

# DISCUSSION PAPER SERIES

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**BIASED SHORTS: STOCK MARKET  
IMPLICATIONS OF SHORT SELLERS'  
DISPOSITION EFFECT**

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*FINANCIAL ECONOMICS*



**Centre for Economic Policy Research**

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# BIASED SHORTS: STOCK MARKET IMPLICATIONS OF SHORT SELLERS' DISPOSITION EFFECT<sup>†</sup>

## Abstract

We investigate whether short sellers are subject to the disposition effect using a novel dataset that allows to identify the weekly closing of short positions. Consistent with the disposition effect, the closing of short sale positions is strongly related to a proxy of Shortsale Capital Gains Overhang (SCGO). Furthermore, while short sellers in general exhibit skill in closing their positions – i.e. closing is followed by positive stock returns – the closing explained by SCGO is followed by negative returns. This suggests that the trades are irrational and caused by the disposition effect. Next, we study the implications of short sellers' disposition effect on stock prices. We provide evidence that SCGO is negatively related to future stock returns. This effect exists after controlling for the standard effect of capital gains overhang of other market participants. A trading strategy based on SCGO achieves yearly three-factor alphas of up to 26%. Overall, our results suggest that short sellers, instead of arbitraging away the mispricing caused by the disposition effect of the other market participants, add to this mispricing due to their own behavioral biases.

JEL Classification: G10, G12 and G14

Keywords: behavioral finance, disposition effect and short selling

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## Introduction

The finance literature has devoted considerable attention to the effects of behavioral biases on the stock market. However, the vast majority of this research focuses either on individual household investors who are neither qualified nor informed enough to make wise financial decisions (e.g., Odean (1998), Odean (1999), Barber and Odean (2000), Huberman (2001), Genesove and Mayer (2001)) or on mutual fund managers (Coval and Moskowitz (1999), Frazzini (2006)), in general assumed to be uninformed. It is less known whether financial professionals possessing both sophistication *and* information also succumb to psychological biases.

The goal of this study is to investigate the prevalence of behavioral biases and irrational trading among investors believed to be rational, sophisticated, and privy to private information. Furthermore, we want to see how their biases affect the stock market. We explore this subject by focusing on short selling, which has the following two advantages. First, short sellers typically are sophisticated and likely informed investors.<sup>1</sup> In fact they often represent large informed traders such as the hedge funds. These characteristics differentiate short sellers markedly from the traditional focus group of the behavioral finance: unsophisticated and/or less informed traders.

Second, the fact that short sellers can scale up their trades to a very high multiple of their underlying capital implies that their actions are likely to have a bigger impact on the market than those of the other investors (individuals or long-only mutual funds). This provides a stronger economic link between the decision-making theory and the financial market effects. This implies that any evidence of behavioral biases among these investors has very relevant equilibrium, practical and normative implications.

While short selling has been extensively researched in the finance literature, it has never been studied in the behavioral context. Rather, short sellers have been perceived as rational speculators and the debate has centered on whether they are detrimental or beneficial to the overall investment community, or whether regulatory short-sale constraints have a tangible effect on stock prices.

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<sup>1</sup> Several studies show that the amount of short selling predicts negative future stock returns (Boehmer, Jones and Zhang (2008), Engelberg, Reed and Ringgenberg (2012), Cohen, Diether and Malloy (2007), Diether, Lee and Werner (2009)) implying that short sellers are informed.

More specifically, we investigate whether the trades of short sellers are indicative of behavioral influence and what are the effects of “irrational” short selling activity on the stock market. We focus on the disposition effect – i.e. the tendency of investors to hold onto their losing stocks to a greater extent than they hold onto their winning stocks (Shefrin and Statman (1985)). This behavioral bias is “one of the most robust facts about the trading of individual investors” (Barberis and Xiong (2009)). If investors are subject to the disposition effect, they should have higher demand for losing stocks than for winning stocks. Therefore, our first hypothesis is that short sellers react to previous accumulated losses/gains by holding on to the stocks in which they lose – i.e., the stocks that experience a cumulated increase in price – and selling the winning stocks – i.e., the stocks that experience a cumulated decrease in price.

This behavior might have equilibrium implications. Following Grinblatt and Han (2005), we argue that short sellers exhibiting the disposition effect will cause stock price underreaction in the presence of market frictions and/or inelastic demand. The argument goes as follows: A series of positive information releases will result in a stock price increase and a capital loss for the short seller. Thus, according to the disposition effect, the short seller will be reluctant to close his losing position (i.e., he will not buy the stock). This implies a downward pressure on prices that would reduce the stock price appreciation caused by the positive news. The same effect causes underreaction to negative news: A negative news event will result in a price decrease leading to capital gains for the short seller and to an early closure of his position. This implies an upward pressure on prices that will reduce the prevailing stock price decrease and therefore induce stock underreaction to negative news as well. As prices revert to their fair value over time, underreaction causes momentum. Therefore, our second hypothesis is that the presence of short sellers with accumulated capital gains (losses) will predict future stock price decrease (increase).

We test these hypotheses by focusing on weekly short selling behavior over the period August 2004 to June 2010 on all US stocks. A novel dataset on equity lending provided by Data Explorers allows us to extract the closing of short positions, which is crucial information when testing for the presence of the disposition effect. We start by investigating whether short sellers are subject to the disposition effect, i.e. whether they are more likely to close positions with higher capital gains. We

therefore define a measure of *Shortsale Capital Gains Overhang (SCGO)* as the average percentage gains of short sellers relative to the price at which they entered their positions. While we do not have individual trading records of short sellers, we can estimate the average price at which positions were entered from aggregate trading behavior by adopting the methodology of Grinblatt and Han (2005). Regressing the closing of short positions on SCGO, we find a strong positive correlation that is statistically very significant and holds across different specifications and econometric methodologies (i.e., both firm and week fixed effects or Fama MacBeth regressions). A one standard deviation increase in SCGO increases the share of open positions that are closed by 0.6 percentage points or 5% relative to the unconditional median. Comparing this finding to the results reported in Odean (1998), we come to the conclusion that individual investors exhibit a disposition effect, which is about 6 times as strong as that of short sellers.

Next, we focus on the profitability of the short sellers' closing of positions. Premature (belated) liquidation of winning (losing) portfolios would indicate a presence of the *disposition effect* previously documented among the general investment public. And indeed, we do find that the closing of positions that can be explained by SCGO is followed by a negative return in the previously shorted stock while the overall closing of short positions is followed by a positive return. This finding is important as it confirms that we observe a behavioral bias – as opposed to some information-related strategy. Short sellers are rational on average, closing their positions with some apparent information of future returns. At the same time, they are also subject to the disposition effect – i.e. they close prematurely (too late) in the presence of positive (negative) capital gains.

Then, we focus on the implications for stock prices. We regress stock returns on our proxy of Shortsale Capital Gains Overhang. We find that *Shortsale Capital Gains Overhang* is negatively related to future stock returns. In particular, one standard deviation increase in *SCGO* decreases the return by 9 basis points per week or 4.7% per year.

Next, we identify the separate impact of Shortsale Capital Gains Overhang when controlling for the capital gains overhang of long investors. We regress stock returns on our proxy of Shortsale Capital Gains Overhang as well as a proxy of capital gains for the market overall (Long Capital Gains Overhang (LCGO)). This allows us to assess whether the effect we have identified is really due to

short selling as opposed to it spuriously proxying for the overall capital gains overhang in the market. We find that SCGO affects future returns even when we control for LCGO. One standard deviation of Shortsale Capital Gain Overhang decreases the return by 6 basis points per week or 3.3% per year, when controlling for Long Capital Gain Overhang. At the same time, one standard deviation increase in Long Capital Gains Overhang, increases the return by 13 basis points per week or 7% per year, when controlling for Shortsale Capital Gain Overhang. This suggests that short sellers' capital gains directly predict negative future returns. Rather than leaning against the mispricing caused by long investors, short sellers add to the mispricing due to their own disposition effect. While the effect of SCGO on future returns is smaller than the effect of LCGO, it is relatively large compared to the fact that short sellers are less biased and constitute a smaller fraction of the market. We approximate that short sellers have a price impact that is roughly 6 times as strong as that of long investors.

Finally, we study portfolios based on a double sort of stocks by past returns and SCGO. Except for the quartile with the most negative past returns, a trading strategy that goes long in the lowest SCGO quartile and short in the highest SCGO quartile earns a 3 factor alpha of 20 to 30 basis points a week or 11.5% to 18% a year. If we exclude January in which trades might be influenced by tax considerations, the alpha increases even more to 26bp to 45bp per week or 14.5% to 26% per year.

