whether anomalies are "real." In contrast, McLean and Pontiff (2016), Jacobs and Müller (2020), and Jensen, Kelly, and Pedersen (2021) conclude that anomalies generate abnormal returns even post-publication. The latter findings are puzzling because many arbitrageurs have the knowledge, capital, and incentives to exploit anomalies.

If the anomalies are real, that is, if they generate apparent alpha both in-sample and out-of-sample, then there should be an important limit to arbitrage that prevents investors from exploiting them. We hypothesize that the stock borrow fees that short sellers must pay on the short side to execute the relevant strategy are a common limit to arbitrage for many seemingly unrelated anomalies. This trading cost provides a barrier to arbitrage that prevents sophisticated investors from exploiting the apparent mispricing.[2]

We begin our analysis by confirming that the average return on a large set of long-short anomaly portfolios is both economically and statistically significant in our sample. We start with the 202 "clear anomalies" identified by Chen and Zimmerman (2021) in their study reproducing many of the in-sample results in the anomalies literature. Then, we restrict our sample to the 162 anomalies out of the 202 for which we can form well-populated decile portfolios. Our analysis is largely out-of-sample due to the constraints imposed by borrow fee availability. The borrow fee is not available until July 2006, and 82.7% of the anomalies in our sample were identified using sample periods ending before 2006.[3] Thus, our results are not driven by potential data snooping that is likely to inflate the average in-sample anomaly return.

We use the anomaly signals to sort stocks into decile portfolios, where the signals are signed so that the average abnormal returns of portfolio one (ten) stocks should be negative

[1] Fama (1991, p. 1585) writes "With many clever researchers on both sides of the efficiency fence, rummaging for forecasting variables, we are sure to find instances of 'reliable' return predictability that are in fact spurious."
[2] This hypothesis does not explain why the mispricing occurs in the first place or why many investors do not simply liquidate long positions in stocks with high borrow costs.
[3] Even for anomalies identified more recently than the beginning of 2006, the borrow fee data are only available near the end of the sample period used in the original paper. For this subset of the anomalies, the median percentage of the sample period before 2006 is 88.0%.

(positive) based on the original paper that first described the anomaly. Initially, we use raw returns for each stock and month to compute the equal-weighted average monthly return for the ten decile portfolios for each anomaly. We calculate the cross-sectional average decile portfolio returns across the 162 anomalies in our sample.

For these 162 anomalies, the cross-sectional average portfolio one return is 0.80% per month and the average portfolio ten return is 0.96% per month. The return on the decile ten minus decile one long-short portfolio is 0.16% per month. While this estimate of the long-short portfolio return for the average anomaly is statistically significant, it is below the typical magnitude reported in the initial publication. This attenuation has been previously observed and discussed (for example, McLean and Pontiff (2016)).[4] Nevertheless, the average anomaly that remains is statistically significant and large enough to warrant further analysis.

With the exceptions of deciles one and two, the average returns on the decile portfolios are in the narrow range from 0.95% to 1.00% per month. This initial evidence suggests that the short side of these anomaly strategies is the likely source of the residual abnormal performance. We analyze the impact of short sale costs on anomaly portfolio returns in two ways.

First, we exclude stocks with high borrow fees (without resorting). A stock has a high borrow fee if the fee exceeds 1% per year at the end of the previous month. The observations with high borrow fees represent only about 12% of the stock-months. However, 22% of the monthly return observations for portfolio one have high borrow fees, so excluding the high-fee stocks has a greater impact on portfolio one performance compared to the other portfolios. When we exclude these observations, the average returns on all decile portfolios are in a narrow range from 1.03% to 1.09% per month. The average return on the 162 anomaly long-short portfolios is only 0.05% per month and is also statistically insignificant. Thus, the significant differential return on the long-short portfolio is due to the high-fee observations.

Second, stock borrow fees are paid by short sellers and received by long-side investors who lend their shares. Thus, they can be viewed as shadow dividends, which decrease the returns to short sellers and increase the returns to long-side investors. However, these dividends are not observed in the CRSP stock return data. Consequently, part of the stock return is usually ignored in the academic literature.

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[4] This attenuation has several potential explanations—we exclude micro-cap stocks, market efficiency may have improved since the original results were published, and the original estimates may reflect a bias towards publishing interesting results.

We adjust stock returns upwards to account for this missing shadow dividend, that is, we modify CRSP returns to reflect the borrow fee that short sellers pay and stock lenders receive. For portfolio one (which would be short sold), a short seller would pay the entire borrow fee. For portfolio ten (which would be held long), an institutional investor whose shares are borrowed would receive the borrow fee, less the intermediation spreads charged by prime brokers.[5] Accounting for the fee by adding it to the CRSP return increases the returns on all portfolios, but it increases returns more for portfolios containing high-fee stocks. The average return difference between portfolio ten and portfolio one completely disappears once we implement this adjustment for the borrow fee, becoming 1.02% − 1.03% = –0.01% per month.

In our main analyses, we examine abnormal returns computed using a characteristics-matched benchmark as in Daniels et al. (1997; DGTW). As in our analysis of raw returns, for each of the 162 anomalies we compute the equal-weighted average abnormal return on each decile portfolio.[6] Across the 162 anomalies, the average abnormal return of portfolio one is –0.24% per month and statistically significant, while the returns on the other nine portfolios are much closer to zero. The average abnormal return on the long-short portfolio is positive and highly significant, driven by the significant negative return on portfolio one.

We analyze the impact of short sale costs on anomaly profitability in the same two ways as in our analysis of raw returns. First, we exclude the relatively small number of stocks with high fees from the sorted portfolios (without resorting), and then recalculate portfolio returns. Omitting the high-fee stocks, the average abnormal return on portfolio one is almost exactly zero (0.2 bps per month). The average returns on portfolios two through ten are also small, between zero and four bps per month. The average abnormal return for the long-short portfolio is also close to zero (3.6 bps per month), and not significant. Thus, the average anomaly abnormal returns must be entirely due to the high-fee stocks.

Second, we retain the high-fee stocks in the sample but adjust the returns for the borrow fees. The fee adjustment changes the average abnormal return for portfolio one from a significant –0.24% per month to an insignificant –0.01% per month. The average abnormal return for the

[5] A long-side investor making shares available for lending would only receive the fee if her shares were actually borrowed. In Section 3.2 we describe the adjustment for portfolios that would be held long that takes account of both this complication and the intermediation spreads charged by prime brokers.
[6] We differ slightly from DGTW in that we compute the characteristics-matched benchmark returns excluding stocks with high borrow fees. This approach addresses the concern that the stocks with high borrow fees distort the performance of the benchmark portfolios.

long-short portfolio switches from a significantly positive estimate to a slightly negative estimate. Thus, the average anomaly cannot be profitably exploited by a hedge fund or other investor who must pay the borrow fees to short sell stocks.

Similar patterns hold for most individual anomalies. Consistent with the proposed mechanism, this adjustment profoundly impacts the short side of these strategies and feeds through the performance of the short side to eliminate the long-short abnormal performance of many anomalies. Thus, most anomalies cannot profitably be exploited by investors who must pay the borrow fees to short sell stocks. This finding is consistent with many anomalies being "real," that is, not simply a consequence of data snooping. It also explains why the performance may persist even in the presence of sophisticated investors.

Our results are robust to plausible variations in the analysis. We split the anomalies into three groups according to whether the anomaly signal is computed from accounting data, stock returns/price data, or other data, and obtain similar results in all three subsets. The results also hold in the subsample of anomalies for which the *t*-statistic in the original paper exceeded five, and in the subsample of anomalies for which the original paper was published in one of the top three finance journals.

We examine five well-known and highly cited anomalies in detail. These are the post-issuance IPO return (Ritter (1991)), share issuance (Fama and French (2008)), idiosyncratic volatility (Ang et al. (2006)), maximum return (Bali, Cakici, and Whitelaw (2011)), and share turnover volatility (Chordia, Subrahmanyam, and Anshuman (2001)). For all five, the average abnormal return for the portfolio to be shorted is negative and economically significant before adjusting for borrow fees. Despite the relatively short sample period, three of the five estimates are statistically significant at the 1% level, and the other two are significant at the 10% level. The long-short portfolio returns are economically substantial for all five anomalies. Once high-fee stocks are excluded from the short portfolios, the average abnormal returns for these portfolios are all near zero, and several flip sign to become positive. Similarly, the net-of-fee long-short portfolio return also is negative for three of the five anomalies, and near zero for the other two. For example, the long-short return of the idiosyncratic volatility strategy is 0.49% per month before fees and −0.03% per month net of fees. Our results change the interpretation of these anomalies because a common limit to arbitrage, namely the stock borrow fee, precludes investors from profiting from the apparent mispricing.[7]

The idea that short-sale costs are a limit to arbitrage that can potentially explain the persistence of mispricing is not novel (see, for example, Lee, Shleifer, and Thaler (1991)). More recently, Stambaugh, Yu, and Yuan (2012) provide evidence that the returns on the short legs of 11 long-short anomaly portfolios are greater when sentiment is high and suggest that short-sale costs allow this profitability to persist. Drechsler and Drechsler (2016) find that the net-of-fee returns on eight long-short anomaly portfolios are positive. They obtain this result using lender-side fees, which are less than the fees a typical short seller would pay. Ours is the first study that shows that the net-of-fee returns on anomaly portfolios are near zero and that excluding stocks with high borrow fees leads to similar performance. We find that the vast majority of anomalies with substantial out-of-sample performance cannot profitably be exploited by an investor who pays the borrow fees to short sell stocks.

A different limit to arbitrage, execution costs related to the bid-ask spread and price impact, has received attention (e.g., Novy-Marx and Velikov (2015) and Frazzini, Israel, and Moskowitz (2018)). The shorting costs that we focus on are distinct from these trade execution costs. A short seller must pay the borrow fee every day while holding a short position, regardless of position size. In contrast, execution costs are incurred only at the time of a trade, are non-linear in trade size, and depend on execution quality. These factors make it difficult to evaluate the effect of execution costs on anomalies, and lead to an active debate regarding their importance. We find that stock borrow fees by themselves prevent investors from exploiting the anomalies, and that trade execution costs are not needed to explain anomalies' persistence.

The remainder of the paper is as follows. Section 2 briefly surveys the literature. Section 3 describes the data and the anomaly sample selection. Section 4 presents the abnormal return results for the 162 anomalies. These include the net-of-fee abnormal returns for the full sample and the results for the low-fee sample. Section 5 examines several specific well-known anomalies, some of which are closely related to popular asset pricing factors. Section 6 presents the results for several subsets of the anomalies. Section 7 briefly concludes.

[7] Interestingly, we obtain this result for the idiosyncratic risk anomaly even though several papers state that idiosyncratic risk is a separate, important limit to arbitrage that interacts with shorting costs (e.g., Mitchell, Pulvino, and Stafford (2002), Pontiff (2006), and Stambaugh, Yu, Yuan (2015)). If idiosyncratic risk were a separate limit to arbitrage, then both the net-of-fee return and the return excluding high-fee stocks on this long-short strategy should be positive, but they are not.

2. Literature Review

There is an active debate about whether stock return anomalies are real. Recently, Harvey, Liu, and Zhu (2016; abstract) assert that "most claimed research findings in financial economics are likely false," while Linnainmaa and Roberts (2018; abstract) "show the majority of accounting-based return anomalies, including investment, are most likely an artifact of data snooping."[8] Green, Hand, and Zhang (2017; abstract) find that, "Outside of microcaps, the hedge returns to exploiting characteristics-based predictability also have been insignificantly different from zero since 2003." Hou, Xue, and Zhang (2020) claim that more than 60% of the results in the anomalies literature cannot even be reproduced in the original samples using conventional critical values once the contribution of microcap stocks is limited (Figure 2 Panel B, p. 2034).[9]

Other researchers reach different conclusions. McLean and Pontiff (2016) examine both out-of-sample and post-publication returns on long-short anomaly portfolios. While they find that the portfolios' out-of-sample and post-publication returns decrease compared to the corresponding in-sample counterparts, they reject the hypothesis that return predictability disappears out-of-sample. Jacobs and Müller (2020) find that anomalies remain strong post-publication in international equity markets and attribute it to mispricing rather than data mining. Chen (2020) adjusts for the selective reporting of anomalies and concludes that "at least 80% of published cross-sectional predictors are real." More recently, Jensen, Kelly, and Pedersen (2021) use a Bayesian statistical model and conclude that the literature's predictability results can be replicated in-sample and out-of-sample for most of the 153 characteristics they study.

We hypothesize that limits to arbitrage make it unprofitable for sophisticated investors to trade on anomaly signals. Of the possible limits to arbitrage, execution costs related to the bid-ask spread and price impact have received the most attention. Using TAQ data, Novy-Marx and Velikov (2015) show that the average trade execution costs of strategies to exploit anomaly returns range from 20 to 57 basis points for the mid-turnover anomalies. By contrast, Frazzini, Israel, and Moskowitz (2018) argue that institutional trading costs are much smaller than implied

[8] Related to this, Chordia, Goyal, and Saretto (2020) estimate that researchers who fail to account for multiple hypothesis testing will incorrectly reject the null hypothesis of zero abnormal returns in approximately 45% of the tests they conduct.

[9] However, Chen and Zimmerman (2021) find that "nearly 100% of the literature's predictability results can be reproduced, including the predictability results for 100% of the characteristics studied in Hou, Xue, and Zhang (2020)."

by the effective bid-ask spreads estimated using TAQ data. We show that short sale costs almost completely explain anomaly profitability even before execution costs are considered.

Our results are also related to the literature that examines whether institutional investors trade to exploit known asset pricing anomalies. Lewellen (2011) finds that the aggregate holdings of institutional investors show no discernible tilt to take advantage of characteristics known to predict stock returns. Edelen, Ince, and Kadlec (2016) find that institutional investors fail to tilt their portfolios to exploit anomalies, and even tend to buy stocks that would be considered overvalued based the anomalies literature. Our results that these anomaly portfolios do not provide superior net-of-fee returns may help explain why many sophisticated investors do not aggressively exploit anomalies.[10] These findings are also consistent with the recent poor performance of many hedge funds (Bollen, Joenväärä, and Kauppila (2021), Sullivan (2021)).

Only a few other studies address the impact of short sale costs on the returns to asset pricing anomalies. They generally find that the net-of-fee returns to anomaly portfolios are not close to zero. These seemingly contrary results should be discounted for at least two reasons. First, some studies that consider stock borrow fees examine the in-sample net-of-fee returns. The in-sample anomaly return reflects both the expected return and data-snooping biases. While borrow fees can explain the expected abnormal return on an anomaly portfolio, they cannot explain the data-snooping biases. Thus, even if borrow fees drive the apparent expected abnormal return on a long-short anomaly portfolio, they are unlikely to explain the in-sample average return. Second, the fees paid by ultimate borrowers such as hedge funds are typically less than the fees received by ultimate lenders due to prime broker markups, which D'Avolio (2002) estimates to be about 30% of the fee. To the extent that academic research uses the fees received by the ultimate lender rather than the fees that would be paid by the ultimate borrower the true cost to borrow stock is not fully reflected in abnormal return estimates.[11]

Drechsler and Drechsler (2016), Geczy, Musto, and Reed (2002), and Engelberg et al. (2020) are closely related papers that conclude that the net-of-fee returns on sets of long-short anomaly portfolios are positive, which differs from our conclusion. Using lender-side fees, Drechsler and Drechsler (2016) find that when stocks are sorted by fees the net-of-fee returns on

[10] However, both Lewellen (2011) and Edelen, Ince, and Kadlec (2016) interpret some of their results as inconsistent with the hypothesis that the institutions are rational but limited by frictions.

[11] For example, the borrow fee data used in D'Avolio (2002), Geczy, Musto, and Reed (2002), Jones and Lamont (2002), Mitchell, Pulvino, and Stafford (2002), Ofek, Richardson, and Whitelaw (2004), and Cohen, Diether, and Malloy (2007), and Drechsler and Drechsler (2016) appear to be measures of the fees received by stock lenders.

the long-short portfolio are positive, and that the net-of-fee returns of several other anomaly portfolios also are positive. Geczy, Musto, and Reed (2002) use lender-side fee data from a one-year period and find that the in-sample net-of-fee returns to shorting certain categories of stocks, including IPO stocks, are positive. Engelberg et al. (2020) reach their conclusion that the net-of-fee returns on anomaly portfolios are positive despite not having borrow fee data. Instead, they have Markit's Daily Cost of Borrow Score (DCBS), which is an ordinal measure ranging from one (low cost) to ten (high cost) computed by Markit.[12] The DCBS category is then mapped to an estimate of the average borrow fee by category from a short sample period of Markit data. In this approach, the average borrow fee in each DCBS category is not time-varying based on financial intermediation conditions. Moreover, the actual stock-specific borrow fee could be considerably different from average fee within the DCBS category.

Muravyev, Pearson, and Pollet (2022) differ from most other papers in that they conclude that the net-of-fee returns on three options-based anomalies are close to zero. While they use the same borrow fee data and the same approach as this paper, they consider only the three options-based anomalies to focus on the explicit link between the borrow fee and the computation of signals from options prices that directly incorporate this fee.

3. Anomalies and Data

This section describes how we identify and select the 162 anomalies, the stock borrow fee and other data we use, and the filters we apply in constructing the sample. We also present some summary statistics that describe the sample.

