Do Mutual Funds Have Decreasing Returns to Scale? Evidence from Fund Mergers

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Abstract

This paper investigates whether mutual funds have decreasing returns to scale. The results show that acquiring funds experience performance deterioration after their size increases abnormally due to mergers. The deteriorated performance, however, is a short-lived phenomenon. As the size of acquiring funds decreases in the post-merger period, fund performance recovers three years after mergers. These findings provide evidence that is consistent with mutual funds having decreasing returns to scale. The results also show that acquiring funds have consistent capital outflows after mergers, which contributes to the size adjustment of acquiring funds in the post-merger period.

1 Introduction

The intuition of mutual funds having decreasing returns to scale is that some fund managers have skills to outperform the market and generate positive alpha before costs, but they can only do so with a certain level of actively invested funds. As a positive alpha fund receives inflows its performance degrades. Some theoretical models in the fund literature are derived based on the assumption of decreasing returns to scale. For example, under this assumption, Berk and Green (2004) derive an equilibrium model which provides a rational explanation for the observed fund flow–performance puzzle (Chevalier and Ellison (1997), Sirri and Tufano (1998), and Sapp and Tiwari (2004)).[1] Decreasing returns to scale also has important practical implications. For example, investors need to consider fund size when they make investment decisions. Fund managers should take fund size into account to determine whether and when to close funds to new investment. This paper examines the size–performance relation in fund mergers and provides evidence that is consistent with decreasing returns to scale.

Previous studies present elusive empirical evidence on how fund size affects performance. Chen, Hong, Huang, and Kubik (2004), Edelen, Evans, and Kadlec (2007), and Yan (2008) document a negative relation between fund size and performance and show that liquidity and trading costs are the underlying driving factors for the adverse effect of size on performance. However, these findings are challenged by the endogeneity of fund size (Reuter and Zitzewitz (2013)). Responding to the endogeneity issue, Phillips, Pukthuanthong, and Rau (2013) use an instrumental variable that is correlated with fund size but unrelated to fund performance and find little evidence that fund size directly affects fund performance. Pástor, Stambaugh, and Taylor (2013) address the endogeneity of fund size by including fund fixed effects to account for heterogeneity in managerial skills. They find a negative but insignificant relation between fund size and performance.

I argue that these studies do not find a significant relation between fund size and performance because they capture a small change of size that is not related to past fund performance. Fund size increases as a fund experiences higher returns and receives capital

[1] Previous studies show that fund performance is neither persistent nor predictable, but mutual fund investors chase past performance. This phenomenon is referred to the fund flow–performance puzzle.

inflows. Capital flows and past fund performance are related. Funds that have superior past performance are more likely to attract new inflows and grow in size. Reuter and Zitzewitz (2013) capture fund flows associated with the discrete changes in Morningstar ratings. Phillips, Pukthuanthong, and Rau (2013) capture fund flows responding to the increase of holding period return caused by dropping a stale negative return at the beginning of the holding period. These two papers examine the size impact on performance in natural experiments. However, the size–performance relation may not be identified if the captured size change which is unrelated to past fund performance is too small. A third source of size increase is merger. Mutual fund merger refers to the combination of two or more funds. The survival fund of a merger is the acquiring fund and the other merging funds are the target funds. The number of equity fund mergers increases from 15 in 1991 to 180 in 2009. There are about 5% of equity funds eliminated through mergers and about 11% of fund families involved in domestic equity fund mergers every year. In this paper, I show that the probability of being an acquiring fund in mergers is not significantly related to past fund performance. This finding enables me to use mutual fund mergers as a shock to fund size to examine the relation between fund size and performance. My paper distinguishes itself from previous studies by examining a discrete and large fund size change which is unrelated to past fund performance and investigating whether this size change affects future fund performance.

My main findings are as follows. First, the likelihood of being an acquiring fund in mergers is not significantly related to past fund performance. I run two logistic regression models. The independent variables are fund characteristics. The dependent variable is the probability of being acquiring funds in mergers. The coefficient estimates on past fund performance are -0.004 (p-value $= 0.42$ and marginal effects $= 0.00$) and -0.005 (p-value $= 0.31$ and marginal effects $= 0.00$) for these two models. I also examine the relation between past fund performance and the probability of being an acquiring fund for within-family and across-family mergers separately. The results show that this relation is insignificant for both types of merger. These findings verify that examining the fund size–performance relation in mergers is not subject to the endogenous fund size issue.

Second, acquiring funds experience abnormal size increase due to mergers. Abnor-

mal size refers to the amount of size change that the acquiring funds would have not experienced if there were no mergers. I use three predictive regression models and a propensity score matching algorithm to obtain the abnormal size increase of acquiring funds due to mergers. All methods yield the same results that the abnormal size of acquiring funds in the merger event month is positive and statistically significant.

Third, fund performance deteriorates after fund size increases abnormally due to mergers and fund performance recovers as fund size decreases in the post-merger period. I use factor model alphas, objective-adjusted returns (OARs), and fund performance deciles to evaluate the performance of acquiring funds around mergers. I find that the performance of acquiring funds decreases significantly after mergers using all three measures. For example, the annualized Carhart alpha and OAR decrease by 0.84% (t-stat = -1.89) and 0.72% (t-stat = -2.09) after mergers, respectively. The results also show that the deteriorated performance, however, is a short-lived phenomenon. Fund performance has recovered by the end of the fourth year after mergers. The recovery of fund performance is related to the decrease of fund size. I use objective-adjusted fund size (OAS) and fund size deciles to measure the change of fund size around mergers. I find that the average size decile of acquiring funds climbs from 7.1 to 7.4 four years before mergers. The size decile reaches above 7.6 due to mergers, decreases thereafter, and reaches the pre-merger level of 7.4 by the end of the fourth year after mergers. The decrease of fund size in the post-merger period is driven by both deteriorated performance and capital outflows. I use objective-adjusted fund flows (OAFs) and fund flow deciles to capture the change of flows of acquiring funds around mergers. The results show that investors redeem their shares from the acquiring funds after mergers. Acquiring funds experience consistent money outflows in the post-merger period.

Fourth, acquiring funds which experience proportionally larger abnormal size increase are more likely to experience worse post-merger performance. I construct a total net asset (TNA) ratio variable to capture the relative size change of acquiring funds and test its relation to the post-merger performance using a multivariate regression model. I find that after controlling for size and the other fund characteristics, the relative size change of acquiring funds is negatively related to their post-merger performance.

Overall, the empirical findings of this paper provide evidence that supports mutual funds having decreasing returns to scale. Fund performance deteriorates as fund size increases and recovers as fund size decreases. My results are most consistent with the model of Berk and Green (2004). In their model, rational investors compete with each other to find skilled managers who can deliver positive alpha. Since managerial skills are not observable to investors, investors take superior past performance as evidence of skills. Investors move their money into superior performing funds and move their money out of the funds that perform poorly. We observe fund flows chasing performance. However, due to decreasing returns to scale, fund performance degrades as capital flows into a fund. Fund flows continue until fund size reaches a point where the fund is no longer expected to either outperform or underperform in the future. The results also show that there is a delayed reaction of investors to the abnormal size increase and performance deterioration of acquiring funds. It takes the acquiring funds more than three years to recover their performance. These findings are consistent with the asymmetric response of fund flows to performance documented by Gruber (1996), Chevalier and Ellison (1997), and Sirri and Tufano (1998).[2]

This paper not only contributes to our understanding of the size–performance relation of mutual funds but also enhances our knowledge of mutual fund mergers. The findings of the paper help investors to respond properly when confronting a merger. The results also provide useful information to fund families in terms of whether and when to make acquisitions.

The remainder of the paper is organized as follows. Section 2 reviews the literature. Section 3 describes the data. Section 4 introduces methodologies and presents empirical findings. Section 5 contains the robustness tests. Section 6 concludes.

[2]Gruber (1996), Chevalier and Ellison (1997), and Sirri and Tufano (1998) show that funds with superior recent performance enjoy disproportionately large new money inflows, while funds with poor performance suffer smaller outflows.

2 Literature Review

This paper makes contributions to three strands of literature. First, there has been discussion on whether mutual funds have decreasing returns to scale. Second, some studies examine whether chasing past performance is a rational investment strategy. Third, some papers try to understand the determinants and influence of fund mergers.

2.1 Decreasing Returns to Scale

Early empirical studies provide evidence that is consistent with decreasing returns to scale. Chen, Hong, Huang, and Kubik (2004) first document a negative relation between fund size and performance. They find that small-cap funds exhibit a stronger adverse effect of size on performance. Since small-cap funds are more likely to have illiquid holdings, the authors argue that fund size erodes performance because of liquidity. Yan (2008) measures liquidity using bid-ask spread and market impact and documents similar results. He finds that funds hold less liquid portfolios and funds that have high liquidity demand, such as growth funds and high-turnover funds, have a stronger negative relation between fund size and performance. Edelen, Evans, and Kadlec (2007) examine the role of trading costs as a source of decreasing returns to scale. They regress fund returns on both relative trade size and fund size and find that relative trade size subsumes fund size in the regression. The authors conclude that trading cost is a major source of diseconomies of scale. Pollet and Wilson (2008) examine the response of mutual funds to asset growth and find that funds do not react to increasing size by adding a large number of new investments. A doubling of fund size increases the number of stocks in a fund by less than 10%. These findings imply that increased transaction cost explains why performance deteriorates with size. However, Elton, Gruber, and Blake (2012) show an insignificant relation between size and performance by examining samples of larger and larger funds. They explain that the reduction of expense ratio outweighes the effect of decreasing returns to scale as a fund increases in size.

Recent literature questions the documented negative relation between fund size and

performance. Reuter and Zitzewitz (2013) raise a concern of endogeneity of fund size. Fund size is not randomly assigned to funds, but is related to past fund performance. Reuter and Zitzewitz (2013) examine the size–performance relation in a natural experiment setting, where small differences in mutual fund returns cause discrete changes in Morningstar ratings. The changes in Morningstar ratings yield discrete differences in fund size. This source of size change is unrelated to fund performance. They find that the magnitude of diseconomies of scale is not strong enough to be significant. Responding to Reuter and Zitzewitz's (2013) concern, Phillips, Pukthuanthong, and Rau (2013) use stale performance chasing as an instrumental variable and re-examine the size–performance relation. The intuition of stale performance chasing is the following. Investors increase asset allocations to the funds which experience improvement in holding period return. One source of this improvement is dropping a stale negative end-return from the horizon of the holding period return calculation. Such improvement is not related to current fund performance. Therefore, stale performance chasing is correlated with fund size but are unrelated to recent fund performance. They find little evidence that fund size directly affects fund performance. Pástor, Stambaugh, and Taylor (2013) address the endogeneity of fund size by including fund fixed effects to account for heterogeneity in managerial skills. The authors argue that including fixed effects is equivalent to running a demeaned model and that the coefficient estimate on the demeaned size is downward biased. The explanation is the following. A fund's full-sample time-series mean is subtracted to compute the demeaned series. The demeaned size of fund i in period $t-1$ depends on observations after period $t-1$. The authors define this demeaned size as forward-demeaned size. A higher return in period t increases the time-series mean of fund size, which decreases the forward-demeaned size in period $t-1$. Thus, the forward-demeaned size of fund i in period $t-1$ is positively correlated with the error term, which causes a downward biased coefficient estimate on the forward-demeaned size (Stambaugh (1999)). To avoid this mechanical negative bias, the authors calculate the demeaned size using only fund i's observations prior to period $t-1$. They define this demeaned size as backward-demeaned size and use it to test whether mutual funds have decreasing returns to scale. They find a negative but insignificant relation between fund size and performance.

2.2 Flow–Performance Relation

Previous studies examining the fund flow–performance relation aim to explain why investors place money with mutual funds despite that fund performance is not persistent and that funds do not outperform passive strategies. Berk and Green (2004) argue that investors infer managerial skills from past returns and rationally move their money across funds. They assume that mutual funds have decreasing returns to scale. Fund performance decreases as funds receive capital inflows. However, some papers provide evidence that mutual fund investors are not rational. Cooper, Gulen, and Rau (2005) show that investors chase funds which change their names to reflect a current hot style but with no improvement in performance. Elton, Gruber, and Busse (2004) use S&P 500 index funds to examine rational behavior. The authors argue that mutual fund investors are not rational, otherwise we should not have inferior funds in the market where arbitrage is impossible. Glode (2011) addresses Elton, Gruber, and Busse's (2004) concern and argues that mutual fund investors exhibit rationality despite of the unconditional inferior performance of some funds as long as these funds tend to perform abnormally well when the economy is doing poorly.

Some studies examine whether mutual fund investors are able to predict future fund performance. Gruber (1996) finds some evidence that new flows gain positive alpha. Zheng (1999) builds on Gruber (1996) and shows the "smart money" effect. She finds that funds with positive flows outperform those with negative flows and that the smart money effect is a short-lived phenomenon. Sapp and Tiwari (2004) re-examine whether mutual fund investors are able to predict fund performance and find that the Carhart alphas are equal across positive and negative flow funds. They conclude that the smart money effect is completely explained by a momentum factor.

2.3 Mutual Fund Mergers

Previous studies examine the determinants of being acquired in fund mergers and the subsequent wealth impact of mergers on shareholders. Jayaraman, Khorana, and Nelling (2002), Zhao (2005) and Ding (2006) find that poor performance of target funds is a main reason for within-family mergers. They show that investors of target funds realize significant benefits in terms of reduced fees and improved performance after mergers. Some other fund characteristics are also shown to be related to fund mergers. Khorana, Wedge, and Tufano (2007) find that across-family mergers are more likely when the target board has a larger percentage of independent directors but less likely when boards are paid higher than average. A defunct fund with higher management fees or 12b-1 fees is more likely to be merged within-family (English, Demiralp, and Dukes (2011)). Namvar and Phillips (2013) show that similarities of management objectives between merger funds positively affect post-merger performance.