Overall, our findings document that short sellers are subject to the disposition effect and show a direct impact of such a bias on stock prices. This analysis has important normative implications. Indeed, there is a big debate on whether short sellers are beneficial or detrimental to the market and whether regulatory short-sale constraints have a tangible effect on stock prices

However, if short sellers themselves are irrational, then the classic view of short selling as an arbitrage device is dubious. We argue and show that the lack of rationality on the short selling side helps to explain why certain market anomalies persist despite the apparent availability of arbitrage capital. This also implies that short sellers may be a source of market frictions as opposed to their deterrent. While this may be considered negative in general, during a crisis, the behavioral biased-related trades help to slow down market reaction, potentially smoothing it. This would imply that any regulation limiting short selling activity may have unintended consequences that go in the direction of amplifying as opposed to reducing the speed and amplitude of market gyrations.

Our findings contribute to several strands of literature. First, we contribute to the literature on short sellers' behavior. Short sellers have been traditionally identified as rational investors either endowed with superior private information (e.g., Cohen, Diether and Malloy (2007)) or better able to process public information (e.g., Engelberg, Reed and Ringgenberg (2012)). We contribute to this literature by showing the behavioral and irrational side of short selling behavior.

Second, we contribute to the literature on the impact of short sellers' behavior on stock prices. Several studies make a connection between short sellers' activity and stock returns (Senchack and Starks (1993), Asquith and Meulbroek (1995), Aitken et al. (1998)). It has been shown that the impact takes the form of improving liquidity and market efficiency (Bris, Goetzmann and Zhu (2007), Boehmer, Jones and Zhang (2008), Boehmer and Wu (2013), Saffi and Sigurdsson (2011)). Alternatively, their impact has been linked to numerous *constraints* to which short sellers are subject (Miller (1977), Jones and Lamont (2002), Diether, Malloy and Scherbina (2002), {{294 Asquith,Paul 2005}}). In both situations, stock characteristics are linked to rational short selling behavior. In contrast, we link mispricing to the unconstrained but *suboptimal decisions* undertaken by the apparently rational and sophisticated traders. The prevalence of the disposition effect among short sellers can explain why stock returns exhibit momentum following salient news announcements. If the winning positions are liquidated too early, then the arbitrage strategy is not executed fully, allowing for the initial mispricing to persist.

Third, we contribute to the literature on behavioral biases and, in particular, on the disposition effect. This is wide both empirical/experimental (e.g., Weber and Camerer (1998), Odean (1998), Locke and Mann (2005), Heath, Huddart and Lang (1999), Grinblatt and Keloharju (2001), {{295 Ben-David,Itzhak 2012}}) and theoretical (Gomes (2005), Berkelaar and Kouwenberg (2000), Barberis and Huang (2001), Barberis, Huang and Santos (2001), Ang, Berkaert, and Liu, 2001). We contribute to it by providing evidence that also supposedly rational and well informed investors such as the short sellers are prone to the disposition effect.

The remainder of the paper is organized as follows. Section 2 lays out the main hypotheses. Section 3, describes the sample and the main variables of interest. Section 4 shows our empirical results. Section 5 contains robustness checks. A brief conclusion follows.

## 2. Main Hypotheses

Much of the economic and financial theory is based on the notion that individuals act rationally and consider all available information in their decision-making process. However, previous research has uncovered substantial evidence that contradicts this assumption and documented repeated errors in judgment by investors. We focus on one bias: the disposition effect (e.g., Weber and Camerer (1998), Odean (1998), Locke and Mann (2005), Gomes (2005), Berkelaar and Kouwenberg (2000), Barberis and Huang (2001), Barberis, Huang and Santos (2001)).

The disposition effect is the bias by which investors do not want to realize their losses and therefore hold on to their losing stocks, while they are willing to close their position to realize paper gains (e.g., Shefrin and Statman (1985)). This bias would induce the investors to react to losses in values for the stocks in their portfolios by increasing risk taking – either holding their stake in the losing stocks or doubling it. This allows us to posit our first hypothesis.

*H1: Short sellers react to previous accumulated losses/gains by holding on to the stocks in which they lose – i.e., the stocks that experience a cumulated increase in price – and selling the winning stocks – i.e., the stocks that experience a cumulated drop in price.*

What are the equilibrium implications? To answer this question, we follow Grinblatt and Han (2005). They provide a theoretical model in which aggregate demand and equilibrium prices evolve over time as a function of the presence of investors who exhibit the disposition effect. They argue that, in the presence of market frictions and/or inelastic demand, if investors are subject to the disposition effect, the presence of unrealized capital gains or losses in the stock would generate price underreaction to public information. “Stocks that have been privy to good news in the past would have excess selling pressure relative to stocks that have been privy to adverse information. This makes the stock price diverge from its fundamental value. Therefore, stocks with aggregate unrealized capital gains (winning stocks) would outperform stocks with aggregate unrealized capital losses (losing stocks)” (Grinblatt and Han (2005)). This implies that the aggregate amount of the unrealized capital gains or losses (“capital gain overhang”) should predict future returns, even after controlling for the effect of past returns. We can therefore posit our second hypothesis.

*H2: Short sale capital gains overhang predicts stock returns. Accumulated short sale capital gains (losses) predict future negative (positive) returns.*

In the presence of some mechanism that determines mean reversion – e.g., fundamentals following a random walk – this may also affect momentum. This mechanism can be originated by any release of information (e.g., a press release about an acquisition, an earnings announcement) that, by reducing uncertainty, induces investors to rely less on their behavioral bias. This lowers the impact on the price of such a bias, allowing the stock price to catch up with its fundamental value. Therefore, the amount of capital gain overhang should help to explain future stock returns.

Before moving on to the main results, we describe the data we use and the main variables.

### **3. The Data and the Main Variables**

We employ a novel dataset on short selling provided by DataExplorers as well as more commonly used datasets on stock returns (CRSP), balance sheet data (Compustat), analyst coverage (I/B/E/S), and institutional ownership (Thompson Reuters 13f filings).

#### **3.1 Short selling data**

We obtain equity lending data from DataExplorers, a privately owned company that supplies financial benchmarking information to the securities lending industry and short-side intelligence to the investment management community. Data Explorers collects data from custodians and prime brokers that lend and borrow securities and is the leading provider of securities lending data. For each stock, Data Explorers reports the following variables at daily frequency: lendable value in dollars, active lendable value in dollars, total balance value on loan in dollars, and weighted average loan fee (across active contracts) in basis points.

While DataExplorers supplies international data for bonds as well as equity, we limit our attention to American common stocks (share codes of 10 or 11 in CRSP). In addition, we exclude all companies with a market capitalization of less than 10 million or a share price of less than 1 USD. The data spans the period from August 2004 to June 2010. Until July 2006, the data are only available at a weekly

frequency, while from then on, data are available at a daily frequency. Since all of our analyses are made at the weekly frequency, we will use the full sample from 2004 to 2010.

In the United States, equity transactions are settled after three trading days, while equity loans are settled immediately. Accordingly, a short seller does not need to borrow a stock until 3 days after taking his or her short position. Therefore, we compute the amount of shorted stocks on a day using the shares on loan at  $t+3$  following Geczy, Musto and Reed (2002) and Thornock (2013).

The DataExplorers dataset has the unique feature that it contains information on the number of shares that are on loan as well as the number of shares that have been lent out during the day.<sup>2</sup> This allows us to compute the number of shares that have been returned to lenders during the day as follows:<sup>3</sup>

$$\text{Shares Returned}_t = \text{Shares newly borrowed}_t - \text{Shares on loan}_t + \text{Shares on loan}_{t-1}$$

Having access to information on the closing of positions is very important for this study, as the disposition effect affects the closing of positions. Our main variable of interest will be *Closing*, which is defined as the percentage of shares at the beginning of the week that were returned to lenders during the week:

$$\text{Closing}_t = \frac{\text{Shares Returned}_t}{\text{Shares on loan}_{t-1}}$$

This variable can be thought of as “percentage realized”, thereby being our analog to the Percentage of Gains Realized (PGR) and Percentage of Losses Realized (PLR) employed in Odean (1998) and Frazzini (2006). In a robustness check, we will also use *Shorting*. This is defined as the number of shares newly lend out during the week divided by the shares outstanding.

### 3.2 Constructing capital gains variables

The disposition effect is the irrational tendency of investors to sell stocks with high capital gains and to hold on to stocks with low capital gains. Capital gains are defined relative to the investor’s reference point. The reference point the investor uses depends on his mental accounting (Thaler

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<sup>2</sup> Strictly speaking it provides information on the value of stocks on loan (“Total Balance Value”) as well as the value of stocks lent out during the latest day (“Balance Value 1 day”). We compute the number of shares by dividing these values by the closing price of the stock on the day.

<sup>3</sup> Due to minor data inconsistencies, this variable can be negative in a small number of cases. In these cases, we set it equal to zero.