3.1 Anomalies

We rely on a comprehensive set of asset pricing anomalies that Chen and Zimmermann (2021) study in their replication of the anomalies' in-sample performance. Chen and Zimmermann (2021) closely replicate the predictors and confirm that almost all replicated signals remain significant predictors of returns in the samples used in the original papers that first described the anomalies. Conveniently, Chen and Zimmermann provide, for each stock and month, the signed signals of the 202 anomalies that remain significant. These monthly anomaly

[12] They convert each DCBS category to an estimate of the borrow fee using the mapping from DCBS to mean fee provided in Table III of Blocher and Whaley (2015) rather than using the stock-specific measure of the borrow fee from Markit. By excluding stocks with high borrow fees from the analysis in several of our specifications, we show that it is these stocks that are likely responsible for any apparent abnormal performance in these other papers.

signal data, which we downloaded from the authors' website, span the period from January 2000 to December 2020 and contain 1,960,237 stock-month observations.[13]

We restrict our sample to the 162 anomalies out of the 202 for which we can form well-populated decile portfolios. Specifically, each decile portfolio must contain at least 20 stocks on average. This filter drops primarily "discrete" anomalies as defined by Chen and Zimmermann (2021) (33 out of the 40 dropped), for which forming portfolios is problematic. Whether a stock paid a dividend is an example of a discrete anomaly. For the 162 anomalies that pass this screen, the bottom decile portfolio, portfolio one, contains 243 stocks on average, with the number of stocks varying from 24.3 to 404.2. As expected, some signals, such as return skewness, are almost always available, while other signals, such as R&D spending, are only available for about 10% of observations. Appendix A provides a complete list of the anomalies in the sample.

3.2 Stock borrow fees

A short seller must pay a borrow fee, also called a loan fee, for every day she borrows the shares she sells short. The fee is expressed as a percentage, so the total fee is proportional to the size of the position. A long-side investor who lends her shares receives the fee on the shares she lends, less the intermediation spread charged by prime brokers. Thus, the return earned by a short seller is equal to her before-fee stock return, less the borrow fee she pays. The return received by a long-side investor who lends her shares is equal to the before-fee return, plus the fee she receives after financial intermediation costs. In summary, the borrow fee is analogous to a dividend. But it is not reflected in the CRSP stock returns commonly used by academic researchers. A researcher who wants to determine the actual returns to short selling must adjust the CRSP stock returns to reflect the borrow fee.

Stock loans almost always cover only one overnight period, with the borrow fee potentially changing from day to day. Thus, a short seller typically cannot lock in the fee for a short sale that extends beyond one day. Rather, the short seller expects to pay the daily market-determined borrow fee for each day his or her short sale remains open, regardless of when the particular position was initially implemented. Importantly, a short seller is not able to ensure a low borrow fee for the life of a short position by establishing the short position before other market participants. Nonetheless, while market-determined borrow fees can change from day to

[13] The Chen and Zimmerman (2021) anomalies data are available at https://www.openassetpricing.com/. We downloaded the file signed_predictors_dl_wide.zip, which contained "202 predictive firm-level characteristics in wide format, signed so future mean returns increase in characteristics," and was last modified on 12/12/2021.

day, the time-series of the borrow fee for a typical stock is very persistent. The borrow fee today and the average borrow fee next month are 97% correlated on average.

We use borrow fees and other data about stock borrowing and lending from the Markit Securities Finance Buy Side Analytics Data Feed available from Markit, Ltd. This database includes daily data on securities borrowing and lending activity, including rebates and borrow (loan) fees, the quantity on loan, the number of loans, the numbers of active brokers and lending agents, and other data. Markit obtains the information from more than 100 equity loan market participants, including beneficial owners, hedge funds, investment banks, lending agents, and prime brokers, who together account for approximately 85% of US securities loans (Markit, 2012). Our sample begins in July 2006 because the data coverage expanded significantly around that time and the data are available at daily frequency beginning June 28, 2006.[14] Most of the stocks for which Markit provides the borrow fees have listed options and are routinely borrowed and sold short by options market makers executing delta hedge trades.

The market for borrowing stock is described by D'Avolio (2002) and Kolasinski, Reed, and Ringgenberg (2013). It includes three groups of participants: (i) lenders such as mutual funds, pension funds, and insurance companies, some of which lend through agent lenders (custodians), (ii) ultimate borrowers, for example, hedge funds, proprietary trading desks, and option market makers, and (iii) prime brokers. Typically hedge funds borrow the securities from their prime brokers, who in turn borrow from mutual funds, pension funds, and other ultimate lenders (Kolasinski, Reed, and Ringgenberg (2013), especially Figure 1). In this process the prime brokers "mark up" the fee, that is, they borrow from the original lender and then relend to the short seller at a higher fee.

The market structure in which prime brokers are typically the financial intermediaries implies that there are two fees, a buy-side fee paid by the ultimate borrower (for example, a hedge fund) and a lender-side fee received by the ultimate lender (for example, a mutual fund), which is lower than the buy-side fee. We use the variable "IndicativeFee," which is a buy-side fee. Specifically, it is Markit's estimate of the "The expected borrow cost, in fee terms, for a

[14] The borrow fees that we obtain from Markit are not usually quoted directly but are derived from the quoted rebate rates. The security borrower usually provides cash collateral to the security lender, and the security lender pays interest, the rebate rate, on the cash collateral it holds. The borrow fee is the difference between the market short-term interest rate and the rebate rate paid on the cash collateral. The rebate rate can be negative when securities are hard to borrow and the borrow fee is high. In rare cases, the borrow fee can also be negative, which occurs when the rebate rate that the security lender pays on cash collateral exceeds the short-term interest rate. During our data period Markit used the Federal Funds Open rate as the short-term interest rate in these calculations.

hedge fund on a given day," based on "both borrow costs between Agent Lenders and Prime Brokers as well as rates from hedge funds to produce an indication of the current market rate" (Markit 2012).[15] To evaluate the performance of trading strategies, it is important to use the borrow fee paid by a typical institutional investor reflecting the cost of financial intermediation rather than the fee received by institutions for lending shares to prime brokers. The borrow fee is typically small, most commonly 0.375% per year, but can occasionally exceed 100% per year.

Adjusting stock returns for the borrow fees is somewhat complicated because the fee received by the ultimate lender is less than the fee paid by the short seller. Thus, the fee-adjusted net return to a short seller is not the negative of the fee-adjusted net return received by a long-side investor. Also, not all shares that long-side investors make available for borrowing are actually borrowed by short sellers (and thus receive part of the fee). Thus, the long side only receives a fraction of the borrow fee.

We compute the net-of-fee returns to short and long-side investors as follows. First, for each stock and month, we compute the average borrow fee over the same period for which we compute returns. We convert this average fee, which is expressed on an annual basis, to a monthly fee, recognizing that the fee accrues every calendar day. When we evaluate the performance of the anomalies, stocks in the lowest decile portfolios, portfolio one, are sold short, and thus, short sellers must pay the entire fee. We use the same approach for the decile two stocks, which might also be sold short. We assume that stocks in the other eight deciles are purchased so that the long-side investor receives only part of the fee. This part is equal to the product of the proportion of all shares lent, that is the utilization rate, and the proportion of the fee passed along by intermediaries, typically 0.7 of the fee (D'Avolio, 2002). The other portion, 0.3 of the fee, is retained by the intermediaries.

3.3 Filters and Sample

Stock prices, returns, and dividend information (amounts and ex-dividend dates) are from the Center for Research in Securities Prices (CRSP) files, and we address delisting returns as in

[15] The full description of the data item is "The expected borrow cost, in fee terms, for a hedge fund on a given day. This is a derived rate using Data Explorers proprietary analytics and data set. The calculation uses both borrow costs between Agent Lenders and Prime Brokers as well as rates from hedge funds to produce an indication of the current market rate. It should not be assumed that the indicative rate is the actual rate a Prime Broker will quote or charge but rather an indication of the standard market cost" (Markit, 2012).

Shumway and Warther (1999). We limit the sample to common stocks (share codes 10 or 11 in CRSP), which is standard in asset pricing literature.

Because the borrow fee data are well populated starting from June 28, 2006, the performance evaluation period begins with July 2006, and the first anomaly signals we use are from the end of June 2006. December 2020, the last month for which we have the stock borrow fees, is the last month over which we evaluate performance. Thus, the performance evaluation period covers the 14 1/2 years running from July 2006 through December 2020. The latest anomaly signals we use are from the end of November 2020.

An anomaly signal observed at the end of a month can potentially use information up through the last day of the month. For some of the signals, including the options-based signals, it is important to skip a day between when signals are observed and the start of the return evaluation period to avoid spurious predictability that can occur when the returns are computed using the same month-end stock prices that enter into the signal. Thus, we compute signals using information available on the last day of each month, and then skip a day and compute monthly returns starting from the second trading day of the next month. Specifically, after skipping a day, we compound daily returns over the next 21 trading days, which typically corresponds to one calendar month. Daily returns are adjusted for delisting before compounding. Thus, the returns are not computed using the closing stock prices from the days when signals are observed, avoiding the potential for spurious return predictability.

We use the stock borrow fee data to compute stock returns adjusted for the fees. Thus, we need to aggregate the Markit data borrow fee data, which are at the stock-day level, to the stock-month level. We require that borrow fee is observed on at least four days for each stock and 21-day performance evaluation period. This requirement results in dropping only 1.6% of stock-months that appear in the Markit data. On average, the fee is observed on 19.8 days per month. Thus, this filter does not have an important impact on our results.

We merge the anomaly signals, borrow fee data, and CRSP stock return data. Once the common stock and sample period filters are applied, the anomaly signal dataset contains 692,466 stock-months. The borrow fee dataset contains 655,728 stock-months, which indicates that Markit provides comprehensive coverage of the stocks used in the anomaly universe. Specifically, borrow fee data are available for approximately 95% of the stock-month observations with anomaly signals. Only 9 observations are dropped when the two datasets are merged.

Anomalies are often concentrated in low-priced stocks, many of which are not readily tradable (Hou, Xue, and Zhang, 2020). Therefore, to distinguish the impact of borrow fees from the role of penny stocks, we drop stocks with a lagged stock price below one dollar or a lagged market capitalization below 50 million dollars. These two filters drop 25,706 and 67,381 stock-months, respectively. For robustness, we confirm that our main results hold if we retain the penny stocks in the sample. The final sample contains 562,632 stock-months for the 162 anomaly signals.

3.4 Summary statistics

Table 1 presents selected percentiles of the distributions and some other statistics for the stock-month observations in the dataset described in subsection 3.3. The unit of observation is a combination of a monthly stock return (specifically, the return from the close of day t +1 to the close of t + 22) with valid data from Markit and CRSP at date t at the end of each month.

The first row of Table 1 reveals that the mean borrow fee is 1.67% per year, and that this variable is positively skewed. The borrow fee is 0.25% at the first percentile, 0.38% at the 50th percentile, and then reaches 3% at the 90th percentile and 30% at the 99th percentile. Thus, the borrow fee can substantially impact the performance of a trading strategy if the strategy requires shorting stocks in the top fee decile.

We classify a stock as high-fee on date t if the borrow fee at t is greater than 1%. Approximately 12% of the observations in our sample are designated as high-fee. We also report information about utilization. The mean of utilization is 21.50% compared to a median of 9.32%, and the 90th and 99th percentiles are 50.71% and 90.09%, respectively. Note that the distribution of stock borrow fees and utilization have similarly right-skewed patterns. These two measures of activity in the market for borrowing stock are likely to be closely tied together.

4. Results for the 162 Anomalies

We begin by examining the 162 anomalies collectively. We first describe how we construct anomaly portfolios and compute abnormal returns. We then examine anomaly profitability for the sample that excludes high-fee stocks and fee-adjusted profitability for the full sample.

4.1 Portfolio methodology

We focus on the returns of sorted decile portfolios, which is standard in the anomaly literature. For each anomaly and month, we first sort stocks into decile portfolios based on the anomaly characteristic. Chen and Zimmermann (2021) sign the anomaly characteristics that we use so that, based on the original paper describing the anomaly, we expect to find negative abnormal returns on portfolio one and positive abnormal returns on portfolio ten. While we briefly analyze raw monthly returns without risk-adjustment to begin our analysis in Section 4.2, the subsequent analysis focuses on abnormal performance. Jensen, Kelly, and Pedersen (2021) emphasize the importance of studying risk-adjusted performance of stock anomalies (e.g., high beta stocks earn higher returns, but their alphas are negative). Consequently, for each stock and month, we compute abnormal returns using the characteristics-matching approach of Daniel, et al. (DGTW; 1997) in which we exclude high-fee stocks in computing the benchmark portfolio returns.[16] This modification of the DGTW characteristic-matching approach prevents the benchmark returns from being affected by the presence of high-fee stocks in the benchmark portfolios.[17] Since we focus on the short side of these anomalies, appropriate risk-adjustment on this side is particularly important.

We compound daily DGTW returns to provide the benchmark at the monthly level in the manner that matches the horizon of each stock's return. The abnormal return on stock *i* in month *t* is the difference between the return on stock *i* and the average value-weighted return on the matched benchmark portfolio during the same month. The abnormal return on a sorted decile portfolio in month *t* is then the cross-sectional average of the abnormal returns on the stocks held in the portfolio during the month.

Next, we compute the equal-weighted average abnormal returns of the various sorted portfolios. It is well known that anomalies are not profitable in the recent sample if returns are value weighted (Hou, Xue, and Zhang, 2020). On the other hand, Jensen, Kelly, and Pedersen (2021) criticize value weighting as introducing unnecessary noise and suggest that equal weighting while excluding low-cap stocks is a better approach. Given our exclusion of stocks

[16] We thank WRDS, and especially Rabih Moussawi and Gjergji Cici, for sharing the code that constructs the DGTW benchmarks. We modified the code to exclude stocks with high borrow fees from the benchmarks. This crucial step is much easier to implement for the DGTW benchmarks than for alternative approaches.

[17] Specifically, to compute the benchmark return for stock *i* in month *t*, we first exclude stocks with average month *t* borrow fees that exceed 1% per year. Using the remaining low-fee stocks, we follow DGTW and match each stock's return to the benchmark return for the same month on a portfolio of low-fee stocks with similar market capitalization, book-to-market value, and previous six-month return.

with low prices or low market capitalizations, our use of equal-weighted portfolio returns is consistent with the spirit of the suggestion from Jensen, Kelly, and Pedersen (2021).

The result is a set of ten decile portfolio average abnormal returns for each anomaly. Alternatively, for each decile, we have 162 average abnormal portfolio returns. For each anomaly, the average abnormal return on each sorted decile portfolio is the time-series average of the monthly portfolio abnormal returns over the sample period running from July 2006 through December 2020.

4.2 Initial analysis of raw returns

We begin by analyzing the average of the raw returns across anomalies for the sorted portfolios in Figure 1. The solid black line in this figure represents the cross-sectional average of the time-series averages of the monthly decile portfolio returns for each anomaly, before adjustment for the stock borrow fee. Without adjusting for borrow fees, the average return for portfolio one is 0.80% per month and the average return for portfolio ten is 0.96% per month. The average returns on portfolios three through ten range from 0.95% to 1.00% per month. Thus, the differential performance is largely associated with the relatively low average return for portfolio one, the short side of these anomaly strategies.

The dashed black line in Figure 1 reports the corresponding average returns for each decile portfolio while excluding stocks with high borrow fees, that is, excluding stocks with fees greater than or equal to 1% per year. The average return for each decile portfolio after excluding high-fee stocks ranges from 1.03% to 1.09% across these portfolios. The average return for portfolio one is 1.04% per month and is not at all distinct from the performance of the other portfolios, once the high-fee stocks have been excluded. Also, the solid gray line presents the corresponding decile returns after adjusting returns for borrow fees. Essentially, the returns are adjusted upwards for the missing shadow dividend, also known as the borrow fee, paid to short stocks in portfolios one and two, as well as the missing shadow dividend that would be received by stock lenders holding stocks in portfolios three through ten. Once this payment is incorporated, portfolios one and ten have virtually identical average returns of 1.03% and 1.02% per month, respectively.

Table 2 explores raw monthly returns in greater detail. Panel A displays the means of the time-series average (raw) returns on the decile one portfolio and the decile ten minus one long-short portfolio, including all stocks and without any adjustment for stock borrow fees. Panel B displays the means of the average returns after excluding the high-fee stocks, and Panel C presents the means of the net-of-fee average returns on the sorted portfolios.

The results in Panel A show that the means of the average raw return are positive and far from zero for all ten sets of decile portfolios, as expected. The mean of the average long-short portfolio returns is 0.16% per month, almost identical to the corresponding mean of the abnormal returns of 0.15% per month in Table 3 Panel A presented in the next subsection. The panel-adjusted *t*-statistic for the mean of the average returns on the long-short portfolios is 2.91, indicating that this mean is significantly different from zero at any conventional level of statistical significance.

The results in Panel B show that the means of the average returns are higher after excluding the high-fee stocks. This has a greater impact on the means of the returns on portfolio one than on portfolio ten. As a result, the mean of the average long-short portfolio returns displayed in Panel B is only 0.05% per month and is not statistically significant. This mean is only one basis point greater than the corresponding mean of 0.04% in Table 4 Panel A, which reports the corresponding results for abnormal returns. The statistically significant performance of the long-short portfolios shown in Table 2 Panel A is driven by the high-fee stocks.

The results in Panel C show that the means of the average fee-adjusted returns on the ten sets of portfolios also exceed the corresponding means displayed in Panel A because the fee adjustment involves adding the fees to portfolios held long. The fee adjustment disproportionately impacts the returns for portfolio one. The mean of the average returns for portfolio one increases by 0.23% per month, while the mean of the average returns for portfolio ten increases by only 0.06% per month. As a result, the mean of the long-short portfolio returns in Panel B is essentially zero after fee adjustment, −0.01% per month. This mean is very close to the corresponding mean of −0.02% per month in Table 5 Panel A for abnormal performance after fee adjustment.

