

Stock Repurchasing Bias of Mutual Funds

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Abstract

This paper investigates whether the positive emotions mutual fund managers have when they have sold a stock for a gain lead to a higher repurchasing probability of this stock in the future. Controlling for fund, stock, and time fixed effects, we show that the probability of a stock being repurchased by a mutual fund is on average around 17% higher if it was previously sold for a gain rather than for a loss. The effect is less pronounced if the stock price has increased after the sale of the stock, which may cause regret and a negative feeling that the stock has been sold in the first place. In line with positive emotions driving the repurchasing behavior, we find that when fund managers change jobs and work at a different fund, they still prefer to repurchase stocks that they sold for a gain at the fund they managed before. We find supportive evidence that this behavior is associated with lower fund performance: repurchased winners underperform repurchased losers by around 5% p.a. after the repurchase. Thus, investors should be aware that mutual fund managers' repurchasing decisions can be biased and eventually may hurt their performance.

JEL-Classification Codes: G11, G23, G41

Keywords: Stock Repurchasing, Mutual Funds, Performance, Behavioral Bias

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1 Introduction

The behavior and performance of mutual fund managers is crucial to the financial well-being and wealth of many households. According to the Investment Company Institute, 55.9 million households in the US owned mutual funds in 2017, while the overall investment volume in mutual funds amounted to \$16.3 trillion.¹ Decisions made in delegated portfolio management obviously affect a large number of individual investors and it is therefore important to understand, how these decisions are made.

In this paper, we examine whether past positive or negative experiences that a fund manager made with a particular stock are predictive for the stock being repurchased in the future. Specifically, we conjecture that selling a stock for a gain is associated with positive emotions such as pride and happiness, while selling a stock for a loss is associated with negative emotions such as regret and disappointment. In an effort to repeat the positive emotional experience and avoid the negative one, mutual fund managers may be more prone to repurchase a stock that they sold for a gain (i.e., a past “winner”), while they may be less prone to repurchase a stock that they sold for a loss (i.e., a past “loser”). This bias may harm mutual fund investors if past winner stocks underperform past loser stocks.

We test this conjecture based on a large data set of quarterly U.S. mutual fund holdings from 1980 to 2014. For each individual mutual fund-stock combination, we define winner and loser stocks as those instances where a mutual fund sold the entire stock position for a gain or a loss, respectively. We then examine whether the probability that a stock is repurchased depends on whether it has been sold for a gain or a loss. We control for various fund characteristics such as fund size, fund age, fund performance, and the fund’s trading activity. We also include stock, fund, and time fixed effects, and even fund \times time fixed effects or stock \times time fixed effects, respectively. These fixed effects account for unobservable (time varying) stock and fund characteristics due to which i) certain stocks may be more

¹For a detailed view on the Investment Company Institute’s annual statistics on households’ mutual fund holdings, see https://www.ici.org/pdf/2017_factbook.pdf.

likely to be repurchased, ii) certain types of funds may be more prone to repurchase stocks, or iii) certain years when repurchasing behavior may be more common due to general market conditions.

Our main result shows that mutual fund managers are significantly more likely to repurchase a stock if it has been sold for a gain before. This result is also economically significant: relative to the average repurchasing probability of all stocks, the probability of a past winner stock to be repurchased is about 17% larger than that the probability of a past loser stock to be repurchased.

We also examine whether stock price changes after the sale influence fund managers' repurchasing decision. We find that if a stock was previously sold for a gain, it is about 1.2% less likely to be repurchased if its price has gone up since the sale. In economic terms, the effect of the price change after the sale accounts for about 23% of the average probability to repurchase a stock. We also find that team-managed funds exhibit a stronger repurchasing bias, which is consistent with the previous literature on the negative impact of group thinking on fund performance (Baer et al. (2005)), and the literature showing that team-managed funds are more subject to the disposition effect (Cici (2012)).

In line with the view that positive (negative) emotions associated with selling a stock for a gain (loss) drive repurchasing bias of mutual fund managers, we find that mutual fund managers carry their trading experiences with them: they are still more likely to repurchase previous winner stocks in their current portfolios, if these stocks were sold for a gain at the previous fund the manager was in charge of. Further, repurchasing bias is stronger if selling the stock for a gain is more salient to the manager, i.e., if no or only a few other stocks were sold at the same time or if the stock was sold right after the purchase.

Finally, we document that repurchased winner stocks underperform repurchased loser stocks by about 5% p.a. Also, repurchased stocks' prices increase between the time they have been sold and repurchased and stock prices of repurchased winners increase even more than those of repurchased losers, suggesting that mutual funds would have benefited from just keeping

these stocks, especially winner stocks that they repurchase later, in their portfolios. These results suggest that repurchasing bias of mutual funds is not due to superior information about past winner stocks.

The previous literature has documented biased investment decisions of individual and institutional investors. Although fund managers are deemed professional investors and thus are supposed to behave more rationally than retail investors, there is evidence that they are also subject to some of the behavioral biases that are widely documented for retail investors. For example, fund managers have been shown to suffer from home bias (Ivković and Weisbenner (2005), Seasholes and Zhu (2010), and Pool et al. (2015)), and overconfidence (Odean (1999) and Puetz and Ruenzi (2011)). Nevertheless, there are some behavioral biases that do not influence mutual funds as much. The disposition effect, which is also widely documented for retail investors (e.g., Shefrin and Statman (1985) and Odean (1998)), does not seem to be strong among mutual fund managers (Frazzini (2006) and Cici (2012)). Barber and Odean (2007) find that attention is a major factor for retail investors to determine which stocks to buy. However, this attention bias does not influence institutional investors (Barber and Odean (2007)).

In this paper, we document that fund managers are subject to repurchasing bias. We argue that selling a stock for a gain or a loss generates positive or negative emotions, respectively, and that these emotions influence future investment decisions. Similar to home bias, the repurchasing bias is an emotion-based bias that leads to personal attachment to a certain kind of stock (specifically, local stocks and stocks that are previously sold for a gain). Therefore, we argue that even though fund managers are professional investors and thus may be able to overcome some behavioral biases that retail investors are subject to, emotion-based biases still have an impact on their behavior, because they are probably the hardest to overcome.

So far, there is little evidence that behavioral biases of fund managers lead to worse fund performance and thus harm the investor. To examine whether repurchasing bias results in

mutual fund underperformance, we first sort mutual funds into quintiles according to the extent to which they engage in repurchasing behavior and then compute the difference in returns between the top and bottom quintiles. We find suggestive evidence that funds that are most heavily engaging in repurchasing behavior underperform funds that are not subject to repurchasing bias. Thus, unlike the previous literature on biased investment behavior of mutual fund managers, we find that mutual funds' stock repurchasing bias is associated with lower returns for mutual fund investors.

Our paper contributes to several strands of the literature. First, we contribute to the broad literature on the impact of emotions on economic decision making (Mellers et al. (1997), Loewenstein (2000), and Frydman and Camerer (2016)). According to Mellers et al. (1997), individuals aim to maximize their expected emotional experiences when choosing between risky options. That is, they will choose the option associated with more positive emotions. In a similar vein, Loewenstein (2000) argues that anticipated emotions predict economic decision making. This view has been supported by Frydman and Camerer (2016), who show that an individual's reluctance to repurchase stocks that have increased in price since they were sold is correlated with neural activity in areas of the brain that are associated with emotional responses. We add to this literature by showing that emotional experiences even have an impact on decisions made on behalf of others, i.e., in delegated portfolio management, where the outcome of an individual trade should be more important for fund investors rather than for fund managers themselves.

We also contribute to the literature documenting that actively managed mutual funds underperform (Jensen (1968), Gruber (1996), and Carhart (1997)). This literature started with the seminal paper by Jensen (1968) showing that funds underperform their passive benchmark by approximately 1.1% per year. Similarly, Gruber (1996) provides evidence that the average mutual fund underperforms passive market indices by about 65 basis points per year. Carhart (1997) also supports these findings and shows that the more actively a mutual fund trades, the lower the fund's performance. We contribute to this literature

by showing one channel through which actively managed funds may underperform: mutual fund managers' biased repurchasing behavior of stocks that they previously sold for a gain. These trades lead to higher costs for the fund, which are not compensated by higher returns of the repurchased stocks. On the contrary, we show that mutual funds would have earned more if they just kept these stocks in their portfolios, rather than traded them.

The paper most closely related to ours is Strahilevitz et al. (2011). The authors show that individual investors are also more likely to repurchase stocks that were previously sold for a gain rather than for a loss. They argue that this repurchasing behavior is due to positive (negative) emotions that retail investors experience when selling stocks for gains (losses).² We show that stock repurchasing bias is present among institutional investors, too. While Strahilevitz et al. (2011) find no strong performance effects among individual investors, though acknowledging that these investors would be better off holding index funds, we find that mutual funds would perform better if they were not subject to a repurchasing bias.

The results of our paper imply that mutual fund managers, who have been viewed as a more sophisticated type of investor, are subject to the same emotion-based biases as retail investors and that their behavior deserves scrutiny as it has potentially negative effects on a large amount of investors.

2 Data and summary statistics

2.1 Data and sample selection

We obtain quarterly stock holdings data of U.S. mutual funds from 1980 to 2014 from the Thomson Reuters Mutual Fund Holdings Database. We then merge the stock holdings data with the CRSP Survivorship-Bias-Free Mutual Fund Database using MFLINKS by Wermers (2000). The CRSP Mutual Fund Database contains data on fund characteristics

²The results of Strahilevitz et al. (2011) were replicated in a lab experiment by Weber and Welfens (2011).

such as total net assets (TNA), monthly returns, expense ratios, and first offer dates. We further merge the data with the Morningstar Direct database using TICKER and CUSIP as fund identifiers since the Morningstar database provides more accurate information on who is running a fund. We aggregate all share classes of the same fund to avoid multiple counting.

We include all actively managed, open-end domestic U.S. equity funds in the sample. As stock repurchasing bias is only relevant for actively managed funds, we exclude ETFs, index funds, and funds with an expense ratio below 0.1% p.a. We also exclude funds with total net assets in the bottom 5% of all observations to make sure that reported stock holdings do not change because of complete liquidation of the fund.³

In the next step, we merge the mutual fund data with stock information from CRSP using the report date (RDATE) and the stock identifiers (CUSIP and PERMNO) in the stock holdings. Following Daniel et al. (1997) and Wermers (1999), we only include regular common stocks traded on NYSE, AMEX or NASDAQ.

Since repurchasing decisions are only relevant when a stock has been sold by a fund before, we only keep those observations in the sample when a fund has sold a certain stock. We define the sale of a stock as clearing the entire position. According to Alexander et al. (2006), selling to zero usually represents value-based sales while selling partial positions may be caused by liquidity restrictions or portfolio rebalancing. Thus, to capture deliberate trades of fund managers that are significant enough to be associated with repurchasing bias, we focus on stocks that have been completely sold before. For each stock sold by a fund, we track it for one year to see whether the stock is repurchased by the same fund.

Our final sample consists of 7,521,881 fund-stock-quarter observations, including 4,404 distinct funds holding 18,164 distinct stocks.

³Including these funds with low total net assets does not materially change our main result.

2.2 Construction of main variables

Repurchasing dummy variable

For each stock sold by a fund, we check whether it re-appears in reported stock holdings of the fund within the next four quarters, i.e., one year after the sale, following Strahilevitz et al. (2011). This way, we ensure that the same managers are likely to be in charge of the fund and the emotions triggered by the previous sale are still vivid in managers' memory.⁴ Our main dependent variable, $\text{Repurchase}_{i,j,q}$, is equal to one for the quarter in which a stock first re-appears in the stock holdings report of the fund after the sale. The repurchase dummy is set to zero, if the stock does not re-appear in the stock holdings report of the fund in the respective quarter within a year after selling the stock. Thus, the repurchase dummy is equal to zero for all opportunities to repurchase the stock within one year after its sale, and it is equal to one if the stock is actually repurchased in a given quarter. We do not include the stock in the sample anymore after it is repurchased and becomes part of the fund's stock holdings, i.e. the sample only comprises repurchasing activities and opportunities to repurchase. Furthermore, we exclude delisted stocks from the sample as they are no longer available for repurchasing.

Appendix B provides an overview of the top 20 funds that engage most strongly in repurchasing behavior (Panel A) and of the top 20 stocks that are most frequently repurchased in our sample period (Panel B).

Definition of winner and loser stocks

We do not directly observe whether a fund sells a stock for a gain or a loss since we only observe quarterly holdings, which do not provide information on the exact trading day within the quarter. A fund may have sold a stock at any point in the time period from the last time the stock appears in the stock holdings of the fund to the next report date of the

⁴In our later analysis, we explore manager changes explicitly.

fund. Therefore, we approximate the returns of sales in two different ways to ensure the robustness of the results.