(1980)). Starting with Shefrin and Statman (1985), many papers have used the price at which investors entered their position as the reference point (e.g. Odean (1998), Frazzini (2006)). Therefore, we assume that the reference point of the short sellers is the price at which they sold the stock short. Since we do not have access to individual short sellers' portfolios, we have to estimate the average price at which the short sellers entered their current position. To do this, we follow the methodology of Grinblatt and Han (2005). We apply it to short sellers weekly trading. More specifically, we estimate:

$$R_t = R_{t-1} * \left(1 - \frac{\text{Shares Newly Shorted}_t}{\text{Shares on loan}_t}\right) + \frac{\text{Shares Newly Shorted}_t}{\text{Shares on loan}_t} * P_t$$

Where  $R_t$  is the reference price and  $P_t$  is the market price.<sup>4</sup> This recursive method computes the new reference price as a weighted average between last week's reference price and today's price. The weight on the new price equals the percentage of total short positions that were entered in the last week. Basically, this approach assumes that all short positions have the same probability of being closed independently of when they were opened. As a robustness check, we also construct the reference point in a different way using the information DataExplorers releases on when a position was entered by a short seller. We only have relatively coarse information. We know which percentage of shares were shorted 1 day ago, in the last 3 days, in the last 7 days, in the last 30 days and longer than thirty days ago. We use this information to estimate the reference price as follows:

$$R_\tau^{alt.} = S_{\tau-1} * P_{\tau-1} + S_{\tau-3,\tau-2} * P_{\tau-2} + S_{\tau-7,\tau-4} * P_{\tau-4} + S_{\tau-30,\tau-8} * P_{\tau-8} + S_{\tau-\infty,\tau-31} * P_{\tau-31},$$

where  $R_\tau^{alt.}$  is the alternative definition of the reference price at date  $\tau$ <sup>5</sup>,  $P_\tau$  is the price at date  $\tau$  and  $S_{\tau,s}$  is the share of stocks that were shorted between dates  $\tau$  and  $s$ . For each window of short selling horizon, we use the prices closest to the current market price. This leads to an underestimation of the difference between the current price and the reference price, but should not introduce any bias.

Because short sellers profit when the stock price decreases, we compute the capital gains overhang of the short seller for both our reference points as:

$$SCGO_t = \frac{R_t - P_t}{R_t}$$

<sup>4</sup> Both market price and reference price include dividend payments, i.e. they are computed from total returns.

<sup>5</sup> We use  $\tau$  to illustrate the daily frequency, while in the equation above,  $t$  referred to the weekly frequency.

We define *Short Sale Capital Gains Overhang I (SCGO I)* as the capital gains overhang using the reference point of the recursive methodology and define *Short Sale Capital Gains Overhang II (SCGO II)* as the capital gains overhang using the reference point computed from short seller horizon. Both variables are an estimate of the average capital gains with which short sellers hold the specific stock. They generally increase as stock prices fall and decrease as stock prices appreciate.

As a comparison, we compute also the capital gains in the overall market. Following Grinblatt and Han (2005), we compute the reference price of long investors at a weekly frequency recursively as<sup>6</sup>:

$$R_t = R_{t-1} * \left(1 - \frac{Shares\ Traded_t}{Shares\ Outstanding_t}\right) + \frac{Shares\ Traded_t}{Shares\ Outstanding_t} * P_t$$

Then we compute the capital gains of long investors as:

$$LCGO_t = \frac{P_t - R_t}{R_t}$$

*Long Capital Gains Overhang (LCGO)* is an estimate of the average capital gains with which long investors hold the specific stock. It is the same variable as constructed in Grinblatt and Han (2005). It generally decreases as stock prices fall and increases as stock prices appreciate.

Following Grinblatt and Han (2005), we run all of our tests at the weekly frequency. The use of the weekly frequency is a good balance between a high enough frequency that allows to have an accurate estimation of computed capital gains and a low enough frequency that reduces the influence of market microstructure effects. Also it allows us to use the longer time period from August 2004 to June 2010 in our short selling data.

### 3.3 Control variables

For firms covered in the short selling data, we retrieve stock market data from CRSP and balance sheet data from Compustat to compute market capitalization and book-to-market ratios. In addition, we use the I/B/E/S database to construct measures of analyst following. We define *Number of Analysts* as the

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<sup>6</sup> A fraction of the buy orders included in the trading volume will be due to short sellers covering their positions and the total number of long positions will equal shares outstanding plus short interest. Therefore, the reference point of long investors would be more precisely estimated using the following equation:

$$R_t = R_{t-1} * \left(1 - \frac{Shares\ Traded_t - Shares\ Closed_t}{Shares\ Outstanding_t + Short\ interest_t}\right) + \frac{Shares\ Traded_t - Shares\ Closed_t}{Shares\ Outstanding_t + Short\ interest_t} * P_t$$

Nevertheless, we use the measure proposed by Grinblatt and Han (2005) to keep our results comparable.

logarithm of one plus the number of analysts that issued earnings forecasts for the stock in the observation period. We obtain data on institutional ownership from Thompson Reuters 13f filings. *Institutional Ownership* is computed as the aggregate number of shares held by institutional investors divided by the total number of shares outstanding. *Breadth of Ownership* is defined as the number of institutions holding the stock divided by the number of all reporting institutions in the period (similar to the definition used by Chen, Hong and Stein (2002)). *Amihud Illiquity* is defined as: 
$$\text{Amihud Illiquidity} = \text{mean}_{\text{over quarter}} \left( \frac{|\text{ret}_{\text{daily}}|}{\text{dollar volume}_{\text{daily}}} \right)$$
. Given that this measure often has large outliers, we use 100 percentiles rather than the continuous variable. Companies with the highest Amihud illiquidity are assigned a value of 100, companies with the lowest Amihud Illiquidity are assigned a value of 1. To reduce the effect of outliers, all variables are winsorized at the 1% cut-off.

### 3.4 Summary Statistics

We report summary statistics in Table 1. In our sample, we have stocks of 6,135 U.S. companies and roughly 1 million company-week observations. In Panel A, we report the average of company variables over company-week observations. The mean market capitalization is 2.5 billion USD (median 350 million USD), so there are some large and many smaller companies. The mean market to book ratio is 2.78 (median 1.94). The companies are covered on average by 5 analysts (median 3), but more than 25% of the sample firms have no analyst coverage. Institutional ownership is on average 50.7% (median 52.8%).

In Panel B, we report summary statistics of the market variables. On average 3.72% (median 1.55%) of shares outstanding are on loan. Every week, on average (median) 0.52% (0.17%) of the shares outstanding are newly borrowed (i.e. newly shorted) and on average (median) 19% (13%) of the shares on loan are returned to lenders (closed short positions). This implies that the average short position is held for approximately 5-8 weeks. The mean turnover is 4.22% per week (median 2.53%). This implies that the average long investors has a longer investment horizon of 24-40 weeks. The average weekly return is 0.1% (median 0%), implying an overall stock market increase of 5.3% per year over our sample period. The average *Short Sale Capital Gains Overhang I (SCGO I)* is slightly positive with 0.97% (median 0%), while the alternative specification (*SCGO II*) is on average slightly

negative with  $-0.07\%$  (median  $-0.28\%$ ). At a value of  $0.87\%$ , *Long Capital Gains Overhang (LCGO)* is also positive on average (median  $1.72\%$ ), probably due to the positive average return. The higher standard deviation of *LCGO* compared to *SCGO* ( $27.59\%$  compared to  $10.86\%$ ) is most likely due to the longer investment horizon of long investors. Since long investors hold on to stocks longer, they can accumulate more extreme levels of capital gains overhang. The standard deviation of *LCGO* is very close to the value reported in the study of Grinblatt and Han (2005) ( $27.59\%$  compared to  $25.08\%$ ).

## 4 The Results

In this section, we present the empirical results of our paper. First, we focus on the *behavior* of short seller and then we examine how this behavior affects stock market characteristics in equilibrium.

### 4.1 Do short sellers hold on to losers and sell winners?

The disposition effect is the irrational tendency to realize gains too early and hold on to losing stocks for too long. Thus, as a first step, we study the closing of short positions. As pointed out above, our dataset allows us to determine the amount of short positions that have been closed, rather than just observing differences in short interest. Therefore, as a first step to test for disposition effect behavior, we study whether the way in which short sellers close their position is influenced by their capital gains on these positions. If short sellers are prone to the disposition effect, we would expect them to close a larger fraction of their positions if they hold it at higher (more positive) capital gains overhang.

We report our results in Table 2. In Panel A, the dependent variable is *Closing* – i.e., the percentage of shares on loan that is returned to lenders during the week. We conduct weekly panel regressions. We employ three different regression set-ups. First, we run weekly Fama Macbeth regressions – i.e. we estimate a separate cross sectional regression for each week and compute the standard errors over the time series of the coefficients from the weekly regression. This methodology is powerful in taking care of time fixed effects and cross-sectional correlations. Since one might be also worried about time-series correlations in short seller behavior and unobserved firm characteristics influencing short seller behavior, we also estimate panel regressions with firm fixed effects and standard errors clustered at the firm level. Finally, as a third set of regression set-up, we re-estimate

the panel specifications adding week fixed effects to control for common effects at both the time and stock level. Intuitively, one can think of this regression as a way of investigating the change in the closing of short positions in stock A compared to the change in the closing of short positions in stock B.

