Short Selling, Timing, and Profitability

Karl B. Diether*

Abstract

I test whether short-sellers are profitable using proprietary short-selling contract data from 1999 to 2005. I find that short-sellers are profitable on average and the magnitude of the profitability is large both before and after taking into account short-sale costs. Short-sale profitability is strongest in micro-cap stocks and in stocks with high shorting costs. Furthermore, I find strong evidence of profitability after the contract has existed for at least two trading months. There is also evidence of significant profitability in the first week among micro-cap and high loan fee stocks. In the first week of a position short-sellers on average make over a 1.0% return in high loan fee stocks. The large first week return in high loan fee and micro-cap stocks is not related to shorting activity around earnings announcements.

*Tuck School of Business at Dartmouth College; I thank Lauren Cohen, Ruediger Fahlenbrach, and Christopher Malloy for helpful comments and suggestions. I also thank Gene Fama and Ken French for generously providing data.

The sheer magnitude of short-selling suggests that it plays an important role in financial markets. For example, in a recent paper Diether, Lee, and Werner (2007) find that short-selling represents about 25% of the trading activity on both the NYSE and Nasdaq exchanges during 2005.[1] The link between shorting costs and future returns also suggests its importance. Jones and Lamont (2002) and Cohen, Diether, and Malloy (2006) find a strong link between short-selling costs and future returns. In addition many papers find a link between short-selling activity and future returns.[2]

Despite the fact that short-selling activity is common and represents a large share of trading volume, very little is known about whether short-sellers actually do have superior information or whether they can spot mispriced stocks. In other words, we don't know if short-sellers generate positive profits. Certainly the preceding evidence is suggestive; both high shorting activity and high loan fees (the interest rate paid to the lender by the short-seller) predict low subsequent average returns. Thus one can find strategies that, historically speaking, produce significant abnormal average returns at least before taking into account short-selling costs. However, none of the previous studies look at whether short-sellers make positive profits in these situations. It is unknown to what extent the typical short-seller is profitable. For example, do short-sellers tend to only make a significant profit when short-selling costs are very high as previous research seems to suggest or are there other systematic situations where short-selling is profitable on average? Additionally, it is important to examine the covering actions of short-sellers. Do short-sellers actually make a profit when they short a stock that is expensive to short or do they cover too early or too late to make a profit? Finally, how do short-selling costs affect profitability?

Additionally, very little is known about the time horizon dynamics of short-selling strategies. Most of the previous work focuses on creating strategies based on short-selling activity or fees over the monthly horizon. Recently, some work (such as Diether, Lee, and Werner (2007)) focuses on examining potential strategies over much shorter horizons. Do short-sellers usually implement short-term strategies or do the strategies tend to be much longer term? Furthermore, are short-

[1] Boehmer, Jones, and Zhang (2005) also find high short-selling activity for a slightly different time period.

[2] See, for example, Asquith, Pathak, and Ritter (2005), Boehmer, Jones, and Zhang (2005), Desai, Ramesh, Thiagarajan, and Balachandran (2002), Lamont (2005), and Diether, Lee, and Werner (2007).

sellers more successful using short or long horizons? How do the short-term strategies differ from the long term strategies? Is short horizon profitability related to ancipating specific informational events? Also, the time horizon dynamics of shorting profitability potentially have implications for understanding the efficiency of the market. For example, if short-sellers are only profitable over short horizons then that would seem to suggest that mispricing is corrected fairly quickly and that long term deviations from fundamentals are rare or at least short-sellers cannot exploit them very easily.

In this paper I attempt to answer the preceding questions. Despite its importance, the direct profitability of short-selling is unaddressed in the existing literature because of the lack of data. More significantly very little is known about how short-selling profitability varies over the horizon of shorting. Direct profitability and particularly the time horizon dynamics of profitability can only be addressed well using contract level data. Most previous studies only have access to monthly short interest. Studies that use contract level data are generally limited to relatively short sample lengths of between one year and 18 months.[3] I use a panel of daily contract level data that span six years (September 1999 to August 2005). The data allow me to directly measure the profitability of short-selling contracts both before and after short-selling costs. Most significantly that data allow me to examine the time horizon dynamics of shorting profitability.

I find that short-selling is profitable on average. If I use a size (market-cap) matched index or a size-book to market matched index as the long side of the trade, then short-sellers show strong profitability on average both before and after shorting costs. For example, the size adjusted average return is, a significant, 1.23% per month before shorting costs and 1.03% after taking into account short-selling costs. On average the short position by itself does make positive profits; the average return is 0.38% before costs and 0.18% after costs per month. However, these results are not statistically significant. Thus short positions, in aggregate, do not capture significant price declines, and are only significantly profitable in aggregate using possible characteristic based pair trades.

[3]See, for example, D'Avolio (2002), Jones and Lamont (2002), Geczy, Musto, and Reed (2002), Ofek and Richardson (2003), Reed (2002), Ofek, Richardson, and Whitelaw (2004), and Mitchell, Pulvino, and Stafford (2002).

Furthermore, I find that profitability is concentrated in stocks with high shorting costs. Stocks, in the lowest loan fee category (less than 1% per annum) actually exhibit negative and insignificant profitability. All other loan fee categories exhibit positive and significant average abnormal returns at least before costs. Average abnormal returns are only significant both before and after costs for the highest loan fee category (a loan fee at least equal to 5% per annum). In fact, the short position itself produces a large in magnitude and significant before cost average return of 2.27% (per month) for the highest loan fee category. Thus for stocks with high loan fees, short-sellers do capture significant profits from the unpaired short-selling position. Profitability is also concentrated in the smallest 25% of stocks based on NYSE market-cap breakpoints. Average abnormal returns are virtually zero for stocks larger than the NYSE median market-cap. This seems to provide evidence about a difference in market efficiency for these two classes of stocks.

In aggregate short-sellers are not profitable over short horizons. Short-selling profitability increases monotonically with horizon. There is no evidence in the overall sample of significant profitability on average in the first few days or weeks of a contract. On the other hand, a portfolio consisting of contracts that have existed for at least 13 weeks does exhibit significant average abnormal returns. This suggests that many profitable trades do not realize their profitability over a short horizon of a week or two. This seems consistent with the hypothesis that at least a significant portion of profitable short-selling is based on longer term fundamentals. The evidence is also consistent with the hypothesis that sometimes mispricing does not get corrected very quickly.

Not all profitability is confined to longer horizons. In both micro-cap stocks and stocks with high loan fees there is evidence of large profitability on average in the first week of a contract. For example, among stocks with high loan fees the average raw return on a portfolio, comprised of positions in their first week of trading, is 4.34% (per month) and the size adjusted return is 5.57% (both before shorting costs). Thus short-sellers show strong ability to anticipate large short-term price declines at least for some subsamples. Not only do short-sellers anticipate these large price declines but their timing seems to be very precise. This may suggest that short-sellers tend to be informed or have private information about upcoming informational events. However, it doesn't appear that short-sellers are not anticipating poor earnings announcements. Excluding short position around earnings announcements only reduces short horizon returns slightly.

There are limitations to the data. I do not know the identity of the short-sellers and cannot track individual short-sellers over time. Thus I cannot test hypotheses related to the persistence in profitability of individual short-sellers. Second, I do not observe the long positions of the short-sellers. I do not know if they engaged in a pairs trade where there is a short position in a stock and a long position in a different stock or index. Thus I compute profits relative to a series of potential benchmark portfolios. Second, I do not know the motivation of the short-seller. Thus it is possible that some of the short-sale contracts represent hedging and not information trades or trades based on a perception of mispricing. In general, I do not think this is the case for most of the contracts because the median shorting cost is close to 3% per annum. Thus the typical contract would represent an expensive hedging instrument.

The remainder of the paper is organized as follows. Section I reviews the related literature. Section II describes the mechanics of short-selling and how to compute the returns of a short-selling strategy. Section III describes the data. Section IV describes the basic methodology and presents empirical results regarding short-selling profitability. Section V explores the relation between short-selling profitability and the characteristics of contracts and stocks shorted. Section VI examines the relation between shorting horizons and profitability. Section VII concludes.

I. Related Literature

Many papers explore the theoretical link between short-selling activity and asset prices.[4] Miller (1977) suggests that short-sale constraints may prevent negative information or opinions from being expressed in stock prices. He argues that a stock's price will reflect the valuations of optimistic investors because pessimists simply sit out of the market when short-selling is not allowed. Miller's (1977) hypothesized effect is most dramatic when short-selling is prohibited, but his hypothesis

[4]See Miller (1977), Harrison and Kreps (1978), Jarrow (1980), Diamond and Verrecchia (1987), Allen, Morris, and Postlewaite (1993), Morris (1996), Duffie, Garleanu, and Pedersen (2002), Hong and Stein (2003), Scheinkman and Xiong (2003), and Rubinstein (2004).

predicts overpricing as long as there are short-sale constraints. Differences of opinion can arise from overconfidence (Scheinkman and Xiong (2003)) or from differences in prior beliefs which are updated rationally as information arrives (Morris (1996)). Regardless of how the differences of opinion arise, all of the models predict if there are short-sale constraints, prices may become too high today and consequently will experience low subsequent returns.

