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Why Does Mutual Fund Performance Not Persist?

The Impact and Interaction of Fund Flows and Manager Changes

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Why does mutual fund performance not persist?
The impact and interaction of fund flows and manager changes

Wolfgang Bessler, David Blake, Peter Lückoff and Ian Tonks*

Abstract

We explain the lack of long-term performance persistence by actively managed U.S. equity mutual funds in terms of two equilibrating mechanisms: fund flows and manager changes. We find that these mechanisms acting together affect the future performance of past outperforming (winner) funds and past underperforming (loser) funds. Fund flows in isolation have a significant effect on performance, whereas manager changes in isolation have only a limited effect. A combination of both fund flows and manager changes has a substantial impact on future fund performance. If neither of these equilibrating mechanisms is operating, winner funds continue to significantly outperform loser funds by 4.08 percentage points per annum. However, the difference between winner and loser funds declines to almost zero if the two mechanisms are acting together. We also document that managers of winner funds increase risk, while managers of loser funds reduce risk, although losers who are fired took more risk than losers who keep their jobs.

JEL Classification: G28, G29, G32.
Keywords: Mutual funds, performance persistence, fund flows, manager changes.

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1. INTRODUCTION

It is widely recognized that equity mutual fund performance does not persist in the long term, even though some studies indicate that short-term persistence exists.[1] Two alternative explanations for the lack of long-term persistence are fund flows (Berk and Green, 2004) and manager changes (Khorana, 1996, 2001; Dangl, Wu and Zechner, 2008). In this paper, we investigate how far these two "equilibrating mechanisms"[2] explain mean reversion in mutual fund performance and whether they interact as substitutes or complements. If they are complements, then they should be more effective in preventing performance persistence when operating together. If they are substitutes, then the incremental effect of one mechanism, conditional on the other operating, should be close to zero. In fact, we find that the two mechanisms act as complements for both past outperforming (winner) and past underperforming (loser) funds, based on a sample of 6,207 actively managed U.S. equity mutual funds over the period from 1992 to 2011. For both outperforming and underperforming funds we find that manager changes reinforce the effect of fund flows and can explain the erosion of performance persistence.

For winner funds, we find that those funds experiencing both of the equilibrating mechanisms – having relatively high net inflows and a manager change – underperform those winner funds in which neither mechanism operates by 0.19 percentage points per month (2.28

[1] See, e.g., Hendricks, Patel, and Zeckhauser (1993), Carhart (1997) and Pastor and Stambaugh (2002) for long-term performance persistence and Bollen and Busse (2005), Busse and Irvine (2006) and Huij and Verbeek (2007) for short-term performance persistence. Busse, Goyal, and Wahal (2010) document a similar pattern for institutional funds.

[2] This terminology was introduced by Berk and Green (2004, p. 1271).

percentage points per annum)[3] on a risk-adjusted basis in the following year. We find that fund flows are the dominant reason for the lack of superior long-term performance persistence amongst winner funds. However, the two mechanisms are complementary, since, in combination, manager changes and fund flows result in an additional deterioration of performance. Further, we provide evidence that winner funds increase their risk exposure.

For loser funds, as predicted by Dangl et al. (2008), we also detect a strong interaction effect between both mechanisms. Manager changes, interpreted as an "internal governance" mechanism, and outflows, treated as an "external governance" mechanism, reinforce each other and the combined effect is a 0.16 percentage points per month (1.92 percentage points per annum) higher risk-adjusted performance for loser funds experiencing both forms of governance relative to funds experiencing neither. Both mechanisms are rather weak when operating in isolation. Thus, while winner funds suffer from fund inflows irrespective of what happens to the manager, the performance of loser funds is only affected when both mechanisms operate together. Further, we confirm the prediction in Dangl et al. (2008) that, prior to a manager change, fund risk increases, but falls post-replacement.

We go on to examine the spread in subsequent 12-month performance between winner and loser funds, and we identify an unconditional spread of 0.22 percentage points per month (2.64 percentage points per annum) in alphas, similar to the results in Carhart (1997). By conditioning only on winner and loser funds that do not experience either of the equilibrating mechanisms, our results produce a highly significant winner-minus-loser spread of 0.34 percentage points per month (4.08 percentage points per annum) in the subsequent year. In

[3] We report fund performance in percent/ percentage points per month throughout the paper as our analysis is based on monthly fund returns (except for section 4.6 where the regression analysis involves annualized changes in performance). However, for comparison with other studies, we add percent/ percentage points per annum in parentheses in the introduction and conclusion.

contrast, by conditioning on winner and loser funds experiencing both equilibrating mechanisms, the corresponding spread narrows to an insignificant -0.02 percentage points per month (-0.24 percentage points per annum), implying that the substantial difference in alphas of 1.71 percentage points per month (20.52 percentage points per annum) between winner and loser funds in the portfolio formation period is completely eliminated in the evaluation period. These results indicate that a combination of both fund flows and manager changes explain the lack of performance persistence and the mean reversion in mutual fund performance. We find that performance persists when funds are not exposed to at least one equilibrating mechanism.

The rest of the paper proceeds as follows. The next section presents a review of the literature and our hypotheses. In section 3, we describe our data set and explain our research methodology. Our results are discussed in section 4. Using ranked portfolio tests, we analyze fund flows, manager changes and their interaction for winner and loser funds separately, and then examine the spread in winner-loser performance, before finally undertaking robustness checks, including a pooled regression approach. Section 5 concludes and discusses the implications of our findings.

2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Berk and Green (2004) argue that mutual fund market equilibrium is attained through fund flows. These respond to past performance, but due to decreasing returns to scale in active fund management, the growth in fund size of recent winner funds causes their performance to deteriorate, while loser-fund performance benefits from withdrawals that force managers to re-optimize their portfolios. Chen et al. (2004) and Yan (2008) find that transaction costs are positively correlated with fund size and the degree of illiquidity of the investment strategy and that small funds outperform large funds. However, this is only an indirect test of the Berk and

Green (2004) hypothesis. Although the finding that small funds outperform large funds is consistent with decreasing returns to scale in fund management, differences in fund sizes are the result of both external growth due to the inflows accumulated throughout a fund's full history since inception and internal growth due to differential performance. Consequently, we focus only on the most recent year's fund flows as a flow variable, rather than fund size, to analyze its equilibrium effect. Sirri and Tufano (1998) and Lynch and Musto (2003) document that past outperformance triggers large inflows, but that investors in poorly performing funds typically fail to withdraw their investments. Explanations for such behavior include: the anticipation of a strategy change by the incumbent manager, the firing of a poorly performing manager, a disposition effect (Shefrin and Statman, 1985; Singal and Xu, 2011), and investor inertia (Berk and Tonks, 2007).

Edelen (1999), Alexander, Cici, and Gibson (2007) and Dubofsky (2010) argue that excessive inflows or outflows encourage liquidity-motivated rather than valuation-motivated trading by the managers subject to these flows and induce immediate transaction costs, both of which are detrimental to short-run fund performance. Rakowski (2010) reports that funds with more volatile flows underperform those with less volatile flows, which implies that outflows can be as harmful for future performance as inflows, a finding that is incompatible with Berk and Green's (2004) conjecture that underperforming funds benefit from withdrawals. Even worse, large outflows result in liquidity-motivated fire sales which distort fund performance and impose even higher costs on loser funds (Coval and Stafford, 2007). Thus, we anticipate asymmetric effects of fund flows on loser funds and winner funds, and we analyze each group separately.

Khorana (1996), Chevalier and Ellison (1999) and Gallagher and Nadarajah (2004) document an inverse relationship between fund performance and manager changes. Star fund managers can extract a larger share of the higher fee income by either moving to a larger fund within the same organization or to another fund family (Hu, Hall, and Harvey, 2000). Moreover, a successful manager anticipating that she will be unable to repeat her outstanding performance in the future may decide to use her current favorable track record to find a higher-paid job with a new fund management company. In this case, the decision to stay or to leave will be the result of the manager's own assessment of her investment skill. The winner fund that loses its star manager will need to hire a new manager, presumably with lower skills. Therefore, we would expect fund performance to deteriorate after the hiring of a new manager. Khorana (2001) finds that a manager change in outperforming funds results in a deterioration in performance from an annual 1.9 percent in the pre-replacement period to 0.4 percent in the third year after replacement. Loser-fund managers, in contrast, may be demoted to run smaller funds in the same family or fired after a sustained period of poor performance. Khorana (2001) reports that the performance of recently underperforming funds improves if the manager is replaced, in which case abnormal performance rises from an annual -2.40 percent to 0.50 percent in the third year after replacement. Hence, manager changes appear to contribute towards rectifying negative performance persistence.

Dangl et al. (2008) develop a theoretical model of the mutual fund industry in which poorly performing managers are subject to both external governance through market discipline with investors withdrawing funds, and internal governance in the form of manager replacement. The new manager also tends to change the fund's risk profile relative to her predecessor. For most parameter values in the calibrated model, there will be capital outflows and an increase in

portfolio risk pre-replacement, as the fund manager anticipating a termination of the employment contract takes on more risk in the hope of getting lucky (Brown, Harlow and Starks, 1996; Chevalier and Ellison, 1997). After the manager is replaced, the model predicts subsequent capital inflows and a decrease in portfolio risk.

Qiu (2003) and Kempf, Ruenzi, and Thiele (2009) suggest that employment risk concerns could lead to fund managers taking less risk, while Huang, Sialm, and Zhang (2011) argue that as well as these agency incentives, there are other risk considerations, such as unskilled managers making poor investment decisions and skilled managers taking advantage of market timing opportunities. Further, behavioral factors may also affect risk shifting behavior. Prospect theory (Kahneman and Tversky, 1979) suggests that successful fund managers will become more risk averse. On the other hand, overconfidence has been recognized as influencing the behavior of both retail investors (Odean, 1999; and Grinblatt and Keloharju, 2009) and institutional investors (Ekholm and Pasternack, 2008; Puetz and Ruenzi, 2011; Bar, Kempf and Ruenzi, 2011). Overconfidence can be explained by biased self-attrition, whereby individuals update their beliefs about their own ability as being attributable to skill following good outcomes, but due to bad luck after bad outcomes. They become more overconfident after good past performance, but not less confident after bad past performance (Daniel, Hirshleifer, and Subrahmanyam, 1998; Gervais and Odean, 2001).

There exist several reasons to believe that fund flows and manager changes are not independent of each other. Both mechanisms will be triggered by past performance, and the results of Khorana (2001) that manager changes affect future fund performance might, in part, be attributable to the effect of contemporaneous fund flows. Thus, it is important to control for this interaction. Moreover, fund flows may have a differential effect on fund performance for

new managers as compared with continuing managers. In order to investigate these interaction effects in detail, we classify the fund flows and manager change mechanisms as being substitutes if the performance impact of one mechanism is smaller when the other mechanism operates simultaneously. Fund flows and manager changes are interpreted as being complements if the performance impact of one mechanism is larger when it operates jointly with the other mechanism. In those cases where the performance impact of each mechanism is the same, irrespective of whether it operates separately from or in combination with the other mechanism, the mechanisms will be classified as being independent of each other.

In the case of winner funds, fund flows and manager changes are potential substitutes because if net inflows remain low despite superior past performance, the fund manager is in a weaker position to negotiate an improved compensation package, increasing the likelihood of her leaving.[4] In contrast, if the fund is subject to high net inflows, the manager may decide to stay and reap the benefits from a larger asset base and hence higher fees. Moreover, if investors observe that the star manager has left, they may rationally anticipate that superior past performance will be less of a predictor of future performance, resulting in a weaker relationship between past performance and current fund flows in the case of a manager change. A further reason for these mechanisms being substitutes is that a newly appointed fund manager is likely to adjust the portfolio holdings towards her own preferred investment strategy. If large net inflows occur at the same time, the manager could use these inflows efficiently to adjust the portfolio weights and, by doing so, reduce the marginal negative performance impact of high net inflows.

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[4] Anecdotal evidence suggests that some mutual fund managers have increased their personal wealth by quitting their job as an employee in the mutual fund industry and setting up a hedge fund, such as Jeffrey N. Vinik, the former manager of Fidelity's Magellan fund, in 1996.

Based on the findings of Pollet and Wilson (2008) that fund managers scale up existing holdings as a response to inflows, it should be the case that fund flows and manager changes are complements among winner funds. Specifically, if managerial skill determines the number of "best ideas" a manager is able to generate (Cohen, Polk and Silli, 2010) and the newly hired manager has lower skills and hence fewer good ideas than the former manager, then the same level of inflows will have a stronger impact on lowering the performance of winner funds with a manager change than on those without.