Overall, these results show that the statistically significant mean return for the long-short portfolio in Table 2 Panel A is due to the high-fee stocks. This result is consistent with the hypothesis that a sophisticated investor that pays the stock borrow fee cannot profitably exploit the anomalies. The close similarity between the results for raw and abnormal returns shows that the results and conclusions are not driven by the choice of benchmark to use to compute the abnormal returns.

4.3 Abnormal returns including all stocks and without adjusting for stock borrow fees

We examine the distributions, across the 162 anomalies, of the time-series average portfolio abnormal returns. Figure 2 Panel A is a histogram that shows the cross-sectional distribution of the time-series average abnormal returns on the 162 decile one portfolios. Based on the original papers, we expect to find that the average abnormal returns on the decile one portfolios are generally negative, and they are. The average abnormal return is negative for 149 of the 162 decile one portfolios. Averaging across the 162 portfolios, the cross-sectional mean of the average decile one portfolio returns is –0.24% or –24 basis points per month. Below we discuss tabulated results and hypothesis tests that show that this cross-sectional mean return is significantly different from zero at conventional levels of statistical significance.

We next shift our focus away from decile one and consider, for the 162 anomalies, the distributions of the average abnormal returns on all decile portfolios. The ten bars shown in Figure 3 Panel A display the interquartile ranges of the distributions of the average abnormal returns on the ten sets of sorted portfolios. For example, the leftmost (and darkest) of the ten bars shows the interquartile range of the distribution of the average abnormal returns on the 162 decile one portfolios, while the rightmost (and lightest) of the ten bars displays the interquartile range of the distribution of the 162 decile ten portfolios. For each bar, the horizontal black line at the approximate middle of the bar indicates the median of the average abnormal returns on the corresponding 162 portfolios, while the black "×" indicates the cross-sectional mean of the time-series average portfolio abnormal returns.

One immediately apparent feature of Panel A is that the cross-sectional mean and median abnormal returns are negative for all ten sets of average portfolio abnormal returns. This occurs because high-fee stocks, which tend to have negative abnormal returns, appear in all decile portfolios but are not included in the benchmark returns. As a result, the cross-sectional means and medians of the average abnormal returns are negative. This result highlights the importance of excluding the high-fee stocks from the benchmarks. If we include high-fee stocks in the benchmark portfolios, then the distributions of the abnormal returns of the ten sets of portfolios would also be determined to a large extent by the average borrow fees of the stocks included in the benchmarks.

More importantly, Figure 3 Panel A also shows that the distribution of the average abnormal returns on the 162 decile one portfolios is quite different from the distributions of the average abnormal returns on the other nine sets of portfolios. In particular, the 25th percentile, median, 75th percentile, and mean of the average abnormal returns on the 162 decile one portfolios is each less than the corresponding statistic for the other nine sets of portfolios. As we show below, this occurs because the decile one portfolios usually have more high-fee stocks, and these stocks tend to have negative abnormal returns. The distribution of the average abnormal returns on the 162 decile two portfolios also appears to be shifted down relative to the distributions for deciles two through ten. This occurs because the decile two portfolios also tend to have more high-fee stocks than the decile three through ten portfolios.[18]

In Table 3, we report the detailed abnormal return results that are summarized in Figure 2 Panel A and Figure 3 Panel A. The first row of Panel A displays the cross-sectional means, across the 162 anomalies, of the time-series average abnormal portfolio returns on the ten decile portfolios. The first row also includes the cross-sectional mean of the 162 long-short portfolio average abnormal returns.

The second row displays *t*-statistics for tests of the hypotheses that the mean returns differ from zero. These *t*-statistics are computed using a panel regression in which the monthly portfolio abnormal return for each anomaly is regressed onto anomaly-by-decile fixed effects and the standard errors are double clustered by anomaly and month. The fixed effects estimate the average returns with the corresponding *t*-statistics. Clustering by month is particularly important because the returns are strongly correlated across anomalies as portfolio one contains many of the same high-fee stocks across many anomalies. This approach also captures any autocorrelation in anomaly returns. The third row shows naïve *t*-statistics computed from the cross-sectional standard deviations, across the 162 anomaly portfolios, of the time-series average portfolio abnormal returns. These naïve *t*-statistics assume that there is no cross-sectional correlation in the abnormal returns of the 162 decile portfolios. Because this assumption is almost certainly not satisfied, these *t*-statistics provide upper bounds on the range of *t*-statistics that might plausibly be computed based on different cross-correlation assumptions.

The fifth and sixth rows of Panel A display the average annual borrow fee in each of the decile portfolios and the average numbers of stocks in each of the decile portfolios, computed in the same way we compute the cross-sectional means of the average abnormal returns reported in

[18] The average abnormal returns at the other extreme, decile ten, also tend to be lower than the average abnormal returns of the decile three through nine portfolios. This occurs because the decile ten portfolios tend to contain more high-fee stocks than the decile three through nine portfolios.

the first row of Panel A.[19] The fourth row shows the average percentage of high-fee stocks; this is calculated from the ratio of the average number of stocks reported in the sixth row of this table and the corresponding row in Table 4 that excludes high-fee stocks from the analysis.

The results show that the decile one portfolios underperform the other portfolios. The cross-sectional mean of the average abnormal portfolio returns across the 162 decile one portfolios is −0.24% per month, with a panel-adjusted *t*-statistic of −2.94. The mean returns of the other portfolios are much closer to zero. For example, the mean average abnormal return of the 162 decile five portfolios is only −0.05% per month. The mean of the 162 long-short portfolio average abnormal returns is 0.15% per month, and is highly statistically significant (panel-adjusted *t*-statistic = 2.93). As emphasized in the discussion of Figure 3 Panel A, one can also see that the means are negative for all portfolios. This occurs because high-fee stocks appear in all portfolios, and high-fee stocks tend to have lower abnormal returns than the sample of low-fee stocks used to construct the benchmarks. In fact, all portfolios contain economically significant percentages of high-fee stocks. Across the ten deciles, the smallest mean percentage of high-fee stocks is 9.25%, and the smallest mean average borrow fee is 1.08% per year.

Foreshadowing the patterns we discuss below, the mean percentage of high-fee stocks in portfolio one is 21.32%, greater than for other decile portfolios. The mean borrow fee for portfolio one is 2.70% per year, also greater than for other deciles. Portfolios two and ten also contain relatively large mean percentages of high-fee stocks, 13.56% and 17.64%, respectively. The relatively high average percentage of high-fee stocks in the decile two portfolios should be unsurprising, given the high mean percentage of high-fee stocks in the decile one portfolios. The high mean percentage of high-fee stocks in portfolio ten is because this portfolio is constructed to include stocks with extreme anomaly signals. These stocks are more likely to have lower market capitalizations and higher volatility, which are related to higher borrow fees.[20]

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[19] For instance, for each anomaly, decile portfolio, and month, we compute average borrow fee of the stocks in the decile portfolio that month. Then, for each anomaly and portfolio, we compute the time-series averages of the average borrow fees. Finally, for each decile, we compute the cross-sectional means, across the 162 anomalies, of the time-series averages.

[20] In Appendix Table 2 we report abnormal return results when we sort the stocks into 30 portfolios. In this more refined sort, for each anomaly the first three portfolios 1–3 together comprise decile one, and the last three portfolios 28–30 together comprise decile ten. The results show that the returns are more extreme and the fees are larger in portfolio 1 as compared to portfolios 2 and 3. Similarly, portfolio 30 displays more extreme returns and higher fees as compared to portfolios 28 and 29.

Panel B displays percentiles that provide summary information about the distributions of the 162 average abnormal portfolio returns for each of the ten deciles. For portfolio one, the 75th percentile of the distribution of the 162 average abnormal returns is −0.11%, indicating that more than 75% of the decile one portfolios have negative average returns. The 95th percentile of the distribution is only 0.05%. The results also indicate that for portfolio one the distribution of the 162 anomaly returns is left-skewed. The median of −0.20% exceeds the mean of −0.24% reported in Panel A, and the minimum and 5th percentiles are further from the median than are the maximum and the 95th percentile. For the other nine decile portfolios, the distributions are generally slightly right-skewed. For decile ten, the distribution of the 162 returns is more disperse than for other portfolios, consistent with the previous observation that this portfolio tends to include a higher percentage of small stocks with more volatile returns.

4.4 Abnormal returns after excluding high-fee stocks

We explore whether the abnormal returns are due to stocks with high borrow fees. We do this by repeating the analyses of the abnormal returns on the sorted decile portfolios, after excluding the high-fee stocks from the decile portfolios (without resorting). Figure 2 Panel B shows the distribution of the average abnormal returns on the 162 decile one portfolios, after excluding the high-fee stocks. The histogram displayed in Figure 2 Panel B is strikingly different from that shown in Figure 2 Panel A. In Panel B only 75 of the 162 decile one portfolios have negative average abnormal returns, while in Panel A 149 of the 162 decile one portfolio average abnormal returns are negative. Across the 162 anomalies, the mean of the decile one average abnormal returns is 0.00% per month, and the median is 0.01% per month. These results excluding the high-fee stocks show that the poor performance of the decile one portfolios apparent in Figure 2 Panel A is due entirely to the high-fee stocks.

The difference in the performance of anomalies with and without high-fee stocks is also evident in the histogram of the abnormal returns on the decile ten minus decile one long-short portfolios across the 162 anomalies displayed in Figure 4. Before excluding high-fee stocks, 111 of the 162 long-short strategies in Figure 4 Panel A have positive abnormal returns. However, in Panel B we exclude stocks with high borrow fees, and the abnormal returns are positive for only 83 of the 162 long-short strategies. This shift in the histogram is less pronounced compared to Figure 2 because decile ten increases the volatility of the long-short strategy compared to the analysis of decile one by itself, but decile ten does not contribute substantially to the expected abnormal performance of these strategies in general. Regardless, after excluding high-fee stocks, the long-short performance of a randomly selected anomaly in our sample is almost equally likely to be positive or negative.

We next examine the distributions of the average abnormal returns on all ten sets of decile portfolios, excluding the high-fee stocks. For each of the ten sets of 162 decile portfolios, Figure 3 Panel B shows the interquartile ranges of the average abnormal returns on the 162 portfolios, after excluding the high-fee stocks. It shows that, for all ten deciles, the means and medians of the average abnormal returns on the 162 decile portfolios are all close to zero after excluding the high-fee stocks. The largest mean, which is for the decile ten portfolios, is only 0.04% per month. Even for this decile, the median of the 162 average abnormal returns is 0.00% per month. The median for decile ten is actually slightly lower than the median for decile one and decile two by 0.01% per month. The results show that the pattern of average abnormal returns evident in the pattern in Figure 3 Panel A is due to the high-fee stocks.

In Table 4 we report the detailed abnormal return results, excluding the high-fee stocks, that are summarized in Figure 2 Panel B and Figure 3 Panel B. The format of Table 4 Panel A follows that of Table 3 Panel A. The first row of Panel A displays the cross-sectional means, across the 162 anomalies, of the time-series average abnormal portfolio returns on the ten decile portfolios, excluding the high-fee stocks. It also includes the cross-sectional mean of the 162 decile ten minus decile one long-short portfolio average abnormal returns. The second and third rows show the panel-adjusted and naïve *t*-statistics, respectively. The fourth row reports the average numbers of stocks in the various decile portfolios, across the 162 anomalies.

Table 4 Panel B displays percentiles that provide summary information about the distributions of the 162 average abnormal portfolio returns for each of the ten deciles. All of the results in Table 4 are computed using the same approach used for the Table 3 results, except that after sorting we exclude the high-fee stocks before we compute the abnormal return for each anomaly, month, and decile portfolio.

The first row of Table 4 Panel A shows that, after excluding the high-fee stocks, the cross-sectional mean of the average abnormal returns of the 162 anomaly portfolios is close to zero for every decile. In particular, the mean of the average abnormal returns of the 162 decile one portfolios is 0.00%. The largest of the cross-sectional means, for the decile ten portfolio, is only 0.04%. The panel-adjusted *t*-statistic that takes account of the contemporaneous correlations among the returns of the 162 decile ten portfolios is only 0.97, indicating that the 0.04% mean of the average abnormal returns is not significantly different from zero at any conventional level of significance. The mean of the long-short portfolio average abnormal returns is also only 0.04% and also not significantly different from zero at conventional levels.

The earlier results including all stocks (in Figure 2 Panel A, Figure 3 Panel A, Figure 4 Panel A, and Table 3) provide evidence of substantially negative abnormal returns on the decile one portfolios and positive abnormal returns on the long-short portfolios. The results in Table 4 show that this evidence of abnormal performance is due entirely to the high-fee stocks. Once we exclude the high-fee stocks, the means of the 162 anomaly portfolio returns are close to zero for all ten deciles, and also for the long-short portfolios.[21] Thus, the results displayed in Table 4 confirm that the visual impression provided by comparing Figure 2 Panel B to Panel A, Figure 3 Panel B to Panel A, and Figure 4 Panel B to Panel A is not misleading.

Similar to Table 3 Panel B, Table 4 Panel B displays percentiles that provide summary information about the distributions of the 162 average portfolio abnormal returns for each of the ten deciles. The results displayed there are consistent with the results for the means of the average abnormal returns shown in the first row of Table 4, Panel A. The median of the distribution of the 162 decile one portfolio average abnormal returns is 0.01%. The medians are between −0.02% and 0.01% for the other nine decile portfolios, and the median of the distribution of decile ten minus decile one long-short portfolio returns is only 0.01%.

4.5 Abnormal returns net of stock borrow fees

We also consider whether an investor who pays the stock borrow fees to short sell stocks would be able to profitably exploit the anomalies. In this analysis we retain the high-fee stocks in the sorted portfolios but adjust the stock returns to reflect the stock borrow fees that would be paid by an investor who borrowed the decile one stocks and sold them short. An investor who wants to short sell the decile one portfolios to exploit the negative average abnormal returns would need to borrow the stocks and pay the stock borrow fees. His or her return would be the negative of the stock return, minus the borrow fee paid during the month. The adjusted return to the corresponding long position is the stock return, *plus* the borrow fee paid during the month.

[21] The results in Appendix Table 2 show that, when we sort the stocks into 30 portfolios and exclude the high-fee stocks, the average abnormal return on the first of the 30 portfolios is only −0.01% per month. Thus, once we drop the high-fee stocks there is no evidence of abnormal returns for even the most extreme of the 30 portfolios. The average abnormal return on the 30-minus-1 long-short portfolio is only 0.06% per month.

Thus, because we report the returns to long positions, when a stock is held in a decile one portfolio, we adjust the returns of stock *i* during month *t* for the stock borrow fees by adding the borrow fee on stock *i* in month *t* to stock *i*'s month *t* return. Because the stocks in the decile two portfolios might also be sold short, we compute the fee-adjusted returns of stocks held in the decile two portfolios in the same way.

Figure 2 Panel C displays a histogram that displays the distribution of the average fee-adjusted abnormal returns on the 162 decile one portfolios. The histogram in Panel C is strikingly different from that in Figure 2 Panel A—in Panel C only 79 of the 162 decile one portfolios have negative average abnormal returns. Taking the mean across the 162 portfolios, the mean decile one portfolio return is 0.01% per month, and the median return is 0.01% per month. These net-of-fee results show that the typical anomaly cannot profitably be exploited by short selling the decile one stocks. Once on takes account of the stock borrow fees that must be paid, the mean of the average fee-adjusted abnormal returns on the 162 decile one portfolios is close to zero, –0.01%.

Figure 3 Panel C presents the interquartile ranges of the distributions of average abnormal returns after adjusting for the stock borrow fees. The adjustment of the returns on the stocks in the decile three through ten portfolios differs from the adjustment of the returns of the stocks in the decile one and two portfolios. Based on the results in the original papers, and also those presented Figure 2 Panel A, Figure 3 Panel A, and Table 3, an investor who wanted to exploit the anomalies would sell short the decile one stocks. If an investor also wanted to trade the decile two stocks, he or she would also sell short those stocks. An investor who held the decile ten and/or nine stocks could make his or her shares available for lending, possibly receiving the borrow fee. We adjust the returns on the decile three through ten portfolios for the borrow fee as described in Section 3.2.

For each decile, Figure 3 Panel C shows the interquartile range of these average fee-adjusted abnormal returns on the 162 portfolios. The results displayed there indicate that the average anomaly cannot profitably be exploited. After the fee adjustment, the interquartile range of the returns on the 162 decile one portfolios is approximately centered on zero, extending from –0.08% per month to 0.09% per month, with a mean of –0.01% per month and a median of 0.01% per month. Turning to the decile two portfolios, which might also be sold short, one can see that the majority of the average fee-adjusted abnormal returns are actually positive. The interquartile range extends from –0.04% to 0.09% per month, and the mean and median of the returns on the 162 portfolios are both equal to 0.03% per month. Thus, the average anomaly cannot profitably be exploited by short selling the decile one and two portfolios.

The fee adjustment has relatively little impact on the returns on the decile three through ten portfolios, for three reasons. First, an investor who holds these stocks and makes them available for lending does not benefit from the full stock borrow fee, due to the intermediation spreads in the stock borrowing/lending market mentioned previously. Second, the probability that the stock is borrowed is equal to the utilization rate, which is less than 100%. Third, as we discuss below, there are fewer high-fee stocks in these portfolios.

In Table 5 we report the detailed results for the average net-of-fee abnormal returns on the ten sorted decile portfolios for the 162 anomalies, including all stocks. The computation of the net-of-fee abnormal returns is described above. The first row of Panel A reports the cross-sectional means of the average net-of-fee abnormal returns, across the 162 anomalies. The second and third rows report the panel-adjusted and naïve *t*-statistics, respectively. The fourth row reports the cross-sectional means, across the 162 anomalies, of the time-series average numbers of stocks in the decile portfolios. Panel B of Table 3 displays some percentiles that provide summary information about the distributions of the 162 average abnormal portfolio returns for each of the ten deciles.