Some studies examine the determinants and impact of fund family mergers. Park (2012) shows that profit-maximization drives mergers among mutual fund families. Luo and Qiao (2013) find that family mergers negatively impact performance of all related funds, including both merged and intact funds.

3 Data

I collect data from the CRSP survivor-bias-free mutual fund database, which is created by Carhart (1997). CRSP provides fund monthly total net asset (TNA) data since 1991. The sample period for this study is 1991–2013. I examine mergers occurred between 1995 and 2009 to have fund characteristics four years before and after the event. Following many previous studies, this paper is restricted to diversified U.S. equity mutual funds.

Mergers are identified by the last TNA report month of target funds and the delist code being M. Because the last TNA report month of target funds may not be the merger event month, I employ the following procedure to identity the merger event month following Lou (2012). I match a target fund to its acquiring fund from one month before

its last report month to three months after. I then designate the month in which the acquiring fund has the largest flows as the event month. Fund flow is calculated following Sirri and Tufano (1998):

$$Flow_{i,t} = \frac{TNA_{i,t} - (1 + R_{i,t}) \times TNA_{i,t-1}}{TNA_{i,t-1}}, \tag{1}$$

where $Flow_{i,t}$, $TNA_{i,t}$, and $R_{i,t}$ are flow, total net asset, and return of fund i in month t.

Table 1 reports the number of funds and families involved in fund mergers.[3] Mergers among share classes of the same fund are excluded. The number of mergers increases during the sample period. There were 15 acquiring funds in 1991. The number of acquiring funds increases beyond one hundred in the early 2000s, reaches a high of 180 in 2009, and decreases to 50 in 2013. The number of acquiring funds is different from the number of target funds every year, because in some merger cases, an acquiring fund acquires multiple funds at the same time. CRSP provides identifiers of fund family since December 1999. I report the number of acquiring families, target families, and total families that have involved in mergers of domestic equity funds for the period of 2000–2013. On average there are about 55 families involved in mergers of domestic equity funds every year, which account for about 11% of all the families that have domestic equity funds.

Table 2 reports fund characteristics of the acquiring funds, the target funds, and the other funds. I use fund-month observations to calculate fund characteristics of each comparing fund group. Characteristics of interest include fund size, performance, volatility of performance, expense ratio, age, and flows. Fund size is measured as the TNA in million dollars. Fund performance is fund monthly returns. I remove the first three years of return data for all funds to eliminate the incubation bias (Evans (2010)). Volatility of performance is the standard deviation of fund returns in the past 12 months (including the current month). Fund age is calculated in months. I calculate the value-weighted characteristics of a fund which has multiple share classes following Wermers (2000). To compare fund characteristics among the acquiring funds, the target funds, and the other

[3]CRSP does not report the investment style of target funds before 2000 due to backfilling of data. Domestic equity target funds for the period of 1991–1999 are identified by assuming that funds being acquired by domestic equity funds are domestic equity funds.

funds, I do the following calculations. First, I calculate the average characteristics 12 months before mergers for each acquiring and target fund. Second, I calculate the cross-sectional average of characteristics of acquiring funds with the same merger month and the cross-sectional average of characteristics of the target funds with the same last report month. Third, I calculate the cross-sectional average of characteristics of the other funds every month in the sample period. These calculations yield time series of characteristics for the acquiring funds, the target funds, and the other funds, respectively. Column (1)–(3) of Table 2 report the time-series mean characteristics of each group of funds. Column (4) reports t-statistics for comparing characteristics between acquiring funds and target funds. Column (5) reports t-statistics for comparing characteristics between acquiring funds and the other funds.

I find that acquiring funds are larger (t-stat = 8.54), older (t-stat = 6.88), cheaper (t-stat = -10.63), have less volatile performance (t-stat = -1.65), and experience greater flows (t-stat = 5.35) than target funds. Comparing to the other funds, acquiring funds are smaller (t-stat = -2.33) and have less volatile performance (t-stat = -2.02). The other characteristics of acquiring funds are not significantly different from the other funds. For example, the performance of acquiring funds is not significantly different from the performance of the other funds. The t-statistics of performance difference between acquiring funds and the other funds is -0.65.[4]

Elton, Gruber, and Blake (2001) show that the reported returns of funds with less than \$15 million in TNA might be upward biased. I exclude the acquiring funds with TNA less than \$15 million to eliminate this upward bias of their reported returns for the following empirical tests. Cooper, Gulen, and Rau (2005) find that funds which change their names to reflect current hot investment styles experience abnormal capital inflows. I remove acquiring funds which experience changes in fund style four years before or after mergers to control the effect of fund style change on fund flows.[5] I identify fund style

[4]Appendix Table A1 reports the cross-sectional distribution of total net assets of all equity funds for the period of 1991–2013. Appendix Table A2 reports the cross-sectional distribution of total net assets of acquiring funds for the period of 1991–2013. Appendix Table A3 reports the cross-sectional distribution of acquired assets for the period of 2000–2013.

[5]There are 102 acquiring funds that change investment styles within four years before or after mergers during the period of 1995–2009.

change using the CRSP fund objective identifier (*crsp_obj_cd*), which combines Strategic Insight, Wiesenberger, and Lipper objective codes into an unique style code for each fund. CRSP fund objective identifier consists four letters. I define the style change as as any changes in either the third or the fourth letter of this objective code.[6] The final sample has 941 acquisitions occurred during 1995–2009.

4 Methodologies and Findings

4.1 Determinants of Fund Mergers

In order to test the fund size–performance relation in fund mergers, I first verify whether fund mergers are a shock to fund size. I test the relation between past fund performance and the probability of being an acquiring fund in mergers using the following logistic regression specification (Model I):[7]

$$\begin{aligned} Probability\ (Acquiring\ Fund)_{i,t} = \beta_0 + \beta_1(Performance)_{i,t-1} + \beta_2(Flows)_{i,t-1} + \\ \beta_3(Size)_{i,t-1} + \beta_4(Expense\ Ratio)_{i,t-1} \\ + \beta_5(Number\ of\ Objectives\ in\ the\ Family)_{i,t-1}, \end{aligned} \quad (2)$$

where i refers to fund i and t indicates month t. The independent variables are fund characteristics. $Performance$ is the objective-adjusted cumulative returns. The objective-adjusted cumulative return is the difference between fund cumulative return and the average cumulative return of the other funds with the same investment objective. Cumulative returns are calculated over the past 12 months. $Flows$ is the objective-adjusted fund flow. The objective-adjusted fund flow is the difference between fund flow and the average flow of the other funds with the same investment objective. Fund flows

[6] Appendix A4 reports the CRSP investment objective codes for domestic equity funds. Appendix A5 reports the number of funds within each investment objective every year in the sample period. Appendix A6 reports the number of acquiring funds within each investment objective every year in the sample period.

[7] Jayaraman, Khorana, and Nelling (2002) use this model to examine the determinants of being a target fund.

are averaged over past 12 months. *Expense Ratio* is the objective-adjusted expense ratio. The objective-adjusted expense ratio is the difference between fund expense ratio and the average expense ratio of the other funds with the same investment objective. Expense ratios are averaged over past 12 months. *Size* is the logarithm of TNA of a fund. *Number of Objectives in the Family* is a measure of the number of investment objectives in a family.[8]

The dependent variable takes on a value of one if a fund acquires other funds in the subsequent 12-month period and a value of zero otherwise. Fund characteristic data over the past 12-month period (including the current month) are used to construct the independent variables. Following Jayaraman, Khorana, and Nelling (2002), I test the model and report results using data of June. In this instance, in June 2000, the dependent variable takes on a value of one if a fund acquires other funds in the subsequent 12-month period of July 2000 to June 2001. Fund characteristic data over July 1999 to June 2000 are used to construct the independent variables. I also test the model using data of the other months of the year and find that the results are similar.

Table 3 column (1) reports the regression coefficients and column (2) reports the marginal effects. The key finding is that past fund performance is not significantly related to the probability of being an acquiring fund in mergers ($\beta_1 = -0.004$, p-value = 0.42, and marginal effect = 0.000). This finding verifies the use of fund mergers as a shock to fund size to test the fund size–performance relation. The results show that fund flows ($\beta_2 = 0.000$, p-value = 0.94, and marginal effect = 0.000) and costs ($\beta_4 = 0.012$, p-value = 0.70) are not significantly related to the probability of acquisition. I find that larger funds ($\beta_3 = 0.055$, p-value = 0.01, and marginal effect = 0.001) are more likely to acquire other funds. Fund families make profits through fees which are proportional to the size of managed assets, thus they are more likely to keep large funds holding the other fund characteristics the same. I also find that the relation between the probability of being an acquiring fund and the size of fund family is positive and significant ($\beta_5 = 0.002$, p-value = 0.00, and marginal effect = 0.000). Because large families are more likely to have multiple funds of the same or similar investment objectives, they can terminate inferior

[8]CRSP does not report the investment style of target funds before 2000 due to backfilling of data. The sample period used to study the determinants of mergers is 2000–2009.

funds via mergers without reducing the diversification of funds they offer. Large families are also more likely to have broader varieties of funds to match the investment objective of the target funds from other families.

I examine the relation between the likelihood of being a target fund and fund characteristics using the same logistic regression specification except that the dependent variable takes on a value of one if a fund is acquired in the subsequent 12-month period and zero otherwise. Table 3 column (3) and (4) report the test results. I find that underperforming funds are more likely to be eliminated via mergers ($\beta_1 = -0.029$, p-value $= 0.00$, and marginal effect $= -0.001$). Because SEC rules require that only the record of surviving funds be reported, fund families can hide previous bad performance record by eliminating them through mergers. Fund families then can advertise only the remaining funds to attract capital inflows and to increase the assets under management. Since small funds with unsatisfying performance record have limited growth potential, they are more likely to be eliminated by their families ($\beta_3 = -0.392$, p-value $= 0.00$, and marginal effect $= -0.017$). I also find that funds charging a lower fee are more likely to be eliminated by their families ($\beta_4 = -0.089$, p-value $= 0.00$, and marginal effect $= -0.004$) because these funds are less profitable compared to the other funds after controlling for other fund characteristics. The relation between the size of fund family and the probability of its fund being acquired is positive and statistically significant ($\beta_5 = 0.002$, p-value $=$ 0.00, and marginal effect $= 0.000$). Large families are more capable of eliminating their underperforming funds via mergers because they have more potential acquiring funds with similar investment objectives and because doing so does not reduce the diversity of funds that large families offer. The results also show that after controlling for the other fund characteristics, fund flows are not significantly related to the probability of a fund being acquired ($\beta_2 = -0.003$, p-value $= 0.27$, and marginal effect $= -0.000$). Overall, I find that small and cheap funds that experience poor performance are more likely to be eliminated by their families through mergers.

Table 2 shows that acquiring funds are older than the target funds and have less volatile performance than the target funds and the other funds. I include fund age and performance volatility in the logistic regression model and examine their relations to the

probability of acquiring (or being acquired by) the other funds (Model II).

$$\begin{aligned} Probability\ (Acquiring\ Fund)_{i,t} = \beta_0 + \beta_1(Performance)_{i,t-1} + \beta_2(Flows)_{i,t-1} + \\ \beta_3(Size)_{i,t-1} + \beta_4(Expense\ Ratio)_{i,t-1} \\ +\beta_5(Number\ of\ Objectives\ in\ the\ Family)_{i,t-1} \\ +\beta_6(Age)_{i,t-1} + \beta_7(Performance\ Volatility)_{i,t-1}, \end{aligned} \tag{3}$$

where Age is the logarithm of fund age in months. $Performance\ Volatility$ is the objective-adjusted performance volatility. The objective-adjusted performance volatility is the difference between fund performance volatility and the average performance volatility of the other funds with the same investment objective. Performance volatility is the standard deviation of fund returns in the past 12 months. Column (5)–(8) of Table 3 report the regression results. I find that after controlling the other fund characteristics, younger funds are more likely to be involved in mergers. Fund performance volatility is not significantly related to the probability of acquiring the other funds but is negatively related to the probability of being acquired. The results show that including fund age and performance volatility does not change the relation between past fund performance and the probability of being an acquiring fund in mergers ($\beta_1 = -0.005$, p-value = 0.31, and marginal effect = -0.000).

There are two types of fund mergers. A within-family merger refers to the combination of two funds within the same fund family. An across-family merger involves the combination of two funds from different fund families. Next, I examine whether the probability of being an acquiring fund is related to its past performance for within-family and across-family mergers separately. Table 4 reports the test results for within-family mergers. Table 5 reposts the test results for across-family mergers. The regression models and variable constructions for these two tables are the same as those in Table 3 except for the dependent variables. The dependent variable takes on a value of one if a fund acquires (or is acquired by) another fund from the same family in the subsequent 12-month period and zero otherwise for within-family merger tests. The dependent variable takes on a value of one if a fund acquires (or is acquired by) another fund from a different family in

the subsequent 12-month period and zero otherwise for across-family merger tests. The results show that the relation between being an acquiring fund and its past performance is insignificant for both within-family ($\beta_1 = -0.003$ (p-value = 0.60) and $\beta_1 = -0.004$ (p-value = 0.57)) and across-family ($\beta_1 = -0.004$ (p-value = 0.53) and $\beta_1 = -0.005$ (p-value = 0.45)) mergers.

Some previous studies examining how size affects performance are susceptible to incorrect inferences, because fund size is related to past fund performance. Funds which have superior past performance grow in size. Decreasing returns to scale implies that the increase in size negatively affects future fund performance. However, future fund performance might be negatively correlated with past fund performance and this correlation might be picked up by fund size. My paper differentiates itself from previous studies by testing the size–performance relation in fund mergers, where acquiring funds experience size change in mergers which is not related to past fund performance. The statistically insignificant relation between past fund performance and the probability of being an acquiring fund in mergers verifies that my paper is not subject to the endogenous fund size issue.