Whether these mechanisms are substitutes or complements is an empirical question that our data set allows us to investigate. We address the following hypotheses and questions about the joint effects of fund flows and manager changes on the performance persistence of winner funds:

- Fund flows: Investors chase past performance and future performance suffers from high inflows, leading to stronger mean reversion for winner funds with higher net inflows.
- Manager changes: A fund manager who leaves a winner fund is replaced with a less skilled manager, resulting in reduced performance and stronger mean reversion for winner funds with a manager change.
- Interaction: Fund flows and manager changes, when occurring simultaneously, have either magnifying (complement) or offsetting (substitute) effects.
- Risk changes: How does a winning fund manager adjust her subsequent risk exposure? According to prospect theory, risk aversion increases in the domain of gains and risk is reduced in order to preserve the gains accrued. On the other hand, if fund managers are

subject to an overconfidence bias, risk will increase (Barber and Odean, 2001; Scheinkman and Xiong, 2003; Puetz and Ruenzi, 2011).

With loser funds, the Dangl et al. (2008) model predicts that the internal (termination of a manager contract) and external (investors withdraw funds) governance mechanisms are potential substitutes. If the manager has been replaced, investors will no longer see any reason to withdraw money and instead will remain invested, waiting for a performance reversal. Similarly, if money has flowed out of the fund, the management company might decide that the existing manager will be able to improve fund performance with the smaller asset base (Berk and Green, 2004).

Alternatively, internal and external governance in loser funds could reinforce each other and act as complements. If the market has reacted quickly to poor past performance, the management company may fire a poorly performing manager in an attempt to stem outflows. Furthermore, causality could be reversed: if the disposition effect explains why many investors in poorly performing funds do not withdraw their investments, a manager replacement can serve as an attention trigger. Once investors are aware of both the manager change and the underperformance, they then start withdrawing funds.[5] Cremers and Nair (2005) investigate the interaction between internal and external control mechanisms in the context of corporate governance, and examine performance differentials between companies where one or both of these mechanisms are present. Their results have implications for the incentives and penalties facing corporate managers from the two governance mechanisms. Our study has similar implications for the incentives and penalties facing fund managers.

[5] There is a potential prisoners' dilemma issue here whereby investors defer withdrawing money from poorly performing funds in anticipation of a manager change, but the fund management company delays firing the poorly performing fund manager because the outflows have not materialized.

As with winner funds, whether these mechanisms for underperforming equity mutual funds are substitutes or complements is an empirical question. We address the following hypotheses and questions about the effects of fund flows and manager changes on performance persistence of loser funds:

- Fund flows: Investors withdraw their money and performance improves as a result of a smaller asset base, since managers can concentrate on the most profitable investment opportunities and this leads to stronger mean reversion for loser funds with higher outflows, although this effect will be dampened by any investor inertia and by the costs of re-optimizing portfolios.
- Manager changes: The fund management company fires an underperforming fund manager and performance improves under a newly appointed fund manager, leading to stronger mean reversion for loser funds with a manager change.
- Interaction: External and internal governance mechanisms, when occurring simultaneously, have either magnifying (complement) or offsetting (substitute) effects.
- Risk changes: Prior to manager replacement, fund risk increases and post-replacement fund risk falls (Dangl et al., 2008), although Kempf et al. (2009) predict employment risk concerns will lead to fund managers taking less risk.

Finally, these two sets of hypotheses for winner and loser fund acting jointly have implications for the spread in performance persistence between winner and loser funds. Our main hypothesis in the paper states that:

- In the absence of fund flows and manager changes, past winners will continue to outperform past losers.

We predict that if both equilibrating mechanisms operate on winner and loser funds together, then the spread between winner and loser funds' subsequent performance will be narrower than when these mechanisms are not present.

3. DATA AND RESEARCH METHODOLOGY

3.1. DATA

Our mutual fund sample from the Center for Research in Security Prices (CRSP) starts in 1992, the first year for which reliable information on manager changes becomes available, and ends in 2011. We follow Pastor and Stambaugh (2002) and select only actively managed U.S. domestic equity funds (see Appendix). We aggregate all share classes of the same fund and drop all observations prior to the IPO date given by CRSP and funds without names in order to account for a potential incubation bias (Evans, 2010). Our final sample consists of 6,207 funds that existed at some time during the period from 1992 to 2011 for at least 12 consecutive months. These funds have an average fund size of 875 million USD (Table 1). Fund size increased over the sample period, whereas average fees fell from 1.45 percent to 1.36 percent of assets under management, probably as a result of economies of scale in asset management.[6]

[Please insert **Table 1** about here]

Monthly fund flows are constructed from the change in total net assets adjusted for internal growth from investment returns:

$$(1) \qquad flow_{it} = TNA_{it} - TNA_{it-1}(1 + R_{it}),$$

[6] Fees are calculated as the sum of the annual expense ratio and 1/7th of the sum of the front end and back end loads. Sirri and Tufano (1998) and Barber, Odean and Zheng (2005) both assume a seven-year average holding period for mutual funds. See French (2008) for an analysis of changes in the fee structure over time.

where TNA_{it} refers to the total net assets of fund *i* at the end of period *t* and R_{it} is the return of fund *i* between *t*-1 and *t*, assuming that all distributions are reinvested and are net of fund expenses. On average, each fund received 2.57 million USD net inflows per month.

To obtain information on manager changes, we focus on the variable "mgr_date" in the CRSP database, instead of using the specific names of the managers.[7] This variable provides the date of the last manager change as reported by the fund management company. By using the manager date variable, we avoid any problems associated with different spellings of manager names. Furthermore, as the number of team-managed funds increased during recent years, the manager date variable has the advantage that fund management companies only report significant changes in manager that are likely to have an impact on performance (Massa, Reuter, and Zitzewitz, 2010). A total of 7,919 manager changes occurred during our sample period and, on average, 15 percent of the fund managers are replaced each year.

3.2. RESEARCH METHODOLOGY

We use both ranked portfolio tests (Carhart, 1997; Carpenter and Lynch, 1999; Tonks, 2005) and pooled regressions to investigate the hypotheses outlined in Section 2.

3.2.a. RANKED PORTFOLIO TESTS

Funds are first ranked into equal-weighted decile portfolios based on their previous performance over rolling twelve-month periods. Then, in a second sorting of the top-decile-10 and the bottom-decile-1 portfolios, we form subgroups based on fund flows (low net inflows / high net

[7] This variable has also been used by Lynch and Musto (2003) and Cooper, Gulen, and Rau (2005). In theory, it shows the date that the manager leaves. However, for around 80 percent of observations, this is reported as the first of January. For the years 1992 and 1993, the variable is evenly distributed over different months. We conclude from this that the variable can only be used as an indicator of the year in which a manager change occurred. One implication of this is that our data set is not sufficiently granular to investigate the impact of timing differences between fund flows and manager changes on subsequent fund performance. In other words, we are unable to test whether fund flows pre-date and hence possibly 'cause' a manager change or vice versa. We are only able to indicate that there were changes in fund flows as well as a manager change within the same year and then assess what effect these had on a fund's subsequent performance.

inflows) or manager changes (with manager change / without manager change), see Figure 1.[8] Furthermore, as we are interested in the interaction effects between both mechanisms, we also form subgroups by double sorting on fund flows and manager changes simultaneously (low with / low without / high with / high without). We analyze the performance of these subgroups of top and bottom decile portfolios and the performance of spread portfolios in order to compare alternative investment strategies.

[Please insert **Figure 1** about here]

The decile portfolios are formed (a) on the basis of each fund's alpha in the previous year or (b) on the basis of previous year raw returns. For the first method, funds are ranked by alphas from a Carhart (1997) four-factor model estimated over the previous 12 months (the formation period), where the four common factors are the excess return above the risk-free rate on the market index (r_{mt}), the returns on a size factor (SMB_t), a book-to-market factor (HML_t), and a momentum factor (MOM_t).[9] Fund excess returns above the risk-free rate accounting for different fund styles are given by:

$$r_{it} = \alpha_i + \beta_{1i} r_{mt} + \beta_{2i} SMB_t + \beta_{3i} HML_t + \beta_{4i} MOM_t + \varepsilon_{it} \quad (2)$$

[8] In Berk and Green (2004), active management suffers from decreasing returns to scale, but it is an empirical question whether these capacity constraints are absolute or relative. Absolute capacity constraints arise once a certain threshold of absolute fund size is exceeded and depend on absolute fund flows. Relative capacity constraints differ across investment strategies and arise after the fund receives a certain level of inflows relative to the initial fund size. We analyze both absolute and relative net inflows, but, in the presentation of our results, we concentrate on absolute flows because the results for relative fund flows are qualitatively very similar though slightly weaker.

[9] We also experimented with different five-factor model: first, a five-factor model that adds a mean reversion factor (based on six value-weighted portfolios formed on the size and prior returns of all NYSE, AMEX and NASDAQ stocks, and downloaded from Kenneth French's website: mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html) to the Carhart model: if winner funds hold on to winner stocks for another one or two years, these winner stocks might eventually experience mean reversion in returns (De Bondt and Thaler, 1985, 1987) and second, a five-factor model that adds a liquidity-factor (downloaded from Lubos Pastor's website: faculty.chicagobooth.edu/lubos.pastor/research) to the Carhart model on the grounds that fund flows may also affect portfolio liquidity. However, we only present the results from the four-factor model, since the results from the five-factor models were qualitatively similar.

To assess performance and fund flows in a timely manner, we focus on the previous 12-month horizon. Using such a short horizon to estimate alphas from a factor model is problematic on account of the low degrees of freedom available for estimating (2). Nevertheless, we are able to efficiently estimate (2) over this short horizon by applying the "empirical Bayesian" adjustment procedure discussed in Huij and Verbeek (2007, hereafter HV), assuming a multivariate normal prior. Let $\theta_i = (\alpha_i, \beta_{1i}, \beta_{2i}, \beta_{3i}, \beta_{4i})'$ be a vector of unknown parameters to be estimated. The cross-sectional distribution of the funds' alphas and betas is assumed to be normal, $\theta_i \sim N(\mu, \Sigma)$, where μ is a 5-dimensional vector of cross-sectional means of alphas and betas, and Σ is a 5x5 covariance matrix. Assuming the errors in (2) are $\varepsilon_{it} \sim IIN(0, \sigma_i^2)$, the posterior distribution of θ_i also is normal with expectation:

$$E(\theta_i) = \left(\frac{1}{\sigma_i^2} X_i' X_i + \Sigma^{-1}\right)^{-1} \left(\frac{1}{\sigma_i^2} X_i' X_i \hat{\theta}_i + \Sigma^{-1}\mu\right) \tag{3}$$

where X_i is the matrix of returns on the four factors plus the intercept, $\hat{\theta}_i$ is the OLS parameter estimate, and σ_i^2 is the variance of the errors in (2). The corresponding covariance matrix is given by:

$$V(\theta_i) = \left(\frac{1}{\sigma_i^2} X_i' X_i + \Sigma^{-1}\right)^{-1} \tag{4}$$

As the prior mean μ and the prior covariance matrix Σ in eq. (3) and (4), we take the cross-sectional averages of the time series OLS estimates of the coefficients of (2) and their corresponding empirical covariance matrix for all funds in the cross section of our sample in a

given 12-month formation period.[10] Thus, we have the same priors for all funds in a given month. According to eq. (3), the posterior estimate of θ_i is the matrix-weighted average of the prior μ and the OLS estimate $\hat{\theta}_i$; the same holds for the posterior estimate of the covariance matrix in eq. (4).[11]. Confidence in the prior is the reciprocal of the estimation efficiency of the OLS estimate for each fund. Thus, the empirical Bayesian adjustment 'shrinks' any extreme parameters towards the mean of the prior, where the degree of shrinkage depends on the cross-sectional dispersion of the parameters, given by Σ. The Bayesian adjustment is greater, the lower the estimation efficiency of the funds' OLS parameters. The intuition is that it is less likely for a fund to generate high alphas if all other funds generate relatively low alphas during the same period. However, the posterior distribution of θ_i also takes the multivariate nature of the coefficients' dependency into account: e.g. if small-cap funds tend to have positive alphas (i.e. there is a positive correlation between α_i and β_{2i} in eq. (2)), a potentially negative OLS estimate of a small-cap fund *i*'s alpha receives a positive adjustment by the Bayesian approach.