The first row of Panel A shows that, for the first decile, the cross-sectional mean of the average net-of-fee abnormal returns of the 162 anomaly portfolios is close to zero, only –0.01%. The means for the other portfolios range from –0.04% to 0.03%. None of the panel-adjusted *t*-statistics that take account of the contemporaneous correlations among the returns on the decile portfolios indicate statistical significance at conventional levels, with the exception that the panel-adjusted *t*-statistic indicates that the mean of the decile four average fee-adjusted abnormal portfolio returns is significant at the 10% level (panel-adjusted *t*-statistic = –1.66). The mean of the long-short portfolio average net-of-fee abnormal portfolio returns is only –0.02%, with a panel-adjusted *t*-statistic of –0.49 and a naïve *t*-statistic of –1.09. [22]

[22] The results in Appendix Table 2 show that, when we sort the stocks into 30 portfolios, the average abnormal return after adjusting for the stock borrow fee on the 30-minus-1 long-short portfolio is only 0.02% per month. The average net-of-fee abnormal return on the first of the 30 portfolios is –0.07% per month.

Table 5 Panel B displays percentiles that summarize the distributions of the 162 portfolio returns for each of the ten deciles. The results displayed there are consistent with the results for the mean abnormal returns in the first row of Table 5, Panel A. The median of the distribution of the decile one average fee-adjusted portfolio abnormal returns is 0.01%. The medians are between −0.05% and 0.03% for the other nine decile portfolios, and the median of the distribution of the long-short portfolio returns is only −0.03%.

These results show that a hedge fund or other sophisticated investor that pays the stock borrow fee cannot profitably exploit these anomalies. After the fee adjustment, the interquartile range of the returns on the 162 decile one average fee-adjusted portfolio abnormal returns is approximately centered on zero, extending from −0.08% per month to 0.09% per month, with a median of 0.01% per month. The mean of the 162 decile one average fee-adjusted portfolio abnormal returns is only −0.01% per month. Turning to the decile two portfolios, which might also be sold short, one can see that the majority of the fee-adjusted returns are actually positive. The interquartile range extends from −0.04% to 0.09% per month, and the mean and median of the returns on the 162 portfolios are both equal to 0.03% per month. Thus, the average anomaly cannot profitably be exploited by short selling the decile one and two portfolios.

5. Returns on Several Specific Anomaly Portfolios

We examine in detail (a) the abnormal returns of five well-known anomalies, and (b) the returns on four long-short portfolios that are related to several of the apparently priced "factors" that appear in some linear factor models of asset returns. Of the four long-short portfolios related to apparently priced factors, the returns of two are completely or almost completely explained by stock borrow fees, one does not garner a risk premium in our sample period, and a significant fraction of the returns of the fourth is explained by stock borrow fees. As a placebo test, we also consider two long-short portfolios related to theoretically well-grounded asset pricing factors. The returns of these two long-short portfolios are not explained by stock borrow fees.

5.1 Abnormal returns of five well-known anomalies

The five well-known anomalies we consider are the post-issuance IPO return anomaly documented by Ritter (1991), the share issuance anomaly described by Fama and French (2008), the idiosyncratic volatility (IVOL) anomaly first studied by Ang et al. (2006), the maximum return anomaly described by Bali, Cakici, and Whitelaw (2011), and the share turnover volatility anomaly described by Chordia, Subrahmanyam, and Anshuman (2001).[23]

In Table 6 we report the results for the five anomalies. Panel A displays the average abnormal returns on the long-short portfolios, including all stocks and without any adjustment for borrow fees. In contrast to Panels A of Tables 2−4 which provided the mean of the time-series abnormal returns across 162 anomalies, each of the average abnormal returns reported in Table 6 is for either a single decile one portfolio or a single decile ten minus decile one long-short portfolio.

For all five anomalies, the point estimates of the abnormal return on the decile one portfolio are negative and large in magnitude, ranging from −0.40% per month (12 × (−0.40%) = −4.80% per year) to −0.80% per month (12 × (−0.80%) = −9.60% per year). The point estimates of the abnormal returns on the long-short portfolios range from 0.33% per month (12 × 0.33% = 3.96% per year) to 0.69% per month (12 × 0.69% = 11.52% per year). Some, but not all, of these average abnormal returns are significantly different from zero at conventional levels. Except for the post-issuance IPO return anomaly documented by Ritter (1991), our 2006−2020 sample period is shorter than the sample periods used in the original papers, which at least partly explains the lack of statistical significance. For the post-issuance IPO return anomaly, which is the anomaly for which the *t*-statistic for the long-short portfolio abnormal returns is smallest, the average number of stocks in portfolio one is only 35, which likely contributes to the lack of statistical significance.

Panel A also shows that large percentages of the stocks in the decile one portfolios have high borrow fees. For example, for the IPO post-issuance and share turnover anomalies, on average 56.17% and 57.45% of the stocks in the decile one portfolio have high fees. Even for the share issuance anomaly, which has the smallest percentage of high-fee stocks in the decile one portfolio, the average percentage of high-fee stocks in the decile one portfolio is 27.20%. The average stock borrow fee (including the low-fee stocks) for the stocks in the decile one portfolios are also high, ranging from 3.76% per year for the share issuance anomaly to 10.01% per year

[23] The bid-ask spread anomaly described by Amihud and Mendelson (1986) is possibly better known than several of the five anomalies we consider. We do not examine it in detail because it does not replicate in our 2006–2020 sample. Based on the original paper, one would expect that illiquid stocks (with large bid-ask spreads) earn higher average returns, but instead they earn lower returns. The average abnormal returns on the decile one, ten, and ten-minus-one portfolios are 0.01% per month (*t*-statistic 0.04), –0.68% per month (*t*-statistic –2.95), and –0.68% per month (*t*-statistic –2.09), respectively.

for the share turnover volatility anomaly. These results for the percentages of high-fee stocks in the decile one portfolios and the average stock borrow fees suggest that the abnormal returns for decile one are due to the high-fee stocks.[24]

This is confirmed by the results in Panel B, which displays the abnormal returns after excluding the high-fee stocks. Excluding the high-fee stocks, the average abnormal returns on the decile one portfolios are all small, ranging from –0.08% (*t*-statistic –0.30) for the share turnover anomaly to 0.10% (*t*-statistic 0.57) for the maximum return anomaly. The long-short portfolio abnormal returns are negative for three of the five anomalies, being –0.11% per month (*t*-statistic –0.23), –0.10% per month (*t*-statistic –0.34), and –0.14% per month (*t*-statistic –0.48) for the IPO post-issuance, idiosyncratic risk, and maximum return anomalies, respectively. For the two anomalies with positive long-short portfolio returns, share issuance and turnover volatility, the average abnormal returns are both only 0.04% per month. These results show that any anomaly portfolio returns that are distant from zero in Panel A are due to the high-fee stocks.

In Panel C we report the results for net-of-fee abnormal returns on anomaly portfolios. These results show that none of these five anomalies can reliably be exploited by an investor who pays the stock borrow fees to short sell the stocks in the decile one portfolios. The decile one portfolio abnormal return that is largest in magnitude (IPO post-issuance) is only –0.21% and is not statistically significant (*t*-statistic –0.63). The other four decile one abnormal returns are all small, ranging from –0.08% per month (*t*-statistic –0.60) for the share issuance anomaly to 0.05% (*t*-statistic 0.17) for the share issuance anomaly. The average long-short portfolio average abnormal return that is largest in magnitude (share turnover) is only –0.15% per month (*t*-statistic –0.36). The long-short portfolio returns for the other four anomalies are all small, ranging from –0.06% per month (*t*-statistic –0.20) for the skewness anomaly to 0.06% per month (*t*-statistic 0.37) for the share issuance anomaly.

5.2 Returns on four long-short portfolios related to asset pricing factors

The returns on some long-short portfolios, such as those based on momentum or profitability, can be interpreted either as anomalies or as priced "factors" that appear in some

[24] Stambaugh, Yu and Yuan (2015) conclude that the idiosyncratic volatility (IVOL) anomaly is at least partly due to short-sale costs because the IVOL-return relation is stronger among overpriced stocks than among underpriced stocks. This is especially true for small stocks, which are more frequently hard-to-borrow. However, Stambaugh, Yu, and Yuan (2015) do not have stock borrow fee data and thus are unable to perform the analyses that we carry out.

linear factor models of returns. For example, Carhart (1997) introduces a momentum factor, while Novy-Marx (2013) proposes a profitability factor. Our finding that short-sale costs explain the returns of many anomaly portfolios then raises the question: Are the returns on some of the long-short factor portfolios explained by short-sale costs? We explore this question by examining the raw returns of several long-short portfolios that are related to widely used asset pricing factors. The asset pricing literature on linear factor models constructs the factor returns without first adjusting the returns of the stocks that comprise the factor portfolios, that is it uses raw stock returns. Thus, different from most of the other analyses, we use raw rather than abnormal returns in this exercise because we want to examine whether the factors, as typically constructed, are impacted by stock borrow fees.

We focus on the returns of four factor-related portfolios that are based on momentum (Carhart (1997)), profitability (Novy-Marx (2013)), book-to-market (Rosenberg, Reid, and Lanstein (1985) and Fama and French (1993)), and investment (Lyandres, Sun and Zhang (2008)).[25] To be consistent with the remainder of this paper, we compute the average returns of the decile ten-minus-one long-short portfolios, rather than use the specific portfolio construction approaches in the papers that originally proposed each of these factors.

We report the results of the analysis in Table 7. Panel A displays the average monthly returns on the long-short portfolio for each of the four factors, including all stocks and not adjusting the returns for stock borrow fees. Panel A also includes the average returns on the decile one and ten portfolios, which would be sold short and held long, respectively, based on the results in the original papers. In Panel B we report the average returns after excluding the high-fee stocks from the portfolios, while in Panel C we report the net-of-fee average returns on the portfolios. The results for momentum are in the left-hand part of the table, followed by the results for profitability, book-to-market, and finally net investment on the right-hand side. Taking account of stock borrow fees has a large impact on the decile one and decile ten-minus-one portfolio returns for all four factors.

5.2.1 Portfolios sorted by momentum and profitability

The results in Panel A show that the momentum and profitability long-short portfolios provide positive returns in our sample, with average returns of 0.21% and 0.62% per month,

[25] Rosenberg, Reid, and Lanstein (1985) interpret the superior performance of value stocks as evidence of market inefficiency, while Fama and French (1993) interpret the same phenomenon as a priced market factor.

respectively. While the *t*-statistics are only 0.46 and 1.79, respectively, this lack of significant is almost certainly at least partly due to the fact that our sample period is considerably shorter than the sample periods used in the original papers that proposed the momentum and profitability factors. Regardless, the lack of significance of some of the point estimates does not prevent us from exploring the extent to which the average returns are affected by short-sale costs.

Panel A also reports the average percentages of high-fee stocks in the decile one and decile ten portfolios, as well as the average fees of the stocks in the portfolios, averaged across both high and low-fee stocks. The results for the percentages of high-fee stocks and the average fees suggest that the positive returns of the long-short portfolios are due to the high-fee stocks. For example, when stocks are sorted by profitability, 44.83% of the decile one stocks have high borrow fees, while only 10.83% of the decile ten stocks have high fees. The average borrow fee in decile one is 5.53% per year, or about 0.46% per month, while the average borrow fee in decile ten is only 1.38% per year, which is less than 0.12% per month.

Panel B displays the estimates of average returns after excluding the high-fee stocks from the portfolios. Excluding the high-fee stocks has a large impact on the returns on the long-short portfolios sorted by momentum or profitability. The returns on the long-short momentum and profitability portfolios fall from 0.21% to 0.02% per month and from 0.62% to 0.10% per month, respectively. Thus, the results show that high-fee stocks account for the bulk of the returns on the momentum and profitability strategies.

In Panel C, we report the net-of-fee average returns on the portfolios. The net-of-fee returns on the long-short momentum and profitability portfolios are –0.01% per month and 0.19% per month respectively, much smaller than the unadjusted long-short portfolio returns of 0.21% and 0.62% reported in Panel A. While the 0.19% per month fee-adjusted return on the long-short profitability portfolio is not close to zero—it annualizes to approximately 12 × 0.19% = 2.26% per year—it is only 0.19%/0.62% = 30.47% of the magnitude of the unadjusted return of 0.62% per month. Thus, these results show taking account of stock borrow fees eliminates most of the returns on the long-short momentum and profitability portfolios.

5.2.2 Portfolios sorted by book-to-market

The results when we use book-to-market to sort stocks into decile portfolios are quite different from those when we sort using momentum or profitability. In our sample period, book-to-market is not associated with a return premium. The results in Table 7 Panel A show that the return on the long-short book-to-market portfolio is very slightly negative in our sample, being −0.02% per month. The results in Panels B and C show that excluding the high-fee stocks or adjusting the stock returns for stock borrow fees reduces the long-short portfolios returns further to −0.22% or −0.23% per month, respectively. Thus, while taking account of stock borrow fees has a significant impact on the returns, it does not eliminate the book-to-market premium because there is not a book-to-market premium during our sample period.

5.2.3 Portfolios sorted by investment

The results when we sort by investment also differ from those when we sort by the other characteristics. The results in Panel A show that when we sort by investment, the average return on the long-short decile portfolio is large, 0.47% per month. This result is similar to the results for the momentum and profitability-sorted portfolios, though when sorting by net investment the average return is significant at conventional levels, as the *t*-statistic is 2.21. But different from the results when stocks are sorted by momentum or profitability, less than half of the 0.47% per month return is due to the high-fee stocks. The results in Table 7 Panel B show that, when we exclude the high-fee stocks from the portfolio, the average long-short portfolio return is 0.27% per month; thus, 57% (= 0.27%/0.47%) of the return remains after high-fee stocks are excluded. Similarly, the results in Panel C show that the fee-adjusted return on the long-short portfolio is 0.30% per month, which is 64% (= 0.30%/0.47%) of the corresponding unadjusted return reported in Panel A. Thus, while either excluding high-fee stocks or adjusting returns for borrow fees reduces the average long-short portfolio returns on the investment strategy, these modifications do not eliminate the performance of this strategy completely.

5.3 Portfolios related to the CAPM

As a placebo test, we also consider the returns on two sets of portfolios related to asset pricing factors that are grounded in traditional theory. The first set of portfolios involves sorting using the Capital Asset Pricing Model (CAPM) beta, where portfolios one and ten contain low and high-beta stocks, respectively. The long-short portfolio is long high-beta stocks and short low-beta stocks. This is the single most theoretically well-grounded asset pricing factor, and so, the stock borrow fee should be largely unrelated to any differential performance across portfolios. The second set of portfolios is constructed using the tail risk beta proposed by Kelly and Jiang (2014); the long-short portfolio is long stocks with high tail risk beta and short stocks with low tail risk beta. While not as prominent as the CAPM beta, the relevance of higher order moments from a utility perspective provides a plausible motivation for this signal to be a measure of risk rather than a potential mispricing anomaly.

We report the results for these two sets of portfolios in Table 8. Similar to the analysis of the four sets of portfolios for which we report returns in Table 7, we examine the raw returns rather than the abnormal returns on the portfolios. As in the previous tables, the three panels display the average returns based on the full sample without any fee adjustment, the average returns after excluding high-fee stocks, and the average net-of-fee returns.

The left-hand part of Table 8 displays the results for the decile one portfolio, the decile ten portfolio, and the long-short portfolio when we stock stocks by the CAPM beta. During our sample period, the average returns on the decile one (low beta) portfolio, decile ten (high beta), and long-short portfolios are 0.55%, 1.04%, and 0.49% per month, respectively. Excluding high-fee stocks, the average returns are 0.69%, 1.30%, and 0.60% per month, respectively. Thus, excluding high-fee stocks increases the average long-short portfolio return by 0.11% per month instead of decreasing it. The average net-of-fee returns on the decile one portfolio, the decile ten portfolio, and the long-short portfolio are 0.71%, 1.16%, and 0.45% per month, respectively. Adjusting the returns for the borrow fees increases the average return on the decile one portfolio by only 0.06% per month and reduces the average return on the long-short portfolio by only 0.04% per month. Thus, excluding high-fee stocks and computing net-of-fee returns has only a modest impact on the returns of portfolios sorted by the CAPM beta, and leaves any qualitative interpretation related to this measure of systematic risk unchanged.

The right-hand side of Table 8 displays the average returns of the portfolios sorted by tail risk beta. The average returns on the decile one (low beta) portfolio, decile ten (high beta), and long-short portfolios are 0.71%, 1.19%, and 0.48% per month, respectively. Excluding high-fee stocks, the average return on the decile one portfolio increases slightly to 0.82% per month, the decile ten return increases to 1.29% per month, and the average return on the long-short portfolio remains 0.48% per month. The net-of-fee returns on the decile one portfolio and the decile long-short portfolio are 0.85%, 1.27%, and 0.42% per month, respectively. Thus, adjusting the returns for the borrow fees reduces the average return on the long-short portfolio by only 0.06% per month. Similar to the corresponding results for portfolios sorted by the CAPM beta, the exclusion of high-fee stocks and accounting for borrow fees by computing net-of-fee returns has little impact on the returns of the tail risk beta long-short portfolio.

These patterns for CAPM beta and tail risk beta indicate that stock borrow fees do not provide an explanation for any observable differences in average returns that are closely related to theoretically well-grounded measures of systematic risk.

6. Results for Groups of Anomalies

Next, we analyze whether the main findings hold in several additional subsets of the anomalies. The results show that an investor who pays the borrow fee cannot profitably exploit the anomalies in any of the subsets we consider.

