
The Aftermath of Fund Management Change

Morningstar Quantitative Research
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Executive Summary

In this paper, we explore the relationship between observed investor preferences for, and eventual investor outcomes in, funds with management changes. Funds undergoing management changes are particularly interesting to us because the market views such changes with apprehension. In recent years there have been a few highly publicized management changes—most notably, Bill Gross and PIMCO or Greg Serruier and Dodge & Cox—that have resulted in notably large outflows. Yet, prior to this study, we did not know how the typical fund fared after a management change. Are investors worse off after management changes? How do investors react? When do the effects of a change in flows or performance kick in, if ever? By studying these questions, can we identify potential behavior gaps for investors?

In short, we find, on average, there is no change in future performance following a fund-management change. Yet, investors overreact and subsequently pull money from these funds. Our findings suggest that the fund industry handles succession planning far better than investors react to such changes.

Key Takeaways

- ▶ We find no relationship between any type of management change and future returns.
- ▶ Investors overreact to fund-management changes.
- ▶ Investors penalize funds with management changes by withdrawing money.
- ▶ The highest-performing funds are given the benefit of the doubt by investors.
- ▶ When there is a management change, the largest funds experience the most outflows.
- ▶ The fund manager's industry experience has no effect on either returns or growth rates.

Introduction

Since January 2003, in the U.S. actively managed equity and fixed-income space, an average of 244 funds each month undergo some form of a manager change, whether new managers are added or tenured managers are removed. While this accounts for less than 1% of fund offerings, they represent on average \$220 billion in assets under management. Despite the magnitude of this turmoil, these facts go underreported relative to other, singular, high-profile management changes.

When media fanfare is given only to name-brand funds undergoing management changes, this leads us to ask: Is the attention deserved? Can we expect investors to react to management changes in a similar fashion? Are a fund manager's departure and the resultant massive outflows an anomaly or a common occurrence?

This paper is a case study in fund-management changes. At Morningstar, we are interested in improving investor outcomes. We want to understand the effects of management changes on performance so we can not only better educate investors, but so we can make better calls about funds through the Morningstar Analyst Rating system and the Morningstar Quantitative Rating for funds by extension.

To fully understand how investor outcomes can be improved, it is necessary to study whether investors should change their behavior. In previous research, we identified several variables that appear to be correlated with investor success among new funds. In the *Rise and Fall of New Funds (2016)*, we found that investor decisions line up nicely with the data that predict success. Therefore, we wanted to take a similar approach in this paper. We believe that investors' behavioral decisions are just as important as the portfolio-management decisions that portfolio managers make following a leadership change.

Thus far, we have used the shorthand "investors react" to discuss how certain types of management changes result in lower growth rates. But this is perhaps misleading. The simple fact is that most of the money in the investing marketplace is heavily intermediated. The majority of flows are not due to the actions of the retail investor, but are directed by the result of complex interaction between an advisor, an institution, and a platform. The intersection of these three parties can result in varying levels of choice for different types of investment products. Therefore, it is perhaps best to conjure an image of the web of intermediaries who compete for platform placement and attention from advisors. When we say "investors," therefore, it's perhaps more accurate to say advisors or intermediaries. Nonetheless, for the paper, we will continue using this shorthand.

In the next section, we explain both our modeling process and how our results can be interpreted. After the interpretation section, we discuss our key takeaways from our study. We then conclude with some thoughts for investors, asset managers, and Morningstar, and ideas for further research. The Appendix details the data used for this analysis, describes the specifics of the methodology we employed, and lists our references. The paper concludes with the full data tables.

Explanation of Our Modeling Approach

The goal of our modeling exercise was threefold. First, we wanted to determine if a manager change is correlated to a change in future performance. Second, we wanted to determine how investors react to a management change. Third, we wanted to determine the time horizon over which a management change affects performance or influences investor behavior.

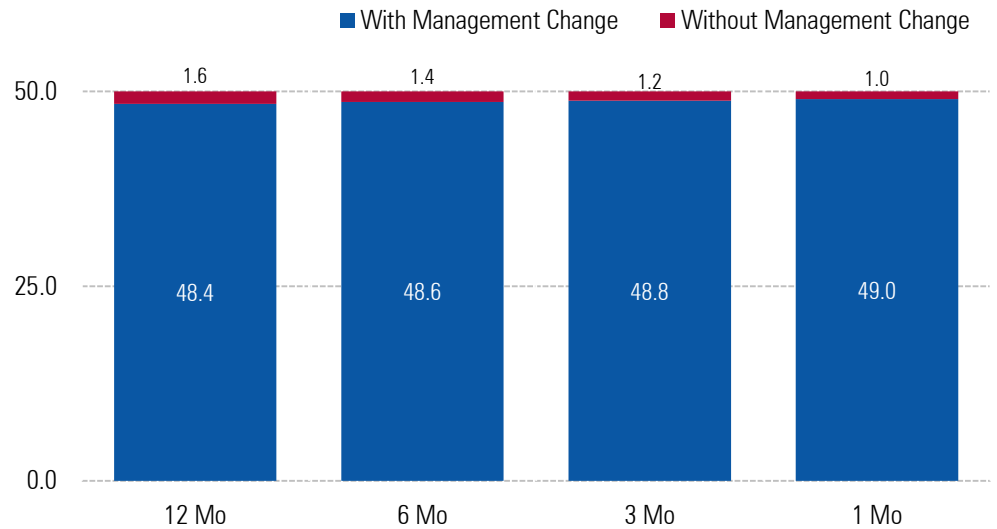
We explored relationships between fund-management characteristics and the subsequent gross excess returns and growth rates over one, three, six, 12, and 36 months by building 10 models to unpack the historical correlations for each time period. By purposefully re-estimating the model over five different time horizons, we can discern the persistence and longevity of an effect.