Since short sellers' trades might be driven by past returns (Diether, Lee and Werner (2009)) and trading volume, we control for stock turnover in the past year and past returns over the non-overlapping 1 month, 1 year and 3 year horizons in every regression – i.e. we add returns from t-4 to t-1, t-52 to t-5 and t-156 to t-53.. Also, given that unusually large short positions might be closed faster, we also control for the number of stocks on loan as a percentage of shares outstanding. In the specifications 2, 4 and 6, we also control for a vast array of stock characteristics that might potentially influence short selling such as: market to book ratio, company size, Amihud illiquidity, breadth of ownership, institutional ownership and number of analysts.

The explanatory variable of interest is *Short Sale Capital Gains Overhang (SCGO I and SCGO II)*. We find a positive effect of both definitions of short sale capital gains overhang on the closing of short positions significant at the 1% level. This results is robust to the different the controls and fixed effects. The findings are also economically important, as a one standard deviation (10.86%) increase in SCGO raises the closing of the short position by 0.6% percentage points, or approximately 5% relative to its median.

We now try to approximate the importance of the disposition effect for short sellers relative to the sample of individual investors studied by Odean (1998). Since Odean (1998) has individual positions, our measures are not directly comparable, but as we pointed out above, our closing variable can be thought of as percentage of positions realized. The fact that more positions are closed the higher the capital gains, implies that the percentage of gains realized is higher than the percentage of losses realized. For positive capital gains, the average capital gain of short sellers is 8.7%. For negative capital gains, the average capital gain is -6.5%. These figures, combined with our regression coefficient of 0.0524, imply that for short sellers the percentage of gains realized (PGR) is approximately 0.8 percentage points higher than the percentage of loss realized (PLR)  $((8.7\% + 6.5\%) * 0.0524 = 0.8\%)$ . In Odean (1998) this difference is 5%, implying that individual investor

experience a disposition effect which is roughly 6 times stronger than the disposition effect of short sellers<sup>7</sup>.

Overall, our results indicate that short sellers are more likely to close positions in which they are holding positive capital gains, consistent with the disposition effect. However, such behavior might also be explained by rational motives. For example an arbitrageur might want to hold on to a losing position as this implies that the mispricing has widened and that he can make a larger profit in the future (Shleifer and Vishny (1997)). If this were the case, we would expect the trades which can be explained by capital gains to be more profitable than the average trades of short sellers. On the other hand in the case of the disposition effect, we would expect lower or even negative profitability of such trades (Odean (1998)). We study this issue in the next subsection.

#### **4.2 Is the closing of short positions triggered by capital gains unprofitable?**

To study the profitability of short sellers' closing of positions, we measure how *Closing* predicts future returns. The shorting of a stock is profitable if it is followed by a negative stock return (e.g.,Cohen, Diether and Malloy (2007), Boehmer, Jones and Zhang (2008)). Similar, a profitable closing of a short position will be followed by a positive return, as the closing prevents the losses that the short seller would have incurred from the positive return. On the other hand, a negative return after the closing of a short position implies that it was closed too early and that the short seller foregoes potential profits.

Therefore, we study how the closing of short positions predicts future returns. We present our results in Table 3. We employ Fama-Macbeth regressions estimated at the weekly frequency. This regression set-up is adequate for dependent variables such as returns that have a large time fixed effect and cross-sectional correlation, but little autocorrelation (Petersen (2009)). In regressions 1 and 2, we regress the weekly return on the closing of short position in the prior week. If we focus on the overall closings of the short positions, we see a positive relation, which is significant at the 1% level. An increase in closing by 10% (one standard deviation) predicts a positive one-week return of 4.4 basis points, which corresponds to a yearly return of 2.3%. Thus, short sellers on average exhibit skill in the closing of their positions.

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<sup>7</sup> We take the PLR and PGR figures from Odean Table 1. The average of PLR is 9.8%, the average of PGR is 14.8%, therefore they are comparable in size to our *Closing* variable, which has a median of 13%.

However, just because short sellers are skillful on average does not mean that they are not influenced by a bias as well. To zoom on the trades originated by a potential disposition effect, we see how the relation between *Closing* and future returns is affected by the amount of capital gain overhang as estimated in Table 2. In specification 6 with full controls and firm and week fixed effects, an increase in SCGO I by 1% leads to an increase in *Closing* by 0.0455%. Therefore, we compute the part of *Closing* being caused by disposition effect behavior as:

$$\text{Closing explained by SCGO I} = \text{SCGO I} * 0.0455.$$

In regressions 3 and 4, we regress the current weekly return on *Closing explained by SCGO I* from the prior week. We find a negative effect that is significant at the 1% level. A one standard deviation increase in *Closing explained by SCGO I* leads to a *negative* return of 9.2 basis points a week or 4.7% per year. Thus, while short sellers are profitable in closing their positions in general, the trades that are caused by holding on to the losers and selling the winners are less profitable. This allows us to conclude that such behavior cannot be explained by rational motives. In fact, it suggests that short sellers are indeed affected by the disposition effect.

In regressions 5 and 6, we repeat the same analysis for our second measure of short sale capital gains. Therefore, we compute the closing, which is explained by SCGO II as:

$$\text{Closing explained by SCGO II} = \text{SCGO II} * 0.0356$$

Our results are consistent to the finding with SCGO I. The *Closing explained by SCGO II* is followed with a negative return, which is significant at the 1% level.

### **4.3 What is the equilibrium effect of short sellers' disposition effect?**

Up to here, we have seen that short sellers are subject to the disposition effect. Now, we will turn our attention to the effect their bias has on the equilibrium prices. Grinblatt and Han (2005) suggest that the disposition effect can cause capital gains overhang to causally affect/predict future returns. The intuition of their model can be summarized as follows. Investors hold stocks at a capital gain, they will be more likely to sell. This “excess” sale will push the stock price below its fair value. As prices revert to their fair value over time, positive capital gains are followed by positive returns. The mirror image is true for negative capital gains. According to this logic, also short sale capital gains overhang should

predict future return. In the presence of positive capital gains, short sellers are more likely to close – i.e. buy back the stock – inflating the price, while in the presence of capital losses they are reluctant to close, thereby depressing the price. As prices revert to their fair value over time, SCGO should predict negative returns.

We now endeavor to test this intuition. We start by replicating the findings of Grinblatt and Han (2005) in our dataset. We present the results in Panel A of Table 4. We use the same set of controls as Grinblatt and Han (2005), namely stock turnover in the past year and past returns over the non-overlapping 1 month, 1 year and 3 year horizons as well as company size. We also add market to book ratio, Amihud illiquidity, breadth of ownership, institutional ownership and number of analysts as additional control variables. In regression 1 and 2, we first study the effect of these control variables on returns.

We find a strong reversal after 4 weeks, but not the usual momentum at the yearly frequency. This implies that in our sample our results are less likely to be confounded by the momentum anomaly of Jegadeesh and Titman (1993). Nonetheless, we control for the past year return in all of our regressions. Following Grinblatt and Han (2005), we run Fama-Macbeth regressions of the current weekly return on the capital gains overhang (LCGO) at the beginning of the *prior* week. Following their approach, we use the extra week lag to avoid confounding micro-structure effects. As in their paper, we find a positive association between capital gains and future returns consistent with return predictability based on the capital gains of long investors. The result is both statistically and economically significant. A one standard deviation increase (27.6%) in *LCGO* corresponds to a positive return of 16 basis points per week or 8.7% per year. This finding is significant at the 1% level.

Next, we study whether the capital gains overhang of short sellers has a similar price impact. The results are reported in Panel B of Table 4. We run the same regression as in Panel A, but replace the capital gains of long investors (*LCGO*) with our variables for short sale capital gains overhang (*SCGO I* and *SCGO II*). Given that the capital gains overhang of short sellers is high after a price decline, we would expect a negative relationship between *SCGO* and future capital gains according to the argument above. And indeed, both *SCGO I* and *SCGO II* predict negative future returns at a 1%

confidence level. The result is also economically significant. A one standard deviation (10.8%) increase in SCGO I predicts a negative return of 9 basis points per week or 4.7% per year.

This result suggests that short sellers do not act as arbitrageurs leaning against the mispricing caused by the disposition effect of long investors. Rather, their own disposition effect makes them increase the mispricing of long investors. When prices have fallen and long investors are reluctant to sell, because they have a capital loss, short sellers are likely to report capital gains and therefore more likely to close their positions – i.e. buy back the stock – thereby increasing the upwards price pressure. Similarly, when prices have gone up and long investors want to secure their gains by selling, short sellers are less likely to close, as they are likely to be at a capital loss.