6.1 Accounting, Price, and Other Anomalies

We partition the 162 anomalies into 82 accounting anomalies, 45 price anomalies, and 35 other anomalies. The accounting and price anomalies are those that Chen and Zimmerman (2021) identify as "Accounting" and "Price." The Accounting anomalies consist of those for which the sorting variable is computed from financial statement data. The Price anomalies consist of those for which the sorting variable is constructed from returns, or, in a few cases, dividend yields, earnings-to-price ratios, or market leverage. Our "Other" category includes the anomalies that Chen and Zimmerman (2021) label as "13F," "Analyst," "Event," "Options," "Trading," and "Other." We group these categories together because the small number of anomalies in some of these categories would severely limit the power of our statistical tests if we examined the categories separately.

For each category, we sort the stocks into decile portfolios, as before, and examine the distributions of the average abnormal returns of the decile-sorted portfolios. Panels A to C of Table 9 report the results (a) including all stocks without adjusting the returns for the borrow fees, (b) after excluding the high-fee stocks, and (c) including all stocks and adjusting the returns for the borrow fee.

For all three groups, the unadjusted abnormal return results displayed in Panel A are consistent with the corresponding results for the full sample shown in Table 3. The means of the average abnormal returns on the decile one portfolios in the Accounting, Price, and Other anomalies are –0.20%, –0.25%, and –0.29% per month, respectively, similar to the corresponding return for the full sample of –0.24% per month shown in Table 3 Panel A. Both the unadjusted and panel-adjusted *t*-statistics we report in Panel A indicate that the three abnormal performance estimates are statistically significant at conventional levels. Following a similar pattern, the means of the average abnormal returns on the long-short decile portfolios are 0.16%, 0.15%, and 0.12% per month, near the corresponding full-sample estimate of 0.15% displayed in Table 3. Both the panel-adjusted and naïve *t*-statistics indicate that these long-short returns are also significantly different from zero at conventional levels.

Panel B reports the mean average abnormal returns after excluding the high-fee stocks from the sorted decile portfolios. The means of the average abnormal returns on the long-short portfolio are small and insignificant for all three subsets of anomalies, ranging from 0.02% to 0.05% per month. The means of the average abnormal returns of the decile one portfolios are also small, ranging from –0.06 to 0.03% per month. None of these means is significant based on the panel-adjusted *t*-statistics.

In Panel C we report the results for the cross-sectional means of the average net-of-fee abnormal returns. Similar to the Panel B results, the means of the average abnormal returns on the long-short portfolios are small and insignificant for all three groups, ranging from –0.07% to 0.00% per month. Turning to the means of the average decile one portfolio abnormal returns, the largest is only –0.07%, which is not significant based on the panel-adjusted *t*-statistic of –0.69. These results are consistent with the hypothesis that the abnormal performance evident in the Panel A results for each subsample is due to the high-fee stocks and cannot be exploited by an investor who pays the stock borrow fees to short-sell stocks.

6.2 Additional subsets of anomalies

In Table 10 we report the means of the average portfolio abnormal returns for three other subsets of the anomalies. The first subset consists of the anomalies for which the sample used in the paper that originally identified the anomaly ended before 2006. For this subset, our analysis is fully out-of-sample, as our sample begins in July 2006. The second subset consists of the anomalies for which the *t*-statistic for the average anomaly return in Chen and Zimmerman's (2021) in-sample replication of the anomalies exceeds 5.0. These are the anomalies for which the statistical evidence is strongest. The third subset consists of the anomalies for which the original papers were published in the *Journal of Finance* (*JF*), *Journal of Financial Economics* (*JFE*), or *Review of Financial Studies* (*RFS*). One might conjecture that such anomalies are more likely to be important and/or robust.

The format of Table 10 is identical to that of Table 9. Panel A displays the means of the average abnormal returns including all stocks with any adjustment for stock borrow fees, Panel B displays the results after excluding the high-fee stocks from the sorted portfolios, and Panel C displays the average net-of-fee abnormal returns.

The results presented in Panel A describe abnormal returns for all three subsets of anomalies. The means of the average abnormal returns on the decile one portfolios range from –0.28% to –0.23% per month, with panel-adjusted *t*-statistics ranging from –2.71 to –3.33. The average abnormal returns on the long-short portfolios range from 0.12% to 0.19% per month, with panel-adjusted *t*-statistics between 2.15 to 2.99. For the pre-2006 subsample of anomalies, the average long-short portfolio abnormal return of 0.12% per month is slightly smaller than the full-sample long-short portfolio abnormal return of 0.15% per month displayed in Table 3 Panel A. For the other two subsamples, the average long-short portfolio abnormal returns of 0.18% and 0.19% per month are slightly larger than the full-sample long-short portfolio abnormal return of 0.15% per month, consistent with these subsamples containing the stronger anomalies.

After excluding the high-fee stocks from the sorted portfolios (Panel B), the means of the abnormal returns on the decile ten portfolios are essentially zero, ranging from –0.02% to 0.01% per month. The average abnormal returns of the long-short portfolios are also small, ranging from 0.01% to 0.07% per month. All three of these mean average abnormal returns are insignificant based on the panel-adjusted *t*-statistics. The naïve *t*-statistic for the abnormal long-short portfolio return in the *JF*, *JFE*, and *RFS* subsample, which almost certainly overstates the statistical significance of the mean, is only 2.28.

The means of the average net-of-fee abnormal returns displayed in Panel C range from –0.06% to 0.00% per month. All are insignificant based on the panel-adjusted *t*-statistics, and the largest of the naïve *t*-statistics is –1.98. The means of the average abnormal returns on the long-short portfolio are also small, ranging from –0.05% to 0.04% per month. While the average abnormal return of –0.05% per month is significant based on the naïve *t*-statistic of –2.07, this overstates the statistical significance of the result. This result provides no evidence that the mean of the average abnormal long-short portfolio returns is positive.

The results for these portfolio subsets further confirm that abnormal anomaly returns are due to the high-fee stocks and cannot be exploited by an investor who must pay the borrow fee to short-sell stocks. Publishing the findings regarding an anomaly in a leading finance journal seems no different in the context of short sale costs as a common limit to arbitrage.

7. Conclusion

The stock borrow fee is a common limit to arbitrage that appears to explain the continued presence of many cross-sectional asset pricing anomalies. Using a sample of 162 anomalies, we find that the average long-short abnormal performance of these anomalies is 0.15% per month, before accounting for stock borrow fees. After adjusting portfolio returns to reflect stock borrow fees, average performance is near zero and flips sign to –0.02% per month. In addition, if the stocks with high borrow fees are removed from the analysis, there is a similar absence of abnormal performance before adjusting for stock borrow fees. Thus, high borrow fees explain why so many of these anomalies continue to exist to some extent despite efforts by sophisticated investors to exploit them.

This paper is the first analysis that shows that the net-of-fee returns on so many anomaly portfolios are near zero after adjusting performance for the stock borrow fee, and that excluding stocks with high borrow fees leads to a similar absence of substantial outperformance. Our findings indicate that most anomalies with significant out-of-sample performance are not exploitable by investors paying the stock borrow fees to short sell stocks. The remaining puzzle is not about the behavior of sophisticated investors, because the stock borrow fee prevents these investors from correcting the residual mispricing. Instead, to understand the underlying market inefficiency we must turn to the multitude of uninformed investors that choose not to liquidate their long positions in assets with high borrowing costs.

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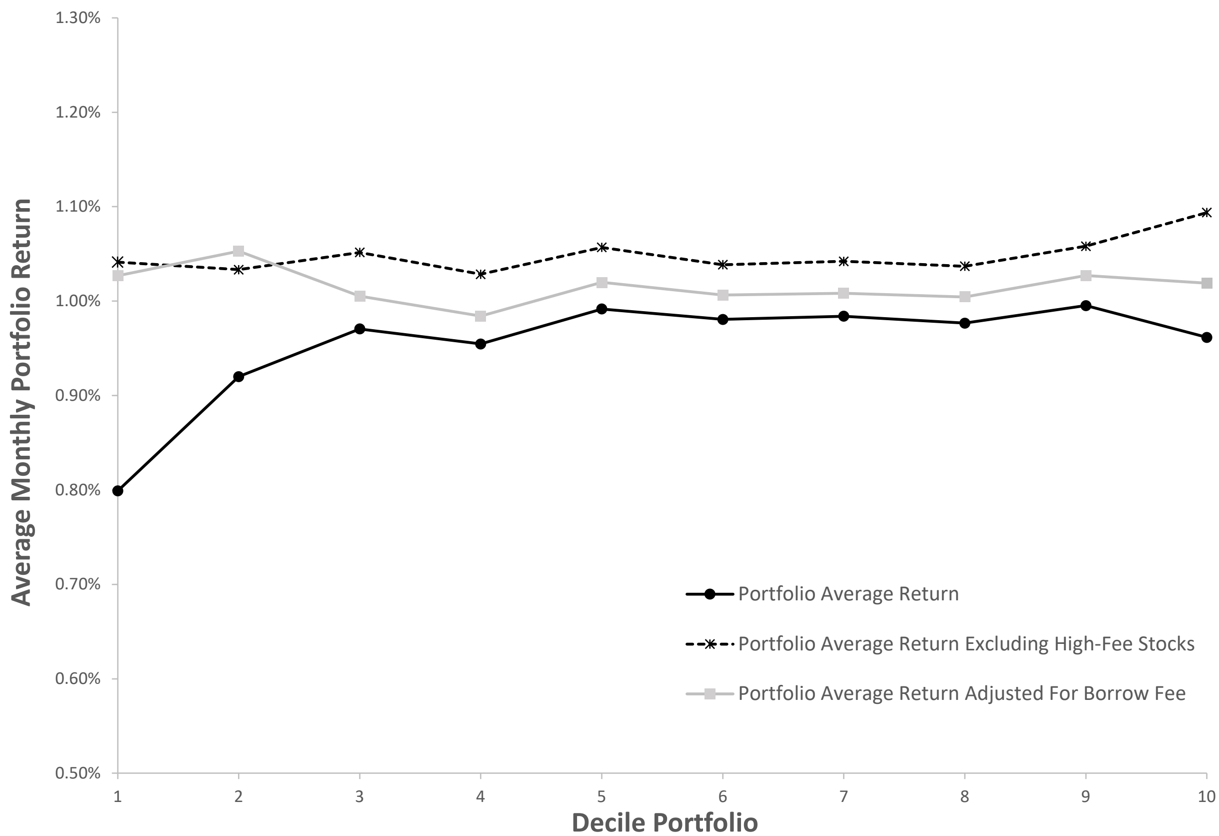

Figure 1. Average monthly return for each decile portfolio across anomalies
The solid black line is the cross-sectional average of the time-series averages of the monthly decile portfolio returns for each anomaly before adjustment for the stock borrow fee. The dashed black line is the cross-sectional average of the time-series averages of the monthly decile portfolio returns for each anomaly excluding stocks with high borrow fees. The solid gray line is the cross-sectional average of the time-series averages of the monthly decile portfolio returns for each anomaly after adjusting returns for stock borrow fees.

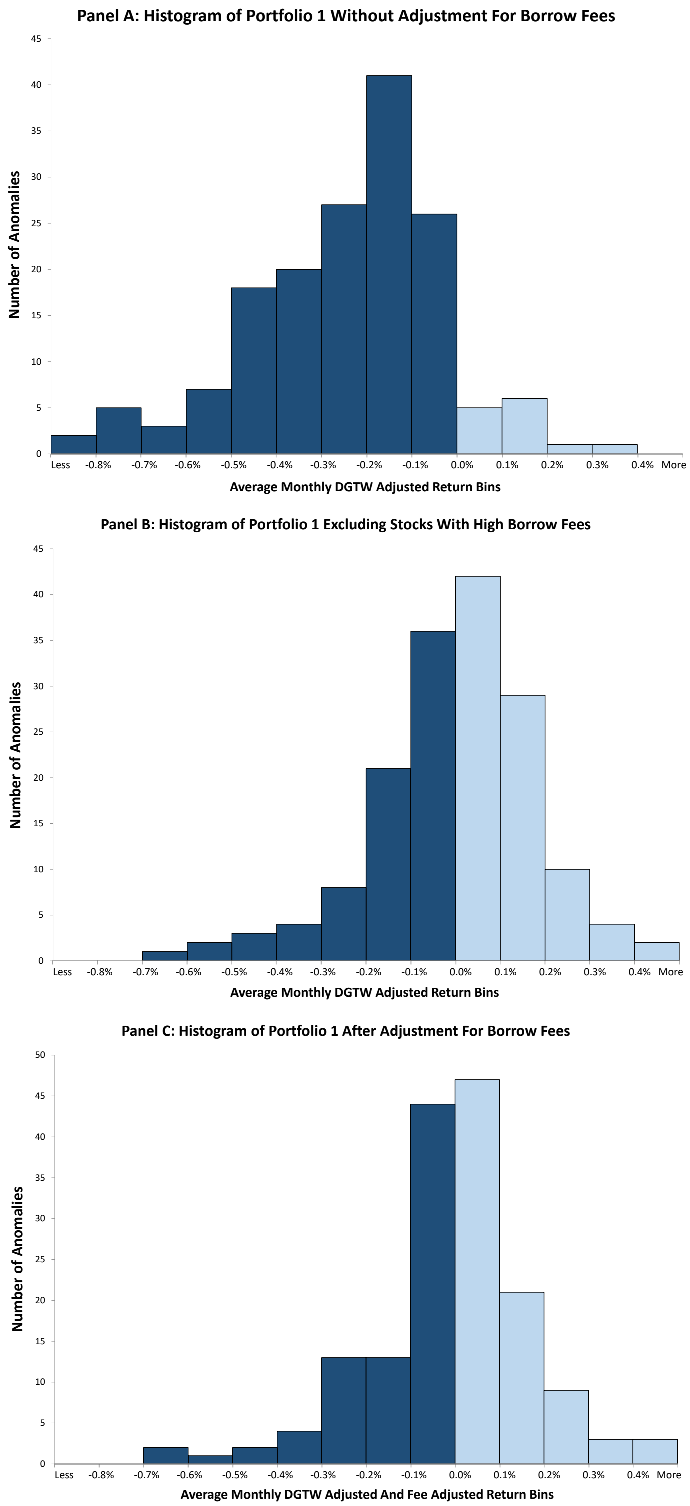

Figure 2. Histograms of Portfolio 1 average performance across anomalies
The histogram in Panel A is for the time-series averages of monthly portfolio performance for each anomaly before adjustment for the stock borrow fee. The histogram in Panel B is for the time-series averages of monthly portfolio performance for each anomaly excluding stocks with high borrow fees. The histogram in Panel C is for the time-series averages of monthly portfolio performance for each anomaly after adjusting returns for stock borrow fees. Return bins that are below zero are in dark blue.

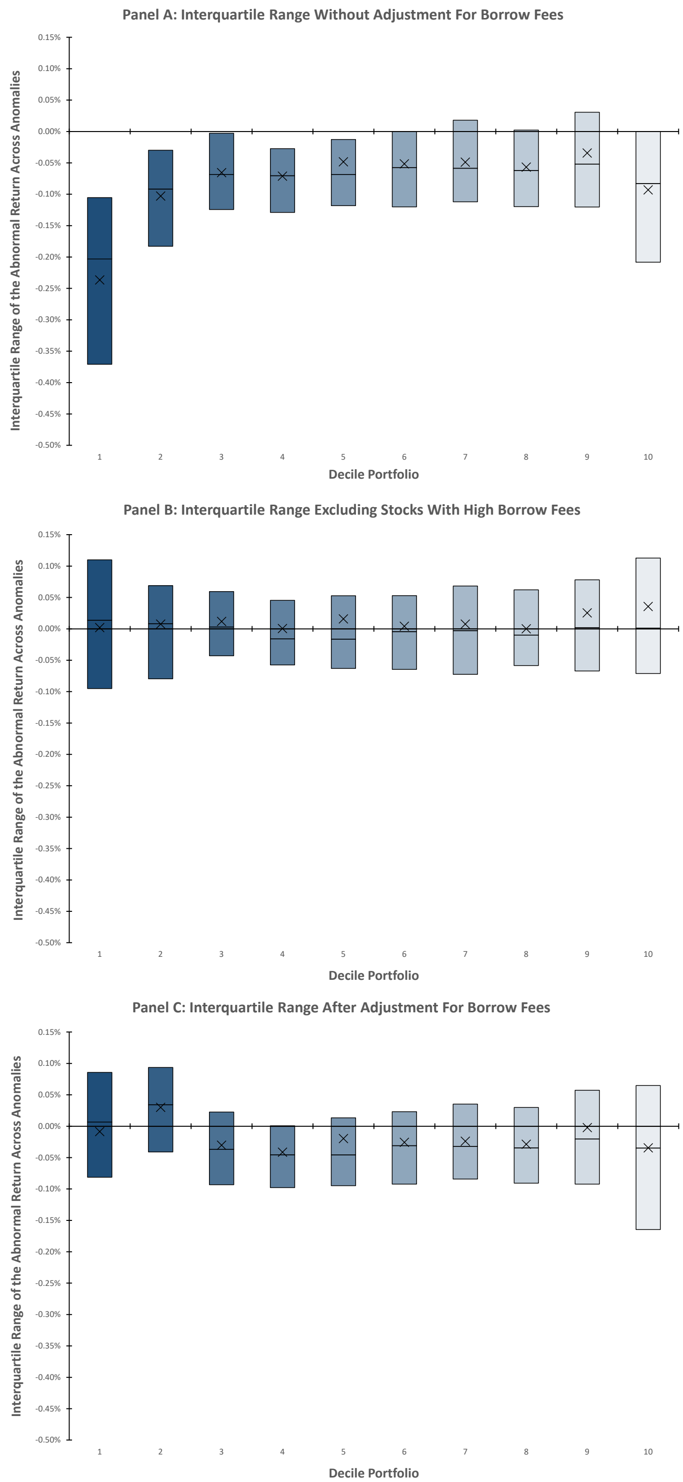

Figure 3. Interquartile ranges for each portfolio's performance across anomalies

The interquartile ranges in Panel A are for the time-series averages of monthly portfolio performance for each anomaly before adjustment for the stock borrow fee. The interquartile ranges in Panel B are for the monthly portfolio performance for each anomaly excluding stocks with high borrow fees. The interquartile ranges in Panel C are for the monthly portfolio performance for each anomaly after adjusting returns for stock borrow fees. The mean and median are marked × and −, respectively.