First, we define a winner dummy, WinnerFIFO, by comparing the price at the time of sale with the weighted average purchase price based on the first-in-first-out (FIFO) principle following Frazzini (2006).⁵ WinnerFIFO equals one if the sale price is higher than the average purchase price of the stock, and equals zero if the sale price is lower than the average purchase price. Second, we also use the value-weighted average of all purchase prices before the sale to measure whether the previous sale was for a gain or a loss and define a winner dummy, WinnerAVG. WinnerAVG is equal to one if the sale price is higher than the value-weighted average of all purchase prices before the sale so the measure is not influenced by the sequence of stock purchases. Both WinnerFIFO and WinnerAVG are used in Cici (2012) when the author defines whether a stock is held with a capital gain or a capital loss in order to examine the disposition effect among mutual funds. To clearly separate repurchasing of winner and loser stocks, we do not consider cases in which a stock is sold with a zero return.⁶

We further calculate the purchase price of stocks with low-in-first-out and high-in-first-out principles following Cici (2012) and compare the purchase price with the selling price to determine whether the stock was sold for a gain or a loss. Additionally, we apply last-in-first-out principle to calculate the purchase price and use the last holding period returns of a stock by a mutual fund to check the robustness. The results are presented in Appendix F.

All other variables are described in detail in Appendix A.

⁵Results (not reported) are robust to using the price at the last time when the stock is reported in the holdings or the first report date when the stock is no longer reported. Results in the paper are based on the assumption that the stocks are sold on the next report date of the fund after the stock's last appearance in the fund's holding.

⁶Our main results do not change if we include stocks sold at a zero return.

2.3 Summary statistics

Panel A of Table 1 reports summary statistics of all variables used in our analysis. We find that stocks in our sample are repurchased by the same fund within one year with a probability of 5.2% on average. According to the WinnerFIFO (WinnerAVG) measure, 50.1% (50.2%) of the stocks in our sample are sold for a gain. Furthermore, 56.5% of stocks increase in price after they have been completely sold by a fund in a given quarter.

In Panel B of Table 1 we compare all control variables according to whether a stock is repurchased or not, respectively. Funds engaging in repurchasing behavior are larger, trade more, and have less volatile returns. We also observe that the average values of both winner dummies differ significantly in the two groups: the average of both winner dummies is higher for the repurchased stocks than for the non-repurchased stocks. More specifically, repurchased stocks are more likely to be winner stocks with an average above 50%, while the stocks that are not repurchased are more likely to be loser stocks with an average below or equal to 50% for proxies, WinnerFIFO and WinnerAVG.

Panel C of Table 1 shows the average difference in the control variables conditional on repurchased stocks being winner or loser stocks according to the WinnerFIFO measure.⁷ We find that winner stocks are significantly more likely to be sold by larger, older, less active, and better performing funds with a lower expense ratio. We also observe that the probability to be repurchased is 1.2% higher if the stock is a previous winner rather than a previous loser. The difference is as high as 23.1% of the baseline repurchase probability and economically significant.

Appendix C presents correlations between all variables used in our analysis. They show that multicollinearity should not be an issue in our regressions. Our two measures of winner stocks are positively and significantly correlated with a coefficient of 0.955.

⁷Results (not reported) are virtually identical if we use the WinnerAVG measure instead.

3 Repurchasing behavior of mutual fund managers

We start by examining whether stocks that were previously sold for a gain are more likely to be repurchased by mutual funds than stocks that were sold for a loss. Figure 1 depicts the average return from a stock's complete sale conditional on whether this stock is repurchased, or not. Visual inspection already shows that returns of repurchased stocks are higher than those of stocks that are sold completely, but not repurchased. According to the WinnerFIFO measure, the return difference amounts to 3.51%, while according to the WinnerAVG measure, the return difference amounts to 4.43%. Both differences are statistically significant at the 1% level.

3.1 Baseline Results

To further test our hypothesis that stocks previously sold for a gain are more likely to be repurchased than stocks previously sold for a loss, we calculate the proportion of winner stocks repurchased (PWR) and the proportion of loser stocks repurchased (PLR) and test for significant differences based on non-parametric t-tests. Following Strahilevitz et al. (2011), PWR and PLR are defined as:

$$(1) \quad PWR = \frac{NWR}{ORW},$$

$$(2) \quad PLR = \frac{NLR}{ORL},$$

where NWR (NLR) is the number of winners (losers) completely sold by a fund and then repurchased within one year after the sale. ORW (ORL) reflects the number of opportunities to repurchase previous winners (losers). It is based on the observations in the four quarters after a stock is completely sold by a fund. NWR (NLR) and ORW (ORL) are aggregated across all funds over the sample period.

Table 2 shows average differences between PWR and PLR. In column (1), winners are measured by WinnerFIFO, while in column (2), winners are measured by WinnerAVG. The difference between PWR and PLR is 1.2%, no matter which proxy for winner stocks is used. The difference is statistically significant at the 1% level. Following Strahilevitz et al. (2011), to be conservative, we only assume that realized repurchases instead of all observations are independent of each other.

The difference between PWR and PLR that we document for fund managers (i.e., 1.2%) is economically smaller than what has been documented for retail investors, where differences range between 2.0% and 4.8% (Strahilevitz et al. (2011)). We also observe that the ratio between PWR and PLR is lower for fund managers: it ranges between 1.255 (0.059/0.047) compared to a range of 1.360 to 2.356 documented for retail investors (Strahilevitz et al. (2011)). Thus, professional investors seem to be less subject to repurchasing bias than individual investors. However, the significant difference in proportions already provides evidence for the conjecture that repurchasing bias also exists among mutual fund managers.

In the next step, we test our hypothesis on the repurchasing bias among fund managers more formally and estimate the following linear probability model with fixed effects and fund characteristics as control variables:

$$\begin{aligned}
 \text{Repurchase}_{i,j,q} = & \alpha + \beta_1 \text{WinnerDummy}_{i,j,q} + \beta_2 \text{FundSize}_{i,q} + \beta_3 \text{FundAge}_{i,q} \\
 (3) \quad & + \beta_4 \text{FundTurnoverRatio}_{i,q} + \beta_5 \text{FundExpenseRatio}_{i,q} + \beta_6 \text{Fund} \\
 & \text{ReturnVolatility}_{i,q} + \beta_7 \text{FundRanking}_{i,q} + u_j + w_i + v_q + \varepsilon_{i,j,q},
 \end{aligned}$$

where i, j, q indicate funds, stocks, and the quarter of the (potential) repurchase within four quarters after the sale, respectively. The dependent variable, $\text{Repurchase}_{i,j,q}$, is an indicator of whether stock j sold completely by fund i is repurchased in quarter q within one year

after the sale. $Winner_{i,j,q}$ denotes our two measures of winner stocks, $WinnerFIFO_{i,j,q}$ or $WinnerAVG_{i,j,q}$, as defined in Section 2.2.

We include various fund characteristics as control variables. Fund size and fund age are included, because repurchasing activity may generally be higher for large funds with more stocks in their portfolios that they could potentially repurchase. We also control for a fund's turnover ratio, as it may be positively correlated with repurchasing activity. A fund's expense ratio is included as another proxy for its trading activity and activeness in general. Furthermore, we include a fund's performance ranking in its segment and its return volatility, as these variables may influence the fund manager's decision to repurchase past winner stocks due to tournament incentives or window dressing (Brown et al. (1996), Kempf and Ruenzi (2008), Agarwal et al. (2014)). A more detailed definition of all variables is contained in Appendix A.

All models include stock, fund, and time fixed effects to control for unobserved fund trading patterns, stock characteristics, and potential time trends in repurchasing behavior. In another specification not presented in Equation 3, we further include fund times time fixed effects to control for any time-variant fund trading patterns. For example, if a mutual fund systematically sold more winner stocks, it may (mechanically) be more likely to repurchase winner stocks in the future. Controlling for fund times time fixed effects helps us mitigate this concern. In addition, we assume that the repurchasing behavior is independent across funds but not within funds and thus cluster standard errors by fund.⁸ Estimation results are presented in Table 3.

In columns (1) and (4), we estimate the baseline effect without any additional control variables, while in columns (2) and (5), we control for fund characteristics. We include fund times time fixed effects in columns (3) and (6). Across all specifications, we find that mutual fund managers are significantly more likely to repurchase stocks that they previously sold for a gain. The impact of the winner dummy on the probability of a stock to be repurchased

⁸In unreported robustness analysis, we cluster standard errors by both, fund, and time. Results do not change.

is positive and statistically significant at the 1% level in all model specifications. The effect is also economically meaningful: depending on the winner measure and the model specification, the estimates show that the probability of being repurchased is 0.9% to 1% higher for previous winners than for previous losers. Relative to the mean repurchasing probability of a stock in the sample (5.2% in Panel A of Table 1), this difference corresponds to a 17% higher probability for a winner stock to be repurchased.

Coefficient estimates of most control variables on fund characteristics are also in line with expectations. We find that larger funds are significantly more likely to repurchase stocks. More active funds also tend to repurchase more stocks: the higher the turnover ratio of a fund, the more likely a fund repurchases a stock. Results also show that a better fund ranking in each sector has a negative impact on the likelihood to repurchase a stock previously sold.

In Table 4, we additionally include stock \times time fixed effects. They should mitigate the concern that mutual funds tend to repurchase stocks with certain characteristics and these stocks happen to be more likely to be previous winners. For example, if mutual funds are more likely to purchase growth stocks and these growth stocks happen to have been sold for a gain by mutual funds, we would observe that previous winners are more likely to be repurchased than previous losers. After adding stock times time fixed effects, the coefficient estimates of the winner dummies are still positive and statistically significant at the 1% level. It means that, even for the same stock, the probability to be repurchased is dependent on whether the stock was sold for a gain or a loss by a mutual fund before. The probability to repurchase increases by 0.1% when the stock was previously sold for a gain and the increase amounts to 0.2% of the baseline probability to repurchase (5.2% in Panel A of Table 1). The influence may seem to be small, however, note that stock \times time fixed effects exclude stocks that have been sold for a gain or a loss by all funds in a given point in time. Thus, the variation in the sample decreases significantly.

We also run regressions of the repurchase dummy on dummy variables for different return intervals to examine how the magnitude of gains and losses in the previous sale influences

the repurchasing bias. Regressions include the same set of fixed effects as in Equation 3. We plot the corresponding coefficients for various return intervals in Figure 2. We find that the repurchasing bias is highly dependent on whether the stock was sold for a gain or for a loss before. Regardless of which measure we use for returns, the coefficient for return intervals becomes positive when the returns move from the negative domain to the positive domain. However, a stock's likelihood of being repurchased does not increase even further the higher the gain that the fund received in the previous sale, while its likelihood of being repurchased decreases even further the higher the losses the fund incurred when selling the stock before. This asymmetric impact of the magnitude of losses and gains on the repurchasing probability may be due to loss aversion: fund managers may feel more pain when selling for a loss compared to the happiness they feel when selling for the gain, even if this gain is of the same (absolute) magnitude as the loss (Tversky and Kahneman (1992) and Kahneman and Tversky (1984)). When deciding whether to repurchase a stock, the magnitude of losses and the associated pain may thus be more vivid and influence the repurchasing probability; for gains it only seems to matter that the stock was sold with a positive return, and not so much at what magnitude.

Investors are probably not willing to repurchase stocks that were sold for a loss in the 30 days after the sale because they are not allowed to claim the capital loss for tax purposes if they do so. In this time period, mutual funds may thus be reluctant to repurchase previous loser stocks to ensure tax benefits for their investors. To test whether these tax considerations explain our results, in a robustness test, we exclude the first quarter after the sale in our analysis. Appendix D presents the results. Even though the effect of winner dummies on repurchase becomes slightly smaller after excluding the first quarter, it still remains statistically significant at the 1% level and accounts for more than 13% of the baseline probability of repurchase. We find evidence that the tax wash-sale rule indeed contributes slightly to the positive effect of being a previous winner on the repurchasing probability, but the effect still exists after accounting for these tax considerations.

Taken together, we find evidence that mutual fund managers are more likely to repurchase a stock if they have sold it for a gain rather than for a loss before. We argue that this pattern in repurchasing behavior is due to the impact of positive (negative) emotions associated with selling a stock for a gain (loss) on the subsequent willingness to buy this stock again.

3.2 The impact of price movements after the sale on fund managers' repurchasing behavior

In addition to the phenomenon that previous winners are more likely to be repurchased than previous losers, Strahilevitz et al. (2011) show that individual investors are less likely to repurchase a stock whose price has increased, rather than decreased since it was sold. They attribute this finding to regret aversion: if the stock price goes up after the sale, investors regret to have sold it, because they would have earned more if they had kept it in their portfolio. Thus, they attach negative feelings to the stocks if the price has gone up since the sale and are less prone to repurchase those stocks. In line with this view, Frydman and Camerer (2016) conduct an experimental study and relate this avoidance behavior to neural measures of regret.

To examine whether the price change of a stock after the sale also influences the repurchasing decision of mutual fund managers, we define a dummy variable, Price Up $_{i,j,q}$, which is an indicator of whether the price of a stock at the sale is lower than the price of this stock in quarter q . The mean of Price up is 0.565 (Panel A of Table 1), which means that slightly more than half of the stocks sold by mutual funds have increased in price between the sale and repurchasing date, rather than decreased. Unconditionally, repurchased stocks are more likely to have increased in price compared to the stocks that are not repurchased, as shown in Panel B of Table 1. However, when observing the price movement of a stock after it has been sold, investors already know what they earned from the previous sale. Therefore, we focus on the impact of the price movement after the sale on the repurchasing behavior of mutual funds, conditional on being a winner or loser in the previous sale.

We re-run our main regression and add an interaction term of the winner dummy and a dummy variable capturing a stock's price change between the time when it was sold and repurchased, Price Up. Results are presented in Table 5.

