

# Longs, Shorts, and the Cross-Section of Stock Returns

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## Abstract

Short sellers and active long investors often disagree. We show that on average more than half of the heavily shorted stocks have high long positions by hedge funds from 2000 through 2011 (and over the extended sample period of 1990 to 2011). Heavily shorted stocks with high hedge fund holdings do not underperform and the heavily shorted stocks experience significant negative abnormal returns only if they have low hedge fund holdings. The results suggest that disagreements of active investors and the actions they take help to incorporate both positive and negative information in stock prices. We further show that the results on the relation between disagreements of active investors and stock returns differ from the results based on other measures of different opinions such as analyst forecasts.

**JEL Codes:**

**Keywords: Short Selling, Hedge Funds, Stock Returns, Disagreement**

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# 1 Introduction

It is well recognized that investors can have very different opinions about the value of a firm. Perhaps the clearest case of such disagreement is between short sellers and active long investors in the same firm. One recent example is the so-called ‘short war’ between well-known investors, William Ackman, who took a large short position in Herbalife Ltd. (a nutrition marketing company) and Daniel Loeb and Carl Icahn, who both took large long positions.<sup>1</sup> The two sides not only took large opposite positions in the firm, but also battled publicly on the prospects and even the legality of Herbalife’s business model.

In this paper we study the disagreements between active investors, specifically the disagreements between short sellers and active long investors, and the relation between such disagreements and stock returns. We use the short interest on a stock to measure the expressed opinions of the short sellers and use the aggregate long positions of hedge funds in a stock to measure the expressed opinions of the active long investors. We assess the prevalence of the disagreements between active investors and further examine how such disagreements are associated with subsequent stock returns.

We classify high and low short positions based on both the absolute level of short interest in a stock (with cutoff points of 1%, 5%, and 10% to form portfolios) as well as the relative ranking of short interest across stocks (with cutoff points of 60%, 75%, and 90%). Similarly, we classify the high and low long positions of hedge funds based on the ratio of the aggregate number of shares held by hedge funds relative to the total number of shares outstanding. Using data on short interest and hedge fund holdings from 2000 to 2011, we document several striking findings.

First, short sellers and active long investors *often* disagree. We find that stocks that are highly shorted typically have high long positions by hedge funds. The results are remarkably similar across the different cutoff points for short interest and hedge fund holdings. For

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<sup>1</sup>See “A Hedge Fund Dogfight, Live, Mesmerizes Wall Street”, *New York Times*, January 25, 2013. Other notable examples include the fight between hedge fund manager David Einhorn’s short of the St. Joe Company and hedge fund manager Bruce Berkowitz’s long in the same company.

example, in every quarter, on average, 361 firms have a short interest larger than 10%. For 115 of these firms, hedge funds hold more than 10% of the outstanding shares of each firm, and for 214 of these firms, hedge fund holding is greater than 5%. This finding is surprising given the well documented evidence that the distribution of short interests and hedge fund holdings are both highly skewed across stocks – a small percentage of stocks have high short interest levels (high hedge fund holdings) and the majority of stocks have low short interest levels (low hedge fund holdings).<sup>2</sup> With the high skewness of the short interest and hedge fund holdings, the significant overlapping of the short and active long positions in the same stock suggests that the two sides likely actively acquired information, possess very different opinions and made differing investment decisions based on their opinions.

Second, stocks that have both high short interest and high hedge fund holdings do not show any abnormal returns over the subsequent one to four quarters. This finding is in sharp contrast with the results based on short interest alone (see, e.g., Asquith and Meulbroek 1995) or based on hedge fund holdings alone (see, e.g., Griffin and Xu 2009)- stocks with high short interest tend to have negative abnormal returns, whereas stocks with high hedge fund holdings tend to have positive abnormal returns. The result suggests that when the long and short investors disagree and trade in the opposite directions, stock prices reflect the information from both sides adequately.

Third, stocks that have high short interest but low hedge fund holdings exhibit significant negative abnormal returns. In particular, a portfolio with high short interest and low hedge fund holding has a significant abnormal monthly return of -1.4% over the subsequent three months on an equal-weighting basis. For the value-weighted portfolio, the abnormal monthly return is -1.2%. This result suggests that much of the predictive power of short interest for lower subsequent stock returns comes from the high short interest stocks with low hedge fund holdings.

Fourth, stocks that have low short interest tend to have positive abnormal returns, and

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<sup>2</sup>See, for example, Asquith, Pathak, and Ritter (2005) and Boehmer, Huszar, and Jordan (2010) on short interest and Griffin and Xu (2009) on hedge fund holdings.

hedge fund holdings generally have little impact on stock returns among these stocks. While there is some evidence that, particularly in the value weighted portfolios, low short interest stocks with high hedge fund holdings exhibit higher subsequent returns than those with low hedge fund holdings, the differences are much weaker than for high short interest stocks and are often insignificant. Extant studies show that high hedge fund holdings weakly predict positive abnormal stock returns (see, e.g., Griffin and Xu 2009 ). Our results show that this relation is mostly driven by the stocks that have high hedge fund holdings and low short interest. Equally important, we find a clear relation between low hedge fund holdings and stock returns, conditional on the level of short interest. Stocks with low hedge fund holdings but high short interest have negative subsequent returns, but stocks with low hedge fund holdings and low short interest have positive or insignificant abnormal returns.

Our findings show that the level of short interest and hedge funds holdings are related to subsequent stock returns. We also examine whether the change in short interest and the change in hedge fund holdings contain similar information. For the portfolio with an increase of short interest more than 1%, the future abnormal returns conditional on a decrease in hedge fund holding are about -6% per annum and statistically significant, while they are not different from zeros if the hedge fund holding also increases by more than 1%. The return spread between the portfolios with an increase and a decrease in hedge fund holding is about -4.8% per annum, but not significant. About 30% of stocks with an increase in short interest of 1% and above are also the ones with an increase of 1% and above in hedge fund holdings. Portfolios with low short interest increase tend to have high future abnormal returns, and the portfolios with high hedge fund holding increase tend to have high future abnormal returns.

Our findings are robust to issues such as portfolio weighting, the risk-adjustment procedure, extended time period of 1990-2011 that covers period with relatively lower short interest and lower hedge fund holdigns, and inclusion/exclusion of the financial crises of 2008-2009 (see, e.g., Ben-David et al. 2012 that document a significant decline in the aggregate short interest in the period of 2008-2009, and that the U.S. market capitalization held

by hedge funds declined significantly during the same period.)

The results we document on the relation between short interest and hedge fund holdings as well as the subsequent return patterns differ from those based on short interest and aggregate institutional ownership (see, e.g., Asquith et al. 2005). Since the overall institutional ownership represents both passive and active holdings, extant studies on the relation between institutional ownership and short selling typically use institutional ownership as a proxy for short-sale constraints, rather than active long positions. We show that our results based on hedge fund holdings are not driven by institutional ownership. In fact, we find that high short interest stocks exhibit lower returns regardless of institutional ownership levels.

The results we document also differ from those based on diverse opinions as proxied by financial analysts earnings forecasts. Diether, Malloy, and Scherbina (2002) find that stocks on which market participants have diverse opinions, as proxied by financial analysts earnings forecasts, tend to have negative returns. Due to short sale constraints, investors who have negative information may not be able to trade on the stocks, i.e., establish short positions in those stocks. Because the prices of these stocks do not fully reflect all negative information, these stocks have lower returns (see also, Miller 1977). Our findings differ from the results based on the different opinions of other market participants in several important aspects. In our analysis, we measure the disagreements of active investors based on the observed trading positions, we show that the stocks with high disagreements do not exhibit abnormal returns, whereas stocks with negative opinions by short sellers without presence of positive opinions have negative returns. We check our results for two subsamples of stocks with high and low dispersions of opinions based on financial analyst forecast and find that our results hold for both subsamples.

Our study contributes to the literature on both short selling and hedge fund investment decisions. Various studies have examined the information content of short interest. Asquith and Meulbroek (1995) find that high short interest predicts negative abnormal returns for NYSE/AMEX stocks, and Desai, Ramesh, Thiagarajan, and Balachandran (2002) find a sim-

ilar relation for NASDAQ stocks. Boehmer, Huszar, and Jordan (2010) find that relatively heavily traded stocks with low short interest experience both statistically and economically significant positive abnormal returns.

A large literature has examined the information content of institutional holdings, as well as the investment decisions of mutual funds and hedge funds. Gompers and Metrick (2001) find a positive relation between institutional ownership and future stock returns. Jiang and Sun (2014) find a positive relation between the dispersion of mutual fund holdings and stock returns. Griffin and Xu (2009), however, only find a weak relation between hedge fund holdings and future stock returns. Brunnermeier and Nagel (2004) study the hedge fund holdings during the technology bubble between 1998 and 2000. They find that the hedge funds heavily invested in technology stocks and skillfully anticipated their price peaks. A portfolio that mimics the hedge fund holdings has positive abnormal future returns. Aragon, Hertz, and Shi (2013) and Agarwal, Jiang, Tang, and Yang (2013) study the hedge fund holdings through confidential 13F filings. They find that stock in these holdings are associated with information-sensitive events and greater information asymmetry. These holdings generates positive abnormal future returns. Our findings show that it is important to evaluate the long and short positions jointly in order to assess the information content of short interests and the long positions of active investors.

Our study also contributes to the recent literature on information acquisition decisions in financial markets. Several recent theoretical papers argue that the information acquisition decision is a critical component of the overall investment decision process and that studying the information acquisition decision can offer new insights on understanding investment decision making (see, e.g., Van Nieuwerburgh and Veldkamp 2009, Van Nieuwerburgh and Veldkamp 2010). In a model with endogenous information acquisition, Nezafat, Schroder, and Wang (2015) show that if the costs of short selling vary across stocks, those with low costs encourage greater information acquisition and can lead to higher short selling activities. Our results are consistent with the arguments of these models. For example, high short interest

by itself may not predict abnormal future stock returns even if short selling activities are driven by information acquisition and negative information acquired by the short sellers. This is because high short interest not only reflects the ‘negative’ information acquired by some investors, but also indicates intensive information acquisition that could lead to ‘information-driven’ long positions by other investors. As such, stocks with both active long and short positions do not exhibit abnormal returns as both positive and negative information acquired by the investors is reflected in the stock price.

The rest of the paper is organized as follows. Section 2 discusses the short interest and hedge fund holdings data we use in the study. The baseline results are presented in Section 3. Section 4 investigates the robustness of the results and potential explanations. Section 5 offers concluding remarks.