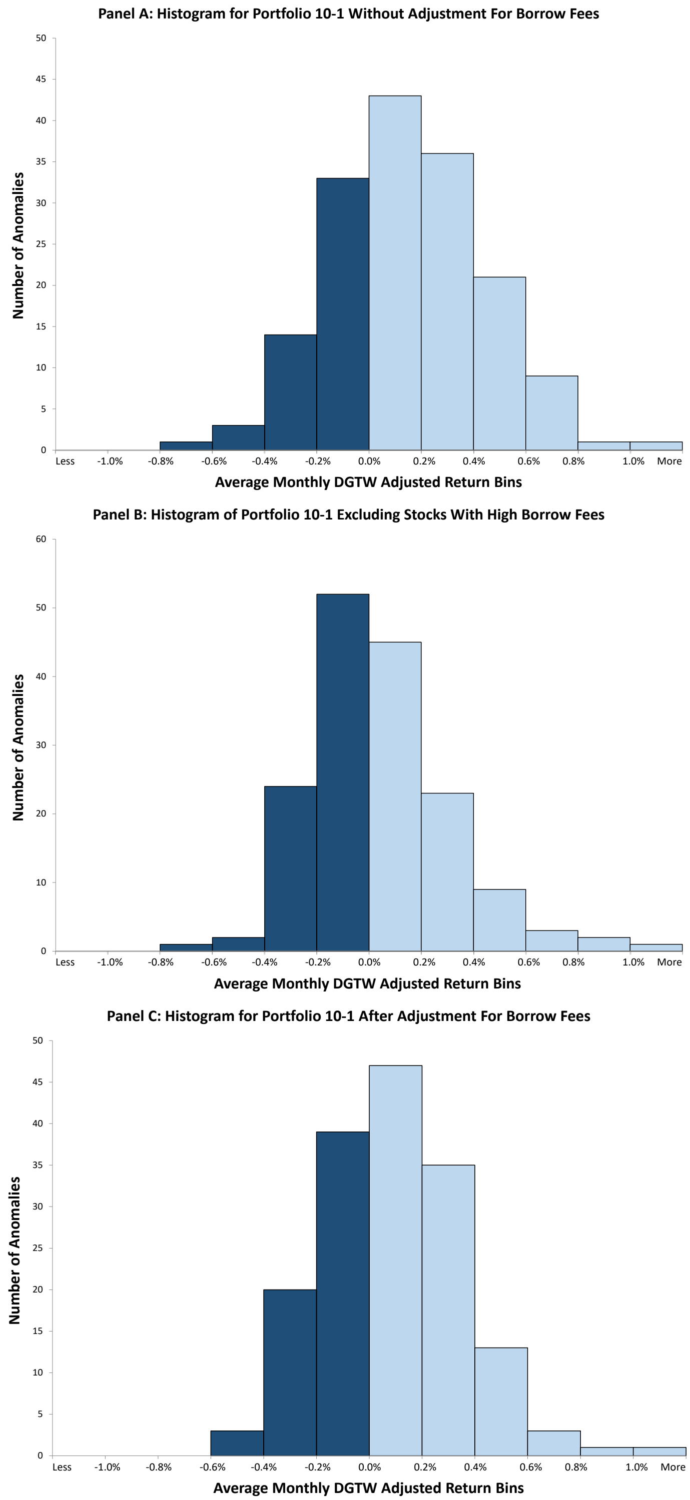

Figure 4. Histograms of Portfolio 10 minus Portfolio 1 average performance across anomalies
The histogram in Panel A is for the time-series averages of monthly differential performance for each anomaly before adjustment for the stock borrow fee. The histogram in Panel B is for the time-series averages of monthly differential performance for each anomaly excluding stocks with high borrow fees. The histogram in Panel C is for the time-series averages of monthly differential performance for each anomaly after adjusting returns for stock borrow fees. Return bins that are below zero are in dark blue.

Table 1
Summary statistics

This table presents selected statistics for the common stocks in CRSP on a given date t that match to an indicative borrowing fee in Markit, subject to the stock filters explained in Section 2. The unit of observation is a stock return from the close of trading date $t+1$ to the close of trading date $t+22$ with valid data in Markit and CRSP. Market capitalization is from CRSP and NYSE size decile is assigned accordingly. The sample period is July 2006 to December 2020.

Summary statistics for the CRSP stocks with an indicative borrowing fee in Markit									
	No. Obs.	Mean	Std. Dev.	Skewness	1%	10%	50%	90%	99%
DGTW ETB return	562,632	-0.0012	0.1327	3.4497	-0.3317	-0.1292	-0.0047	0.1230	0.3931
Regular return	562,632	0.0083	0.1500	2.7156	-0.3750	-0.1416	0.0055	0.1520	0.4544
Indicative borrowing fee	559,263	0.0166	0.0545	7.2294	0.0025	0.0028	0.0038	0.0300	0.3000
Fee, next month	562,392	0.0168	0.0548	7.2906	0.0026	0.0029	0.0038	0.0288	0.2854
Utilization	554,290	18.0742	21.50	1.67	0.07	0.74	9.32	50.71	90.09
Market cap, $mn	562,371	6104	28282	20	54	97	741	10517	107981
NYSE size decile	548,420	6	3	0	2	3	7	10	10

Table 2

Statistics for the average return across portfolios formed for each strategy without abnormal performance adjustment

This table presents the average, across strategies, of the monthly raw return for equal-weighted portfolios. The sample includes the common stocks in CRSP on a given date t that match to an indicative borrowing fee in Markit, subject to the stock filters in Section 2. Stocks are sorted into deciles for each strategy using a particular signal on trading date t and held in portfolios from the close of trading date t+1 until the close of trading date t+22. The sample period is July 2006 to December 2020. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	1 Low	2	3	4	5	6	7	8	9	10 High	10-1
Panel A: Average monthly raw returns across decile portfolios sorted for each anomaly											
Average return	0.80%	0.92%	0.97%	0.95%	0.99%	0.98%	0.98%	0.98%	1.00%	0.96%	0.16%
t-statistic (panel adj.)	[1.43]	[1.77]	[1.92]	[1.94]	[2.01]	[2.02]	[2.04]	[2.00]	[1.98]	[1.82]	[2.91]
t-statistic (naive)	44.87	70.08	74.74	85.82	45.16	75.46	92.42	100.82	72.62	59.65	6.67
Percentage high fee	21.91%	13.73%	10.93%	10.04%	9.96%	9.39%	9.50%	10.20%	12.03%	18.33%	
Average fee (annual)	2.70%	1.58%	1.25%	1.16%	1.12%	1.08%	1.09%	1.14%	1.31%	2.03%	
Average # of stocks	243	239	244	247	250	240	237	238	239	236	
Panel B: Average monthly raw returns across decile portfolios for each anomaly and excluding stocks with high borrow fees											
Average return	1.04%	1.03%	1.05%	1.03%	1.06%	1.04%	1.04%	1.04%	1.06%	1.09%	0.05%
t-statistic (panel adj.)	[1.90]	[2.02]	[2.11]	[2.11]	[2.16]	[2.15]	[2.17]	[2.13]	[2.13]	[2.10]	[0.98]
t-statistic (naive)	62.47	87.25	86.99	93.85	46.35	80.37	92.64	108.54	78.12	64.96	2.10
Average # of stocks	190	207	217	222	225	217	215	214	210	193	
Panel C: Average monthly returns across decile portfolios for each anomaly after adjustment for borrow fees											
Average return	1.03%	1.05%	1.01%	0.98%	1.02%	1.01%	1.01%	1.00%	1.03%	1.02%	-0.01%
t-statistic (panel adj.)	[1.81]	[2.02]	[1.98]	[2.00]	[2.06]	[2.06]	[2.08]	[2.04]	[2.03]	[1.91]	[-0.04]
t-statistic (naive)	62.23	85.01	77.09	89.78	45.45	76.53	95.04	103.24	76.72	62.35	-0.49

Table 3

Statistics for abnormal performance across portfolios formed for each strategy without adjustment for borrow fees

This table presents the average, across strategies, of the abnormal monthly performance for equal-weighted portfolios relative to the stocks without high borrowing fees in each associated DGTW benchmark portfolio. The sample includes the common stocks in CRSP on a given date t that match to an indicative borrowing fee in Markit, subject to the stock filters explained in Section 2. Stocks are sorted into deciles for each strategy using a particular signal on trading date t and held in portfolios from the close of trading date $t+1$ until the close of trading date $t+22$. The sample period is July 2006 to December 2020. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	1 Low	2	3	4	5	6	7	8	9	10 High	10-1
Panel A: Statistics for monthly abnormal performance across strategies for stocks sorted by signals into decile portfolios											
Average return	-0.24%	-0.10%	-0.07%	-0.07%	-0.05%	-0.05%	-0.05%	-0.06%	-0.03%	-0.09%	0.15%
t-statistic (panel adj.)	[-2.94]	[-2.44]	[-2.31]	[-2.82]	[-1.98]	[-1.94]	[-1.67]	[-1.95]	[-1.16]	[-1.81]	[2.93]
t-statistic (naive)	-13.90	-9.25	-7.12	-7.79	-4.06	-5.96	-5.25	-6.22	-2.83	-6.62	6.28
Percentage high fee	21.91%	13.73%	10.93%	10.04%	9.96%	9.39%	9.50%	10.20%	12.03%	18.33%	
Average fee (annual)	2.70%	1.58%	1.25%	1.16%	1.12%	1.08%	1.09%	1.14%	1.31%	2.03%	
Average # of stocks	243	239	244	247	250	240	237	238	239	236	
Panel B: Distribution of monthly abnormal performance across strategies for stocks sorted by signals into decile portfolios											
Min	-0.83%	-0.68%	-0.40%	-0.74%	-0.41%	-0.48%	-0.55%	-0.59%	-0.38%	-0.68%	-0.68%
P5	-0.66%	-0.30%	-0.23%	-0.19%	-0.21%	-0.21%	-0.21%	-0.22%	-0.23%	-0.35%	-0.27%
P25	-0.37%	-0.18%	-0.12%	-0.13%	-0.12%	-0.12%	-0.11%	-0.12%	-0.12%	-0.21%	-0.08%
Median	-0.20%	-0.09%	-0.07%	-0.07%	-0.07%	-0.06%	-0.06%	-0.06%	-0.05%	-0.08%	0.13%
P75	-0.11%	-0.03%	0.00%	-0.03%	-0.01%	0.00%	0.02%	0.00%	0.03%	0.00%	0.33%
P95	0.05%	0.08%	0.10%	0.07%	0.13%	0.13%	0.13%	0.13%	0.23%	0.18%	0.66%
Max	0.35%	0.56%	0.52%	0.76%	1.06%	0.31%	0.50%	0.34%	1.01%	0.62%	1.09%

Table 4

Statistics for abnormal performance across portfolios formed for each strategy excluding stocks with high borrow fees

This table presents the average, across strategies, of the abnormal monthly performance for equal-weighted portfolios relative to the stocks without high borrowing fees in each associated DGTW benchmark portfolio. Stocks with borrow fees of more than 1% are excluded from the performance of each strategy. The sample includes the common stocks in CRSP on a given date t that match to an indicative borrowing fee in Markit, subject to the stock filters in Section 2. Stocks are sorted into deciles for each strategy using a particular anomaly signal on trading date t and held in portfolios from the close of trading date t+1 until the close of trading date t+22. The monthly performance for each portfolio is calculated only using the stocks with an indicative borrowing fee less than or equal to 1%, that is, stocks with borrow fees of more than 1% are excluded from the performance of each strategy. The sample period is July 2006 to December 2020. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	1 Low	2	3	4	5	6	7	8	9	10 High	10-1
Panel A: Statistics for monthly abnormal performance across strategies for stocks sorted by signals into decile portfolios											
Average return	0.00%	0.01%	0.01%	0.00%	0.02%	0.00%	0.01%	0.00%	0.03%	0.04%	0.04%
t-statistic (panel adj.)	[0.04]	[0.22]	[0.46]	[0.01]	[0.36]	[0.02]	[0.26]	[0.04]	[0.85]	[0.97]	[0.81]
t-statistic (naive)	0.14	0.74	1.37	0.05	1.14	0.45	0.77	0.01	2.20	2.47	1.69
Average # of stocks	190	207	217	222	225	217	215	214	210	193	
Panel B: Distribution of monthly abnormal performance across strategies for stocks sorted by signals into decile portfolios											
Min	-0.63%	-0.56%	-0.27%	-0.19%	-0.27%	-0.34%	-0.35%	-0.52%	-0.27%	-0.28%	-0.61%
P5	-0.32%	-0.17%	-0.13%	-0.13%	-0.15%	-0.15%	-0.17%	-0.16%	-0.15%	-0.21%	-0.34%
P25	-0.10%	-0.08%	-0.04%	-0.06%	-0.06%	-0.06%	-0.07%	-0.06%	-0.07%	-0.07%	-0.14%
Median	0.01%	0.01%	0.00%	-0.02%	-0.02%	0.00%	0.00%	-0.01%	0.00%	0.00%	0.01%
P75	0.11%	0.07%	0.06%	0.05%	0.05%	0.05%	0.07%	0.06%	0.08%	0.11%	0.18%
P95	0.27%	0.22%	0.18%	0.15%	0.19%	0.23%	0.22%	0.17%	0.27%	0.30%	0.50%
Max	0.46%	0.64%	0.75%	0.98%	1.42%	0.42%	0.59%	0.42%	1.00%	0.86%	1.01%

Table 5

Statistics for abnormal performance across portfolios formed for each strategy after adjustment for borrow fees

This table presents the average, across strategies, of the abnormal monthly performance for equal-weighted portfolios relative to the stocks without high borrowing fees in each associated DGTW benchmark portfolio. The cumulative indicative borrow fee during the evaluation period is added to each stock's return to adjust performance of each strategy for the potential cost of borrowing stock. The sample includes the common stocks in CRSP on a given date t that match to an indicative borrowing fee in Markit, subject to the stock filters in Section 2. Stocks are sorted into deciles for each strategy using a particular signal on trading date t and held in portfolios from the close of trading date t+1 until the close of trading date t+22. The sample period is July 2006 to December 2020. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	1 Low	2	3	4	5	6	7	8	9	10 High	10-1
Panel A: Statistics for monthly abnormal performance across strategies for stocks sorted by signals into decile portfolios											
Average return	-0.01%	0.03%	-0.03%	-0.04%	-0.02%	-0.03%	-0.02%	-0.03%	0.00%	-0.03%	-0.02%
t-statistic (panel adj.)	[-0.10]	[0.72]	[-1.09]	[-1.66]	[-0.94]	[-1.04]	[-0.78]	[-0.98]	[-0.12]	[-0.65]	[-0.49]
t-statistic (naive)	-0.60	2.93	-3.36	-4.64	-1.57	-2.90	-2.53	-3.15	-0.19	-2.47	-1.09
Percentage high fee	21.91%	13.73%	10.93%	10.04%	9.96%	9.39%	9.50%	10.20%	12.03%	18.33%	
Average fee (annual)	2.70%	1.58%	1.25%	1.16%	1.12%	1.08%	1.09%	1.14%	1.31%	2.03%	
Average # of stocks	243	239	244	247	250	240	237	238	239	236	
Panel B: Distribution of monthly abnormal performance across strategies for stocks sorted by signals into decile portfolios											
Min	-0.67%	-0.54%	-0.36%	-0.58%	-0.36%	-0.45%	-0.53%	-0.56%	-0.30%	-0.45%	-0.72%
P5	-0.31%	-0.14%	-0.19%	-0.15%	-0.18%	-0.17%	-0.19%	-0.20%	-0.17%	-0.31%	-0.43%
P25	-0.08%	-0.04%	-0.09%	-0.10%	-0.09%	-0.09%	-0.08%	-0.09%	-0.09%	-0.16%	-0.23%
Median	0.01%	0.03%	-0.04%	-0.05%	-0.05%	-0.03%	-0.03%	-0.03%	-0.02%	-0.03%	-0.03%
P75	0.09%	0.09%	0.02%	0.00%	0.01%	0.02%	0.04%	0.03%	0.06%	0.06%	0.16%
P95	0.29%	0.23%	0.12%	0.11%	0.16%	0.16%	0.15%	0.16%	0.26%	0.24%	0.43%
Max	0.46%	0.65%	0.60%	0.86%	1.15%	0.40%	0.57%	0.40%	1.04%	0.74%	0.90%

Table 6

Statistics for abnormal performance across portfolios formed for specific anomalies