This argument is similar to the methodology of Cohen, Coval and Pastor (2005) who, in addition, take the similarity in investment strategies into account. They attribute a higher skill level to fund managers who deliver their outperformance with a similar strategy to other skilled fund managers in comparison with managers who used a completely different strategy. The latter are classified as lucky rather than skilled. Consequently, alpha-sorting based on Bayesian

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[10] Specifically, we estimate time-series OLS regressions for each of the *N* funds in the data set for months 1 to 12. We average the *N* $\hat{\theta}_i$ estimates to form μ and use the empirical covariance matrix of these *N* $\hat{\theta}_i$ estimates to form Σ. We plug μ and Σ into eq. (3) and (4) to obtain the mean and variance of the posterior distribution of θ_i for month 13. We repeat this process using the observations in months 2 to 13 in order to obtain the posterior distribution in month 14. We continue until the end of our data set using these rolling windows.

[11] HV experimented with various methods to obtain the posterior estimates, namely simple linear shrinkage, iterative Bayesian, and Gibbs sampling, but found that these other methods for estimating the posterior did not improve on their empirical Bayesian approach, and therefore we follow HV in adopting the same approach.

four-factor alphas accounts for a risk-adjustment of the performance measure used for the ranking, corrects for different investment styles and reduces the influence of high-risk strategies on the ranking. We also compare these results with portfolio formation based on raw returns, but we believe that, in contrast to the raw return-sorting, the Bayesian alpha-sorting provides a much more reliable separation between skilled and unskilled but lucky fund managers.[12]

3.2.b. REGRESSION

We also perform a pooled regression with the difference in annualized performance between the evaluation year and the formation year as the dependent variable. These performance changes over time are then regressed on a set of control variables, including net inflows and a manager change dummy. This regression offers additional insights into the impact of fund flows and manager changes on fund performance over time. Furthermore, it provides us with the opportunity not only of separating the effects of fund flows and manager changes, but also of measuring their marginal impact and their interaction with other fund characteristics.

4. EMPIRICAL RESULTS

4.1. PERFORMANCE PERSISTENCE

Figure 2 reveals that our results on the dynamics of mutual fund returns over time are consistent with the earlier conclusions of Carhart (1997) who reported a lack of performance persistence and a strong tendency for performance to mean revert. Specifically, the top ten percent of funds (winner funds)[13] generate raw returns in the formation year of 1.45 percent per month which decline to 0.59 percent per month in the subsequent evaluation year. The bottom ten percent of

[12]The average fund flows in the deciles and subgroups are not qualitatively different when we form portfolio deciles based on raw returns instead of the Bayesian four-factor alphas. One might conjecture raw returns are more relevant because retail investors are unlikely to calculate four-factor alphas. The subgroups should not be affected as we explicitly use fund flows as a second sorting mechanism.

[13] Determined by having the highest 10 percent of Bayesian four-factor alphas.

funds (loser funds), in contrast, experience a mean reversion in raw returns from -0.36 to 0.34 percent per month. In other words, a raw return spread of 1.81 percent per month (21.72 percent per annum) in the formation year declines to 0.25 percent per month (3.00 percent per annum) in the evaluation year. Having established that performance persistence is mean reverting amongst both winner funds and loser funds, we now investigate how fund flows and manager changes affect these results.

[Please insert **Figure 2** about here]

4.2. WINNER FUNDS

Winner funds, on average, have a formation-period fund size of 794.0 million USD, receive 8.5 million USD of new net inflows per month and the manager changes in 17 percent of the cases (Table 2). They grow to an average size of 1,037.0 million USD in the evaluation period due to internal (investment performance) and external growth (fund flows). Conditioning on fund flows, we separate winner funds into a subgroup with "low absolute net inflows" during the formation period averaging -5.6 million USD per month and a subgroup with "high absolute net inflows" averaging 22.6 million USD per month, a significant difference of 28.2 million USD. The fraction of managers leaving winner funds is the same for both subgroups at 17 percent, but winner funds with low absolute net inflows tend to be smaller (675.0 million USD) than winner funds with high absolute net inflows (976.4 million USD).[14] Conditioning on manager changes yields a subgroup "without manager change" which has slightly higher inflows and a larger average fund size compared to the subgroup "with manager change" (Table 2, panel (c)).

[14] According to Chen et al. (2004), differences in fund size affect fund performance. However, using relative net inflows instead of absolute net inflows yields more uniformly distributed subgroups with respect to fund size, but with very similar conclusions with respect to investment performance. Thus, our results do not seem to be affected by differences in fund size. This conclusion is also supported by the pooled regression results (Table 9).

[Please insert **Table 2** about here]

Winner Decile-10 funds, on average, generate alphas of 0.01 percent per month, equivalent to a mean reversion from the formation to the evaluation period of -0.81 percentage points per month (Table 3, panels (a) and (c), and Figure 3). Winner funds experiencing neither inflows nor a manager change outperform the benchmark model (2) by 0.08 percentage points per month, though this is not significantly different from zero. This corresponds to a significant mean reversion of only -0.69 percentage points per month. Winner funds suffering from both high inflows and a manager change generate negative, albeit insignificant, alphas of -0.11 percent per month, equivalent to a significant mean reversion of -0.96 percentage points per month. The evaluation-period spread in alphas of 0.19 percentage points per month between winner funds suffering from neither mechanism and those experiencing both is significant, both in statistical and economic terms (0.19 = 0.08 (low/ without) – (-0.11) (high/ with), Table 3, panel (a)). The difference in raw returns between winner funds suffering from both equilibrating mechanisms and those affected by neither one is also striking: raw returns of the former revert to equilibrium at -1.16 percentage points per month compared with -0.62 percentage points per month for the latter (Table 4, panel (c)). We conclude from this that fund flows and manager changes acting together strongly contribute to mean reversion in winner-fund performance.

[Please insert **Tables 3** and **4** and **Figure 3** about here]

As we have seen in Table 2, panel (b), the occurrence of a manager change seems to be independent of fund flows, since, on average, 17 percent of managers change each year in both subgroups with high and low net inflows. The difference in fund flows between winner funds without and those with a manager change is statistically significant but economically small at

3.6 million USD. We conclude that the incidence of one mechanism does not affect the likelihood of the other mechanism occurring.

Even though the occurrence of either mechanism appears to be independent, controlling for one mechanism could still alter the impact of the other mechanism on future investment performance. In fact, this is what we find. Among winner funds, there is evidence that the two mechanisms interact as complements. If there is a manager change, fund inflows have a significantly negative impact on performance of 0.22 percentage points per month, whereas if there is no manager change, the differential effect of low and high fund inflows is only 0.13 percentage points per month (Table 3, panel (a)). When controlling for fund flows and investigating the effects of a manager change, the spread in alphas is an insignificant -0.03 percentage points per month for the low-inflow subgroup, but a positive, though insignificant 0.06 percentage points per month for the high-inflow subgroup, in contrast with the case of a manager change (Table 3, panel (a)). Comparing the single sorting results, fund flows have a powerful effect on performance with the spread in alphas between the low inflows and high inflows groups being a significant 0.15 percentage points per month. In contrast, a single sort on the change in manager has little effect on the performance of these winner funds with only a 0.01 percentage points per month spread. We conclude that fund flows by themselves and also in conjunction with manager changes significantly affect winner-fund performance and are complementary to each other. High net inflows are more harmful for subsequent performance than a manager change, possibly as a result of the transaction costs triggered by a liquidity-induced increase in trading.

Finally for winner funds, we examine portfolio risk changes between the formation and valuation periods. Table 5 presents the standard deviations of monthly returns for each winner

fund sub-group and the spread portfolios. In addition, the fractions of the standard deviation explained by systemic risk according to the four-factor model (2), are reported in square brackets underneath each standard deviation. Table 5, panel (c) shows that winner funds significantly increase risk between the two periods by 0.33 percentage points per month irrespective of whether there is a manager change or whether inflows are high or low. However, the increase in risk is much larger (0.43 percentage points per month) if there is no manager change and if the fund is experiencing high inflows. The increase in risk is much weaker (0.07 percentage points per month), and not statistically significant, in the case of a manager change and low inflows. These findings are consistent with the presence of an overconfidence bias in investment decision making by successful fund managers. Comparing the changes in these systematic and idiosyncratic values between the formation and evaluation periods for each portfolio, it can be seen that there are only very minor changes between the formation and evaluation periods, so the changes in risk must be explained by both systematic and idiosyncratic components (Table 5, panels (a) and (b)).

[Please insert **Table 5** about here]

4.3. LOSER FUNDS

Loser funds, on average, are smaller compared with winner funds with total net assets of 700.4 million USD in the formation period (Table 6). Fund size remains relatively stable over time and decreases only slightly to 681.0 million USD in the evaluation period. This is explained by net inflows being negative, as expected, although small in magnitude at only -2.3 million USD per month, on average. It is clear that many investors are reluctant to withdraw money from poorly performing funds. We sort the loser-decile-1 funds into two subgroups on the basis of net inflows, one experiencing the lowest net inflows (i.e., the largest outflows) averaging -12.4

million USD and the other with high net inflows averaging 7.8 million USD. The difference in average fund flows between the low- and high-fund-flow subgroups of loser funds is only about two-thirds as large as the same difference for winner funds (20.2 million USD versus 28.2 million USD). Loser funds with high net inflows and a manager change are the smallest subgroup in the formation period with a size of 374.1 million USD, while loser funds experiencing both governance mechanisms simultaneously are the largest at 688.6 million USD (Table 6, panel (c)).

[Please insert **Table 6** about here]

Tables 7 and 8 report the interaction of the two governance mechanisms and fund performance (see also Figure 4). Loser-fund performance, on average, reverts from alphas of -0.89 percent per month in the formation period to a still significantly negative -0.21 percent per month in the evaluation period, a statistically significant performance improvement of 0.68 percentage points per month (Table 7, and Figure 4). However, distinct differences emerge in evaluation-period performance when conditioning on both governance mechanisms. Loser funds that benefit from both mechanisms have insignificant alphas of -0.09 percent per month in the evaluation period compared with significant alphas of -0.90 percent per month in the formation period which corresponds to a striking degree of mean reversion of 0.81 percentage points per month. Funds without either form of governance mechanism continue to significantly underperform by -0.25 percentage points per month, regressing to the mean by only 0.63 percentage points per month. The spread in alphas between loser funds experiencing both governance mechanisms and those not benefiting from either is a highly significant 0.16 percentage points per month (0.16 = -0.09 (low/ with) – (-0.25) (high/without), Table 7, panel (a)). Differences in mean reversion based on

raw returns are even more pronounced: the raw returns of loser funds with a manager replacement and low net inflows improve by a (weakly) significant 0.84 percentage points per month; while the raw returns of loser funds without a manager change and high net inflows improve by an insignificant 0.56 percentage points per month (Table 8, panel (c)). Thus, if operating simultaneously, the internal and external governance mechanisms strongly contribute to an improvement in loser-fund performance.

[Please insert **Tables 7** and **8** and **Figure 4** about here]

How do both mechanisms contribute to this effect? A comparison of the characteristics of the subgroups reveals that the internal and external governance mechanisms interact positively: funds with low net inflows have a higher fraction of manager changes (22 percent) than funds with high net inflows (16 percent) and funds with a manager change have lower net inflows (-4.5 million USD per month) than funds without (-1.8 million USD per month) (Table 6, panels (a) and (b)). Moreover, internal and external governance among loser funds are also complements in terms of their performance impact. The alpha spread between loser funds with low net inflows and those with high net inflows is significantly positive at 0.19 percentage points per month only when internal governance is operating at the same time. If there is no internal governance, this spread is a weakly significant 0.08 percentage points per month (Table 7, panel (a)). Conversely, the spread between loser funds with a manager replacement and those without is positive but insignificant at 0.08 percentage points per month if money is flowing out of the fund at the same time, while it is negative and also insignificant at -0.03 percentage points per month if outflows do not occur. Also internal governance seems to be more effective if external governance is simultaneously operating.

The results for raw returns are similar though slightly smaller in magnitude, especially in the case where both mechanisms are not operating simultaneously. In fact, outflows appear to improve loser-fund raw returns by significant 0.21 percentage points per month in combination with a manager replacement, although the low-minus-high raw-return spread is still a positive but insignificant 0.08 percentage points per month in the case of no manager change (Table 8, panel (a)). Compared with the similar sized alpha spread of the same subgroup, this implies that fund managers who stay with the fund do not seem to use the outflows to re-optimize their portfolio by bringing in new investment ideas, but merely scale down existing investments in a way that reduces unfavorable factor loadings in the benchmark model. Specifically, loser funds without outflows have significantly negative momentum loadings, while those experiencing outflows reduce these loadings to levels close to zero (not reported in the tables).

