Disposition Effect Among Mutual Fund Managers

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Abstract

This paper documents the existence among mutual fund managers of the disposition effect (the reluctance to sell poorly performing stocks) by focusing on the trading behavior of funds that recently experienced recent managerial change. These funds are more likely to reduce holdings of momentum losers than funds that have not changed managers even after controlling for the initial portfolio composition. In contrast, continuing managers tilt the portfolio composition towards momentum losers by disproportionately selling momentum winners. Given that mutual funds hold a large fraction of the U.S. equity market the existence of the disposition effect could illuminate such price behaviors as the momentum effect.

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Abstract

This paper documents the existence among mutual fund managers of the disposition effect (the reluctance to sell poorly performing stocks) by focusing on the trading behavior of funds that recently experienced recent managerial change. These funds are more likely to reduce holdings of momentum losers than funds that have not changed managers even after controlling for the initial portfolio composition. In contrast, continuing managers tilt the portfolio composition towards momentum losers by disproportionately selling momentum winners. Given that mutual funds hold a large fraction of the U.S. equity market the existence of the disposition effect could illuminate such price behaviors as the momentum effect.

1. Introduction

This paper investigates the existence of the disposition effect among professional money managers by examining holding and trading patterns of U.S. mutual funds following instances of managerial change. Disposition effect is defined as investor tendency to retain poorly performing over well-performing stocks. The decision to hold onto momentum losers, because it, on average, decreases expected future returns and increases tax liability, is suboptimal. Because momentum losers, on average, continue to underperform in the near future, selling them immediately avoids further losses. An investor who sells a losing stock, moreover, can write off the price loss against price gains elsewhere in the portfolio and thereby reduce total capital gains tax. Finally, the steeper capital gains tax on short-term investments is offset by short-term losses incurred in selling losers early. The "window-dressing" reason for selling losers before required holdings reports is, of course, to avoid publicly revealing mutual funds' bad investment decisions.

Ample evidence exists for the disposition effect among individual investors, but substantially more research is needed to associate it with institutional investors. Additionally, that institutions hold and trade a large fraction of stocks in the U.S. market amplifies the importance for asset prices of the implications of any biases in the behavior of professional managers.

The disposition effect arises from the psychological cost associated with admitting mistakes. An investor who sells a stock that has lost money admits to having been wrong to purchase it in the first place. (Weber and Camerer (1998) show, both theoretically and through experiments, that forcing investors to sell their entire portfolio

at the end of the period and form a new portfolio at the beginning of the next greatly reduces the disposition effect.) Of course, managers who "inherit" others' investment portfolios, because they will not feel responsible for the decisions of the previous portfolio managers, will not exhibit the disposition effect.

We use this logic to investigate the existence of the disposition effect among mutual fund managers. We examine for instances in which the previous fund management has been entirely replaced whether the new management sells disproportionably more losers than winners and whether this difference is smaller for funds that have not changed management.

We find strong evidence for the disposition effect. We show (1) that new fund managers sell disproportionately larger numbers of losers than winners, and (2) that the tendency to sell more losers than winners is more characteristic of new than of continuing managers. A fund that has experienced a managerial change, on average, increases its value-weighted portfolio momentum-based ranking in the next four quarters and this increase is greater than for funds that did not experience managerial replacement at that time. Our results are robust to various measures of selling and different definitions of the control group. We formed control groups of funds that did not experience managerial change by matching on time and in some specification as well as on fund investment style and specific stocks.

Literature Review

The term "disposition effect," coined by Shefrin and Statman (1986) to explain the widespread pattern of selling winners too soon and holding too long onto losers, has its

origins in the prospect theory of Kahneman and Tversky (1977), which models investor loss aversion,. The effect has been documented in a variety of settings. Lakonishok and Smidt (1986) and Ferris, Haugen and Makhija (1988) study abnormal trading volume for past winners and losers; Weber and Camerer (1998) provide experimental evidence; Odean (1998) shows the effect in the holdings of discount brokerage traders; and Haigh and List (2004) provide experimental evidence for professional traders at the Chicago Mercantile Exchange. In non-U.S. markets, the distribution effect is documented by Grinblatt and Keloharju (2001) among Finnish traders and by Shapira and Venezia (2001) among Israeli investors.

Perhaps the two most important papers on the disposition effect are those of Odean (1998) and Grinblatt and Keloharju (2001). Odean compardes for retail investor accounts at a major U.S. discount brokerage house for the period January 1988 through December 1993 the proportion of losses incurred out of all available losses to the proportion of gains realized out of all available gains. He presents strong evidence that investors systematically sell from their portfolios a larger fraction of winners than losers. Grinblatt and Keloharju (2001) estimate for investors who traded on the Finnish stock market in 1995 and 1996 a logit model of the probability of buying and selling a position. Their results suggest a higher propensity for investors to sell stocks when recent returns are high. Investors also tend to be reluctant to incur losses except in December, when driven by tax-saving considerations. Sophisticated investors are less influenced by past returns in their trading decisions relative to less sophisticated investors such as households and government and non-profit institutions, which exhibit a predisposition to sell rather than buy stocks with high past returns.

Grinblatt and Han (2004), who link the disposition effect to larger asset pricing issues such as momentum effect, argue that the disposition effect creates a spread between a stock's fundamental value and equilibrium price that begets price underreaction to new information. Spread convergence, arising from the random evolution of fundamental values and updating of reference prices, generates predictable equilibrium prices that are consistent with the momentum effect.

Existing research leaves open the question of whether the disposition effect exists among mutual fund managers. The answer is important for at least two reasons. First, individual investors are more likely than more sophisticated and disciplined professional money managers to exhibit behavioral biases. Grinblatt and Keloharju (2001) suggest that more sophisticated investors might be less influenced by such biases. Second, the behavior of institutions such as mutual funds that control a large fraction of the U.S. equity market has the potential to influence prices. Additionally, the disposition effect is more pronounced for large stocks, as demonstrated empirically by Ranguelova (2001), and mutual fund managers are more likely than individuals to hold relatively large stocks

Khorana (1996, 2001), who studies the relationship between management turnover and past mutual fund performance documents an inverse relation between the likelihood of managerial replacement and fund performance (Khorana 1996). He also finds funds that subsequently change managers to have higher portfolio turnover and higher expenses than otherwise similar funds. Khorana (2001) finds significant improvements in post-replacement performance when the departing manager has been underperforming and significant deterioration of performance if the departing manager has been outperforming. He also finds evidence of strategic risk shifting and window

dressing for fund portfolios prior to replacement. Specifically, portfolio risk increases in the pre-replacement period and declines in the post-replacement period; portfolio turnover decreases significantly after the new manager takes over.

2. Data and Methodology

We study the disposition effect with reference to the time periods around changes in mutual fund managers. Consistent with Weber and Camerer (1998), we assume that new managers are unlikely to exhibit the disposition effect with respect to inherited portfolios. We compare their trading patterns with those of continuing fund managers to better understand the existence and magnitude of disposition effect.[1]

Mutual funds in our sample are often managed by more than one managerconcurrently. Replacing a subset of managers is likely to mask the disposition effect, it will be most decidedly be in evidence once more when all of the previous managers have been replaced. We therefore consider only "complete replacements."