This table presents the average abnormal monthly performance for equal-weighted portfolios relative to the stocks without high borrowing fees in each associated DGTW benchmark portfolio for each specific anomaly. The sample includes the common stocks in CRSP on a given date t that match to an indicative borrowing fee in Markit, subject to the stock filters in Section 2. Stocks are sorted into deciles for each strategy using a particular signal on trading date t and held in portfolios from the close of trading date t+1 until the close of trading date t+22. The sample period is July 2006 to December 2020. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Specific Anomaly	IPO		Share Issuance		Idiosyncratic Risk		Skewness		Turnover Volatilty	
Portfolio	1 Low	10-1 Diff	1 Low	10-1 Diff	1 Low	10-1 Diff	1 Low	10-1 Diff	1 Low	10-1 Diff
Panel A: Statistics for monthly abnormal performance for each anomaly without adjustment for borrow fees										
Average return	-0.63%	0.40%	-0.40%	0.33%	-0.54%	0.49%	-0.42%	0.39%	-0.80%	0.69%
t-statistic	-1.84	1.07	-2.94	2.04	-2.21	1.46	-1.94	1.19	-2.70	1.60
Percentage high fee	56.17%		27.20%		42.99%		37.18%		57.45%	
Average fee (annual)	5.23%		3.76%		6.17%		5.31%		10.01%	
Average # of stocks	35		297		323		324		126	
Panel B: Statistics for monthly abnormal performance for each anomaly excluding stocks with high borrow fees										
Average return	0.01%	-0.11%	-0.02%	0.04%	0.05%	-0.10%	0.10%	-0.14%	-0.08%	0.04%
t-statistic	0.01	-0.23	-0.18	0.29	0.21	-0.34	0.57	-0.48	-0.30	0.11
Average # of stocks	15		216		184		203		53	
Panel C: Statistics for monthly abnormal performance for each anomaly after adjustment for borrow fees										
Average return	-0.21%	0.02%	-0.08%	0.06%	-0.02%	-0.03%	0.03%	-0.06%	0.05%	-0.15%
t-statistic	-0.63	0.05	-0.60	0.37	-0.06	-0.09	0.15	-0.20	0.17	-0.36

Table 7

Statistics for raw returns across portfolios formed for specific anomalies often used as factors

This table presents the average monthly returns for equal-weighted portfolios for each specific anomaly commonly used as a factor. The sample includes the common stocks in CRSP on a given date t that match to an indicative borrowing fee in Markit, subject to the stock filters in Section 2. Stocks are sorted into deciles for each strategy using a particular signal on trading date t and held in portfolios from the close of trading date t+1 until the close of trading date t+22. The sample period is July 2006 to December 2020. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Strategy Category	Momentum			Profitability			Book-To-Market			Investment		
Portfolio	1 Low	10 High	10-1 Diff	1 Low	10 High	10-1 Diff	1 Low	10 High	10-1 Diff	1 Low	10 High	10-1 Diff
Panel A: Statistics for monthly raw returns for each anomaly without adjustment for borrow fees												
Average return	0.78%	0.99%	0.21%	0.54%	1.16%	0.62%	0.99%	0.97%	-0.02%	0.51%	0.98%	0.47%
t-statistic	1.00	1.83	0.46	0.83	2.24	1.79	1.94	1.26	-0.04	0.79	1.70	2.21
Percentage high fee	30.83%	21.46%		44.83%	13.46%		21.81%	18.22%		19.10%	15.57%	
Average fee (annual)	3.92%	2.83%		5.53%	1.38%		3.12%	2.08%		2.63%	2.07%	
Average # of stocks	316	315		256	242		292	291		248	247	
Panel B: Statistics for monthly raw returns for each anomaly excluding stocks with high borrow fees												
Average return	1.15%	1.17%	0.02%	1.15%	1.25%	0.10%	1.38%	1.16%	-0.22%	0.78%	1.05%	0.27%
t-statistic	1.49	2.25	0.04	1.79	2.48	0.26	2.85	1.52	-0.47	1.25	1.87	1.29
Average # of stocks	218	247		141	209		228	238		201	209	
Panel C: Statistics for monthly returns for each anomaly after adjustment for borrow fees												
Average return	1.11%	1.10%	-0.01%	1.01%	1.20%	0.19%	1.25%	1.02%	-0.23%	0.73%	1.03%	0.30%
t-statistic	1.42	2.02	-0.02	1.55	2.32	0.54	2.45	1.32	-0.50	1.14	1.79	1.42

Table 8

Statistics for raw returns across portfolios formed using risk-based betas

This table presents the average monthly returns for equal-weighted portfolios sorted using CAPM Beta and Tail Risk Beta signals. The sample includes the common stocks in CRSP on a given date t that match to an indicative borrowing fee in Markit, subject to the stock filters in Section 2. Stocks are sorted into deciles for each strategy using a particular signal on trading date t and held in portfolios from the close of trading date t+1 until the close of trading date t+22. The sample period is July 2006 to December 2020. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Strategy Category	CAPM Beta			Tail Risk Beta		
Portfolio	1 Low	10 High	10-1 Diff	1 Low	10 High	10-1 Diff
Panel A: Statistics for monthly raw returns for each anomaly without adjustment for borrow fees						
Average return	0.55%	1.04%	0.49%	0.71%	1.19%	0.48%
t-statistic	1.77	1.29	0.87	2.29	1.74	1.09
Percentage high fee	19.41%	26.14%		14.56%	19.24%	
Average fee (annual)	1.95%	3.33%		1.68%	2.53%	
Average # of stocks	297	296		242	241	
Panel B: Statistics for monthly raw returns for each anomaly excluding stocks with high borrow fees						
Average return	0.69%	1.30%	0.60%	0.82%	1.29%	0.48%
t-statistic	2.31	1.61	1.04	2.71	1.90	1.05
Average # of stocks	239	219		207	195	
Panel C: Statistics for monthly returns for each anomaly after adjustment for borrow fees						
Average return	0.71%	1.16%	0.45%	0.85%	1.27%	0.42%
t-statistic	2.31	1.44	0.79	2.74	1.86	0.95

Table 9

Statistics for abnormal performance across portfolios formed for broad categories of strategies

This table presents the average, across strategies, of the abnormal monthly performance for equal-weighted portfolios relative to the stocks without high borrowing fees in each associated DGTW benchmark portfolio. The sample includes the common stocks in CRSP on a given date t that match to an indicative borrowing fee in Markit, subject to the stock filters in Section 2. Stocks are sorted into deciles for each strategy using a particular signal on trading date t and held in portfolios from the close of trading date t+1 until the close of trading date t+22. The sample period is July 2006 to December 2020. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Strategy Category	Accounting (82 Anomalies)			Price (45 Anomalies)			Other (35 Anomalies)		
Portfolio	1 Low	10 High	10-1 Diff	1 Low	10 High	10-1 Diff	1 Low	10 High	10-1 Diff
Panel A: Statistics for monthly abnormal performance for subsets of strategies without adjustment for borrow fees									
Average return	-0.20%	-0.05%	0.16%	-0.25%	-0.12%	0.15%	-0.29%	-0.17%	0.12%
t-statistic (panel adj.)	[-2.63]	[-0.75]	[3.06]	[-2.76]	[-1.80]	[1.87]	[-3.00]	[-2.98]	[1.04]
t-statistic (naive)	-9.06	-2.51	5.27	-7.87	-4.07	3.00	-7.49	-7.18	2.31
Percentage high fee	21.82%	17.20%		24.11%	18.07%		18.77%	21.51%	
Average fee (annual)	2.59%	2.02%		2.94%	2.15%		2.64%	1.88%	
Average # of stocks	236	231		268	259		226	219	
Panel B: Statistics for monthly abnormal performance for subsets of strategies excluding stocks with high borrow fees									
Average return	0.03%	0.08%	0.05%	0.00%	0.01%	0.02%	-0.06%	-0.04%	0.02%
t-statistic (panel adj.)	[0.46]	[1.58]	[0.99]	[-0.01]	[0.35]	[0.32]	[-0.74]	[-0.79]	[0.15]
t-statistic (naive)	1.41	3.66	1.66	-0.02	0.49	0.54	-2.00	-2.39	0.44
Average # of stocks	185	191		203	212		184	172	
Panel C: Statistics for monthly abnormal performance for subsets of strategies after adjustment for borrow fees									
Average return	0.01%	0.01%	0.00%	-0.01%	-0.05%	-0.04%	-0.07%	-0.12%	-0.06%
t-statistic (panel adj.)	[0.19]	[0.22]	[-0.01]	[-0.07]	[-0.78]	[-0.48]	[-0.69]	[-2.36]	[-0.58]
t-statistic (naive)	0.73	0.69	-0.02	-0.24	-1.91	-0.85	-2.19	-6.25	-1.43

Table 10

Statistics for abnormal performance across portfolios formed for interesting subsets of strategies

This table presents the average, across strategies, of the abnormal monthly performance for equal-weighted portfolios relative to the stocks without high borrowing fees in each associated DGTW benchmark portfolio. The sample includes the common stocks in CRSP on a given date t that match to an indicative borrowing fee in Markit, subject to the stock filters in Section 2. Stocks are sorted into deciles for each strategy using a particular signal on trading date t and held in portfolios from the close of trading date t+1 until the close of trading date t+22. The sample period is July 2006 to December 2020. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Strategy Subset	Sample End < 2006			t-statistic > 5			JF, JFE, RFS		
Portfolio	1 Low	10 High	10-1 Diff	1 Low	10 High	10-1 Diff	1 Low	10 High	10-1 Diff
Panel A: Statistics for monthly abnormal performance for subsets of strategies without adjustment for borrow fees									
Average return	-0.23%	-0.11%	0.12%	-0.28%	-0.10%	0.19%	-0.26%	-0.09%	0.18%
t-statistic (panel adj.)	[-2.71]	[-2.15]	[2.15]	[-3.33]	[-1.56]	[2.99]	[-3.01]	[-1.59]	[2.89]
t-statistic (naive)	-12.58	-7.06	4.91	-8.30	-4.39	3.92	-10.92	-4.36	5.41
Percentage high fee	21.99%	18.88%		20.14%	19.44%		22.56%	19.33%	
Average fee (annual)	2.74%	2.07%		2.60%	2.27%		2.81%	2.08%	
Average # of stocks	247	239		255	248		239	230	
Panel B: Statistics for monthly abnormal performance for subsets of strategies excluding stocks with high borrow fees									
Average return	0.01%	0.02%	0.01%	-0.02%	0.05%	0.07%	-0.01%	0.04%	0.06%
t-statistic (panel adj.)	[0.17]	[0.55]	[0.22]	[-0.22]	[1.00]	[1.18]	[-0.22]	[1.18]	[1.17]
t-statistic (naive)	0.74	1.22	0.49	-0.52	1.67	1.47	-0.80	2.19	2.16
Average # of stocks	192	194		204	200		185	185	
Panel C: Statistics for monthly abnormal performance for subsets of strategies after adjustment for borrow fees									
Average return	0.00%	-0.05%	-0.05%	-0.06%	-0.04%	0.04%	-0.02%	-0.03%	0.00%
t-statistic (panel adj.)	[0.00]	[-0.98]	[-0.85]	[-0.72]	[-0.48]	[0.57]	[-0.26]	[-0.43]	[0.05]
t-statistic (naive)	0.02	-3.28	-2.07	-1.98	-1.42	0.76	-1.07	-1.32	-0.02

Appendix Table 1

Abnormal performance and other characteristics of the decile 1 portfolio for each anomaly in our sample

This table presents the abnormal monthly performance for the decile 1 portfolio relative to the stocks without high borrowing fees in each associated DGTW benchmark portfolio for each individual anomaly. The sample includes the common stocks in CRSP on a given date t that match to an indicative borrowing fee in Markit, subject to the stock filters in Section 2. Stocks are sorted into deciles for each strategy using a particular signal on trading date t and held in portfolios from the close of trading date t+1 until the close of trading date t+22, the subsequent month. The average indicative fee for the decile 1 portfolio is the time-series average of the annualized cross-sectional average for the stocks in the portfolio for each month. The percentage of stocks with a high fee for each anomaly is the average number of stocks with an indicative fee greater than 1% for all months divided by the average number of stocks in the decile 1 portfolio for all months. First, the abnormal performance is calculated for all stocks in the portfolio. Second, the abnormal performance is calculated while excluding stocks with an indicative fee greater than 1% at the end of the previous month. Third, the abnormal performance for all stocks is adjusted for the indicative borrow fee during the month. The sample period is July 2006 to December 2020. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

			Decile 1 Characteristics				
Description	Authors	Year Pub.	Avg. Fee	% High Fee	Avg. Return	Avg. Return No High Fees	Avg. Return Adj. For Fees
52 week high	George and Hwang	2004	5.59%	40.6%	-0.37%	0.17%	0.09%
Abnormal accruals	Xie	2001	2.98%	22.7%	-0.11%	0.06%	0.14%
Accruals	Sloan	1996	2.81%	21.4%	-0.15%	0.06%	0.08%
Advertising expense	Chan, Lakonishok and Sougiannis	2001	1.67%	14.2%	0.02%	0.28%	0.16%
Amihud's illiquidity	Amihud	2002	0.41%	0.9%	-0.05%	-0.04%	-0.01%
Analyst earnings per share	Cen, Wei, and Zhang	2006	4.17%	39.3%	-0.30%	0.20%	0.05%
Analyst optimism	Frankel and Lee	1998	1.04%	9.4%	-0.07%	0.00%	0.02%
Analyst value	Frankel and Lee	1998	2.66%	27.7%	-0.15%	0.11%	0.07%
Asset growth	Cooper, Gulen and Schill	2008	2.96%	22.5%	-0.35%	0.07%	-0.10%
Bid-ask spread	Amihud and Mendelsohn	1986	0.72%	7.7%	0.01%	0.02%	0.06%
Book leverage (annual)	Fama and French	1992	1.79%	19.1%	-0.42%	-0.34%	-0.27%
Book to market using December ME	Fama and French	1992	3.27%	25.0%	0.13%	0.39%	0.41%
Book to market using most recent ME	Rosenberg, Reid, and Lanstein	1985	3.12%	21.8%	-0.07%	0.30%	0.20%
Brand capital investment	Belo, Lin and Vitorino	2014	0.56%	2.8%	-0.03%	-0.01%	0.02%
Breadth of ownership	Chen, Hong and Stein	2002	0.76%	4.8%	-0.15%	-0.08%	-0.08%
CAPM beta	Fama and MacBeth	1973	1.95%	19.4%	-0.41%	-0.26%	-0.25%
Cash flow to market	Lakonishok, Shleifer, Vishny	1994	5.05%	42.1%	-0.38%	0.06%	0.05%
Cash productivity	Chandrashekar and Rao	2009	2.61%	14.9%	-0.22%	0.04%	0.00%
Cash to assets	Palazzo	2012	1.19%	10.2%	-0.30%	-0.21%	-0.20%
Cash-based operating profitability	Ball et al.	2016	6.34%	46.5%	-0.53%	0.11%	0.01%
Cash-flow to price variance	Haugen and Baker	1996	3.68%	27.1%	-0.01%	0.13%	0.30%
Change in asset turnover	Soliman	2008	1.44%	12.7%	0.11%	0.18%	0.23%
Change in capex (three years)	Anderson and Garcia-Feijoo	2006	2.15%	18.9%	-0.36%	-0.18%	-0.18%
Change in capex (two years)	Anderson and Garcia-Feijoo	2006	2.50%	22.5%	-0.40%	-0.10%	-0.19%
Change in capital inv (ind adj)	Abarbanell and Bushee	1998	2.30%	20.9%	-0.37%	-0.15%	-0.18%
Change in current operating assets	Richardson et al.	2005	2.43%	18.2%	-0.15%	0.11%	0.05%
Change in current operating liabilities	Richardson et al.	2005	2.84%	20.9%	-0.20%	0.09%	0.04%
Change in equity to assets	Richardson et al.	2005	2.94%	23.6%	-0.31%	0.08%	-0.06%
Change in financial liabilities	Richardson et al.	2005	2.33%	17.6%	-0.16%	0.06%	0.03%
Change in net financial assets	Richardson et al.	2005	2.56%	20.6%	-0.06%	0.13%	0.15%
Change in net noncurrent op assets	Soliman	2008	2.68%	19.4%	-0.19%	0.05%	0.04%
Change in net operating assets	Hirshleifer, Hou, Teoh, Zhang	2004	2.71%	19.1%	-0.31%	0.00%	-0.08%
Change in net working capital	Soliman	2008	2.86%	22.5%	-0.18%	0.04%	0.06%

Appendix Table 1 (Continued A)

Abnormal performance and other characteristics of the decile 1 portfolio for each anomaly in our sample