We conclude from this that loser funds suffer from two types of disposition effect: one due to investor behavior and one due to the actions of the fund management company. It appears that a large fraction of loser-fund investors are reluctant to withdraw their money. This behavior is consistent with a disposition effect whereby investors are hesitant to realize losses and so stay invested in the hope that the fund price eventually returns to the original purchase price. However, our results show that staying invested in loser funds is a sub-optimal strategy, because performance remains negative. In contrast, investors could earn 0.08 percent per month abnormal returns by switching to previous-year winner funds with lower inflows and no manager change (Table 3, panel (a)). The second disposition effect relates to the reluctance of the fund management company to fire the underperforming manager. Even when outflows occur, as in case of the low-inflow subgroups, the performance of existing fund managers does

not respond positively to the smaller asset base. It is only when outflows are combined with a manager change that performance improves.

Finally for loser funds, we examine risk changes between the formation and evaluation periods. Table 9, panel (b) shows that managers with low net inflows (i.e., high outflows) who are subsequently fired take on significantly (at 10 percent level) higher risk (5.49 percent per month) in the formation period than managers with low net inflows who are not fired (5.43 percent per month). Panel (c) shows that loser funds reduce risk between the two periods irrespective of whether there is a manager change or whether inflows are high or low. The reduction in risk is the same whether there is a change in manager or not (-0.18 percentage points per month). These results provide support for the predictions by Dangl et al. (2008).[15] As with the winner funds, there are only slight changes in the systematic and idiosyncratic risks between the formation and evaluation period for each portfolio.

[Please insert **Table 9** about here]

4.4. WINNER-LOSER SPREADS

We now extend our analysis and explore the effect of the two equilibrating mechanisms on the subsequent spread in winner and loser portfolio returns. The spread in alphas between winner and loser funds for the 12-month portfolio formation period is 1.71 percentage points per month, obtained as the difference between the unconditional alphas in panel (b) of Table 3 (0.82 percent per month) and panel (b) of Table 7 (-0.89 percent per month). The spread in alphas between the winner and the loser portfolio is 0.22 percentage points per month for the 12-month evaluation period, obtained as the difference between the unconditional alphas in panel (a) of Table 3 (0.01

[15] A comparison between Table 9 and Table 5 reveals that risk taking is generally higher in winner funds than loser funds during both the formation and evaluation periods.

percent per month) and panel (a) of Table 7 (-0.21 percent per month). This spread is similar to the winner-minus-loser spread in the Carhart (1997) study, although his spread is statistically significant.

A key issue now is how this spread is affected by the equilibrating mechanisms. Specifically, we compare the performance of the winner and loser portfolios in six different scenarios, which are defined in panel (a) of Table 10. Panel (b) reports the corresponding alphas (see also Figure 5). In the first column of panel (b), we report the alphas of funds that experience neither equilibrating mechanism. Our hypotheses suggest that we would expect to find the highest level of positive and negative performance persistence among these funds. The next two columns report the performance results when either manager changes or fund flows are not operating. The fourth column reports the unconditional winner-minus-loser spread, not taking fund flows or manager changes into account. The next two columns report the results for funds that experience one of the mechanisms. In the last column, the results where both mechanisms operate simultaneously are reported. In this last case, we would expect to find the strongest tendency of fund performance to revert to the mean.

[Please insert **Table 10** and **Figure 5** about here]

We find that winner and loser funds that experience neither mechanism yield a highly significant winner-minus-loser spread of 0.34 percentage points per month (Table 10, panel (b) and Figure 5). This spread falls when conditioning on funds not experiencing a manager change (but without conditioning on fund flows). For the unconditional winner-minus-loser spread portfolio, alphas turn out to be an insignificant 0.22 percentage points per month as noted above. This spread decreases further when concentrating only on funds that experience either the

manager-change mechanism or the fund-flow mechanism to an insignificant 0.20 and 0.09 percentage points per month, respectively. For winner and loser funds that experience both equilibrating mechanisms simultaneously, we find an insignificant spread between winner and loser funds of -0.02 percentage points per month. Thus, when investors and managers take advantage of outperformance or react to underperformance in the formation period, the equilibrium processes force the spread between previous winner and loser funds to become virtually zero (-0.02 percentage points per month) in the evaluation period. In contrast, if funds are not exposed to these mechanisms, the spread is a significant 0.34 percentage points per month. The equilibrating mechanisms seem to be able to explain the reduction in the winner-minus-loser spread by 0.36 percentage points per month. This highlights the importance of fund flows and manager changes in explaining mean reversion in mutual fund performance and why mutual fund performance is unlikely to persist in well-functioning markets.

4.5. ROBUSTNESS TESTS[16]

In this section, we report the results of a number of tests on the robustness of the above findings. First, we report rankings based on returns adjusted for peer-group benchmarks, since these are widely used by practitioners for evaluation purposes. We classified funds in our sample into 13 styles: large-cap, mid-cap, small-cap, growth, growth & income, income, sector funds (financial, health, natural resources, technology, utilities, other), and other. We defined peer-group-adjusted returns as the difference between the fund's returns and the average returns of all peer-group funds with the same fund style. The results from evaluating performance from a ranking based on these peer-adjusted benchmark returns are presented in Table 11. Compared with the results for raw returns, the rankings by benchmark-adjusted returns do not change greatly. The

[16] We are grateful to a referee for suggesting these tests.

one exception is for the returns of winner funds with manager change but low net inflows which are significantly lower: the corresponding "low minus high" spread is no longer significant for this subgroup, although it remains significant when not conditioning on manager change.

[Please insert **Table 11** about here]

Second, to control for the fact that estimation errors are potentially not independently distributed in the cross section of funds, we estimated the model recently suggested by Hunter, Kandel, Kandel and Wermers (2014) which adds an active peer benchmark (APB) to the four-factor model. Adding an APB factor can help to account for dynamically changing "commonalities" across fund returns (as a result of the funds following similar investment strategies) and improve the estimation of the prior covariance matrix (see also Pastor and Stambaugh, 2002). Hunter et al. (2014) show that the APB factor can explain a significant proportion of the cross correlation between the residuals in the four-factor model for the different funds. In particular, they show that the within-group (individual fund pair) residual correlations are decreased by one-third to one-half of their prior levels, depending on the peer group. This indicates that the APB factor successfully captures common idiosyncratic risk-taking within peer groups. The APB factor for each peer-group is estimated as the residual series from a regression of an equal-weighted portfolio of all funds with the same investment style on the standard four factors in eq. (2). We use the same 13 investment styles as for the peer-group-adjusted returns listed above.

[Please insert **Table 12** about here]

Table 12 reports the performance evaluation results from ranking funds on the basis of this APB adjustment, and these results can be compared with the performance results from the

standard benchmark model in Tables 3 and 7. The results are robust to the addition of the APB factor for ranking on past performance. For winner funds, the alphas in panel (a) of Table 12 are in general similar to those in panel (a) of Table 3. There is again one exception: winner funds with low inflows and manager change now significantly outperform the benchmark model (2) by 0.23 percentage points per month (without the APB adjustment, the outperformance was an insignificant 0.11 percentage points per month). The results for loser funds are quantitatively very similar, comparing panel (b) of Table 12 with panel (a) of Table 7.

Finally, in an unreported robustness test, we addressed the concern that in our empirical Bayesian approach the prior and conditioning information are potentially not independent because the prior is the cross-sectional mean (θ_i) of all the funds in the sample which includes the fund *i* under consideration. We therefore re-estimated the model using the cross-sectional median rather than the mean as the prior to reduce the effect of any outliers. However, this does not significantly affect our results; monthly alphas only change by 1-2 basis points and, in a very few cases, by 3 basis points.

4.6. REGRESSION ANALYSIS

In this section, we perform a pooled regression of the change in annualized Bayesian four-factor alphas between the formation and evaluation periods (each 12 months long) on relative net inflows, manager changes and a set of other control variables documented in the literature as having an influence on performance. Over this time-frame, fund flows and manager changes will be simultaneously determined with the change in performance, and we allow for potential endogeneity by estimating a system of equations using three-stage least squares (3SLS). In the first stage, the endogenous regressors (change in performance, fund flows, and manager change) are regressed against predetermined and exogenous control variables (all the other variables in

the system), and their predicted values are used as instruments in the second stage regressions. The third stage estimates the model using generalized least squares (GLS) to allow for the correlation structure in the disturbances across the three structural equations in the system. We focus on relative flows to ensure comparability across funds. The aims of the regression analysis are threefold: first, by controlling for other performance determinants, we are able to measure the marginal impact of fund flows and manager changes, as well as the interaction with other control variables, and hence identify the factors that explain why the equilibrating mechanisms work for some funds but not others; second, it allows us to analyze the performance impact of both equilibrating mechanisms over time; and third, it serves as a further robustness check on the ranked portfolio results.

In our first model, we include the following predetermined control variables: fund size (measured by total net assets, TNA), fund fees, fund age and the portfolio turnover ratio.[17,18] In addition, following the models of fund flows by Sirri and Tufano (1998), and Del Guercio and Tkac (2002) potential instruments used for fund flows are lagged fund performance and the predetermined control variables; and following Khorana (1996) the same instruments are used in the manager change equation.[19] The Hansen *J*-test identified lagged flows and lagged portfolio turnover as valid instruments for fund flows, and with these instruments the Durbin-Wu-Hausman test for regressor endogeneity confirmed that fund flows are indeed endogenous. We

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[17] Chen et al. (2004) and Cremers and Petajisto (2009) find a negative effect of fund size on performance; Carhart (1997) documents a negative effect from fees; Huij and Verbeek (2007) and Karoui and Meier (2009) report an outperformance by young funds. Results on turnover are ambiguous. Elton et al. (1993) and Carhart (1997) find a negative relationship, Wermers (2000) documents that turnover is unrelated to fund performance, while Dahlquist, Engstroem, and Soederlind (2000) and Chen, Jegadeesh, and Wermers (2000) find a positive relationship.

[18] The portfolio turnover ratio is defined as the minimum of aggregated sales and aggregated purchases of securities, divided by the average 12-month total net assets of the fund. It measures the fraction of the portfolio traded over the previous 12 months.

[19] Because the same instruments are used in both the fund flows and manager change first-stage reduced-form regressions, it was not possible to identify both of these equations, and we subsequently only allow for the endogeneity of fund flows.

also test for weak instruments, and can confirm that the null of weak instruments is rejected using the Stock-Yogo criteria. The results with these instruments estimated using 3SLS are presented in Table 13. Because there is a strong tendency for the extremes in fund performance to revert to the mean, we add to our regression two dummy variables that indicate whether a fund is currently in decile 10 (winner) or decile 1 (loser), based on previous-year performance. These dummies capture the pure mean reversion effect and ensure that the other coefficients are not biased. The key variables of interest are net inflows and the manager change dummy.[20] We also include an interaction term between fund flows and the decile-10 and decile-1-dummies in order to analyze the differential effects of fund flows on performance in the top and bottom funds. Similarly, we use a manager-change dummy indicating whether the fund manager has been replaced during the previous year and an interaction term between manager change and the decile-10 and decile-1 dummies.

In a second model, we analyze the impact of being a small-cap or a sector fund on performance and the marginal impact of fund flows on winner and loser funds that belong to these two investment-style categories. We anticipate that capacity constraints are more prevalent in narrow and illiquid markets where transactions costs are higher and, as a result, fund flows have a stronger impact on performance in these investment categories. A third model investigates the interaction effect between a manager change and the fund being a member of a large fund family. Gervais, Lynch, and Musto (2005) argue that the replacement of an underperforming manager in a large fund family reveals more information than the replacement of a manager in a small fund family. We assign a fund to the large-family group if its fund

[20] We winsorize all variables at the 1st and 99th percentile to avoid any influence from extreme outliers.

family was in the top 30 percent of fund families by number of funds offered at the end of the previous year.

A fourth model assesses the interaction between the manager-change and fund-flow mechanisms. Specifically, we include a dummy for winner funds that have higher-than-median net inflows and a manager change and a dummy for loser funds that have lower-than-median net inflows (i.e., net outflows) and a manager change.