In contrast to Miller's (1977) hypothesis, Diamond and Verrecchia (1987) argue that rational uninformed agents take the presence of short sale constraints into account when forming their valuations. Thus in their model there is no overpricing conditional on public information because all participants recognize that negative opinions have not made their way into the order flow. Diamond and Verrecchia's (1987) model *does* predict that short sale constraints impede the flow of private information, and that the release of negative private information (e.g., via an unexpected increase in shorting activity) leads to negative returns.

Empirically, much of the literature focuses on the link between monthly short interest (shares sold short divided by shares outstanding) and future returns. In general, these studies find that when short interest is high subsequent average returns are low. For example, Asquith and Meulbroek (1995) and Desai, Ramesh, Thiagarajan, and Balachandran (2002) find significant average abnormal returns for stocks with high short interest on, respectively, the NYSE and Nasdaq exchanges for 1976 to 1993 and 1988 to 1994. Figlewski and Webb (1993), Figlewski (1981), and Dechow, Hutton, Meulbroek, and Sloan (2001) also find that stocks with high short interest experience low subsequent returns. Not all past studies find a significant relation between monthly short interest and future returns. Desai, Ramesh, Thiagarajan, and Balachandran (2002) argue that the weak results in early studies could be due to the use of small and/or biased samples. Recently, some papers have examined the link between daily measures of shorting activity and future returns. Boehmer, Jones, and Zhang (2005) and Diether, Lee, and Werner (2007) both find that high daily shorting activity predicts low subsequent average returns.

Other studies use proxies for short-sale constraints and/or demand to investigate the link between short-selling and future returns. Chen, Hong, and Stein (2002) use breadth of mutual fund ownership, Diether, Malloy, and Scherbina (2002) use dispersion in analysts' earnings per share forecasts, Nagel (2005) uses residual institutional ownership, and Lamont (2004) uses actions by firms that impede short-selling. All of these studies find that when their proxies indicate that short-selling demand is high, future returns are low on average.

Recent studies examine the role of shorting costs in the lending market and the equity market (see D'Avolio (2002), Cohen, Diether, and Malloy (2006), Jones and Lamont (2002), Geczy, Musto, and Reed (2002), Ofek and Richardson (2003), Reed (2002), Ofek, Richardson, and Whitelaw (2004), and Mitchell, Pulvino, and Stafford (2002)). Jones and Lamont (2002) and Cohen, Diether, and Malloy (2006) focus on and find evidence of a significant relation between shorting costs and future returns. Jones and Lamont (2002) using a small database of loan fees from 1926 to 1933, find that stocks with high loan fees experience low subsequent returns. However, the effect is modest; the authors only find large negative size-adjusted returns (-2.52% in the following month) among stocks that are both expensive to short and new to the loan crowd (another proxy for high shorting demand). Cohen, Diether, and Malloy (2006) find that high costs predict low future returns. On average stocks with loan fees greater than 5% per annum experience a significant subsequent average abnormal return lower than -2% the following month. Furthermore, stocks that experience an increase in their lending fee, quantity shorted, or both also experience significantly negative subsequent average abnormal returns.

Overall, the previous literature finds a link between shorting activity and future returns and shorting costs and future returns. Certainly the preceding evidence is suggestive that short-sellers actually are profitable, but it is indirect and may under or overstate how successful short-sellers are in terms of picking mispriced stocks or timing their trades. Furthermore, very little is known about the dynamics of their trades and whether short-sellers can be persistently profitable. In this paper I attempt to fill this void in the literature.

II. Returns to Short-Selling

If a short-seller borrows a stock (via her broker) and sells the stock short, then the short-seller does not get access to the proceeds of the sale. Instead, the proceeds are held in a collateral account until the short-seller closes out her position by returning the borrowed shares. The collateral requirement is usually slightly higher than 100% of the proceeds. The collateral requirement is quite similar for most stocks but there is some variation across shorting contracts. For example, collateral requirements are often higher for low priced stocks. The collateral account accrues interest; the account usually has a rate of return close to LIBOR or the Fed funds rate. The short-seller does not receive all of the interest from the collateral account. A portion of the interest is payed to the lender. The portion received by the short-seller is called the rebate rate. The loan fee is the difference between the rebate rate and the interest rate paid by the collateral account. The loan fee is the main direct cost of shorting, and it is the price that equilibrates supply and demand in the equity lending market. Loan fees can be larger than the collateral account interest rate. In this situation the lender is receiving all of the interest from the collateral account plus the short-seller is paying an additional interest charge out of pocket. This situation mechanically corresponds with a negative rebate rate. Finally, the short-seller is also required to pay any dividends to the lender if the firm sold short pays a dividend.

If a short-seller takes a short position in General Motors, then the return on her position before short-selling costs is,

$$r_{\text{before costs}} = r_f - r_{gm}, \tag{1}$$

and the return on her position after accounting for short-selling costs is,

$$r_{\text{after costs}} = r_f - r_{gm} - \frac{P_{collateral}}{P} fee \tag{2}$$

where r_f is the rate of return on the collateral account, r_{gm} is the return on General Motors (GM),

P is the price the shares are sold at, $P_{collateral}$ is the collateral requirement per share sold short, and fee is the loan fee that the short-seller must pay to short GM. The short-seller is taking a long position in the riskfree rate (or a very similar rate) implicitly as part of the short-selling process because the proceeds are held in a collateral account. The full direct cost of shorting is the loan fee multiplied by the collateral requirement ($\frac{P_{collateral}}{P} fee$).

Suppose, that a short-seller forms a zero cost portfolio by buying Toyota and shorting GM. The short-seller does not have access to the short-sale proceeds so she must borrow inorder to form a zero cost portfolio. Assuming she can do this at the same rate as the collateral account interest rate (r_f), then the return on her portfolio before shorting costs is,

$$r_{\text{before costs}} = r_{toy} - r_{gm} \tag{3}$$

and the return on her portfolio after accounting for short-selling costs is,

$$r_{\text{after costs}} = r_{toy} - r_{gm} - \frac{P_{collateral}}{P} fee \tag{4}$$

where r_{toy} is the return on Toyota. Regardless of whether the short-seller engages in a pairs trade or simply shorts a stock and consequently implicitly takes a long position in the riskfree rate, the direct cost of shorting is the loan fee multiplied by the collateral requirement.

III. Data

A. Data Description

I use a proprietary database of stock lending contracts from a large institutional investor during the period of September 1999 to August 2005. I do not name the institution because of a confidentiality agreement. However, the institution is an active lender. The institution is particularly active in the small-cap lending market. The database contains daily contract level short-selling data. For each contract-day I have the following variables: loan fees, rebate rates, shares on loan, collateral amount, rate of return on the collateral account, estimated income from each loan, and broker firm names.

In this paper I examine the profitability of short-selling contracts. To do this I have to be able to uniquely identify the short-selling contracts over time. The basic unit of observation is the contract-day. The database does not have an explicit contract identifier, but I can track the contracts over time with a very high degree of accuracy. I can uniquely identify virtually all the contracts over time because the data specify the size of the contract, the date the contract began, and the broker used for the contract.

I identify 282,811 contracts during the period of September 1, 1999 to August 31, 2005. I only include a contract in the sample if it lasts at least one day. I exclude contracts that start and end on the same trading day because I confine our study to the daily and not the intra-daily horizon. I also exclude contracts that cannot be matched with daily return data from CRSP.

B. Summary Statistics

Table I presents summary statistics for a pooled sample of all 282,811 contracts. The loan fee variable is the loan fee on the first day of the contract expressed per annum. The median (average) loan fee is 2.45% (3.14%). There is substantial variation in loan fees across contracts. The 25th percentile is 0.16% and the 75th percentile is 5.19%. Furthermore, about 45% of the sample had a negative rebate rate on the first day of the contract (loan fee greater than the collateral account interest rate). The substantial overall costs for the sample suggests that most or at least a large portion of the contracts are not driven by hedging concerns. The median contract size is $57,750. The average is much larger than the median which reflects the fact that there are some very large contracts in the data. The median contract lasts 11 trading days, and the average is 38.12 days. Thus, the contract data are *not* primarily comprised of very short term contracts lasting only a few days. Even the 25th percentile is 4 days. Of course, I exclude intra-day contracts from the data which inflates the numbers relative to the universe of all contracts in the lending database. If the contracts that start and end during the same trading day are included, the median contract length is

7 trading days.

I also merge the contract data with information from a variety of other sources. I draw data on daily returns, prices, shares outstanding, and other items from CRSP, book equity and earnings announcements from COMPUSTAT, analyst and quarterly institutional holding data from CDA/Spectrum. Table I also presents summary statistics for the characteristics of the stocks sold short. The typical contract shorts a small low priced growth stock. The median market-cap (measured the first day of the contract) is only 266 million. This clearly puts the typical stock below the 25th NYSE market-cap percentile throughout the sample.[5] This is a clear manifestation of the small-cap lending tilt of the data provider. On the other hand, some contracts involve very large stocks. For example, there are contracts involving both Microsoft and Intel in the sample.

Despite a tendency to short growth stocks, the short-sellers show little tendency to short past winners. The median return from 250 trading days to 5 days before the start of the contract is -8.17%. However, the average return during this same period is 21.86%. Therefore, there are some shorted stocks that did quite well during the year before the beginning of the contract. Also, there doesn't seem to be much of a tilt towards short-term past winners: the past five day median return is 0.00%. However, once again the average is positive. This seems to be at odds with the findings of Diether, Lee, and Werner (2007); they find that short-selling activity is significantly higher in days where the return over the past 5 days was high. This difference may be caused by the different nature of the samples. I exclude contracts that start and end in the same trading day, and the contracts represent loans from one particular lender rather than all short-selling transactions in a given day.