In all model specifications, the coefficient estimates of the interaction terms are negative and statistically significant at the 1% level. If a fund sold a stock for a gain, but the price of the stock went up since it was sold, it decreases the probability of repurchasing the previous winner stock by 1.1% to 1.2%, depending on the winner measure. For instance, results in column (1)-(3) show that the probability of repurchasing a previous winner whose price has increased since the sale is 1.2% lower than that of repurchasing a previous winner whose price has decreased since the sale. Given that the difference in the probability to repurchase previous winners and previous losers is 1.6% when the stock price decreases after the sale, the negative marginal effect of an increasing price after the sale amounts to 75% of the difference, which is economically significant. Thus, mutual fund managers are more likely to repurchase past winner stocks if their price has decreased after they were completely sold.

3.3 The impact of team management on mutual funds' repurchasing bias

Whether group decision-making leads to better decisions is widely debated in the economic and psychological literature (e.g., Lamm and Myers (1978) and Adams and Ferreira (2003)). In the mutual fund industry, Baer et al. (2005) find that team-managed funds earn slightly lower returns than single-managed funds. In light of the above discussion, we examine whether decision making in a team reduces or increases the influence of the repurchasing bias.

We construct a dummy variable, Team managed_{*i,j,q*}, which is equal to one if a fund is managed by more than one fund manager in a given quarter, and zero otherwise. 60.8% of the funds in our sample are team-managed (Panel A of Table 1), and repurchasing activity is positively related to the fund being managed by a team rather than a single manager (Panel B of Table 1).

To test whether repurchasing bias is higher for team-managed funds, we interact our main winner dummy variable with a variable indicating team-managed funds, and include it in our baseline regression. Results are presented in Table 6.

We find that team-managed funds are significantly more likely to repurchase stocks they sold for a gain than single-managed funds. The interaction term of the winner dummy and the indicator for team-managed funds is positive and statistically significant at the 5% or 10% level, depending on which winner proxy is used. In economic terms, the coefficient on the interaction term indicates that the difference in the probability to repurchase previous winners and previous losers increases by 0.2%, if a fund is team-managed, rather than single-managed. In economic terms, team-managed mutual funds are 25% more likely to repurchase previous winner stocks rather than previous loser stocks. This finding suggests that group decision making in portfolio management does not reduce but rather exacerbates the influence of fund managers' repurchasing bias. This finding is consistent with Cici (2012), who shows that the disposition effect is stronger among team-managed mutual funds than single-managed funds.

4 Do fund manager changes mitigate the repurchasing bias?

To further establish that fund managers' repurchasing bias is due to their emotional attachment to stocks they sold for a gain or a loss, respectively, we now explore manager changes. If repurchasing bias is due to positive or negative emotions experienced when selling a stock for a gain or a loss, we expect it to be much weaker after a manager change. There still may be a small effect due to analysts or the back-office of the fund that remains the same and still remembers whether a stock was sold for a gain or loss, but we should not observe a repurchasing bias similar to a fund where no manager change took place.

Furthermore, we conjecture that fund managers should still be more likely to repurchase stocks they sold for a gain, even if they have left a fund A and now manage a new fund B.

In this case, we expect them to be more likely to repurchase stocks sold for a gain at fund A such that the portfolio of fund B now contains these stocks, too.

We first examine whether fund manager changes help eliminate the repurchasing bias in a given fund. We define a dummy variable, *Manager change*, which is equal to one if a stock was sold before the funds' management is replaced, but the repurchase decision is made only after the new fund management has taken over. We identify complete manager changes following Jin and Scherbina (2010): a complete manager change for team-managed funds begins when the first new manager arrives and ends when the last old manager leaves. Correspondingly, for single-managed funds, a complete manager change is defined to begin when a new manager arrives and to end when the old manager leaves. In addition, the replacement period is set to at most 90 days in order to avoid double counting of closely spaced sequential changes. Overall, there are 2.3% complete management changes in our whole sample (Panel A Table 1).

We then re-run our baseline linear probability model from Table 3, but additionally include an interaction term of our winner dummy with a dummy variable reflecting a complete manager change. Results are presented in Table 7. In all specifications, the coefficient estimates of the interaction term are negative in all model specifications and statistically significant at the 5% or 10% level in most cases. For example, the result in column (1) means that new fund managers are 0.4% less likely to repurchase previous winners sold by their predecessors than fund managers who remain in charge of the same fund. The decrease is about half of the baseline repurchasing bias, according to which fund managers are 0.9% more likely to repurchase previous winners rather than previous losers. Nevertheless, we still observe a significant repurchasing bias even after a complete management change. This may be due to the fact that the new fund management is still supported by the same research and advisory team as the old fund management. This team may also be subject to repurchasing bias and thus recommend buying stocks sold for a gain more frequently than stocks sold for a loss.

In the next step, we analyze whether fund managers are still more likely to repurchase stocks they sold for a gain, even if the sale was made at an earlier fund this fund manager was in charge of before managing the current fund. In this part of our analysis, we restrict our sample to single-managed funds only, because it is less clear whether one of the managers in a team-managed fund responds strongly emotionally to a trading decision made by the team regarding a stock, and then has enough power to influence the decision to repurchase the same stock in another team.

In the following analysis, the sample consists of repurchasing activities and opportunities to repurchase stocks previously sold by a fund manager in another fund she managed before. Thus, the repurchase dummy is now defined on the fund manager level.

To account for the fact that single fund managers may be responsible for several funds at the same point in time and thus sell the same stock through different funds, we calculate previous returns of stocks sold as the average return of the stock across all funds belonging to the same single manager. We then run a regression of the repurchasing dummy on the main winner dummy with manager fixed effects, time fixed effects and manager \times time fixed effects after a fund manager has left all funds where she sold a particular stock.

As shown in Panel A of Table 8, fund managers are still 0.2% to 0.3% more likely to repurchase previous winners rather than previous losers in a newly managed fund, even if they have already left all funds where they sold this particular stock. All coefficient estimates are statistically significant at the 1% level. Relative to the average of the repurchase dummy of 0.85% in this sample, the effect of being a previous winner accounts for about 25% of the baseline probability to repurchase a given stock. Results are very similar if we restrict the sample to cases where one manager managed only one fund when she sold a particular stock (Panel B of Table 8). This results supports the view that the repurchasing bias we document is indeed caused by positive (negative) emotions experienced when a stock was previously sold for a gain (loss).

5 The impact of memory salience on the repurchasing bias

Our results so far are consistent with emotional attachment of fund managers to their previous trading experiences leading to a repurchasing bias. We therefore conjecture that repurchasing bias should be stronger when the memory of a previous sale is more salient.

We define several memory salience proxies to test our conjecture. First, it has been established in the psychology literature that individuals have limited capacity when processing incoming information (e.g., Miller (1956) and Craik and Lockhart (1972)). Thus, if mutual fund managers trade many stocks at the same time, their memory of one individual stock trade may be less salient than if they trade only one stock. Therefore, we use a fund's turnover ratio and also the number of other stocks sold at given point in time as proxies for memory salience.

Furthermore, the psychology literature suggests that repetitions of a stimuli enhance future recall or recognition of that stimuli. According to Sawyer (1974), presentation frequency increases recall and recognition. Thus, if the purchase of a stock is close to its subsequent sale, fund managers may better remember their trading experience in this stock. Therefore, we use the holding period of a stock as another proxy for memory salience, arguing that shorter holding periods should be associated with stronger repurchasing bias⁹.

We then re-run our baseline regression in Equation 3 and additionally include proxies for memory salience, as well as their interaction with our winner dummies.¹⁰ Results are reported in Table 9.

We find that the repurchasing bias decreases with the number of other stocks sold, the holding period before the sale, and the fund turnover ratio. Thus, it is stronger if memory salience is high. For example, in Column (1), the difference between the probabilities to

⁹We also use the time period between the sales and repurchase decisions as a memory salience measure because of the decay theory in psychology (e.g., Berman et al. (2009)), i.e., the memory fades over time. Results (unreported) show that repurchasing bias decreases in the one year after the sale of a stock.

¹⁰As all of our proxies for memory salience are continuous variables, we sort them into quintiles.

repurchase previous winners and losers decreases by 0.2% to 0.5% when the number of other stocks sold goes up from the lowest quintile to the higher quintiles. In economic terms, the decrease accounts for around 20% to 40% of the baseline repurchasing bias.

6 The impact of repurchasing bias on mutual fund performance

We now examine whether fund managers' repurchasing bias as documented in the previous section has an impact on mutual fund performance. Retail investors' repurchasing bias may still maximize their utility function if they obtain positive emotions from repurchasing stocks they have sold for a gain. Thus, even if retail investors' repurchasing bias resulted in underperformance of their portfolios, the extra utility obtained from repurchasing a past winner stock may outweigh the financial loss. In contrast, mutual fund managers are clearly supposed to maximize their investors' financial outcome, i.e., fund performance. Any utility they obtain from repurchasing past winner stocks should not lead to increased trading in these stocks, unless these stocks outperform others and thus contribute to a higher fund performance.

To investigate whether fund managers' repurchasing bias affects mutual fund performance, we compute a fund's monthly net return, and its CAPM, Fama-French three-factor, and Carhart four-factor alphas as measures of fund performance.¹¹ We then sort funds into quintiles according to the extent to which they are subject to repurchasing bias. Repurchasing bias is determined by the ratio of PWR and PLR, as shown in Equations 1 and 2¹². Specifically, we rank funds into quintiles based on their PWR/PLR ratio in the previous quarter or in the current quarter, respectively. Funds with the highest PWR/PLR are included in the top quintiles and funds with the lowest PWR/PLR are in the bottom quintile.

¹¹The risk factors to compute monthly alphas are obtained from Kenneth French's website: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

¹²We report the results in this section by defining winner stocks based on the WinnerFIFO measure. Results are similar if we use WinnerAVG.

Portfolios are formed for each quintile and are held for three months on a quarterly rolling basis. We then compute the equal-weighted performance of the portfolios for each quintile. As shown in Table 10, the difference of returns and alphas between the top quintile and bottom quintile is negative in most cases and is statistically significant in some cases when we measure the bias level in the same quarter as the return difference. Thus, we find some, albeit weak, evidence that mutual funds that are more likely to repurchase winners perform worse than mutual funds that are not subject to a repurchasing bias.

In the next step, we switch to the stock level to examine whether repurchased winner stocks underperform repurchased loser stocks. If this is the case, we can conclude that mutual fund managers do not repurchase stocks they sold for a gain because they possess superior information about these stocks and know that they will outperform again in the future. However, they may still repurchase these stocks because of the positive emotional experiences they made when selling them for a gain. As a result, they may even ignore negative information about this stock, which they would otherwise consider when acting purely rationally.

To analyze whether stocks sold for a gain underperform stocks sold for a loss after the repurchase, we assign repurchased stocks in each mutual fund portfolio (based on the holdings report at the previous quarter end) to one of two portfolios: repurchased winners and repurchased losers. Repurchased winners (losers) refer to the stocks that were repurchased within one year after the sale with a gain (loss). We compute monthly returns on the repurchased winners and repurchased losers until the quarter end if the stocks are still held in the fund portfolio during this quarter. Portfolios are re-balanced every quarter. Within a given fund portfolio, stocks are value-weighted by the fund's dollar holdings. Finally, we compute average portfolio values for all funds across time.

Results are presented in Table 11. We find that repurchased winner stocks significantly underperform repurchased loser stocks in the quarter after they are repurchased. Specifically, annualized returns of repurchased winner stocks are 5.35% lower than repurchased

loser stocks and the difference is statistically significant. CAPM, Fama-French three-factor, and Carhart four-factor alphas are also lower for the repurchased winner portfolio. The difference is particularly pronounced for the Carhart four-factor alpha, which accounts for the momentum effect. The Carhart four-factor alpha of the repurchased winner portfolio is more than 4% lower than that of the repurchased loser portfolio.

Finally, we examine how returns of repurchased winners and losers would have developed if a mutual fund did not sell and repurchase a particular stock but held them in its portfolio for a longer period of time. If mutual funds are able to avoid a drop in the stock price by selling the stock and repurchasing it again later, we can regard the avoidance as timing ability of fund managers. However, if the stock price increases after the sale and mutual funds repurchase the stock at a higher price, it is surprising why a fund sells and repurchases the stock instead of just keeping it in its portfolio.

We focus on the stock returns that mutual funds have foregone between the sale and the repurchase of a stock. Specifically, we construct a portfolio with repurchased stocks in each mutual fund in the months between the sale and the repurchase of the stock. We compute monthly returns on the repurchased stocks in the fund portfolio, weighted by the fund's dollar holdings. We then compute the average portfolio return across all funds. Results are presented in Panel A of Table 12.

Both, raw returns and alphas of the portfolio comprising repurchased stocks are positive and most of them are statistically significant, except for the Fama French three-factor alpha. The raw annual return amounts to 17.81% and the risk-adjusted alphas are about 3% p.a. This finding suggests that repurchased stocks outperform after they have been sold. Thus, a mutual fund would have benefited from keeping these stocks in its portfolio.

In the next step, we use the same portfolio construction method and form portfolios for repurchased winners and repurchased losers separately. We then test the long-short returns of these two portfolios against a zero return. As shown in Panels B and C of Table 12, the difference in returns of repurchased winner portfolio and repurchased loser portfolio

is as high as 10% p.a. and is statistically significant at the 5% or 10% level. This means that mutual funds forego higher returns when they sell and repurchase previous winners. Furthermore, we observe negative risk-adjusted returns in repurchased losers but only one of them is statistically significant.