Since we measure the change in performance between consecutive 12 month periods, a significant coefficient on one of the control variables would indicate a trend in performance over time. Table 13 indicates that, across all models, each billion USD increase in TNA reduces alpha by 0.09 percentage points per annum. The decile-1 and decile-10-dummies are both highly significant and indicate that loser funds improve their annualized alphas by 6.91 to 6.92 percentage points per annum in the following year, irrespective of the specific model, while the alphas of winner funds deteriorate by 7.10 to 7.14 percentage points per annum in the following year, before conditioning on any other variable. These findings, indicating strong mean reversion, are consistent with the results of the ranked portfolio tests.

[Please insert **Table 13** about here]

We document a significant negative relationship between relative net inflows and subsequent performance. An increase in relative net inflows by one standard deviation during the previous year decreases the alpha for the average fund by 0.65 (= -0.49 x 1.33) percentage points per annum on average in the following year.[21] Model 1 reveals that performance decreases by an additional 0.63 (= -0.47 x 1.33) percentage points per annum for winner funds,

[21] 1.33 is the standard deviation of relative fund flows, not reported in the tables.

although this decrease is not statistically significant. Controlling for a fund's market segment shows that performance decreases by a significant additional 1.52 (= -1.14 x 1.33) percentage points per annum if the winner fund is a small-cap or sector fund and receives high inflows (Models 2-4). This supports the notion that capacity constraints are partly driven by transaction costs.

A manager change has a significant positive impact on the average fund, but if the manager of a winner-decile-10 fund changes, performance subsequently significantly deteriorates by between 1.10 and 1.14 percentage points per annum in the following year, according to Models 1-3. The more general Model 4 shows that this effect operates through fund flows: winner funds that lose their manager, while also experiencing above-median net inflows, experience an average deterioration in performance of 2.17 percentage points per annum in the following year. Thus, the pooled regression results confirm the complementary of the interaction between the mechanisms among winner funds identified in the ranked portfolio tests. If the star manager of a large fund family leaves, the effect is not significantly different from the case in which the manager of a small fund family departs, implying that not even large fund families have access to the fund management skills that would prevent the deterioration in performance following the loss of a talented manager.

For loser funds, there is an improvement in alpha of 1.40 (= (0.49 + 0.56) x 1.33) percentage points per annum following a one standard deviation increase in relative outflows, although this effect is not significantly different from the general performance improvement of 0.65 percentage points per annum for the average fund (Model 1). Further, being a small-cap or sector fund has little effect on the relationship between outflows and subsequent performance (Model 2). The improvement in performance following a manager change, although positive, is

insignificant for a typical loser fund, according to Models 1 and 2. However, the more sophisticated Models 3 and 4 reveal that replacing an underperforming manager in a fund belonging to a large fund family improves performance significantly by an additional 1.84 to 1.90 percentage points per annum in the following year. This finding supports the predictions of Gervais, Lynch, and Musto (2005) that a manager replacement in a large family contains more information, particularly if it is associated with an underperforming manager. Model 4 additionally shows a strong interaction between the two mechanisms: if loser funds fire their manager, while also experiencing above-median outflows, this results in an aggregate performance improvement of 2.86 percentage points per annum in the following year – although this is attenuated by a deterioration of 1.72 percentage points per annum as a result of the pure effect of a manager change in a bottom performing fund. These results support the findings from the ranked portfolio tests that manager changes and fund flows work together to prevent performance persistence.

5. CONCLUSIONS AND IMPLICATIONS

We have examined the role of fund flows and manager changes as equilibrating mechanisms that explain the elimination of persistence in mutual fund performance over time. Using a CRSP sample of 6,207 actively managed U.S. equity mutual funds over the period from 1992 to 2011, we find that a significant part of the mean reversion in winner funds and loser funds can be explained by the two mechanisms operating together, i.e., by the responses of investors, fund managers and fund management companies to past performance.

In the case of winner funds, these effects are much more important in explaining below-average performance than, say, the impact of fees. We provide empirical support for the Berk and Green (2004) hypothesis that inflows of new money have a significant effect in inducing

mean reversion and are more important than manager changes. Both mechanisms together cause a reduction in risk-adjusted performance of 0.19 percentage points per month (2.28 percentage points per annum), and they appear to operate in a complementary manner to each other. For loser funds, fund flows (which we associate with external governance) and manager changes (which we associate with internal governance) also complement each other. There is little significant impact on risk-adjusted returns when one of the mechanisms is operating alone. But when both governance mechanisms operate simultaneously, the risk-adjusted performance of loser funds improves by 0.16 percentage points per month (1.92 percentage points per annum) compared with the subgroup of loser funds that are not subject to either mechanism.

We also analyzed the spread between the subsequent performance of winner and loser funds, as a measure of performance persistence, with and without changes in fund flows and fund management. The comparison of the winner-minus-loser spread reveals that both mechanisms strongly contribute to performance persistence and to mean reversion. The unconditional winner-minus-loser spread is 0.22 percentage points per month (2.64 percentage points per annum) but insignificant. However, when we separate out the effects, we find that conditioning only on those winner and loser funds that are not exposed to both equilibrating mechanisms, the winner-minus-loser spread increases to a highly significant 0.34 percentage points per month (4.08 percentage points per annum), indicating strong performance persistence. When these winner and loser funds experience both types of mechanisms simultaneously, the corresponding spread is dramatically reduced to an insignificant -0.02 percentage points per month (-0.24 percentage points per annum).

In respect of changes in risk taking, we find that winning fund managers increase risk in a way that suggests that they are subject to an overconfidence bias. In the case of losing fund

managers, our results confirm the predictions of Dangl et al. (2008). Loser funds reduce their risk levels irrespective of whether there has been a change of either manager or the level of fund inflows. But, losing fund managers who are subsequently fired take on significantly higher risk in the formation period than managers who are not fired. However, risk taking is generally higher in winner funds than loser funds during both the formation and evaluation periods.

What are the potential implications of these findings? First of all, investors should pay close attention to fund flows and the resulting changes in fund size as well as to the career paths of individual fund managers across different funds: our results suggest that superior past performance is only a reliable indicator of future performance for those cases where the manager remains in post and fund flows are not excessively responsive to past performance. An example of a potentially successful strategy would therefore be to invest in previous-year winner funds with low inflows and no manager change. Following directly from the previous point, it would be very valuable for investors if fund management companies were required to publish regular information on fund flows and report any manager changes immediately.

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Appendix: Data Selection

In constructing our sample, we follow Pastor and Stambaugh (2002) and select only domestic equity funds. We exclude international funds, global funds, balanced funds, flexible funds, and funds of funds. We further drop all funds containing terms in their name that commonly refer to passive vehicles. We require our funds to have at least 12 months of return data available to be included in our sample. Additionally, we drop all observations prior to the IPO date given by CRSP and funds without names in order to account for a potential incubation bias (Evans, 2010). This results in 6,207 funds that existed at some time during our sample period from 1992 to 2011. Different share classes of the same fund have the same manager and fund flows of individual share classes cancel out at the portfolio level. Hence, we combine all share classes that belong to the same fund and have the same underlying portfolio to one observation. We use a matching algorithm that combines information from the fund's name and the portfolio number variable given by CRSP.[22] Fund characteristics, such as the investment objective or the first offer date, are taken from the oldest share class. Quantitative information is either summed up, such as total net assets, or the weighted average over all share classes are taken, such as returns and fees. If two share classes of the same funds have different manager change dates, we use the most recent date. We classify the funds in our sample into three groups: (1) large and mid-cap funds (LMC), (2) small-cap funds (SC), and (3) sector funds (SEC). Because ICDI classification codes are no longer available in the 2011 cut off of the CRSP mutual fund database, we modify the selection criteria of Pastor and Stambaugh (2002) as follows. For our classification, we use Lipper codes, Wiesenberger codes and Strategic Insight codes (priority is given in that order if different codes are not consistent). Details are given in Table 14. A fund is assigned to one of

[22] A matching solely based on the portfolio number variable is not possible, as this variable is available only from December 1998 onwards.

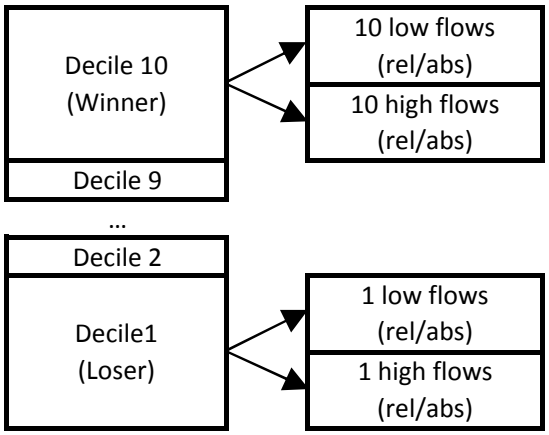
the three groups for the total sample period if it belonged to this group for at least 50 percent of the observations in our sample period. We also classified our sample of domestic equity funds into the following 13 style groups: cap-based funds large-cap; cap-based funds mid-cap; cap-based funds small-cap; style funds growth; style funds growth and income; style funds income; sector funds financial; sector funds health; sector funds natural resources; sector funds technology; sector funds utilities; sector funds other; and other.

[Please insert **Table 14** about here]

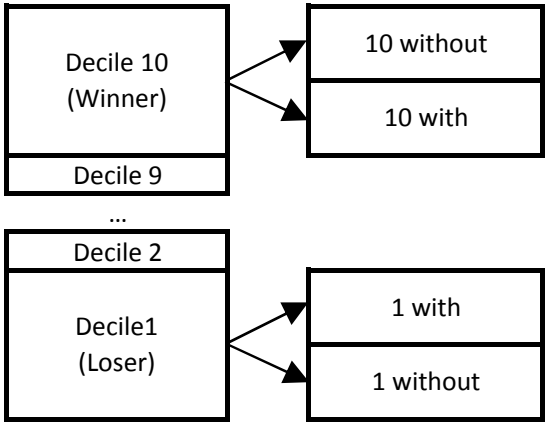
Figure 1: Portfolio formation

This figure presents the methodology we apply to construct the subgroup portfolios. Funds are first sorted into deciles based on their performance in the formation period. Then, the winner (decile 10) and loser (decile 1) funds are further divided into: (a) a low-net-inflow (high-net-inflow) subgroup if the net inflows in the formation period are lower (higher) than the median net inflows of the decile to which the funds belong (we use either absolute net inflows or relative net inflows, but, in the presentation of our results, we concentrate on absolute flows, see also footnote 7); (b) a without (with) manager-change subgroup if the manager remained the same (changed) during the formation period; and (c) into four subgroups combining the criteria in (a) and (b) in a double sorting mechanism.

(a) absolute / relative flows



(b) manager change



(c) double sorting

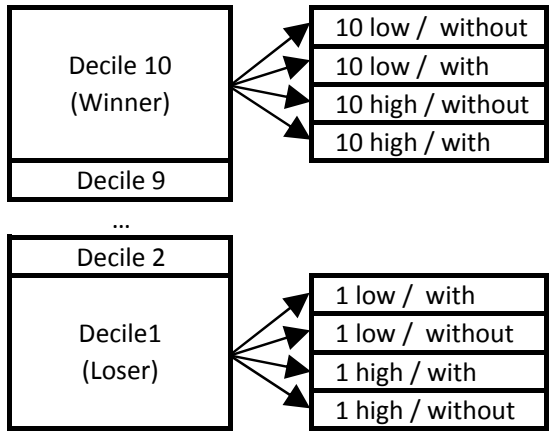


Figure 2: Mean reversion of fund performance

This figure presents the average monthly raw returns in percent of the decile portfolios relative to the evaluation year (t). Portfolios are formed based on previous-year Bayesian four-factor alphas.