## 2 Data and Summary Statistics

The short interest on a stock represents the positions established by short sellers in the stock. Though not exclusively, short selling typically is conducted by active professional investors such as hedge fund managers. Short interest on a stock thus reflects the opinions of a group of active investors as well as the actions taken by these investors based on their opinions. We obtain monthly short interest data from the New York Stock Exchange (NYSE), the American Stock Exchange (AMEX), and NASDAQ for the period of January 1988 to December 2011. The level of short interest in individual stocks is reported to the exchanges by member firms. Exchanges report short interest twice per month since September 2007. To be consistent with the short interest data from the earlier period we keep the data at the monthly frequency. Nasdaq short interest data start from July of 1988.

To identify active investors who hold long positions in stocks, we focus on the sample of investors who have similar objectives as those of short sellers. Hedge fund managers are active investors who are not highly constrained and could hold long or short positions

depending on their information. Thus the long positions of hedge fund managers and short positions of short sellers (mostly hedge funds) are from a homogeneous group of investors. We use hedge funds as the sample of active investors for two additional reasons. First, many institutional investors are passive investors, so overall institutional ownership represents both active and passive holdings. Second, even for active mutual fund and pension fund managers, they often face short-sale constraints and many other types of institutional constraints, and such constraints can directly affect their information acquisition decisions (see, e.g., Nezafat et al., 2015) and their use of information (Cao, Han and Wang, 2014).

To construct the sample of hedge funds, we start from the list of institutional investors in Thomson Financial’s CDA/Spectrum 13F database. CDA/Spectrum divides institutions into five types: 1) bank trust departments; 2) insurance companies; 3) investment companies and their managers; 4) independent investment advisers; and 5) others. We exclude institutions classified as type 1 (bank trust departments) or type 2 (insurance companies). For each of the remaining institutions, we manually check its SEC ADV forms (like Brunnermeier and Nagel 2004 and Griffin and Xu 2009) and require an institution to have over 50 percent of investment listed as ‘other pooled investment vehicles’ (private investment companies, private equity, and hedge funds) or over 50 percent of clients as ‘high net worth individuals’ to be included in our hedge fund sample. Further, we require the institutions to charge performance-based fees to be included in the hedge fund sample. Finally, we manually check the website of each institution that satisfies the above requirements to confirm whether it is a hedge-fund-only business or not.

One may be concerned that some hedge fund holding companies do not register as investment advisors and hence do not file ADV forms. This issue is of little significance because as detailed in Brown, Goetzmann, Liang, and Schwarz (2008), a 2004 SEC investment advisor rule amendment requires all U.S. based hedge funds with more than 14 clients, assets more than \$25 million, and lockup period of less than two years, to file ADV forms. It also requires all internationally based hedge funds with more than 14 U.S. based investors to file



ADV forms. All hedge funds satisfying the above requirements had to register as investment advisors by February 1, 2006. Thus, the large number of hedge funds that made form ADV filings in 2006 are included in our sample.

Our procedure of identifying hedge funds is conservative and leads us to large and prominent hedge funds without any non-hedge fund business, which is the fund sample we intend to focus on in this study. Our final hedge fund sample includes 401 hedge fund holding companies with 13F filings from the first quarter of 2000 to the second quarter of 2007. For comparison, Brunnermeier and Nagel (2004) identify 53 hedge fund holding companies from 1998 to 2000, while Griffin and Xu (2009) identify 306 hedge fund holding companies from 1980 to 2004. Each fund holding company often has multiple hedge funds under management and it is easily conceivable that our sample of 401 firms represents over one thousand funds. Although our sample can be extended to earlier periods, we focus on the post-2000 period in our analyses. In additional tests, we examine the results for the extended time period of 1990 to 2011.

After obtaining the hedge fund sample, we compute hedge fund holdings based on the 13F filings. Hedge funds, as well as other types of investors, are only required to report their long positions in 13F filings. As a result, hedge fund holdings from the 13F data only represent long positions held by these investors. We further scale the aggregate hedge fund holdings in a stock using the number of shares outstanding of the stock to compute the hedge fund holding (HFH) variable.

We keep the stocks listed on the NYSE, AMEX, or NASDAQ that have a CRSP share code of 10 or 11. The sample period is from 2000 to 2011. We start from the first quarter of 2000, so in total there are 141 months. We replace missing value of short interest and hedge fund holding with zeros, and our results are robust if we drop the missing values.

In our analysis, we form portfolios based on the one-way sort of the level of short interest, on the one-way sort of the level of hedge fund holdings, and the two-way sort of short interest and hedge fund holdings. For the one-way sort of the level of short interest, we use the

absolute level of short interest in a stock and cutoff points of 1%, 5%, and 10% to form 4 portfolios. For instance, a firm with a short interest above 10% belongs to the high-short-interest portfolio and a firm with a short interest below 1% belongs to the low-short-interest portfolio. We also use the relative ranking of short interest across stocks and cutoff points of 60%, 75%, and 90% to form portfolios. Similar approaches are used to form portfolios based on hedge fund holdings using the ratio of the aggregate number of shares held by hedge funds to the total number of shares outstanding to assign a firm to a portfolio. For the two-way sort of short interest and hedge fund holdings, we form 16 portfolios based on both the absolute level and the relative ranking of short interest and hedge fund holdings to assign a firm to a portfolio.

Table 1 presents the average firm's characteristics of firms with high short interest, high hedge fund holdings, and both the high short interest and high hedge fund holdings.

The distribution of short interests and hedge fund holdings are both highly skewed across stocks. Extant studies show that only a small percentage of stocks have high short interest levels (high hedge fund holdings) and the majority of stocks have low short interest levels (low hedge fund holdings) (see, e.g., Asquith et al. 2005 and Boehmer et al. 2010 on short interest and Griffin and Xu 2009 on hedge fund holdings).

## 3 Empirical Results

### 3.1 A Comparison of Short and Active Long Positions

We start with examining the abnormal returns of the one-way sorted portfolios. At the end of each quarter, firms are sorted into 4 portfolios based on the level of short interest or the level of hedge fund holdings. The equal and value weighted abnormal returns of each portfolio in the next three months are computed.<sup>3</sup> We consider two approaches for computing the

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<sup>3</sup>We use the stock's market value at the end of the quarter as the portfolio weight for the next three months.

abnormal returns. The first one is based on the characteristic adjusted benchmarks from Daniel, Grinblatt, Titman, and Wermers (1997) (hereafter DGTW) and further developed by Wermers (2004). The second one is the regression method, based on the Carhart four-factor model as in Carhart (1997).

Table 2 presents the results. In the top panel, the results for absolute-based sorted portfolios are reported. The left side of the panel shows the results for four portfolios formed based on the short interest. The first and third rows represent the average abnormal returns for equal and value weighted portfolios. Table 2 shows that the portfolio with low short interest tend to have high future abnormal return, and the difference between the highest and lowest short interest portfolios are significant. The portfolio with the highest short interest has negative future abnormal returns, but those are not significantly different from zero.

The right side of the panel shows the results for four portfolios formed based on the hedge fund holdings. Portfolios with high hedge fund holdings tend to have high future abnormal returns, and the difference between the highest and lowest value weighted portfolios are significant. The portfolio with the highest hedge fund holdings has positive and significant future abnormal returns. The value weighted portfolio with the lowest hedge fund holdings has significant and negative future abnormal returns. In the last row, we provide the average number of firms in each portfolio over the sample period. By constructions, the number of firms are not evenly distributed, and the bottom portfolios have more firms than the top one.

In the top panel, the results for relative-based sorted portfolios are reported. The relative-based sorting can eliminate the impact of time trend in the short interest and hedge fund holdings. The results are largely similar to those in the first panel. One difference is that the portfolio with the highest short interest now has significant and negative future abnormal returns, and that the portfolio with the lowest short interest has significant and positive future abnormal returns. The number of firms in each portfolio are different from those in

the first panel, but the qualitative pattern is similar.

The results in Table 2 show that the distribution of stocks across the different short-interest and hedge fund holding portfolios as well as the results on stock returns of these portfolios are consistent with results reported in recent studies (see, e.g., Boehmer et al. 2010 and Griffin and Xu 2009). We find similar results when we use Carhart four-factor model for computing abnormal returns and for space considerations we do not report the results.

### 3.2 Disagreement and Subsequent Stock Returns

We next present our main findings based on the two-way sort of short interest and hedge fund holdings. Table 3 shows the two-way double sorting results based on the DGTW benchmarks. At the end of each quarter, firms are sorted into 16 portfolios based on the level of short interest and the level of hedge fund holdings. The equal and value weighted abnormal returns of each portfolio in the next three months are computed. In the first panel, we sort firms by the absolute value of their short interest and hedge fund holdings. The cutoff points are 1%, 5%, and 10% for both short interest and hedge fund holdings.

In 3, the row titled 'Firms' reports the average number of firms in each portfolio. An unexpected finding is that for the most shorted portfolio (i.e., the portfolio that includes firms with short interest  $\geq 10\%$ ), the number of firms conditional on the most hedge-fund-hold portfolio (i.e., the portfolio that includes firms for which at least 10% of shares are held by hedge funds) contains about four times more firms than the one conditional on the least hedge-fund-hold portfolio (115 vs. 34). This means that almost 80% of the most shorted stocks are also the ones most longed by hedge funds even though the majority of stocks have low hedge fund ownership. If we group the two highest short-interest stock portfolios ( $\geq 5\%$ ) as high short-interest stocks, the results are even more striking (214 vs. 34). Even if we use 5% as the single cutoff point for classifying high and low short-interest and hedge fund holdings, more than half of the high short interest stocks have high hedge fund holdings (214 vs. 147).

The finding is even more surprising given the well documented evidence, which is further confirmed in our sample that the distribution of short interest and hedge fund holdings are both highly skewed across stocks- a small percentage of stocks have high short interest levels (high hedge fund holdings) and the majority of stocks have low short interest levels (low hedge fund holdings). With the high skewness of the short interest and hedge fund holdings, the significant overlapping of the short and active long positions in the same stock suggests that the two sides likely actively acquired information, possess very different opinions and made investment decisions based on their opinions.

The panel reports the equal and value weighted abnormal returns of each portfolio in the next three months. The left part shows the equal weighted results. For the highest short interest portfolio, the results conditional on hedge fund holdings are sharply different. For the portfolio with the lowest hedge fund holdings and the highest short interest, the future abnormal returns are negative and significant. In particular, the average abnormal returns are -16.8% per annum. For comparison, the average abnormal returns of the highest short interest portfolio in the one-way sorting are -4.8% per annum for both equal and value weighted portfolios. The magnitude of the conditional average abnormal returns is three times as large as the one of the unconditional results.

For the portfolio with the highest hedge fund holdings and the highest short interest, the future abnormal returns are insignificant and even positive. When the long side and the short side disagree with each other by trading the same stock in the opposite directions, the future abnormal returns are not different from zero. This result is in sharp contrast with the one conditional on the lowest hedge fund holdings. Within the highest short interest portfolios, the return spread between the highest and lowest hedge fund holdings portfolios is 20.4% per annum. This spread is five times as large as the average abnormal returns of the highest short interest portfolio. This large variation within the highest short interest portfolio is due to the different opinions of long investors. The information of long investor can not be ignored when study the future returns of shorted stocks.