We take care to define the time frame of managerial change in order to accommodate the possibility that not all changes happen on the same day. In fact, we group managerial changes that occur in a short sequence, one after the other, as the same managerial change as they likely signal an effort to select the best manager for the job. We explain the methodology in detail below.

[1] Of course, as demonstrated in the previous literature, managerial change might be associated with other fund activities such as a systematic shifting of risk and turnover. We plan to control for these effects in a subsequent draft. It is not clear ex ante whether these activities would bias our results, although they might add noise to our results.

Data sources:

The main data used in our study comes from Morningstar. The Morningstar dataset covers 10,211 funds, 7998 managers, and over 30,000 managerial changes since 1924.[2] Funds that are categorized as bond, government, munis, index, REIT, and convertible are excluded from our analysis. We study the remaining data and from there we identify our target: funds that undergo complete replacement (hereafter CR). We define CR as:

> *Replacement of the entire existing fund managers through (potentially) a series of managerial changes, the last of which occur within 90 days of the previous change.*

Our definition groups together all the events that are within 90days of the previous one. This is to make sure that we blend all the correlated changes into one event. Also, any two sets of managerial changes within the same fund are by definition mutually exclusive. Furthermore, funds often have multiple managers and CR does not have to be an equal number of managers replacing an old managerial team. As long as all the old managers prior to the event are completely replaced by the end of it, we define it as a CR. Table I provides summary statistics of CR that we have identified in the Morningstar dataset.

The second dataset that we use is the Thomson Financial ("TF") mutual fund dataset (SP12). SP12 provides mutual fund common stock holdings since 1980, which in turn determines the starting date of our analysis. Note that SP12 provides quarterly information, but since mutual funds are only required to file N-30D with the SEC twice a

[2] The earliest managerial change recorded is on July 29, 1924, the "Dean of Institutional Investors", Paul Cabot, joined State Street Research Investment A. The last event was recorded on March 8, 2004.

year, there may be gaps in reporting.[3] When that happens, TF backfills the gap with information from previous quarters. However, since our study is highly sensitive to the accuracy and timing of holdings reports, we decide to exclude such quarters from our analysis. The rdate column in SP12 dataset, which represents the report date of the holdings, makes this filtering an extremely simple task.

The aim of this paper is to investigate disposition effect among mutual fund managers. Therefore, we need to differentiate winning stocks from the losers. For that, we rely on the CRSP monthly stock dataset. We extract monthly returns with dividends and compile a trailing 12-month return for each stock on a quarterly basis (since SP12 reports every March, June, September, and December). Those stocks that do not have a valid trailing 12-month return or valid adjustment factor for shares are thrown out of our study. Every quarter we calculate the rank of each stock based on its 12-month return, and then we categorize all the stocks into ten deciles, with rank = 1 being the worst performing decile. We call this raw rank. As a robustness check, we also create a relative rank that only focuses on return relative to stocks in the particular mutual fund portfolio.

Finally, MFLINK file contains information that allows us to link the mutual fund holdings data to CRSP dataset.

From these data, we attempt to address the following four questions: 1) what, 2) how, 3) when, and 4) whom to compare. We want to compare pre-CR portfolio to post-

[3] Through conversations with representatives at Thomson Financial, we learn that sometimes holding information is retrieved directly from the fund company (voluntary reporting) rather than from the SEC because of faster turn-around time. The drawback is that in the dataset there is not indication of the source, and the integrity of voluntary reporting solely relies on the good faith of the fund companies. It might also be endogenously determined: funds that are doing better might have more (or less) incentives to show the book. We looked into that and don't see any systematic pattern of underreporting.

CR portfolio among funds that undergo complete replacement. Pre-CR refers to the quarter before CR gets started. In case holding information is not current as of that quarter, we go back one more quarter for pre-CR portfolio. We exclude that particular case of CR from our analysis if no new reporting information is available even in the previous quarter.

For the post-CR part, we focus on the quarter in which CR ends, and four quarters afterward. One rationale is to make sure that we are able to capture at least one quarter of post-CR holding information for each case of CR. For funds that report regularly, we also want to make sure that we capture any lagged effect of managerial changes.[4] At the same time, it is not ideal to extend the time window too further out since we do not want to pick up investment choices that are made independent of the effect of CR. For example, a new manager may have initially sold a basket of losing stocks inherited from the old manager, and then buy them back 18 months later for an unrelated reason.

We employ three measurements to gauge changes in portfolio: 1) percentage change in number of shares held, 2) raw change in number of shares held, and 3) raw change in portfolio weight:

Percentage change in number of shares for stock i = $(N^i_t - N^i_{preCR} * Adj^i_{preCR}/Adj^i_t)$

$/(N^i_{preCR} * Adj^i_{preCR}/Adj^i_t)$,

raw change in number of shares for stock i = $(N^i_t - N^i_{preCR} * Adj^i_{preCR} / Adj^i_t)$,

where

N^i_t = number of shares held in t quarter after the end of CR

N^i_{preCR} = number of shares held preCR

[4] In reality, using our definition, there are cases in SP12 that an active fund has reporting gap that lasts longer than one year

Adj^{i}_{t} = shares adjustment factor from CRSP for t quarter after the end of CR

Adj^{i}_{preCR} = shares adjustment factor in the pre-CR quarter, whereas

weight change for stock i = W^{i}_{t}-W^{i}_{preCR}, where

$W^{i}_{preCR} = N^{i}_{preCR} * P^{i}_{preCR} / \sum (N^{j}_{preCR} * P^{j}_{preCR})$, and

$W^{i}_{t} = N^{i}_{t} * P^{i}_{preCR} / \sum_{j} (N^{j}_{t} * P^{j}_{preCR})$ where j = 1 to number of stocks held pre-CR

Raw change in number of shares is important piece to control for the law of small number. However, the raw change does not undermine the importance of percentage change, since adding 100 Class A shares of Berkshire Hathaway Inc., which has one of the highest price stocks in the US, is not the same as adding 100 shares of XYZ Inc. whose price per share is more "normal". Finally, including weights into our analysis surely make the results more robust. The raw change and the percentage change are both very particularized statistics, in a sense that knowing the results for both statistics of a stock does not tell you anything about another stock. Weights, on the other hand, help us to understand the picture on a portfolio basis. For example, let's assume that there are five stocks in a portfolio before complete replacement, and there are 1000 shares of each of them. For the sake of simplicity let's also assume that prices are one dollar per shares for all five stocks, which gives all of the stocks an equal weight of 20%. Two quarters after the end of the complete replacement, the new manager decides to increase the holding of four of the stocks by 50%, and the remaining one by 20%. The percentage change for the last stock, obviously, is 20%, and the raw change is +200. Looking at these two numbers without considering the weights may give one a deluded picture about

the stock on the positive side, because it weight has actually dropped from 20% to 16.67%.