Note, that the potential losses presented here can be reconciled with the harm of the disposition effect and reflect that mutual funds may miss some opportunities to gain by selling winners too early. We conclude that the repurchasing bias towards stocks sold for a gain cannot be information driven, since mutual funds would have been better off if they just kept these stocks in their portfolios.

7 Conclusion

This paper provides the first evidence that mutual funds are biased towards repurchasing stocks that they previously sold for a gain rather than for a loss. We conjecture that this behavior is driven by a preference to re-experience the positive emotions evoked when they sold the stock for a gain. In contrast, mutual fund managers try to avoid re-experiencing negative emotions such as regret or disappointment that were triggered when a stock was sold for a loss before. In line with this view, we find that repurchasing bias at a given fund is strongly reduced after a complete replacement of the fund management. Furthermore, even after a fund manager leaves the fund where she sold a particular stock for a gain, she is still more likely to repurchase this stock when managing any new fund.

We do not find support for the view that mutual funds are biased towards repurchasing past winner stocks because of superior information, betting on momentum, or because past winner stocks generally outperform past loser stocks. In contrast, repurchased winners underperform repurchased losers by around 5% p.a. after the repurchase.

Our results are important for investors delegating portfolio management to actively managed funds, by highlighting that mutual fund managers are subject to behavioral biases, too.

Investors may be better off investing in a passively managed fund that, by definition, does not engage in this type of trading behavior.

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Figure 1: Average returns of stocks sold that are (not) repurchased

This figure plots average returns of stocks that are sold and repurchased and of stocks that are sold, but not repurchased. A stock is defined as repurchased if it has been sold completely and then is repurchased by the same fund within one year. Returns are computed by either the first-in-first-out principle, or by using the value-weighted average of all purchase prices of a stock.

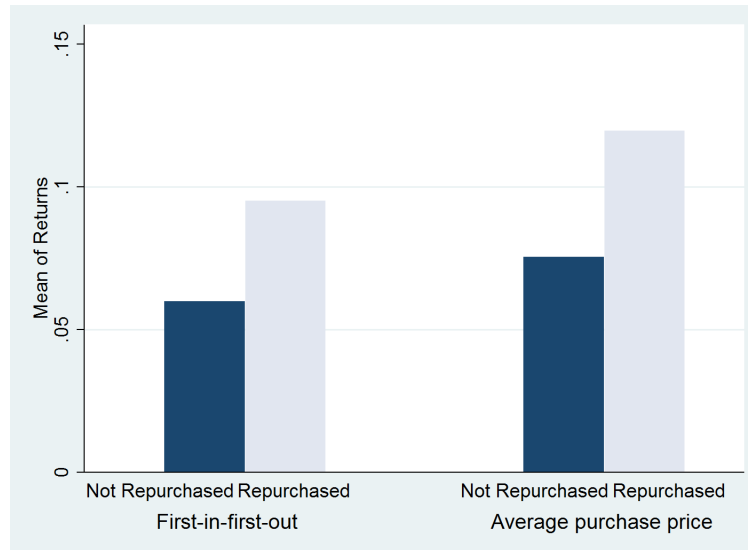


Figure 2: Repurchasing probability conditional on past stock returns

This figure plots the probability to repurchase a stock for different intervals of past stock returns. The probability to repurchase a stock is estimated from a linear probability model with stock, fund, and time fixed effects. The red vertical line indicates the probability to repurchase a stock when a stock was previously sold at a zero return. Blue vertical lines indicate 95% confidence intervals. Standard errors are clustered by fund.



Table 1: Summary statistics and mean comparisons

Panel A of this table shows descriptive statistics of all variables in our sample of stocks sold completely at least once by a U.S actively managed equity fund. The sample runs from January 1980 to December 2014. The number of observations (Obs), means, medians, and standard deviations (Std. Dev.) are reported in columns (1) to (4). A detailed description of all variables is provided in Appendix A. Panel B shows the average winner dummies as well as average characteristics of funds who sold and repurchased a stock (column (1)), or sold but not repurchased a stock (column (2)). Panel C shows the average repurchase dummy as well as average fund characteristics for previous winner stocks and previous loser stocks, defined by the WinnerFIFO measure. Differences between groups are reported in column (3). Significance based on a two-sided t -test is reported in column (4). Standard errors are clustered by fund and time.

| Panel A: Descriptive Statistics | | | | |
|---|--------------------|------------------------|---------------|--------------------|
| | Obs (1) | Mean (2) | Median (3) | Std. Dev. (4) |
| Variables on the stock-fund-quarter level | | | | |
| Repurchase | 7,521,881 | 0.052 | 0 | 0.222 |
| Winner (first-in-first-out) | 6,845,158 | 0.501 | 1 | 0.500 |
| Winner (average purchase price) | 6,849,812 | 0.507 | 1 | 0.500 |
| Price up | 5,703,662 | 0.565 | 1 | 0.496 |
| Team managed | 6,131,280 | 0.608 | 1 | 0.488 |
| Manager change | 7,521,881 | 0.023 | 0 | 0.148 |
| Variables on the fund-quarter level | | | | |
| Fund size | 148,386 | 5.508 | 5.428 | 1.729 |
| Fund age | 156,763 | 13.905 | 9.833 | 13.310 |
| Fund turnover Ratio | 139,753 | 0.899 | 0.660 | 0.892 |
| Fund expense ratio | 143,936 | 0.013 | 0.012 | 0.004 |
| Fund return volatility | 145,580 | 0.169 | 0.152 | 0.087 |
| Fund performance rank | 156,879 | 0.516 | 0.519 | 0.282 |
| Panel B: Mean comparison of stocks that are (not) repurchased | | | | |
| | Repurchased (1) | Not Repurchased (2) | Diff (3) | t-statistic (4) |
| Winner (first-in-first-out) | 0.557 | 0.498 | 0.059 | 7.08 |
| Winner (average purchase price) | 0.553 | 0.500 | 0.053 | 7.74 |
| Price up | 0.626 | 0.561 | 0.064 | 9.37 |
| Team managed | 0.639 | 0.606 | 0.033 | 3.05 |
| Manager change | 0.020 | 0.023 | -0.003 | -2.26 |
| Fund size | 5.874 | 5.697 | 0.177 | 5.82 |
| Fund age | 13.781 | 13.664 | 0.116 | 0.51 |
| Fund turnover ratio | 1.408 | 1.236 | 0.172 | 3.49 |
| Fund expense ratio | 0.012 | 0.013 | -0.001 | -2.88 |
| Fund return volatility | 0.168 | 0.175 | -0.007 | -2.50 |
| Fund performance rank | 0.503 | 0.514 | -0.010 | -3.17 |

Panel C: Mean comparison of stocks sold for a gain (loss)

| | Previous Winner (1) | Previous Loser (2) | Diff (3) | t-statistic (4) |
|------------------------|------------------------|-----------------------|-------------|--------------------|
| Repurchase | 0.058 | 0.047 | 0.012 | 6.59 |
| Price up | 0.574 | 0.557 | 0.017 | 1.02 |
| Team managed | 0.614 | 0.610 | 0.004 | 0.57 |
| Manager change | 0.022 | 0.023 | -0.001 | -0.78 |
| Fund size | 5.821 | 5.692 | 0.129 | 5.91 |
| Fund age | 14.351 | 13.732 | 0.620 | 4.47 |
| Fund turnover Ratio | 1.213 | 1.266 | -0.051 | -3.93 |
| Fund expense ratio | 0.012 | 0.013 | -0.001 | -3.16 |
| Fund return volatility | 0.156 | 0.189 | -0.033 | -7.30 |
| Fund performance rank | 0.526 | 0.500 | 0.026 | 4.97 |

Table 2: Preferences for repurchasing stocks previously sold for a gain versus a loss

This table presents the difference between the Proportion of Winners Repurchased (PWR) and the Proportion of Losers Repurchased (PLR) aggregated over the sample period. PWR (PLR) is the ratio between NWR (NLR) and ORW (OLR). NWR (NLR) and ORW (OLR) reflect the number of winners (losers) repurchased, and the number of opportunities to repurchase winners (losers). All variables are defined in detail in Appendix A. In column (1), winner stocks are defined based on the WinnerFIFO measure. In column (2), winner stocks are defined based on the value-weighted average of all purchase prices before the sale. We assume that realized repurchases are independent observations when computing standard errors.

| | First-in-first-out (1) | Average purchase price (2) |
|---|---------------------------|-------------------------------|
| No. of winners repurchased (NWR) | 201,680 | 204,917 |
| Opportunities to repurchase winners (ORW) | 3,430,223 | 3,470,308 |
| Proportion of winners repurchased (PWR) | 0.059 | 0.059 |
| No. of losers repurchased (NLR) | 160,508 | 157,445 |
| Opportunities to repurchase losers (ORL) | 3,414,935 | 3,379,504 |
| Proportion of losers repurchased (PLR) | 0.047 | 0.047 |
| Diff (PWR-PLR) | 0.012 | 0.012 |
| t-stats (PWR=PLR) | 15.75 | 16.61 |

Table 3: Repurchasing bias in a multivariate regression framework

This table contains results of linear probability models. The dependent variable is Repurchase, a dummy variable equal to one if a stock is repurchased by the same fund within one year after it was sold, and zero otherwise. The main independent variable, Winner, is equal to one if a stock was sold for a gain, and zero otherwise. The winner dummy is based on the difference between selling price and average purchase price. The average purchase price is calculated either following first-in-first-out principle or by taking the value-weighted average of all purchase prices before the sale. Control variables include fund characteristics (Fund size, Fund age, Fund turnover ratio, Fund expense ratio, Fund return volatility, Fund performance rank), which are all defined in detail in Appendix A. Columns (1), (2), (4) and (5) include stock, fund, and time fixed effects. Columns (3) and (6) include stock and fund×time fixed effects. *t*-statistics are provided in parentheses. Standard errors are clustered by fund. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

| | First-in-first-out | | | Average purchase price | | |
|-------------------------|---------------------|----------------------|---------------------|------------------------|----------------------|---------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Winner | 0.009*** (24.13) | 0.009*** (22.77) | 0.009*** (29.36) | 0.009*** (25.22) | 0.010*** (23.77) | 0.009*** (30.32) |
| Fund size | | 0.003*** (3.22) | | | 0.003*** (3.20) | |
| Fund age | | 0.000 (0.16) | | | 0.000 (0.15) | |
| Fund turnover ratio | | 0.005*** (7.19) | | | 0.005*** (7.21) | |
| Fund expense ratio | | -0.175 (-0.50) | | | -0.176 (-0.51) | |
| Fund return volatility | | -0.008 (-0.70) | | | -0.008 (-0.69) | |
| Fund performance rank | | -0.005*** (-2.93) | | | -0.005*** (-2.92) | |
| Stock fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Fund fixed effects | Yes | Yes | No | Yes | Yes | No |
| Time fixed effects | Yes | Yes | No | Yes | Yes | No |
| Fund×Time fixed effects | No | No | Yes | No | No | Yes |
| Observations | 6,844,959 | 5,592,522 | 6,837,715 | 6,849,613 | 5,596,088 | 6,842,386 |
| Adjusted R^2 | 0.039 | 0.040 | 0.115 | 0.039 | 0.040 | 0.115 |

Table 4: Repurchasing bias controlling for time-varying stock and fund characteristics

This table contains results of a linear probability model with stock×time fixed effects. The dependent variable is Repurchase, a dummy variable equal to one if a stock is repurchased by the same fund within one year after it was sold, and zero otherwise. The main independent variable, Winner, is equal to one if a stock was sold for a gain, and zero otherwise. The winner dummy is based on the difference between selling price and average purchase price. The average purchase price is calculated either following first-in-first-out principle or by taking the value-weighted average of all purchase prices before the sale. Control variables include fund characteristics (Fund size, Fund age, Fund turnover ratio, Fund expense ratio, Fund return volatility, Fund performance rank), which are all defined in detail in Appendix A. In columns (1), (2), (4) and (5), Fund and stock×time fixed effects are included. Columns (3) and (6) include fund×time and stock ×time fixed effects. *t*-statistics are provided in parentheses. Standard errors are clustered by fund. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

| | First-in-first-out | | | Average purchase price | | |
|--------------------------|--------------------|----------------------|--------------------|------------------------|----------------------|--------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Winner | 0.001*** (2.67) | 0.001*** (2.95) | 0.001*** (5.16) | 0.001*** (3.85) | 0.001*** (4.10) | 0.002*** (6.18) |
| Fund size | | 0.003*** (2.97) | | | 0.003*** (2.96) | |
| Fund age | | 0.000 (0.08) | | | 0.000 (0.07) | |
| Fund turnover ratio | | 0.005*** (6.53) | | | 0.005*** (6.56) | |
| Fund expense ratio | | -0.252 (-0.74) | | | -0.255 (-0.75) | |
| Fund return volatility | | -0.012 (-0.98) | | | -0.012 (-0.97) | |
| Fund performance rank | | -0.004*** (-2.65) | | | -0.004*** (-2.65) | |
| Fund fixed effects | Yes | Yes | No | Yes | Yes | No |
| Stock×Time fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Fund×Time fixed effects | No | No | Yes | No | No | Yes |
| Observations | 6,773,424 | 5,540,218 | 6,765,602 | 6,777,986 | 5,543,716 | 6,770,188 |
| Adjusted R^2 | 0.058 | 0.060 | 0.134 | 0.058 | 0.060 | 0.134 |