This argument might however also raise worries about our methodology. As SCGO and LCGO are negatively correlated, it may be that SCGO just acts as a proxy for the capital gains of long investors. To address this issue, we present results of a “horse-race” between the two variables in Table 5. We repeat the regression set-up of Table 4, but regress the return on both lagged *SCGO* and lagged *LCGO*. We find that both variables stay significant at the 1% threshold, but, as expected, the effect of each individual variable is reduced. Controlling for SCGO, a standard deviation increase in LCGO predicts a positive return of 13 basis points per week or 7% per year. Controlling for LCGO, a standard deviation increase in SCGO predicts a negative return of 6 basis points or 3.3% per year. This means that both SCGO and LCGO have predictive powers on future returns, suggesting that prices are driven by both the disposition effect of short sellers and the disposition effect of long investors.

As short sale investors are generally better informed (e.g.,Cohen, Diether and Malloy (2007), Boehmer, Jones and Zhang (2008)) or better able to process information better than the rest of the market (e.g. Engelberg, Reed and Ringgenberg (2012)), we would expect them to have a larger impact on prices (Admanti and Pflleiderer (1991)). Therefore, we try to put their price impact in relationship with the importance of their behavioral bias. As we have seen above, individual investors exhibit a disposition effect, which is 6 times stronger than that of short sellers. Since short sellers make up approximately one third of the market (Diether, Lee and Werner (2009)), we would expect them to have a price impact, which is only 1/12 of the price impact of long investors. However, we find that the effect of SCGO is roughly half as large as the effect of LCGO, suggesting that they have an effect

on prices, which is 6 times as strong as that of individual investors. In other words, short sellers' biases, seem more likely to "punch above their weight".

#### **4.4 Portfolio Analysis**

We now focus on whether the predictive power of SCGO can be converted into a profitable trading strategy. We employ the method of portfolio analysis. At the beginning of each week, we assign stocks to 16 portfolios by simultaneously sorting them on the past 12 week cumulative return and our measure of short sale capital gains overhang. As in Grinblatt and Han (2005), we employ this double sort to control for the general momentum effect. We use a shorter window of only 12 weeks, because short sellers have a shorter investment horizon than long investors (see Section 3.4).

We report our results in Table 6. The disposition effect might have a lower effect in January due to tax reasons as investors have an incentive to realize losses before the end of the fiscal year in December (Grinblatt and Han (2005)). Therefore, we present our results for both the entire year and excluding January. We display both the raw returns of the different portfolios, as well as the 3 Fama and French (1993) factor-adjusted alphas. We do not add the momentum factor, since we already control for momentum through the double sort.

The trading strategy that we are interested in goes long in the 25% of stocks with the highest SCGO and short in the 25% of stocks with the lowest SCGO within each past return percentile. This strategy yields statistically significant negative returns in three out of four cases. Only in the case of very negative past returns, it does not yield significantly negative returns. This might be due to the fact that the disposition effect of short sellers is mainly manifested in the area of losses – i.e. that they hold losing positions too long more than they close winning positions too early. In the other three cases, the trading strategy yields very large negative returns. Excluding January, the returns range from 26 basis points per week to 45 basis points per week, which corresponds to yearly returns of 14% to 26%. This finding is significant at the 1% level. If we include January, the returns are slightly lower with 20 to 30 basis points per week or 11% to 17% per year. These returns are significant at least at the 5% level. One might be worried that our portfolios load up on well known risk factors, but the 3 factor alphas of the trading strategy are actually slightly higher than the returns.

In Panels C and D, we repeat the analysis with our second proxy of short sale capital gains overhang (*SCGO II*). Also in this case, we find significant negative returns of our strategy for 3 out of 4 past return quartiles in the non-January sample. Returns are somewhat smaller, but still very large in economic terms ranging from 17 bp to 36 bp a week or 9% to 21% a year. In the sample including the full year, the returns are lower ranging from 11bp to 23 bp per week or 6% to 13% per year. Overall, the portfolio analysis underlines the fact that large capital gains of short sellers predict negative stock returns and that it is possible to construct a very profitable trading strategy based on this predictability.

## **5 Robustness Checks**

### **5.1 The opening of short positions**

We have seen in Section 4.1 that short sellers are more likely to close a position if they have higher capital gains. However, one might be worried that simply the trading volume of short sellers increases in case of high capital gains, i.e. that the closing of positions as well as the opening of new positions increases. To address this concern, we regress *Shorting* – i.e. the opening of new short positions as a function of shares outstanding – on the level of short sale capital gains. The regression set-up and the control variables are the same as in our analysis of *Closing*. We run weekly Fama-Macbeth regressions, as well as weekly panel regressions with firm fixed effects and firm and week fixed effects. In 5 out of 6 regressions, capital gains are actually associated with fewer newly opened positions, while in the specification with full controls and firm fixed effects positive capital gains are not significantly related to *Shorting*. This means, that short sellers are in general more likely to short a stock in which they already have negative capital gains, which is consistent with a stronger form of the disposition effect in which short sellers double up on their losing positions. Overall, these results indicate that the increase in *Closing* cannot be explained by a mere increase in trading of short sellers.

## **Conclusion**

We study whether investors traditionally considered to be rationally and sophisticated investors privy to private information – the short sellers – suffer from behavioral biases and whether this affects the stock market. We focus on the disposition effect (Shefrin and Statman (1985)). Using a new dataset on stock lending for all U.S. stocks from 2004 to 2010, we are able to examine the closing of short

positions. We show that short sellers tend to hold on to their losing positions too long and close their winning positions too early. We establish this by showing that the closing of short sale positions is strongly related to a proxy of Shortsale Capital Gains Overhang (SCGO). Furthermore, we show that the closing of short positions induced by capital gains is followed by negative returns, suggesting that the closing is suboptimal and caused by a bias. We also posit that, short sellers' disposition effect will have direct implications for stock prices. If short sellers are prone to the disposition effect, in the presence of market frictions and/or inelastic demand, the presence of unrealized (for the short sellers) capital gains/losses will generate price underreaction to public information. Indeed, we provide evidence that Shortsale Capital Gain Overhang is negatively related to future stock returns. This effect exists over and above the general effect of capital gains overhang for the rest of the market.

Our findings have important normative implications. Indeed, if short sellers themselves are irrational, then the classic view of short selling as an arbitrage device is dubious. If short sellers are a source of market frictions as opposed to their deterrent, any regulation limiting short selling activity may have unintended consequences that go in the direction of amplifying as opposed to reducing the speed and amplitude of market gyrations.

## Table 1: Summary Statistics

In Panel A we list the company specific variables for the 6135 companies in our sample. Breadth of Ownership is defined as number of institutions holding the stock divided by total number of reporting institutions. Number of Analysts is the number of analysts on IBES that issue an earnings forecast for the stock. This variable is set to zero if the company is not covered in IBES. Institutional Ownership is the percentage of shares held by institutions. In Panel B we list summary statistics of market variables for the 1,303,530 company-weeks in the period of August 2004 to June 2010. Loaned Stocks is the number of stocks on loan at the end of the week divided by shares outstanding. Shorting is the number of shares borrowed from lenders during the week divided by shares outstanding. Closing is the number of shares returned to lenders during the week divided by shares on loan at the beginning of the week. SCGO I and SCGO II (Short Sale Capital Gains Overhang variables) are both defined as  $\frac{\text{Reference Price} - \text{Price}_t}{\text{Reference Price}}$ , but for SCGO I the reference price is defined recursively as:  $\text{Reference price}_t = \frac{\text{Shorting}_t}{\text{Loaned Stocks}_t} * \text{Price}_t + \left(1 - \frac{\text{Shorting}_t}{\text{Loaned Stocks}_t}\right) * \text{Reference Price}_{t-1}$ , while we construct SCGO II using the investment horizon of short investors given in the data (see Section 3.2 for a more detailed description). LCGO (Long Capital Gains Overhang) is defined as  $\frac{\text{Price} - \text{Reference Price}}{\text{Reference Price}}$ , where the reference price is defined recursively as:  $\text{Reference price}_t = \frac{\text{Trading volume}_t}{\text{Shares Outstanding}_t} * \text{Price}_t + \left(1 - \frac{\text{Trading volume}_t}{\text{Shares Outstanding}_t}\right) * \text{Reference Price}_{t-1}$ .