As a reminder, the pivot of our analyses is changes to pre-CR holdings. For example, if a fund has ten stocks pre-CR and the new manager comes in and buy 1000 stocks, we pay absolutely no attention to the 1000 new issues at all.

We think of two methods that can utilize the three measurements to handle different circumstances. The first way is very straightforward. We simply identify all the stocks that belong to the same rank group r (r=1 to 10) in t quarters post-CR (t = 0 to 4), let's assume there are Y of them. We then calculate the three statistics, and we will have Y % changes in shares, Y raw changes in shares, and Y weight changes for us to unlock information from. What if the 20/80 rule applies in here? We certainly do not want our conclusion to heavily depend on decisions by a few managers. The second method should take care of this potential problem. Instead of treating all Y instances independently, method II requires the three statistics to be averaged within each fund first, and then we will examine $\tilde{Y}$ values afterwards, where $\tilde{Y}$ = number of funds that have stocks in the rank r and report in t quarters post-CR.

When we prepare our dataset, we suspect that the underlying population may not be distributed normally, especially the % change series, which has a lower bound at –100%, and preliminary check does show a lot of the data points have value of –100%. Therefore, despite its fairly large sample size of our dataset, we choose to use the median as the main descriptive statistics for our analysis[5].

[5] Kolmogorov-Smirnov test for normality has been ran on all series. All tests return less than .01 p-value, which validate our choice of median as the main descriptive statistics.

So far we have discussed what to analyze, the time frame of our analysis and how to carry out our analysis. We still have to define what our control group is.

As a reminder, the pivot of our analyses is changes to pre-CR holdings. For that reason, we only focus on the stocks that are in the pre-CR portfolios and analyze how they change after the CR.

We employ two methods that can utilize the three measurements to handle different circumstances. The first simply identify all the stocks that belong to the same rank group r (r=1 to 10) in t quarters post-CR (t = 0 to 4). If we have Y such incidences, we calculate the three statistics, and we will have Y percentage changes in shares, Y raw changes in shares, and Y weight changes. Note that such measures might potentially be influenced by decisions by a few managers. The second method should take care of this potential problem. Instead of treating all Y instances independently, method II requires the three statistics to be averaged within each fund first, and then we will examine the Y' values afterwards, where Y' = number of funds that have stocks in the rank r and report in t quarters post-CR.

We compare our results to control groups that don't experience managerial changes. Using Morningstar dataset, we identify our control group as all the fund-quarters that are not in the span of one year before and two years after any type of managerial changes, not just CR. For example, let's assume fund ABCXX has been in business since 1990, and in 2000 Q1 it adds a new manager. As a consequence, we exclude fund quarters 1999 Q1 to 2002 Q1 from our control group.

To fully utilize the control group, we conduct a "differences in differences" comparison with all the funds that undergo CR, which we term the test group. First, we have to calculate the three statistics for the control group just like the way we calculate them in the test group. Later on we match the two groups by a) a one-to-one stock match, and b) a one-to-one rank match, and then compute the differences between them[6]. Both are easy to implement, but a tiny nuisances does exists in both cases. Whenever there is a one-to-many match between the test group and the control group, we always average the values in the control group and then move on to carry out a one-to-one match.

To complete the final step of our main analysis, we will take the differences, which are supposed to be free from non-managerial related effect, from the best and the worst performing deciles and perform 2-sided hypothesis testing on them. Disposition effect among new mutual funds managers that undergo CR, or lack thereof, will be revealed.

After presenting all the test results in the following section, we will run some robustness check to further strength our conclusion.

3. Empirical results

Our main hypothesis is that a fund manager who "inherits" the predecessor's portfolio will be much more likely to rid it of poorly performing stocks. As a result, the portfolio will increase in the value-weighted average momentum ranking, and it will do so faster than portfolios of funds that have not experienced managerial change. Table II shows that this is indeed the case. The median fund that has experienced complete

[6] We will explain in detail how the merging is done in the appendix.

management replacement has, on average, increased its value-weighted portfolio rank, while the median fund in the control group has reduced its median portfolio rank.

Table IIIA shows changes in portfolio among funds that undergo complete replacement, measured by percentage change in number of shares held pre and post-CR. We do not see evidence of new managers purchasing stocks in the best performing decile and getting rid of stocks that do poorly over the same period of time. However, on a relative basis, our hypothesis is still sound. In the quarter when CR ends, the median percentage change in number of shares of stocks in the worst performing decile (rank=1) is -52.89% versus -0.41% for stocks in the best performing decile (rank=10). Median is chosen as the main descriptive statistics for our analysis because the underlying population does not satisfy the normality assumption despite its fairly large sample size[7].

Table IIIB illustrates similar idea, but in terms of raw changes instead of percentage changes. For example, two quarters after the end of CR, new managers lose appeal to rank 1 stocks and half of the stocks in that group are reduced by at least 11,200 shares, Meanwhile, in the same quarter, the median change among stocks in the best decile is only -3,700 shares, outperforming its peers in the worst decile by almost 70%. Finally, changes in portfolio measured by individual stock weight are reported in Table IIIC. Again, consistent results across 5 different quarters backup our interpretation of Table IIIA and IIIB. For example, three quarters after the end of CR, half of the stocks in the worst performing decile at that time experience a reduction in weight of at least 0.2% since pre-CR. For stocks that rank the 1st in the same quarter, half undertake no/positive changes since pre-CR.

Kolmogorov-Smirnov test for normality has been ran on all series, and all tests return less than .01 p-value.

Tables IVA, IVB, and IVC show changes in portfolio when the three measurements are calculated on a per fund basis, described as the second method in the preceding section. The modification does not undermine the conclusion we draw from Table IIIA, IIIB, and IIIC. For all the quarters post-CR, the median percentage change in number of shares held, the median raw change in the number of shares held, and the median weight change all bear an uptrend when we follow the statistics from the worst performing to the best performing decile[8].

We can solidify our conclusion by examining the three target statistics after controlling for behavior in the control group. Table VA, VB, and VC demonstrates the net percentage change in number of shares, the net raw change in the number of shares, and the net change in portfolio weight among funds that undergo CR. The matching is done on a stock-to-stock basis. The matching mechanism will be discussed in the appendix.

Controlling for changes in portfolio among funds that are "free" of managerial changes does not waken our conclusion. Looking over Table VA – VC, it is apparent that stocks in rank 1 have the most negative median in all measurements and across all time frames. When we examine the three tables more closely, we also realize that none of the median has a higher reading than its correspondence in Table IIIA, IIIB, and IIIC. A possible explanation of this one-sided shift is that funds in the control group have been buying stocks that are in the pre-CR portfolio of the test group. What is even more interesting is their buying pattern. If our hypothesis about their purchases cannot be rejected, we would further develop the idea that funds in the control group take the exact

[8] None of the new series pass the Kolmogorov-Smirnov test for normality, so we continue to report median of the data series

opposition position to the test group: instead of selling, they are buying, and instead of having preference to own more winners than losers, they are loading up on the losers. Table VI provides summary statistics on changes in portfolio among the control group.