4.2 Abnormal Size Increases Due to Mergers

There are three sources of fund size change in general, which are fund returns, flows, and acquisitions. Funds which have superior past performance grow in size. Funds which receive capital inflows also experience size growth. Capital inflows and fund performance are related. Higher performance funds are more likely to attract new capital inflows than poorly performing funds. The third source of size increase is acquisition. As shown in the previous section, the likelihood of being an acquiring fund is not significantly related to past fund performance. In this section, I examine whether acquiring funds experience an abnormal size increase due to mergers. The abnormal size is the difference between fund real size (TNA) and its would-be size (denoted as $Size^*$) if there were no mergers. I use predictive regression models and a propensity score matching algorithm to obtain $Size^*$.

4.2.1 Predictive Regression Models

I build three predictive regression models based on previous theoretical work and empirical findings. The first predictive regression model (Model (1)) is constructed based on the theoretical model of Berk and Green (2004):

$$\begin{aligned}\Delta\%Size_{i,t} = \beta_0 + \beta_1(Performance)_{i,t-1} + \beta_2(Performance\ Volatility)_{i,t-1} \\ +\beta_3(Size)_{i,t-1} + \beta_4(Age)_{i,t-1} + \beta_5(Expense\ Ratio)_{i,t-1} \\ +\beta_6(Performance \times Performance\ Volatility)_{i,t-1} \\ +\beta_7(Performance \times Age)_{i,t-1},\end{aligned} \tag{4}$$

where i refers to fund i and t indicates month t. The dependent variable is the percentage change of fund size:

$$\Delta\%Size_{i,t} = \frac{TNA_{i,t} - TNA_{i,t-1}}{TNA_{i,t-1}}.^{9} \tag{5}$$

The independent variables of Model (1) are fund characteristics, which are lagged one period. *Performance* is the cumulative returns over past 12 months. *Performance Volatility* is the standard deviation of returns over past 12 months. $Size$ is the logarithm of fund TNA. *Age* is the logarithm of fund age in months. *Expense Ratio* is fund expense ratio. *Performance* $\times$ *Performance Volatility* interacts fund cumulative returns with standard deviation of past returns. *Performance* $\times$ *Age* interacts the cumulative returns with the logarithm of fund age in months.

These fund characteristics affect the change of fund size in an intuitive way (Berk and Green (2004)). Fund size increases as a fund experiences superior performance ($\beta_1 > 0$). Because it is hard for investors to learn managerial skills when past performance volatility is high, the relation between past fund performance volatility and future fund

[9]The percentage change of fund size in period t is the sum of fund flow and return in period t: $\Delta\%Size_{i,t} = Flow_{i,t} + Return_{i,t}$. An alternative methodology approach is to model fund flows and returns separately. My main goal of using predictive regression models is to obtain the would-be size of acquiring funds (denoted as $Size^*$) if there were no mergers. Berk and Green (2004) provide a theoretic model between fund size change and fund characteristics. Since their model directly serves the purpose of obtaining the would-be size ($Size^*$) of acquiring funds, I model change in size rather than modelling flows and returns separately in this paper.

flows is negative ($\beta_2 < 0$). Large and old funds are less likely to attract new capital inflows as their managers may have already used their best investment ideas (Pollet and Wilson (2008)). The expected future abnormal returns of these funds are relatively lower than the promising young and small funds ($\beta_3 < 0$ and $\beta_4 < 0$). Funds become less attractive to investors as their fees increase ($\beta_5 < 0$). Some fund characteristics may affect the responsiveness of size change to performance. As performance volatility increases, investors learn less from returns about managerial skills. A given return triggers less response in flows and size change ($\beta_6 < 0$). As the age of fund increases, investors have more information about managerial skills. Fund flows and size change respond less to the next return ($\beta_7 < 0$).

The second predictive regression model (Model (2)) includes two more independent variables following Sirri and Tufano (1998).

$$\begin{aligned}\Delta\%Size_{i,t} = \beta_0 &+ \beta_1(Performance)_{i,t-1} + \beta_2(Performance\ Volatility)_{i,t-1} \\ &+ \beta_3(Size)_{i,t-1} + \beta_4(Age)_{i,t-1} + \beta_5(Expense\ Ratio)_{i,t-1} \\ &+ \beta_6(Performance \times Performance\ Volatility)_{i,t-1} \\ &+ \beta_7(Performance \times Age)_{i,t-1} \\ &+ \beta_8(Performance \times Performance\ Decile)_{i,t-1} \\ &+ \beta_9(Number\ of\ Objectives\ in\ the\ Family)_{i,t-1},\end{aligned} \tag{6}$$

where *Performance* $\times$ *Performance Decile* interacts the cumulative returns with fund performance decile. I calculate the performance decile for each equity fund among the funds with the same investment objective. $Number\ of\ Objectives\ in\ the\ Family$ is a measure of the number of investment objectives in a family.

Sirri and Tufano (1998) document an asymmetric flow–performance relation. Funds with superior recent performance enjoy disproportionately large new money inflows. The asymmetric flow–performance relation implies that fund's relative performance to the other funds with the same investment objective positively affects the responsiveness of size change to performance. Holding the other fund characteristics the same, a given return will trigger more inflows and size increase for a fund which has a relatively higher

performance decile ($\beta_8 > 0$). Sirri and Tufano also document a "spillover effect." If a fund performs extremely well, not only this superior fund but also the other funds in the same family experience increases in capital inflows. Other things equal, a large family with many funds with different investment objectives is more likely to have a fund fall into the top performing group than would a small family ($\beta_9 > 0$).

Following Ferson and Kim (2012) and Lou (2012), I include four lags of flows in the predictive regression (Model (3)) to control for the persistence in investment flows:

$$\begin{aligned}\Delta\%Size_{i,t} = \beta_0 &+ \beta_1(Performance)_{i,t-1} + \beta_2(Performance\ Volatility)_{i,t-1} \\ &+ \beta_3(Size)_{i,t-1} + \beta_4(Age)_{i,t-1} + \beta_5(Expense\ Ratio)_{i,t-1} \\ &+ \beta_6(Performance \times Performance\ Volatility)_{i,t-1} \\ &+ \beta_7(Performance \times Age)_{i,t-1} \\ &+ \beta_8(Performance \times Performance\ Decile)_{i,t-1} \\ &+ \beta_9(Number\ of\ Objectives\ in\ the\ Family)_{i,t-1} \\ &+ \beta_{10}(Flow)_{i,t-1} + \beta_{11}(Flow)_{i,t-2} + \beta_{12}(Flow)_{i,t-3} + \beta_{13}(Flow)_{i,t-4}.\end{aligned} \tag{7}$$

I run a panel regression with time fixed effects using all domestic equity funds to obtain coefficient estimates ($\widehat{\beta}$) for each model. Table 6 reports the regression results. The results are consistent with the theoretical model predictions and previous empirical findings. I use the regression results for Model (3) to explain my findings. I find that fund size change is positively related to fund performance ($\beta_1 = 0.087$ and t-stat $= 6.03$) and negatively related to fund performance volatility ($\beta_2 = -0.032$ and t-stat $= -1.69$). Better performing funds with stable performance records are more likely to attract new investors. Small, old, and expensive funds are less likely to increase in size ($\beta_3 = -0.003$ and t-stat $= -9.98$, $\beta_4 = -0.005$ and t-stat $= -7.98$, and $\beta_5 = -0.419$ and t-stat $= -4.99$). I also find that when volatility of past performance is high, investors learn less from returns about managers' ability and higher returns lead to smaller size increase of funds ($\beta_6 = -0.159$ and t-stat $= -3.27$). As fund age increases, investors have more information about fund performance and are less responsive to recent performance ($\beta_7 = -0.015$, t-stat $= -5.63$). A given good return triggers more size increase if the fund's

relative performance to its peer group is higher ($\beta_8 = -0.002$ and t-stat $= 3.40$). Funds from large families benefit from the spillover effect ($\beta_9 = 0.001$, t-stat $= 2.51$). I find that past fund flows are not significantly related to the fund size change.

After obtaining the coefficient estimates ($\widehat{\beta}$), I calculate the expected size change in the merger event month (period $t+1$):

$$E_t\left[\Delta\%Size_{i,t+1}\right] = \mathbf{X}_{i,t}\widehat{\beta}, \tag{8}$$

where $\mathbf{X}_{i,t}$ refers to characteristics of fund i one month before mergers (period t). Next, I calculate $Size^*$ in the merger month using the expected size change:

$$Size^*_{i,t+1} = TNA_{i,t} \times \left(1 + E_t\left[\Delta\%Size_{i,t+1}\right]\right). \tag{9}$$

I test whether the abnormal size and the abnormal size change due to mergers are significantly different from zero. The abnormal size change due to mergers is the difference between fund real size change and the expected size change calculated using the predictive regression models. Table 8 reports the test results. I find that acquiring funds experience a 31% (t-stat $= 11.35$) (Model (3)) abnormal size increase due to mergers. Their abnormal size in the merger event month is \$144 million (t-stat $= 9.27$) (Model (3)). Using predictive regression model (1) and (2) yield similar results.

4.2.2 Propensity Score Matching Algorithm

I use a propensity score matching algorithm to construct a control group by matching each acquiring fund to another domestic equity fund (Cooper, Gulen, and Rau (2005)). I use the regression model (Model II Equation 3) testing determinants of mergers to estimate a propensity score for acquiring funds and their potential matching funds. The independent variables are constructed the same way as for the test of determinants of acquisition. The dependent variable takes on a value of one for acquiring funds one month before mergers and zero for the other domestic equity funds that have never been involved in mergers in the sample period. I run a panel regression with time fixed effects and collect

the coefficient estimates. I use these coefficient estimates to calculate the probability of acquisition – the propensity score – for each acquiring fund and all potential matching funds. For each acquiring fund, a matching fund is identified as the fund with the closest propensity score one month before mergers to the acquiring fund.

In order to verify that the matching algorithm works well, I compare fund characteristics between the acquiring funds and their matching funds. Characteristics of interests include fund returns, size, age, expense ratios, flows, and percentage change of fund size. I calculate the characteristic difference between the acquiring funds and their matching funds and test whether the characteristic difference is significantly different from zero.

Table 7 reports characteristic difference estimates and t-statistics. Characteristics are compared one month before mergers. *Return* is fund monthly return. $Size$ is the logarithm of fund TNA. *Age* is the logarithm of fund age in months. I find that acquiring funds exhibit similar characteristics to their matching funds. The difference of all characteristics of interests is not significantly different from zero. For example, the difference of the percentage change of size is -0.58% (t-stat $= -1.14$). These findings justify the use of the percentage change of size of a matching fund as the percentage change of size for its matched acquiring fund to calculate the would-be size of the acquiring fund ($Size^*$) if there were no mergers:

$$Size^*_{i,t+1} = TNA_{i,t} \times \left(1 + \Delta\%Size^{match(i)}_{t+1}\right), \tag{10}$$

where $\Delta\%Size^{match(i)}_{t+1}$ is the percentage change of size of the matching fund for acquiring fund i in the merger event month. Next, I calculate the abnormal size change and the abnormal size of acquiring funds due to mergers and test whether they are positive and significant. Table 8 last column reports the test results. I find that acquiring funds experience 33% (t-stat $= 10.33$) abnormal size increase due to mergers. Their abnormal size in the merger event month is \$147 million (t-stat $= 7.09$). Overall, all the predictive regression models and the propensity score matching algorithm yield the same result that acquiring funds experience abnormal size increase due to mergers.

4.3 Size–Performance Relation

I have shown that acquiring funds experience abnormal size increase due to mergers. Decreasing returns to scale implies that fund performance will decrease after mergers. On the other hand, should no relation exist between fund size and performance, fund performance will not necessarily respond to fund size change. In this section, I examine whether fund performance deteriorates after fund size increases abnormally due to mergers. I use factor model alphas, objective-adjusted returns (OARs), and fund performance deciles to evaluate performance of acquiring funds around mergers.

4.3.1 Deteriorated Performance after Mergers

I use the Capital Asset Pricing Model (CAPM) of Sharpe (1964) and Lintner (1965), the Fama–French three-factor model (Fama and French (1993)), and the Carhart four-factor model (Carhart (1997)) to obtain fund alphas before and after mergers. To obtain the CAPM alpha, I estimate the following regression:

$$R_{i,t} - R_{f,t} = \alpha_i^{capm} + \beta_i^{mkt} \left(R_{m,t} - R_{f,t}\right) + \epsilon_{i,t}, \tag{11}$$

where the dependent variable is monthly return on fund i in month t minus the risk-free rate, and the independent variable is the excess return of the market portfolio over the risk-free rate. The intercept of the model, α_i^{capm}, is the CAPM alpha. To obtain the Fama–French three-factor alpha, I estimate the following regression:

$$R_{i,t} - R_{f,t} = \alpha_i^{ff3} + \beta_i^{mkt} \left(R_{m,t} - R_{f,t}\right) + \beta_i^{smb} SMB_t + \beta_i^{hml} HML_t + \epsilon_{i,t}, \tag{12}$$

where SMB is the return difference between small and large capitalization stocks, and HML is the return difference between high and low book-to-market stocks. The intercept of the model, α_i^{ff3}, is the Fama–French measure of abnormal performance. The Carhart four-factor model adjusts for momentum in stock returns (Jegadeesh and Titman (1993)).