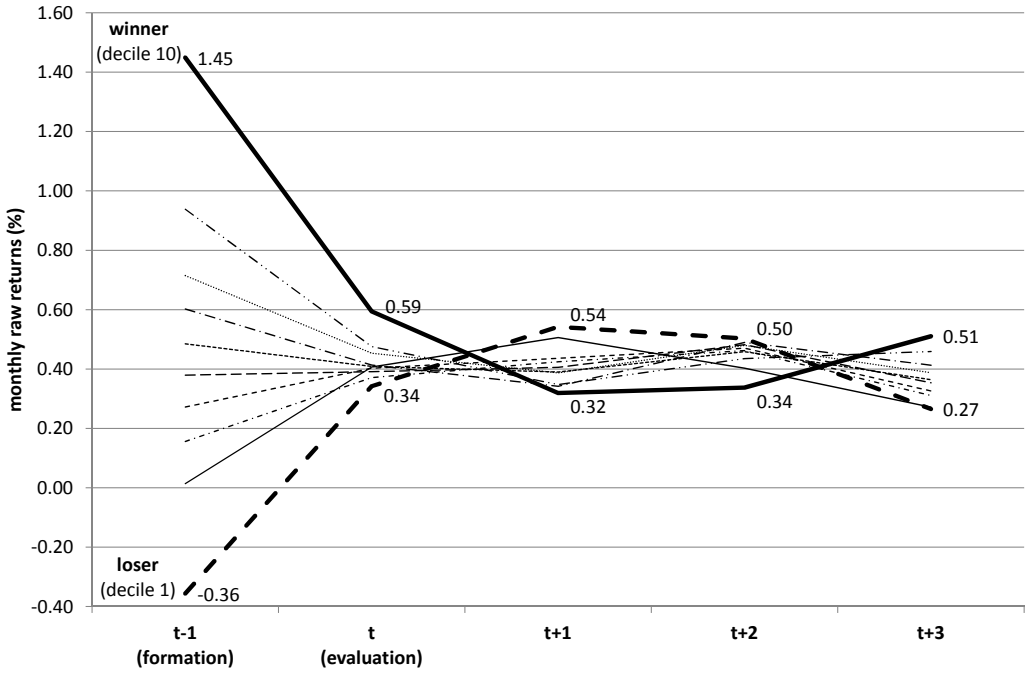


Figure 3: Performance of winner funds and winner-fund subgroups

This figure presents monthly four-factor alphas in percent for winner funds and winner-fund subgroups based on a single sorting and also a double sorting on absolute fund flows and / or manager change. The top panel presents the level of performance (four-factor alpha) in the evaluation period and the bottom panel presents the change in performance between the formation and evaluation periods (Δ alpha). Funds are assigned to the high-net-inflow (high) or low-net-inflow (low) subgroup based on whether their net inflows during the formation period are higher or lower than the median net inflows of all other funds in the same decile. Funds are assigned to the manager-change (with) or no-manager-change (without) subgroup based on whether their fund manager changed during the formation period. Portfolios are formed based on previous-year Bayesian four-factor alphas. ***, ** and * indicate significance at the 1%, 5%, and 10% levels, respectively. White's heteroscedasticity-consistent standard errors are used for the regression coefficients.

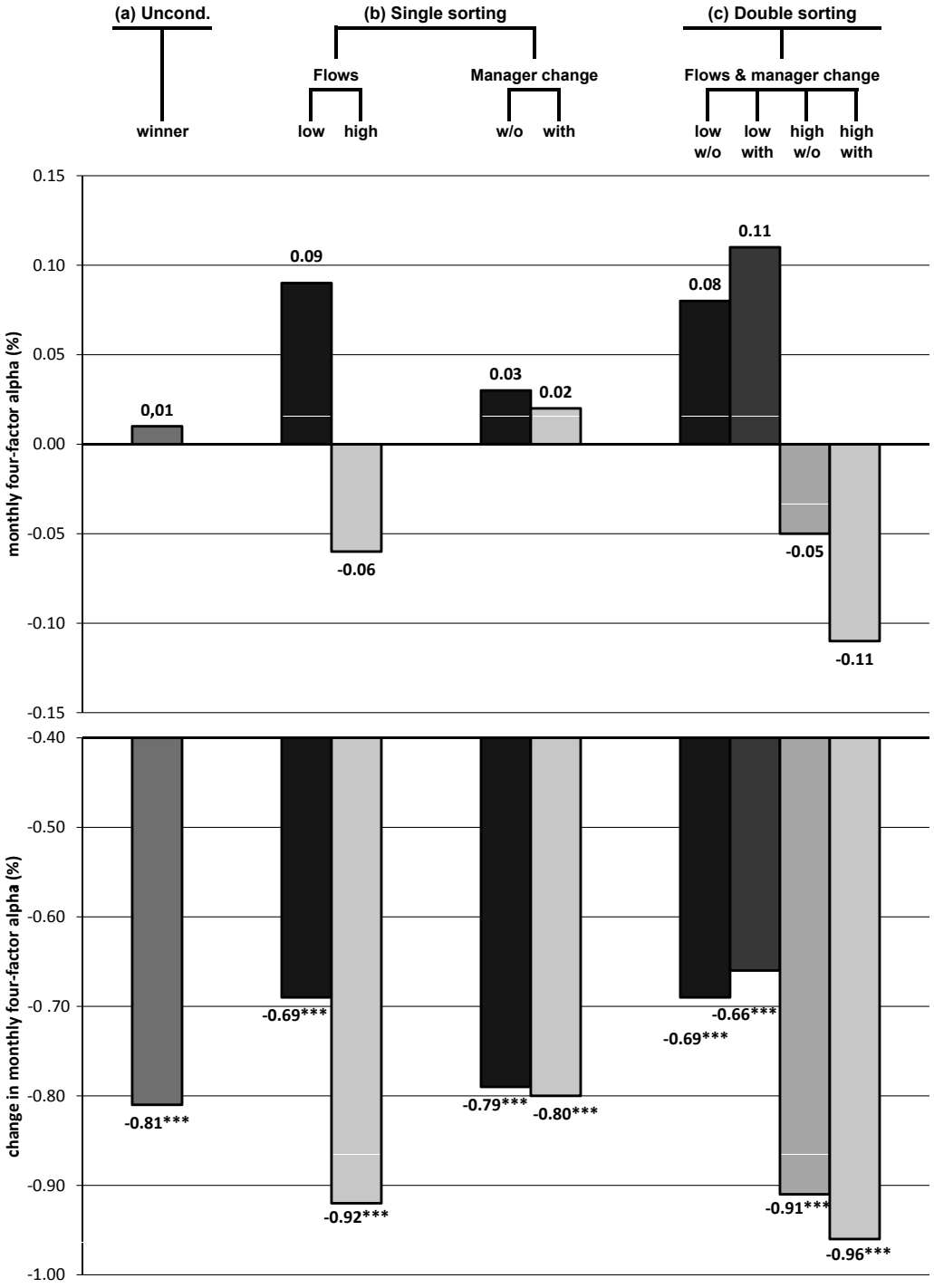


Figure 4: Performance of loser funds and loser-fund subgroups

This figure presents monthly four-factor alphas in percent for loser funds and loser-fund subgroups based on a single sorting and also a double sorting on absolute fund flows and / or manager change. See the note to figure 3 for more explanation.

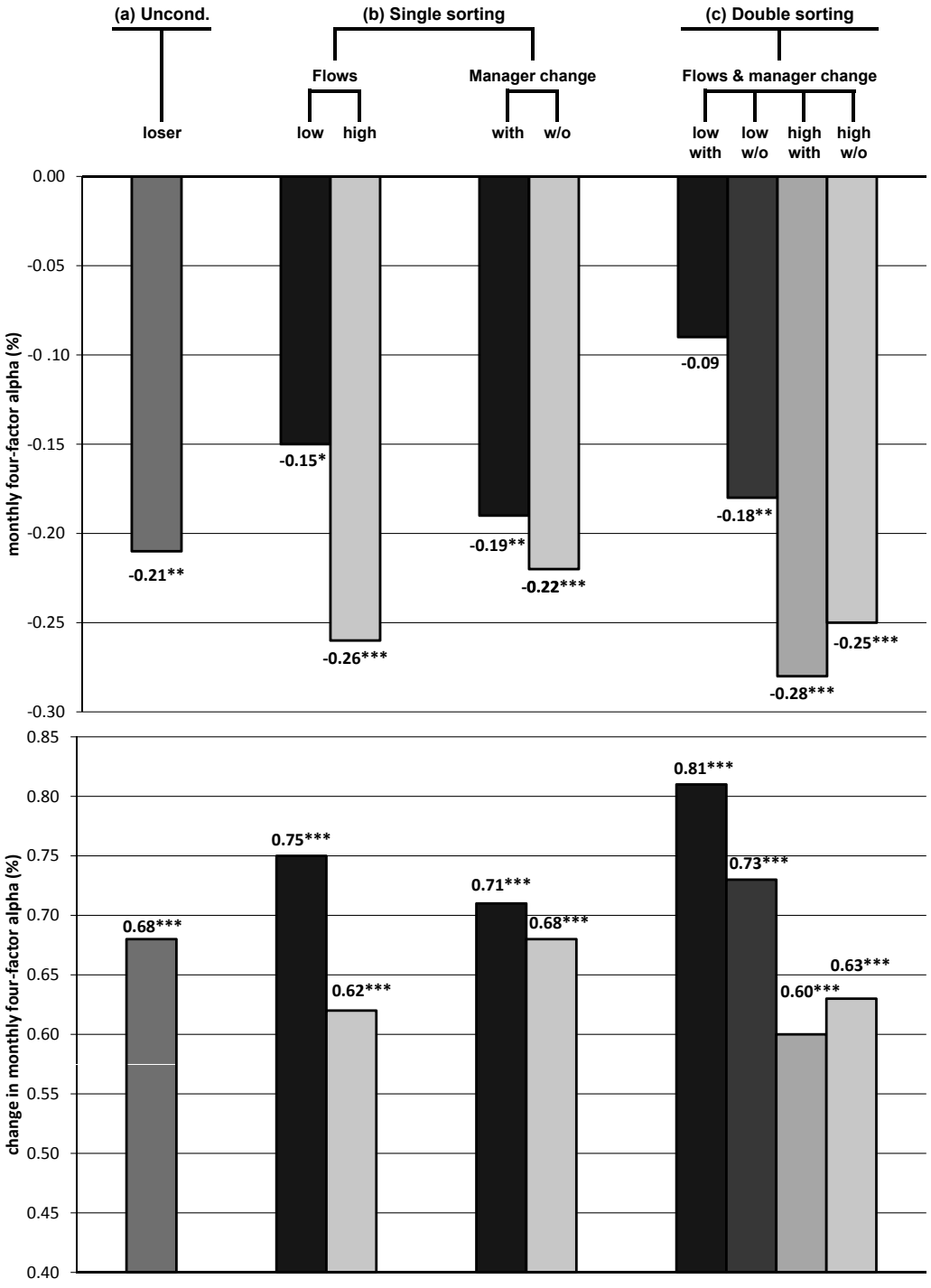


Figure 5: Performance of winner-minus-loser spread portfolios

This figure presents monthly four-factor alphas in percentage points in the evaluation period for the winner-minus-loser spread portfolio based on a single sorting and also a double sorting on absolute fund flows and / or manager change. See the note to figure 3 for more explanation.

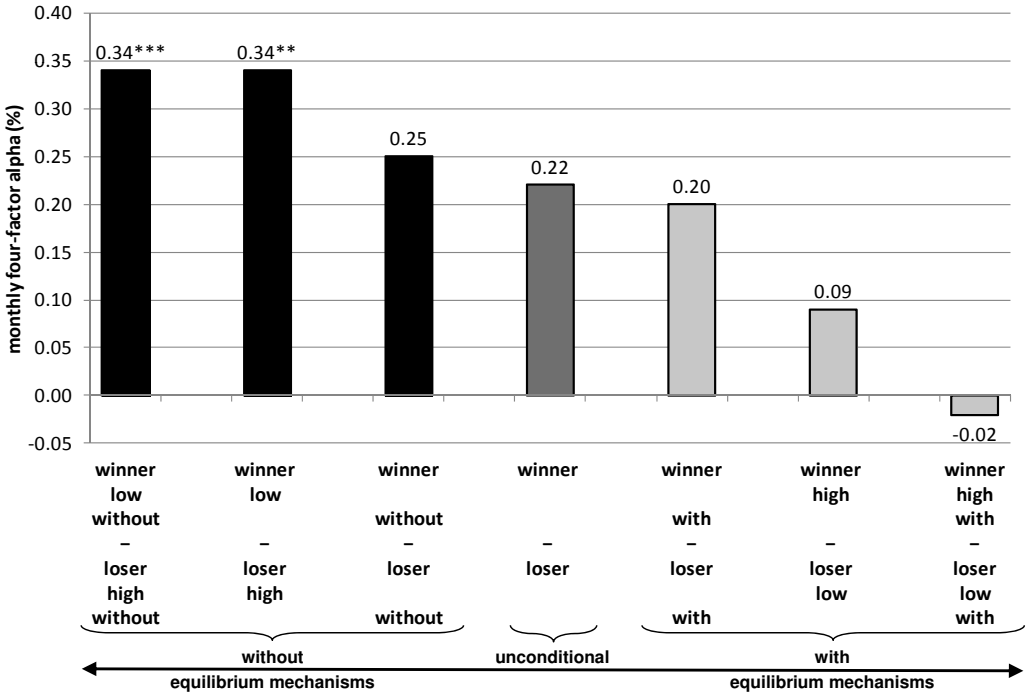


Table 1: Characteristics of the funds in the sample

This table presents the characteristics of the sample of funds for subperiods and for the whole period from 1992 to 2011. We restrict our sample to funds that have at least 12 months of available return data and information on the variable "mgr_date" in the CRSP database (see Appendix). Row (1) reports the number of months in the respective period; row (2) reports monthly (arithmetic) average raw returns in excess of the rate on the risk-free asset in percent; row (3) reports the average portfolio turnover in percent; row (4) reports average fees in percent; row (5) reports the average age of the funds in years; row (6) reports the average fund size in million USD; row (7) reports monthly average absolute net inflows in million USD; row (8) reports the number of funds in existence; and row (9) reports the number of manager changes that occurred during this period.