For the purposes of this study, we define "management change" as one where a manager listed on the fund is added or removed. Remember, we are interested in how the management team—whether the team be a single person or multiple people—affects the investor experience. Thus, any change in the "team" can alter the decision-making process. Additions should not be discounted as less effectual than removals. It is understood that a single person joining the team has the potential to ruin or improve the team dynamic, just as the removal of a person can improve or ruin a team culture. Thus, we include both types of change into our study. Note, we constrain our sample to include only U.S. open-end actively managed equity and fixed-income funds from January 2003 to December 2016.

To begin our study, we defined 10 dependent variables: gross excess return for each of the five time periods listed above and the corresponding growth rates. For each dependent variable, we deployed a Fama-MacBeth cross-sectional regression to our data. Our technique allows us to measure the average change in gross excess returns and flows over each period, given a one-unit increase in each variable.

For example, let's consider two active U.S.-domiciled funds, Fund A and Fund B. They have the same characteristics, which all happen to be average relative to their category. Based on these characteristics, we expect each fund to be placed in the 50th percentile of its Morningstar Category in terms of forward growth rates. They are expected to be average funds. Now suppose we gather additional information, learning Fund A has had a management change in the past four to six months, while Fund B has not had a management change. For argument's sake, let's say we have observed historically that every fund with a management change has experienced subsequent outflows. We might reasonably expect then that Fund A will have a lower growth rate moving forward. As a result, we would change our expectation, surmising that Fund A will drop in relative category percentile growth rates below Fund B.

Conceptually, this is what our modeling approach accomplishes. Using our data set, we find that funds with management changes four to six months prior tend to have lower subsequent growth rates than funds without a management change, holding all else equal. We expect this effect to decrease Fund A's growth rate relative to Fund B by 1.0, 1.2, 1.4, and 1.6 category percentiles over the next one, three, six, and 12 months, respectively.

Exhibit 1 Regression Output Interpretation

Source: Morningstar, Inc. Data as of Dec. 31, 2016.

Above, the 50th percentile line represents the fund's initial category placement. The blue bars represent Fund A's projected category placement given a change in fund management. The red bars represent the expected loss of growth rate percentiles. Going forward, we will report these effects by the expected change—as in, the red bars only. So, for the example above, we would have columns with 1.0, 1.2, 1.4, and 1.6 only. Those are the changes in category growth rates, over time, following a management change.

Finally, the set of explanatory variables we use for the performance model is slightly different than the set for the growth rate model. By using gross excess return, we remove any variation associated with differences in style or expenses. However, since we cannot remove these effects from growth rates, we control for fees, trailing performance, and fund size when modeling variation in growth rates. The remaining variables are included in both models: management change; management change interactions with alpha; fund size; industry tenure; and complete team change, over the trailing three, six, 12, and 24 months. By including trailing manager change variables, we can see how long after the management change it takes for the effect to kick in to performance, or how long it takes for an investor to react. Exhibit 2 outlines the variables and the time period over which they were calculated.

Exhibit 2 Model Variables

Variables	Explanatory Time Period (Months)
Management Change	t-3
Alpha:Management Change	t-4 to 6
AUM:Management Change	t-7 to 12
Industry Experience:Management Change	t-13 to 24
Complete Team Change:Management Change	
Assets Under Management	t
Net Expense Ratio	
Trailing Gross Excess Return	t-12

Source: Morningstar, Inc. Data as of Dec. 31, 2016.

Key Takeaways**We find no relationship between any type of management changes and future returns.**

A management change is not predictive of a performance downturn. In fact, there is zero relationship between a management change and future returns over the next month up to the next three years. Furthermore, this holds true for all different types of management changes. Gross excess performance does not depend on the fund's alpha, size, or industry experience at the time of management change.

We constructed our study to isolate and tease out the effects of management change. No matter which way we sliced the data, we found statistically no relationship between future performance and adding or removing a single manager or an entire team. This is shown in two ways. First, the model's r-squared is effectively 0%. See Exhibit 5 and page 8 for further discussion. Second, even if variables are statistically significant, the economic significance is negligible. For example, a management change happening in the past seven to 12 months at a fund with alpha above the category median increases the fund's gross excess return by 0.1 basis points over the next 12 months. A 0.1 basis point increase is hardly an impact. Another way of saying this is that there might be a correlation between a type of management change and performance, but the effect on performance itself is moot. Exhibit 3 displays the average effect of management change on gross excess returns measured in basis points. Statistically significant variables are italicized.

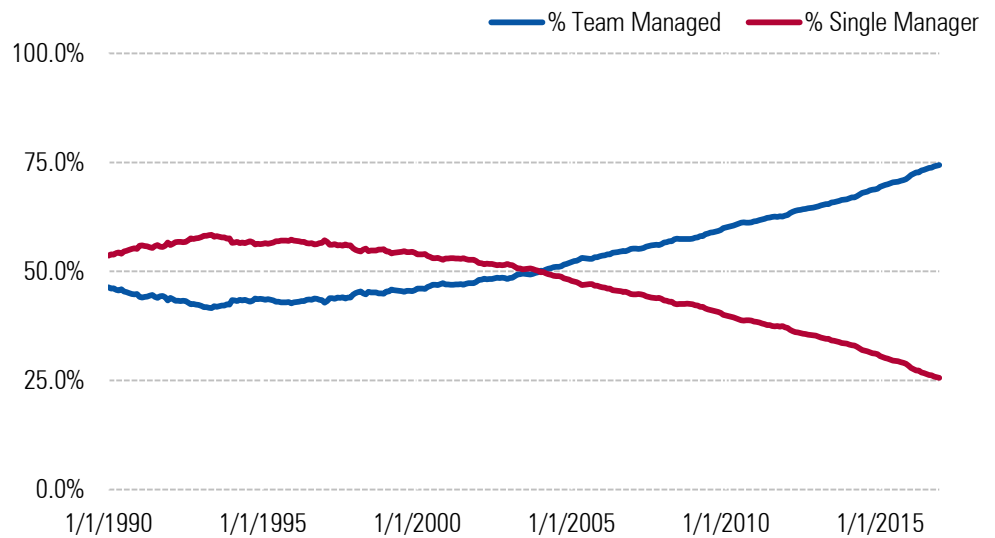
Exhibit 3 The Average Effect of Management Change on Gross Excess Returns

Months	36	12	6	3	1
Management Change 3 Mo	-0.001	0.001	0.000	0.000	0.008
Management Change 6 Mo	0.001	0.001	0.000	0.000	0.004
Management Change 12 Mo	-0.001	0.001	0.000	0.000	-0.002
Management Change 24 Mo	<i>0.007</i>	<i>0.002</i>	<i>0.001</i>	<i>0.001</i>	0.019

Source: Morningstar, Inc. Data as of Dec. 31, 2016.