Table VI validates our idea about the general buying pattern among funds in the control group. We see that those managers not only like to buy, but also have a preference for the worse performing decile over the best decile. However, since we are restricting this analysis only to stocks that are held by mutual funds that undergo CR, not to mention 50% of the sample happened post 2000, i.e., in a bear market, there is no guarantee that this kind of buying into losers strategy will stay if we extend the study chronologically or with a more diverse basket of stocks. Such research remains an exciting task for the future.

Now we want to turn our attention to Table VII and state the main conclusion of our study. We want to demonstrate that statistically past performance of a stock plays a huge role in the decision making process of new mutual fund managers that take control in a CR. For each of the three measurements and five post-CR quarters, we compare the data representing the best and the worst deciles. Once again, neither the individual series nor the combined series passes the normality test. Hence, the standard two-sample Student's t-test, which has the normality assumption, may not be our first choice for hypothesis testing. Instead, we conduct the hypothesis testing by the Nonparametric Wilcoxon Rank-Sum (Mann-Whitney) test.[9]

[9] In a nutshell, to use the Rank-Sum test on a two-sample problem, you first rank all of data together, and then sum up the ranks that are associated to the smaller size group. The sum is your test statistics, and if the size or of both groups are <10, tables are available in a basic statistics text that cover nonparametric methods. If both groups have more than 10 data points, we can apply the central limit theory and simply refer to a standard normal table for critical values for your test

All the standardized Z scores in Table VII point to the same conclusion: For funds that undergo complete replacement, the worst performing stock group in their portfolio faces more negative changes compared to the best performing stock group in the same portfolio. The Z scores are strong (very negative) in all five quarters that we cover. Indeed, the highest Z score is still 10 standard deviations away from the mean! Our conclusion is also robust to measure being used, or to matching schemes between the test group and the control group.

In addition to rank1 versus rank10, we have also run other tests that compare combined ranks, such as rank1+rank2 versus rank9+rank10, rank1+rank2+rank3 versus rank8+rank9+rank10, and finally (rank1 to rank5) versus (rank6 to rank 10). All of these tests return promising results, similar to those numbers in Table VII.

4. Robustness Checks

A. Relative Rank

Nobody likes change. It is not a trivial decision to completely replace existing fund managers. Granted, some might have left voluntarily for whatever reason, but we believe such cases are the exceptions rather than the norm. It is also fair to argue that the main reason to completely replace existing managers is performance related. If that truly is the case, then previously shown results may just be the side-effect of lack of good performing stocks to sell. To show that our conclusion is not sensitive to possible asymmetry in portfolio pre-CR, we re-run our analyses, using relative rank instead of raw rank.

Relative rank of a stock is calculated by comparing its trailing12-month performance among those stocks that were also in the portfolio pre-CR. For example, suppose a fund holds stock S_1, S_2, …, S_{10} in pre-CR quarter. In the first quarter after the end of CR, S_1 ranks in the 1st percentile, S_2 in the 2nd percentile, …, and S_{10} in the 10th percentile in performance, compare too all the stocks in CRSP dataset. If we use raw rank, all ten stocks are going to have a raw rank of 1. However, if we use the relative rank, S_1 will rank 1, S_2 will rank 2, …, S_{10} will rank 10th.

The results, which are not reported here, are qualitatively similar to Table VII. Therefore, even if asymmetry does indeed exist in portfolio pre-CR and weaken our previous conclusion, we are now able to prove the disposition effect on a relative basis.

B. Exclude CRs that lasted for more than 60 days

Our analyses compare portfolio decisions before and after the event and ignore anything changes in between, and this raises the importance of the time it took to complete the CR. The thought about the length of the CR is that, if it takes a prolonged period of time to complete the replacement, many other things might have happened in the interim. While this is conservative in the sense that we definitely include everything that truly can be associated with the managerial change itself, we might pickup too much noise. For example, we may have examined non first-order post-CR portfolio changes if the event window stretched out long enough for the new managers to make multiple investment decisions on the stocks that were held pre-CR.

For these reasons, this second set of robustness test excludes CRs that lasted for more than 60 days. That translates into roughly 5% reduction in sample size. However, it does

not reduce the strength of our previous conclusion. The Z scores are in the –30 areas, just as persuasive as those scores reported in Table VII. Again, to conserve the use of paper, the results are not provided in here but available upon request.

We see that even after prolonged CRs have been excluded from our analyses, disposition effects among mutual fund managers are still statistically significant.

5. Conclusion

In this paper we show that mutual fund managers, much like individual investors are subject to the disposition bias. But unlike individuals, mutual fund managers control a large chunk of the U.S. equity market. Therefore, their trading and holding patterns have a much more significant impact on asset prices. Disposition effect among professional money managers may potentially explain why price momentum has persisted in the U.S. stock market. Another possible extension of this result is to investigate whether managerial replacements have an immediate and predictable impact on asset prices and liquidity due to their predictable trading activities. Finally, this result suggest that mutual fund families stand to benefit from overseeing fund portfolios more closely and even periodically moving managers between similar funds in the family.

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Appendix A. How to merge the test group with the control group?

Our analysis is not complete if we do not examine the net changes in portfolio among the test group after controlling for the investment activities by funds that are "free" of managerial changes. As a result, we feel that it is important for our reader to get a clear picture of the mechanism behind the two matching schemes that are used for our study. Table A1, A2, and A3 together demonstrate a hypothetical example.

On the left hand side of Table A1 we see holding information of the test group, while the information for the control group is displayed on the right. All the variables should be self-explanatory except tgroupfund on the right hand side. Tgroupfund represents the fund in the test group that the control entry corresponds to. To determine if a control group entry is a relevant match to the test group, three conditions must be satisfied. First, the control fund must have a new holding report in the pre-CR quarter. Second, they must be the same stock. Finally, there must be at least one quarter in the post-CR period that both funds have a new holding report.

Once we have identified all the potential matching candidates in the control group, the remaining process is quite simple, especially in terms of computing time in SAS. For each entry in the test group, we locate entry(s) in the control group whose tgroupfund, reportquarter, and stock match the fundno, pre-CR quarter, and stock of the test group entry. If multiple matches are found, such as the first and the fourth entry under the controlgroup, which both match the first entry of the test group, we calculate and report

the linear average in the new dataset. In our example, it comes to (500+0)/2 =250, which is exactly the value of the mean from control group in Table A2.

ONE-TO-ONE rank match is actually very similar to a stock match. Instead of matching by individual stocks, as the name suggests, we match by rank of those stocks. First, we average over all stocks in the same fund that have the same rank, same tgroupfund, and the same pre-CR quarter. Then we compute the per controlfund average by grouping funds that have the same tgroupfund, pre-CR, and rank together. Let's look at another example. The second and the third entry have the same rank, same tgroupfund, same report quarter, and they are in the same fund, so we average the two together. The fifth row has the same tgroupfund, report quarter, and stock rank as the averages that we just compute, so we take the average of the two funds and create a match for Q1 94 rank = 4 in the testgroup.