Table II reports pooled correlation estimates between contract characteristics and the characteristics of the stocks shorted. First, the strongest correlation with the loan fee of the contract is the log market-cap of the stock shorted. The estimated coefficient is -0.567. Small-cap stocks are more expensive to short than large-cap stocks. Loan fees are also negatively correlated with the log of contract size in dollars (Csize). The estimated coefficient is -0.435. This is probably a reflection

[5]The 25th NYSE market-cap percentile measured June 30 of each year of the sample period ranges from a low of 267 million in June 2000 to a high of 750 million in June of 2005

of the fact that on average short-sellers are able to take larger positions in larger stocks. Loan fees are also positively related to past volatility and the coefficient is 0.333.

IV. The Short-Selling Portfolio

To examine whether short-sellers are profitable on average, I form an aggregate short-selling portfolio where I mimic the positions of the contracts in the lending sample. In day $t-1$, I compute the number of shares on loan by the lender for every stock in the sample. The weight on a stock in the portfolio is the dollar value of shares sold short (closing price times shares sold short) divided by the dollar value of all shares on loan by the lender in day $t-1$. Thus the weight on stock i (w_{it}) in the short-selling portfolio (P) is

$$w_{it} = \frac{\sum_{j=1}^{C_{it}} s_{ijt-1} P_{it-1}}{\sum_{i=1}^{N_t} \sum_{j=1}^{C_{it}} s_{ijt-1} P_{it-1}}, \tag{5}$$

where s_{ijt-1} is the number of shares of stock i on loan for contract j on day $t-1$, P_{it-1} is the price of stock i on day $t-1$, C_{it} is the number of contracts that involve shorting stock i on day t, and N_t is the number of stocks in the portfolio (and the number on loan by the lender) on day t. Thus, the before cost return on the short-selling portfolio ($-r_{pt}$) in day t is

$$\begin{aligned} -r_{pt} &= \sum_{i=1}^{N_t} w_{it}(-r_{it}) \\ &= \sum_{i=1}^{N_t} \left(\frac{\sum_{j=1}^{C_{it}} s_{ijt-1} P_{it-1}}{\sum_{i=1}^{N} \sum_{j=1}^{C_{it}} s_{ijt-1} P_{it-1}} \right) (-r_{it}), \end{aligned} \tag{6}$$

where r_{it} is the return on stock i in day t.

I also compute the after short-selling cost return on the portfolio. The direct daily cost of short-selling is equal to the daily loan fee multiplied by the collateral requirement. For each contract I compute the daily loan fee as the daily rate that, over the number of trading days in a year (250 days), compounds to the reported (annual) loan fee. Many times there are multiple short-selling contracts for a particularly stock on a given day. Most of the time these contracts have the same or very similar loan fees, but there is variation. Thus the return in day t for every contract is potentially different even when the contracts represent short positions in the same stock. Thus, the weight of contract j that shorts stock i on day t (w_{ijt}) in the short-selling portfolio is

$$w_{ijt} = \frac{s_{ijt-1}P_{it-1}}{\sum_{i=1}^{N_t}\sum_{j=1}^{C_i} s_{ijt-1}P_{it-1}}, \tag{7}$$

and the after short-selling cost return on the portfolio is

$$-r_{pt} = \sum_{i=1}^{N}\sum_{j=1}^{C_i} w_{ijt}\left(-r_{it} - \frac{P_{collateral,ijt-1}}{P_{it-1}} f_{ijt}\right), \tag{8}$$

where f_{ijt} is the daily loan fee for contract j shorting stock i on day t and $P_{collateral_{ijt-1}}$ is the collateral requirement per share sold short for contract j and stock i in day $t-1$.

I form the short-selling portfolio every trading day and compute the return both before and after shorting costs. I also benchmark the returns using a series of benchmark portfolios. First, I simply benchmark relative to the riskfree rate ($r_f - r_p$). The daily riskfree rate is computed as the daily rate that, over the number of trading days in the month, compounds to the 1-month t-bill rate. If the short-seller takes no explicit long position (i.e., a pairs trade) then the short-seller is implicitly taking a long position in the riskfree security because the short-sale proceeds are put into the collateral account where they earn a rate of return close to the t-bill rate (at least before shorting costs). Second, I benchmark relative to the CRSP daily value-weight stock index ($r_M - r_p$). Third, I characteristically adjust the returns (as in Grinblatt and Moskowitz (1999) and Daniel, Grinblatt, Titman, and Wermers (1997)) using size benchmark portfolios ($r_{ME} - r_p$): 10 value-weight size portfolios. Lastly, I characteristically adjust the returns (as in Grinblatt and Moskowitz (1999) and Daniel, Grinblatt, Titman, and Wermers (1997)) using size-book to market benchmark portfolios ($r_p - r_{ME,B/M}$): 25 value-weight size-book to market portfolios.[6] In each of these last three cases,

[6] I form the size and the size-book to market (B/M) portfolios as in Fama and French (1993). On the last day of June of year t I sort NYSE stocks by their market equity (ME). I also sort NYSE stocks independently by their book to market ratio. I use the ME and B/M breakpoints to allocate all stocks into the appropriate ME deciles and ME and B/M quintiles. I then form 10 value-weight size and size-B/M portfolios using all common stock on CRSP. I compute

the benchmark portfolio represents the long side of the zero-cost portfolio as described in section III. The long position is funded by borrowing because the short-seller does not have access to the short-sale proceeds.

Panel A of Table III presents average returns for the short-selling portfolio. I multiply all the daily returns by 21 inorder to make the numbers more comparable to the typical monthly return found in the literature. I account for autocorrelation in daily returns by using Newey-West (1987) standard errors with a lag length of one. Short-sellers do make positive returns on average both before and after costs from just their short-selling positions ($r_f - r_p$). The average monthly return on $r_f - r_p$ is 0.38% before costs and 0.18% after costs. However, these magnitudes are not significant. If the long position is the CRSP value-weight index of stocks, then the average returns are slightly larger (0.45% before costs and 0.25% after costs) but still insignificant. The short-selling portfolio displays significantly positive average returns when a size-matched or size-B/M matched portfolio is used as the long position. For example, when the size-matched portfolio is used the average return is 1.23% before costs and 1.03% after costs. The t-statistics are quite large both before and after costs (3.12 and 2.45 respectively). Thus the relative performance of the shorted stocks is very poor; the shorted stocks perform significantly worse over the horizon they are shorted than stocks with similar market-cap or similar market-cap and book to market ratio. Thus the relative but not the absolute performance of short-sellers is significantly positive both before and after short-selling costs.

I prefer using the characteristic benchmarking instead of factor model benchmarking because it has a natural correspondence with long/short zero cost portfolios. In addition, it is possible that the short-selling portfolio does not have stable factor loadings because of the changing composition through time. However, I also compute but do not tabulate average abnormal returns using the Fama-French (1993) three factor model and a four factor model that adds a momentum factor

daily returns on the portfolio from July of year t to June of year $t+1$. The B/M ratio in June of year t is comprised of the book equity (B) for the fiscal year ending in calendar year $t-1$, and market equity (M) from end of December of $t-1$. The portfolios are rebalanced annually.

(Carhart (1997)).[7] Both the three factor and four factor model alphas are very similar in terms of magnitude and significance to the characteristic benchmarking based on size or size-B/M portfolios. For example, the three factor model alpha for the before shorting costs portfolio is 1.32% and the t-statistic is 2.91.

The results do suggest that short-selling is profitable on average. However, I do not find significant average returns until I use a size or size-B/M benchmark portfolio as the long side of the trade. In both cases I find large and significant average abnormal returns. Thus I find positive but insignificant absolute performance but significant relative performance. These results seem to suggest that short-sellers often have better information or are able to spot mispricing better than the previous literature has been able to identify. The previous literature finds that significant abnormal returns are confined to strategies involving extremely high loan fees and/or quantities and that shorting in general doesn't predict significant average abnormal returns.(for example, see Cohen, Diether, and Malloy (2006)). This suggests an even stronger link between short-selling and future returns than has been previously documented.

The previous portfolios included all lending contracts in the sample. This is likely to lump both uninformed and informed short-sellers together. I try to isolate more informed samples of short-selling by disaggregating the short-selling portfolio by contract size. First, I form three (bottom 30%, middle 40%, and top 30%) shorting portfolios based on the contract size (price times shares on loan) of the loan on day $t-1$. Panel B of Table III presents the results. Average returns are much smaller among the smallest contracts. For example, the average excess return ($r_f - r_p$) is actually a negative but insignificant -0.56% per month before cost and -1.11% after cost. The size adjusted average returns are 0.77% before costs and 0.21% after costs (both insignificant).

[7] I compute the three factor model and four factor model average abnormal returns by regressing

$$r_f - rp = a_p + b_p(r_M - r_f) + s_p(SMB) + h_p(HML) + e_p \tag{9}$$

$$r_f - rp = a_p + b_p(r_M - r_f) + s_p(SMB) + h_p(HML) + u_p(UMD) + e_p, \tag{10}$$

where $r_M - r_f$ is the excess return on CRSP value-weight index of stocks, SMB is the return on the size factor, HML is the return on the value factor, and UMD is the return on the momentum factor. I obtain daily returns on the factors (SMB, HML, and UMD) from Ken French's data web-site: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/. I account for autocorrelation in daily returns by using Newey-West (1987) standard errors with a lag length of one.