The results from value weighted portfolios are similar to the ones from equal weighted portfolios, but the economic magnitude and statistical significance level are slightly smaller. For the highest short interest portfolios, the future abnormal returns conditional on the highest hedge fund holdings are insignificant, while they are negative and significant conditional on the lowest hedge fund holdings. The spread between these two portfolios are -13.2%. The reduce economic magnitude suggests that the disagreement between long and short investors is likely to be on the stocks with small capitalization.

The rest results in the first panel are consistent with those in Table 2. Portfolios with low short interest tend to have high future abnormal returns, and the portfolios with high hedge fund holdings tend to have high future abnormal returns. The one-way sorting results hold in the two-way sorting.

In the second panel, firms are sorted by the percentiles in each quarter. For short interest, the cutoff points are 80%, 90%, and 95%. For hedge fund holdings, the cutoff points are 60%, 75%, and 90%. The results are largely similar to those in the first panel. For the highest short interest portfolios, the future abnormal returns conditional on the highest hedge fund holdings are insignificant, while they are negative and significant conditional on the lowest hedge fund holdings. Within the highest short interest portfolios, the return spread between the highest and lowest hedge fund holdings portfolios is 13.2% per annum for equal weighted portfolio, and it is about 60% higher than the average abnormal returns of the highest short interest portfolio. These results hold consistently for both equal and value weighted portfolios, while the economic magnitude of results from equal weighted portfolios are stronger than those from value weighted portfolios.

The number of firms in the second panel is more evenly distributed within the highest short interest portfolios than the one in the first panel, so the difference between the highest and lowest hedge fund holdings portfolio is not as striking as before. However, there are still 20% of the most shorted stocks that are also the ones most longed by hedge funds. The hedge fund holdings materially changes the future abnormal returns of these most sorted

stocks.

In the third and fourth panel, we repeat the exercise but use alternative percentile sorting methods. In the third panel, the cutoff points are 80%, 90%, and 95% for both short interest and hedge fund holdings. In the fourth panel, the cutoff points are 60%, 75%, and 90% for both short interest and hedge fund holdings. The results are largely similar to those in the first and second panel. The results from value weighted portfolios are stronger than before, and become close to those from equal weighted portfolios. The economic magnitude and the statistical significance level vary across different sorting specifications, but the qualitative results are robust.

In Table 3, we use different sorting methods and find that the future abnormal returns are sharply different for most shorted stocks conditional on different hedge fund holdings. Nonetheless, the results can be driven by the benchmarks. To address this concern, Table 4 presents the results based on the Carhart regression models. At the end of each quarter, firms are independently sorted into 4 by 4 portfolios by their short interest and by their hedge fund holdings. The equal and value weighted raw returns of each portfolio in the next three months are computed. We use one-month Treasury bill rate to calculate excess returns for each portfolio, and use Fama-French three-factor and a momentum factor to calculate the alpha. Standard errors are adjusted by Newey-West method.

In the first panel, we sort firms by the absolute value of their short interest and hedge fund holdings. The cutoff points are 1%, 5%, and 10%. The left part shows the equal weighted results. Conditional on the lowest hedge fund holdings, the future abnormal returns are -20.4% per annum for the most shorted stocks, and are highly significant. In contrast, conditional on the highest hedge fund holdings, the future abnormal returns are 0% for the most shorted stocks, and are not significant. The value weighted results are similar. For the most shorted stocks, the future abnormal returns conditional on the lowest hedge fund holdings are -16.8% per annum and highly significant, while they are not different from zeros conditional on the lowest hedge fund holdings. In addition, portfolios with low short interest

tend to have high future abnormal returns, and the portfolios with high hedge fund holdings tend to have high future abnormal returns. All these results are consistent with those in Tables 3 and 2, and therefore they are robust to alternative benchmarks.

For comparison, from the second to the fourth panel, we repeat the exercise and use different percentile sorting methods. The cutoff points are the same as those from the corresponding panels in Table 3. Again, the results are similar to those in the first panel. The economic magnitude are slightly changed but the significance level are intact. For the most shorted stocks, the future abnormal returns conditional on the lowest hedge fund holdings are about -14% per annum and highly significant, while they are not different from zeros conditional on the lowest hedge fund holdings. In general, only the portfolio conditional on the highest hedge fund holdings has insignificant future abnormal returns. For moderate hedge fund holdings, such as the second and third hedge fund holdings portfolios, the abnormal returns are negative and significant for most shorted stocks.

Both the DGTW and regression benchmarks give similar results, which are also robust to different sorting methods. Next we perform additional tests to check the robustness and to see whether the results are unique to our mechanism.

### **3.3 Longer Holding Period**

Table ?? shows the two-way double sorting results of abnormal returns based on the DGTW benchmarks. At the end of each quarter, firms are independently sorted into 4 by 4 portfolios by their short interest and by their hedge fund holdings. We report the number of firms in each portfolios and compute the equal and value weighted abnormal returns of each portfolio in the next 6 months. Because we sort portfolios every 3 months and hold a portfolio for the next 6 months, a problem of overlapping portfolios arises. We take the average to solve this problem. For example, at the end of March, or the end of the quarter, firms are sorted into 16 portfolios, and we hold these portfolio from April to September. At the end of the June, or the end of the second quarter, firms are again sorted into 16 portfolios, and we hold



these portfolio from July to December. For any portfolio  $i$ , there are two such portfolios from July to September: one is formed based on the information at the end of March, and one is formed based on the information at the end of June. We first calculate the equal and value weighted abnormal return as well as the number of firms for each of the overlapping portfolios, and then take the average as the abnormal return (equal or value weighted) and the number of firms for portfolio  $i$  in each month from July to September. We repeat the exercise and calculate the monthly abnormal return for each portfolio from 2000 to 2011.

In the first panel, we sort firms by the absolute value of their short interest and hedge fund holdings. The cutoff points are 1%, 5%, and 10% for both short interest and hedge fund holdings. The results in the first panel are largely similar to those in the first panel of Table 3. The sign, the significance, and even the economic magnitude are barely changed. In the second panel, firms are sorted by the percentiles in each quarter. For short interest, the cutoff points are 80%, 90%, and 95%. For hedge fund holdings, the cutoff points are 60%, 75%, and 90%. These results are similar to those in the third panel of Table 3, but the economic magnitude as well as the significance level is smaller. It is expected as the portfolio is formed based on both the recent and the dated information.

Table 5 presents the results based on the Carhart regression models. At the end of each quarter, firms are independently sorted into 4 by 4 portfolios by their short interest and by their hedge fund holdings. The equal and value weighted raw returns of each portfolio in the next 6 months are computed. The portfolio sorting is the same as the one in Table ??.

Table ?? shows the two-way double sorting results of abnormal returns based on the DGTW benchmarks. At the end of each quarter, firms are independently sorted into 4 by 4 portfolios by their short interest and by their hedge fund holdings. We report the number of firms in each portfolios and compute the equal and value weighted abnormal returns of each portfolio in the next 12 months. Because we sort portfolios every 3 months and hold a portfolio for the next 12 months, there could be 4 overlapping portfolios in a month. We take the average of these 4 portfolios. For example, for a portfolio  $i$  in July, one is formed at the

end of June, one is formed at the end of March, one is formed at the end of December in last year, and one is formed at the end of September in last year. We first calculate the equal and value weighted abnormal return as well as the number of firms for each of the overlapping portfolios, and then take the average as the abnormal return (equal or value weighted) and the number of firms for portfolio  $i$  in the month of July. We repeat the exercise and calculate the monthly abnormal return for each portfolio from 2000 to 2011.

Table 6 presents the results based on the Carhart regression models. At the end of each quarter, firms are independently sorted into 4 by 4 portfolios by their short interest and by their hedge fund holdings. The equal and value weighted raw returns of each portfolio in the next 12 months are computed. The portfolio sorting is the same as the one in Table ??.

### **3.4 Changes in Disagreement and Subsequent Stock Returns**

We argue that the combination of hedge fund holdings and short interest contains important information of the stocks, and we find that the most shorted stocks can also be the ones that are most longed by hedge fund. In the previous section, we use the levels of short interest and the level of hedge fund holdings to measure the opinions of long and short investors. If the level of holding contains important information, we conjecture that the change of the hedge fund holdings short interest should also contain similar information. We test this idea, and present the results in Tables 7 and 8.

The change of hedge fund holdings in quarter  $t$  is the difference between the hedge fund holdings in quarter  $t$  and  $t-1$ . The short interest data are monthly updated. To be consistent, the change of short interest in quarter  $t$  is the difference between the short interest at the end of quarter  $t$  and  $t-1$ . Table 7 presents the results based on the DGTW benchmark. In the first panel, we sort firms by the absolute value of the change of their short interest and hedge fund holdings. The cutoff points are 0, 0.5%, and 1%. Given the cutoff based on the absolute value in Table 3, these changes represent roughly 10 percentage increase per quarter.

Consistent with our conjecture, the results are indeed similar to those in Table 3. For the portfolio with an increase of short interest more than 1%, the future abnormal returns conditional on a decrease in hedge fund holdings are about -6% per annum and statistically significant, while they are not different from zeros if the hedge fund holdings also increases by more than 1%. This result hold for both equal and value weighted portfolios. The return spread between the portfolios with an increase and a decrease in hedge fund holdings is about -4.8% per annum, but not significant. About 30% of stocks with an increase in short interest of 1% and above are also the ones with an increase of 1% and above in hedge fund holdings. Portfolios with low short interest increase tend to have high future abnormal returns, and the portfolios with high hedge fund holdings increase tend to have high future abnormal returns.

In the second panel, firms are sorted by the percentiles of the change in each quarter. For short interest, the cutoff points are 80%, 90%, and 95%. For hedge fund holdings, the cutoff points are 60%, 75%, and 90%. All results are similar to the ones in the first panel, with some variations in the economic magnitude, statistical significance level and the number of firms in each portfolio. These variations do not change our basic findings.

Tables 8 reports the results based on the Carhart four-factor model. The first and second panels use the same sorting as the corresponding ones in Table 7, but the results are somewhat stronger. For the portfolio with an increase of short interest more than 1%, the future abnormal returns conditional on a decrease in hedge fund holdings are about -8% per annum and highly significant, while they are not different from zeros if the hedge fund holdings also increases by more than 1%. This result holds for both equal and value weighted portfolios. The return spread between the portfolios with an increase and a decrease in hedge fund holdings is about -5% per annum.