Table 5: Preferences for repurchasing stocks conditional on their subsequent price changes

This table contains results of linear probability models including interaction terms of our winner dummies with a dummy reflecting whether a stock's price increased after it was sold by a fund. The dependent variable is Repurchase, a dummy variable equal to one if a stock is repurchased by the same fund within one year after it was sold, and zero otherwise. Price up is equal to one if the price of a stock has increased since it was sold, and zero otherwise. Winner is equal to one if a stock was sold for a gain, and zero otherwise. The winner dummy is based on the difference between selling price and average purchase price. The average purchase price is calculated either following first-in-first-out principle or by taking the value-weighted average of all purchase prices before the sale. Control variables include fund characteristics (Fund size, Fund age, Fund turnover ratio, Fund expense ratio, Fund return volatility, Fund performance rank), which are all defined in detail in Appendix A. Columns (1), (2), (4) and (5) include stock, fund, and time fixed effects. Columns (3) and (6) include stock and fund×time fixed effects. *t*-statistics are provided in parentheses. Standard errors are clustered by fund. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

| | First-in-first-out | | | Average purchase price | | |
|--------------------------------|-----------------------|-----------------------|-----------------------|------------------------|-----------------------|-----------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Winner× Price up | -0.012*** (-20.74) | -0.012*** (-19.65) | -0.012*** (-23.17) | -0.011*** (-19.32) | -0.011*** (-18.41) | -0.012*** (-21.77) |
| Winner | 0.016*** (34.31) | 0.017*** (33.05) | 0.017*** (40.97) | 0.016*** (34.41) | 0.017*** (33.29) | 0.017*** (40.68) |
| Price up | 0.020*** (32.79) | 0.021*** (32.01) | 0.021*** (34.60) | 0.020*** (33.16) | 0.021*** (32.37) | 0.021*** (35.09) |
| Fund size | | 0.003*** (2.72) | | | 0.003*** (2.71) | |
| Fund age | | 0.000 (0.28) | | | 0.000 (0.27) | |
| Fund turnover ratio | | 0.005*** (6.82) | | | 0.006*** (6.84) | |
| Fund expense ratio | | -0.346 (-0.95) | | | -0.344 (-0.94) | |
| Fund return volatility | | -0.009 (-0.67) | | | -0.009 (-0.67) | |
| Fund performance rank | | -0.005*** (-3.10) | | | -0.005*** (-3.09) | |
| Stock fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Fund fixed effects | Yes | Yes | No | Yes | Yes | No |
| Time fixed effects | Yes | Yes | No | Yes | Yes | No |
| Fund×Time fixed effects | No | No | Yes | No | No | Yes |
| Observations | 5,303,062 | 4,571,412 | 5,295,512 | 5,305,972 | 4,573,986 | 5,298,445 |
| Adjusted <i>R</i> ² | 0.042 | 0.044 | 0.121 | 0.042 | 0.044 | 0.121 |

Table 6: Preferences for repurchasing stocks in team- versus single- managed funds

This table contains results of linear probability models including interaction terms of our winner dummies with a dummy reflecting whether a fund is team-managed. The dependent variable is Repurchase, a dummy variable equal to one if a stock is repurchased by the same fund within one year after it was sold, and zero otherwise. Team managed is a dummy variable equal to one if the fund is managed by a team in a given quarter, and zero otherwise. Winner is equal to one if a stock was sold for a gain, and zero otherwise. The winner dummy is based on the difference between selling price and average purchase price. The average purchase price is calculated either following first-in-first-out principle or by taking the value-weighted average of all purchase prices before the sale. Control variables include fund characteristics (Fund size, Fund age, Fund turnover ratio, Fund expense ratio, Fund return volatility, Fund performance rank), which are all defined in detail in Appendix A. All regressions include stock, fund, and time fixed effects. *t*-statistics are provided in parentheses. Standard errors are clustered by fund. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

| | First-in-first-out | | Average purchase price | |
|------------------------|---------------------|----------------------|------------------------|----------------------|
| | (1) | (2) | (3) | (4) |
| Winner × Team managed | 0.002** (2.07) | 0.002** (2.01) | 0.002* (1.92) | 0.002* (1.86) |
| Winner | 0.008*** (11.63) | 0.008*** (11.10) | 0.008*** (12.01) | 0.008*** (11.48) |
| Team managed | -0.001 (-0.56) | -0.001 (-0.37) | -0.001 (-0.51) | -0.000 (-0.32) |
| Fund size | | 0.003*** (2.96) | | 0.003*** (2.95) |
| Fund age | | 0.000 (0.79) | | 0.000 (0.78) |
| Fund turnover ratio | | 0.005*** (6.84) | | 0.005*** (6.86) |
| Fund expense ratio | | -0.228 (-0.61) | | -0.230 (-0.62) |
| Fund return volatility | | -0.006 (-0.51) | | -0.006 (-0.51) |
| Fund performance rank | | -0.005*** (-3.02) | | -0.005*** (-3.01) |
| Stock fixed effects | Yes | Yes | Yes | Yes |
| Fund fixed effects | Yes | Yes | Yes | Yes |
| Time fixed effects | Yes | Yes | Yes | Yes |
| Observations | 5,608,530 | 5,287,957 | 5,612,030 | 5,291,120 |
| Adjusted R^2 | 0.040 | 0.041 | 0.040 | 0.041 |

Table 7: Repurchasing bias after a manager change

This table contains results of linear probability models including interaction terms of our winner dummies and a dummy variable reflecting manager changes. The dependent variable is Repurchase, a dummy variable equal to one if a stock is repurchased by the same fund within one year after it was sold, and zero otherwise. Manager change is a dummy variable equal to one if a complete manager change took place at a fund after a stock was sold, but before the repurchasing decision is made, and zero otherwise. A complete manager change is defined for the time period starting when the first new manager arrives and ending when the last incumbent manager leaves (Jin and Scherbina (2010)). Winner is equal to one if a stock was sold for a gain, and zero otherwise. The winner dummy is based on the difference between selling price and average purchase price. The average purchase price is calculated either following first-in-first-out principle or by taking the value-weighted average of all purchase prices before the sale. Control variables include fund characteristics (Fund size, Fund age, Fund turnover ratio, Fund expense ratio, Fund return volatility, Fund performance rank), which are all defined in detail in Appendix A. Columns (1), (2), (4) and (5) include stock, fund, and time fixed effects. Columns (3) and (6) include stock and fund×time fixed effects. *t*-statistics are provided in parentheses. Standard errors are clustered by fund. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

| | First-in-first-out | | | Average purchase price | | |
|--------------------------------|---------------------|----------------------|---------------------|------------------------|----------------------|---------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Winner × Manager change | -0.004** (-2.34) | -0.004** (-2.12) | -0.002* (-1.71) | -0.004** (-2.12) | -0.004* (-1.90) | -0.002 (-1.45) |
| Winner | 0.009*** (24.01) | 0.009*** (22.61) | 0.009*** (29.07) | 0.009*** (25.04) | 0.010*** (23.55) | 0.009*** (30.00) |
| Manager change | -0.001 (-0.83) | -0.000 (-0.21) | -0.001 (-0.67) | -0.002 (-0.97) | -0.001 (-0.34) | -0.001 (-0.80) |
| Fund size | | 0.003*** (3.22) | | | 0.003*** (3.20) | |
| Fund age | | 0.000 (0.17) | | | 0.000 (0.17) | |
| Fund turnover ratio | | 0.005*** (7.21) | | | 0.005*** (7.23) | |
| Fund expense ratio | | -0.174 (-0.50) | | | -0.176 (-0.50) | |
| Fund return volatility | | -0.008 (-0.70) | | | -0.008 (-0.69) | |
| Fund performance rank | | -0.005*** (-2.93) | | | -0.005*** (-2.92) | |
| Stock fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Fund fixed effects | Yes | Yes | No | Yes | Yes | No |
| Time fixed effects | Yes | Yes | No | Yes | Yes | No |
| Fund×Time fixed effects | No | No | Yes | No | No | Yes |
| Observations | 6,844,959 | 5,592,522 | 6,837,715 | 6,849,613 | 5,596,088 | 6,842,386 |
| Adjusted <i>R</i> ² | 0.039 | 0.040 | 0.115 | 0.039 | 0.040 | 0.115 |

Table 8: Repurchasing bias after a manager leaves a single-managed fund

This table contains regression results of linear probability models on the fund manager level. The sample is restricted to single-managed funds and cases where fund managers switch to another fund after selling a stock, but before making a repurchase decision. The dependent variable is Repurchase, a dummy variable equal to one if a stock is repurchased by the fund manager in a new fund within one year after it was sold at the previous fund the manager was in charge of, and zero otherwise. Winner is equal to one if a stock was sold for a gain, and zero otherwise. The winner dummy is based on the difference between selling price and average purchase price. The average purchase price is calculated either following first-in-first-out principle or by taking the value-weighted average of all purchase prices before the sale. In Panel A, winner stocks are defined based on the average return of a stock across all funds through which a manager previously sold the stock. Panel B includes only cases where a fund manager was in charge of just one single-managed fund when they sold the stock. Columns (1) and (3) include manager and time fixed effects, and columns (2) and (4) include manager×time fixed effects. *t*-statistics are provided in parentheses. Standard errors are clustered by fund. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

| | First-in-first-out | | Average purchase price | |
|---|--------------------|--------------------|------------------------|--------------------|
| | (1) | (2) | (3) | (4) |
| Panel A: Single-managed funds | | | | |
| Winner | 0.003*** (3.95) | 0.002*** (4.06) | 0.003*** (4.03) | 0.003*** (4.12) |
| Observations | 105,289 | 105,119 | 105,367 | 105,195 |
| Adjusted R^2 | 0.093 | 0.196 | 0.093 | 0.196 |
| Panel B: Single-managed funds and only managers in charge of one fund | | | | |
| Winner | 0.003*** (3.92) | 0.002*** (3.89) | 0.003*** (3.84) | 0.003*** (3.79) |
| Observations | 94,855 | 94,656 | 94,931 | 94,730 |
| Adjusted R^2 | 0.109 | 0.211 | 0.109 | 0.211 |
| Manager fixed effects | Yes | No | Yes | No |
| Time fixed effects | Yes | No | Yes | No |
| Manager×Time fixed effects | No | Yes | No | Yes |

Table 9: Memory salience and repurchasing bias

This table contains results of linear probability models with interaction terms of our winner dummies and quintiles of memory salience measures. The dependent variable is Repurchase, a dummy variable equal to one if a stock is repurchased by the same fund within one year after it was sold, and zero otherwise. Winner is equal to one if a stock was sold for a gain, and zero otherwise. The winner dummy is based on the difference between selling price and average purchase price. The average purchase price is calculated either following first-in-first-out principle or by taking the value-weighted average of all purchase prices before the sale. Memory salience is measured by the number of other stocks sold at the same time as a given stock (columns (1) and (4)), the holding period (in quarters) of a stock before it is sold (columns (2) and (5)), and the fund's turnover ratio (columns (3) and (6)). All measures are defined in detail in Appendix A. Stock, fund, and time fixed effects are included in all models. *t*-statistics are provided in parentheses. Standard errors are clustered by fund. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

| | First-in-first-out | | | Average purchase price | | |
|---------------------|------------------------------------|-----------------------|-----------------------|------------------------------------|-----------------------|-----------------------|
| | Number of other stocks sold (1) | Holding period (2) | Turnover ratio (3) | Number of other stocks sold (4) | Holding period (5) | Turnover ratio (6) |
| Winner × Quintile 2 | -0.004*** (-3.95) | -0.002*** (-3.18) | -0.003** (-2.03) | -0.005*** (-4.07) | -0.002*** (-3.20) | -0.004** (-2.14) |
| Winner × Quintile 3 | -0.004*** (-3.11) | -0.002*** (-3.14) | -0.002 (-1.48) | -0.004*** (-3.06) | -0.002*** (-3.20) | -0.003 (-1.52) |
| Winner × Quintile 4 | -0.005*** (-3.99) | -0.002** (-2.55) | -0.003* (-1.95) | -0.005*** (-3.72) | -0.002** (-2.37) | -0.004** (-2.05) |
| Winner × Quintile 5 | -0.002* (-1.70) | -0.002*** (-2.62) | -0.001 (-0.83) | -0.002 (-1.24) | -0.001 (-1.42) | -0.001 (-0.85) |
| Winner | 0.012*** (12.98) | 0.011*** (17.44) | 0.011*** (8.45) | 0.012*** (12.06) | 0.011*** (17.49) | 0.011*** (8.19) |
| Quintile 2 | -0.002 (-1.16) | -0.003*** (-5.74) | 0.005*** (3.92) | -0.002 (-1.00) | -0.003*** (-5.73) | 0.006*** (3.99) |
| Quintile 3 | -0.002 (-1.41) | -0.003*** (-4.85) | 0.006*** (3.88) | -0.002 (-1.33) | -0.003*** (-4.81) | 0.006*** (3.88) |
| Quintile 4 | -0.004* (-1.93) | -0.001 (-1.19) | 0.011*** (6.19) | -0.004* (-1.91) | -0.001 (-1.36) | 0.011*** (6.19) |
| Quintile 5 | -0.005** (-2.13) | -0.001 (-1.01) | 0.014*** (8.05) | -0.005** (-2.22) | -0.002** (-2.06) | 0.014*** (7.95) |
| Stock fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Fund fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Time fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 6,844,959 | 6,844,959 | 5,848,361 | 6,849,613 | 6,849,613 | 5,852,500 |
| Adjusted R^2 | 0.039 | 0.039 | 0.040 | 0.039 | 0.039 | 0.040 |