	subperiods				whole period
	1992–2000	2001–2003	2004–2007	2008–2011	
# months	108	36	48	48	240
raw returns	0.82	-0.29	0.52	0.12	0.36
turnover	105.17	136.15	95.64	92.42	104.42
annual fees	1.45	1.51	1.39	1.36	1.42
fund age	9.74	9.39	11.03	11.97	10.65
fund size	753.68	754.38	1095.53	899.34	875.48
net inflows	5.13	1.35	0.88	1.94	2.57
# funds	3,194	3,374	3,870	4,850	6,207
# man. ch.	3,173	1,517	1,799	1,430	7,919

Table 2: Characteristics of winner funds and winner-fund subgroups

This table presents the characteristics for the winner-fund subgroups and the resulting spread portfolios based on independent sorts on absolute fund flows and manager change. See the note to Figure 1 for more explanation on the portfolio formation. Panel (a) reports average absolute net inflows in the formation period in million USD; panel (b) reports the fraction of funds experiencing a manager change during the formation period; panel (c) reports the average fund size in the evaluation period in million USD; panel (d) reports the average fund size in the formation period in million USD. The first two rows and columns report values conditional on net inflows and manager change, respectively. Row (3) and column (3) report spreads between the subgroups conditional on net inflows and manager changes, respectively. Row (4) and column (4) report unconditional values, i. e. not conditioned on net inflows or manager changes, respectively. ***, ** and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Net inflows	Manager change			
	Without	With	Without − with	All
(a) Net inflows in formation period (flows_{t-1}, in million USD)				
Low	−5.0	−8.4	3.4***	−5.6
High	23.4	18.6	4.9***	22.6
Low − High	−28.4***	−27.0***	−23.6***	−28.2***
All	9.5	5.4	3.6***	8.5
(b) Manager changes in formation period (mgr_ch_{t-1}, in percentage points)				
Low	0	100	–	17
High	0	100	–	17
Low − High	–	–	–	–
All	0	100	–	17
(c) Fund size in evaluation period (TNA_t, in million USD)				
Low	657.6	1,016.1	−358.5***	715.8
High	1,542.1	936.2	605.9***	1,438.6
Low − High	−884.6***	79.9	−278.7***	−722.9
All	1,050.2	966.8	83.3*	1,037.0
(d) Fund size in formation period (TNA_{t-1}, in million USD)				
Low	622.7	947.0	−324.3***	675.0
High	1,055.8	590.0	465.9***	976.4
Low − High	−433.1***	357.1***	32.6	−301.4***
All	801.0	756.9	44.2	794.0

Table 3: Performance of winner funds and winner-fund subgroups

This table presents monthly four-factor alphas in percent for winner funds and the winner-fund subgroups as well as the resulting spread portfolios (in percentage points) based on independent sorts on absolute fund flows and manager change. See the note to Figure 1 for more explanation on the portfolio formation and the note to Table 2 for more explanation on row and column definitions. Panel (a) reports average four-factor alphas in the evaluation period; panel (b) reports average four-factor alphas in the formation period; panel (c) reports the change in four-factor alphas between the formation and evaluation periods. ***, ** and * indicate significance at the 1%, 5%, and 10% levels, respectively. White's heteroscedasticity-consistent standard errors are used for the regression coefficients.

Net inflows	Manager change			
	Without	With	Without − with	All
(a) Four-factor alphas in evaluation period (α_t)				
Low	0.08	0.11	−0.03	0.09
High	−0.05	−0.11	0.06	−0.06
Low − High	0.13**	0.22**	0.19**	0.15***
All	0.03	0.02	0.01	0.01
(b) Four-factor alphas in formation period (α_{t-1})				
Low	0.77***	0.77***	0.00	0.77***
High	0.86***	0.86***	0.00	0.86***
Low − High	−0.09	−0.09	−0.08	−0.09
All	0.82***	0.82***	0.00	0.82***
(c) Change in four-factor alphas ($\Delta\alpha_t = \alpha_t - \alpha_{t-1}$)				
Low	−0.69***	−0.66***	–	−0.69***
High	−0.91***	−0.96***	–	−0.92***
Low − High	–	–	–	–
All	−0.79***	−0.80***	–	−0.81***

Table 4: Raw returns of winner funds and winner-fund subgroups

This table presents monthly raw returns in percent for winner funds and the winner-fund subgroups as well as the resulting spread portfolios (in percentage points) based on independent sorts on absolute fund flows and manager change. See the note to Figure 1 for more explanation on the portfolio formation and the note to Table 2 for more explanation on row and column definitions. Panel (a) reports average raw returns in the evaluation period; panel (b) reports average raw returns in the formation period; panel (c) reports the change in raw returns between the formation and evaluation periods. ***, ** and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Net inflows	Manager change			
	Without	With	Without − with	All
(a) Raw returns in evaluation period (r_t)				
Low	0.65	0.72	−0.07	0.66
High	0.54	0.50	0.03	0.53
Low − High	0.11*	0.21**	0.15	0.13**
All	0.60	0.62	−0.01	0.59
(b) Raw returns in formation period (r_{t-1})				
Low	1.27	1.23	0.04	1.26
High	1.63	1.66	−0.03	1.63
Low − High	−0.35	−0.43	−0.39	−0.37
All	1.46	1.43	0.03	1.45
(c) Change in raw returns ($\Delta r_t = r_t - r_{t-1}$)				
Low	−0.62	−0.51	–	−0.60
High	−1.09**	−1.16**	–	−1.10**
Low − High	–	–	–	–
All	−0.86*	−0.81	–	−0.85*

Table 5: Standard deviations of winner-fund returns and winner-fund subgroup returns

This table presents the standard deviations of monthly returns in percent for winner funds and the winner-fund subgroups as well as the resulting spread portfolios (in percentage points) based on independent sorts on absolute fund flows and manager change. Numbers in squared brackets ([.]) in panels (a) and (b) show the fraction of the standard deviation explained by systematic risk according to the four-factor model, the remainder is explained by idiosyncratic risk. See the note to Figure 1 for more explanation on the portfolio formation and the note to Table 2 for more explanation on row and column definitions. Panel (a) reports the standard deviations in the evaluation period; panel (b) the standard deviations in the formation period; panel (c) reports change in the standard deviations between the formation and evaluation periods. ***, ** and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Net inflows	Manager change			
	Without	With	Without − with	All
(a) Standard deviations in evaluation period (Std_t)				
Low	5.63	6.04	−0.42	5.70
	[0.86]	[0.85]	[0.01]	[0.86]
High	5.70	5.99	−0.29	5.75
	[0.86]	[0.86]	[0.01]	[0.86]
Low − High	−0.07	0.06	−0.36	−0.05
	[−0.00]	[−0.01]	[0.00]	[−0.01]
All	5.68	6.00	−0.32***	5.73
	[0.86]	[0.86]	[0.01]	[0.86]
(b) Standard deviations in formation period (Std_{t-1})				
Low	5.31	5.97	−0.66***	5.42
	[0.86]	[0.84]	[0.02]	[0.85]
High	5.26	5.63	−0.36***	5.33
	[0.85]	[0.83]	[0.02]	[0.85]
Low − High	0.05	0.35***	−0.31***	0.09***
	[0.00]	[0.01]	[0.02]	[0.00]
All	5.32	5.78	−0.46***	5.40
	[0.85]	[0.84]	[0.02]	[0.85]
(c) Change in standard deviations ($\Delta\text{Std}_t = \text{Std}_t - \text{Std}_{t-1}$)				
Low	0.32***	0.07	–	0.28***
High	0.43***	0.36***	–	0.42***
Low − High	–	–	–	–
All	0.36***	0.22***	–	0.33***

Table 6: Characteristics of loser funds and loser-fund subgroups

This table presents the characteristics for the loser-fund subgroups and the resulting spread portfolios based on independent sorts on absolute fund flows and manager change. See the note to Table 2 for more explanation.

Net inflows	Manager change			
	With	Without	With − without	All
(a) Net inflows in formation period ($flows_{t-1}$, in million USD)				
Low	−13.2	−12.2	−1.0	−12.4
High	6.9	7.9	−1.0	7.8
Low − High	−20.1***	−20.1***	−21.1***	−20.2***
All	−4.5	−1.8	−2.7***	−2.3
(b) Manager changes in formation period (mgr_ch_{t-1}, in percentage points)				
Low	100	0	–	22
High	100	0	–	16
Low − High	–	–	–	–
All	100	0	–	19
(c) Fund size in evaluation period (TNA_t, in million USD)				
Low	554.3	724.1	−169.8***	689.3
High	430.9	717.7	−286.8***	672.9
Low − High	123.4***	6.4	−163.4***	16.4
All	493.6	696.2	−202.7***	681.0
(d) Fund size in formation period (TNA_{t-1}, in million USD)				
Low	688.6	861.3	−172.8***	826.1
High	374.1	612.0	−238.0***	575.4
Low − High	314.5***	249.3***	76.5**	250.7***
All	547.2	712.1	−164.9***	700.4

Table 7: Performance of loser funds and loser-fund subgroups

This table presents monthly four-factor alphas in percent for loser funds and the loser-fund subgroups as well as the resulting spread portfolios (in percentage points) based on independent sorts on absolute fund flows and manager change. See the note to Table 3 for more explanation.

Net inflows	Manager change			
	With	Without	With − without	All
(a) Four-factor alphas in evaluation period (α_t)				
Low	−0.09	−0.18**	0.08	−0.15*
High	−0.28***	−0.25***	−0.03	−0.26***
Low − High	0.19**	0.08*	0.16**	0.10**
All	−0.19**	−0.22***	0.03	−0.21**
(b) Four-factor alphas in formation period (α_{t-1})				
Low	−0.90***	−0.91***	0.00	−0.91***
High	−0.88***	−0.88***	0.01	−0.88***
Low − High	−0.03	−0.02	−0.02	−0.03
All	−0.89***	−0.90***	0.01	−0.89
(c) Change in four-factor alphas ($\Delta\alpha_t = \alpha_t - \alpha_{t-1}$)				
Low	0.81***	0.73***	–	0.75***
High	0.60***	0.63***	–	0.62***
Low − High	–	–	–	–
All	0.71***	0.68***	–	0.68***

Table 8: Raw returns of loser funds and loser-fund subgroups

This table presents monthly raw returns in percent for loser funds and the loser-fund subgroups as well as the resulting spread portfolios (in percentage points) based on independent sorts on absolute fund flows and manager change. See the note to Table 4 for more explanation.

Net inflows	Manager change			
	With	Without	With − without	All
(a) Raw returns in evaluation period (r_t)				
Low	0.49	0.37	0.12**	0.40
High	0.28	0.29	−0.01	0.29
Low − High	0.21***	0.08	0.20***	0.11**
All	0.39	0.32	0.07*	0.34
(b) Raw returns in formation period (r_{t-1})				
Low	−0.35	−0.46	0.11	−0.44
High	−0.28	−0.27	−0.01	−0.27
Low − High	−0.07	−0.19	−0.08	−0.18
All	−0.33	−0.38	0.05	−0.36
(c) Change in raw returns ($\Delta r_t = r_t - r_{t-1}$)				
Low	0.84*	0.83*	–	0.84*
High	0.56	0.56	–	0.56
Low − High	–	–	–	–
All	0.71	0.69	–	0.70

Table 9: Standard deviations of loser-fund returns and loser-fund subgroup returns

This table presents the standard deviations of monthly returns in percent for loser funds and the loser-fund subgroups as well as the resulting spread portfolios (in percentage points) based on independent sorts on absolute fund flows and manager change. Numbers in squared brackets ([.]) in panels (a) and (b) show the fraction of the standard deviation explained by systematic risk according to the four-factor model, the remainder is explained by idiosyncratic risk. See the note to Table 5 for more explanation.