The evidence above would appear to strongly support the hypothesis that fund success does not depend on any single individual. Indeed, running a fund is much more team-driven today than it ever has been. In Exhibit 4, we show the percentage of funds run by a single person versus a team through time. Since the 1990s, we have seen a divergence in management structure. Seventy-five percent of actively managed U.S. equity and fixed-income funds are run by teams. The remaining 25% may have a single manager listed but are assumed to be supported by a research staff with strict processes and restrictions for what stocks fit into their narrow mandate. As a result, we see in the performance data that funds are able to maintain their consistency, even when one of the names at the top changes.

Exhibit 4 Percentage U.S. Market by Management Type



Source: Morningstar, Inc. Data as of Dec. 31, 2016.

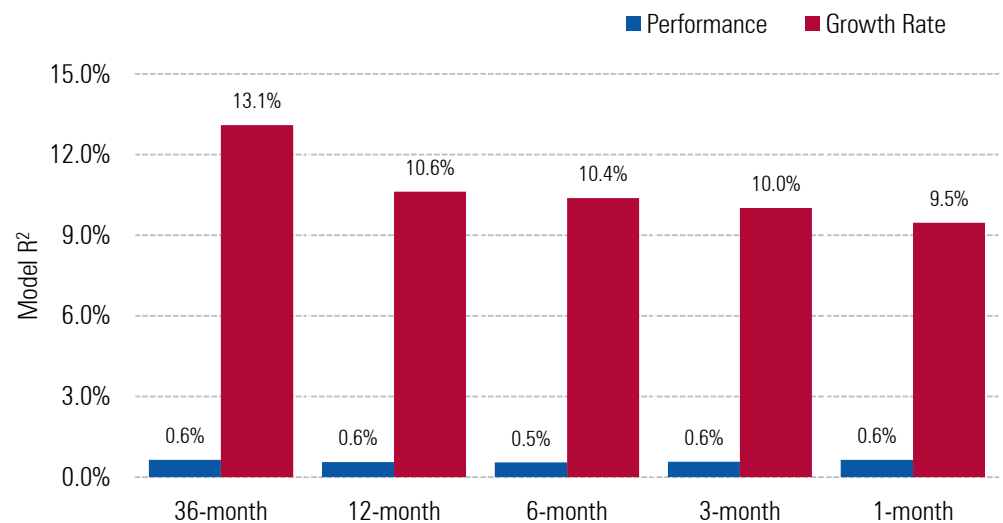
From a statistical perspective, gross excess returns for active management statistically behave somewhat like a random variable. When we swap out one random variable for another, albeit different, random variable, the overall pattern is still random. Thus, it's not terribly surprising that we did not find a relationship between those with a change and those without a change since both return patterns are still random.

As a counterargument, one might point out that the effect of management changes is not immediately felt. Given a fund experiencing management change, the new team will want to put their own stamp on the fund, divest old holdings, and invest in their newest and best ideas. One way to proxy for this effect is to incorporate their turnover ratio. However, determining when an entire portfolio can be attributable to the new management team is guesswork at best. Turnover numbers are reported for an entire fiscal year, not month by month, and are the average experience during what could be two team tenures. As such, the true date of when a management team's portfolio is attributable to them can be still unknown months after the change.

To account for such argument, however, we tested management change over varying historical time horizons: zero-three months, four to six, seven to 12, and 13-24 months. Instead of estimating fund by fund when to attribute the portfolio to which management team, we allow for flexible event times. The data can then reveal significant patterns, if any. We find our approach reasonable for multiple reasons. One, we are not imposing a time frame over which the new management team must be deemed effective. Two, it is very reasonable to expect that it would take some time before a management team can settle in to run the fund. Whether that time frame is zero-three months, four to six, seven to 12, or 13-24 months, we did not have a prior put onto our data before this study.

As a result of constructing our study in such a manner, we still found the relationships between management change and future gross excess returns to be insignificant. Management changes up to 12 months in the past were statistically insignificant. Management changes 13-24 months prior were statistically significant but economically insignificant. The average fund with a management change 13-24 months prior had negligible positive impact on returns. Thus, there is no evidence for management change having a delayed impact on future performance. No matter which way we looked at the data, on average, a management change will not alter the performance of a fund.

Exhibit 5 Model Correlations to Performance and Growth Rates



Source: Morningstar, Inc. Data as of Dec. 31, 2016.

Investors overreact to fund-management changes.

Not only do investors overreact to fund-management changes, but in fact, the investor reaction strengthens through time, persisting up to 36 months after the event. We see this above in Exhibit 2 as the model's r-squared increases as the time period considered lengthens. After one month, 9.5% of the variation in growth rates can be attributed to variables in our model—four characteristics of management changes over four historical time horizons and three control variables. After 36 months, 13.1% of the variation can be explained by these same variables. Second, almost all the variables

considered over each time horizon are statistically significant at the 99% level. The coming sections explain the factors' effect on investor preferences.

Stated simply, we are trying to measure if investor behavior aligns with their objectives. Keep in mind, we define performance as gross excess returns. By doing so, we limit the effects due to fees or investment style and isolate the value a manager adds to a stated portfolio objective. If we found a notable shift in performance after a management change then we might say investors react rationally. However, as we have shown, there is no effect on performance given a management change, regardless of time period or attribute. This effect represents an investor behavior gap. Investors react to an event that, on average, does not change the status quo. Our study suggests investors use management change, all else equal, as a signal to divest when they otherwise should not do so. Since we find a management change, on average, will not alter performance, if the fundamental reasons why the investor originally decided to invest into the fund remain constant, their investment should stay put.