TABLE I.
Complete Replacement of Mutual Fund Managers

The following table summarizes the five most common type of complete replacements of mutual funds managers between January 1980 and February 2004. Complete Replacement is defined as the removal of all current managers in a series of managerial changes in which the last event happens within 90 calendar days of the second to last event. An event is either an addition or a subtraction of a fund manager. A fund is defined as team managed only it was shown as team managed in the MorningStar dataset

			Length of Time for complete replacement					
Type of Complete Replacement	N	%	Mean	Median	75th percentile	90th percentile	95th percentile	99th percentile
One manager replaced by one manager	1260	56.76	2.16	0*	0	1	13	60
Two managers replaced by one manager	120	5.41	7.44	0	0	31	48.5	89
One manager replaced by two managers	203	9.14	7.3	0	0	30	60	88
Two managers replaced by two managers	129	5.81	18.09	0	31	68	83	90
One manager replaced by Team	111	5.00	1.53	0	0	0	1	61
The rest	397	17.88	14.59	0	13	63	80	133
Total (all CR):	**2220**	**100**	**6.03**	**0**	**0**	**25**	**56**	**89**

* Zero length of time means the addition and subtraction of managers happened on the same day

Table II
Changes in Value-Weighted Mutual Fund Momentum Portfolio Rank

quarters since chng.	number of obs.	change in rank (test group)	change in rank (control group)	difference in difference	difference in deciles
start of event	2172	0.00	0.00	0.00	0.94
0	2109	-0.30	-0.29	0.07	0.87
1	2049	0.35	-0.09	0.44	1.31
2	1973	0.58	-0.10	0.63	1.55
3	1957	0.42	-0.24	0.45	1.64
4	1863	0.43	-0.81	0.44	1.70
5	1803	0.17	-1.45	0.24	1.52
6	1732	-0.30	-0.83	0.63	1.64
7	1633	-0.43	-1.12	1.00	1.39
8	1576	-0.43	-0.58	1.14	1.76
Year of management change $\leq$ 1994					
start of event	419	0.00	0.00	0.00	-0.13
0	407	0.08	0.34	-0.08	-0.58
1	407	1.20	1.05	0.91	0.36
2	406	2.11	0.87	1.75	0.96
3	418	2.54	0.80	1.63	1.01
4	416	3.04	2.21	1.49	1.73
5	416	3.08	1.40	1.52	1.19
6	417	2.54	0.83	1.80	1.94
7	416	3.19	2.21	1.73	0.97
8	415	3.36	1.89	1.47	1.93
Year of management change $\geq$ 1995					
start of event	1753	0.00	0.00	0.00	1.31
0	1702	-0.35	-0.29	0.09	1.18
1	1642	0.12	-0.11	0.25	1.62
2	1567	0.23	-0.34	0.30	1.78
3	1539	-0.34	-0.66	0.09	1.79
4	1447	-0.41	-0.84	0.15	1.70
5	1387	-0.69	-1.92	0.09	1.69
6	1315	-1.33	-1.32	0.12	1.55
7	1217	-2.32	-1.75	0.44	1.49
8	1161	-2.03	-2.61	0.99	1.67

Note: this table presents changes in the value-weighted momentum decile of a median fund's portfolio holdings over time. Test group consists of funds that have experienced complete management replacements; control group consists of funds that have not experienced any managerial change in the same time frame and is matched to the test group in time. Portfolio momentum rank is determined as follows. In a given quarter, each stock in the CRSP universe is assigned to one of 100 groups based on the relative return during the past six months. Value-weighted portfolio ranks are then calculated. *Quarters since change* is the number of quarters since the quarter immediately following complete managerial replacement. *Change in decile* is the change in the value-weighted portfolio decile since the quarter immediately preceding managerial replacement. *Difference in Difference* is the difference between the rank change of the test group and the control group portfolios. *Difference in Deciles* is the difference is the portfolio momentum ranking between the test and control group at the time of the report.

TABLE III A. CHANGES IN PORTFOLIO, ON A PER STOCK BASIS, AMONG FUNDS THAT HAVE COMPLETE REPLACEMENT

Rank of individual holdings in 0 to 4 quarters post-CR	Quarters post-CR (0 = quarter in which CR ends)									
	0		1		2		3		4	
	Number of stocks in this rank group in this quarter	Median % change in number of shares	Number of stocks in this rank group in this quarter	Median % change in number of shares	Number of stocks in this rank group in this quarter	Median % change in number of shares	Number of stocks in this rank group in this quarter	Median % change in number of shares	Number of stocks in this rank group in this quarter	Median % change in number of shares
1	6252	-52.89	6647	-100.00	7529	-100.00	7316	-100.00	7250	-100.00
2	9770	-15.25	9323	-49.09	9883	-100.00	9416	-100.00	8968	-100.00
3	12605	-5.07	11856	-19.52	12287	-90.30	11423	-100.00	10804	-100.00
4	13721	-2.01	13341	-17.39	12968	-53.04	12450	-100.00	11623	-100.00
5	14332	0.00	13479	-15.09	12756	-42.50	12214	-63.66	11846	-97.11
6	13857	0.00	13071	-10.32	12354	-30.40	11638	-61.31	11114	-80.58
7	14451	0.00	13413	-7.69	12883	-27.59	12013	-50.00	11768	-60.79
8	14328	0.00	12701	-7.14	12533	-25.00	11546	-44.98	11371	-59.33
9	13946	0.00	12340	-8.18	11532	-26.67	10557	-44.14	10568	-60.68
10	10500	-0.41	9164	-12.25	8263	-31.32	6907	-54.90	7315	-77.11

Notes: In this table changes in portfolio is gauged by % change in number of shares = $100*(S_t-S_{pre\text{-}CR})/S_{pre\text{-}CR}$, S_t = number of shares held at quarter t post-CR, t = 0 to 4, and $S_{pre\text{-}CR}$ is number of shares held pre-CR (all shares information are splited-adjusted). E.g., in the first quarter after the end of CR, 6,647 stocks are held preCR and have the worst trailing 12-month performance (rank=1) compared to other stocks in the CRSP dataset (multiple observations of the same stock are treated individually). Among those stocks, median % change in number of shares from pre-CR is -100%.