The middle contract size is the most profitable but both the middle and large portfolios achieve significant size and size-B/M adjusted abnormal returns both before and after short-selling costs. The raw average returns are not significant for either the middle or large contracts. Thus removing the smallest contract and focusing on more economically important contracts does slightly increase overall profitability.

V. Short-Selling Profitability by Market-Cap and Loan Fee

A. Loan Fees

The previous literature finds a strong link between high loan fees and future returns. In untabulated results I find that stocks with loan fees greater than 5.0% in month $t-1$ experience a significant size-adjusted average return of -1.84% in month t. However, the excess returns for this strategy are much smaller and not significant. Is this pattern true when I examine the actual short-selling positions? Are short-sellers most profitable among stocks with high loan fees? Do they sell too early or late? Are the contracts still profitable after taking costs in account? Do contracts involving high loan fees drive the significant average returns I find in section IV?

I disaggregate the short-selling portfolio by the loan fee on the first day of the contract.[8] I split the contracts into four categories based on the first day loan fee:

1. $fee < 1\%$,
2. $1\% \leq fee < 3\%$,
3. $3\% \leq fee < 5\%$,
4. and $fee \geq 5\%$.

In day $t-1$, I compute the number of shares on loan by the lender for every stock in the lending sample. The weight on a stock in the portfolio is the dollar value of shares sold short divided by the dollar value of all shares on loan by the lender in the respective loan fee category. I then compute the returns on the portfolios both before and after shorting costs as I described in section IV.

[8]Loan fees within a particularly contract do often vary over the life of the contract.

Panel A of Table IV present results for short-selling portfolios disaggregated by loan fee categories. There are substantial differences across the loan fee categories. The average return on the first loan fee portfolio ($fee < 1\%$) is actually negative even when benchmarked relative to size or size-B/M portfolios. In fact, the low fee short-selling portfolio actually displays good (but insignificant) performance from a long perspective. The return using the t-bill rate as the long position is -0.90% (monthly).

In every other loan fee category, I find evidence of significant profitability at least before short-selling costs are taken into account. The size adjusted average return on the 2^{nd} loan fee ($1\% < Fee \geq 3\%$) portfolio before costs is, a significant, 1.45% (t-statistic = 2.07). The 3^{rd} loan fee ($3\% < Fee \geq 5\%$) portfolio has a significant size adjusted average return of 1.69% (t-statistic = 2.34). However, neither one of these portfolios has a significant size or size-B/M adjusted after shorting costs average return. Although, the magnitudes are still well over 1% and the t-statistics over 1.6 for both portfolios. The highest loan fee ($fee > 5\%$) portfolio is significant with respect to every type of benchmarking. Even the short-selling position itself ($r_f - r_p$) is significant before costs; the average return is 2.27% and the t-statistic is 1.95. However, the after shorting costs average return on the raw position is not significant. Both the size and size-B/M adjusted average returns are strongly significant both before and after accounting for short-selling costs. For example, the before cost size adjusted average return is 3.81% (t-statistic = 4.35) and the after cost average return is 3.27% (t-statistic = 3.74). Thus, once again, I find that the link between short-selling and future returns is actually much stronger when I look at the actual short-selling positions. The timing skill of the short-sellers in terms of covering their positions adds significantly to the return of the portfolios. The returns are very large for the high loan fee category even after taking into account short-selling costs.

I perform a more coarse sort in panel B of Table IV by splitting stocks into "cold" and "hot" categories. Hot refers to a negative rebate rate (loan fee greater than the interest rate of the collateral account) and cold to a non-negative rebate rate. This splits the sample into low and high cost contracts. Average raw short-selling returns ($r_f - r_p$) of the cold portfolio are insignificant but the size-adjusted and size-B/M adjusted average returns are significant. The magnitude is 0.73% before costs for the cold portfolio. Raw average returns are not quite significant for the hot portfolio but the magnitude is fairly large: 1.75% per month before costs. The size adjusted returns are quite large and significant: 2.93% per month before costs and 2.51% per month after costs.

B. Market Cap

I now explore the relation between profitability and market-cap. First, I form three portfolios based on NYSE market-cap (measured the last day of June each year) breakpoints: 25%, 50%, and 100%. I combine the largest market-cap quartile with the $3rd$ quartile because there are very few stocks per month in the highest NYSE market-cap quartile. Panel A of Table V presents the results. As expected, I find that profitability is much stronger in micro-cap stocks (the smallest 25%). The largest short-selling portfolio exhibits average returns very close to zero regardless of the benchmark portfolio. Interestingly, the 2^{nd} size portfolio does exhibit positive average returns but even the before cost size or size-B/M adjusted average returns are not significant (e.g., $\bar{r}_{ME} - \bar{r}_p =$ 0.88%). Thus short-sellers are not profitable on average in all small-cap stocks. It appears that the profitability of short-selling is primarily confined to micro-cap stocks.

Market-cap and loan fee are strongly negatively correlated. I attempt to disentangle the role of each by forming portfolios from the intersection of my three market-cap breakpoints and the "cold" and "hot" fee categories from Table IV. Hot refers to a negative rebate rate (loan fee greater than the interest rate of the collateral account) and cold to a non-negative rebate rate. This splits the sample into low and high cost contracts. Panel B of Table V reports the results. In the double sort, I see clear evidence the short-sellers are profitable in non micro-cap stocks. Size adjusted average returns are significant both before and after short-selling costs for small-cap stocks (the second category). The before cost size adjusted average return is 2.95% per month. The raw average return is large (2.20%) but not significant. Thus short-selling profitability does exist outside the micro-cap category. However, overall the small-cap portfolio does not exhibit significant profitability. This may be because loan fees on average are smaller for small-cap stocks than large-cap stocks.

This seems consistent with the hypothesis that extreme mispricing (at least mispricing identified by short-sellers) is only common in micro-cap stocks. Furthermore, there is no evidence of profitability among large-cap stocks. Thus short-seller are unprofitable in large-cap stocks regardless of the loan fee.

I do find evidence of profitability in micro-cap stocks regardless of loan fee. Size-adjusted average abnormal returns are significant and almost 1.5% per month for micro-cap stocks with low loan fees (at least before short-selling costs). Thus at least relative profitability is not confined to only high loan fee contracts.

VI. Timing and profitability

A. The Overall Sample

Next I exam the dynamics and timing of short-selling profitability. Every contract in day $t-1$ is placed in a category based on how many days as of day t the contract has existed. I sort the portfolios into six categories: (1) week 1 ($days < 6$), (2) week 2 ($6 \leq days < 11$), (3) week 3-4 ($11 \leq days < 21$), (4) week 5-8 ($21 \leq days < 31$), (5) week 9-12 ($41 \leq days < 61$), and (6) week ≥ 13 ($days \geq 61$). Thus, for example, the first portfolio only includes shorting contracts that have existed (as of day t) for one trading week or less.

Table VI presents the results for the days shorted portfolios that are comprised of all stocks on loan within their respective categories. I only find evidence of significant profitability for the sixth portfolio; this portfolio is composed of contracts that have been trading 13 weeks or more. The before cost size-adjusted average return is 1.48% (t-statistic = 2.32), and the after cost average is 1.18% (t-statistic = 2.18). There is also a monotonic increase in the size-adjusted average returns: 0.90% per month to 1.48% per month. On the other hand, if I form one portfolio that includes all contracts during that are in their first 4 weeks of trading, then the average before cost sized adjusted return is 1.05% per month and significant. Thus profitability isn't entirely confined to long term horizons. Still, this does suggest that many of the profitable trades do not realize their profitability over a short horizon of a week or two. There is no evidence in the overall sample of significant average profitability in the first few days or weeks of shorting contracts. This seems consistent with the hypothesis that at least a significant portion of profitable short-selling seems to be based on longer term fundamentals. The evidence is also consistent with the hypothesis that sometimes mispricing does not get corrected very quickly.

B. Timing Subsamples

The results in table VI could be potentially misleading or at least not give a very complete picture because short-selling profitability is concentrated in high fee contracts and in contracts involving micro-cap stocks. Consequently, I form days shorted portfolios for various subsamples. First, I form days shorted portfolios for micro-cap stocks (less than the 25th NYSE market-cap percentile) and non micro-cap stocks. Table VII reports the results. In non micro-cap stocks profitability is insignificant over all horizons; none of the categories are significant. Unsurprisingly, there is strong evidence of relative profitability among micro-cap stocks. Sized adjusted before cost returns are significant for contracts that are trading in at least their 13th week. However, there is also large and significant average returns in the first week: 2.98% per month before costs and 2.64% after costs. The raw average is 1.64% per month but is not significant. Thus among micro-cap stocks there evidence of short horizon profitability.

In table VIII I form days shorted portfolios for low and high loan fee categories. In panels B and C I sort contracts into "cold" and "hot" categories. Hot refers to a negative rebate rate (loan fee greater than the interest rate of the collateral account) and cold to a non-negative rebate rate. This splits the sample into low and high cost contracts. Once again, I find evidence of long horizon profitability. The size adjusted return for the 13 weeks or greater portfolio is 2.13% per month before costs and 1.66% after costs. In both cases the average return is significant. The raw return ($r_f - r_p$) is not significant but over 1% per month before costs. The short horizon results are striking. The raw short-selling average return is 4.34% per month for week 1 contracts. Even after costs the raw average return is 3.89%. In both cases the average is highly significant. On a size adjusted basis the average return is 5.57% before costs. Thus there is strong evidence that for high fee stocks, short-sellers anticipate significant price declines at begin short-selling right before the decline.