It is important to note the nuance of this study. Let's walk through what we know so far. One, investors follow performance (Davidson, Strauts 2015). Two, management change does not alter performance trajectory, by above. Thus by controlling for a fund's trailing performance, we have eliminated that this effect can be due to underperformance. The effect that investors overreact to management changes is above and beyond any relationship to poor returns.

We also know that management change is a signal for fund closure (Davidson, Sargis 2017). Overwhelmingly, we find that obsolete funds experience a management change prior to closure, all else equal. However, we also know such funds exhibit other characteristics of closure: low AUM, low fees, unpopular category, and a high firm and category closure rate. Management change itself does not correlate with poor performance, but it does correlate with lower flows and higher risk of closure. Thus, unless the fund is exhibiting such characteristics, investors should not react to management changes as strongly as our study suggests.

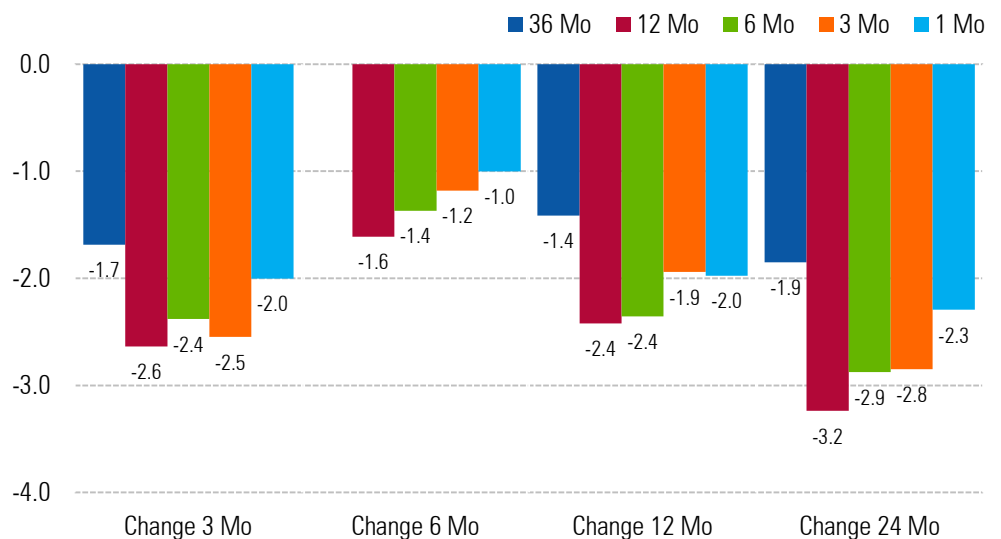
Investors penalize funds with management changes by withdrawing money.

This study highlights a flaw in current investor behavior. Whether the investor is an intermediary — such as an advisor or wealth manager — or an individual, our study suggests that investors are too quick to act. When a management change occurred within the prior three months, the average fund will experience outflows resulting in 2.0, 2.5, 2.3, 2.6, and 1.7 lower category percentile growth rates over the next one, three, six, 12, and 36 months, respectively. The effect is persistent. Funds experiencing management changes more than a year ago still experience lower growth rates. Over the same respective time periods, the outflows result in 2.3, 2.9, 2.9, 3.2, and 1.9 lower category percentile growth rates. Any way we looked at the data, funds with management changes experience sustained periods of outflows. Investors continue to withdraw money from funds even though there is no change in fund performance.

The effect has a rational explanation. When change occurs, investors want to take action. People are comfortable with what they know and are averse to change. Thus, when a new manager is added or a

tenured manager is removed, there is an implicit unknown entering their portfolio. Investors want to feel like they are in control, adding value, getting ahead of what they surmise will be a negative situation. However, our study highlights a flaw in investor behavior. Management changes do not often result in changes in performance. A fund may already be experiencing a period of underperformance, but a management change will not alter that path. Funds with stellar performance are just as likely to continue on that trajectory regardless of the addition or removal of a single manager. What our study shows is that funds no longer live and die by their managers. The fund industry has matured. Funds are run by a team of people, down to the entry-level research analyst performing due diligence on a stock or bond. Thus, investors need to be patient. If a fund's process is operationalized; if a fund's parent company has invested in their staff; if the fund's fees remain constant, then investors should probably take a "wait and see" approach. The fund's performance will not change as drastically as their reactions suggest.

Exhibit 6 Effect of Management Change on Growth Rates



Source: Morningstar, Inc. Data as of Dec. 31, 2016.

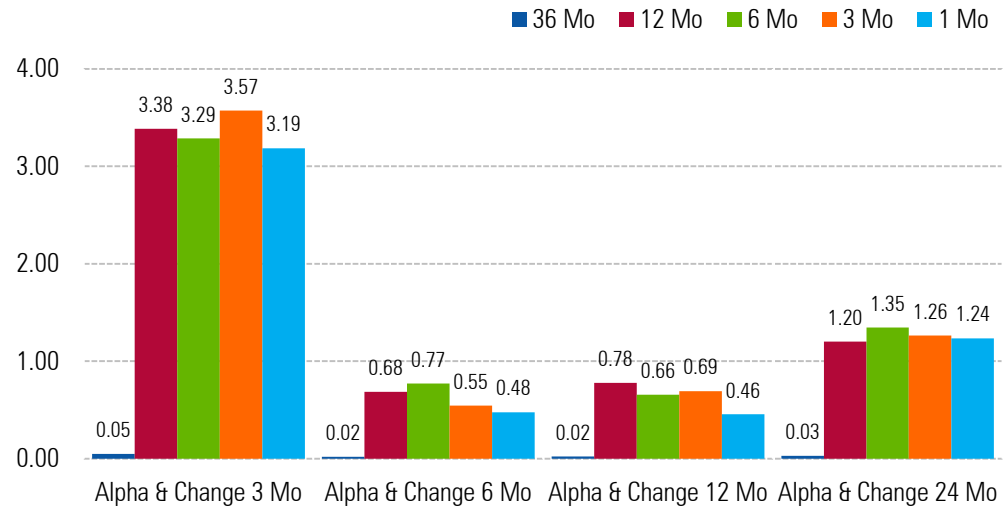
The highest-performing funds are given the benefit of the doubt by investors.