Description	Authors	Year Pub.	Decile 1 Characteristics: Avg. Fee	% High Fee	Avg. Return	Avg. Return No High Fees	Avg. Return Adj. For Fees
Change in order backlog	Baik and Ahn	2007	1.05%	11.4%	-0.21%	-0.21%	-0.12%
Change in ppe and inv/assets	Lyandres, Sun and Zhang	2008	2.63%	19.1%	-0.53%	-0.26%	-0.31%
Change in recommendation	Jegadeesh et al.	2004	1.23%	9.5%	-0.13%	-0.07%	-0.02%
Change in taxes	Thomas and Zhang	2011	1.51%	13.2%	-0.26%	-0.11%	-0.13%
Composite debt issuance	Lyandres, Sun and Zhang	2008	1.78%	13.5%	-0.14%	0.07%	0.01%
Composite equity issuance	Daniel and Titman	2006	3.45%	26.3%	-0.46%	-0.25%	-0.17%
Conglomerate return	Cohen and Lou	2012	1.08%	8.9%	-0.47%	-0.43%	-0.38%
Coskewness	Harvey and Siddique	2000	2.52%	20.9%	-0.48%	-0.33%	-0.26%
Coskewness using daily returns	Ang, Chen and Xing	2006	2.75%	23.8%	-0.30%	-0.15%	-0.06%
Customer momentum	Cohen and Frazzini	2008	1.34%	12.8%	-0.78%	-0.40%	-0.67%
Days with zero trades	Liu	2006	3.40%	24.0%	-0.20%	0.09%	0.09%
Days with zero trades	Liu	2006	3.87%	25.6%	-0.17%	0.13%	0.16%
Days with zero trades	Liu	2006	2.91%	22.1%	-0.22%	-0.01%	0.02%
Deferred revenue	Prakash and Sinha	2012	1.69%	17.2%	-0.06%	0.12%	0.08%
Earnings announcement return	Chan, Jegadeesh and Lakonishok	1996	2.75%	21.3%	-0.43%	-0.03%	-0.20%
Earnings consistency	Alwathainani	2009	2.35%	20.2%	-0.35%	-0.14%	-0.15%
Earnings forecast revisions	Chan, Jegadeesh and Lakonishok	1996	2.34%	24.7%	-0.76%	-0.63%	-0.56%
Earnings forecast to price	Elgers, Lo and Pfeiffer	2001	4.65%	45.0%	-0.10%	0.39%	0.29%
Earnings surprise	Foster, Olsen and Shevlin	1984	1.69%	13.3%	-0.23%	-0.01%	-0.09%
Earnings surprise of big firms	Hou	2007	2.21%	21.3%	-0.44%	-0.24%	-0.25%
Earnings surprise streak	Loh and Warachka	2012	3.62%	30.7%	-0.78%	-0.51%	-0.48%
Earnings-to-price ratio	Basu	1977	1.14%	11.0%	-0.05%	0.01%	0.04%
Efficient frontier index	Nguyen and Swanson	2009	2.82%	19.6%	0.15%	0.46%	0.39%
Employment growth	Bazdresch, Belo and Lin	2014	2.72%	21.6%	-0.35%	0.07%	-0.12%
Enterprise component of BM	Penman, Richardson and Tuna	2007	1.53%	12.3%	-0.21%	-0.09%	-0.08%
Enterprise multiple	Loughran and Wellman	2011	1.34%	13.2%	-0.06%	0.08%	0.05%
EPS forecast dispersion	Diether, Malloy and Scherbina	2002	2.24%	22.1%	-0.26%	-0.16%	-0.07%
EPS forecast revision	Hawkins, Chamberlin, Daniel	1984	1.99%	18.3%	-0.41%	-0.31%	-0.24%
Equity duration	Dechow, Sloan and Soliman	2004	4.36%	35.5%	-0.24%	0.19%	0.13%
Excluded expenses	Doyle, Lundholm and Soliman	2003	1.16%	8.4%	-0.15%	-0.10%	-0.06%
Firm age - momentum	Zhang	2004	4.22%	36.0%	-0.83%	-0.21%	-0.47%
Firm age based on CRSP	Barry and Brown	1984	0.47%	1.7%	-0.15%	-0.13%	-0.11%
Frazzini-Pedersen beta	Frazzini and Pedersen	2014	2.10%	26.8%	-0.21%	-0.12%	-0.03%
Gross profits / total assets	Novy-Marx	2013	5.53%	44.8%	-0.49%	0.16%	-0.02%
Growth in advertising expenses	Lou	2014	2.05%	17.5%	-0.12%	0.05%	0.05%
Growth in book equity	Lockwood and Prombutr	2010	2.55%	20.8%	-0.33%	0.00%	-0.12%
Growth in long term operating assets	Fairfield, Whisenant and Yohn	2003	2.96%	21.4%	0.00%	0.18%	0.25%
Idiosyncratic risk	Ang et al.	2006	6.17%	43.0%	-0.54%	0.05%	-0.02%
Idiosyncratic risk (3 factor)	Ang et al.	2006	6.45%	44.3%	-0.54%	0.11%	0.01%
Idiosyncratic risk (AHT)	Ali, Hwang, and Trombley	2003	7.97%	54.1%	-0.70%	0.08%	-0.03%
Idiosyncratic skewness (3F model)	Bali, Engle and Murray	2015	2.23%	17.6%	-0.05%	0.06%	0.14%
Industry concentration (assets)	Hou and Robinson	2006	1.20%	9.8%	-0.12%	-0.08%	-0.02%
Industry concentration (equity)	Hou and Robinson	2006	1.35%	11.0%	-0.10%	-0.04%	0.01%
Industry concentration (sales)	Hou and Robinson	2006	1.32%	11.4%	-0.14%	-0.09%	-0.03%
Industry momentum	Grinblatt and Moskowitz	1999	1.71%	15.1%	-0.51%	-0.32%	-0.37%

Appendix Table 1 (Continued B)

Abnormal performance and other characteristics of the decile 1 portfolio for each anomaly in our sample

Description	Authors	Year Pub.	Decile 1 Characteristics: Avg. Fee	% High Fee	Avg. Return	Avg. Return No High Fees	Avg. Return Adj. For Fees
Industry return of big firms	Hou	2007	2.12%	20.8%	-0.78%	-0.55%	-0.60%
Intangible return using BM	Daniel and Titman	2006	1.83%	13.9%	-0.07%	0.07%	0.09%
Intangible return using CF to P	Daniel and Titman	2006	1.71%	14.8%	-0.17%	-0.10%	-0.02%
Intangible return using EP	Daniel and Titman	2006	1.65%	14.0%	-0.16%	-0.06%	-0.02%
Intangible return using sales to price	Daniel and Titman	2006	1.02%	8.2%	-0.07%	-0.02%	0.02%
Intermediate momentum	Novy-Marx	2012	4.22%	32.2%	-0.28%	0.11%	0.08%
Inventory growth	Thomas and Zhang	2002	1.93%	15.4%	-0.16%	0.03%	0.01%
Inventory growth	Belo and Lin	2012	2.86%	21.8%	-0.13%	0.22%	0.11%
Investment to revenue	Titman, Wei and Xie	2004	1.51%	15.3%	-0.18%	-0.10%	-0.06%
IPO and age	Ritter	1991	5.23%	56.2%	-0.63%	0.01%	-0.21%
Junk stock momentum	Avramov et al	2007	3.52%	25.6%	-0.13%	0.22%	0.17%
Leverage component of BM	Penman, Richardson and Tuna	2007	1.73%	14.2%	-0.22%	-0.08%	-0.08%
Long-run reversal	De Bondt and Thaler	1985	1.71%	13.9%	-0.04%	0.12%	0.11%
Long-term EPS forecast	La Porta	1996	1.39%	13.1%	-0.14%	0.00%	-0.03%
Long-vs-short EPS forecasts	Da and Warachka	2011	1.54%	14.7%	-0.33%	-0.17%	-0.20%
Market leverage	Bhandari	1988	3.67%	28.7%	-0.18%	0.18%	0.14%
Maximum return over month	Bali, Cakici, and Whitelaw	2010	5.31%	37.2%	-0.42%	0.10%	0.03%
Medium-run reversal	De Bondt and Thaler	1985	2.26%	17.9%	-0.20%	-0.01%	-0.01%
Momentum (12 month)	Jegadeesh and Titman	1993	4.29%	33.4%	-0.28%	0.14%	0.08%
Momentum (6 month)	Jegadeesh and Titman	1993	3.92%	30.8%	-0.30%	0.05%	0.03%
Momentum based on FF3 residuals	Blitz, Huij and Martens	2011	1.66%	14.1%	0.03%	0.14%	0.17%
Momentum in high volume stocks	Lee and Swaminathan	2000	3.25%	23.5%	-0.28%	0.08%	0.00%
Momentum without the seasonal part	Heston and Sadka	2008	3.67%	30.3%	-0.35%	0.01%	-0.04%
Net debt financing	Bradshaw, Richardson, Sloan	2006	2.10%	16.3%	-0.15%	0.02%	0.02%
Net debt to price	Penman, Richardson and Tuna	2007	2.76%	23.5%	-0.06%	0.12%	0.17%
Net equity financing	Bradshaw, Richardson, Sloan	2006	4.17%	32.4%	-0.24%	0.17%	0.11%
Net external financing	Bradshaw, Richardson, Sloan	2006	5.23%	41.4%	-0.38%	0.27%	0.07%
Net income / book equity	Haugen and Baker	1996	4.93%	38.9%	-0.34%	0.24%	0.08%
Net operating assets	Hirshleifer et al.	2004	2.00%	15.1%	-0.43%	-0.13%	-0.26%
Net payout yield	Boudoukh et al.	2007	4.45%	35.0%	-0.40%	-0.03%	-0.02%
Off season long-term reversal	Heston and Sadka	2008	2.80%	21.6%	-0.16%	0.06%	0.08%
Off season reversal years 11 to 15	Heston and Sadka	2008	1.31%	11.4%	0.00%	0.10%	0.11%
Off season reversal years 16 to 20	Heston and Sadka	2008	1.13%	9.9%	0.20%	0.16%	0.29%
Off season reversal years 6 to 10	Heston and Sadka	2008	1.79%	15.9%	-0.11%	-0.02%	0.04%
Operating cash flow to price	Desai, Rajgopal, Venkatachalam	2004	5.44%	44.2%	-0.33%	0.24%	0.13%
Operating leverage	Novy-Marx	2010	1.46%	17.0%	-0.47%	-0.42%	-0.35%
Operating profitability R&D adjusted	Ball et al.	2016	6.36%	47.2%	-0.66%	-0.12%	-0.12%
operating profits / book equity	Fama and French	2006	2.36%	22.8%	-0.18%	0.17%	0.02%
Option to stock volume	Johnson and So	2012	3.40%	20.4%	-0.42%	-0.16%	-0.14%
Option volume to average	Johnson and So	2012	1.73%	12.0%	-0.20%	-0.07%	-0.06%
Order backlog	Rajgopal, Shevlin, Venkatachalam	2003	0.80%	7.4%	0.14%	0.02%	0.21%
Organizational capital	Eisfeldt and Papanikolaou	2013	1.94%	15.1%	-0.43%	-0.17%	-0.27%
Past trading volume	Brennan, Chordia, Subra	1998	0.56%	2.1%	-0.02%	0.02%	0.03%
Pastor-Stambaugh liquidity beta	Pastor and Stambaugh	2003	2.68%	22.4%	-0.03%	0.14%	0.20%
Payout yield	Boudoukh et al.	2007	1.38%	12.8%	0.06%	0.11%	0.17%

Appendix Table 1 (Continued C)

Abnormal performance and other characteristics of the decile 1 portfolio for each anomaly in our sample

Description	Authors	Year Pub.	Decile 1 Characteristics: Avg. Fee	% High Fee	Avg. Return	Avg. Return No High Fees	Avg. Return Adj. For Fees
Pension funding status	Franzoni and Marin	2006	1.52%	11.8%	0.27%	0.21%	0.40%
Percent operating accruals	Hafzalla, Lundholm, Van Winkle	2011	2.46%	20.6%	-0.23%	-0.02%	-0.02%
Percent total accruals	Hafzalla, Lundholm, Van Winkle	2011	1.54%	16.3%	-0.14%	-0.07%	-0.01%
Piotroski F-score	Piotroski	2000	3.12%	27.2%	-0.56%	-0.25%	-0.30%
Predicted analyst forecast error	Frankel and Lee	1998	0.78%	5.4%	0.17%	0.26%	0.23%
Price delay coeff	Hou and Moskowitz	2005	1.89%	16.9%	-0.23%	-0.13%	-0.08%
Price delay R-squared	Hou and Moskowitz	2005	0.54%	2.7%	0.00%	0.04%	0.02%
Price delay SE adjusted	Hou and Moskowitz	2005	1.66%	13.7%	-0.15%	-0.01%	-0.03%
Put volatility minus call volatility	Yan	2011	6.65%	36.4%	-0.83%	-0.27%	-0.11%
R&D ability	Cohen, Diether and Malloy	2013	1.29%	8.7%	0.35%	0.46%	0.31%
R&D over market cap	Chan, Lakonishok and Sougiannis	2001	1.23%	10.6%	-0.11%	-0.01%	-0.09%
Real dirty surplus	Landsman et al.	2011	0.87%	4.8%	-0.01%	0.07%	0.06%
Real estate holdings	Tuzel	2010	3.63%	27.0%	-0.01%	0.29%	0.23%
Return on assets (qtrly)	Balakrishnan, Bartov and Faurel	2010	5.61%	44.4%	-0.26%	0.21%	0.40%
Return seasonality last year	Heston and Sadka	2008	3.50%	27.0%	-0.12%	0.17%	0.18%
Return seasonality years 11 to 15	Heston and Sadka	2008	1.75%	15.4%	-0.19%	-0.04%	-0.08%
Return seasonality years 16 to 20	Heston and Sadka	2008	1.52%	13.9%	-0.19%	-0.07%	-0.17%
Return seasonality years 2 to 5	Heston and Sadka	2008	3.21%	25.0%	-0.07%	0.20%	0.11%
Return seasonality years 6 to 10	Heston and Sadka	2008	2.30%	18.5%	-0.27%	-0.08%	-0.01%
Return skewness	Bali, Engle and Murray	2015	2.67%	20.6%	-0.10%	0.13%	0.09%
Revenue growth rank	Lakonishok, Shleifer, Vishny	1994	1.17%	10.6%	-0.04%	0.06%	0.06%
Revenue surprise	Jegadeesh and Livnat	2006	1.49%	12.5%	-0.18%	-0.05%	-0.04%
Sales growth over inventory growth	Abarbanell and Bushee	1998	2.40%	20.6%	-0.28%	-0.08%	-0.13%
Sales growth over overhead growth	Abarbanell and Bushee	1998	2.52%	20.0%	-0.19%	0.02%	-0.07%
Sales-to-price	Barbee, Mukherji and Raines	1996	5.22%	40.3%	-0.44%	0.00%	0.07%
Share issuance (1 year)	Pontiff and Woodgate	2008	3.76%	27.2%	-0.40%	-0.08%	-0.02%
Share issuance (5 year)	Daniel and Titman	2006	1.83%	13.4%	-0.07%	0.09%	-0.01%
Share turnover volatility	Chordia, Subra, Anshuman	2001	10.01%	57.4%	-0.80%	0.05%	-0.08%
Short Interest	Dechow et al.	2001	4.20%	36.6%	-0.41%	-0.06%	-0.10%
Systematic volatility	Ang et al.	2006	3.32%	26.9%	-0.12%	0.16%	0.19%
Tail risk beta	Kelly and Jiang	2014	1.68%	14.6%	-0.23%	-0.09%	-0.11%
Tangibility	Hahn and Lee	2009	1.21%	8.1%	0.00%	0.10%	0.10%
Taxable income to income	Lev and Nissim	2004	4.06%	32.6%	-0.40%	-0.06%	0.02%
Total accruals	Richardson et al.	2005	2.37%	18.4%	-0.26%	-0.06%	0.00%
Total assets to market	Fama and French	1992	3.77%	26.4%	0.00%	0.32%	0.36%
Volatility smirk near the money	Xing, Zhang and Zhao	2010	3.78%	18.2%	-0.51%	-0.19%	-0.19%
Volume to market equity	Haugen and Baker	1996	4.36%	29.1%	-0.30%	0.07%	0.09%
Volume trend	Haugen and Baker	1996	3.63%	27.3%	-0.32%	-0.01%	-0.07%
Volume variance	Chordia, Subra, Anshuman	2001	2.39%	13.9%	-0.16%	0.05%	-0.04%

Appendix Table 2

Statistics for the average abnormal performance of more extreme portfolios formed using 30 equally-weighted groups for each anomaly

This table presents the average, across strategies, of the abnormal monthly performance for the top three portfolios and bottom three portfolios based on sorting stocks into 30 equal-weighted portfolios for each anomaly. Abnormal performance is relative to the stocks without high borrowing fees in each associated DGTW benchmark portfolio. The sample includes the common stocks in CRSP on a given date t that match to an indicative borrowing fee in Markit, subject to the stock filters in Section 2. Stocks are sorted into 30 equal-weighted for each strategy using a particular signal on trading date t and held in portfolios from the close of trading date t+1 until the close of trading date t+22. In Panel A all stocks are included and portfolio perfomance is not adjusted for the stock borrow fee. In Panel B stocks with borrow fees of more than 1% are excluded from the performance of each strategy. In Panel C the cumulative indicative borrow fee during the evaluation period is added to each stock's return to adjust performance of each strategy for the potential cost of borrowing stock. The sample period is July 2006 to December 2020. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	1 Low	2	3	…	28	29	30 High	30-1
Panel A: Average abnormal performance and other statistics for more extreme portfolios for each anomaly								
Average return	-0.35%	-0.18%	-0.18%		-0.07%	-0.06%	-0.13%	0.22%
t-statistic (panel adj.)	-3.29	-2.26	-2.85		-1.80	-1.69	-1.64	3.76
t-statistic (naive)	-13.02	-10.29	-10.71		-4.61	-2.49	-5.75	6.09
Percentage high fee	26.86%	20.95%	17.84%		14.33%	16.97%	23.78%	
Average fee (annual)	3.38%	2.32%	1.94%		1.48%	1.75%	2.57%	
Average # of stocks	85	81	82		81	80	78	
Panel B: Average abnormal performance for more extreme portfolios sorted for each anomaly and excluding stocks with high borrow fees								
Average return	-0.01%	0.03%	-0.02%		0.03%	0.05%	0.05%	0.06%
t-statistic (panel adj.)	-0.17	0.54	-0.32		0.88	0.93	0.97	1.27
t-statistic (naive)	-0.57	1.48	-1.16		2.11	2.28	2.32	1.97
Average # of stocks	62	64	67		69	67	59	
Panel C: Average abnormal performance for more extreme portfolios sorted for each anomaly after adjustment for borrow fees								
Average return	-0.07%	0.02%	-0.11%		-0.03%	-0.02%	-0.05%	0.02%
t-statistic (panel adj.)	-0.65	0.31	-1.84		-0.81	-0.71	-0.58	0.38
t-statistic (naive)	-3.04	1.09	-7.43		-1.96	-0.61	-2.10	0.61