TABLE III B. CHANGES IN PORTFOLIO, ON A PER STOCK BASIS, AMONG FUNDS THAT HAVE COMPLETE REPLACEMENT

Rank of individual holdings in 0 to 4 quarters post-CR	Quarters post-CR (0 = quarter in which CR ends)									
	0		1		2		3		4	
	Number of stocks in this rank group in this quarter	Median raw change in number of shares	Number of stocks in this rank group in this quarter	Median raw change in number of shares	Number of stocks in this rank group in this quarter	Median raw change in number of shares	Number of stocks in this rank group in this quarter	Median raw change in number of shares	Number of stocks in this rank group in this quarter	Median raw change in number of shares
1	6252	-2400	6647	-5000	7529	-11200	7316	-12983	7250	-12312
2	9770	-900	9323	-2900	9883	-7000	9416	-9000	8968	-10377
3	12605	-452	11856	-1500	12287	-5000	11423	-7402	10804	-10000
4	13721	-200	13341	-1385	12968	-4100	12450	-7424	11623	-8200
5	14332	0	13479	-1063	12756	-3500	12214	-5600	11846	-7792
6	13857	0	13071	-661	12354	-2500	11638	-4617	11114	-7000
7	14451	0	13413	-425	12883	-2057	12013	-4300	11768	-5600
8	14328	0	12701	-400	12533	-1749	11546	-4000	11371	-5900
9	13946	0	12340	-500	11532	-2200	10557	-4800	10568	-6500
10	10500	-52	9164	-900	8263	-3700	6907	-5750	7315	-8500

Notes: In this table changes in portfolio is gauged by raw change in number of shares = (S_t-$S_{pre\text{-}CR}$), S_t = number of shares held at quarter t post-CR, t = 0 to 4, and $S_{pre\text{-}CR}$ is number of shares held pre-CR (all shares information are splited-adjusted). E.g., in the first quarter after the end of CR, 6,647 stocks are held preCR and have the worst trailing 12-month performance (rank=1) compared to other stocks in the CRSP dataset (multiple observations of the same stock are treated individually). Among those stocks, median raw change in number of shares from pre-CR is -5000.

TABLE III C. CHANGES IN PORTFOLIO, ON A PER STOCK BASIS, AMONG FUNDS THAT HAVE COMPLETE REPLACEMENT

	Quarters post-CR (0 = quarter in which CR ends)									
	0		1		2		3		4	
Rank of individual holdings in 0 to 4 quarters post-CR	Number of stocks in this rank group in this quarter	Median individual weight change in %	Number of stocks in this rank group in this quarter	Median individual weight change in %	Number of stocks in this rank group in this quarter	Median individual weight change in %	Number of stocks in this rank group in this quarter	Median individual weight change in %	Number of stocks in this rank group in this quarter	Median individual weight change in %
1	6252	0.0000	6647	-0.0191	7529	-0.1000	7316	-0.2000	7250	-0.2000
2	9770	0.0027	9323	0.0000	9883	-0.1000	9416	-0.1000	8968	-0.1000
3	12605	0.0138	11856	0.0032	12287	-0.0190	11423	-0.1000	10804	-0.1000
4	13721	0.0235	13341	0.0099	12968	0.0000	12450	-0.0467	11623	-0.0656
5	14332	0.0327	13479	0.0157	12756	0.0000	12214	-0.0081	11846	-0.0263
6	13857	0.0367	13071	0.0198	12354	0.0000	11638	0.0000	11114	-0.0222
7	14451	0.0378	13413	0.0278	12883	0.0062	12013	0.0000	11768	0.0000
8	14328	0.0429	12701	0.0313	12533	0.0172	11546	0.0000	11371	0.0000
9	13946	0.0419	12340	0.0318	11532	0.0176	10557	0.0001	10568	0.0000
10	10500	0.0362	9164	0.0297	8263	0.0097	6907	0.0000	7315	0.0000

Notes: In this table changes in portfolio is gauged by individual weight change = W_t-$W_{pre\text{-}CR}$, W_t = stock weight (return-adjusted) at quarter t post-CR, t = 0 to 4, and $W_{pre\text{-}CR}$ is weight pre-CR. E.g., in the first quarter after the end of CR, 6,647 stocks are held preCR and have the worst trailing 12-month performance (rank=1) compared to other stocks in the CRSP dataset (multiple observations of the same stock are treated individually). Among those stocks, median weight change from pre-CR is -0.0191%.

TABLE IV A. CHANGES IN PORTFOLIO, ON A PER FUND BASIS, AMONG FUNDS THAT HAVE COMPLETE REPLACEMENT

	Quarters post-CR (0 = quarter in which CR ends)									
	0		1		2		3		4	
Rank of individual holdings in 0 to 4 quarters post-CR	Number of stocks in this rank group in this quarter	Median % change in number of shares	Number of stocks in this rank group in this quarter	Median % change in number of shares	Number of stocks in this rank group in this quarter	Median % change in number of shares	Number of stocks in this rank group in this quarter	Median % change in number of shares	Number of stocks in this rank group in this quarter	Median % change in number of shares
1	956	-66.67	912	-100.00	985	-100.00	921	-100.00	912	-100.00
2	1181	-45.83	1104	-62.91	1120	-75.00	1077	-81.08	1050	-88.91
3	1288	-29.90	1189	-44.44	1205	-60.27	1159	-65.39	1118	-70.69
4	1317	-24.77	1194	-37.89	1219	-51.56	1156	-59.68	1123	-66.67
5	1339	-21.64	1211	-36.80	1235	-48.94	1171	-51.59	1137	-60.35
6	1325	-18.68	1214	-33.33	1218	-45.57	1157	-52.62	1123	-59.31
7	1328	-17.70	1205	-30.15	1218	-40.99	1146	-47.43	1122	-55.97
8	1330	-16.41	1189	-27.35	1205	-39.02	1138	-46.60	1109	-52.93
9	1286	-17.21	1158	-25.00	1169	-37.83	1093	-47.83	1079	-54.82
10	1103	-21.43	977	-31.80	994	-50.18	929	-60.49	928	-68.99

Notes: In this table changes in portfolio is gauged by % change in number of shares = $100*(S_t-S_{pre\text{-}CR})/S_{pre\text{-}CR}$, S_t = number of shares held(split-adjusted) at quarter t post-CR, t = 0 to 4, and $S_{pre\text{-}CR}$ is number of shares held pre-CR (all shares information are splited-adjusted). However, instead of averaging over the total number of stocks that fit the rank and quarter constraints, we calculate the average within each fund, and then analyze the per fund averages. E.g., in the second quarter after the end of CR, 994 funds pre-CR hold stocks that have the best trailing 12-month performance (rank=10) compared to other stocks in the CRSP dataset. Among those funds, median of average % change in number of shares within each fund is -50.175%.