### Panel A: Company Variables

	Median	Mean	25 <sup>th</sup> Percentile	75 <sup>th</sup> Percentile	Standard Deviation
Market capitalization in m \$	350	2507	102	1328	7615
Market to Book	1.94	2.78	1.25	3.22	2.75
Breadth of Ownership (%)	2.98	4.81	0.92	6.13	5.87
Number of Analysts	3	5	0	7	6.1
Institutional Ownership (%)	52.8	50.7	23.2	78.2	30.2

### Panel B: Market variables

	Median	Mean	25 <sup>th</sup> Percentile	75 <sup>th</sup> Percentile	Standard Deviation
Loaned Stocks (%)	1.55	3.72	0.16	5.03	5.27
Shorting (%)	0.17	0.52	0.01	0.67	0.81
Closing (%)	13.07	19.06	5.45	25.17	20.21
Weekly Turnover	2.53	4.22	0.99	5.12	8.13
Weekly Return	-0.00	0.10	-3.05	3.07	6.65
SCGO I	0.00	0.97	-4.02	4.67	10.86
SCGO II	-0.28	-0.07	-5.18	4.92	10.80
LCGO	1.70	0.87	-13.56	14.90	27.59

## Table 2: Do short sellers hold losers and sell winners?

This table contains the results of weekly panel regressions that examine the effect of Shortsale Capital Gains Overhang (SCGO) on the closing of short sale positions from August 2004 to June 2010. The dependent variable is Closing (percentage of loaned shares that are returned to lenders during the week). The explanatory variable of interest is SCGO at the beginning of the week. We show results of SCGO I and SCGO II in Panel A and Panel B respectively. Loaned Stocks is the number of stocks on loan at the beginning of the week divided by shares outstanding. Market to Book is the market capitalization divided by the book value of equity at the beginning of the quarter. Size is the logarithm of market capitalization at the beginning of the quarter. Amihud Illiquidity is a percentage rank at the beginning of the quarter, where companies are ranked by Amihud illiquidity defined as:  $Amihud\ Illiquidity = mean_{over\ quarter} \left( \frac{|ret_{daily}|}{dollar\ volume_{daily}} \right)$ . Companies with the highest Amihud illiquidity are assigned a value of 100, companies with the lowest Amihud Illiquidity are assigned a value of 0. Breadth of Ownership is defined as the number of institutions holding the stock at the beginning of the year divided by the total number of reporting institutions at that time. Institutional Ownership is the percentage of shares held by institutions at the beginning of the year. Number of Analysts is the logarithm of 1 + the number of analysts on IBES that issue an earnings forecast for the stock at the beginning of the quarter. This variable is set to zero if the company is not covered in IBES. Average Return t-k to t-j is the average weekly return in the specified weeks. Average Turnover t-52 to t-1 is the weekly average of number of shares traded divided by shares outstanding. Fama-Macbeth regressions are at weekly frequency. In the OLS regressions, standard errors are clustered at the firm level. T-statistics are below the parameter estimates in parenthesis. \*\*\* indicates significance at the 1% level, \*\* indicates significance at the 5% level, and \* indicates significance at the 10% level.

Panel A: Shortsale Capital Gains Overhang I

	Closing					
	(1)	(2)	(3)	(4)	(5)	(6)
SCGO I	0.0378*** (2.79)	0.0524*** (3.75)	0.0196*** (3.95)	0.0355*** (5.71)	0.0403*** (7.94)	0.0445*** (6.90)
Return t-4 to t-1	0.3109*** (8.13)	0.4195*** (10.88)	0.0896*** (6.10)	0.0777*** (4.31)	0.2769*** (17.32)	0.3274*** (16.94)
Return t-52 to t-5	1.3217*** (18.50)	1.7885*** (22.39)	0.4001*** (6.88)	-0.1258 (-1.20)	1.1572*** (17.01)	1.4782*** (12.79)
Return t-156 to t-53	0.6898*** (10.85)	1.1873*** (17.91)	-1.3764*** (-12.40)	-1.8176*** (-11.59)	0.5197*** (4.15)	0.8218*** (4.74)
Turnover t-52 to t-1	0.5644*** (33.98)	0.4716*** (29.90)	0.3614*** (13.52)	0.3695*** (10.67)	0.2312*** (9.04)	0.2635*** (8.16)
Loaned Stocks	-0.0097*** (-58.27)	-0.0113*** (-49.58)	-0.0046*** (-39.25)	-0.0057*** (-36.31)	-0.0061*** (-43.49)	-0.0071*** (-39.59)
Market to Book		-0.0015*** (-17.17)		-0.0005 (-1.09)		0.0001 (0.13)
Size		-0.0149*** (-15.86)		0.0185*** (6.54)		-0.0070** (-2.33)
Amihud Illiquidity		-0.0003*** (-4.45)		0.0001 (1.15)		0.0002 (1.31)
Breadth of Ownership		0.4500*** (25.48)		-0.3712*** (-4.91)		0.1916*** (2.98)
Inst. Ownership		0.0602*** (9.33)		0.0144*** (5.62)		0.0209*** (3.47)
Number of Analysts		-0.0022*** (-3.70)		-0.0118*** (-12.55)		-0.0070*** (-6.31)
Constant	0.2034*** (73.28)	0.4899*** (22.76)	0.1944*** (179.35)	-0.1481** (-2.54)		
Observations	964697	776169	964697	776169	964697	776169
Adjusted R <sup>2</sup>			0.14	0.14	0.18	0.18
Fama Macbeth	Yes	Yes	No	No	No	No
Weekly Fixed Effects	No	No	No	No	Yes	Yes
Firm Fixed Effects	No	No	Yes	Yes	Yes	Yes

*Panel B: Shortsale Capital Gains Overhang II*

	Closing					
	(1)	(2)	(3)	(4)	(5)	(6)
SCGO II	0.0474*** (3.34)	0.0493*** (3.34)	0.0289*** (8.65)	0.0379*** (9.09)	0.0326*** (8.56)	0.0356*** (7.41)
Return t-4 to t-1	0.3543*** (8.36)	0.4360*** (9.81)	0.1079*** (8.20)	0.0810*** (4.58)	0.2617*** (17.30)	0.3115*** (15.84)
Return t-52 to t-5	1.3141*** (21.52)	1.7295*** (25.29)	0.4002*** (7.41)	-0.1730 (-1.64)	1.1012*** (17.18)	1.4115*** (12.06)
Return t-156 to t-53	0.7002*** (10.23)	1.1637*** (17.02)	-1.2516*** (-11.28)	-1.7204*** (-10.82)	0.5294*** (4.26)	0.8310*** (4.75)
Turnover t-52 to t-1	0.5794*** (35.46)	0.4878*** (30.10)	0.3755*** (13.78)	0.3863*** (10.96)	0.2508*** (9.65)	0.2783*** (8.47)
Loaned Stocks	-0.0098*** (-60.84)	-0.0114*** (-51.74)	-0.0047*** (-39.21)	-0.0057*** (-36.49)	-0.0061*** (-43.36)	-0.0071*** (-39.18)
Market to Book		-0.0015*** (-16.03)		-0.0005 (-1.05)		0.0000 (0.03)
Size		-0.0151*** (-15.40)		0.0196*** (7.05)		-0.0067** (-2.27)
Amihud Illiquidity		-0.0003*** (-4.48)		0.0002 (1.48)		0.0001 (1.18)
Breadth of Ownership		0.4472*** (26.04)		-0.3911*** (-5.15)		0.1881*** (2.92)
Inst. Ownership		0.0563*** (9.28)		0.0146*** (5.60)		0.0154** (2.47)
Number of Analysts		-0.0023*** (-3.90)		-0.0119*** (-12.51)		-0.0075*** (-6.60)
Constant	0.2048*** (73.27)	0.4954*** (22.20)	0.1936*** (172.41)	-0.1723*** (-3.00)		
Observations	924557	743887	924557	743887	924557	743887
Adjusted R <sup>2</sup>			0.14	0.14	0.18	0.18
Fama Macbeth	Yes	Yes	No	No	No	No
Weekly Fixed Effects	No	No	No	No	Yes	Yes
Firm Fixed Effects	No	No	Yes	Yes	Yes	Yes

### Table 3: Is the closing of positions explained by capital gains profitable?

This table contains the results of weekly Fama-Macbeth Regressions that examine how the closing of short positions predicts future returns. The dependent variable is the weekly stock return. There are three independent variables of interest: Closing is the total percentage of short positions that have been closed. "Closing explained by SCGO I" is the part of Closing that is explained by SCGO I. It is computed as SCGO I multiplied by 0.0445. "Closing explained by SCGO II" is the part of Closing that is explained by SCGO II. It is computed as SCGO II multiplied by 0.0356. Other dependent variables are defined as above. T-statistics are below the parameter estimates in parenthesis. \*\*\* indicates significance at the 1% level, \*\* indicates significance at the 5% level, and \* indicates significance at the 10% level.