To obtain the Carhart four-factor alpha, I estimate the following regression:

$$R_{i,t} - R_{f,t} = \alpha_i^{c4} + \beta_i^{mkt}\left(R_{m,t} - R_{f,t}\right) + \beta_i^{smb} SMB_t + \beta_i^{hml} HML_t + \beta_i^{umd} UMD_t + \epsilon_{i,t}, \tag{13}$$

where UMD is the return difference between stocks with high and low past returns.[10] The intercept of the model, α_i^{c4}, is the Carhart measure of abnormal returns. I use four years of returns before and after mergers to obtain the pre-merger and post-merger alphas for acquiring funds. Funds are required to have at least 12 months of return data to be included in the time-series regressions. Next, I calculate the changes of alpha of each acquiring fund. To test whether fund alphas before and after mergers are significantly different from zero and whether the changes of alpha are negative and significant, I regress the pre-merger alphas, the post-merger alphas, and the changes of alpha on a constant and cluster by time.

Table 9 reports the test results. The key finding is that the performance of acquiring funds decreases significantly after mergers. The annualized CAPM alpha decreases by 1.20% (t-stat = -2.20), the Fama–French three-factor alpha decreases by 0.96% (t-stat = -1.92), and the Carhart alpha decreases by 0.84% (t-stat = -1.89). These findings provide evidence that acquiring funds experience performance deterioration after their size increases abnormally due to mergers.

In addition to factor model alphas, I test whether the performance of acquiring funds decreases after mergers using the objective-adjusted returns (OARs). The OAR is the difference between fund return and the average return of the other funds with the same investment objective. The OAR measures fund performance relative to the other funds in its peer group and implicitly adjusts for sector, industry, or style-specific factors that may affect the performance of all funds with the same investment objective. I calculate the OAR of acquiring funds every month four years before and after mergers. Next, I calculate the average pre-merger and post-merger OARs for each acquiring fund. Consistent with the factor model alpha tests, I require that funds have at least 12 months

[10]The market, the size, the value, and the momentum factor returns and the risk-free rate are from Kenneth French's website at http://mba.tuck.dartmouth.edu/page/faculty/ken.french/. I thank Kenneth French for making data available.

of return data to be included in the OAR tests. I regress the pre-merger OARs and the post-merger OARs on a constant and cluster by time to test whether they are significantly different from zero. I calculate the change of OAR of each acquiring fund and test whether the change is negative and significant by regressing it on a constant and cluster by time.

The last row of Table 9 reports the test results. I find that the OAR of acquiring funds is positive before mergers (OAR = 0.41% and t-stat = 1.37) and becomes negative after mergers (OAR = -0.29% and t-stat = -2.27). The change of OAR is negative and significant (Δ OAR = -0.72% and t-stat = -2.09). Overall, these findings provide evidence that is consistent with decreasing returns to scale. Acquiring funds experience performance deterioration after their size increases abnormally due to mergers.

4.3.2 Fund Performance, Size, and Flows around Mergers

The third measure that I use to capture the change of fund performance around mergers is fund return decile. I calculate monthly return decile of the acquiring funds among the funds with the same investment objective four years before and after mergers and plot them in Figure 1 (dotted line). The horizontal axis is the time line of mergers. The numbers indicate months around mergers. The right vertical axis is for the return decile. I find that the pre-merger performance decile fluctuates around 5.6. The return decile of acquiring funds decreases to around 5.4 during the first three years after mergers and increases to 5.6 by end of the fourth year. This finding indicates that the deteriorated performance of acquiring funds after mergers is a short-lived phenomenon. Fund performance recovers after three years. Decreasing returns to scale implies that the recovered performance is related to the decrease of fund size. Next, I test this implication by examining whether the size of acquiring funds decreases in the post-merger period. I use fund size decile and objective-adjusted size (OAS) to capture the change of fund size around mergers.

I calculate monthly size decile of the acquiring funds among the funds with the same investment objective four years before and after mergers and plot them in Figure 1 (solid line). The left vertical axis is for the size decile. I find that during the four years before

mergers, acquiring funds increase in size. Their average size decile climbs from 7.1 to 7.4. The size decile reaches above 7.6 due to mergers, as indicated by the almost vertical solid line in the event month (0). In the post-merger period, acquiring funds consistently lose assets under management compared to the other funds with the same investment objective. Their average size decile decreases from above 7.6 to below 7.4 by the end of the fourth year after mergers. Overall, Figure 1 depicts the negative relation between fund size and performance. Fund performance decreases after fund size increases due to mergers. As fund size decreases in the post-merger period, fund performance recovers in the fourth year after mergers. These findings provide evidence that supports decreasing returns to scale.

Next, I examine the change of fund size using the objective-adjusted size (OAS). The OAS is the difference between fund size and the average size of the other funds with the same investment objective. The OAS implicitly adjusts for sector, industry, or style-specific factors that may affect fund size for the same investment objective. I calculate the average OAS of acquiring funds every year four years before and after mergers and report them in column (1) and (2) of Table 10. I regress the OAS of acquiring funds on a constant and cluster by time to obtain the t-statistics. I find that the OAS of acquiring funds grows from \$134 million four years before mergers to \$251 million one year before mergers. It increases to \$448 million due to mergers but subsequently decreases to \$422 million in the second year and to \$373 million in the third year after mergers. These findings show that acquiring funds lose some of the acquired assets during the first three years after mergers. I also find that the OAS increases to \$415 million in the fourth year. This finding is consistent with the previous results that fund performance recovers in the fourth year after mergers as measured by fund performance decile.

Similarly, I calculate the OAR of acquiring funds every year four years before and after mergers and report them in column (3) and (4) of Table 10. The results show that the OAR of acquiring funds is positive before mergers and becomes negative after mergers for two years. The OAR becomes positive in the third and fourth year after mergers. These findings provide additional evidence that fund performance deteriorates after their size increases abnormally due to mergers. The deteriorated performance, however, is

a short-lived phenomenon. Fund performance has recovered in the fourth year after mergers.

There are two sources of fund size change after mergers: $TNA_{i,t+1} = TNA_{i,t} \times (1 + R_{i,t+1} + Flow_{i,t+1})$, where $TNA_{i,t+1}$, $R_{i,t+1}$, and $Flow_{i,t+1}$ are the total net asset, return, and flow of fund i in period $t+1$, respectively. When $R_{i,t+1} + Flow_{i,t+1} < 0$, fund size decreases and $TNA_{i,t+1} < TNA_{i,t}$. The decrease of fund size may be caused by either negative returns or fund outflows. Fund flows are directed by the investments and redemptions made by fund shareholders. I have shown that acquiring funds experience performance deterioration after mergers. Next, I examine whether investment behaviors exhibited by fund shareholders contribute to the size adjustment of acquiring funds by testing whether acquiring funds experience negative and significant post-merger money outflows.

Consistent with previous size and performance tests, I use the objective-adjusted fund flows (OAFs) and fund flows decile to capture the changes of flows around mergers. The OAF is the difference between fund flow and the average flow of the other funds with the same investment objective. The OAF measures capital flows of a fund relative to the other funds in its peer group and implicitly adjusts for sector, industry, or style-specific factors that may affect fund flows for the same investment objective. I calculate the OAF of acquiring funds every year four years before and after mergers and report them in column (5) and (6) of Table 10. I find that the OAF of acquiring funds is not significantly different from zero before mergers and becomes significantly negative after mergers. The OAF four years before mergers are -0.01 (t-stat $= -0.59$), 0.01 (t-stat $=$ 0.87), -0.02 (t-stat $= -1.07$), and -0.03 (t-stat $= -1.24$). The OAF four years after mergers are -0.14 (t-stat $= -1.62$), -0.09 (t-stat $= -1.97$), -0.13 (t-stat $= -2.00$), and -0.25 (t-stat $= -1.82$). These findings provide evidence that shareholders of acquiring funds redeem their shares after mergers and their investment behaviors contribute to the size adjustment of acquiring funds in the post-merger period.

The second measure I use to capture the change of fund flows around mergers is the fund flow decile. I calculate monthly flow decile of the acquiring funds among the funds with the same investment objective four years before and after mergers and plot them in

Figure 2. The horizontal axis is the time line of mergers. The numbers indicate months around mergers. The vertical axis is for the fund flow decile. I find that during the four years before mergers, the average flow decile of acquiring funds fluctuates around 5.5 (the median level). The spike in the event month (0) indicates the acquired assets from the target funds. However, the average flow decile of acquiring funds decreases to about 5.0 after mergers. These findings indicate that acquiring funds experience consistent fund outflows after mergers. Both the deteriorated performance and investor redemptions contribute to the decrease of fund size in the post-merger period.

My findings of post-merger capital outflows of acquiring funds are consistent with the model prediction of Berk and Green (2004). They argue that fund flows chase performance because managerial skills are not directly observable and rational investors use past performance as proxies for skills. Their model predicts that money will flow out of acquiring funds due to their deteriorated performance after mergers.

Overall, I have shown that before mergers, acquiring funds are neither superior funds that attract consistent capital inflows nor poorly performing funds that suffer consistent capital outflows and they grow in size steadily from returns and flows. However, these funds experience performance deterioration after their size increases abnormally due to mergers. Facing the deteriorated performance, shareholders redeem their shares after mergers. Both deteriorated returns and capital outflows lead to the decrease of fund size in the post-merger period. As fund size decreases, fund performance has recovered in the fourth year after mergers.

4.4 Cross-Sectional TNA Ratio Test

Decreasing returns to scale implies that an acquiring fund which experiences a proportionally larger abnormal size increase is more likely to experience worse post-merger performance. In order to test this implication, I construct a TNA ratio (TNAR) variable which captures the relative size change of acquiring funds due to mergers. TNAR is defined as the sum of TNA of all target funds to the TNA of their common acquiring

fund in a merger:[11]

$$TNAR_i = \frac{\sum_{j=1}^{J} TNA_j^{target}}{TNA_i^{acquirer}}, \tag{14}$$

where $TNA_i^{acquirer}$ is the total net asset of the acquiring fund i, and TNA_j^{target} is the total net asset of the target fund j, and $j = 1, ..., J$. The mean and median of TNAR are 0.56 and 0.11, respectively. The standard deviation of TNAR is 1.61.[12]

I test the relation between TNAR and the post-merger performance of acquiring funds using a multivariate regression model.

$$\begin{aligned} Performance_{i,t} = \beta_0 + \beta_1(TNAR)_{i,t-1} + \beta_2(Size)_{i,t-1} + \beta_3(Expense\ Ratio)_{i,t-1} \\ +\beta_4(Age)_{i,t-1} + \beta_5(Flow)_{i,t-1} + \beta_6(Number\ of\ Objectives\ in\ the\ Family)_{i,t-1}. \end{aligned} \tag{15}$$

The dependent variable is fund performance after mergers. I use fund factor model alphas (α^{capm}, α^{ff3}, and α^{c4}) and objective-adjusted returns (OARs) to measure fund performance. Fund factor model alphas are obtained using four years of returns after mergers. I require that funds have at least 12 months of return data to be included in the regression. The independent variables are collected one month before mergers. $TNAR$ is the logarithm of TNAR. *Size* is the logarithm of fund TNA. *Age* is the logarithm of fund age in months. *Number of Objectives in the Family* is a measure of the number of investment objectives in a family. The parameter of interest is β_1. If fund size is not related to fund performance, then β_1 is zero. On the other hand, decreasing returns to scale implies that β_1 is negative.

Table 11 reports the results for the cross-sectional TNAR test. Column (1) to (4) use the CAPM alpha, the Fama–French three-factor alpha, the Carhart alpha, and the OAR, respectively. I find that β_1 are -0.02 (t-stat $= -2.43$), -0.02 (t-stat $= -2.07$), -0.01 (t-stat $= -1.95$), and -0.07 (t-stat $= -1.57$) using the CAPM alpha, the Fama–French alpha, the Carhart alpha, and the OAR, respectively. These findings show that funds have relative larger size increase due to mergers are more likely to experience worse

[11] In some merger cases, one fund acquires multiple funds at the same time.

[12] Appendix Table A7 reports the cross-sectional distribution of TNA ratio for the period of 2000–2013. Appendix Table A8 reports the cross-sectional distribution of TNA ratio for the period of 2000–2013. Acquiring funds with TNA<= \$15 million one month before mergers are excluded.

performance after mergers. I also find that the relation between fund size and fund post-merger performance is significant and negative. The coefficient estimates on fund size (β_2) are -0.06 (t-stat $= -4.00$), -0.04 (t-stat $= -2.94$), -0.03 (t-stat $= -2.83$), and -0.20 (t-stat $= -2.80$) using the CAPM alpha, the Fama–French alpha, the Carhart alpha, and the OAR, respectively. Both the negative relation between size and post-merger performance and the negative relation between TNAR and post-merger performance provide evidence of decreasing returns to scale. I also replace TNAR by the dollar amount of acquired assets and find similar results.

4.5 Discussion of Findings and Contributions

Jayaraman, Khorana, and Nelling (2002) (JKN) examine the determinants of being acquired in fund mergers and find that poor past performance of target funds is a driving factor for within-family mergers. The authors also find that shareholders of the target funds benefit from mergers through reduction in expense ratios and improvements in performance after mergers. Acquiring funds experience performance deterioration and capital outflows in the year following mergers. My paper builds on and extends their paper in three aspects.

First, JKN examine fund performance and flows two years after mergers. The authors argue that their limited post-merger data prevents them from doing a long-term post-merger analysis. My paper examines the change of fund size, performance, and flows four years after mergers. I find that acquiring funds experience performance deterioration after mergers, which is consistent with the findings of JKN. However, my results also show that the deteriorated performance is a short-lived phenomenon. As fund size adjusts to its would-be size if there were no mergers, fund performance has recovered in the fourth year after mergers.