To assess the importance of these short horizon results in terms of their affect on overall profitability I form a hot (rebate rate < 0) portfolio that excludes contract positions in the first 5 days of existence. The average size adjusted return of this constrained portfolio before costs is still 2.48% per month and significant. Thus the average return is reduced about 0.5% per month when the week 1 contract-days are excluded (see Table IV). The reduction is similar when the week 1 contract-days are excluded from the micro-cap shorting portfolio.

The large short horizon returns suggest that these short-sellers may have private information about soon to be revealed public information. For example, they main have information about earnings a few days in advance of an earnings announcement. To test this possibility I reform my days shorted portfolios but exclude contract days around earnings announcement windows. Specifically, I exclude the five days before, the earnings announcement day, and the day after the earnings announcement: t-5 to t+1. I the form the days shorted portfolios for all contracts and the micro-cap and hot subsamples. Table IX reports the results for the size adjusted average returns of each of the portfolios. It also reports the results of the difference in average returns of the portfolios that include and exclude the earnings announcement windows. The differences are quite small in most cases and none of the differences are significant. For example, excluding the earnings announcement window only reduces the week 1 hot portfolio average return by 0.18% per month. The excluded portfolio still earns an average size-adjusted return of 5.39% before shorting costs. Additionally, excluding the announcement window actually increases the average return for the week 1 micro-cap portfolio. Thus the large short horizon returns for high loan fee contracts and contracts in micro-cap stocks do not seem related to anticipating or predicting bad earnings announcements.

VII. Conclusion

Despite the fact the short-selling activity is common and represents a large share of trading volume, very little is known about whether short-sellers actually do have superior information or whether they can spot mispriced stocks. Additionally, very little is known about the dynamics of short-selling strategies and whether short-sellers consistently pick the right stocks to short.

Short-sellers do seem to be profitable on average. If I use a size (market-cap) matched index or a size-book to market matched index as the long side of the trade, then I find profitability that is large in magnitude and statistically significant on average both before and after shorting costs. This profitability is concentrated in micro-cap stocks and stocks with high loan fees. Stocks, in the lowest loan fee category (less then 1% per annum) actually exhibit negative and insignificant profitability. All other loan fee categories exhibit positive and significant average abnormal returns at least before costs. However, average abnormal returns are only significant both before and after costs for the highest loan fee category (a loan fee at least equal to 5%). In fact, the short position by itself earns a large and significant before cost average return for the highest loan fee category.

In aggregate short-sellers are not profitable over short horizons. Short-selling profitability increases monotonically with horizon. There is no evidence in the overall sample of significant profitability on average in the first few days or weeks of a contract. On the other hand, a portfolio consisting of contracts that have existed for at least 13 weeks does exhibit significant average abnormal returns. This suggests that many profitable trades do not realize their profitability over a short horizon of a week or two. This seems consistent with the hypothesis that at least a significant portion of profitable short-selling is based on longer term fundamentals. The evidence is also consistent with the hypothesis that sometimes mispricing does not get corrected very quickly.

Not all profitability is confined to longer horizons. In both micro-cap stocks and stocks with high loan fees there is evidence of large profitability on average in the first week of a contract. For example, among stocks with high loan fees the average raw return on a portfolio, comprised of positions in their first week of trading, is 4.34% (per month) and the size adjusted return is 5.57% (both before shorting costs). Thus short-sellers show strong ability to anticipate large short-term price declines at least for some subsamples. Not only do short-sellers anticipate these large price declines but their timing seems to be very precise. This may suggest that short-sellers tend to be informed or have private information about upcoming informational events. However, it doesn't appear that short-sellers are not anticipating poor earnings announcements. Excluding short position around earnings announcements only reduces short horizon returns slightly.

Overall, the evidence seems clear. Short-sellers are profitable on average and the magnitude of the profitability is large both before and after taking into account short-sale costs. Additionally, the evidence suggests that overall short-sellers are most successful in longer horizon trades. However, among some subsamples that show spectacular success anticipating and large short-term price declines.

References

Allen, Franklin, Stephen Morris, and Andrew Postlewaite, 1993, Finite bubbles with short sales constraints and asymmetric information, *Journal of Economic Theory* 61, 206–229.

Asquith, Paul, and Lisa Meulbroek, 1995, An empirical investigation of short interest, Working paper, Harvard Business School.

Asquith, Paul, Parag Pathak, and Jay Ritter, 2005, Short interest, institutional ownership, and stock returns, *Journal of Financial Economics* 78, 243–276.

Boehmer, Ekkehart, Charles M. Jones, and Xiaoyan Zhang, 2005, Which Shorts are Informed, Working Paper Columbia University.

Carhart, Mark M., 1997, On persistence in mutual fund performance, *Journal of Finance* 52, 57–82.

Chen, Joseph, Harrison Hong, and Jeremy C. Stein, 2002, Breadth of ownership and stock returns, *Journal of Financial Economics* 66, 171–205.

Cohen, Lauren, Karl B. Diether, and Christopher J. Malloy, 2006, Supply and Demand Shifts in the Shorting Market, *Journal of Finance*, forthcoming.

Daniel, Kent D., Mark Grinblatt, Sheridan Titman, and Russ Wermers, 1997, Measuring mutual fund performance with characteristic-based benchmarks, *Journal of Finance* 52, 1035–1058.

D'Avolio, Gene, 2002, The market for borrowing stock, *Journal of Financial Economics* 66, 271–306.

Dechow, P., A. Hutton, L. Meulbroek, and R. Sloan, 2001, Short-sellers, fundamental analysis and stock returns, *Journal of Financial Economics* 61, 77–106.

Desai, Hemang, K. Ramesh, S. Ramu Thiagarajan, and Bala V. Balachandran, 2002, An investigation of the informational role of short interest in the Nasdaq Market, *Journal of Finance* 52, 2263–2287.

Diamond, Douglas W., and Robert E. Verrecchia, 1987, Constraints on short-selling and asset price adjustment to private information, *Journal of Financial Economics* 18, 277–311.

Diether, Karl B., Kuan-Hui Lee, and Ingrid M. Werner, 2007, Can short-sellers predict returns? Daily evidence, Working paper, Ohio State University.

Diether, Karl B., Christopher J. Malloy, and Anna Scherbina, 2002, Differences of opinion and the cross-section of stock returns, *Journal of Finance* 57, 2113–2140.

Duffie, Darrell, Nicolae Garleanu, and Lasse Heje Pedersen, 2002, Securities lending, shorting, and pricing, *Journal of Financial Economics* 66, 307–339.

Fama, Eugene F., and Kenneth R. French, 1993, Common risk factors in the returns of stocks and bonds, *Journal of Financial Economics* 33, 3–56.

Figlewski, S., 1981, The informational effects of restrictions on short sales: Some empirical evidence, *Journal of Financial and Quantitative Studies* 16, 463–476.

Figlewski, S., and G. Webb, 1993, Options, short sales, and market completeness, *Journal of Finance* 48, 761–777.

Geczy, Chris, David Musto, and Adam Reed, 2002, Stocks are special too: An analysis of the equity lending market, *Journal of Financial Economics* 66, 241–269.

Grinblatt, Mark, and Tobias Moskowitz, 1999, Do industries explain momentum?, *Journal of Finance* 54, 1249–1290.

Harrison, J., and D. Kreps, 1978, Speculative investor behavior in a stock market with heterogeneous expectations, *Quarterly Journal of Economics* 92, 323–336.

Hong, Harrison, and Jeremy C. Stein, 2003, Differences of opinion, short-sales constraints, and market crashes, *Review of Financial Studies* 16, 487–525.

Jarrow, Robert, 1980, Heterogeneous expectations, restrictions on short sales and equilibrium asset prices, *Journal of Finance* 35, 1105–1114.

Jones, Charles M., and Owen A. Lamont, 2002, Short sale constraints and stock returns, *Journal of Financial Economics* 66, 207–239.

Lamont, Owen A., 2004, Go down fighting: Short sellers vs. firms, Working paper, Yale School of Management.

Miller, Edward M., 1977, Risk, uncertainty, and divergence of opinion, *Journal of Finance* 32, 1151–1168.

Mitchell, Mark, Todd Pulvino, and Eric Stafford, 2002, Limited arbitrage in equity markets, *Journal of Finance* 57, 551–584.

Morris, Stephen, 1996, Speculative investor behavior and learning, *Journal of Financial Economics* 111, 1111–1133.

Nagel, Stefan, 2005, Short sales, institutional investors, and the cross-section of stock returns, *Journal of Financial Economics* 78, 277–309.

Newey, Whitney K., and Kenneth D. West, 1987, A Simple, Positive Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix, *Econometrica* 55, 703–708.

Ofek, Eli, and Matthew Richardson, 2003, Dot com mania: The rise and fall of Internet stock prices, *Journal of Finance* 58, 1113–1137.

Ofek, Eli, Matthew Richardson, and Robert Whitelaw, 2004, Limited arbitrage and short sales restrictions: Evidence from the options markets, *Journal of Financial Economics* 74, 305–342.