Although the qualitative results in Tables 7 and 8 are similar to the ones before, the economic magnitude and statistical significance level are smaller. There are several possible reasons. First, the hedge fund holdings and short interest can be persistent. For two stocks

with persistently high short interest, the subsequent return for the stock with persistently high hedge fund holdings will be different from the one with persistently low hedge fund holdings. These two stocks will be in different portfolios in Table 3. If we sort firms by the change, these two stocks can be in the same portfolio. Therefore, the results are not as sharp as the ones from the sorting based on the level. Second, this change is based on the absolute value. It is likely that the percentage change for a individual stock may not be high, so it contains less information. Despite the potential disadvantages of this sorting, similar results are still obtained, reinforcing the robustness of our findings.

## 4 Robustness Checks

### 4.1 Aggregate Institutional Ownership

We argue that hedge fund holdings represents long positions of active investors thus could contain important information that could affect the future abnormal returns for the most shorted stocks. In this subsection we test whether the general institutional holdings could replace the information role of the hedge fund holdings. Because overall institutional ownership represents both passive and active holdings, extant studies on the relation between institutional ownership and short selling typically use institutional ownership as a proxy for short-sale constraints, rather than active long positions (see, e.g., Asquith et al., 2005 and Nagel, 2005). Nevertheless, these studies did find some evidence on the relation between the intersection of institutional holdings and short interest and stock returns. We now examine whether or not our results based on hedge fund holdings differs from those based on institutional ownership.

We obtain institutional equity holding and trading from CDA Spectrum 13F Filings, currently distributed by Thomson Financial. Under the 1978 amendment to the Securities and Exchange Act of 1934, all institutional investors managing a portfolio with an investment value of \$100 million or more are required to file quarterly 13F reports to the SEC, listing

their equity positions greater than 10,000 shares or \$200,000 in market value as of the last date of each quarter. The reporting requirements encompass various types of institutional managers such as banks, investment companies, pension funds, insurance companies, and brokerage houses.

Table 11 presents the results when we use the institutional ownership to replace hedge fund holdings. Because the institutional ownership is much higher than the hedge fund holdings, the sorting based on the same absolute value is not directly comparable. Therefore, we focus on the relative sorting with the cutoff points of 80%, 90%, and 95% for short interest, and 60%, 75%, and 90% for institutional ownership. In the first panel, the results based on the DGTW benchmark are reported. In the second panel, the results based the Carhart regression model are reported. They are analogous to those in the second panel in Tables 3 and 4.

In both panels, the future abnormal returns for most shorted stocks are negative and highly significant irrespective of the level of the institutional ownership. For the DGTW benchmark, the future abnormal returns for the highest short interest is about -7.2% per annum conditional on the highest institutional ownership. In regressions, this number is about -9.6% per annum. In addition, the return spreads for the most shorted stocks between the highest and lowest institutional ownership portfolios is smaller than those between hedge fund holdings portfolios. The results imply that the long side information in the hedge fund holdings is not the same as that in the general institutional holdings.

## 4.2 Dispersion of Financial Analyst Opinions

Our results based on the disagreements of active investors differ from the results based on the different opinions of other market participants in several important aspects. Diether, Malloy, and Scherbina (2002) find that, stocks on which market participants have diverse opinions, as proxied by financial analysts earnings forecasts, tend to have negative returns. Due to short sale constraints, investors who have negative information may not be able to

trade on the stocks, i.e., establish short positions in those stocks. Because the prices of these stocks do not fully reflect all negative information, these stocks have lower returns (see also, Miller, 1977). In our analysis, we measure the disagreements of active investors based on the observed trading positions, we show that the stocks with high disagreements do not exhibit abnormal returns while stocks with negative opinions by short sellers without presence of positive opinions have negative returns.

In this subsection, we study the relation between our results and those based on the different opinions of financial analysts. The major proxy we use is the analyst forecast dispersion scaled by the mean monthly price. The results are similar if we use the analyst forecast dispersion scaled by absolute mean forecast. We examine our results for two sub-samples of stocks with high and low dispersions of opinions based on financial analyst forecast.

In each quarter, firms are independently sorted by the percentiles. For dispersion, the cutoff point is 50%. For short interest, the cutoff points are 80%, 90%, and 95%. For hedge fund holdings, the cutoff points are 60%, 75%, and 90%. We have 2 by 4 by 4, and in total 32 portfolios in each month. The equal and value weighted abnormal returns of each portfolio in the next three months are computed. The results based on the DGTW benchmark and Carhart regression model are reported in Tables ?? and 12 respectively.

For both low and high dispersion portfolios, portfolios with low short interest tend to have high future abnormal returns, and the portfolios with high hedge fund holdings tend to have high future abnormal returns. This result is similar to the one in previous tables. Because the analyst forecast dispersion are related to the different options among investors, we expect that our results are stronger in the high dispersion portfolios. Indeed, in the second panel in Table 12 the results are similar to the ones in previous tables. For the high dispersion portfolios, the future abnormal returns for the most shorted stock are negative and significant conditional on the lowest hedge fund holdings, and they are not different from zeros conditional on the highest hedge fund holdings. This result holds for both equal and value weighted portfolios.

For the low dispersion portfolios in the first panel in Table 12, the qualitative results are similar to the second panel, but the economic magnitude and statistical significance level become smaller. Actually, the abnormal returns in Table ?? are generally not significant. One issue is the data limitation. The requirement for the dispersion measure reduce 50% of the sample, while in the three-way sorting the number of portfolio in each month is doubled from 16 to 32. These changes result in small number of firm in each portfolio. The portfolio returns are volatile, and the statistical significance is difficult to achieve. Nonetheless, it still provides important information how the measure of different opinion is related to our results.

### 4.3 Extended-Period Analysis

In the main analysis we focus on the sample period from 2000 to 2011. One major reason is that the hedge fund holdings information is sparse and the level of holding is small before 2000. However, it is still interesting to see whether our results hold for a longer period. In this subsection we provide the evidence for the period from 1990 to 2011 in Tables ?? and 10.

Table ?? reports the results analogous to those in Table 3. All results remain. For example, the left part in the first panel shows the equal weighted results. Conditional on the lowest hedge fund holdings, the future abnormal returns are -15.6% per annum for the most shorted stocks, and are highly significant. In contrast, conditional on the highest hedge fund holdings, the future abnormal returns are 7.2% for the most shorted stocks, but not significant. For the most shorted stocks, the return spread between the highest and lowest hedge fund holding portfolios is 22.8% per annum. Similar results are obtained in value weighted portfolios. The economic magnitude and statistical significance level are almost the same as those in Table 3.

Table 10 reports the results analogous to those in Table 4. All results remain. One exception is in the second panel with the percentile sorting. For the most shorted stocks,

the future abnormal returns are negative and significant for both the highest and lowest hedge fund holding portfolios. One possible reason is that the hedge fund holdings before 2000 is low. Even at the 90 percentile and above, the level of the hedge fund holdings may not be large enough to materially change the subsequent returns of the most shorted stocks. It could explain why the results based on the absolute value sorting in the first panel are robust. Nonetheless, the return spread for the most shorted stocks between the highest and lowest hedge fund holding portfolios is still large. It is 9.6% per annum for equal weighted portfolio, and 3.6% per annum for value weighted portfolio.

## 5 Conclusions

In this paper we study the disagreements between active investors, specifically the disagreements between short sellers and active long investors, and the relation between such disagreements and stock returns. We use the short interest on a stock to measure the expressed opinions of the short sellers and use the aggregate long positions of hedge funds in a stock to measure the expressed opinions of the active long investors. We assess the prevalence of the disagreements between active investors and further examine how such disagreements are associated with subsequent stock returns.

We find that short sellers and active long investors often disagree. Over our sample period, on average, more than half of the stocks with high short interest have high long positions by hedge funds. Furthermore, the differing opinions of the active investors matter for future stocks returns. Stocks that have both high short interest and high hedge fund holdings do not show any abnormal returns. Stocks that have high short interest but low hedge fund holdings, however, exhibit significant negative abnormal returns.

Our findings show that it is important to evaluate the long and short positions jointly in order to assess the information content of short interest and of the long holdings of active investors.



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Table 1: Summary Statistics

This table presents the firm characteristics of portfolios. Market capitalization (in millions) is calculated monthly as shares outstanding (Item *shrout*) times the month-end share price (Item *prc*). Total sales is the quarterly total sales (in millions, Item *saleq*). Book-to-market (equity) is the book value of equity (Item *ceqq*) relative to the market value (Item *prccq*  $\times$  Item *chsq*). Book-to-market (asset) is the sum of the book value of equity (Item *ceqq*) and the book value of debt (Item *dlttq* + Item *dlcq*) relative to the sum of the market value of equity (Item *prccq*  $\times$  Item *chsq*) and the book value of debt (Item *dlttq* + Item *dlcq*). Debt-equity ratio is the total debt (Item *dlttq* + Item *dlcq*) to the book value of equity (Item *ceqq*). Earnings-price ratio is the EPS (Item *epspxq*) relative to the quarter-end share price (Item *prccq*). Profit margin is the operating income before depreciation (Item *oibdp*) relative to the sales (Item *saleq*). Turnover is the monthly number of shares traded (Item *vol*) relative to the number of shares outstanding (Item *shrout*). Market capitalization, turnover, and share price are from the CRSP. The other variables are from the quarterly Compustat/CRSP Merged (CCM) data set. Item names refer the names in the data sets respectively. At the end of each quarter, firms are sorted independently into 4 by 4 portfolios by short interest (SI) and hedge fund holding (HFH). We report the mean and the median of the firm characteristics for the overall sample, the most shorted portfolio, the most longed portfolio, and the most both short and longed portfolio. Variables from CCM are winsorized at a 1% level each tail in each year. In the first panel, firms are sorted based on the absolute value. The cutoff points are 1%, 5%, and 10% for SI and HFH. In the second panel, firms are sorted based on the relative value. The cutoff points are 80%, 90%, and 95% for SI, and 60%, 75%, and 90% for HFH. The sample is from 2000-2011.

	n	mean	median	Std.	25%	75%
SI	234936	0.032	0.013	0.046	0.001	0.042
HFH	234936	0.048	0.025	0.061	0.002	0.071

SI and HFH: 0.01, 0.05, 0.1

	Overall		High SI		High HFH		High SI&HFH	
	mean	median	mean	median	mean	median	mean	median
Market capitalization	2800.741	243.475	1147.004	635.489	1430.890	392.007	1165.953	685.438
Total sales	500.235	51.021	371.293	119.218	435.235	88.063	395.834	146.479
Book-to-market (equity)	0.682	0.532	0.566	0.411	0.613	0.502	0.521	0.390
Book-to-market (asset)	0.704	0.660	0.596	0.539	0.661	0.614	0.585	0.536
Debt-equity ratio	0.855	0.345	0.892	0.314	0.775	0.287	0.939	0.345
Earnings-price ratio	-0.034	0.009	-0.049	0.006	-0.030	0.006	-0.043	0.004
Profit margin	-0.395	0.122	-0.660	0.114	-0.449	0.107	-0.674	0.104
Turnover	0.153	0.087	0.400	0.297	0.220	0.151	0.439	0.340
Share price	39.464	12.990	23.201	17.480	19.512	13.360	23.718	16.920

SI: percentile 80%, 90%, 95%; HFH: percentile 60%, 75%, 90%.