Investors view management change as a negative signal and pull their money from such funds. However, in the cases of high-alpha funds, investors think twice. Investors are willing to look past the change in fund leadership when the portfolio has been successful. The negative management change signal is offset by the positive high-alpha signal. Funds achieving high alpha at time of management change would experience less outflows than such a fund with low alpha.

The high-alpha signal counteracts the negative outflows. For funds with management changes within the past three months, the effects of above-average category alpha can offset the outflows by 3.2, 3.6, 3.3, and 3.4 category percentiles over one, three, six, and 12 months, respectively. However, this effect is only short-term. Over the following 36 months, the alpha factor only offsets lower growth rates by 0.5 percentiles. Similarly, when we take a historical view of when the manager change occurred, there is

still favoritism toward high-alpha funds, but the effect is muted. Our finding illustrates that the investor's momentum bias overrides any bias toward leadership change. Investors are willing to give the management team some leeway and time to settle in. However, if the results do not stay consistent, the preferential treatment wears off.

Exhibit 7 Effect of Alpha and Management Change on Growth Rates



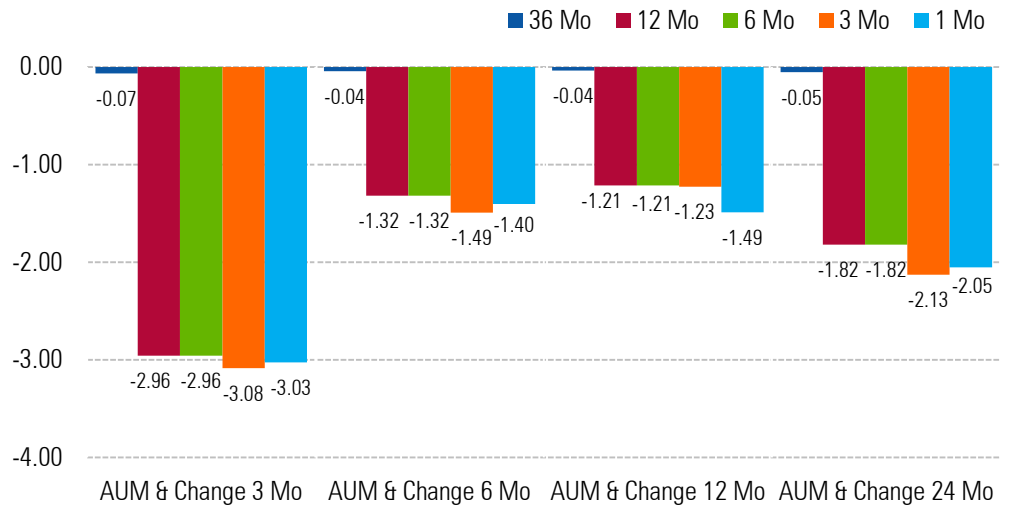
Source: Morningstar, Inc. Data as of Dec. 31, 2016.

When there is a management change, the largest funds experience the most outflows.

While large funds are no less likely to perform differently than their smaller peers, investors penalize larger funds more by withdrawing money from the fund at faster rates than small funds. The effect of fund flows is immediately felt. When a fund engages in a management change within the prior three months, the forward flows are 3.0 category percentiles lower over the next month to the next year. However, the effect drops off after one year and has effectively gone away by three years.

Regardless, it is interesting to note that we are forecasting forward growth rates, not cumulative flows. It follows then that large funds must experience, in absolute value terms, far more outflows than a smaller fund to maintain the same growth rate. This goes to show that investors fear management changes at these large institutional funds. They are comfortable with what they currently know, and are apprehensive about change. The potential for the discontinuity of investment style execution stokes concern, drives outflows, and acts like a herd effect. Once the outflows start pouring out, investors feel compelled to continue removing money.

The fund-size effect could be attributable to the disproportionate attention that larger funds receive than smaller funds. The financial news cannot scrutinize all small funds as they do larger funds. Thus, the information regarding manager turnover is more likely to be missed at a small fund. The potential for negative attention stoking concerns in investors is lower. Therefore, the rates of withdrawal could be a proxy for the amount of media coverage given to the fund.

Exhibit 8 Effect of AUM and Management Change on Growth Rates

Source: Morningstar, Inc. Data as of Dec. 31, 2016.

Industry experience has no effect on either returns or growth rates.

Fund manager industry experience is a variable we constructed explicitly for this study. We thought the length of time a manager has been in the industry would influence fund flows. Our hypothesis was that if a fund lost a manager with high industry experience, then investors would react and pull money from the fund. Conversely, if a fund added a manager with high industry tenure, then investors would prefer such a fund and drive flows. Therefore, we tested the change in industry tenure on a fund: When positive, funds added managers with more industry tenure than the current management team, and when negative, a fund removed the most experienced manager from the team.

Yet, contrary to our hypothesis, we found virtually no relationship between industry tenure, management change, and subsequent flows. In only the cases where there was a management change four to six months prior where industry tenure was added did we see a slight uptick in forward growth rates. Similarly, removing a manager with lengthy industry experience resulted in a similarly small change in outflows. For the rest of the time periods, management change coupled with industry tenure did not prove to be consistently statistically significant.

Furthermore, management change defined by industry experience had no relationship with forward gross excess returns. This bolsters our case for the suggestion that the fund industry has matured. On average, funds are not run by a personality; rather, a team complete with a supporting cast of research analysts, risk-management professionals, and the portfolio managers. Replacing the most senior member of the cast will not stop the investing process. Thus, we do not expect to see a change in performance due to a change in fund manager industry tenure.