TABLE IV B. CHANGES IN PORTFOLIO, ON A PER FUND BASIS, AMONG FUNDS THAT HAVE COMPLETE REPLACEMENT

Rank of individual holdings in 0 to 4 quarters post-CR	Quarters post-CR (0 = quarter in which CR ends)									
	0		1		2		3		4	
	Number of stocks in this rank group in this quarter	Median raw change in number of shares	Number of stocks in this rank group in this quarter	Median raw change in number of shares	Number of stocks in this rank group in this quarter	Median raw change in number of shares	Number of stocks in this rank group in this quarter	Median raw change in number of shares	Number of stocks in this rank group in this quarter	Median raw change in number of shares
1	956	-28000	912	-36492	985	-40000	921	-41646	912	-41218
2	1181	-15375	1104	-24481	1120	-32699	1077	-36616	1050	-36869
3	1288	-12989	1189	-18333	1205	-27409	1159	-28000	1118	-32118
4	1317	-9800	1194	-16483	1219	-23892	1156	-27150	1123	-28967
5	1339	-9160	1211	-16100	1235	-21188	1171	-23333	1137	-28333
6	1325	-8100	1214	-13825	1218	-20875	1157	-25000	1123	-29109
7	1328	-7552	1205	-13400	1218	-17417	1146	-20875	1122	-27550
8	1330	-6818	1189	-11400	1205	-18750	1138	-23218	1109	-24667
9	1286	-7993	1158	-10360	1169	-18250	1093	-24641	1079	-25983
10	1103	-8431	977	-13050	994	-23127	929	-27667	928	-33100

Notes: In this table changes in portfolio is gauged by raw change in number of shares = (S_t-$S_{pre\text{-}CR}$), S_t = number of shares held at quarter t post-CR, t = 0 to 4, and $S_{pre\text{-}CR}$ is number of shares held pre-CR (all shares information are splited-adjusted). However, instead of averaging over the total number of stocks that fit the rank and quarter constraints, we calculate the average within each fund, and then analyze the per fund averages. E.g., in the second quarter after the end of CR, 994 funds pre-CR hold stocks that have the best trailing 12-month performance (rank=10) compared to other stocks in the CRSP dataset. Among those funds, median of average raw change in number of shares within each fund is -23,127.

TABLE IV C. CHANGES IN PORTFOLIO, ON A PER FUND BASIS, AMONG FUNDS THAT HAVE COMPLETE REPLACEMENT

Rank of individual holdings in 0 to 4 quarters post-CR	Quarters post-CR (0 = quarter in which CR ends)									
	0		1		2		3		4	
	Number of stocks in this rank group in this quarter	Median individual weight change in %	Number of stocks in this rank group in this quarter	Median individual weight change in %	Number of stocks in this rank group in this quarter	Median individual weight change in %	Number of stocks in this rank group in this quarter	Median individual weight change in %	Number of stocks in this rank group in this quarter	Median individual weight change in %
1	956	-0.1375	912	-0.3000	985	-0.4727	921	-0.5000	912	-0.6000
2	1181	-0.0090	1104	-0.1076	1120	-0.1818	1077	-0.2759	1050	-0.3697
3	1288	0.0687	1189	0.0414	1205	0.0060	1159	-0.0103	1118	-0.0585
4	1317	0.1196	1194	0.0891	1219	0.0575	1156	0.0567	1123	0.0586
5	1339	0.1835	1211	0.1276	1235	0.1589	1171	0.1721	1137	0.0858
6	1325	0.2071	1214	0.1536	1218	0.1250	1157	0.1000	1123	0.0885
7	1328	0.2398	1205	0.2389	1218	0.2063	1146	0.2463	1122	0.1441
8	1330	0.2503	1189	0.2710	1205	0.2990	1138	0.2521	1109	0.2839
9	1286	0.2475	1158	0.3005	1169	0.2878	1093	0.2179	1079	0.1937
10	1103	0.1614	977	0.1517	994	0.0697	929	0.0162	928	0.0118

Notes: In this table changes in portfolio is gauged by individual weight change = W_t-$W_{pre\text{-}CR}$, W_t = stock weight (return-adjusted) at quarter t post-CR, t = 0 to 4, and $W_{pre\text{-}CR}$ is weight pre-CR. However, instead of averaging over the total number of stocks that fit the rank and quarter constraints, we calculate the average within each fund, and then analyze the per fund averages. E.g., in the second quarter after the end of CR, 994 funds pre-CR hold stocks that have the best trailing 12-month performance (rank=10) compared to other stocks in the CRSP dataset. Among those funds, median of average individual weight change within each fund is 0.07%.

TABLE V A. CHANGES IN PORTFOLIO, ON A PER STOCK BASIS, AMONG FUNDS THAT HAVE COMPLETE REPLACEMENT. CONTROLLED FOR CHANGES OF THE SAME STOCK IN THE CONTROL GROUP

Rank of individual holdings in 0 to 4 quarters post-CR	Quarters post-CR (0 = quarter in which CR ends)									
	0		1		2		3		4	
	Number of stocks in this rank group in this quarter	Median net % change in number of shares	Number of stocks in this rank group in this quarter	Median net % change in number of shares	Number of stocks in this rank group in this quarter	Median net % change in number of shares	Number of stocks in this rank group in this quarter	Median net % change in number of shares	Number of stocks in this rank group in this quarter	Median net % change in number of shares
1	6122	-97.18	6502	-112.41	7226	-134.94	6977	-155.41	6784	-168.81
2	9649	-62.40	9234	-100.00	9694	-121.61	9220	-136.38	8672	-149.02
3	12491	-41.99	11782	-74.12	12112	-112.46	11259	-126.13	10542	-138.49
4	13631	-35.06	13283	-65.64	12825	-105.31	12333	-121.40	11439	-133.41
5	14233	-30.28	13411	-59.48	12621	-100.00	12125	-115.03	11683	-126.96
6	13775	-28.26	12996	-52.65	12239	-91.11	11512	-109.14	10954	-124.13
7	14361	-26.20	13337	-47.37	12784	-83.16	11905	-105.32	11615	-117.77
8	14232	-24.19	12603	-44.99	12386	-76.45	11410	-101.23	11186	-114.38
9	13847	-25.61	12264	-45.97	11376	-77.28	10418	-97.47	10399	-112.51
10	10402	-27.94	9085	-50.73	8109	-73.83	6763	-96.35	7117	-109.39

Notes: After performing a one-to-one stock match between the test and the control group, we subtract the % change in number of shares of the control group from the test group (testgroup_change$_i$-controlgroup_change$_i$, i = 1 to 6502) and present the results in the above table. E.g., in the first quarter after the end of CR, 6,502 stocks are held preCR both in the test group and the control group, and have the worst trailing 12-month performance (rank=1). Among those stocks, median net % change in number of shares from pre-CR is -112.41%.

TABLE V B. CHANGES IN PORTFOLIO, ON A PER STOCK BASIS, AMONG FUNDS THAT HAVE COMPLETE REPLACEMENT. CONTROLLED FOR CHANGES OF THE SAME STOCK IN THE CONTROL GROUP

Rank of individual holdings in 0 to 4 quarters post-CR	Quarters post-CR (0 = quarter in which CR ends)									
	0		1		2		3		4	
	Number of stocks in this rank group in this quarter	Median net raw change in number of shares	Number of stocks in this rank group in this quarter	Median net raw change in number of shares	Number of stocks in this rank group in this quarter	Median net raw change in number of shares	Number of stocks in this rank group in this quarter	Median net raw change in number of shares	Number of stocks in this rank group in this quarter	Median net raw change in number of shares
1	6122	-14582	6502	-22507	7226	-36770	6977	-41819	6784	-43950
2	9649	-9599	9234	-17818	9694	-27488	9220	-31306	8672	-36908
3	12491	-6559	11782	-11782	12112	-19894	11259	-24799	10542	-30740
4	13631	-5071	13283	-9841	12825	-16822	12333	-23235	11439	-25300
5	14233	-4606	13411	-8292	12621	-14098	12125	-18729	11683	-22805
6	13775	-3744	12996	-6863	12239	-11959	11512	-17031	10954	-21476
7	14361	-3250	13337	-5646	12784	-10353	11905	-15210	11615	-19958
8	14232	-2676	12603	-5256	12386	-9503	11410	-14098	11186	-18401
9	13847	-2519	12264	-4858	11376	-8701	10418	-13275	10399	-18121
10	10402	-1310	9085	-3354	8109	-6400	6763	-11699	7117	-18825

Notes: After performing a one-to-one stock match between the test and the control group, we subtract the raw change in number of shares of the control group from the test group (testgroup_change$_i$-controlgroup_change$_i$, i = 1 to 6502) and present the results in the above table. E.g., in the first quarter after the end of CR, 6,502 stocks are held preCR both in the test group and the control group, and have the worst trailing 12-month performance (rank=1). Among those stocks, median net raw change in number of shares from pre-CR is -22507.