	Overall		High SI		High HFH		High SI&HFH	
	mean	median	mean	median	mean	median	mean	median
Market capitalization	2800.741	243.475	1118.724	565.898	1071.120	306.291	1070.590	596.775
Total sales	500.235	51.021	341.228	102.380	354.599	66.267	373.132	131.826
Book-to-market (equity)	0.682	0.532	0.558	0.382	0.636	0.513	0.523	0.360
Book-to-market (asset)	0.704	0.660	0.585	0.506	0.676	0.628	0.582	0.521
Debt-equity ratio	0.855	0.345	0.949	0.255	0.805	0.282	1.047	0.345
Earnings-price ratio	-0.034	0.009	-0.060	0.004	-0.037	0.004	-0.050	0.001
Profit margin	-0.395	0.122	-0.844	0.106	-0.574	0.094	-1.161	0.086
Turnover	0.153	0.087	0.429	0.311	0.206	0.133	0.471	0.368
Share price	39.464	12.990	22.929	17.460	17.928	12.150	23.701	16.680

Table 2: A Comparison of Short and Active Long Positions

This table presents the single sorting results. At the end of each quarter, firms are sorted into 4 portfolios either by short interest (SI) or by hedge fund holding (HFH). Equal weighted (E.W.) and value weighted (V.W.) abnormal returns based on the DGTW benchmark are calculated in the next 3 months. In the first panel, the summary statistics for the overall sample of the quarterly SI and HFH are reported. In the second panel, firms are sorted based on the absolute value. The cutoff points are 1%, 5% and 10% for SI and HFH. In the third panel, firms are sorted based on the relative value. The cutoff points are 60%, 75%, and 90% for SI and HFH. The average number of firms in each portfolio is listed at the bottom of each panel. The sample period is 2000-2011.

SI and HFH: 0.01, 0.05, 0.1.										
	Short Interest					Hedge Fund Holding				
	1=Low	2	3	4=High	L-H	1=Low	2	3	4=High	L-H
E.W.	0.005*	0.001	-0.003	-0.004	0.009**	0.001	0.002*	0.003**	0.004**	-0.002
T-stat	(1.92)	(0.99)	(-1.49)	(-1.30)	(2.17)	(0.57)	(1.90)	(2.37)	(2.34)	(-0.86)
V.W.	0.000	0.000	-0.003*	-0.004*	0.004*	-0.003**	0.000	0.002**	0.003**	-0.006***
T-stat	(-0.10)	(0.34)	(-1.86)	(-1.78)	(1.66)	(-2.46)	(-0.20)	(2.15)	(2.00)	(-3.13)
Firms	1802	1383	577	361		1401	1288	807	626	

  

SI: percentile 60%, 75%, 90%; HFH: percentile 60%, 75%, 90%.										
	Short Interest					Hedge Fund Holding				
	1=Low	2	3	4=High	L-H	1=Low	2	3	4=High	L-H
E.W.	0.004**	0.002*	-0.001	-0.005**	0.011***	0.002	0.003***	0.003**	0.003**	-0.002
T-stat	(2.26)	(1.75)	(-0.35)	(-2.05)	(3.19)	(0.92)	(2.65)	(2.03)	(1.99)	(-0.71)
V.W.	0.001	0.000	-0.001	-0.005***	0.007***	-0.001*	0.001	0.002	0.003**	-0.003**
T-stat	(0.96)	(-0.05)	(-0.92)	(-2.93)	(3.09)	(-1.87)	(0.79)	(1.52)	(2.00)	(-2.43)
Firms	2396	695	650	432		2466	635	626	395	

*t* statistics in parentheses

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 3: Disagreement and Subsequent Stock Returns

This table presents the double sorting results. At the end of each quarter, firms are sorted independently into 4 by 4 portfolios by short interest (SI) and hedge fund holding (HFH). Equal weighted (E.W.) and value weighted (V.W.) abnormal returns based on the DGTW benchmark are calculated in the next 3 months. In the first panel, firms are sorted based on the absolute value. The cutoff points are 1%, 5%, and 10% for SI and HFH. From the second to the third panel, firms are sorted based on the relative value. In the second panel, the cutoff points are 60%, 75%, and 90% for SI and HFH. In the third panel, the cutoff points are 80%, 90%, and 95% for SI, and 60%, 75%, and 90% for HFH. In each panel, the rows from the top to bottom represent low to high SI, and the columns from left to right represent low to high HFH. The average portfolio abnormal return, the t-statistics, and the number of firms are reported for each portfolio. The sample period is 2000-2011.

SI and HFH: 0.01, 0.05, 0.1										
	E.W.					V.W.				
	Hedge Fund Holding				L-H	Hedge Fund Holding				L-H
Short Interest	1=Low	2	3	4=High		1=Low	2	3	4=High	
1=Low	0.004 (1.47)	0.006*** (2.96)	0.004* (1.89)	0.005* (1.77)	-0.000 (-0.10)	-0.001 (-0.38)	0.000 (0.26)	0.005** (2.26)	0.003 (1.32)	-0.004 (-1.29)
Firms	1010	422	220	150		1010	422	220	150	
2	-0.005** (-2.31)	0.002* (1.73)	0.003** (2.20)	0.004* (1.97)	-0.009*** (-3.03)	-0.003* (-1.79)	0.000 (-0.11)	0.002* (1.68)	0.004*** (2.62)	-0.007*** (-3.10)
Firms	284	547	329	224		284	547	329	224	
3	-0.012*** (-3.28)	-0.005** (-2.05)	0.002 (1.04)	0.002 (0.76)	-0.013*** (-3.13)	-0.010*** (-3.00)	-0.003 (-1.22)	0.003 (0.97)	0.003 (1.01)	-0.013*** (-2.96)
Firms	74	206	159	138		74	206	159	138	
4=High	-0.014** (-2.41)	-0.007* (-1.81)	0.000 (-0.11)	0.003 (0.91)	-0.017** (-2.56)	-0.012* (-1.82)	-0.006* (-1.68)	-0.002 (-0.32)	-0.001 (-0.21)	-0.011 (-1.51)
Firms	34	113	99	115		34	113	99	115	
L-H	0.019*** (2.81)	0.013*** (3.04)	0.005 (1.07)	0.002 (0.44)		0.011 (1.65)	0.006* (1.68)	0.007 (1.15)	0.004 (0.94)	

t statistics in parentheses

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

SI and HFH: percentile 60%, 75%, 90%.										
Short Interest	E.W.					V.W.				
	Hedge Fund Holding					Hedge Fund Holding				
	1=Low	2	3	4=High	L-H	1=Low	2	3	4=High	L-H
1=Low	0.004*	0.005***	0.004**	0.005**	-0.001	0.000	0.002	0.004**	0.005**	-0.005**
	(1.87)	(3.55)	(2.39)	(2.12)	(-0.28)	(-0.26)	(1.52)	(2.29)	(2.36)	(-2.28)
Firms	1674	281	270	171		1674	281	270	171	
2	0.001	0.003**	0.004**	0.003*	-0.003	-0.001	0.001	0.002	0.000	-0.001
	(0.33)	(2.59)	(2.11)	(1.66)	(-1.15)	(-0.61)	(0.66)	(1.39)	(0.16)	(-0.45)
Firms	365	135	124	71		365	135	124	71	
3	-0.004	0.002	0.003	0.001	-0.005	-0.003**	0.001	0.000	0.003	-0.006**
	(-1.58)	(1.10)	(1.44)	(0.55)	(-1.55)	(-2.12)	(0.66)	(0.02)	(1.47)	(-2.44)
Firms	296	137	137	80		296	137	137	80	
4=High	-0.009***	-0.003	-0.003	0.000	-0.010**	-0.009***	-0.004*	-0.003	0.000	-0.009**
	(-2.69)	(-1.09)	(-1.40)	(0.12)	(-2.23)	(-3.07)	(-1.89)	(-1.10)	(-0.070)	(-2.20)
Firms	167	88	101	77		167	88	101	77	
L-H	0.013***	0.008**	0.008**	0.005		0.009***	0.006**	0.006**	0.005	
	(3.26)	(2.58)	(2.56)	(1.34)		(2.84)	(2.38)	(2.23)	(1.49)	

SI: percentile 80%, 90%, 95%; HFH: percentile 60%, 75%, 90%.										
Short Interest	E.W.					V.W.				
	Hedge Fund Holding					Hedge Fund Holding				
	1=Low	2	3	4=High	L-H	1=Low	2	3	4=High	L-H
1=Low	0.003*	0.004***	0.004***	0.005**	-0.002	0.000	0.001	0.003**	0.004***	-0.004**
	(1.66)	(3.99)	(2.90)	(2.40)	(-0.60)	(0.36)	(1.28)	(2.20)	(2.71)	(-2.47)
Firms	2107	455	431	262		2107	455	431	262	
2	-0.004	0.002	0.002	0.001	-0.005	-0.004**	-0.001	0.001	0.002	-0.006**
	(-1.64)	(0.90)	(0.95)	(0.26)	(-1.42)	(-2.55)	(-0.54)	(0.34)	(0.75)	(-2.15)
Firms	192	92	94	56		192	92	94	56	
3	-0.008**	0.001	-0.001	0.003	-0.011**	-0.009***	-0.003	-0.002	0.004	-0.013***
	(-2.57)	(0.26)	(-0.34)	(0.94)	(-2.44)	(-2.96)	(-1.31)	(-0.79)	(1.27)	(-2.89)
Firms	90	45	48	33		90	45	48	33	
4=High	-0.012***	-0.006*	-0.005*	-0.001	-0.011**	-0.010**	-0.005	-0.003	-0.004	-0.007
	(-2.73)	(-1.88)	(-1.93)	(-0.28)	(-1.99)	(-2.44)	(-1.62)	(-1.06)	(-0.97)	(-1.20)
Firms	77	43	53	43		77	43	53	43	
L-H	0.015***	0.010***	0.010***	0.006		0.010**	0.006*	0.006*	0.008*	
	(3.16)	(3.01)	(3.07)	(1.44)		(2.46)	(1.95)	(1.78)	(1.96)	

*t* statistics in parentheses

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 4: Regression: Double Sorting

This table presents the double sorting results. At the end of each quarter, firms are sorted independently into 4 by 4 portfolios by short interest (SI) and hedge fund holding (HFH). Equal weighted (E.W.) and value weighted (V.W.) raw returns are calculated in the next 3 months. We use the Carhart regression model and report the alpha for the excess return of each portfolio. In the first panel, firms are sorted based on the absolute value. The cutoff points are 1%, 5%, and 10% for SI and HFH. From the second to the third panel, firms are sorted based on the relative value. In the second panel, the cutoff points are 60%, 75%, and 90% for SI and HFH. In the third panel, the cutoff points are 80%, 90%, and 95% for SI, and 60%, 75%, and 90% for HFH. In each panel, the rows from the top to bottom represent low to high SI, and the columns from left to right represent low to high HFH. The alpha and the t-statistics are reported for each portfolio. The sample period is 2000-2011. Standard errors are adjusted by Newey-West method.