Second, JKN find that acquiring funds experience negative objective-adjusted flows in the year before mergers and argue that mergers may be motivated by the desire to renew interest in acquiring funds. They also find that acquiring funds experience capital outflows after mergers and argue that acquisitions do not reverse the trend of declining

assets of acquiring funds. I examine fund flows and performance four years before and after mergers. Different from the results of JKN, I find that the objective-adjusted flows of acquiring funds fluctuate around zero four years before mergers and their size decile steadily increases in the same period. These findings indicate that acquiring funds do not lose their shareholders before mergers and thus do not need to acquire other funds to keep alive. My results also indicate that funds cannot acquire other funds to renew the interests of investors and attract new inflows due to decreasing returns to scale. Consistent with the results of JKN, I find that acquiring funds experience performance deterioration and capital outflows after mergers. However, I argue that investors redeem their shares from the acquiring funds because they are not satisfied with their fund performance. Berk and Green (2004) explain that managerial skills are not directly observable, thus investors use past performance as proxies for managerial skills. Because shareholders of acquiring funds realize that their managers do not have the skills to manage the merged funds, they redeem their shares from the acquiring funds after mergers.

Third, JKN examine and analyze the changes of fund size, performance, and flows separately in fund mergers. I argue that the changes of fund size, performance, and flows are related. I find that acquiring funds are not poor performing funds before mergers but experience performance deterioration after their size increases abnormally due to mergers. These findings provide evidence that is consistent with mutual funds having decreasing returns to scale. As fund size increases, fund performance decreases. I also find that money flows out of the acquiring funds as a response to the deteriorated post-merger performance. As fund size decreases in the post-merger period due to both bad performance and consistent money outflows, fund performance recovers in the fourth year after mergers. These findings also provide evidence that is consistent with decreasing returns to scale. As fund size decreases, fund performance increases.

5 Robustness

5.1 12b-1 Fee and Turnover Tests

An alternative explanation for the deteriorated post-merger performance is increased 12b-1 fee or increased fund turnover after mergers.[13] Acquiring funds may charge a higher 12b-1 fee after mergers to advertise the newly merged fund. Higher advertisement fee reduces fund net returns. Acquiring funds may experience higher post-merger turnover, as managers may reorganize portfolio holdings, which increases transaction costs and reduces fund net returns. In this section, I test whether acquiring funds increase their 12b-1 fee and turnover after mergers.

I calculate the average of 12b-1 fee and turnover one-year, two-year, three-year, and four-year before and after mergers. Next, I calculate the change of 12b-1 fee and turnover:

$$\Delta 12b1 = 12b1_{after} - 12b1_{before}, \tag{16}$$

$$\Delta turnover = turnover_{after} - turnover_{before}. \tag{17}$$

I test whether $\Delta 12b1$ and $\Delta turnover$ are zero and report the results in Table 12. I find that 12b-1 fee significantly decreases after mergers with small magnitude. The changes of 12b-1 fee are -0.004% (t-stat $= -1.58$), -0.010% (t-stat $= -3.26$), -0.016% (t-stat $= -4.32$), and -0.021% (t-stat $= -5.04$) using one-year, two-year, three-year, and four-year average values, respectively. The change of turnover is not significant four years before and after mergers. These findings imply that the deterioration in performance of acquiring funds after mergers is not related to either increased 12b-1 fee or increased turnover.

[13] CRSP reports fund turnover as the minimum of aggregated sales or aggregated purchases of securities divided by the average 12-month total net assets of the fund.

5.2 Multiple Acquisitions in Life Cycle

Some funds acquire multiple times in their life cycle. I exclude mergers if there are less than four years between two consecutive acquisitions made by the same fund because fund characteristics are double counted for these two acquisitions. For example, a fund makes acquisitions in January 2000 and January 2004. Fund returns between these two acquisitions are classified as post-merger performance for the first acquisition and as pre-merger performance for the second acquisition. There are 552 acquisitions satisfy this requirement. I test the size–performance relation using this new sample and find similar results. The findings show that acquiring funds experience abnormal size increase due to mergers and subsequent performance deterioration after mergers. The deteriorated performance, however, is a short-lived phenomenon. Fund performance recovers as fund size decreases. These findings provide evidence that is consistent with mutual funds having decreasing returns to scale.

6 Conclusion

This paper examines whether mutual funds have decreasing returns to scale. I study the size–performance relation in fund mergers, where acquiring funds experience an abnormal increase in size. I show that the probability of being an acquiring fund in mergers is not significantly related to past fund performance. This finding verifies that this paper is not subject to the endogenous fund size issue. I find that acquiring funds experience performance deterioration after their size increases abnormally due to mergers. In the cross-sectional TNA ratio test, I find that acquiring funds which experience proportionally larger abnormal size increase are more likely to experience worse post-merger performance. The deteriorated performance, however, is a short-lived phenomenon. As the size of acquiring funds decreases in the post-merger period, fund performance recovers in the fourth year after mergers. I also show that acquiring funds have consistent fund outflows after mergers, which contributes to the decreases of fund size.

Overall, the empirical findings of this paper provide evidence that supports mutual

funds having decreasing returns to scale. Fund performance deteriorates as fund size increases and recovers as fund size decreases. My results are most consistent with the model of Berk and Green (2004). In their model, rational investors compete with each other for positive alpha. They move their money into superior performing funds and move their money out of the funds that perform poorly. Fund performance degrades as capital flows into a fund. Fund flows continue until fund size reaches a point where the fund is no longer expected to either outperform or underperform in the future. The results also show that there is a delayed reaction of investors to the abnormal size increase and performance deterioration of acquiring funds. It takes the acquiring funds three years to recover their performance.

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Table 1. Number of Equity Funds and Families Involved in Mergers

Table 1 reports the number of equity funds and fund families involved in fund mergers for the period of 1991–2013. CRSP provides fund monthly total net asset data since 1991. Following many previous studies, this paper is restricted to diversified U.S. equity mutual funds. CRSP identifies mergers by the target fund's last report month and the delist code being M. Mergers among share classes of the same fund are excluded. CRSP provides fund family's identifier since December 1999. I report the number of acquiring fund families, target fund families, and total fund families for the period of 2000–2013.

Year	Acquiring Fund	Target Fund	Acquiring Family	Target Family	Total Family
1991	15	20			
1992	18	20			
1993	19	24			
1994	12	16			
1995	28	39			
1996	15	21			
1997	26	54			
1998	42	67			
1999	40	72			
2000	74	122	38	39	463
2001	74	150	31	41	488
2002	98	219	44	52	507
2003	104	220	48	56	508
2004	77	107	34	35	496
2005	95	116	34	39	478
2006	85	122	31	39	467
2007	111	150	42	46	480
2008	100	186	40	40	486
2009	180	311	56	59	476
2010	97	188	46	50	475
2011	88	113	37	38	472
2012	60	72	37	37	466
2013	50	59	31	32	482

Table 2. Compare Fund Characteristics: Acquiring, Target, and Other Funds

Table 2 reports fund characteristics of the acquiring funds, the target funds, and the other funds. I use fund-month observations to calculate fund characteristics of each comparing fund group. Characteristics of interest include fund size, performance, volatility of performance, expense ratio, age, and flows. Fund size is measured as the total net asset (TNA) in million dollars. Fund performance is fund monthly returns. The first three years of return data for all funds are removed to eliminate the incubation bias. Volatility of performance is the standard deviation of fund returns in the past 12 months (including the current month). Fund age is calculated in months. Fund flow is calculated as: $Flow_{i,t} = \frac{TNA_{i,t}-(1+R_{i,t})\times TNA_{i,t-1}}{TNA_{i,t-1}}$, where $Flow_{i,t}$, $TNA_{i,t}$, and $R_{i,t}$ are flow, total net asset, and return of fund i in month t. I calculate the value-weighted characteristics of a fund which has multiple share classes. To compare fund characteristics among the acquiring funds, the target funds, and the other funds, I do the following calculations. First, I calculate the average characteristics 12 months before mergers for each acquiring and target fund. Second, I calculate the cross-sectional average of characteristics of acquiring funds with the same merger event month and the cross-sectional average of characteristics of the target funds with the same TNA last report month. Third, I calculate the cross-sectional average of characteristics of the other funds every month in the sample period. These calculations yield time series of characteristics for the acquiring funds, the target funds, and the other funds, respectively. Column (1)–(3) report the time-series mean characteristics of each group of funds. Column (4) reports t-statistics for comparing characteristics between the acquiring funds and the target funds. Column (5) reports t-statistics for comparing characteristics between the acquiring funds and the other funds.

Fund Characteristics	(1)	(2)	(3)	(4)	(5)
	Mean			t-stat	
	Acquiring Funds	Target Funds	Other Funds	Acquiring vs. Target Funds	Acquiring vs. Other Funds
Size ($ Million)	864	178	1086	(8.54)	(−2.33)
Performance (%)	0.36	0.02	0.70	(1.28)	(−0.65)
Volatility of Returns (%)	4.78	4.96	4.97	(−1.65)	(−2.02)
Expense Ratio (%)	1.34	1.62	1.37	(−10.63)	(−1.37)
Age (Months)	145	104	143	(6.88)	(0.67)
Flow (%)	0.54	−1.41	0.51	(5.35)	(0.57)

Table 3. Determinants of Fund Mergers

Table 3 reports the probability of being an acquiring fund (target fund) in mergers using two logistic regression models. The dependent variable takes on a value of one if a fund acquires (is acquired by) other funds in the subsequent 12-month period and zero otherwise. The independent variables are constructed using fund characteristic data over the past 12-month period (including the current month). $Performance$ is the objective-adjusted cumulative returns. The objective-adjusted cumulative return is the difference between fund cumulative return and the average cumulative return of the other funds with the same investment objective. Cumulative returns are calculated over the past 12 months. $Flows$ is the objective-adjusted fund flow. The objective-adjusted fund flow is the difference between fund flow and the average flow of the other funds with the same investment objective. Fund flows are averaged over the past 12 months. *Expense Ratio* is the objective-adjusted expense ratio. The objective-adjusted expense ratio is the difference between fund expense ratio and the average expense ratio of the other funds with the same investment objective. Expense ratios are averaged over the past 12 months. $Size$ is the logarithm of the total net asset (TNA) of a fund. $Number\ of\ Objectives\ in\ the\ Family$ is a measure of the number of investment objectives in a family. Age is the logarithm of fund age in months. $Performance\ Volatility$ is the objective-adjusted performance volatility. The objective-adjusted performance volatility is the difference between fund performance volatility and the average performance volatility of the other funds with the same investment objective. Performance volatility is the standard deviation of fund returns in the past 12 months. I test the model and report results using data of June. In this instance, in June 2000, the dependent variable takes on a value of one if a fund acquires (is acquired) in the subsequent 12-month period of July 2000 to June 2001. Fund characteristic data over July 1999 to June 2000 are used to calculate the independent variables. Column (1) to (4) report the regression results for Model I. Column (5) to (8) report the regression results for Model II . Numbers in parentheses are p-values.

Independent Variables	(1) Acquiring Fund	(2) Acquiring Fund	(3) Target Fund	(4) Target Fund	(5) Acquiring Fund	(6) Acquiring Fund	(7) Target Fund	(8) Target Fund
	Regression Coefficient	Marginal Effect	Regression Coefficient	Marginal Effect	Regression Coefficient	Marginal Effect	Regression Coefficient	Marginal Effect
Intercept	−4.640		4.090		−4.190		4.470	
	(0.00)		(0.00)		(0.00)		(0.00)	
Performance	−0.004	0.000	−0.029	−0.001	−0.005	0.000	−0.031	−0.001
	(0.42)		(0.00)		(0.31)		(0.00)	
Flow	0.000	0.000	−0.003	0.000	0.000	−0.001	−0.003	0.000
	(0.94)		(0.27)		(0.90)		(0.22)	
Size	0.055	0.001	−0.392	−0.017	0.075	0.000	−0.380	−0.017
	(0.01)		(0.00)		(0.00)		(0.00)	
Expense Ratio	0.012	0.000	−0.089	−0.004	0.020	0.002	−0.077	−0.003
	(0.70)		(0.00)		(0.50)		(0.00)	
Number of Objectives in the Family	0.002	0.000	0.002	0.000	0.002	0.000	0.002	0.000
	(0.00)		(0.00)		(0.00)		(0.00)	
Performance Volatility					−0.022	0.000	−0.033	−0.001
					(0.42)		(0.09)	
Age					−0.170	−0.004	−0.119	−0.005
					(0.04)		(0.07)	
Number of Acquiring (Target) Funds	529		1105		529		1105	
Number of Observations	22,031		22,031		22,031		22,031	
Year Fixed Effect	Yes		Yes		Yes		Yes	

Table 4. Determinants of Within-Family Fund Mergers

Table 4 reports the probability of being an acquiring fund (target fund) in within-family mergers using two logistic regression models. The dependent variable takes on a value of one if a fund acquires (is acquired by) other funds from the same family in the subsequent 12-month period and zero otherwise. The independent variables are constructed using fund characteristic data over the past 12-month period (including the current month). *Performance* is the objective-adjusted cumulative returns. The objective-adjusted cumulative return is the difference between fund cumulative return and the average cumulative return of the other funds with the same investment objective. Cumulative returns are calculated over the past 12 months. *Flows* is the objective-adjusted fund flow. The objective-adjusted fund flow is the difference between fund flow and the average flow of the other funds with the same investment objective. Fund flows are averaged over the past 12 months. *Expense Ratio* is the objective-adjusted expense ratio. The objective-adjusted expense ratio is the difference between fund expense ratio and the average expense ratio of the other funds with the same investment objective. Expense ratios are averaged over the past 12 months. *Size* is the logarithm of the total net asset (TNA) of a fund. *Number of Objectives in the Family* is a measure of the number of investment objectives in a family. *Age* is the logarithm of fund age in months. *Performance Volatility* is the objective-adjusted performance volatility. The objective-adjusted performance volatility is the difference between fund performance volatility and the average performance volatility of the other funds with the same investment objective. Performance volatility is the standard deviation of fund returns in the past 12 months. I test the model and report results using data of June. In this instance, in June 2000, the dependent variable takes on a value of one if a fund acquires (is acquired) in the subsequent 12-month period of July 2000 to June 2001. Fund characteristic data over July 1999 to June 2000 are used to calculate the independent variables. Column (1) to (4) report the regression results for Model I. Column (5) to (8) report the regression results for Model II . Numbers in parentheses are p-values.