Conclusion

Our study sought to explain the relationship between investor outcomes and investor reactions to funds with management changes. We identified the time horizons over which these effects take place. By comparing the results of each model, we uncovered a behavioral problem among investors.

Investor Outcomes

The U.S. mutual fund industry is mature and appears to handle management changes quite well. Most often, manager changes appear to be planned and thought out in advance. Fund companies have succession planning, where research analysts are groomed to eventually take over as portfolio managers. Fund companies have robust research and risk teams so when there is a manager change, the new manager is still using analysis produced by the fund company. Fund companies also set narrow mandates for funds. Given a fund's stated objective, there is a stated, and restrictive, range of capital deployment by which managers must abide. Given all of the above, we find performance continuity among funds, regardless of who is noted at the top.

Investor Reactions

Investors react negatively to management changes. They remove money from funds with new leadership and reallocate it to funds where they know the management team. They do this in spite of the evidence that changes at the top of funds do not affect performance. There is no discernable increase or decrease in gross excess returns given a fund-management leadership change. Investors—whether that is an advisor, wealth manager, or individual—want to appear to be in control. They want to appear that they are adding value. Thus, given a new unknown, such as a management change, people want to take action. They are comfortable with the team that they originally invested in, so when this team changes, they raise concerns and subsequently exit the fund.

What does this mean for investors?

First, and foremost, investors need to think twice about acting on a management change. They need to ask themselves, is this truly an outlier fund? One of the few remaining where the strategy and manager are outside the norm, where the fund is truly run by a personality or highly specialized individual at the top? Where the range of their deployment cannot be stated in an investment process or replicated by anyone else? In most cases, the answer will be no.

Second, investors need to ask themselves about the account holding the fund. Is it a taxable account? Do the tax consequences justify moving to a comparable fund? If the rest of the fundamentals still hold, the reason investors bought in the first place, then the investor is better off holding the fund and waiting out the management change, rather than selling out of fear of the performance changing. Otherwise, the investor will incur an unnecessary tax bill.

Third, investors need to ask themselves if the fund expenses have changed. If a fund's expenses go up, then moving to a cheaper option, net the incoming tax bill, may be justified. If the expenses do not

change, then investors should think long and hard about selling out of the fund. As we all know, the only certainties of investing are costs.

At Morningstar, we have a history of being skeptical of management changes, putting funds on watch lists. From our study, we find that we do not need to downgrade a fund every time there is a management change if we feel confident in the parent, the fund's process, and finally the cost. However, we do need to identify the cases when there is a policy change in the fund's strategy versus simply a management change, and alert investors of such cases. We need to do this because we find on average, most management change cases result in business as usual at the fund. As an advocate for the investor, we can do them a favor and help close their behavior gap.

The outcome of this study leads us to two new research topics. First, now that we know the outcomes of management changes, can we forecast them? Are there signals leading up to such events? By doing so, can we proactively help investors so they are not caught off-guard when there is a change?

Second, now that we know that investors react strongly to management changes, can we identify how this relationship compares to other known drivers of returns? Can we re-estimate our expectations for fund flows to accurately account for the management effect?

We expect to address these topics in later papers. ■■■

Appendix

Data

Our study relied on Morningstar fund data sources. The sample period began in January 2003 and ended in December 2016. Only active equity and fixed-income funds domiciled in the U.S. were included in the sample. Over the entirety of the sample, 11,419 unique funds were included. Monthly fund counts ranged from 5,470 to 6,746. Our sample included funds in multiple broad asset classes—equity 4,178 to 5,456, and fixed-income from 1,119 to 1,360.

Because we are interested in fund characteristics, we rolled up share class data to the fund level. For funds providing complete asset information for all share classes, we calculated the asset-weighted variables. For those funds where complete asset information was not available, we computed equally weighted variables.

Our sample of funds did not suffer from survivorship bias. Morningstar's global fund databases return a full history of dead funds, and these funds are included in our sample where applicable. Moreover, our evaluation technique dynamically incorporated monthly changes in fund-universe composition, providing a more holistic and realistic picture of historical performance. Each monthly snapshot captured any funds that were subsequently merged or liquidated away.

Regression Coefficients

The control and dependent variables in our regressions are important to understand. Many continuous explanatory variables are standardized into percentile units across all funds (1 lowest percentile, 100 highest percentile) cross-sectionally by date and their Morningstar Category. Imputation by category was performed on all missing data for continuous explanatory variables. We imputed each category's percentile median for each date.

Dependent Variables

Cumulative Gross Excess Returns at One, Three, Six, 12, and 36 Months

We define excess returns as the fund's ability to outperform the category benchmark. Each month, we convert each share class gross return to U.S. dollars as well as the category benchmark's return to U.S. dollars, and subtract the two to calculate the monthly excess return. The monthly fund return is calculated by aggregating the return information for all the fund's share classes. For those who provide complete asset information for all share classes, we calculate the asset-weighted cumulative excess returns. For those funds where complete asset information is not available, we compute equally weighted cumulative excess returns.

We calculate rolling cumulative excess returns aggregating the forward one-, three-, six-, and 12-month excess returns.

Cumulative Net Flows at One, Three, Six, 12, and 36 Months

We define flow as the organic growth in a fund's net assets not attributable to capital appreciation. Each month, we calculate the monthly flow experienced by individual share classes and convert the amount back into U.S. dollars. The monthly fund flow is calculated by aggregating the flow information from all the fund's share classes. We calculate rolling cumulative flows by aggregating the forward one-, three-, six-, and 12-month flows. We then percentile all fund flows by date and asset class. Higher percentiles indicate higher flows.

Independent Variables

Alpha

We run rolling 12-month CAPM regressions of a fund's return onto the category average return. All returns are in U.S. dollars, include dividends and capital gains, and are not continuously compounded.

The regression rolls monthly, providing a set of factor betas, alpha, and R-squared each month estimated from the prior 12 months' experience. The regression takes the form:

$$r_{i,t} = \alpha_i + \beta_i^{r_{mcatavg}} RMCatAvg_t + e_{i,t}$$

To estimate a fund's alpha, we require 12 months of return history. For those funds that do not have 12 months of return history, they will not have their own set of factor betas, alphas, or R-squared. In this case, we impute the Morningstar Category average value by date. Once the fund passes the 12-month mark, we stop the imputation.