Table 10: Portfolios sorts based on PWR/PLR

This table presents raw returns and risk-adjusted returns of quintile portfolios based on a fund's PWR/PLR ranking. PWR (PLR) is the proportion of winners (losers) repurchased, calculated by scaling the number of winners (losers) repurchased with the opportunities to repurchase winners (losers). At the beginning of each quarter, we sort funds into quintiles based on their PWR/PLR ratio in the previous quarter (Panel A), or in the current quarter (Panel B). Funds with the highest PWR/PLR are included in the top quintile and funds with the lowest PWR/PLR are included in the bottom quintile, respectively. Winner stocks are defined based on the WinnerFIFO measure. Portfolios are held for three months on a rolling basis. Column (1) reports the number of observations in each portfolio. In column (2), Monthly return reflects equal-weighted fund returns for each portfolio. In columns (3) to (5), CAPM α , FF3 α and Carhart α refer to CAPM, Fama-French three-factor (Fama and French (1993)) and Carhart four-factor (Carhart (1997)) alphas for each portfolio. Returns are expressed in annual percentages.

| Panel A: Sorting based on PWR/PLR of the previous quarter | | | | | |
|---|-------------|-----------------------|----------------------|---------------------|-------------------------|
| Quintile | Obs. (1) | Monthly return (2) | CAPM α (3) | FF3 α (4) | Carhart α (5) |
| 1 (bottom) | 319 | 10.99% | -0.84% | -1.18% | -1.18% |
| 2 | 261 | 10.03% | 0.08% | -0.09% | -0.16% |
| 3 | 302 | 11.21% | 0.02% | -0.37% | -0.52% |
| 4 | 312 | 11.31% | -0.65% | -0.81% | -1.03% |
| 5 (top) | 329 | 10.03% | -1.20% | -1.10% | -1.15% |
| Diff (top-bottom) | 319 | -0.16% | -0.44% | 0.00% | -0.05% |
| <i>t</i> -statistics | | -0.33 | -0.91 | -0.01 | -0.10 |
| Panel B: Sorting based on PWR/PLR of the current quarter | | | | | |
| Quintile | Obs. (1) | Monthly return (2) | CAPM α (3) | FF3 α (4) | Carhart α (5) |
| 1 (bottom) | 319 | 11.12% | -0.45% | -0.71% | -0.64% |
| 2 | 265 | 7.82% | -0.42% | -0.98% | -1.36% |
| 3 | 306 | 11.28% | -0.74% | -0.99% | -1.19% |
| 4 | 313 | 10.35% | -1.59% | -1.80% | -2.12% |
| 5 (top) | 331 | 9.89% | -1.56% | -1.31% | -1.55% |
| Diff (top-bottom) | 319 | -0.65% | -1.05% | -0.65% | -0.96% |
| <i>t</i> -statistics | | -1.25 | -2.07 | -1.33 | -2.01 |

Table 11: Returns of repurchased winner and loser stocks

This table contains calendar time portfolio returns and risk-adjusted returns of repurchased winner and loser stocks. At the beginning of each quarter, we assign repurchased stocks in each mutual fund portfolio (based on the report at the previous quarter end) to one of two portfolios: repurchased winners (column (1)) and repurchased losers (column (2)). Repurchased winners (losers) are stocks that are repurchased within one year after the sale with a gain (loss). Winner stocks are defined based on the WinnerFIFO measure. We compute monthly returns on the repurchased winners and repurchased losers until the quarter end, if a stock is still in the fund's portfolio. Portfolios are re-balanced every quarter and within a given fund portfolio, stocks are weighted by the fund's dollar holdings. Finally, we compute time portfolios by taking the equal-weighted average across funds. In column (3), "Diff" represents a portfolio long in repurchased winners and short in repurchased losers. Returns are expressed in annual percentages.

| | Repurchased winners (1) | Repurchased losers (2) | Diff (3) | t-statistic (4) |
|-------------------|----------------------------|---------------------------|-------------|--------------------|
| Return | 13.98% | 19.34% | -5.35% | -2.00 |
| CAPM α | 2.48% | 7.52% | -5.04% | -1.88 |
| FF3 α | 2.15% | 5.48% | -3.32% | -1.27 |
| Carhart4 α | 2.57% | 7.38% | -4.81% | -1.85 |

Table 12: Stock returns between sale and repurchase

This table contains calendar time portfolio returns and risk-adjusted returns of stocks after they have been sold and before they are repurchased. In Panel A, we form a portfolio with repurchased stocks in each mutual fund portfolio in the months between the previous sale and the repurchase of the stock. We compute monthly returns on the repurchased stocks in the fund portfolio, weighted by the fund's dollar holdings. Then, we compute time portfolios by taking the equal-weighted average across funds and tests the returns of the portfolio on repurchased stocks in the months between the sale and the repurchase against zero. In Panels B and C, we assign the repurchased stocks to one of two portfolios: repurchased winners and repurchased losers. Repurchased winners (losers) refer to the stocks that were previously sold for a gain (loss) and were repurchased by the fund within one year. Winner stocks are defined based on the WinnerFIFO measure. We compute time portfolios in the same way as in Panel A. In column (3), "Diff" represents a portfolio long in repurchased winners and short in repurchased losers. Returns are expressed in annual percentages.

| Panel A: Portfolio of repurchased stocks between the sale and the repurchase | | | | |
|--|----------------------------|---------------------------|---------------------|--------------------------|
| | Return (1) | CAPM α (2) | FF3 α (3) | Carhart4 α (4) |
| Portfolio return | 17.61% | 3.00% | 2.20% | 3.94% |
| t-statistic | 4.85 | 2.02 | 1.52 | 2.83 |
| Panel B: Portfolio returns between the sale and the repurchase | | | | |
| | Repurchased winners (1) | Repurchased losers (2) | Diff (3) | t-statistic (4) |
| Return | 21.68% | 11.58% | 10.10% | 2.03 |
| CAPM α | 8.85% | -2.41% | 11.26% | 2.30 |
| FF3 α | 8.59% | -3.98% | 12.56% | 2.27 |
| Carhart4 α | 8.39% | -0.42% | 8.81% | 2.31 |

Appendix

A Variable description

This table describes all variables used in our empirical analyses. Data sources are as follows:

1. TR Holdings: Thomson Reuters Mutual Funds Holdings Database
2. CRSP Stock: CRSP U.S. Stock Database
3. CRSP Fund: CRSP Survivorship-Bias-Free Mutual Fund Database
4. MS Fund: Morningstar Direct
5. FF: Data Library on Kenneth French's website
6. MC: Variable is manually constructed by the authors.

| Variable name | Description | Data Source |
|---------------------------------|--|-------------------------------|
| CAPM α | α from the regression of fund returns under CAPM. | CRSP Fund, CRSP stock, FF, MC |
| Carhart4 α | α from the regression of fund returns under Carhart four-factor model. | CRSP Fund, CRSP stock, FF, MC |
| Fund age $_{i,q}$ | Fund age in quarter q . | CRSP Fund |
| Fund expense ratio $_{i,q}$ | Annual expense ratio of a fund. | CRSP Fund |
| FF3 α | α from the regression of fund returns under Fama-French three-factor model. | CRSP Fund, CRSP stock, FF, MC |
| Fund performance rank $_{i,q}$ | Annual rank of a fund by ordering all funds with the same CRSP objective code. | CRSP Fund |
| Fund return volatility $_{i,q}$ | Annualized volatility of fund monthly net returns. | CRSP Fund |
| Fund size $_{i,q}$ | Logarithm of the total net assets of fund i of million dollars in quarter q . | CRSP Fund |
| Fund turnover ratio $_{i,q}$ | Fund turnover over a year. | CRSP Fund |
| Holding period $_{i,j,q}$ | The number of quarters for which fund i has held stock j before the stock is completely sold. | TR Holdings, MC |
| Manager Change $_{i,j,q}$ | Dummy variable equal to one if stock j was sold by fund i before a complete manager change and a repurchase decision is made after the complete manager change in fund i . A complete manager change begins when the first new manager arrives and ends when the last old manager leaves (Jin and Scherbina (2010)). | MS Fund, TR Holdings, MC |

| Variable name | Description | Data Source |
|--|--|-----------------------------|
| Number of other stocks sold $_{i,j,q}$ | The number of other stocks sold by fund i when stock j is completely sold. For example, assume a mutual fund sold all stocks of company A, 200 stocks of company B, and 300 stocks of company C in the same quarter. Then, the number of other stocks sold is 500, defined at the time when the decision on whether to repurchase stock A is made. | TR Holdings, MC |
| NWR (NLR) | No. of winners (losers) repurchased accumulated across the sample. | CRSP Stock, TR Holdings, MC |
| ORW (ORL) | No. of opportunities to repurchase winners (losers) accumulated across the sample. | CRSP Stock, TR Holdings, MC |
| Price up $_{i,j,q}$ | Dummy variable equal to one if the price of stock j has increased in quarter q compared to the price when it was completely sold by fund i . | CRSP Stock, TR Holdings, MC |
| PWR (PLR) | Proportion of winners (losers) repurchased accumulated across the sample. | CRSP Stock, TR Holdings, MC |
| Repurchase $_{i,j,q}$ | Dummy variable equal to one if stock j sold by fund i is repurchased in quarter q within one year after the sale. | TR Holdings, MC |
| Return | Annualized returns of a portfolio | CRSP Fund, CRSP stock |
| Team managed $_{i,q}$ | Dummy variable equal to one if fund i is managed by a team in quarter q | CRSP Fund, MC |
| Winner $_{i,j,q}$ | Dummy variable equal to one if the stock j was sold by fund i for a gain before quarter q . It compares the selling price of the stock and the average purchase price. The average purchase price is calculated either following first-in-first-out principal or taking value-weighted average of all purchase prices before the sale. | CRSP Stock, TR Holdings, MC |

B Top 20 funds repurchasing and Top 20 stocks repurchased

This table lists the Top 20 funds that repurchase most stocks (Panel A) and the top 20 stocks that are most frequently repurchased (Panel B). In Panel A, No. of Repurchases accumulates the number of times that a fund repurchases stocks within one year after the sale and No. of Sales accumulates the number of sales of a fund across the whole sample period from 1980 to 2014. Repurchase rate is equal to No. of Repurchases divided by No. of Sales. The funds with the bottom 10% No. of Sales (less than 7) are excluded to avoid an abnormally high Repurchase rate because of the extremely low number of observations in sales of the fund. Funds are sorted according to Repurchase rate. In Panel B, No. of Repurchases accumulates the number of times a stock is repurchased and No. of Sales accumulates the number of sales of a stock across the whole sample period from 1980 to 2014. Repurchase rate is equal to No. of Repurchases divided by No. of sales. Stocks are sorted according to No. of Repurchases.

Panel A: Top 20 funds repurchasing most

| Fund Name | No. of Repurchases | No. of Sales | Repurchase rate |
|---|--------------------|--------------|-----------------|
| VOYA PARTNERS, INC: VY OPPENHEIMER GLOBAL PORTFOLIO | 28 | 34 | 82% |
| EQ ADVISORS TRUST: EQ/INVESCO COMSTOCK PORTFOLIO | 53 | 88 | 60% |
| OLYMPIC TRUST-SMALL CAP FUND | 5 | 9 | 56% |
| INVESTMENT HOUSE FUNDS: INVESTMENT HOUSE GROWTH FUND | 34 | 65 | 52% |
| CREDIT SUISSE WARBURG PINCUS VALUE II FUND | 27 | 52 | 52% |
| ALLIANCEBERNSTEIN BLENDED STYLE SERIES, INC: ALLIANCEBERNSTEIN 2040 RETIREMENT STRATEGY | 900 | 1877 | 48% |
| AMG FUNDS I: AMG FRONTIER SMALL CAP GROWTH FUND | 73 | 153 | 48% |
| COLUMBIA FUNDS SERIES TRUST II: COLUMBIA GLOBAL EQUITY VALUE FUND | 58 | 123 | 47% |
| UNION INVESTORS VALUE MOMENTUM | 7 | 15 | 47% |
| ALLIANCEBERNSTEIN BLENDED STYLE SERIES, INC: ALLIANCEBERNSTEIN 2055 RETIREMENT STRATEGY | 241 | 530 | 45% |
| VOYA INVESTORS TRUST: VOYA MULTI-MANAGER LARGE CAP CORE PORTFOLIO | 66 | 148 | 45% |
| VOYA PARTNERS, INC: VY AMERICAN CENTURY SMALL-MID CAP VALUE PORTFOLIO | 217 | 494 | 44% |
| DAVIS SERIES, INC: DAVIS APPRECIATION & INCOME FUND | 23 | 54 | 43% |
| BLACKROCK FUNDS: BLACKROCK ENERGY & RESOURCES PORTFOLIO | 62 | 156 | 40% |
| VOYA EQUITY TRUST: VOYA LARGE CAP VALUE FUND | 44 | 114 | 39% |
| JACKSON NATIONAL CAP MGMT:GROWTH FUND | 153 | 397 | 39% |
| CREDIT SUISSE TRUST: US EQUITY FLEX II PORTFOLIO | 6 | 16 | 38% |
| MEMBERS MUTUAL FUNDS: SMALL CAP FUND | 43 | 115 | 37% |
| VOYA INVESTORS TRUST: VOYA LARGE CAP GROWTH PORTFOLIO | 40 | 107 | 37% |
| BLACKROCK FUNDS: GLOBAL RESOURCES PORTFOLIO | 86 | 231 | 37% |