Independent Variables	(1) Acquiring Fund	(2) Acquiring Fund	(3) Target Fund	(4) Target Fund	(5) Acquiring Fund	(6) Acquiring Fund	(7) Target Fund	(8) Target Fund
	Regression Coefficient	Marginal Effect	Regression Coefficient	Marginal Effect	Regression Coefficient	Marginal Effect	Regression Coefficient	Marginal Effect
Intercept	−4.772		3.559		−3.911		4.575	
	(0.00)		(0.00)		(0.00)		(0.00)	
Performance	−0.003	0.000	−0.031	−0.001	−0.004	0.000	−0.033	−0.001
	(0.60)		(0.00)		(0.57)		(0.00)	
Flow	0.000	0.000	−0.008	0.000	0.000	0.000	−0.008	0.000
	(0.99)		(0.01)		(0.93)		(0.00)	
Size	0.051	0.001	−0.397	−0.010	0.087	0.000	−0.369	−0.010
	(0.06)		(0.00)		(0.00)		(0.00)	
Expense Ratio	-0.002	0.000	−0.067	−0.002	0.009	0.001	−0.050	−0.001
	(0.97)		(0.01)		(0.87)		(0.04)	
Number of Objectives in the Family	0.002	0.000	0.006	0.000	0.002	0.000	0.006	0.000
	(0.01)		(0.00)		(0.01)		(0.00)	
Performance Volatility					0.011	0.000	−0.023	−0.001
					(0.77)		(0.38)	
Age					−0.321	−0.004	−0.313	−0.008
					(0.00)		(0.00)	
Number of Acquiring (Target) Funds	311		637		311		637	
Number of Observations	22,031		22,031		22,031		22,031	
Year Fixed Effect	Yes		Yes		Yes		Yes	

Table 5. Determinants of Across-Family Fund Mergers

Table 5 reports the probability of being an acquiring fund (target fund) in across-family mergers using two logistic regression models. The dependent variable takes on a value of one if a fund acquires (is acquired by) other funds from a different family in the subsequent 12-month period and zero otherwise. The independent variables are constructed using fund characteristic data over the past 12-month period (including the current month). *Performance* is the objective-adjusted cumulative returns. The objective-adjusted cumulative return is the difference between fund cumulative return and the average cumulative return of the other funds with the same investment objective. Cumulative returns are calculated over the past 12 months. *Flows* is the objective-adjusted fund flow. The objective-adjusted fund flow is the difference between fund flow and the average flow of the other funds with the same investment objective. Fund flows are averaged over the past 12 months. *Expense Ratio* is the objective-adjusted expense ratio. The objective-adjusted expense ratio is the difference between fund expense ratio and the average expense ratio of the other funds with the same investment objective. Expense ratios are averaged over the past 12 months. *Size* is the logarithm of the total net asset (TNA) of a fund. *Number of Objectives in the Family* is a measure of the number of investment objectives in a family. *Age* is the logarithm of fund age in months. *Performance Volatility* is the objective-adjusted performance volatility. The objective-adjusted performance volatility is the difference between fund performance volatility and the average performance volatility of the other funds with the same investment objective. Performance volatility is the standard deviation of fund returns in the past 12 months. I test the model and report results using data of June. In this instance, in June 2000, the dependent variable takes on a value of one if a fund acquires (is acquired) in the subsequent 12-month period of July 2000 to June 2001. Fund characteristic data over July 1999 to June 2000 are used to calculate the independent variables. Column (1) to (4) report the regression results for Model I. Column (5) to (8) report the regression results for Model II . Numbers in parentheses are p-values.

Independent Variables	(1) Acquiring Fund	(2) Acquiring Fund	(3) Target Fund	(4) Target Fund	(5) Acquiring Fund	(6) Acquiring Fund	(7) Target Fund	(8) Target Fund
	Regression Coefficient	Marginal Effect	Regression Coefficient	Marginal Effect	Regression Coefficient	Marginal Effect	Regression Coefficient	Marginal Effect
Intercept	−6.349		2.079		−6.397		2.001	
	(0.00)		(0.00)		(0.00)		(0.00)	
Performance	−0.004	0.000	−0.024	0.000	−0.005	0.000	−0.027	−0.001
	(0.53)		(0.00)		(0.45)		(0.00)	
Flow	0.000	0.000	0.000	0.000	0.000	−0.001	0.000	0.000
	(0.92)		(0.99)		(0.93)		(0.97)	
Size	0.058	0.001	−0.331	−0.007	0.055	0.000	−0.332	−0.007
	(0.08)		(0.00)		(0.13)		(0.00)	
Expense Ratio	0.021	0.000	−0.128	−0.003	0.026	0.001	−0.117	−0.002
	(0.56)		(0.01)		(0.44)		(0.01)	
Number of Objectives in the Family	0.002	0.000	−0.011	0.000	0.002	0.000	−0.011	0.000
	(0.01)		(0.00)		(0.01)		(0.00)	
Performance Volatility					−0.059	0.000	−0.049	−0.001
					(0.15)		(0.07)	
Age					0.026	0.000	0.025	0.000
					(0.82)		(0.79)	
Number of Acquiring (Target) Funds	218		468		218		468	
Number of Observations	22,031		22,031		22,031		22,031	
Year Fixed Effect	Yes		Yes		Yes		Yes	

Table 6. Predictive Regression Models for the Expected Change of Fund Size

Table 6 reports coefficient estimates and t-statistics for three predictive regression models. The first predictive regression model (Model (1)) is constructed based on the theoretical model of Berk and Green (2004). The dependent variable is the change of fund size: $\Delta\%Size_{i,t} = \frac{TNA_{i,t} - TNA_{i,t-1}}{TNA_{i,t-1}}$. The independent variables are fund characteristics, which are lagged one period. *Performance* is the cumulative returns over past 12 months. *Performance Volatility* is the standard deviations of returns over past 12 months. *Size* is the logarithm of fund TNA. *Age* is the logarithm of fund age in months. *Expense Ratio* is the expense ratio. *Performance* × *Performance Volatility* interacts fund cumulative returns with standard deviation of past returns. *Performance* × *Age* interacts the cumulative returns with the logarithm of fund age in months. The second predictive regression model (Model (2)) includes two more independent variables following Sirri and Tufano (1998). *Performance* × *Performance Decile* interacts the cumulative returns with fund performance decile. I calculate the performance decile for each equity fund among the funds with the same investment objective.
Number of Objectives in the Family is a measure of the number of investment objectives in a family. Following Ferson and Kim (2012) and Lou (2012), I include four lags of flows in Model (3) to control for the persistence in investment flows. I run a panel regression with time fixed effects using all domestic equity funds for each model. t-statistics are reported in parentheses.

Independent Variable	Model (1)	Model (2)	Model (3)
Intercept	0.105	0.096	0.096
	(18.38)	(17.12)	(17.07)
Performance	0.129	0.087	0.087
	(9.24)	(6.04)	(6.03)
Performance Volatility	0.039	−0.029	−0.032
	(1.97)	(−1.50)	(−1.69)
Size	−0.003	−0.003	−0.003
	(−10.57)	(−10.05)	(−9.98)
Age	−0.004	−0.005	−0.005
	(−6.58)	(−7.99)	(−7.98)
Expense Ratio	−0.440	−0.427	−0.419
	(−5.30)	(−5.12)	(−4.99)
Performance * Performance Volatility	−0.170	−0.152	−0.159
	(−3.88)	(−3.15)	(−3.27)
Performance * Age	−0.019	−0.015	−0.015
	(−6.98)	(−5.63)	(−5.63)
Performance * Performance Decile		0.002	0.002
		(3.39)	(3.40)
Number of Objectives in the Family		0.001	0.001
		(2.53)	(2.51)
Flow $(t-1)$			0.000
			(0.85)
Flow $(t-2)$			0.000
			(0.50)
Flow $(t-3)$			0.000
			(−0.14)
Flow $(t-4)$			0.000
			(−0.05)
Number of Observations	422,246	314,138	312,657
R Squared	0.0070	0.0093	0.0093
Year Fixed Effect	Yes	Yes	Yes

Table 7. Characteristic Difference between the Acquiring Funds and Their Matching Funds

Table 7 reports estimates and t-statistics for the characteristic differences between the acquiring funds and their matching funds. I use a propensity score matching algorithm to construct a control group by matching each acquiring fund to another domestic equity fund. I use the regression model (Model II Equation 3) testing determinants of mergers to estimate a propensity score for acquiring funds and their potential matching funds. The independent variables are constructed the same way as for the test of determinants of acquisition. The dependent variable takes on a value of one for acquiring funds one month before mergers and zero for the other domestic equity funds that have never been involved in mergers in the sample period. I run a panel regression with time fixed effects and collect the coefficient estimates. I use these coefficient estimates to calculate the probability of acquisition – the propensity score – for each acquiring fund and all potential matching funds. For each acquiring fund, a matching fund is identified as the fund with the closest propensity score one month before mergers to the acquiring fund. In order to verify that the matching algorithm works well, I compare fund characteristics between the acquiring funds and their matching funds. Characteristics of interests include fund returns, size, age, expense ratios, flows, and percentage change of fund size. I calculate the characteristic difference between the acquiring fund and their matching funds and test whether the characteristic difference is significantly different from zero. Characteristics are compared one month before mergers. *Return* is fund monthly return. *Size* is the logarithm of fund TNA. *Age* is the logarithm of fund age in months.

Characteristics	Estimates	t-stat
Return (%)	0.02	(0.12)
Size	0.07	(0.78)
Age	0.03	(0.90)
Expense Ratio (%)	−0.03	(−1.09)
Flow (%)	−0.61	(−1.29)
Δ % Size	−0.58	(−1.14)

Table 8. Abnormal Size Increase Due to Mergers

Table 8 reports the abnormal size change of acquiring funds due to mergers. The abnormal size is the difference between fund real size (TNA) and its would-be size (denoted as $Size^*$) if there were no mergers. I use three predictive regression models and a propensity score matching algorithm to obtain $Size^*$. After obtaining the coefficient estimates ($\widehat{\beta}$) of each predictive regression model, I calculate the expected size change in the merger event month (period $t+1$): $E_t\left[\Delta\%Size_{i,t+1}\right] = \mathbf{X}_{i,t}\widehat{\beta}$, where $\mathbf{X}_{i,t}$ refers to characteristics of fund i one month before mergers (period t). Next, I calculate $Size^*$ using the expected size change: $Size^*_{i,t+1} = TNA_{i,t} \times (1 + E_t\left[\Delta\%Size_{i,t+1}\right])$. I test whether the abnormal size change and the abnormal size due to mergers are significantly different from zero. The abnormal size change due to mergers is the difference between fund real size change and the expected size change calculated using the predictive regression models. I also construct a control group by matching each acquiring fund to another domestic equity fund using a propensity score matching algorithm. I use the percentage change of size of a matching fund as the percentage change of size for its matched acquiring fund to calculate the would-be size of the acquiring fund ($Size^*$) if there were no mergers: $Size^*_{i,t+1} = TNA_{i,t} \times \left(1 + \Delta\%Size^{match(i)}_{t+1}\right)$, where $\Delta\%Size^{match(i)}_{t+1}$ is the percentage change of size of the matching fund for acquiring fund i in the merger event month. Next, I calculate the abnormal size change and the abnormal size of acquiring funds due to mergers and test whether they are positive and significant. t-statistics are reported in parentheses.

Parameter	Predictive Regression Model			Propensity Score Matching Algorithm
	Model (1)	Model (2)	Model (3)	
Abnormal Size ($ Million)	126	145	144	147
	(9.09)	(9.33)	(9.27)	(7.09)
Abnormal $\Delta\%Size$	30%	31%	31%	33%
	(11.88)	(11.34)	(11.35)	(10.33)
Number of Observations	905	814	807	804

Table 9. Fund Performance Around Mergers: Factor Model Alphas and Objective-Adjusted Returns

Table 9 reports test results of examining fund performance around mergers using factor model alphas and objective-adjusted returns (OARs). I use the Capital Asset Pricing Model (CAPM), the Fama–French three-factor model, and the Carhart four-factor model to examine fund performance around mergers. I use four years of returns before and after mergers to obtain the pre-merger and post-merger alphas for acquiring funds. Funds are required to have at least 12 months of return data to be included in the time-series regressions. Next, I calculate the change of alpha. I test whether the pre-merger alpha, the post-merger alpha, and the change of alpha are significantly different from zero by regressing them on a constant and clustering by time. The OAR is the difference between fund return and the average return of the other funds with the same investment objective. I calculate the average OAR of acquiring funds four years before and after mergers and the change of OAR. Consistent with the factor model alpha tests, I also require funds have at least 12 months of return data to be included in the OAR tests. I examine whether the pre-merger OAR, the post-merger OAR, and the change of OAR are significantly different from zero by regressing them on a constant and clustering by time. The factor model alphas, the OARs and their changes are annualized values. t-statistics are reported in parentheses.