Net inflows	Manager change			
	With	Without	With − without	All
(a) Standard deviations in evaluation period (Std_t)				
Low	5.34	5.31	0.03	5.31
	[0.85]	[0.85]	[0.00]	[0.85]
High	5.42	5.40	0.03	5.40
	[0.85]	[0.86]	[−0.01]	[0.86]
Low − High	−0.09*	−0.09***	−0.06	−0.09***
	[−0.00]	[−0.01]	[−0.01]	[−0.01]
All	5.37	5.38	−0.01	5.38
	[0.85]	[0.86]	[−0.01]	[0.86]
(b) Standard deviations in formation period (Std_{t-1})				
Low	5.49	5.43	0.07*	5.44
	[0.86]	[0.87]	[−0.01]	[0.86]
High	5.65	5.60	0.05	5.61
	[0.86]	[0.87]	[−0.01]	[0.87]
Low − High	−0.15***	−0.17***	−0.10***	−0.17***
	[0.00]	[−0.01]	[−0.01]	[−0.00]
All	5.55	5.56	−0.01	5.56
	[0.86]	[0.87]	[−0.01]	[0.87]
(c) Change in standard deviations ($\Delta\text{Std}_t = \text{Std}_t - \text{Std}_{t-1}$)				
Low	−0.16***	−0.12***	–	−0.12***
High	−0.22***	−0.20***	–	−0.20***
Low − High	–	–	–	–
All	−0.18***	−0.18***	–	−0.17***

Table 10: Performance of winner-minus-loser spread portfolios

This table presents monthly four-factor alphas in percent for the winner- and loser-fund subgroups and the resulting spread portfolios (in percentage points) based on independent sorts on absolute fund flows and manager change. Panel (a) reports details on the portfolio formation and panel (b) reports four-factor alphas. See the note to Figure 1 for more explanation on the portfolio formation. ***, ** and * indicate significance at the 1%, 5%, and 10% levels, respectively. White's heteroscedasticity-consistent standard errors are used for the regression coefficients.

	Without equilibrium mech.			Uncond.	With equilibrium mech.		
	Neither	No flows	No manager change	–	Manager ch. only	Flows only	Both
(a) Portfolio formation							
Winner funds							
Inflows	low	low	–	–	–	high	high
Manager ch.	without	–	without	–	with	–	with
Loser funds							
Inflows	high	high	–	–	–	low	low
Manager ch.	without	–	without	–	with	–	with
(b) Four-factor alphas in evaluation period (α_t)							
Winner	0.08	0.09	0.03	0.01	0.02	−0.06	−0.11
Loser	-0.25^{***}	-0.26^{**}	-0.22^{***}	-0.21^{**}	-0.19^{**}	-0.15^{*}	−0.09
Winner − loser	0.34^{***}	0.34^{**}	0.25	0.22	0.20	0.09	−0.02

Table 11: Peer-group adjusted returns of winner- and loser-fund subgroups

This table presents monthly peer-group adjusted returns in percent for winner and loser funds and the winner- and loser-fund subgroups as well as the resulting spread portfolios (in percentage points) based on independent sorts on absolute fund flows and manager change. Peer-group adjusted returns are defined as the difference between fund i's returns and the average returns of all peer-group funds P with the same fund style. The following style groups exist in our sample (all U. S. domestic equity): cap-based funds large-cap; cap-based funds mid-cap; cap-based funds small-cap; style funds growth; style funds growth and income; style funds income; sector funds financial; sector funds health; sector funds natural resources; sector funds technology; sector funds utilities; sector funds other, and other. See the note to Table 4 for more explanation.

(a) Winner funds: Peer-group adjusted returns ($r_{i,t} - r_{P,t}$)

Net inflows	Manager change			
	Without	With	Without − with	All
Low	0.16	0.09	0.06	0.14
High	0.06	0.06	−0.01	0.06
Low − High	0.10*	0.03	0.10*	0.09**
All	0.12	0.08	0.04	0.10

(b) Loser funds: Peer-group adjusted returns ($r_{i,t} - r_{P,t}$)

Net inflows	Manager change			
	With	Without	With − without	All
Low	0.04	−0.11	0.15***	−0.07
High	−0.15	−0.14	−0.01	−0.15
Low − High	0.19***	0.03	0.18***	0.07**
All	−0.00	−0.13	0.08**	−0.11

Table 12: Performance of winner- and loser-fund subgroups based on a ranking including the active peer benchmark (APB) factor

This table presents monthly four-factor alphas in percent in the evaluation period for winner and loser funds and the winner- and loser-fund subgroups as well as the resulting spread portfolios (in percentage points) based on independent sorts on absolute fund flows and manager change. For ranking funds into decile portfolios, the four-factor model (Carhart, 1997) has been augmented by an active peer benchmark (APB) factor in order to control for the fact that estimation errors are potentially not independently distributed in the cross section of funds as suggested by Hunter et al. (2014). See the note to Figure 1 for more explanation on the portfolio formation and the note to Tables 2 and 6 for more explanation on row and column definitions. Panel (a) reports the results for winner funds and winner-fund subgroups and panel (b) reports the results for loser funds and loser-fund subgroups. ***, ** and * indicate significance at the 1%, 5%, and 10% levels, respectively. White's heteroscedasticity-consistent standard errors are used for the regression coefficients.

(a) Winner funds: Four-factor alphas in evaluation period (α_t)

Net inflows	Manager change			
	Without	With	Without − with	All
Low	0.13	0.23*	−0.10	0.14
High	−0.04	−0.06	0.01	−0.05
Low − High	0.17**	0.28**	0.18*	0.19**
All	0.05	0.09	−0.04	0.05

(b) Loser funds: Four-factor alphas in evaluation period (α_t)

Net inflows	Manager change			
	With	Without	With − without	All
Low	−0.07	−0.16*	0.09	−0.14
High	−0.29***	−0.24***	−0.05	−0.25***
Low − High	0.22**	0.08*	0.17***	0.11***
All	−0.17**	−0.21**	0.04	−0.20**

Table 13: Regressions for change in fund performance

This table presents the results of a 3SLS regression for the change in annualized Bayesian four-factor alphas on percentage points per annum between the formation and evaluation years. The explanatory variables of model 1 are total net assets (TNA) in billion USD, fees in percent, fund age in years and portfolio turnover in the previous year, two dummies that indicate whether the fund is currently in decile 10 or decile 1 based on previous year performance, respectively, relative fund flows for previous year, an interaction term between fund flows and the decile-10 and decile-1 dummy, respectively, a dummy indicating whether the manager changed during the previous year, an interaction term between a manager change and the decile-10 and decile-1 dummy, respectively. Model 2 additionally contains a dummy indicating whether the fund is a small-cap or sector fund (SC/SEC) and an interaction term between fund flows into small-cap or sector funds and the decile-10 and decile-1 dummy, respectively. Model 3 additionally contains an interaction term indicating whether the manager change among decile-10 and decile-1 funds, respectively, occurred in a large fund family. Model 4 additionally contains a dummy indicating whether the fund was ranked into decile 10, had higher-than-median flows and a manager change during the previous year and a dummy indicating whether the fund was ranked into decile 1, had lower-than-median flows and a manager change during the previous year. The instruments used for fund flows are lagged fund flows and lagged portfolio turnover as indicated by the Hansen J-test. The last row present the number of observations. Funds are ranked into deciles based on their previous-year Bayesian four-factor alphas. Following French (2008), we winsorize all variables at the 1^{th} and 99^{th} percentile to avoid any bias resulting from extreme outliers.

	Model 1		Model 2		Model 3		Model 4	
	coeff.	p-val	coeff.	p-val	coeff.	p-val	coeff.	p-val
constant	0.29	0.12	0.29	0.12	0.29	0.12	0.30	0.11
TNA_{t-1} (bn USD)	-0.09^{***}	0.00	-0.09^{***}	0.00	-0.09^{***}	0.00	-0.09^{***}	0.00
fees_{t-1} (%)	-0.23^{**}	0.03	-0.19^{*}	0.07	-0.19^{*}	0.07	-0.19^{*}	0.07
age_{t-1} ($\cdot 100$)	-0.20	0.68	-0.26	0.60	-0.26	0.60	-0.30	0.55
turnover_{t-1}	-0.10^{*}	0.06	-0.09	0.11	-0.09	0.11	-0.09	0.11
dec10_t	-7.10^{***}	0.00	-7.10^{***}	0.00	-7.10^{***}	0.00	-7.14^{***}	0.00
dec1_t	6.91^{***}	0.00	6.92^{***}	0.00	6.92^{***}	0.00	6.91^{***}	0.00
flows_{t-1}	-0.49^{*}	0.10	-0.52^{*}	0.08	-0.53^{*}	0.07	-0.51^{*}	0.08
$\text{flows}_{t-1} \cdot \text{dec10}_t$	-0.47	0.13	0.06	0.85	0.06	0.85	0.13	0.68
$\text{flows}_{t-1} \cdot \text{dec1}_t$	-0.56	0.14	-0.46	0.31	-0.43	0.33	-0.27	0.54
style SC/SEC	–	–	-0.17	0.14	-0.18	0.13	-0.18	0.13
$\text{flows}_{t-1} \cdot \text{SC/SEC} \cdot \text{dec10}_t$	–	–	-1.14^{***}	0.00	-1.14^{***}	0.00	-1.14^{***}	0.00
$\text{flows}_{t-1} \cdot \text{SC/SEC} \cdot \text{dec1}_t$	–	–	-0.23	0.64	-0.27	0.59	-0.21	0.68
mgr_ch_{t-1}	0.31^{**}	0.03	0.31^{**}	0.03	0.31^{**}	0.03	0.32^{**}	0.03
$\text{mgr\_ch}_{t-1} \cdot \text{dec10}_t$	-1.13^{***}	0.01	-1.10^{**}	0.01	-1.14^{**}	0.03	-0.16	0.80
$\text{mgr\_ch}_{t-1} \cdot \text{dec1}_t$	0.47	0.27	0.48	0.28	-0.19	0.72	-1.72^{***}	0.01
$\text{mgr\_ch}_{t-1} \cdot \text{lfam} \cdot \text{dec10}_t$	–	–	–	–	0.13	0.87	0.18	0.81
$\text{mgr\_ch}_{t-1} \cdot \text{lfam} \cdot \text{dec1}_t$	–	–	–	–	1.84^{**}	0.02	1.90^{**}	0.01
$\text{mgr\_ch}_{t-1} \cdot \text{hi fl}_{t-1} \cdot \text{dec10}_t$	–	–	–	–	–	–	-2.17^{***}	0.01
$\text{mgr\_ch}_{t-1} \cdot \text{lo fl}_{t-1} \cdot \text{dec1}_t$	–	–	–	–	–	–	2.86^{***}	0.00
# observations (fund-years)	28,816		28,816		28,816		28,816	

Table 14: Classification of investment objectives

This table presents the classification codes we have used to construct our sample. We use Lipper codes, Wiesenberger codes and Strategic Insight codes (priority is given in this order if different codes assign funds to different investment categories) in order to classify our funds into the following three groups: (1) Large- and mid-cap funds (LMC), (2) small-cap funds (SC) and (3) sector funds (SEC).

	Large- and mid-cap (LMC)	Small-cap (SC)	Sector (SEC)
Lipper	CA, EI, EIEI, G, GI, I, LCCE, LCGE, LCVE, MC, MCCE, MCGE, MCVE, MLCE, MLGE, MLVE	SCCE	FS, H, NR, S, SESE, TK, TL, UT
Wiesenberger	AGG, G, G-I, G-I-S, G-S, G-S-I, GCI, GRI, GRO, I-G, I-G-S, I-S, I-S-G, IEQ, ING, LTG, MCG, S-G, S-G-I, S-I-G, S-I, I[a]	SCG	ENR, FIN, HLT, TCH, UTL
Strategic Insight	AGG, GMC, GRI, GRO, ING	SCG	ENV, FIN, HLT, NTR, SEC, TEC, UTI

[a] Note that Wiesenberger code I for income funds is not restricted to income equity funds but also contains income money market funds, income bond funds etc. Consequently we use a combination of Wiesenberger code I and policy code CS or I-S or Wiesenberger code I and an allocation to stocks of at least 50 percent as condition for funds to be included in our sample.