		SI and HFH: 0.01, 0.05, 0.1							
		E.W.				V.W.			
		Hedge Fund Holding				Hedge Fund Holding			
Short Interest		1 = Low	2	3	4 = High	1 = Low	2	3	4 = High
1 = Low		0.006** (2.00)	0.007*** (3.03)	0.007** (2.53)	0.007** (2.16)	-0.001 (-0.62)	0.001 (0.87)	0.007*** (2.75)	0.007*** (2.63)
2		-0.009*** (-3.24)	0.000 (0.27)	0.003* (1.85)	0.004* (1.87)	-0.005*** (-2.98)	-0.000 (-0.22)	0.002 (1.56)	0.007*** (2.90)
3		-0.014*** (-4.82)	-0.006*** (-3.08)	0.001 (0.86)	0.002 (0.72)	-0.010*** (-3.57)	-0.004** (-2.26)	-0.002 (-0.76)	0.003 (1.05)
4 = High		-0.017*** (-3.62)	-0.011*** (-4.67)	-0.004 (-1.32)	0.000 (0.14)	-0.014** (-2.36)	-0.009*** (-3.67)	-0.006* (-1.79)	-0.002 (-0.86)

*t* statistics in parentheses

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$



SI and HFH: percentile 60%, 75%, 90%.								
Short Interest	E.W.				V.W.			
	Hedge Fund Holding				Hedge Fund Holding			
	1 = Low	2	3	4 = High	1 = Low	2	3	4 = High
1 = Low	0.006** (2.41)	0.006*** (3.20)	0.006** (2.30)	0.007** (2.37)	0.000 (0.09)	0.003** (2.02)	0.004** (2.13)	0.006** (2.21)
2	-0.001 (-0.72)	0.003* (1.81)	0.004** (2.08)	0.004* (1.94)	-0.003 (-1.56)	0.002 (1.01)	0.005* (1.86)	0.001 (0.52)
3	-0.006*** (-3.69)	0.001 (0.53)	0.001 (0.42)	0.001 (0.69)	-0.005*** (-3.37)	0.001 (0.31)	-0.001 (-0.51)	0.005** (2.33)
4 = High	-0.012*** (-4.96)	-0.006*** (-3.37)	-0.006*** (-3.63)	-0.001 (-0.34)	-0.011*** (-4.15)	-0.007*** (-3.13)	-0.006** (-2.32)	-0.001 (-0.17)

SI: percentile 80%, 90%, 95%; HFH: percentile 60%, 75%, 90%.								
Short Interest	E.W.				V.W.			
	Hedge Fund Holding				Hedge Fund Holding			
	1 = Low	2	3	4 = High	1 = Low	2	3	4 = High
1 = Low	0.004* (1.93)	0.005*** (3.45)	0.006** (2.55)	0.006** (2.54)	-0.000 (-0.37)	0.001 (1.56)	0.004** (2.39)	0.006** (2.57)
2	-0.007*** (-3.25)	-0.001 (-0.88)	-0.000 (-0.22)	-0.000 (-0.00)	-0.007*** (-3.32)	-0.003 (-1.42)	-0.001 (-0.52)	0.004* (1.81)
3	-0.014*** (-4.89)	-0.003 (-1.43)	-0.003 (-1.29)	0.001 (0.33)	-0.014*** (-3.29)	-0.005** (-2.33)	-0.004 (-1.45)	0.005 (1.27)
4 = High	-0.015*** (-4.67)	-0.011*** (-4.52)	-0.009*** (-4.67)	-0.001 (-0.42)	-0.012*** (-2.86)	-0.010*** (-4.18)	-0.008** (-2.40)	-0.005 (-1.42)

*t* statistics in parentheses

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 5: Regression: 6 months holding

This table presents the double sorting results. At the end of each quarter, firms are sorted independently into 4 by 4 portfolios by short interest (SI) and hedge fund holding (HFH). Equal weighted (E.W.) and value weighted (V.W.) returns are calculated in the next 6 months. We take the average for overlapping portfolios. For example, for a portfolio  $i$  in July, one is formed at the end of June, and one is formed at the end of March. We first calculate the equal and value weighted return for each of the overlapping portfolios, and then take the average as the return (equal or value weighted) for portfolio  $i$  in the month of July. We use the Carhart regression model and report the alpha for the excess return of each portfolio. In the first panel, firms are sorted based on the absolute value. The cutoff points are 1%, 5%, and 10% for SI and HFH. In the second panel, firms are sorted based on the relative value. The cutoff points are 80%, 90%, and 95% for SI, and 60%, 75%, and 90% for HFH. In each panel, the rows from the top to bottom represent low to high SI, and the columns from left to right represent low to high HFH. The alpha and the t-statistics are reported for each portfolio. The sample period is 2000-2011. Standard errors are adjusted by Newey-West method.

SI and HFH: 0.01, 0.05, 0.1								
Short Interest	E.W.				V.W.			
	Hedge Fund Holding				Hedge Fund Holding			
	1 = Low	2	3	4 = High	1 = Low	2	3	4 = High
1 = Low	0.005*	0.006***	0.007***	0.006*	-0.003*	0.001	0.007***	0.005*
	(1.87)	(2.62)	(2.77)	(1.89)	(-1.96)	(0.50)	(3.19)	(1.97)
2	-0.006**	0.001	0.004**	0.005**	-0.004**	0.001	0.003*	0.006***
	(-2.45)	(1.23)	(2.49)	(2.12)	(-2.46)	(0.97)	(1.94)	(2.90)
3	-0.010***	-0.006***	0.000	0.004	-0.008***	-0.004**	-0.001	0.003
	(-3.37)	(-2.70)	(0.12)	(1.61)	(-2.63)	(-2.42)	(-0.44)	(1.06)
4 = High	-0.016***	-0.009***	-0.004*	-0.000	-0.012**	-0.005*	-0.005*	-0.004
	(-3.82)	(-3.85)	(-1.79)	(-0.23)	(-2.13)	(-1.66)	(-1.90)	(-1.43)

SI: percentile 80%, 90%, 95%; HFH: percentile 60%, 75%, 90%.								
Short Interest	E.W.				V.W.			
	Hedge Fund Holding				Hedge Fund Holding			
	1 = Low	2	3	4 = High	1 = Low	2	3	4 = High
1 = Low	0.004**	0.004***	0.005**	0.006**	-0.000	0.001	0.003	0.004**
	(2.08)	(2.87)	(2.36)	(2.24)	(-0.06)	(1.03)	(1.54)	(2.46)
2	-0.004*	0.001	0.001	0.001	-0.004***	0.001	0.000	0.005**
	(-1.84)	(0.82)	(0.85)	(0.46)	(-3.57)	(0.59)	(0.23)	(2.29)
3	-0.007**	-0.001	-0.001	0.003	-0.008***	-0.003	-0.004*	0.005
	(-2.60)	(-0.37)	(-0.68)	(1.11)	(-2.75)	(-1.35)	(-1.82)	(1.51)
4 = High	-0.011***	-0.008***	-0.008***	-0.003	-0.006	-0.007**	-0.008***	-0.006
	(-3.88)	(-3.25)	(-4.47)	(-0.79)	(-1.59)	(-2.47)	(-2.71)	(-1.65)

$t$  statistics in parentheses

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 6: Regression: 12 months holding

This table presents the double sorting results. At the end of each quarter, firms are sorted independently into 4 by 4 portfolios by short interest (SI) and hedge fund holding (HFH). Equal weighted (E.W.) and value weighted (V.W.) returns are calculated in the next 12 months. We take the average for overlapping portfolios. For example, for a portfolio  $i$  in July, one is formed at the end of June, one is formed at the end of March, one is formed at the end of December in last year, and one is formed at the end of September in last year. We first calculate the equal and value weighted return for each of the overlapping portfolios, and then take the average as the return (equal or value weighted) for portfolio  $i$  in the month of July. We use the Carhart regression model and report the alpha for the excess return of each portfolio. In the first panel, firms are sorted based on the absolute value. The cutoff points are 1%, 5%, and 10% for SI and HFH. In the second panel, firms are sorted based on the relative value. The cutoff points are 80%, 90%, and 95% for SI, and 60%, 75%, and 90% for HFH. In each panel, the rows from the top to bottom represent low to high SI, and the columns from left to right represent low to high HFH. The alpha and the t-statistics are reported for each portfolio. The sample period is 2000-2011. Standard errors are adjusted by Newey-West method.

		SI and HFH: 0.01, 0.05, 0.1							
		E.W.				V.W.			
		Hedge Fund Holding				Hedge Fund Holding			
Short Interest		1 = Low	2	3	4 = High	1 = Low	2	3	4 = High
1 = Low		0.005*	0.005**	0.007***	0.006*	-0.001	0.001	0.006***	0.004
		(1.82)	(2.47)	(2.65)	(1.75)	(-0.80)	(0.66)	(2.82)	(1.42)
2		-0.006**	0.002*	0.004***	0.005**	-0.004***	0.001	0.004***	0.006***
		(-2.35)	(1.69)	(2.73)	(2.13)	(-2.91)	(0.88)	(2.98)	(3.06)
3		-0.008**	-0.004**	0.000	0.003	-0.006**	-0.002	-0.002	0.003
		(-2.14)	(-2.06)	(0.02)	(1.38)	(-2.08)	(-1.51)	(-1.04)	(1.32)
4 = High		-0.015***	-0.007***	-0.003	-0.002	-0.009**	-0.005	-0.003	-0.004
		(-4.05)	(-3.18)	(-1.28)	(-0.87)	(-2.06)	(-1.48)	(-1.36)	(-1.41)

		SI: percentile 80%, 90%, 95%; HFH: percentile 60%, 75%, 90%.							
		E.W.				V.W.			
		Hedge Fund Holding				Hedge Fund Holding			
Short Interest		1 = Low	2	3	4 = High	1 = Low	2	3	4 = High
1 = Low		0.004**	0.004***	0.005**	0.006**	0.000	0.002**	0.003	0.005***
		(2.01)	(3.31)	(2.44)	(2.31)	(0.77)	(2.05)	(1.64)	(2.78)
2		-0.003*	0.002	0.001	-0.000	-0.004***	-0.000	0.000	0.004*
		(-1.82)	(1.35)	(0.81)	(-0.10)	(-3.01)	(-0.23)	(0.17)	(1.94)
3		-0.006**	-0.000	-0.001	0.002	-0.007***	-0.002	-0.003	0.004
		(-2.27)	(-0.11)	(-0.38)	(0.88)	(-2.79)	(-0.93)	(-1.51)	(1.43)
4 = High		-0.009***	-0.006***	-0.005***	-0.003	-0.005	-0.006**	-0.005**	-0.004
		(-3.04)	(-3.22)	(-3.14)	(-0.89)	(-1.47)	(-2.37)	(-2.28)	(-1.32)

$t$  statistics in parentheses

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 7: DGTW: Change

This table presents the double sorting results. At the end of each quarter, firms are sorted independently into 4 by 4 portfolios by the change of short interest (CSI) and the change of hedge fund holding (CHFH). Equal weighted (E.W.) and value weighted (V.W.) abnormal returns based on the DGTW benchmark are calculated in the next 3 months. In the first panel, firms are sorted based on the absolute value. The cutoff points are 0, 0.5%, and 1% for CSI and CHFH. In the second panel, firms are sorted based on the relative value. The cutoff points are 80%, 90%, and 95% for CSI, and 60%, 75%, and 90% for CHFH. In each panel, the rows from the top to bottom represent low to high CSI, and the columns from left to right represent low to high CHFH. The average portfolio abnormal return, the t-statistics, and the number of firms are reported for each portfolio. The sample period is 2000-2011.