Model	α (Before Merger)		α (After Merger)		$\Delta\alpha$	
	Estimate (%)	t-stat	Estimate (%)	t-stat	Estimate (%)	t-stat
CAPM	0.24	(0.84)	−0.60	(−1.82)	−1.20	(−2.20)
Fama-French	−0.36	(−1.50)	−1.20	(−4.33)	−0.96	(−1.92)
Carhart	−0.60	(−2.57)	−1.32	(−4.69)	−0.84	(−1.89)
OAR	0.41	(1.37)	−0.29	(−2.27)	−0.72	(−2.09)

Table 10. The Objective-Adjusted Size, Performance, and Flows Around Mergers

Table 10 reports the objective-adjusted fund size, performance, and flows around mergers. The objective-adjusted fund size (OAS) is the difference between fund size and the average size of the other funds with the same investment objective. I report the average OAS of acquiring funds every year four years before and after mergers in column (1). The objective-adjusted return (OAR) is the difference between fund return and the average return of the other funds with the same investment objective. I report the average OAR of acquiring funds every year four years before and after mergers in column (3). The objective-adjusted fund flow (OAF) is the difference between fund flow and the average flow of other funds with the same investment objective. I report the average OAF of acquiring funds every year four years before and after mergers in column (5). I test whether the OAS, OAR, and OAF are significantly different from zero by regressing them on a constant and clustering by time. The OAS is in $ million. The OAR is annualized value and in %. t-statistics are in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)
Year	Objective-Adjusted		Objective-Adjusted		Objective-Adjusted	
Around	Size	($ Million)	Return	(%)	Flow	
Mergers	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat
$(t-4)$ Year	134	(0.70)	1.92	(2.10)	−0.01	(−0.59)
$(t-3)$ Year	198	(0.88)	0.04	(0.08)	0.01	(0.87)
$(t-2)$ Year	181	(0.96)	0.33	(0.74)	−0.02	(1.07)
$(t-1)$ Year	251	(1.64)	1.15	(2.22)	−0.03	(−1.24)
$(t+1)$ Year	448	(2.86)	−0.30	(−1.09)	−0.14	(−1.62)
$(t+2)$ Year	422	(2.92)	−0.11	(−0.32)	−0.09	(−1.97)
$(t+3)$ Year	373	(2.86)	0.13	(0.34)	−0.13	(−2.00)
$(t+4)$ Year	415	(2.82)	0.37	(1.41)	−0.25	(−1.82)

Table 11. Cross-Sectional TNA Ratio Test

Table 11 reports results of the cross-sectional TNA ratio (TNAR) test. I construct the TNAR variable to capture the relative size change of acquiring funds due to mergers. TNAR is defined as the sum of TNA of all target funds to the TNA of their common acquiring fund: $TNAR_i = \frac{\sum_{j=1}^{J} TNA_j^{target}}{TNA_i^{acquirer}}$, where $TNA_i^{acquirer}$ is the total net asset of the acquiring fund i, and TNA_j^{target} is the total net asset of the target fund j, and $j = 1, ..., J$. I test the relation between TNAR and the post-merger performance of acquiring funds using a multivariate regression model. The dependent variable is fund performance after mergers. I use fund factor model alphas (α^{capm}, α^{ff3}, and α^{c4}) and objective-adjusted returns (OARs) to measure fund performance. Fund factor model alphas are obtained using four years of returns after mergers. I require that funds have at least 12 months of return data to be included in the regression. Independent variables are collected one month before mergers. $TNAR$ is the logarithm of TNAR. *Size* is the logarithm of fund TNA. *Age* is the logarithm of fund age in months. *Number of Objectives in the Family* is a measure of the number of investment objectives in a family. Column (1) to (4) use the CAPM alpha, the Fama–French three-factor alpha, the Carhart alpha, and the OAR, respectively. t-statistics are reported in parentheses.

Independent Variables	(1) α^{capm}	(2) α^{ff3}	(3) α^{c4}	(4) OAR
Intercept	0.63	0.31	0.28	2.71
	(2.49)	(1.41)	(1.29)	(2.07)
TNA Ratio	−0.02	−0.02	−0.01	−0.07
	(−2.43)	(−2.07)	(−1.95)	(−1.57)
Size	−0.06	−0.04	−0.03	−0.20
	(−4.00)	(−2.94)	(−2.83)	(−2.80)
Expense Ratio	0.05	−0.01	−0.01	−0.83
	(1.33)	(−0.21)	(−0.18)	(−4.06)
Age	0.02	0.02	0.02	0.14
	(0.61)	(0.70)	(0.66)	(0.98)
Flow	−0.13	−0.14	−0.18	−1.30
	(−0.74)	(−0.99)	(−1.23)	(−1.48)
Number of Objectives in the Family	0.03	0.03	0.03	0.22
	(1.60)	(2.04)	(2.11)	(2.49)
Number of Observations	581	581	581	581
R Squared	0.0953	0.0761	0.0704	0.0578
Year Fixed Effect	Yes	Yes	Yes	Yes

Table 12. Changes of 12b-1 Fee and Turnover After Mergers

Table 12 reports the change of 12b-1 fee and the change of turnover of acquiring funds after mergers. I calculate the average 12b-1 fee and turnover one-year, two-year, three-year, and four-year before and after mergers. Next, I calculate the change of 12b-1 fee and the change of turnover: $\Delta 12b1 = 12b1_{after} - 12b1_{before}$, and $\Delta turnover = turnover_{after} - turnover_{before}$ using one-year to four-year average values before and after mergers. I test whether $\Delta 12b1$ and $\Delta turnover$ are zero. t-statistics are in parentheses.

Variable	One-Year Average	Two-Year Average	Three-Year Average	Four-Year Average
Δ 12b1	-0.004	-0.010	-0.016	-0.021
	(-1.58)	(-3.26)	(-4.32)	(-5.04)
Δ Turnover	0.305	0.698	-0.587	-1.022
	(0.21)	(0.43)	(-0.35)	(-0.57)
Number of Observations	772	784	794	798

Figure 1. Size–Performance Relation: Size Decile and Return Decile

Figure 1 plots monthly size decile and return decile of acquiring funds four years before and after mergers. I calculate monthly size decile and return decile of the acquiring funds among the funds with the same investment objective. The horizontal axis is the time line of mergers, and the numbers indicate months around mergers. The left vertical axis is for the size decile. The right vertical axis is for the return decile. The solid line is fund size decile. The dotted line is fund return decile.

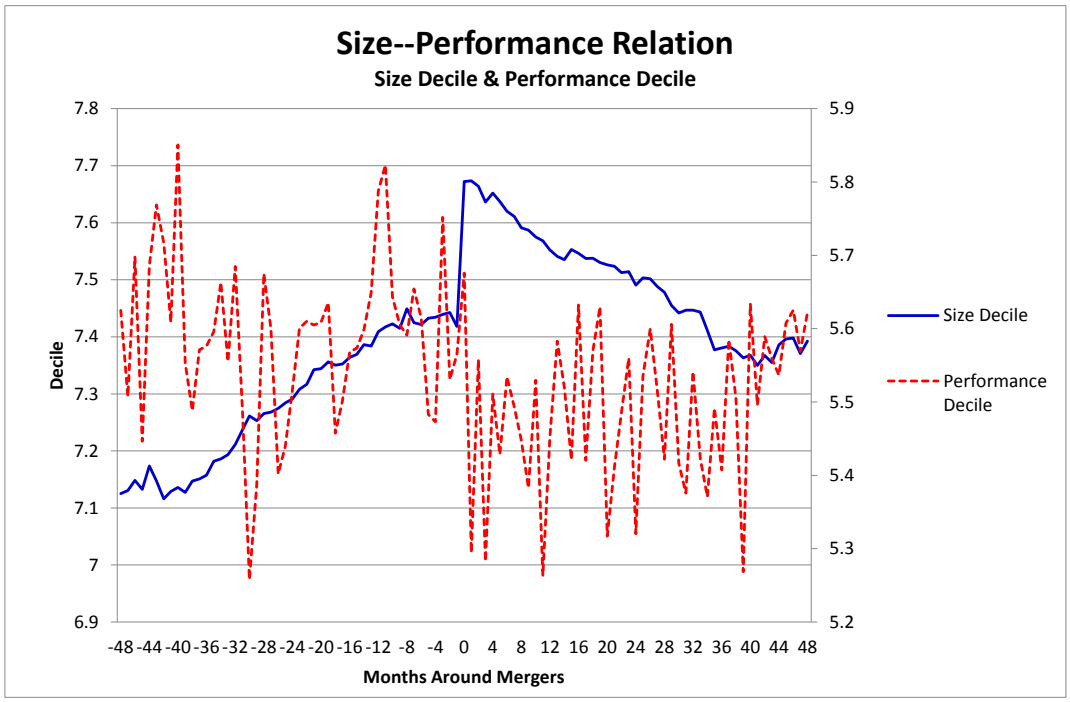

Figure 2. Fund Flow Decile Around Mergers

Figure 2 plots the monthly fund flow decile of acquiring funds four years before and after mergers. I calculate monthly flow decile of the acquiring funds among the funds with the same investment objective. The horizontal axis is the time line of mergers, and the numbers indicate months around mergers. The vertical axis is for fund flow decile.

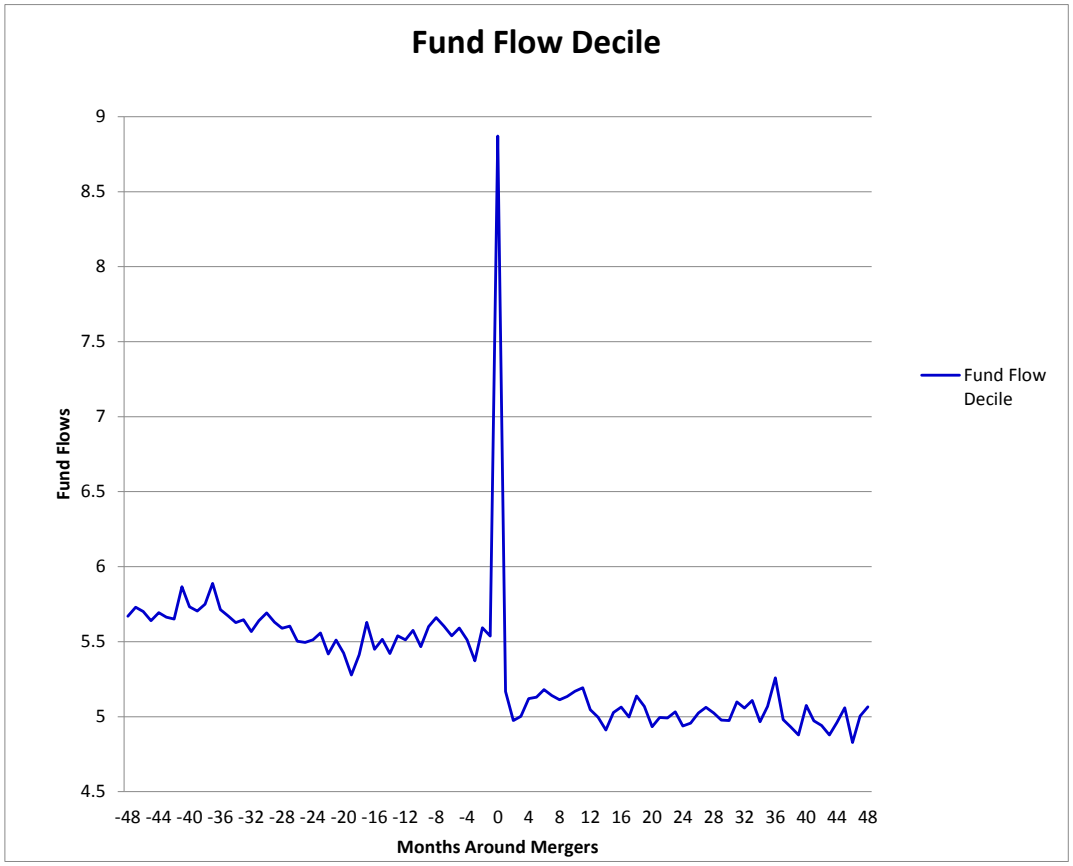

Table A1. Cross-Sectional Distribution of Total Net Assets of Equity Mutual Funds (1991–2013)

Appendix Table A1 reports the cross-sectional distribution of total net assets (TNA) of equity mutual funds for the period of 1991–2013. Funds with non-positive TNA are excluded. I calculate the annual average TNA of each fund and report their cross-sectional distributions. Numbers are in $ million.

Year	Number of Observations	Mean	Standard Deviation	Maximum	Minimum	P5	P25	P50	P75	P95
1991	589	413	1033	16109	0.6	6	32	118	374	1641
1992	679	505	1318	20781	0.5	7	39	132	438	2186
1993	703	661	1736	27651	0.6	9	55	174	563	2895
1994	748	703	1969	34978	0.1	10	64	190	571	2965
1995	879	778	2356	46746	0.3	9	54	188	581	3118
1996	1085	913	2832	54294	0.2	8	50	197	658	3931
1997	1319	1074	3468	58611	0.2	6	53	195	727	4534
1998	1627	1140	4051	71357	0.1	5	47	168	700	4496
1999	1909	1220	4801	94201	0.1	3	36	153	679	4976
2000	2187	1262	4995	102105	0.1	3	29	144	610	4896
2001	2404	962	3869	82547	0.1	2	24	120	510	3769
2002	2614	764	3141	65794	0.1	2	20	97	415	3102
2003	2895	720	3069	67031	0.1	2	19	91	382	2785
2004	2941	910	4037	98598	0.1	2	24	116	489	3323
2005	2943	1023	4670	105273	0.1	2	24	127	559	3809
2006	3000	1148	5398	147349	0.1	1	25	135	649	4181
2007	3180	1248	6040	183354	0.1	1	25	142	691	4504
2008	3280	1003	5003	165913	0.1	1	20	115	538	3688
2009	3143	803	4061	129382	0.1	1	18	97	431	2915
2010	2852	1082	5139	141905	0.1	3	33	151	646	3749
2011	2809	1260	5706	143268	0.1	6	44	185	789	4557
2012	2812	1352	6086	171662	0.1	6	44	191	893	5217
2013	2850	1621	7478	230117	0.1	6	50	227	1029	6217

Table A2. Cross-Sectional Distribution of Total Net Assets of Acquiring Funds (1991–2013)

Appendix Table A2 reports the cross-sectional distribution of total net assets (TNA) of acquiring funds for the period of 1991–2013. Funds with non-positive TNA are excluded. TNA of acquiring funds one month before the merger event month are collected. Numbers are in $ million.