Fund Size (AUM)

Fund size or assets under management are measured as the fund's total market value of investments in U.S. dollars. The variable is placed into percentiles by date and category.

Management Change Zero-Three Months

This is a categorical, dummy variable that indicates whether there has been a fund management change within the previous three months.

Management Change Zero-Three Months Alpha Interaction

This is a numerical variable that interacts whether the fund had a management change within the last three months with the fund's alpha at the time of management change. To calculate this variable, we multiply the fund's Management Change Zero-Three Months variable and its Alpha Category Percentile.

Management Change Zero-Three Months AUM Interaction

This is a numerical variable that interacts whether the fund had a management change within the last three months with the fund's AUM at the time of management change. To calculate this variable, we multiply the fund's Management Change Zero-Three Months variable and its Fund Size Category Percentile.

Management Change Zero-Three Months Complete Team Change Interaction

This is a numerical variable that interacts whether the fund had a management change within the last three months with whether the entire fund management team turned over during the time of management change. To calculate this variable, we multiply the fund's Management Change Zero-Three Months variable and its complete team change variable.

Management Change Zero-Three Months Industry Tenure Interaction

This is a numerical variable that interacts whether the fund had a management change within the last three months with the number of months of the fund's longest industry-tenured manager at the time of management change. To calculate this variable, we multiply the fund's Management Change Zero-Three Months variable and its longest industry tenure variable.

Management Change Four to Six Months

This is a categorical, dummy variable that indicates whether there has been a fund management change within the previous four to six months.

Management Change Four to Six Months Alpha Interaction

This is a numerical variable that interacts whether the fund had a management change within the last four to six months with its alpha at the time of management change. To calculate this variable, we multiply the fund's Management Change Four to Six Months variable and its Alpha Category Percentile.

Management Four to Six Months AUM Interaction

This is a numerical variable that interacts whether the fund had a management change within the last four to six months with the fund's AUM at the time of management change. To calculate this variable, we multiply the fund's Management Change Four to Six Months variable and its Fund Size Category Percentile.

Management Change Four to Six Months Complete Team Change Interaction

This is a numerical variable that interacts whether the fund had a management change within the last four to six months with whether the entire fund management team turned over during the time of management change. To calculate this variable, we multiply the fund's Management Change Four to Six Months variable and its longest industry tenure variable.

Management Change Four to Six Months Industry Tenure Interaction

This is a numerical variable that interacts whether the fund had a management change within the last four to six months with the number of months of its longest industry-tenured manager at the time of management change. To calculate this variable, we multiply the fund's Management Change Four to Six Months variable and its longest industry tenure variable.

Management Change Seven to 12 Months

This is a categorical, dummy variable that indicates whether there has been a fund management change within the previous seven to 12 months.

Management Change Seven to 12 Months Alpha Interaction

This is a numerical variable that interacts whether the fund had a management change within the last seven to 12 months with the fund's alpha at the time of management change. To calculate this variable, we multiply the fund's Management Change Seven to 12 Months variable and its Alpha Category Percentile.

Management Change Seven to 12 Months AUM Interaction

This is a numerical variable that interacts whether the fund had a management change within the last seven to 12 months with the fund's AUM at the time of management change. To calculate this variable, we multiply the fund's Management Change Seven to 12 Months variable and its Fund Size Category Percentile.

Management Change Seven to 12 Months Complete Team Change Interaction

This is a numerical variable that interacts whether the fund had a management change within the last seven to 12 months with whether the entire fund management team turned over during the time of management change. To calculate this variable, we multiply the fund's Management Change Seven to 12 Months variable and the fund's longest industry tenure variable.

Management Change Seven to 12 Months Industry Tenure Interaction

This is a numerical variable that interacts whether the fund had a management change within the last seven to 12 months with the number of months of its longest industry-tenured manager at the time of management change. To calculate this variable, we multiply the fund's Management Change Seven to 12 Months variable and the fund's longest industry tenure variable.

Manager Change 13-24 Months

This is a categorical, dummy variable that indicates whether there has been a fund management change within the previous 13 to 24 months.

Manager Change 13-24 Months Alpha Interaction

This is a numerical variable that interacts whether the fund had a management change within the last 13-24 months with the fund's AUM at the time of management change. To calculate this variable, we multiply the fund's Manager Change 13-24 Months variable and its Alpha Category Percentile.

Management Change 13-24 Months AUM Interaction

This is a numerical variable that interacts whether the fund had a management change within the last 13-24 months with the fund's alpha at the time of management change. To calculate this variable, we multiply the fund's Manager Change 13-24 Months variable and its Fund Size Category Percentile.

Management Change 13-24 Months Complete Team Change Interaction

This is a numerical variable that interacts whether the fund had a management change within the last 13-24 months with whether or not the entire fund management team turned over during the time of

management change. To calculate this variable, we multiply the fund's Management Change 13-24 Months variable and its longest industry tenure variable.

Management Change 13-24 Months Industry Tenure Interaction

This is a numerical variable that interacts whether the fund had a management change within the last 13-24 months with the number of months of the fund's longest industry-tenured manager at the time of management change. To calculate this variable, we multiply the fund's Management Change 13-24 Months variable and its longest industry tenure variable.

Net Expense Ratio

Different regions have different reporting requirements for mutual fund expenses. For example, in the U.S., net expense ratio is the most commonly used data point that encompasses all fees levied on the investor over the past year, including performance-based fees. In the United Kingdom and Europe, ongoing charge is the most commonly used data point to express fees levied on investors in the past year. Unlike net expense ratio, ongoing charge does not include performance-based fees. Therefore, to harmonize net expense ratios of U.S.-, U.K.-, and Europe-domiciled funds, we add back in performance fees to the ongoing charge.

For fund of funds, we also included acquired fund expenses.