Reed, Adam, 2002, Costly short-selling and stock price adjustment to earnings announcements, Working paper, University of North Carolina.

Rubinstein, Mark, 2004, Great moments in financial economics: III. Short-sales and stock prices, *Journal of Investment Management* 2, 16–31.

Scheinkman, Jose, and Wei Xiong, 2003, Overconfidence and speculative bubbles, *Journal of Political Economy* 111, 1183–1219.

Table I
Summary Statistics: Short-Sale Contracts

This table presents pooled summary statistics for short-sale contracts. Loan Fee is the interest rate per annum that the short-seller pays to the lender. The rebate rate is the interest rate from the collateral account that is rebated back to the short-seller. The loan fee plus the rebate rate equals that interest rate earned off of the short-sale collateral. Contract size is the number of shares borrowed by the short-seller mutliplied the price. Contract length is the number of trading day the shares were on loan. Price is the closing stock price on the first day of the short-sale. ME is the market-cap of the shorted stocks on the first day of the contract. B/M is lagged book to market ratio computed as in Fama and French (1993). Institutional ownership (*instown*) is expressed as a percent of shares outstanding and is measured at the end of the most recent quarter before the start of the contract. *tv* is the average daily exchange-adjusted share turnover during the previous 12 months before the start of the contract. σ is the standard deviation of daily returns (multiplied by 21) during the past twelve months before the start of the contract. $r_{-5,-1}$ ($r_{-125,-6}$) is the return on the stock sold-short from day $t-5$ ($t-125$) to day $t-1$ ($t-6$) where day t is the first day of the contract. Panel A reports results for all contracts and panel B sorts contracts into three categories based on the market-cap of the shorted stock (measured on the first day of the contract). The sort is based on NYSE market-cap percentiles: 25%, 50%, and 100%. The time period is September 1, 1999 to August 31, 2005.

	Panel A: All Contracts (N=282,811)			
	Mean	Median	25 Ptile	75 Ptile
Loan Fee	3.14	2.45	0.16	5.19
Rebate Rate < 0%	0.45	0.00	0.00	1.00
Contract Size ($)	578316.99	57750.00	10200.00	353662.50
Contract Length (days)	38.12	11.00	4.00	36.00
Price	15.59	9.05	3.40	22.12
ME (millions)	3380.21	266.11	84.32	1131.53
B/M	0.82	0.47	0.20	0.91
instown	40.50	35.58	13.18	66.49
tv	1.98	1.41	0.79	2.46
σ	23.12	20.15	13.47	29.77
$r_{-5,-1}$	1.15	0.00	-5.21	5.56
$r_{-125,-6}$	9.99	-1.81	-34.16	29.01

	Panel B: By Market-Cap					
	Micro		Small		Large	
	Mean	Median	Mean	Median	Mean	Median
Loan Fee	4.76	4.16	1.75	0.74	0.30	0.12
Rebate Rate < 0%	0.71	1.00	0.20	0.00	0.03	0.00
Contract Size ($)	118523.74	23265.00	667456.02	193375.17	1618531.22	515623.35
Contract Length (days)	49.43	16.00	33.46	11.00	14.38	6.00
Price	6.56	4.31	20.65	18.22	33.55	29.94
ME (millions)	140.32	102.07	735.12	719.23	13157.03	4497.85
B/M	0.92	0.45	0.72	0.45	0.68	0.51
instown	26.92	20.11	50.24	53.37	65.88	70.24
tv	1.80	1.18	2.59	1.95	1.93	1.50
σ	28.01	25.04	20.28	17.77	13.50	11.52
$r_{-5,-1}$	0.83	-0.54	2.03	0.72	1.28	0.78
$r_{-125,-6}$	2.79	-15.46	26.11	8.83	15.18	7.54

Table II
Correlation: Short-Sale Contracts

This table presents pooled estimated correlation coefficient for the sample of short-sale contracts. Loan Fee is the interest rate per annum that the short-seller pays to the lender. Csize refers to the number of shares borrowed by the short-seller multiplied by the stock price from CRSP. Cont. Length refers to the number of trading days the shares were on loan. Price is the price of the stock sold short on the first day of the contract. ME is the market-cap of the stock sold short on the first day of the contract. B/M is lagged book to market ratio computed as in Fama and French (1993). *instown* is institutional ownership expressed as a percent of shares outstanding as is measured at the end of the most recent quarter before the first day of the contract. tv is the average daily exchange-adjusted share turnover during the previous 12 months before the start of the contract. σ is the standard deviation of daily returns (multiplied by 21) during the past twelve months before the start of the contract. $r_{-5,-1}$ ($r_{-125,-6}$) is the return on the stock sold-short from day $t-5$ ($t-125$) to day $t-1$ ($t-6$) where day t is the first day of the contract. The time period is September 1, 1999 to August 31, 2005.

	loan Fee	$\log(Csize)$	Cont. Length	Stock Price	$\log(ME)$	$\log(B/M)$	*instown*	tv	σ	$r_{-5,-1}$	$r_{-125,-6}$
Loan Fee	1.000										
$\log(Csize)$	-0.435	1.000									
Cont. Length	0.080	-0.140	1.000								
Stock Price	-0.425	0.437	-0.161	1.000							
$\log(ME)$	-0.567	0.570	-0.218	0.684	1.000						
$\log(B/M)$	-0.119	0.066	0.031	-0.061	-0.055	1.000					
instown	-0.420	0.379	-0.139	0.426	0.577	0.101	1.000				
tv	0.094	0.009	0.006	0.060	0.069	-0.111	0.062	1.000			
σ	0.333	-0.402	0.159	-0.474	-0.565	-0.031	-0.419	0.158	1.000		
$r_{-5,-1}$	0.002	0.017	-0.024	0.020	0.025	-0.033	0.010	0.007	-0.011	1.000	
$r_{-125,-6}$	0.012	-0.006	0.006	-0.006	-0.003	0.005	-0.000	-0.080	-0.010	0.062	1.000

Table III
Daily Short-Selling Portfolio Returns (in monthly %)

The table presents excess and abnormal returns for a portfolio of all short-selling contracts and portfolios disaggregated by market-cap. In day $t-1$, I compute the number of shares on loan by the lender for every stock. The weight on a stock in the portfolio is the dollar value of shares sold short (price times shares sold short) divided by the dollar value of all shares on loan by the lender. I then compute the return in day t. Panel A reports portfolio average returns before short-selling costs. In panel B I form three portfolios (30/40/30) based on the contract size of the loan in day $t-1$. I report portfolio returns using a series of benchmark portfolios (the benchmark portfolio represents the long position). First, I simply benchmark relative to the riskfree rate ($r_f - r_p$). The daily riskfree rate is the daily rate that, over the number of trading days in the month, compounds to the 1-month t-bill rate. Second, I benchmark relative the the CRSP value-weight stock index ($r_M - r_f$). Third, I use size benchmark portfolios (r_{ME}): 10 value-weight size portfolios. Lastly, I use size-book to market benchmark portfolios ($r_{ME,B/M}$): 25 value-weight size-B/M portfolios. All returns are in percent and multiplied by 21 to make them comparable to monthly returns. T-statistics are computed with a Newey-West lag of 1 and are in parentheses. The time period is September 7, 1999 to August 31, 2005.

	Panel A: Short-Selling Average Portfolio Returns				
	Costs	$r_f - r_p$	$r_M - r_p$	$r_{ME} - r_p$	$r_{ME,B/M} - r_p$
All	Before	0.38	0.45	1.23	1.32
		(0.42)	(0.83)	(3.12)	(3.21)
All	After	0.18	0.25	1.03	1.12
		(0.20)	(0.45)	(2.45)	(2.72)

	Panel B: Short-Selling Average Portfolio Returns by Contract Size				
	Costs	$r_f - r_p$	$r_M - r_p$	$r_{ME} - r_p$	$r_{ME,B/M} - r_p$
small	Before	-0.56	-0.49	0.77	0.53
		(-0.49)	(-0.52)	(0.96)	(0.68)
2	Before	0.82	0.88	2.03	1.78
		(0.82)	(1.22)	(3.40)	(3.14)
large	Before	0.40	0.47	1.20	1.31
		(0.44)	(0.85)	(2.79)	(3.12)
small	After	-1.11	-1.04	0.21	-0.03
		(-0.98)	(-1.12)	(0.26)	(-0.04)
2	After	0.49	0.56	1.71	1.46
		(0.50)	(0.77)	(2.86)	(2.57)
large	After	0.27	0.34	1.07	1.18
		(0.29)	(0.61)	(2.49)	(2.81)

Table IV
Daily Short-Selling Portfolios (in monthly %) Disaggregated by Loan Fee

The table present excess and abnormal returns for daily short-selling portfolios disaggregated based on the loan fee on the first day of the contract. I split the contracts into four categories based on the first day loan fee: $fee < 1\%$, $1\% \leq fee < 3\%$, $3\% \leq fee < 5\%$, and $fee \geq 5\%$. I also split into a $cold$ and "hot" portfolios where hot refers to a negative rebate rate (loan fee greater than the interest rate of the collateral) and cold to a non-negative rebate rate. In day $t-1$, I compute the number of shares on loan by the lender for every stock in CRSP. The weight on a stock in the portfolio is the dollar value of shares sold short (price time shares sold short) divided by the dollar value of all shares on loan by the lender in the respective loan fee category. I then compute the return in day t. Portfolio returns are computed both before and after shorting costs. I report portfolio returns using a series of benchmark portfolio (the benchmark portfolio represent the long position). First, I simply benchmark relative to the riskfree rate ($r_f - r_p$). The daily riskfree rate is the daily rate that, over the number of trading days in the month, compounds to the 1-month t-bill rate. Second, I benchmark relative the the CRSP value-weight stock index ($r_M - r_f$). Third, I use size benchmark portfolios (r_{ME}): 10 value-weight size portfolios. Lastly, I use size-book to market benchmark portfolios ($r_{ME,B/M}$): 25 value-weight size-B/M portfolios. All returns are in percent and multiplied by 21 to make them comparable to monthly returns. T-statistics are computed with a Newey-West lag of 1, and are in parentheses. The time period is September 7, 1999 to August 31, 2005.