Year	Number of Observations	Mean	Standard Deviation	Maximum	Minimum	P5	P25	P50	P75	P95
1991	14	811	2004	7636	10.1	10	64	91	414	7636
1992	20	509	714	2423	19.0	24	80	183	395	2139
1993	18	246	232	702	5.1	5	76	143	428	702
1994	12	585	440	1503	15.5	16	245	517	895	1503
1995	28	336	620	3280	14.6	19	46	180	352	882
1996	14	269	216	720	39.8	40	112	211	375	720
1997	26	730	1469	7508	8.5	15	93	283	682	1646
1998	43	588	791	4003	2.5	6	63	266	857	1868
1999	43	495	621	2681	0.7	34	74	206	677	1926
2000	74	1118	3630	29181	0.1	1	48	178	756	3754
2001	73	865	2933	22276	4.4	17	74	174	413	2386
2002	98	526	775	5731	0.4	2	34	316	708	1649
2003	103	1100	2257	14830	0.1	6	81	311	914	4660
2004	69	898	2519	16215	0.6	5	33	118	571	4954
2005	103	903	1228	6461	7.5	29	127	472	1138	3571
2006	84	1896	3190	15947	0.4	16	166	677	1967	8977
2007	103	1049	1682	9092	0.7	6	114	423	1235	4189
2008	108	1200	2091	11936	0.1	1	49	313	1477	5826
2009	177	644	2019	22981	0.1	11	56	155	452	2834
2010	92	595	1731	14758	0.1	6	43	144	415	2122
2011	95	1774	4907	43271	13.8	27	157	527	1416	7397
2012	60	877	1392	6697	5.1	11	78	216	1244	3886
2013	49	755	1232	6022	0.1	6	72	250	885	3522

Table A3. Cross-Sectional Distribution of Acquired Assets (2000–2013)

Appendix Table A3 reports the cross-sectional distribution of acquired assets for the period of 2000–2013. CRSP reports TNA of target funds since 2000. Funds with non-positive TNA are excluded. TNA of target funds in their last report month are collected. Numbers are in $ million.

Year	Number of Observations	Mean	Standard Deviation	Maximum	Minimum	P5	P25	P50	P75	P95
2000	37	89	125	532	0.2	1	8	43	132	499
2001	39	89	145	705	0.3	0	9	33	105	510
2002	51	71	135	565	0.1	0	2	17	52	501
2003	75	102	183	1303	0.1	1	11	39	114	426
2004	62	85	173	1032	0.3	1	6	31	93	224
2005	89	220	385	1856	0.2	3	22	72	230	846
2006	59	376	870	4937	0.3	0	31	78	301	2298
2007	94	150	268	1665	0.1	1	4	38	163	647
2008	78	171	568	4130	0.1	1	4	35	112	554
2009	91	203	658	5819	0.1	0	2	41	125	671
2010	82	368	1555	13601	0.1	0	8	53	204	1009
2011	89	322	730	6378	1	8	40	133	282	1191
2012	52	178	215	882	0.1	11	38	73	227	659
2013	53	346	509	2754	5.7	13	48	142	424	1533

Table A4. Investment Objectives of Domestic Equity Funds

Appendix Table A4 lists the investment objectives of domestic equity funds defined by CRSP. The CRSP objective code combines Strategic Insight, Wiesenberger, and Lipper objective codes into an unique objective code for each fund. The CRSP objective code has four letters.

1^{st} Letter	2^{nd} Letter	3^{rd} Letter	4^{th} Letter
Equity (E)	Domestic (D)	Cap-based (C)	Micro Cap (I)
			Large Cap (L)
			Mid Cap (M)
			Small Cap (S)
		Sector (S)	Telecom (A)
			Commodities (C)
			Financial (F)
			Gold (G)
			Health (H)
			Industrials (I)
			Materials (M)
			Natural Resources (N)
			Real Estate (R)
			Consumer Services (S)
			Technology (T)
			Utilities (U)
		Style (Y)	Growth and Income (B)
			Growth (G)
			Hedged (H)
			Income (I)
			Short (S)

Table A5. Number of Funds within Each Investment Objective

Appendix Table A5 reports the number of funds within each investment objective every year for the period of 1991–2013.

Year	Cap-Based Funds (DEC)				Sector Funds (DES)												Style Funds (DEY)				
	CI	CL	CM	CS	SA	SC	SF	SG	SH	SI	SM	SN	SR	SS	ST	SU	YB	YG	YH	YI	YS
1991	0	0	0	40	0	0	8	22	7	0	0	12	0	0	11	11	147	309	0	34	0
1992	0	0	0	76	0	0	10	22	8	0	0	14	4	0	15	16	243	345	0	35	0
1993	0	0	0	95	0	0	10	23	8	0	0	16	4	0	16	19	237	316	0	3	0
1994	0	0	21	106	0	0	11	24	7	0	0	15	4	0	13	16	238	314	0	1	0
1995	0	0	33	119	0	0	11	24	10	0	0	20	4	0	12	22	274	339	0	1	0
1996	0	0	49	164	0	0	11	24	10	0	0	22	7	0	14	38	326	414	0	1	0
1997	0	0	87	216	0	0	12	28	10	0	0	26	15	0	20	46	382	504	0	0	0
1998	17	34	148	290	8	0	15	29	16	0	0	28	33	0	28	51	487	631	0	85	0
1999	21	42	179	316	8	0	22	27	24	0	0	24	41	0	39	51	397	627	0	117	0
2000	30	51	204	375	7	0	33	23	23	0	0	29	53	0	45	47	453	695	0	130	0
2001	36	60	223	407	12	0	39	21	31	0	0	27	69	0	55	37	497	781	0	128	0
2002	36	68	242	439	13	0	41	19	44	0	0	30	65	0	82	33	502	916	0	106	0
2003	41	80	263	468	18	0	45	20	57	0	0	32	67	0	145	30	519	1027	0	99	0
2004	41	83	299	478	15	0	47	20	69	0	0	32	71	0	135	23	507	1048	0	93	0
2005	45	73	319	480	13	0	50	21	80	0	0	30	73	0	130	24	483	1045	0	92	0
2006	45	70	329	506	13	0	47	21	73	0	0	31	82	0	123	27	495	1050	23	104	15
2007	54	71	368	552	14	0	52	21	73	0	0	40	93	0	122	27	507	1076	41	109	25
2008	52	70	390	562	15	9	53	25	71	10	4	41	98	10	111	27	496	1094	79	119	33
2009	52	69	386	555	11	6	36	25	40	11	4	18	76	10	52	26	495	1077	94	120	41
2010	35	50	315	475	10	9	32	27	33	12	6	20	69	11	51	22	475	985	101	104	43
2011	35	46	281	414	10	13	28	27	31	11	6	18	65	11	45	19	502	967	191	93	44
2012	35	45	267	401	9	14	23	26	22	11	5	16	59	10	40	16	541	927	249	87	33
2013	32	41	252	396	9	22	24	27	21	10	5	19	61	10	39	16	534	913	318	93	32

Table A6. Number of Acquiring Funds within Each Investment Objective

Appendix Table A6 reports the number of acquiring funds within each investment objective every year for the period of 1991–2013.

Year	Cap-Based Funds (DEC)				Sector Funds (DES)												Style Funds (DEY)				
	CI	CL	CM	CS	SA	SC	SF	SG	SH	SI	SM	SN	SR	SS	ST	SU	YB	YG	YH	YI	YS
1991	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	5	7	0	1	0
1992	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	11	0	2	0
1993	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	8	10	0	0	0
1994	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	1	4	3	0	0	0
1995	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	2	10	13	0	0	0
1996	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	5	8	0	0	0
1997	0	0	1	1	0	0	0	2	0	0	0	0	0	0	0	0	11	11	0	0	0
1998	0	0	4	4	1	0	0	1	0	0	0	0	1	0	0	0	12	17	0	2	0
1999	0	1	3	9	0	0	0	0	0	0	0	2	2	0	1	1	12	8	0	1	0
2000	1	2	4	13	0	0	1	0	1	0	0	2	3	0	1	2	21	19	0	4	0
2001	0	2	10	11	0	0	1	2	0	0	0	0	6	0	0	1	12	23	0	6	0
2002	0	5	4	9	1	0	1	0	0	0	0	0	3	0	8	2	23	39	0	3	0
2003	0	1	13	12	0	0	1	0	2	0	0	1	0	0	7	0	16	46	0	5	0
2004	1	3	8	13	0	0	0	0	0	0	0	1	0	0	2	0	11	34	0	4	0
2005	3	4	9	13	0	0	1	0	3	0	0	1	2	0	4	0	20	29	0	6	0
2006	1	3	10	14	0	0	0	1	1	0	0	0	1	0	2	1	11	36	0	4	0
2007	2	2	14	10	0	0	1	0	2	0	0	0	2	0	5	1	28	38	1	5	0
2008	1	1	13	10	0	0	0	0	1	0	0	0	3	0	7	1	19	39	1	4	0
2009	2	4	25	36	0	0	0	0	1	0	1	1	3	0	2	0	32	63	3	7	0
2010	2	3	18	19	0	0	1	0	0	0	0	0	0	0	1	1	16	33	0	3	0
2011	1	2	11	14	0	0	0	0	1	0	0	1	3	0	1	1	12	34	1	6	0
2012	2	3	9	6	0	0	0	0	0	0	0	0	0	0	1	0	8	26	1	4	0
2013	0	1	12	5	0	0	0	0	0	0	0	0	0	0	1	0	9	18	0	4	0

Table A7. Cross-Sectional Distribution of TNA Ratio (2000–2013)

Appendix Table A7 reports the cross-sectional distribution of TNA ratio (TNAR) for the period of 2000–2013. CRSP reports TNA of target funds since 2000. Funds with non-positive TNA are excluded. TNAR is defined as the sum of TNA of all target funds to the TNA of their common acquiring fund: $TNAR_i = \frac{\sum_{j=1}^{J} TNA_j^{target}}{TNA_i^{acquirer}}$, where $TNA_i^{acquirer}$ is the total net asset of the acquiring fund i, and TNA_j^{target} is the total net asset of the target fund j, and $j = 1, ..., J$.

Year	Number of Observations	Mean	Standard Deviation	Maximum	Minimum	P5	P25	P50	P75	P95
2000	37	1.17	4.53	27.68	0.00	0.00	0.04	0.20	0.44	2.87
2001	39	0.31	0.39	1.89	0.00	0.01	0.06	0.14	0.51	1.13
2002	51	0.43	1.09	6.45	0.00	0.00	0.04	0.08	0.35	2.48
2003	75	175.28	1504.31	13029.00	0.00	0.00	0.03	0.15	0.39	3.16
2004	62	5.11	26.66	207.50	0.00	0.01	0.03	0.13	1.01	11.47
2005	89	1.12	2.76	15.93	0.00	0.01	0.05	0.13	0.67	4.93
2006	59	31.38	235.92	1812.75	0.00	0.00	0.02	0.20	0.78	5.13
2007	94	7.87	48.83	387.21	0.00	0.00	0.02	0.10	0.38	3.61
2008	78	6.13	26.08	155.33	0.00	0.00	0.04	0.14	0.60	24.37
2009	91	1.04	3.16	20.22	0.00	0.00	0.02	0.15	0.74	5.04
2010	82	0.89	1.49	8.57	0.00	0.00	0.04	0.31	1.11	3.18
2011	89	1.45	5.29	44.11	0.00	0.01	0.07	0.25	0.94	3.42
2012	52	1.29	3.51	24.47	0.00	0.01	0.12	0.32	1.07	5.11
2013	53	15.51	96.14	701.00	0.02	0.04	0.19	0.47	1.18	20.92

Table A8. Cross-Sectional Distribution of TNA Ratio (TNA(Acquiring Fund)>=$15 Million) (2000–2013)

Appendix Table A8 reports the cross-sectional distribution of TNA ratio (TNAR) for the period of 2000–2013. Acquiring funds with TNA<=$15 million one month before mergers are excluded. CRSP reports TNA of acquired funds since 2000. TNAR is defined as the sum of TNA of all target funds to the TNA of their common acquiring fund: $TNAR_i = \frac{\sum_{j=1}^{J} TNA_j^{target}}{TNA_i^{acquirer}}$, where $TNA_i^{acquirer}$ is the total net asset of the acquiring fund i, and TNA_j^{target} is the total net asset of the target fund j, and $j = 1, ..., J$.

Year	Number of Observations	Mean	Standard Deviation	Maximum	Minimum	P5	P25	P50	P75	P95
2000	33	0.45	0.72	2.87	0.00	0.00	0.03	0.17	0.37	2.75
2001	38	0.30	0.40	1.89	0.00	0.01	0.06	0.13	0.43	1.13
2002	44	0.30	0.72	4.13	0.00	0.00	0.04	0.07	0.26	1.10
2003	67	0.34	0.78	5.90	0.00	0.00	0.03	0.13	0.32	1.12
2004	51	0.70	1.93	11.47	0.00	0.00	0.02	0.10	0.51	4.05
2005	86	0.99	2.60	15.93	0.00	0.01	0.05	0.12	0.63	4.12
2006	56	0.68	1.26	5.61	0.00	0.00	0.02	0.20	0.73	4.80
2007	85	0.31	0.63	3.61	0.00	0.00	0.01	0.07	0.28	1.41
2008	59	0.32	0.83	5.31	0.00	0.00	0.02	0.08	0.22	2.07
2009	83	0.79	2.45	20.22	0.00	0.00	0.03	0.16	0.69	2.17
2010	79	0.86	1.51	8.57	0.00	0.00	0.03	0.27	1.06	3.83
2011	88	1.46	5.32	44.11	0.00	0.01	0.07	0.24	0.95	3.42
2012	49	0.73	1.17	5.29	0.00	0.01	0.11	0.32	0.91	3.98
2013	49	2.07	5.70	29.87	0.02	0.04	0.18	0.47	1.00	19.84