	Return					
	(1)	(2)	(3)	(4)	(5)	(6)
Closing (t-1)	0.0022*** (3.07)	0.0022*** (2.78)				
Closing explained by SCGO I (t-1)			-0.1716*** (-3.48)	-0.1927*** (-3.83)		
Closing explained by SCGO II (t-1)					-0.1973*** (-2.88)	-0.1906*** (-2.75)
Return t-4 to t-1	-0.0556*** (-5.95)	-0.0462*** (-4.84)	-0.0667*** (-7.35)	-0.0604*** (-6.57)	-0.0647*** (-6.41)	-0.0559*** (-5.46)
Return t-52 to t-5	0.0357 (0.75)	0.0627 (1.38)	0.0156 (0.34)	0.0337 (0.77)	0.0248 (0.53)	0.0496 (1.12)
Return t-156 to t-53	0.0619 (1.64)	0.0971** (2.42)	0.0447 (1.22)	0.0852*** (2.19)	0.0578 (1.56)	0.1025** (2.56)
Turnover t-52 to t-1	-0.0073 (-0.75)	0.0014 (0.14)	-0.0093 (-1.00)	0.0025 (0.26)	-0.0095 (-1.02)	0.0017 (0.17)
Market to Book	-0.0001 (-1.19)		-0.0000 (-0.81)		-0.0000 (-0.66)	
Size	-0.0002 (-0.49)		-0.0004 (-1.32)		-0.0004 (-1.15)	
Amihud Illiquidity	-0.0000* (-1.86)		-0.0001*** (-3.10)		-0.0001*** (-2.86)	
Breadth of Ownership	-0.0046 (-0.66)		-0.0030 (-0.41)		-0.0035 (-0.49)	
Inst. Ownership	0.0025** (2.07)		0.0022* (1.73)		0.0020 (1.60)	
Number of Analysts	-0.0003* (-1.71)		-0.0003 (-1.62)		-0.0003 (-1.61)	
Constant	0.0052 (0.73)	-0.0006 (-0.45)	0.0123* (1.74)	0.0000 (0.01)	0.0110 (1.53)	0.0001 (0.09)
Observations	776203	964656	821412	1017872	787038	974954
Fama Macbeth	Yes	Yes	Yes	Yes	Yes	Yes

## Table 4: Does Short Sellers' Disposition Effect predict stock returns?

This table contains the results of weekly Fama MacBeth regressions that examine the effect of Shortsale Capital Gains Overhang (SCGO) and Long Capital Gains Overhang (LCGO) on stock returns from August 2004 to June 2010. The dependent variable is the weekly return. The explanatory variables of interest are SCGO I and SCGO II as well as LCGO. Following Grinblatt and Han (2005), these variables are taken at the beginning of the *prior* week. Control variables are defined as above. T-statistics are below the parameter estimates in parenthesis. \*\*\* indicates significance at the 1% level, \*\* indicates significance at the 5% level, and \* indicates significance at the 10% level.

### Panel A: Long Capital Gains Overhang

	Return			
	(1)	(2)	(3)	(4)
LCGO (t-1)			0.0045*** (4.46)	0.0058*** (5.68)
Return t-4 to t-1	-0.0508*** (-5.45)	-0.0589*** (-6.55)	-0.0603*** (-6.31)	-0.0687*** (-7.41)
Return t-52 to t-5	0.0673 (1.53)	0.0443 (0.96)	-0.0005 (-0.01)	-0.0370 (-0.75)
Return t-156 to t-53	0.0967** (2.51)	0.0592 (1.57)	0.0518 (1.25)	0.0058 (0.14)
Turnover t-52 to t-1	0.0004 (0.03)	-0.0100 (-1.06)	-0.0022 (-0.22)	-0.0157* (-1.67)
Market to Book		-0.0001 (-1.14)		-0.0000 (-0.61)
Size		-0.0002 (-0.66)		-0.0009*** (-2.90)
Amihud Illiquidity		-0.0000** (-2.29)		-0.0001*** (-3.84)
Breadth of Ownership		-0.0044 (-0.57)		0.0025 (0.33)
Inst. Ownership		0.0021* (1.67)		0.0020 (1.56)
Number of Analysts		-0.0003 (-1.61)		-0.0002 (-1.20)
Constant	-0.0000 (-0.02)	0.0070 (1.02)	0.0002 (0.17)	0.0229*** (3.39)
Observations	1075778	867641	1075777	867640
Fama MacBeth	Yes	Yes	Yes	Yes

### Panel B: Short Sale Capital Gains Overhang

	Return			
	(1)	(2)	(3)	(4)
SCGO I (t-1)	-0.0093*** (-4.14)	-0.0082*** (-3.74)		
SCGO II (t-1)			-0.0072*** (-2.94)	-0.0073*** (-2.99)
Return t-4 to t-1	-0.0620*** (-6.73)	-0.0678*** (-7.46)	-0.0569*** (-5.56)	-0.0654*** (-6.47)
Return t-52 to t-5	0.0333 (0.76)	0.0158 (0.34)	0.0511 (1.15)	0.0260 (0.56)
Return t-156 to t-53	0.0886** (2.28)	0.0500 (1.35)	0.1062*** (2.66)	0.0621* (1.66)
Turnover t-52 to t-1	0.0018 (0.18)	-0.0097 (-1.04)	0.0009 (0.10)	-0.0098 (-1.05)
Market to Book		-0.0000 (-0.87)		-0.0000 (-0.72)
Size		-0.0004 (-1.26)		-0.0004 (-1.06)
Amihud Illiquidity		-0.0001*** (-3.01)		-0.0001*** (-2.75)
Breadth of Ownership		-0.0032 (-0.44)		-0.0039 (-0.54)
Inst. Ownership		0.0022* (1.76)		0.0020 (1.56)
Number of Analysts		-0.0003 (-1.58)		-0.0003 (-1.56)
Constant	-0.0001 (-0.07)	0.0117* (1.65)	0.0000 (0.00)	0.0102 (1.41)
Observations	1016767	820138	973835	785726
Fama MacBeth	Yes	Yes	Yes	Yes

## Table 5: Horse-Race: SCGO vs. LCGO

This table contains the results of weekly Fama MacBeth regressions that examine the effect of Shortsale Capital Gains Overhang (SCGO) and Long Capital Gains Overhang (LCGO) on stock returns from August 2004 to June 2010. The dependent variable is the weekly return. The explanatory variables of interest are SCGO and LCGO. Both variables are taken at the beginning of the *prior* week. Control variables are defined as above. T-statistics are below the parameter estimates in parenthesis. \*\*\* indicates significance at the 1% level, \*\* indicates significance at the 5% level, and \* indicates significance at the 10% level.

*Panel A: Short Sale Capital Gains*

	Return			
	(1)	(2)	(3)	(4)
SCGO I (t-1)	-0.0073*** (-3.40)	-0.0058*** (-2.79)		
SCGO II (t-1)			-0.0049** (-2.04)	-0.0048** (-2.02)
LCGO (t-1)	0.0034*** (3.44)	0.0047*** (4.70)	0.0041*** (3.99)	0.0051*** (4.98)
Return t-4 to t-1	-0.0658*** (-6.98)	-0.0719*** (-7.72)	-0.0615*** (-5.97)	-0.0696*** (-6.82)
Return t-52 to t-5	-0.0085 (-0.18)	-0.0396 (-0.80)	-0.0033 (-0.07)	-0.0384 (-0.76)
Return t-156 to t-53	0.0588 (1.42)	0.0122 (0.31)	0.0683 (1.60)	0.0206 (0.51)
Turnover t-52 to t-1	-0.0005 (-0.06)	-0.0139 (-1.48)	-0.0025 (-0.28)	-0.0148 (-1.57)
Market to Book		-0.0000 (-0.52)		-0.0000 (-0.31)
Size		-0.0009*** (-2.83)		-0.0009*** (-2.68)
Amihud Illiquidity		-0.0001*** (-3.99)		-0.0001*** (-3.69)
Breadth of Ownership		0.0019 (0.27)		0.0017 (0.25)
Inst. Ownership		0.0022* (1.72)		0.0019 (1.49)
Number of Analysts		-0.0002 (-1.24)		-0.0002 (-1.20)
Constant	0.0001 (0.08)	0.0231*** (3.26)	0.0002 (0.21)	0.0221*** (3.06)
Observations	1016766	820137	973835	785726
Fama MacBeth	Yes	Yes	Yes	Yes

## Table 6: Portfolio Analysis

This table contains the results of weekly portfolio analysis. At the beginning of each week, stocks are sorted simultaneously into 4 quartiles on cumulative returns over the prior 12 weeks (R1=losers, R4=winners) and by a measure of short sale capital gains overhang (SCGO 1 = low capital gains SCGO 4 = high capital gains). On the basis of these quartiles, we form 16 equal weighted portfolios at the beginning of each week. On the left half of the panel we report average returns of the portfolios, on the right half we report 3 Factor Alphas controlling for the Fama French (1993) factors. T-statistics are below the parameter estimates in parenthesis. \*\*\* indicates significance at the 1% level, \*\* indicates significance at the 5% level, and \* indicates significance at the 10% level.