		Panel A: Short-Selling Average Portfolio Returns by Fee			
	Costs	$r_f - r_p$	$r_M - r_p$	$r_{ME} - r_p$	$r_{ME,B/M} - r_p$
$fee < 1\%$	Before	-0.90	-0.83	-0.35	-0.39
		(-0.92)	(-1.31)	(-0.58)	(-0.63)
$1\% \leq fee < 3\%$	Before	0.16	0.23	1.22	1.43
		(0.15)	(0.28)	(1.70)	(2.00)
$3\% \leq fee < 5\%$	Before	0.48	0.55	1.66	1.56
		(0.44)	(0.64)	(2.19)	(2.10)
$Fee \geq 5\%$	Before	2.27	2.34	3.68	3.65
		(1.95)	(2.33)	(4.15)	(4.11)
$fee < 1\%$	After	-0.93	-0.86	-0.38	-0.42
		(-0.95)	(-1.36)	(-0.63)	(-0.68)
$1\% \leq fee < 3\%$	After	-0.06	0.01	1.00	1.22
		(-0.05)	(0.02)	(1.39)	(1.70)
$3\% \leq fee < 5\%$	After	0.08	0.15	1.25	1.16
		(0.07)	(0.18)	(1.66)	(1.56)
$fee \geq 5\%$	After	1.57	1.64	2.97	2.94
		(1.34)	(1.62)	(3.35)	(3.31)

		Panel B: Cold and Hot Average Portfolio Returns			
	Costs	$r_f - r_p$	$r_M - r_p$	$r_{ME} - r_p$	$r_{ME,B/M} - r_p$
rebate rate ≥ 0 (Cold)	Before	-0.05	0.02	0.73	0.82
		(-0.06)	(0.03)	(2.01)	(2.12)
rebate rate < 0 (Hot)	Before	1.75	1.82	2.93	2.92
		(1.71)	(2.25)	(4.30)	(4.20)
rebate rate ≥ 0 (Cold)	After	-0.21	-0.14	0.58	0.67
		(-0.23)	(-0.27)	(1.59)	(1.72)
rebate rate < 0 (Hot)	After	1.33	1.40	2.51	2.50
		(1.30)	(1.73)	(3.68)	(3.60)

Table V
Daily Short-Selling Portfolios (in monthly %) Disaggregated by Loan Fee and Market-Cap

The table present excess and abnormal returns for daily short-selling portfolios disaggregated on the market-cap of a stock and on the loan fee on the first day of the contract. In panel A I form three portfolios based on NYSE market-cap (measured during end of June each year) breakpoints: 25%, 50%, and 100%. In panel B further split the portfolios into a cold" and hot" portfolios where hot refers to a negative rebate rate and cold to a non-negative rebate rate. I form portfolios from the intersection of the market-cap and fee breakpoints. In day $t-1$, I compute the number of shares on loan by the lender for every stock in CRSP. The weight on a stock in the portfolio is the dollar value of shares sold short (price time shares sold short) divided by the dollar value of all shares on loan by our lender in the respective market-cap and/or loan fee category. I then compute the return in day t. I report portfolio returns using a series of benchmark portfolio (the benchmark portfolio represent the long position). First, I simply benchmark relative to the riskfree rate ($r_f - r_p$). The daily riskfree rate is the daily rate that, over the number of trading days in the month, compounds to the 1-month t-bill rate. Second, I benchmark relative the the CRSP value-weight stock index ($r_M - r_f$). Third, I use size benchmark portfolios (r_{ME}): 10 value-weight size portfolios. Lastly, I use size-book to market benchmark portfolios ($r_{ME,B/M}$): 25 value-weight size-B/M portfolios. All returns are in percent and multiplied by 21 to make them comparable to monthly returns. T-statistics are computed with a Newey-West lag of 1, and are in parentheses. The time period is September 7, 1999 to August 31, 2005.

Panel A: Short-Selling Average Portfolio Returns by ME

	Costs	$r_f - r_p$	$r_M - r_p$	$r_{ME} - r_p$	$r_{ME,B/M} - r_p$
Micro	Before	0.82	0.89	2.15	2.18
		(0.81)	(1.16)	(3.64)	(3.75)
Small	Before	0.06	0.13	0.88	0.89
		(0.05)	(0.16)	(1.28)	(1.31)
Large	Before	-0.16	-0.09	0.16	0.32
		(-0.16)	(-0.12)	(0.23)	(0.46)
Micro	After	0.45	0.52	1.78	1.80
		(0.44)	(0.67)	(3.01)	(3.10)
Small	After	-0.09	-0.02	0.72	0.74
		(-0.09)	(-0.03)	(1.06)	(1.09)
Large	After	-0.20	-0.13	0.11	0.27
		(-0.21)	(-0.19)	(0.16)	(0.39)

Panel B: Short-Selling Average Portfolio Returns by ME and Fee

		$r_f - r_p$		$r_{ME} - r_p$	
	Costs	Cold	Hot	Cold	Hot
Micro	Before	0.17	1.55	1.46	2.93
		(0.15)	(1.48)	(2.05)	(4.12)
Small	Before	-0.26	2.20	0.55	2.95
		(-0.23)	(1.42)	(0.85)	(2.27)
Large	Before	-0.30	0.35	0.03	1.01
		(-0.30)	(0.14)	(0.04)	(0.45)
		$r_f - r_p$		$r_{ME} - r_p$	
	Costs	Cold	Hot	Cold	Hot
Micro	After	-0.09	1.10	1.20	2.48
		(-0.08)	(1.05)	(1.68)	(3.49)
Small	After	-0.39	1.85	0.42	2.60
		(-0.35)	(1.20)	(0.64)	(2.00)
Large	After	-0.34	0.02	-0.01	0.68
		(-0.34)	(0.01)	(-0.02)	(0.30)

Table VI
Daily Short-Selling Portfolios (in monthly %) Disaggregated by Days Shorted

The table presents excess and abnormal returns for short-selling portfolios disaggregated by days shorted (trading days). I split the contracts into six categories based days shorted: week 1, week 2, week 3-4, week 5-8, week 9-12, and week $\geq$ 13. Every contract in day t is placed in a category based on how many days as of day t the contract has existed. In day $t-1$, I compute the number of shares on loan by the lender for every stock in CRSP. The weight on a stock in the portfolio is the dollar value of shares sold short divided by the dollar value of all shares on loan by the lender in the respective days shorted category. I then compute the return in day t. I report portfolio returns using a two different benchmark portfolios (the benchmark portfolio represents the long position): the daily riskfree rate (r_f) and 10 value-weight size benchmark portfolios (r_{ME}). All returns are in percent and multiplied by 21 to make them comparable to monthly returns. T-statistics are computed with a Newey-West lag of 1, and are in parentheses. The time period is September 7, 1999 to August 31, 2005.

Panel A: Before Shorting Costs Average Portfolio Returns						
	Week 1	Week 2	Week 3-4	Week 5-8	Week 9–12	Week $\geq$ 13
$r_f - r_p$	0.19	0.37	0.25	0.43	0.46	0.44
	(0.20)	(0.34)	(0.22)	(0.36)	(0.35)	(0.43)
$r_{ME} - r_p$	0.90	1.13	1.15	1.34	1.45	1.48
	(1.66)	(1.61)	(1.51)	(1.59)	(1.42)	(2.32)

Panel B: After Shorting Costs Average Portfolio Returns						
	Week 1	Week 2	Week 3-4	Week 5-8	Week 9–12	Week $\geq$ 13
$r_f - r_p$	0.04	0.20	0.06	0.21	0.19	0.14
	(0.04)	(0.18)	(0.05)	(0.17)	(0.15)	(0.13)
$r_{ME} - r_p$	0.75	0.95	0.95	1.12	1.19	1.18
	(1.39)	(1.36)	(1.25)	(1.33)	(1.16)	(1.85)

Table VII
Daily Short-Selling Portfolios Average Returns (in monthly %) by Days Shorted and Market-Cap

The table presents excess and abnormal returns for short-selling portfolios disaggregated by days shorted (trading days) and market-cap. I split the contracts into six categories based days shorted: week 1, week 2, week 3-4, week 5-8, week 9-12, and week $\geq$ 13. Every contract in day t is placed in a category based on how many days as of day t the contract has existed. I form days shorted portfolio for micro-cap stocks (less than the 25th percentile based NYSE market-cap from the previous June end) and non micro-cap stocks (greater than the 25th percentile). In day $t-1$, I compute the number of shares on loan by the lender for every stock in CRSP. The weight on a stock in the portfolio is the dollar value of shares sold short divided by the dollar value of all shares on loan by the lender in the respective days shorted category. I then compute the return in day t. I report portfolio returns using a two different benchmark portfolios (the benchmark portfolio represents the long position): the daily riskfree rate (r_f) and 10 value-weight size benchmark portfolios (r_{ME}). All returns are in percent and multiplied by 21 to make them comparable to monthly returns. T-statistics are computed with a Newey-West lag of 1, and are in parentheses. The time period is September 7, 1999 to August 31, 2005.