TABLE V C. CHANGES IN PORTFOLIO, ON A PER STOCK BASIS, AMONG FUNDS THAT HAVE COMPLETE REPLACEMENT. CONTROLLED FOR CHANGES OF THE SAME STOCK IN THE CONTROL GROUP

Rank of individual holdings in 0 to 4 quarters post-CR	Quarters post-CR (0 = quarter in which CR ends)									
	0		1		2		3		4	
	Number of stocks in this rank group in this quarter	Median net individual weight change in %	Number of stocks in this rank group in this quarter	Median net individual weight change in %	Number of stocks in this rank group in this quarter	Median net individual weight change in %	Number of stocks in this rank group in this quarter	Median net individual weight change in %	Number of stocks in this rank group in this quarter	Median net individual weight change in %
1	6122	-0.2911	6502	-0.4901	7226	-0.8242	6977	-1.0688	6784	-0.9916
2	9649	-0.2618	9234	-0.4738	9694	-0.7538	9220	-0.9248	8672	-0.9170
3	12491	-0.2583	11782	-0.4013	12112	-0.6744	11259	-0.8869	10542	-0.9323
4	13631	-0.2247	13283	-0.3805	12825	-0.5923	12333	-0.8233	11439	-0.8469
5	14233	-0.2025	13411	-0.3712	12621	-0.5502	12125	-0.7285	11683	-0.8374
6	13775	-0.2000	12996	-0.3488	12239	-0.5069	11512	-0.6971	10954	-0.8108
7	14361	-0.1931	13337	-0.3367	12784	-0.5007	11905	-0.6859	11615	-0.7945
8	14232	-0.1763	12603	-0.3197	12386	-0.4622	11410	-0.6819	11186	-0.7770
9	13847	-0.1770	12264	-0.3172	11376	-0.4415	10418	-0.6399	10399	-0.7686
10	10402	-0.1522	9085	-0.3067	8109	-0.3571	6763	-0.5665	7117	-0.6698

Notes: After performing a one-to-one stock match between the test and the control group, we subtract the individual weight change in number of shares of the control group from the test group (testgroup_change$_i$-controlgroup_change$_i$, i = 1 to 6502) and present the results in the above table. E.g., in the first quarter after the end of CR, 6,502 stocks are held preCR both in the test group and the control group, and have the worst trailing 12-month performance (rank=1). Among those stocks, median net individual weight change from pre-CR is -0.4901%.

TABLE VI. CHANGES IN PORTFOLIO, ON A PER STOCK BASIS, AMONG FUNDS ARE "FREE" OF MANAGERIAL

Rank of individual holdings in 0 to 4 quarters post-CR	Quarters post-CR (0 = quarter in which CR ends)									
	0		1		2		3		4	
	Number of stocks in this rank group in this quarter	Median % change in number of shares	Number of stocks in this rank group in this quarter	Median % change in number of shares	Number of stocks in this rank group in this quarter	Median % change in number of shares	Number of stocks in this rank group in this quarter	Median % change in number of shares	Number of stocks in this rank group in this quarter	Median % change in number of shares
1	6122	21.00	6494	39.06	7218	55.89	6963	77.31	6770	94.11
2	9649	19.07	9216	31.84	9676	48.67	9207	64.40	8659	81.04
3	12491	16.25	11760	28.64	12090	43.05	11248	54.82	10531	70.78
4	13631	15.63	13253	25.74	12795	39.74	12317	52.04	11423	68.29
5	14233	14.35	13391	24.49	12601	35.97	12099	48.80	11657	61.83
6	13775	14.43	12973	24.04	12216	34.73	11490	45.28	10932	59.40
7	14361	13.45	13318	23.35	12765	32.99	11882	43.59	11592	58.22
8	14232	13.02	12582	22.44	12365	31.67	11386	42.30	11162	55.53
9	13847	12.38	12252	22.38	11364	29.71	10403	41.48	10384	53.24
10	10402	12.16	9077	22.26	8101	26.46	6760	39.45	7114	50.66

Notes: In this table changes in portfolio is gauged by % change in number of shares = $100*(S_t-S_{pre\text{-}CR})/S_{pre\text{-}CR}$, S_t = number of shares held at quarter t post-CR, t = 0 to 4, and $S_{pre\text{-}CR}$ is number of shares held pre-CR (all shares information are splited-adjusted). E.g., in the first quarter after the end of CR, 6,647 stocks are held preCR and have the worst trailing 12-month performance (rank=1) compared to other stocks in the CRSP dataset (multiple observations of the same stock are treated individually). Among those stocks, median % change in number of shares from pre-CR is -100%.

TABLE VII. STANDARDIZED TEST STATISTICS FOR TWO-SAMPLE RANKED SUM TEST, RANK 1 VERSUS RANK 10

Quarters post-CR (0 = quarter in which CR ends)	one-to-one stock match			one-to-one rank match		
	Net % change in number of shares	Net raw change in number of shares	Net individual weight change in %	Net % change in number of shares	Net raw change in number of shares	Net individual weight change in %
0	-31.22	-29.67	-20.36	-18.13	-17.00	-14.92
1	-34.41	-31.77	-18.20	-18.30	-15.96	-13.60
2	-43.49	-33.37	-29.07	-19.86	-14.40	-18.40
3	38.73*	26.08*	24.29*	-17.92	-12.36	-16.90
4	-35.48	-20.79	-16.35	-16.55	-10.85	-14.29

Notes: The above table gives the standardized Z statistics generated by the Wilcoxon two-sample test to check whether the net changes in portfolio in the worst performing decile are different in location compare to the best performing decile. Extreme values imply the distribution of data point in the group with smaller sample size has a location bias toward to sign of the Z statistics relative to another group, and whether that bias is statistically significant can be concluded by conducting standard Z-score inference procedures.

*** For this and only this particular case, there are less stocks in rank 10 than in rank 1. PROC NPAR1WAY in SAS compute the Z test statistics based on the group with smaller sample size, which means that almost surely stocks with better trailing 12-month performance experience higher net % change in number of shares, higher net raw change in number of shares, and higher net individual weight change compare to the worst performing stocks**