Change of SI and Change of HFH: 0, 0.005, 0.01.										
Change of SI	E.W.					V.W.				
	Change of HFH				L-H	Change of HFH				L-H
	1=Low	2	3	4=High		1=Low	2	3	4=High	
1=Low	0.003 (1.46)	0.002 (0.95)	0.006*** (3.41)	0.006*** (3.29)	-0.003 (-1.25)	-0.001 (-1.03)	0.001 (0.60)	0.004** (2.03)	0.001 (0.47)	-0.002 (-0.90)
Firms	700	713	128	279		700	713	128	279	
2	0.002 (1.49)	0.003 (1.20)	0.005*** (2.86)	0.003 (1.58)	-0.000 (-0.20)	0.001 (0.90)	0.000 (-0.22)	0.002 (1.05)	0.003 (1.25)	-0.002 (-0.63)
Firms	447	742	81	173		447	742	81	173	
3	0.000 (-0.02)	0.001 (0.42)	-0.001 (-0.60)	0.004 (1.55)	-0.004 (-1.29)	-0.004* (-1.71)	-0.002 (-0.91)	0.001 (0.38)	0.007** (2.23)	-0.011*** (-2.81)
Firms	134	78	27	69		134	78	27	69	
4=High	-0.005** (-2.03)	-0.006** (-2.39)	0.000 (-0.01)	0.000 (-0.15)	-0.004 (-1.42)	-0.004* (-1.95)	0.000 (0.15)	-0.001 (-0.45)	0.000 (-0.11)	-0.004 (-1.14)
Firms	235	109	47	160		235	109	47	160	
L-H	0.008** (2.50)	0.008** (2.42)	0.006 (1.35)	0.006** (2.29)		0.003 (1.45)	0.000 (0.19)	0.006 (1.48)	0.001 (0.34)	

Change of SI: percentile 80%, 90%, 95%; Change of HFH: percentile 60%, 75%, 90%										
Change of SI	E.W.					V.W.				
	Change of HFH				L-H	Change of HFH				L-H
	1=Low	2	3	4=High		1=Low	2	3	4=High	
1=Low	0.003* (1.81)	0.001*** (0.66)	0.006*** (5.22)	0.006 (3.34)	-0.003 (-1.38)	-0.001 (-1.10)	0.000 (0.03)	0.002** (2.17)	0.002* (1.74)	-0.003** (-2.03)
Firms	1493	943	457	266		1493	943	457	266	
2	0.001 (0.81)	-0.001 (-0.43)	0.000 (-0.23)	0.004* (1.68)	-0.003 (-1.03)	-0.001 (-0.77)	-0.003 (-1.20)	-0.001 (-0.52)	-0.002 (-0.54)	0.001 (0.21)
Firms	227	163	96	66		227	163	96	66	
3	-0.003* (-1.69)	-0.004 (-1.43)	0.000 (-0.15)	-0.001 (-0.20)	-0.003 (-0.87)	-0.006*** (-2.88)	-0.004 (-1.14)	0.000 (-0.07)	0.002 (0.79)	-0.008** (-2.35)
Firms	98	34	42	34		98	34	42	34	
4=High	-0.007** (-2.11)	-0.003 (-0.58)	-0.004 (-1.32)	-0.001 (-0.19)	-0.006 (-1.49)	-0.004 (-1.60)	-0.003 (-0.70)	-0.002 (-0.77)	0.000 (-0.11)	-0.004 (-0.93)
Firms	88	28	41	47		88	28	41	47	
L-H	0.009*** (2.67)	0.004 (0.82)	0.010*** (3.12)	0.006* (1.93)		0.004 (1.35)	0.003 (0.69)	0.005 (1.39)	0.003 (0.76)	

*t* statistics in parentheses

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 8: Regression: Change

This table presents the double sorting results. At the end of each quarter, firms are sorted independently into 4 by 4 portfolios by the change of short interest (CSI) and the change of hedge fund holding (CHFHF). Equal weighted (E.W.) and value weighted (V.W.) raw returns are calculated in the next 3 months. We use the Carhart regression model and report the alpha for the excess return of each portfolio. In the first panel, firms are sorted based on the absolute value. The cutoff points are 0, 0.5%, and 1% for CSI and CHFHF. In the second panel, firms are sorted based on the relative value. The cutoff points are 80%, 90%, and 95% for CSI, and 60%, 75%, and 90% for CHFHF. In each panel, the rows from the top to bottom represent low to high CSI, and the columns from left to right represent low to high CHFHF. The alpha and the t-statistics are reported for each portfolio. The sample period is 2000-2011. Standard errors are adjusted by Newey-West method.

Change of SI and Change of HFH: 0, 0.005, 0.01.								
Change of SI	E.W.				V.W.			
	Change of HFH				Change of HFH			
	1 = Low	2	3	4 = High	1 = Low	2	3	4 = High
1 = Low	0.003* (1.74)	0.005*** (2.64)	0.006** (2.59)	0.006*** (2.63)	-0.001 (-0.98)	0.001 (0.72)	0.005*** (2.96)	0.001 (0.49)
2	0.004** (1.99)	0.004** (2.09)	0.006*** (2.93)	0.004* (1.94)	0.003 (1.55)	0.002 (1.30)	0.006** (2.03)	0.004 (1.63)
3	-0.001 (-0.77)	0.001 (0.69)	-0.000 (-0.03)	0.001 (0.51)	-0.005* (-1.84)	-0.001 (-0.47)	0.003 (0.59)	0.006* (1.79)
4 = High	-0.007*** (-4.22)	-0.004 (-1.62)	-0.004 (-1.26)	-0.002 (-1.21)	-0.006** (-2.51)	0.003 (0.98)	-0.005 (-1.57)	-0.002 (-0.89)

Change of SI: percentile 80%, 90%, 95%; Change of HFH: percentile 60%, 75%, 90%								
Change of SI	E.W.				V.W.			
	Change of HFH				Change of HFH			
	1 = Low	2	3	4 = High	1 = Low	2	3	4 = High
1 = Low	0.003** (2.03)	0.004* (1.67)	0.006*** (3.98)	0.006*** (2.69)	-0.001 (-0.86)	-0.002 (-1.42)	0.003*** (3.10)	0.003 (1.64)
2	-0.000 (-0.07)	-0.003 (-1.32)	-0.002 (-0.73)	0.003 (1.34)	-0.002 (-1.08)	-0.003 (-0.87)	-0.002 (-0.57)	-0.004 (-1.44)
3	-0.005*** (-2.69)	-0.004 (-1.35)	-0.002 (-0.58)	-0.003 (-0.86)	-0.006*** (-2.77)	-0.005 (-1.31)	0.000 (0.14)	0.003 (0.77)
4 = High	-0.010*** (-4.16)	-0.004 (-1.11)	-0.007** (-2.54)	-0.002 (-1.04)	-0.007*** (-2.70)	-0.001 (-0.29)	-0.005 (-1.46)	-0.002 (-0.85)

*t* statistics in parentheses

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 9: Regression: Exclude Financial Crisis Period

This table presents the double sorting results. At the end of each quarter, firms are sorted independently into 4 by 4 portfolios by short interest (SI) and hedge fund holding (HFH). Equal weighted (E.W.) and value weighted (V.W.) raw returns are calculated in the next 3 months. We use the Carhart regression model and report the alpha for the excess return of each portfolio. In the first panel, firms are sorted based on the absolute value. The cutoff points are 1%, 5%, and 10% for SI and HFH. In the second panel, firms are sorted based on the relative value. The cutoff points are 80%, 90%, and 95% for SI, and 60%, 75%, and 90% for HFH. In each panel, the rows from the top to bottom represent low to high SI, and the columns from left to right represent low to high HFH. The alpha and the t-statistics are reported for each portfolio. The sample period is 2000-2011 and excludes the years 2008 and 2009.

SI and HFH: 0.01, 0.05, 0.1								
Short Interest	E.W.				V.W.			
	Hedge Fund Holding				Hedge Fund Holding			
	1 = Low	2	3	4 = High	1 = Low	2	3	4 = High
1 = Low	0.007** (2.29)	0.007*** (4.06)	0.007*** (4.22)	0.005** (2.49)	-0.001 (-0.67)	0.001 (0.73)	0.006*** (3.37)	0.005** (2.20)
2	-0.007*** (-2.72)	-0.000 (-0.22)	0.002 (1.54)	0.003* (1.77)	-0.006*** (-3.18)	0.000 (0.31)	0.002 (1.12)	0.005*** (2.74)
3	-0.015*** (-4.03)	-0.007*** (-3.62)	0.000 (0.00)	0.001 (0.42)	-0.009*** (-2.65)	-0.004* (-1.96)	-0.004* (-1.72)	0.003 (0.78)
4 = High	-0.015*** (-2.64)	-0.012*** (-3.99)	-0.003 (-0.73)	-0.001 (-0.48)	-0.012** (-2.07)	-0.009*** (-3.04)	-0.006 (-1.26)	-0.004 (-1.23)

SI: percentile 80%, 90%, 95%; HFH: percentile 60%, 75%, 90%								
Short Interest	E.W.				V.W.			
	Hedge Fund Holding				Hedge Fund Holding			
	1 = Low	2	3	4 = High	1 = Low	2	3	4 = High
1 = Low	0.005** (2.26)	0.005*** (4.63)	0.005*** (4.05)	0.005*** (3.24)	0.001 (0.63)	0.003** (2.13)	0.003** (2.30)	0.004** (2.40)
2	-0.005** (-2.25)	0.000 (0.07)	-0.002 (-1.17)	0.002 (0.77)	-0.007*** (-3.78)	-0.002 (-0.85)	-0.002 (-1.11)	0.005* (1.92)
3	-0.009*** (-3.12)	-0.004 (-1.54)	-0.005** (-2.10)	0.001 (0.37)	-0.010*** (-3.62)	-0.005* (-1.71)	-0.004 (-1.48)	0.005 (1.27)
4 = High	-0.014*** (-3.87)	-0.008*** (-2.88)	-0.009*** (-3.58)	-0.004 (-1.56)	-0.010*** (-2.99)	-0.010** (-2.58)	-0.009** (-2.53)	-0.007* (-1.94)

*t* statistics in parentheses

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 10: Regression: 1990-2011

This table presents the double sorting results. At the end of each quarter, firms are sorted independently into 4 by 4 portfolios by short interest (SI) and hedge fund holding (HFH). Equal weighted (E.W.) and value weighted (V.W.) raw returns are calculated in the next 3 months. We use the Carhart regression model and report the alpha for the excess return of each portfolio. In the first panel, firms are sorted based on the absolute value. The cutoff points are 1%, 5%, and 10% for SI and HFH. In the second panel, firms are sorted based on the relative value. The cutoff points are 80%, 90%, and 95% for SI, and 60%, 75%, and 90% for HFH. In each panel, the rows from the top to bottom represent low to high SI, and the columns from left to right represent low to high HFH. The alpha and the t-statistics are reported for each portfolio. Standard errors are adjusted by Newey-West method. The sample period is 1990-2011.