		Panel A: Micro-Cap Stocks					
	Costs	Week 1	Week 2	Week 3-4	Week 5-8	Week 9–12	Week $\geq$ 13
$r_f - r_p$	Before	1.64	0.01	1.04	0.41	0.15	0.54
		(1.28)	(0.00)	(0.76)	(0.29)	(0.10)	(0.49)
$r_{ME} - r_p$	Before	2.98	1.00	2.28	1.60	1.86	1.87
		(3.00)	(0.88)	(2.12)	(1.39)	(1.50)	(2.40)
$r_f - r_p$	After	1.28	-0.38	0.65	0.01	-0.26	0.14
		(1.00)	(-0.26)	(0.48)	(0.01)	(-0.17)	(0.13)
$r_{ME} - r_p$	After	2.63	0.61	1.89	1.20	1.45	1.47
		(2.64)	(0.54)	(1.76)	(1.05)	(1.16)	(1.89)

		Panel B: Non-Micro-Cap Stocks					
	Costs	Week 1	Week 2	Week 3-4	Week 5-8	Week 9–12	Week $\geq$ 13
$r_f - r_p$	Before	-0.04	0.43	0.58	0.23	1.55	-0.76
		(-0.04)	(0.36)	(0.45)	(0.18)	(1.02)	(-0.58)
$r_{ME} - r_p$	Before	0.31	1.12	1.42	0.90	1.72	-0.08
		(0.49)	(1.28)	(1.49)	(0.89)	(1.42)	(-0.07)
$r_f - r_p$	After	-0.12	0.32	0.47	0.09	1.38	-0.96
		(-0.12)	(0.27)	(0.36)	(0.07)	(0.90)	(-0.73)
$r_{ME} - r_p$	After	0.23	1.01	1.30	0.76	1.54	-0.28
		(0.36)	(1.16)	(1.37)	(0.76)	(1.27)	(-0.26)

Table VIII
Daily Short-Selling Portfolios Average Returns (in monthly %) by Days Shorted and Loan Fee

The table presents average returns for short-selling portfolios disaggregated by days shorted and beginning of contract loan fee. I split the contracts into six categories based days shorted: week 1, week2, week 3, week 4, week 5–9, and week ≥ 9. I then form days shorted portfolios for different loan fee categories. In day $t-1$, we compute the number of shares on loan by the lender for every stock in CRSP. The weight on a stock in the portfolio is the dollar value of shares sold short divided by the dollar value of all shares on loan by the lender in the respective days shorted category. I then compute the return in day t. Every contract in day t is placed in a category based on how many days as of day t the contract has existed. I report portfolio returns using a two different benchmark portfolios: the daily riskfree rate (r_f) and 10 value-weight size benchmark portfolios (r_{ME}). All returns are in percent and multiplied by 21 to make them comparable to monthly returns. T-statistics are computed with a Newey-West lag of 1, and are in parentheses. The time period is September 7, 1999 to August 31, 2005.

		Panel A: $fee > 1\%$					
	Costs	Week 1	Week 2	Week 3-4	Week 5-8	Week 9–12	Week $\geq$ 13
$r_f - r_p$	Before	1.71	-0.15	0.29	0.95	1.42	0.64
		(1.42)	(-0.11)	(0.22)	(0.72)	(0.99)	(0.61)
$r_{ME} - r_p$	Before	2.95	0.94	1.54	2.07	2.71	1.76
		(3.34)	(0.93)	(1.52)	(2.07)	(2.33)	(2.42)
$r_f - r_p$	After	1.36	-0.52	-0.09	0.56	1.02	0.25
		(1.13)	(-0.38)	(-0.07)	(0.43)	(0.71)	(0.23)
$r_{ME} - r_p$	After	2.60	0.57	1.16	1.68	2.31	1.37
		(2.94)	(0.56)	(1.14)	(1.68)	(1.98)	(1.88)

		Panel B: rebate rate < 0 (Hot)					
	Costs	Week 1	Week 2	Week 3-4	Week 5-8	Week 9–12	Week $\geq$ 13
$r_f - r_p$	Before	4.34	1.39	-0.44	1.71	2.18	1.06
		(2.96)	(0.94)	(-0.28)	(1.17)	(1.36)	(0.95)
$r_{ME} - r_p$	Before	5.57	2.57	0.93	2.83	3.48	2.13
		(4.47)	(2.12)	(0.67)	(2.27)	(2.50)	(2.55)
$r_f - r_p$	After	3.89	0.93	-0.89	1.28	1.74	0.65
		(2.65)	(0.63)	(-0.56)	(0.87)	(1.08)	(0.58)
$r_{ME} - r_p$	After	5.15	2.15	0.45	2.40	2.82	1.66
		(4.19)	(1.82)	(0.33)	(1.92)	(2.05)	(1.99)

		Panel C: rebate rate $\geq$ 0 (Cold)					
	Costs	Week 1	Week 2	Week 3-4	Week 5-8	Week 9–12	Week $\geq$ 13
$r_f - r_p$	Before	-0.29	0.12	0.33	0.16	-0.03	-0.30
		(-0.30)	(0.11)	(0.29)	(0.13)	(-0.02)	(-0.29)
$r_{ME} - r_p$	Before	0.36	0.82	1.14	1.05	0.91	0.68
		(0.69)	(1.11)	(1.55)	(1.29)	(0.94)	(1.08)
$r_f - r_p$	After	-0.40	-0.01	0.18	-0.02	-0.24	-0.53
		(-0.42)	(-0.01)	(0.16)	(-0.01)	(-0.19)	(-0.51)
$r_{ME} - r_p$	After	0.25	0.68	0.99	0.87	0.70	0.44
		(0.47)	(0.92)	(1.35)	(1.08)	(0.72)	(0.70)

Table IX
Before Cost Daily Short-Selling Portfolio Size Adjusted Average Returns ($r_{ME} - r_p$) in monthly %) Excluding Earnings Announcements

The table presents excess and abnormal returns for short-selling portfolios disaggregated by days shorted (trading days) and excluding shorting position taken around earnings announcement windows. I split the contracts into six categories based days shorted: week 1, week 2, week 3-4, week 5-8, week 9-12, and week $\geq$ 13. I also exclude all contract position taken from 5 days before to 1 day after an earnings announcement. In day $t-1$, we compute the number of shares on loan by the lender for every stock in CRSP. The weight on a stock in the portfolio is the dollar value of shares sold short divided by the dollar value of all shares on loan by the lender in the respective days shorted category. I then compute the return in day t. Every contract in day t is placed in a category based on how many days as of day t the contract has existed. I report portfolio returns using a two different benchmark portfolios (the benchmark portfolio represents the long position): the daily riskfree rate (r_f) and 10 value-weight size benchmark portfolios (r_{ME}). All returns are in percent and multiplied by 21 to make them comparable to monthly returns. T-statistics are computed with a Newey-West lag of 1, and are in parentheses. The time period is September 7, 1999 to August 31, 2005.

	Panel A: All					
Include Earnings Announcement Window	Week 1	Week 2	Week 3-4	Week 5-8	Week 9–12	Week $\geq$ 13
Yes	0.90	1.13	1.15	1.34	1.45	1.48
	(1.66)	(1.61)	(1.51)	(1.59)	(1.42)	(2.32)
No	0.80	0.66	0.85	1.40	0.93	1.41
	(1.45)	(0.94)	(1.10)	(1.67)	(0.90)	(2.15)
Diff: Yes-No	0.10	0.47	0.30	-0.06	0.52	0.06
	(0.53)	(1.34)	(0.95)	(-0.20)	(1.65)	(0.31)

	Panel B: Micro-Cap					
Include Earnings Announcement Window	Week 1	Week 2	Week 3-4	Week 5-8	Week 9–12	Week $\geq$ 13
Yes	2.98	1.00	2.28	1.60	1.86	1.87
	(3.00)	(0.88)	(2.12)	(1.39)	(1.50)	(2.40)
No	3.44	0.21	2.55	1.63	1.42	1.78
	(3.42)	(0.19)	(2.37)	(1.48)	(1.13)	(2.19)
Diff: Yes-No	-0.46	0.79	-0.27	-0.04	0.43	0.09
	(-1.31)	(1.73)	(-0.69)	(-0.07)	(1.07)	(0.36)

	Panel C: rebate rate $<$ 0 (Hot)					
Include Earnings Announcement Window	Week 1	Week 2	Week 3-4	Week 5-8	Week 9–12	Week $\geq$ 13
Yes	5.57	2.57	0.93	2.83	3.48	2.13
	(4.47)	(2.12)	(0.67)	(2.27)	(2.50)	(2.55)
No	5.39	2.35	0.99	2.97	2.73	2.05
	(4.38)	(1.92)	(0.71)	(2.42)	(1.92)	(2.40)
Diff: Yes-No	0.18	0.22	-0.06	-0.14	0.75	0.09
	(0.37)	(0.43)	(-0.15)	(-0.35)	(1.90)	(0.33)