Panel B: Top 20 stocks most frequently repurchased

| Company Name | No. of Repurchases | No. of Sales | Repurchase rate |
|----------------------------------|--------------------|--------------|-----------------|
| INTERNATIONAL BUSINESS MACHS COR | 1272 | 11940 | 11% |
| TEXAS INSTRUMENTS INC | 1241 | 11771 | 11% |
| INTEL CORP | 1238 | 10593 | 12% |
| HEWLETT PACKARD CO | 1228 | 12413 | 10% |
| MICROSOFT CORP | 1067 | 7730 | 14% |
| PFIZER INC | 1066 | 11425 | 9% |
| GENERAL ELECTRIC CO | 1065 | 9598 | 11% |
| JOHNSON & JOHNSON | 1052 | 10797 | 10% |
| MOTOROLA INC | 1042 | 12266 | 8% |
| E M C CORP MA | 1026 | 10503 | 10% |
| PROCTER & GAMBLE CO | 995 | 9183 | 11% |
| HALIBURTON COMPANY | 966 | 10312 | 9% |
| QUALCOMM INC | 936 | 7110 | 13% |
| AMGEN INC | 935 | 8770 | 11% |
| MORGAN STANLEY DEAN WITTER D & C | 931 | 8268 | 11% |
| GILEAD SCIENCES INC | 914 | 6021 | 15% |
| HOME DEPOT INC | 900 | 9330 | 10% |
| DISNEY WALT PRODUCTIONS | 895 | 10335 | 9% |
| GOLDMAN SACHS GROUP INC | 886 | 7130 | 12% |
| BANK OF AMERICA CORP | 880 | 7203 | 12% |

C Correlations

This table shows pairwise correlation coefficients between all variables used in our analysis. A detailed description of all variables is contained in Appendix A. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

| | Winner (first-in -first-out) | Winner (average purchase price) | Price up | Team managed managed | Manager change | Fund size | Fund age | Fund turnover ratio | Fund expense ratio | Fund return volatility | Fund perfor- -mance rank |
|---------------------------------|---------------------------------|------------------------------------|-----------|-------------------------|-------------------|-----------|-----------|------------------------|-----------------------|---------------------------|-----------------------------|
| Winner (first-in-first-out) | 1.000 | | | | | | | | | | |
| Winner (average purchase price) | 0.955*** | 1.000 | | | | | | | | | |
| Price Up | 0.017*** | 0.017*** | 1.000 | | | | | | | | |
| Team managed | 0.004*** | 0.003*** | 0.010*** | 1.000 | | | | | | | |
| Manager Change | -0.002*** | -0.002*** | 0.000 | -0.033*** | 1.000 | | | | | | |
| Fund Size | 0.038*** | 0.042*** | 0.021*** | -0.013*** | -0.004*** | 1.000 | | | | | |
| Fund Age | 0.024*** | 0.028*** | 0.018*** | -0.062*** | 0.016*** | 0.388*** | 1.000 | | | | |
| Fund Turnover Ratio | -0.025*** | -0.025*** | -0.011*** | -0.052*** | 0.019*** | -0.196*** | -0.109*** | 1.000 | | | |
| Fund Expense Ratio | -0.027*** | -0.028*** | -0.019*** | -0.031*** | 0.009*** | -0.352*** | -0.213*** | 0.295*** | 1.000 | | |
| Fund Return Volatility | -0.192*** | -0.194*** | -0.071*** | -0.015*** | 0.005*** | -0.081*** | -0.078*** | 0.098*** | 0.074*** | 1.000 | |
| Fund Ranking | 0.047*** | 0.046*** | 0.043*** | -0.017*** | 0.002*** | 0.053*** | 0.027*** | -0.064*** | -0.096*** | -0.137*** | 1.000 |

D The tax saving wash-sale rule and repurchasing bias

This section examines whether the finding that previous winners are more likely to be repurchased by mutual funds than previous losers is driven by the wash-sale rule. The “wash-sale rule” refers to the fact that if a stock sold for a loss is repurchased within 30 days, tax payers cannot claim the capital loss. If mutual funds try to minimize tax consequences to fund investors, they may be less likely to repurchase previous losers in the month after selling the stocks. We therefore exclude all observations in the first quarter after the sale to address the possibility of this tax saving behavior. Results are presented below.

The table contains results of the same linear probability models as in Table 3. Observations within the first quarter after a stock is sold have been excluded from the sample. *t*-statistics are provided in parentheses. The standard errors are clustered by fund. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

| | First-in-first-out | | | Average purchase price | | |
|-------------------------|---------------------|----------------------|---------------------|------------------------|----------------------|---------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Winner | 0.006*** (18.78) | 0.007*** (18.22) | 0.007*** (23.36) | 0.007*** (19.78) | 0.007*** (19.00) | 0.008*** (24.22) |
| Fund size | | 0.003*** (3.86) | | | 0.003*** (3.85) | |
| Fund age | | -0.000** (-2.06) | | | -0.000** (-2.07) | |
| Fund turnover ratio | | 0.004*** (6.48) | | | 0.004*** (6.51) | |
| Fund expense ratio | | 0.120 (0.50) | | | 0.114 (0.48) | |
| Fund return volatility | | -0.006 (-0.62) | | | -0.006 (-0.62) | |
| Fund performance rank | | -0.005*** (-3.68) | | | -0.005*** (-3.67) | |
| Stock fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Fund fixed effects | Yes | Yes | No | Yes | Yes | No |
| Time fixed effects | Yes | Yes | No | Yes | Yes | No |
| Fund×Time fixed effects | No | No | Yes | No | No | Yes |
| Observations | 4,896,131 | 3,988,699 | 4,887,814 | 4,899,471 | 3,991,197 | 4,891,169 |
| Adjusted R^2 | 0.031 | 0.032 | 0.084 | 0.031 | 0.032 | 0.084 |

E Current flows and repurchasing bias

This table contains the results of the linear probability models with interaction terms of winner dummies and the current inflow dummy. The dependent variable is Repurchase, a dummy variable equal to one if the stock sold is repurchased by the fund in the quarter within one year after the sale. Current Inflow is a dummy variable equal to one if the fund encountered an inflow when selling the stock. Winner is equal to one if a stock was sold for a gain, and zero otherwise. The winner dummy is based on the difference between selling price and average purchase price. The average purchase price is calculated either following first-in-first-out, low-in-first-out, high-in-first-out, and last-in-first-out principles or by taking the value-weighted average of all purchase prices before the sale. We also use the last holding period return to measure the previous trading experience. We include an interaction term between Current Inflow and the winner dummies in the regressions. Control variables include fund characteristics (Fund size, Fund age, Fund turnover ratio, Fund expense ratio, Fund return volatility, Fund performance rank), which are all defined in Appendix A. Column (1), (2), (4) and (5) include stock, fund, and time fixed effects. Column (3) and Column (6) include stock and fund×time fixed effects. *t*-statistics are provided in parentheses. The standard errors are clustered by fund. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

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| | first-in-first-out | | | Average price | | | Low in first out | | | High in first out | | | Last in first out | | | Last holding period return | | |
|--------------------------------|---------------------|----------------------|----------------------|----------------------|---------------------|----------------------|----------------------|---------------------|----------------------|----------------------|---------------------|----------------------|----------------------|---------------------|----------------------|----------------------------|---------------------|----------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (17) | (18) | (15) | (15) |
| Winner × Current Inflow | 0.001 (1.17) | 0.001 (1.13) | 0.000 (0.55) | 0.001 (1.07) | 0.001 (0.99) | 0.000 (0.58) | 0.001 (1.10) | 0.001 (1.07) | 0.000 (0.49) | 0.001 (1.31) | 0.001 (1.25) | 0.000 (0.83) | 0.001 (1.27) | 0.001 (1.19) | 0.000 (0.71) | 0.002* (1.89) | 0.002* (1.86) | 0.000 (0.76) |
| Winner | 0.008*** (15.82) | 0.009*** (16.39) | 0.009*** (22.65) | 0.009*** (16.87) | 0.009*** (17.47) | 0.009*** (22.99) | 0.009*** (16.84) | 0.009*** (17.35) | 0.009*** (23.21) | 0.009*** (16.55) | 0.009*** (17.09) | 0.009*** (22.92) | 0.009*** (16.62) | 0.009*** (17.11) | 0.009*** (22.87) | 0.006*** (10.08) | 0.006*** (10.64) | 0.007*** (17.26) |
| Current Inflow | 0.001 (0.62) | -0.001 (-0.53) | -0.003*** (-4.42) | 0.001 (0.67) | -0.000 (-0.45) | -0.003*** (-4.42) | 0.001 (0.66) | -0.001 (-0.49) | -0.003*** (-4.35) | 0.001 (0.61) | -0.001 (-0.54) | -0.003*** (-4.53) | 0.001 (0.66) | -0.001 (-0.49) | -0.003*** (-4.45) | 0.001 (0.54) | -0.001 (-0.61) | -0.003*** (-4.27) |
| Fund size | | 0.003*** (3.19) | | 0.003*** (3.17) | | | 0.003*** (3.17) | | | 0.003*** (3.16) | | | 0.003*** (3.25) | | | 0.003*** (3.11) | | |
| Fund age | | 0.000 (0.13) | | 0.000 (0.13) | | | 0.000 (0.20) | | | 0.000 (0.22) | | | 0.000 (0.23) | | | 0.000 (0.11) | | |
| Fund turnover ratio | | 0.005*** (7.11) | | 0.005*** (7.13) | | | 0.005*** (7.08) | | | 0.005*** (7.07) | | | 0.005*** (7.05) | | | 0.005*** (7.23) | | |
| Fund expense ratio | | -0.175 (-0.50) | | -0.175 (-0.50) | | | -0.187 (-0.54) | | | -0.189 (-0.54) | | | -0.194 (-0.56) | | | -0.165 (-0.49) | | |
| Fund return volatility | | -0.008 (-0.67) | | -0.008 (-0.67) | | | -0.008 (-0.69) | | | -0.008 (-0.70) | | | -0.008 (-0.70) | | | -0.008 (-0.72) | | |
| Fund performance rank | | -0.005*** (-2.89) | | -0.005*** (-2.88) | | | -0.004*** (-2.81) | | | -0.004*** (-2.81) | | | -0.004*** (-2.75) | | | -0.005*** (-3.00) | | |
| Stock fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Fund fixed effects | Yes | Yes | No | Yes | Yes | No | Yes | Yes | No | Yes | Yes | No | Yes | Yes | No | Yes | Yes | No |
| Time fixed effects | Yes | Yes | No | Yes | Yes | No | Yes | Yes | No | Yes | Yes | No | Yes | Yes | No | Yes | Yes | No |
| Fund×Time fixed effects | No | No | Yes | No | No | Yes | No | No | Yes | No | No | Yes | No | No | Yes | No | No | Yes |
| Observations | 5,982,979 | 5,535,542 | 5,977,526 | 5,987,387 | 5,539,076 | 5,981,953 | 5,907,229 | 5,466,164 | 5,901,715 | 5,870,072 | 5,430,413 | 5,864,510 | 5,818,490 | 5,381,560 | 5,812,845 | 6,195,385 | 5,717,790 | 6,190,138 |
| Adjusted <i>R</i> ² | 0.039 | 0.040 | 0.111 | 0.039 | 0.040 | 0.111 | 0.039 | 0.040 | 0.111 | 0.039 | 0.040 | 0.111 | 0.039 | 0.040 | 0.111 | 0.039 | 0.040 | 0.111 |

F Robustness checks with different winner measures

This section contains robustness checks using various winner measures. We calculate the purchase price of stocks with low-in-first-out and high-in-first-out principles following Cici (2012) and compare the purchase price with the selling price to determine whether the stock was sold for a gain or a loss. We further use last-in-first-out principle to calculate the purchase price. Prior studies on the disposition effect find that investors tend to sell stocks with recent gains, thus, they seem to focus on recent performance rather than historical averages (Odean (1998), Grinblatt and Keloharju (2001) and Jackson (2003)). Therefore, we additionally use the last holding period returns of a stock by a mutual fund to measure the previous trading experience: a stock is defined to be a previous winner if the last holding period return of the stock by the fund is positive. We rerun all the analyses from Table 2 to Table 8 and present the results as follows.