### Panel A: Short Sale Capital Gains I – Excluding January

	Returns				3 Factor Alphas			
	R1 (low)	R2	R3	R4 (high)	R1 (low)	R2	R3	R4 (high)
SCGO_I 1 (low)	0.0041 (1.49)	0.0022 (1.06)	0.0017 (0.98)	0.0018 (0.90)	0.0019 (1.55)	0.0004 (0.51)	0.0001 (0.13)	0.0000 (-0.03)
SCGO_I 2	0.0027 (1.06)	0.0022 (1.16)	0.0011 (0.66)	0.0010 (0.53)	0.0007 (0.65)	0.0005 (1.07)	-0.0005* (-1.81)	-0.0007 (-1.41)
SCGO_I 3	0.0030 (1.17)	0.0017 (0.87)	0.0012 (0.63)	0.0003 (0.14)	0.0009 (0.94)	-0.0001 (-0.13)	-0.0006 (-1.33)	-0.0015** (-2.05)
SCGO_I 4 (high)	0.0037 (1.26)	-0.0004 (-0.17)	-0.0013 (-0.57)	-0.0028 (-1.03)	0.0013 (1.22)	-0.0024*** (-3.89)	-0.0032*** (-4.17)	-0.0048*** (-3.10)
SCGO_I 4 - SCGO_I 1	-0.0004 (-0.31)	-0.0026*** (-2.93)	-0.0030*** (-3.13)	-0.0045*** (-2.97)	-0.0006 (-0.53)	-0.0027*** (-3.14)	-0.0032*** (-3.62)	-0.0048*** (-3.28)

### Panel B: Short Sale Capital Gains I – Entire Year

	Returns				3 Factor Alphas			
	R1 (low)	R2	R3	R4 (high)	R1 (low)	R2	R3	R4 (high)
SCGO_I 1 (low)	0.0038 (1.50)	0.0019 (0.97)	0.0013 (0.77)	0.0012 (0.62)	0.0021* (1.75)	0.0004 (0.58)	-0.0001 (-0.31)	-0.0004 (-0.64)
SCGO_I 2	0.0027 (1.13)	0.0020 (1.11)	0.0008 (0.52)	0.0007 (0.43)	0.0011 (1.10)	0.0006 (1.35)	-0.0005* (-1.90)	-0.0007 (-1.42)
SCGO_I 3	0.0026 (1.11)	0.0017 (0.89)	0.0011 (0.62)	0.0003 (0.17)	0.0010 (1.13)	0.0002 (0.41)	-0.0004 (-0.91)	-0.0012* (-1.74)
SCGO_I 4 (high)	0.0037 (1.35)	-0.0001 (-0.02)	-0.0009 (-0.42)	-0.0018 (-0.71)	0.0017* (1.70)	-0.0017*** (-2.82)	-0.0025*** (-3.33)	-0.0036** (-2.43)
SCGO_I 4 - SCGO_I 1	-0.0001 (-0.09)	-0.0020** (-2.25)	-0.0022** (-2.32)	-0.0030** (-2.02)	-0.0004 (-0.32)	-0.0021** (-2.45)	-0.0024*** (-2.69)	-0.0032** (-2.24)

### Panel C: Short Sale Capital Gains II – Excluding January

	Returns				3 Factor Alphas			
	R1 (low)	R2	R3	R4 (high)	R1 (low)	R2	R3	R4 (high)
SCGO_II 1 (low)	0.0028 (0.95)	0.0025 (1.13)	0.0014 (0.72)	0.0019 (0.97)	0.0005 (0.36)	0.0005 (0.72)	-0.0004 (-0.79)	0.0001 (0.19)
SCGO_II 2	0.0036 (1.38)	0.0022 (1.08)	0.0014 (0.82)	0.0011 (0.60)	0.0015 (1.52)	0.0004 (0.80)	-0.0002 (-0.85)	-0.0006 (-1.13)
SCGO_II 3	0.0028 (1.09)	0.0019 (0.96)	0.0008 (0.45)	0.0008 (0.41)	0.0007 (0.81)	0.0001 (0.22)	-0.0009** (-2.37)	-0.0010 (-1.54)
SCGO_II 4 (high)	0.0037 (1.27)	-0.0003 (-0.14)	-0.0004 (-0.16)	-0.0017 (-0.65)	0.0013 (1.21)	-0.0023*** (-3.87)	-0.0023*** (-3.28)	-0.0037*** (-2.94)
SCGO_II 4 - SCGO_II 1	0.0010 (0.79)	-0.0028*** (-2.88)	-0.0017* (-1.86)	-0.0036*** (-2.85)	0.0009 (0.71)	-0.0028*** (-2.94)	-0.0019** (-2.08)	-0.0038*** (-3.12)

*Panel D: Short Sale Capital Gains II – Entire Year*

	Returns				3 Factor Alphas			
	R1 (low)	R2	R3	R4 (high)	R1 (low)	R2	R3	R4 (high)
SCGO_II 1 (low)	0.0025 (0.92)	0.0020 (0.98)	0.0008 (0.46)	0.0013 (0.67)	0.0007 (0.53)	0.0004 (0.59)	-0.0007 (-1.36)	-0.0003 (-0.50)
SCGO_II 2	0.0032 (1.31)	0.0019 (1.01)	0.0011 (0.70)	0.0008 (0.45)	0.0015 (1.64)	0.0005 (1.00)	-0.0002 (-0.89)	-0.0007 (-1.36)
SCGO_II 3	0.0025 (1.05)	0.0018 (0.98)	0.0008 (0.46)	0.0009 (0.49)	0.0009 (1.04)	0.0003 (0.79)	-0.0007* (-1.85)	-0.0006 (-1.00)
SCGO_II 4 (high)	0.0038 (1.39)	0.0001 (0.06)	-0.0003 (-0.14)	-0.0010 (-0.41)	0.0019* (1.75)	-0.0015** (-2.57)	-0.0019*** (-2.88)	-0.0027** (-2.26)
SCGO_II 4 - SCGO_II 1	0.0013 (1.17)	-0.0019** (-2.02)	-0.0011 (-1.26)	-0.0023* (-1.87)	0.0012 (1.07)	-0.0019** (-2.06)	-0.0013 (-1.44)	-0.0024** (-2.02)

## Table 7: Robustness check: Opening of short positions

This table contains the results of weekly panel regressions that examine the effect of Shortsale Capital Gains on the new opening of short sale positions from August 2004 to June 2010. The dependent variable is shorting (percentage of shares newly lent during the week). The explanatory variable of interest is SCGO I, which is defined as above. Fama-Macbeth regressions are at weekly frequency. In the OLS regressions, standard errors are clustered at the firm level. T-statistics are below the parameter estimates in parenthesis. \*\*\* indicates significance at the 1% level, \*\* indicates significance at the 5% level, and \* indicates significance at the 10% level.

*Panel A: Shorting - Shortsale Capital Gains Overhang*

	Shorting					
	(1)	(2)	(3)	(4)	(5)	(6)
SCGO I	-0.2181*** (-11.03)	-0.1005*** (-5.76)	-0.1516*** (-6.97)	0.0146 (0.66)	-0.1117*** (-5.30)	-0.0494** (-2.23)
Return t-4 to t-1	-0.4210*** (-6.52)	-0.1158* (-1.95)	-0.8776*** (-17.73)	-1.0748*** (-19.49)	-0.3575*** (-7.12)	-0.3328*** (-6.09)
Return t-52 to t-5	3.4788*** (18.62)	2.1318*** (11.17)	1.4488*** (7.36)	-4.0149*** (-14.77)	3.0558*** (13.15)	0.4833* (1.67)
Return t-156 to t-53	2.8310*** (12.60)	1.2972*** (7.39)	-0.3126 (-0.95)	-6.4480*** (-15.67)	3.3139*** (8.23)	-0.4061 (-0.87)
Turnover t-52 to t-1	3.9269*** (42.69)	2.9661*** (34.97)	2.6462*** (21.76)	2.5556*** (17.93)	2.6444*** (22.78)	2.3660*** (17.52)
Loaned Stocks	0.0866*** (69.87)	0.0825*** (67.48)	0.0965*** (128.84)	0.0933*** (99.80)	0.0860*** (106.73)	0.0854*** (86.33)
Market to Book		-0.0000 (-0.10)		0.0008 (0.54)		0.0019 (1.31)
Size		0.0010 (0.45)		0.1986*** (27.67)		0.0598*** (7.95)
Amihud Illiquidity		-0.0023*** (-13.80)		0.0011*** (3.82)		-0.0017*** (-6.03)
Breadth of Ownership		-0.7451*** (-22.02)		-3.8165*** (-15.93)		-1.6956*** (-9.47)
Inst. Ownership		0.1002*** (8.87)		0.0393*** (4.67)		0.0522*** (3.38)
Number of Analysts		0.0203*** (15.16)		-0.0086*** (-3.16)		0.0071** (2.36)
Constant	0.0425*** (12.82)	0.1344*** (2.67)	0.0743*** (13.99)	-3.7647*** (-26.17)		
Observations	1008798	813466	1008798	813466	1008798	813466
Adjusted R <sup>2</sup>			0.32	0.31		
Fama Macbeth	Yes	Yes	No	No	No	No
Weekly Fixed Effects	No	No	No	No	Yes	Yes
Firm Fixed Effects	No	No	Yes	Yes	Yes	Yes

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