SI and HFH: 0.01, 0.05, 0.1								
Short Interest	E.W.				V.W.			
	Hedge Fund Holding				Hedge Fund Holding			
	1 = Low	2	3	4 = High	1 = Low	2	3	4 = High
1 = Low	0.007*** (3.38)	0.006*** (3.75)	0.005*** (3.07)	0.007*** (2.96)	-0.001 (-0.93)	0.001 (1.11)	0.003 (1.62)	0.004** (2.03)
2	-0.006*** (-2.92)	0.000 (0.25)	0.000 (0.09)	0.003 (1.46)	-0.003** (-2.22)	0.000 (0.25)	-0.001 (-0.30)	0.003 (1.04)
3	-0.010*** (-4.17)	-0.006*** (-3.45)	-0.002 (-1.27)	-0.005 (-1.48)	-0.007*** (-2.94)	-0.003 (-1.33)	-0.003 (-1.38)	-0.004 (-1.19)
4 = High	-0.013*** (-3.44)	-0.008*** (-3.79)	-0.007** (-2.01)	0.003 (0.76)	-0.010*** (-2.88)	-0.004 (-1.48)	-0.007* (-1.79)	0.001 (0.28)

SI: percentile 80%, 90%, 95%; HFH: percentile 60%, 75%, 90%								
Short Interest	E.W.				V.W.			
	Hedge Fund Holding				Hedge Fund Holding			
	1 = Low	2	3	4 = High	1 = Low	2	3	4 = High
1 = Low	0.006*** (3.18)	0.004*** (3.92)	0.004*** (2.72)	0.005*** (3.11)	-0.001 (-1.08)	0.002** (2.06)	0.002 (1.62)	0.003** (1.98)
2	-0.004** (-2.33)	0.001 (1.03)	0.000 (0.07)	-0.000 (-0.22)	-0.004*** (-2.90)	-0.001 (-0.38)	-0.000 (-0.23)	0.003 (1.24)
3	-0.008*** (-3.34)	0.001 (0.34)	-0.003* (-1.69)	-0.000 (-0.06)	-0.007*** (-2.94)	-0.001 (-0.22)	-0.003 (-1.62)	-0.000 (-0.09)
4 = High	-0.012*** (-4.68)	-0.006*** (-2.98)	-0.006*** (-3.34)	-0.004* (-1.75)	-0.008*** (-3.27)	-0.005** (-2.11)	-0.003 (-1.07)	-0.005** (-2.13)

*t* statistics in parentheses

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 11: Institutional Ownership: Double Sorting

This table presents the double sorting results. At the end of each quarter, firms are sorted independently into 4 by 4 portfolios by short interest (SI) and institutional ownership (IO). Firms are sorted based on the relative value. The cutoff points are 80%, 90%, and 95% for SI, and 60%, 75%, and 90% for HFH. In the first panel the equal weighted (E.W.) and value weighted (V.W.) abnormal returns based on the DGTW benchmark are calculated in the next 3 months. In the second panel the equal weighted (E.W.) and value weighted (V.W.) raw returns are calculated in the next 3 months. We use the Carhart regression model and report the alpha for the excess return of each portfolio. In each panel, the rows from the top to bottom represent low to high SI, and the columns from left to right represent low to high HFH. The average portfolio abnormal return, the t-statistics, and the number of firms are reported for each portfolio. The sample period is 2000-2011. Standard errors are adjusted by Newey-West method in the second panel.

		DGTW									
		E.W.					V.W.				
		Institutional Ownership					Institutional Ownership				
Short Interest		1=Low	2	3	4=High	L-H	1=Low	2	3	4=High	L-H
1=Low		0.004*	0.003***	0.003***	0.002	0.002	0.000	0.001	0.001	0.000	0.000
		(1.66)	(3.34)	(2.82)	(1.50)	(0.74)	(0.04)	(0.72)	(0.72)	(-0.10)	(0.11)
Firms		2119	504	455	178		2119	504	455	178	
2		-0.007	0.001	0.001	0.001	-0.008*	-0.006**	-0.001	-0.003	-0.001	-0.005
		(-1.61)	(0.64)	(0.75)	(0.81)	(-1.78)	(-2.05)	(-0.44)	(-1.47)	(-0.64)	(-1.50)
Firms		123	85	121	105		123	85	121	105	
3		-0.011***	0.002	0.001	0.000	-0.011**	-0.010*	-0.006	-0.003	-0.003	-0.008
		(-2.63)	(0.52)	(0.40)	(-0.23)	(-2.30)	(-1.84)	(-1.53)	(-1.42)	(-1.11)	(-1.24)
Firms		56	37	53	71		56	37	53	71	
4=High		-0.015***	-0.006	-0.001	-0.005**	-0.011*	-0.014**	-0.012**	0.001	-0.006***	-0.009
		(-2.81)	(-1.26)	(-0.16)	(-2.27)	(-1.84)	(-2.60)	(-2.40)	(0.22)	(-2.74)	(-1.43)
Firms		52	30	40	95		52	30	40	95	
L-H		0.019***	0.010*	0.004	0.006***		0.014**	0.013**	-0.000	0.006**	
		(3.22)	(1.89)	(1.05)	(2.72)		(2.57)	(2.48)	(-0.02)	(2.21)	

		Regression								
		E.W.					V.W.			
		Institutional Ownership					Institutional Ownership			
Short Interest		1 = Low	2	3	4 = High		1 = Low	2	3	4 = High
1 = Low		0.005**	0.004***	0.004**	0.003*		0.000	0.001	0.001	0.001
		(2.02)	(4.36)	(2.59)	(1.85)		(0.01)	(1.36)	(0.80)	(0.47)
2		-0.008***	-0.002	0.001	0.001		-0.008***	-0.003	-0.004*	-0.001
		(-3.32)	(-1.22)	(0.50)	(0.58)		(-2.65)	(-1.12)	(-1.93)	(-0.48)
3		-0.013***	-0.002	-0.002	-0.001		-0.014***	-0.008*	-0.004*	-0.004
		(-3.66)	(-0.89)	(-0.88)	(-0.60)		(-2.92)	(-1.91)	(-1.79)	(-1.31)
4 = High		-0.018***	-0.008**	-0.004	-0.007***		-0.015***	-0.011**	-0.005	-0.009***
		(-4.87)	(-2.27)	(-1.28)	(-3.33)		(-2.89)	(-2.12)	(-1.38)	(-4.23)

t statistics in parentheses

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$



Table 12: Regression: Dispersion

This table presents the three-way sorting results. At the end of each quarter, firms are sorted independently into 2 by 4 by 4 portfolios by dispersion(DP), short interest (SI) and hedge fund holding (HFH). The cutoff points are 50% for dispersion, 80%, 90%, and 95% for SI, and 60%, 75%, and 90% for HFH. Equal weighted (E.W.) and value weighted (V.W.) raw returns are calculated in the next 3 months. We use the Carhart regression model and report the alpha for the excess return of each portfolio. In each panel, the rows from the top to bottom represent low to high SI, and the columns from left to right represent low to high HFH. The alpha and the t-statistics are reported for each portfolio. The sample period is 2000-2011. Standard errors are adjusted by Newey-West method.

		Low Dispersion							
		E.W.				V.W.			
		Hedge Fund Holding				Hedge Fund Holding			
Short Interest		1 = Low	2	3	4 = High	1 = Low	2	3	4 = High
1 = Low		0.001 (1.13)	0.004*** (3.64)	0.003** (2.18)	0.004** (2.01)	-0.000 (-0.47)	0.004*** (2.85)	0.003 (1.24)	0.006** (2.03)
2		-0.005*** (-2.73)	0.001 (0.22)	-0.002 (-0.60)	0.006 (1.39)	-0.002 (-0.50)	-0.008 (-1.43)	-0.007 (-1.65)	0.009* (1.82)
3		-0.007*** (-2.81)	-0.012*** (-3.31)	-0.007 (-1.43)	0.012* (1.66)	-0.011*** (-3.31)	-0.013** (-2.59)	-0.003 (-0.55)	0.007 (0.90)
4 = High		-0.004* (-1.79)	0.004 (0.90)	-0.003 (-0.68)	-0.006 (-0.95)	-0.006 (-1.54)	-0.001 (-0.21)	-0.009 (-1.40)	-0.003 (-0.44)

		High Dispersion							
		E.W.				V.W.			
		Hedge Fund Holding				Hedge Fund Holding			
Short Interest		1 = Low	2	3	4 = High	1 = Low	2	3	4 = High
1 = Low		0.002 (0.98)	0.001 (0.62)	0.005** (1.99)	0.006* (1.97)	-0.001 (-0.67)	-0.001 (-0.33)	0.008*** (2.81)	0.004 (1.58)
2		-0.007** (-2.25)	-0.001 (-0.26)	0.001 (0.19)	0.002 (0.41)	-0.008*** (-2.76)	-0.003 (-0.72)	-0.005 (-1.48)	0.004 (0.97)
3		-0.013*** (-3.13)	-0.007 (-1.56)	-0.002 (-0.50)	0.005 (0.91)	-0.012** (-2.41)	-0.008* (-1.68)	-0.004 (-0.92)	0.003 (0.55)
4 = High		-0.015*** (-3.55)	-0.012* (-1.81)	-0.009* (-1.95)	0.000 (0.00)	-0.014*** (-2.65)	-0.010 (-1.25)	-0.011* (-1.89)	0.000 (0.09)

*t* statistics in parentheses

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$