Table F.1: Repurchase of stocks previously sold for a gain versus stocks previously sold for a loss

| | (1) | (2) | (3) | (4) |
|---|------------------|-------------------|-------------------|----------------------------|
| | Low-in-first-out | High-in-first-out | Last-in-first-out | Last holding period return |
| No. of winners repurchased | 200,464 | 199,715 | 196,385 | 192,616 |
| Opportunities to repurchase winners | 3,382,109 | 3,392,342 | 3,330,870 | 3,378,140 |
| Proportion of winners repurchased (PWR) | 0.059 | 0.059 | 0.059 | 0.057 |
| No. of Losers Repurchased | 156,987 | 154,855 | 154,577 | 180,420 |
| Opportunities to repurchase losers | 3,373,128 | 3,320,660 | 3,324,279 | 3,731,132 |
| Proportion of losers repurchased (PLR) | 0.047 | 0.047 | 0.046 | 0.048 |
| Diff (PWR-PLR) | 0.013*** | 0.012*** | 0.012*** | 0.009*** |
| t-stats (PWR=PLR) | (16.87) | (16.16) | (16.40) | (11.86) |

Table F.2: Are previous winners more likely to be repurchased by funds?

| | Low in first out | | | High in first out | | | Last in first out | | | Last holding period winner | | |
|-------------------------|---------------------|----------------------|---------------------|---------------------|----------------------|---------------------|---------------------|----------------------|---------------------|----------------------------|----------------------|---------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| Winner | 0.009*** (25.31) | 0.010*** (23.76) | 0.009*** (30.45) | 0.009*** (25.56) | 0.010*** (24.06) | 0.009*** (30.82) | 0.009*** (25.46) | 0.010*** (23.79) | 0.009*** (30.69) | 0.006*** (16.33) | 0.007*** (15.87) | 0.007*** (21.71) |
| Fund size | | 0.003*** (3.21) | | | 0.003*** (3.21) | | | 0.003*** (3.29) | | | 0.003*** (3.16) | |
| Fund age | | 0.000 (0.23) | | | 0.000 (0.24) | | | 0.000 (0.26) | | | 0.000 (0.12) | |
| Fund turnover ratio | | 0.005*** (7.16) | | | 0.005*** (7.15) | | | 0.005*** (7.13) | | | 0.005*** (7.28) | |
| Fund expense ratio | | -0.187 (-0.54) | | | -0.189 (-0.55) | | | -0.193 (-0.56) | | | -0.167 (-0.49) | |
| Fund return volatility | | -0.008 (-0.71) | | | -0.008 (-0.72) | | | -0.008 (-0.72) | | | -0.008 (-0.72) | |
| Fund performance rank | | -0.005*** (-2.85) | | | -0.004*** (-2.85) | | | -0.004*** (-2.78) | | | -0.005*** (-3.03) | |
| Stock fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Fund fixed effects | Yes | Yes | No | Yes | Yes | No | Yes | Yes | No | Yes | Yes | No |
| Time fixed effects | Yes | Yes | No | Yes | Yes | No | Yes | Yes | No | Yes | Yes | No |
| Fund×Time fixed effects | No | No | Yes | No | No | Yes | No | No | Yes | No | No | Yes |
| Observations | 6,755,036 | 5,522,582 | 6,747,697 | 6,712,804 | 5,486,756 | 6,705,416 | 6,654,949 | 5,437,816 | 6,647,472 | 7,109,075 | 5,782,484 | 7,102,299 |
| Adjusted R^2 | 0.039 | 0.040 | 0.115 | 0.039 | 0.040 | 0.115 | 0.038 | 0.040 | 0.114 | 0.038 | 0.040 | 0.114 |

Table F.3: The impact of subsequent price changes of sold stocks on repurchasing probability

| | Low in first out | | | High in first out | | | Last in first out | | | Last holding period winner | | |
|-------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|----------------------------|-----------------------|-----------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| Winner × Price up | -0.011*** (-19.10) | -0.011*** (-18.11) | -0.011*** (-21.49) | -0.011*** (-19.24) | -0.011*** (-18.33) | -0.012*** (-21.84) | -0.011*** (-18.96) | -0.011*** (-17.98) | -0.011*** (-21.20) | -0.009*** (-17.08) | -0.009*** (-16.18) | -0.009*** (-18.76) |
| Winner | 0.016*** (34.50) | 0.017*** (33.42) | 0.017*** (40.85) | 0.016*** (34.70) | 0.017*** (33.49) | 0.017*** (41.45) | 0.016*** (34.49) | 0.017*** (33.15) | 0.017*** (40.92) | 0.012*** (25.83) | 0.013*** (25.05) | 0.013*** (32.70) |
| Price up | 0.020*** (32.79) | 0.021*** (32.01) | 0.021*** (34.66) | 0.020*** (33.00) | 0.021*** (32.26) | 0.021*** (34.87) | 0.020*** (32.92) | 0.021*** (32.21) | 0.021*** (34.82) | 0.018*** (29.34) | 0.019*** (28.57) | 0.019*** (31.15) |
| Fund size | | 0.003*** (2.72) | | | 0.003*** (2.71) | | | 0.003*** (2.80) | | | 0.003*** (2.66) | |
| Fund age | | 0.000 (0.34) | | | 0.000 (0.37) | | | 0.000 (0.37) | | | 0.000 (0.30) | |
| Fund turnover ratio | | 0.005*** (6.78) | | | 0.005*** (6.76) | | | 0.005*** (6.74) | | | 0.005*** (6.86) | |
| Fund expense ratio | | -0.362 (-1.00) | | | -0.368 (-1.02) | | | -0.366 (-1.02) | | | -0.341 (-0.96) | |
| Fund return volatility | | -0.009 (-0.67) | | | -0.009 (-0.67) | | | -0.009 (-0.67) | | | -0.009 (-0.71) | |
| Fund performance rank | | -0.005*** (-3.03) | | | -0.005*** (-3.04) | | | -0.005*** (-2.99) | | | -0.005*** (-3.22) | |
| Stock fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Fund fixed effects | Yes | Yes | No | Yes | Yes | No | Yes | Yes | No | Yes | Yes | No |
| Time fixed effects | Yes | Yes | No | Yes | Yes | No | Yes | Yes | No | Yes | Yes | No |
| Fund×Time fixed effects | No | No | Yes | No | No | Yes | No | No | Yes | No | No | Yes |
| Observations | 5,239,401 | 4,519,043 | 5,231,797 | 5,202,932 | 4,487,850 | 5,195,278 | 5,155,677 | 4,446,844 | 5,147,916 | 5,469,479 | 4,703,834 | 5,462,128 |
| Adjusted R^2 | 0.042 | 0.043 | 0.120 | 0.042 | 0.043 | 0.120 | 0.041 | 0.043 | 0.120 | 0.041 | 0.043 | 0.120 |

Table F.4: Team- or single- managed funds and repurchasing behavior

| | Low in first out | | High in first out | | Last in first out | | Last holding period winner | |
|------------------------------|---------------------|----------------------|---------------------|----------------------|---------------------|----------------------|----------------------------|----------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Winner \times Team managed | 0.002* (1.93) | 0.002* (1.87) | 0.002** (2.07) | 0.002** (1.99) | 0.002** (2.06) | 0.002** (1.99) | 0.001 (0.68) | 0.001 (0.58) |
| Winner | 0.008*** (12.01) | 0.008*** (11.47) | 0.008*** (11.95) | 0.008*** (11.43) | 0.008*** (11.91) | 0.008*** (11.38) | 0.006*** (9.78) | 0.007*** (9.45) |
| Team managed | -0.001 (-0.51) | -0.000 (-0.32) | -0.001 (-0.53) | -0.000 (-0.33) | -0.001 (-0.55) | -0.001 (-0.35) | 0.000 (0.04) | 0.000 (0.23) |
| Fund size | | 0.003*** (2.94) | | 0.003*** (2.95) | | 0.003*** (3.01) | | 0.003*** (2.92) |
| Fund age | | 0.000 (0.87) | | 0.000 (0.89) | | 0.000 (0.87) | | 0.000 (0.74) |
| Fund turnover ratio | | 0.005*** (6.81) | | 0.005*** (6.80) | | 0.005*** (6.78) | | 0.005*** (6.93) |
| Fund expense ratio | | -0.242 (-0.66) | | -0.244 (-0.67) | | -0.246 (-0.68) | | -0.231 (-0.64) |
| Fund return volatility | | -0.006 (-0.53) | | -0.007 (-0.54) | | -0.007 (-0.55) | | -0.006 (-0.54) |
| Fund performance rank | | -0.005*** (-2.95) | | -0.005*** (-2.94) | | -0.005*** (-2.87) | | -0.005*** (-3.10) |
| Stock fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Fund fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Time fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 5,538,255 | 5,222,301 | 5,503,401 | 5,188,464 | 5,454,957 | 5,141,630 | 5,811,030 | 5,464,624 |
| Adjusted R^2 | 0.040 | 0.041 | 0.040 | 0.041 | 0.040 | 0.040 | 0.039 | 0.040 |

Table F.5: Repurchasing behavior after manager change

| | Low in first out | | | High in first out | | | Last in first out | | | Last holding period winner | | |
|-------------------------|---------------------|----------------------|---------------------|----------------------|---------------------|---------------------|----------------------|---------------------|---------------------|----------------------------|---------------------|---------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| Winner × Manager change | -0.004** (-2.09) | -0.004* (-1.87) | -0.002 (-1.38) | -0.004* (-1.93) | -0.004* (-1.77) | -0.002 (-1.29) | -0.004** (-1.96) | -0.004* (-1.76) | -0.002 (-1.29) | -0.002 (-1.05) | -0.002 (-1.10) | -0.000 (-0.14) |
| Winner | 0.009*** (25.05) | 0.010*** (23.46) | 0.009*** (30.09) | 0.009*** (25.38) | 0.010*** (23.83) | 0.009*** (30.49) | 0.009*** (25.22) | 0.010*** (23.50) | 0.009*** (30.35) | 0.006*** (16.28) | 0.007*** (15.77) | 0.007*** (21.31) |
| Manager change | -0.002 (-1.12) | -0.001 (-0.51) | -0.001 (-0.94) | -0.002 (-1.17) | -0.001 (-0.55) | -0.001 (-0.91) | -0.002 (-1.25) | -0.001 (-0.65) | -0.001 (-0.95) | -0.003* (-1.73) | -0.001 (-0.91) | -0.002 (-1.51) |
| Fund size | | 0.003*** (3.21) | | 0.003*** (3.21) | | | 0.003*** (3.29) | | | 0.003*** (3.16) | | |
| Fund age | | 0.000 (0.25) | | 0.000 (0.26) | | | 0.000 (0.27) | | | 0.000 (0.14) | | |
| Fund turnover ratio | | 0.005*** (7.18) | | 0.005*** (7.17) | | | 0.005*** (7.15) | | | 0.005*** (7.30) | | |
| Fund expense ratio | | -0.186 (-0.54) | | -0.188 (-0.54) | | | -0.192 (-0.56) | | | -0.166 (-0.49) | | |
| Fund return volatility | | -0.008 (-0.71) | | -0.008 (-0.72) | | | -0.008 (-0.72) | | | -0.008 (-0.72) | | |
| Fund performance rank | | -0.005*** (-2.85) | | -0.004*** (-2.85) | | | -0.004*** (-2.78) | | | -0.005*** (-3.03) | | |
| Stock fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Fund fixed effects | Yes | Yes | No | Yes | Yes | No | Yes | Yes | No | Yes | Yes | No |
| Time fixed effects | Yes | Yes | No | Yes | Yes | No | Yes | Yes | No | Yes | Yes | No |
| Fund×Time fixed effects | No | No | Yes | No | No | Yes | No | No | Yes | No | No | Yes |
| Observations | 6,755,036 | 5,522,582 | 6,747,697 | 6,712,804 | 5,486,756 | 6,705,416 | 6,654,949 | 5,437,816 | 6,647,472 | 7,109,075 | 5,782,484 | 7,102,299 |
| Adjusted R^2 | 0.039 | 0.040 | 0.115 | 0.039 | 0.040 | 0.115 | 0.038 | 0.040 | 0.114 | 0.038 | 0.040 | 0.114 |

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Table F.6: Repurchasing behavior after a manager leaves a single-managed fund

| | Low in first out | | High in first out | | Last in first out | | Last holding period winner | |
|---|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|----------------------------|--------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Panel A: Single-managed funds | | | | | | | | |
| Winner | 0.003*** (4.34) | 0.003*** (4.52) | 0.003*** (4.24) | 0.003*** (4.41) | 0.003*** (4.08) | 0.003*** (4.26) | 0.002*** (3.01) | 0.002*** (3.11) |
| Observations | 103,970 | 103,796 | 103,306 | 103,135 | 102,433 | 102,261 | 109,453 | 109,282 |
| Adjusted R^2 | 0.092 | 0.193 | 0.092 | 0.194 | 0.091 | 0.192 | 0.091 | 0.191 |
| Panel B: Single-managed funds and only managers in charge of one fund | | | | | | | | |
| Winner | 0.003*** (4.02) | 0.003*** (4.00) | 0.003*** (3.95) | 0.003*** (3.93) | 0.003*** (3.71) | 0.002*** (3.71) | 0.002*** (2.79) | 0.002*** (2.98) |
| Observations | 93,627 | 93,422 | 93,003 | 92,801 | 92,198 | 91,995 | 98,859 | 98,657 |
| Adjusted R^2 | 0.107 | 0.208 | 0.107 | 0.209 | 0.105 | 0.207 | 0.106 | 0.205 |
| Manager fixed effects | Yes | No | Yes | No | Yes | No | Yes | No |
| Time fixed effects | Yes | No | Yes | No | Yes | No | Yes | No |
| Manager×Time fixed effects | No | Yes | No | Yes | No | Yes | No | Yes |