For all domiciles in our purview, we do our best to harmonize fee-reporting differences across geographies using the following mapping procedure:

$$\text{NetExpenseRatio} = \begin{cases} \text{NetExpenseRatio} & \text{Domicile} = \text{USA} \\ \text{IndirectCostRatio(orMER)} & \text{Domicile} = \text{AUS} \\ \text{ManagementExpenseRatio} & \text{Domicile} = \text{CAN or NZL} \\ \text{OngoingCharge} + \text{PerformanceFee(orNER)} & \text{Region} = \text{UK, EU} \\ \text{JPAf} - \text{TaxTotalExpenseRatio} & \text{Domicile} = \text{JAP} \\ \text{FoF.NetExp}_i = \text{FoF.exp}_i + \text{AcquiredFundExpense} & \text{FoF} = \text{Yes, Acq Fund Exp} \neq \text{NA} \\ \text{FoF.NetExp}_i = \text{FoF.exp}_i + \sum_{i=1}^N w_i \text{exp}_i & \text{FoF} = \text{Yes and Region} = \text{US} \\ \text{NetExpenseRatio} & \text{Otherwise} \end{cases}$$

Trailing 12-Month Gross Excess Return

We define excess returns as the fund's ability to outperform the Morningstar Category benchmark. Each month, we convert each share class gross return to U.S. dollars as well as the category benchmark's return to U.S. dollars, and subtract the two to calculate the monthly excess return. The monthly fund return is calculated by aggregating the return information for all the fund's share classes. For those who provide complete asset information for all share classes, we calculate the asset-weighted cumulative excess returns. For those funds where complete asset information is not available, we compute equally weighted cumulative excess returns. We calculate rolling cumulative excess returns aggregating the previous 12-month excess returns.

Methodology

To evaluate what specific factors are related to the excess return and flow persistence of management change, we employ a series of monthly cross-sectional linear regressions. Each month, we regress the 10 dependent variables (cumulative excess returns for one, three, six, 12, and 36 months, and cumulative flows for one, three, six, 12, and 36 months) on a set of contemporaneous explanatory variables. As constructed, we believe the model offers a glimpse at the inherent implications of a management change.

We apply the following framework to the data globally:

Cross-Sectional Regression:

$$\text{cumulative excess returns/flows}_i = \alpha + \lambda_t X_{i,t} + \sigma_t B_{i,t} + \varepsilon_{i,t+1}$$

Where *cumulative excess returns/flows_i* is a continuous variable from 1-100 with 1 indicating the category's lowest cumulative excess returns or flows and 100 indicating the category's highest cumulative excess returns or flows, over the time period specified by the model. *X_{i,t}* is a vector of explanatory characteristics at time *t* and *B_{i,t}* is a set of indicator characteristics.

The contents of the vectors *X_{i,t}* and *B_{i,t}* are as follows:

Exhibit 9 Growth Rate Model Regression Results

X_{i,t}

Trailing 12 Mo Gross Excess Return*
 Assets Under Management*
 Net Expense Ratio*
 Alpha:Management Change 3 Mo
 Alpha:Management Change 6 Mo
 Alpha:Management Change 12 Mo
 Alpha:Management Change 24 Mo
 AUM:Management Change 3 Mo
 AUM:Management Change 6 Mo
 AUM:Management Change 12 Mo
 AUM:Management Change 24 Mo
 Industry Experience:Management Change 3 Mo
 Industry Experience:Management Change 6 Mo
 Industry Experience:Management Change 12 Mo
 Industry Experience:Management Change 24 Mo

B_{i,t}

Management Change 3 Mo
 Management Change 6 Mo
 Management Change 12 Mo
 Management Change 24 Mo
 Complete Team Change:Management Change 3 Mo
 Complete Team Change:Management Change 6 Mo
 Complete Team Change:Management Change 12 Mo
 Complete Team Change:Management Change 24 Mo

*Growth rate model only. Source: Morningstar, Inc.

How to Obtain Final Estimates

Cross-sectional regressions, as specified above, are run each month. As a result, we are left with several vectors of coefficients on each date estimated from each model. For example, we have a matrix \vec{B} that collects the time-series of estimated coefficients from $t=1$ to $t=T$ for each vector:

$$\vec{B} = \begin{bmatrix} \Omega_1 & \phi_1 & \lambda_1 \\ \vdots & \vdots & \vdots \\ \Omega_T & \phi_T & \lambda_T \end{bmatrix}$$

Then, the final estimates of the coefficient vectors Ω , ϕ , λ are averages across time:

$$\begin{aligned} \hat{\Omega} &= \frac{1}{T} \sum_{t=1}^T \hat{\Omega}_t \\ \hat{\phi} &= \frac{1}{T} \sum_{t=1}^T \hat{\phi}_t \\ \hat{\lambda} &= \frac{1}{T} \sum_{t=1}^T \hat{\lambda}_t \end{aligned}$$

Standard errors are assumed to be uncorrelated over time:

$$\begin{aligned} \sigma(\hat{\Omega}) &= \frac{1}{T} \text{var}(\Omega_t) = \frac{1}{T^2} \sum_{t=1}^T (\hat{\Omega}_t - \Omega)^2 \\ \sigma(\hat{\phi}) &= \frac{1}{T} \text{var}(\phi_t) = \frac{1}{T^2} \sum_{t=1}^T (\hat{\phi}_t - \phi)^2 \\ \sigma(\hat{\lambda}) &= \frac{1}{T} \text{var}(\lambda_t) = \frac{1}{T^2} \sum_{t=1}^T (\hat{\lambda}_t - \lambda)^2 \end{aligned}$$

Data Tables

In the tables below, we show the cross-sectional regression results. Coefficients are expressed in percentage terms and are italicized when deemed significant at the 5% level. Below the coefficients, t-statistics are presented in parenthesis. Coefficients can be interpreted as the maximum amount fund can obtain from the characteristic. For continuous variables, this is in the change in the interquartile range of the variable, or in the case of dummy variables, when the factor moves from false to true. Exhibit 11 describes the numerical distribution change for each variable.

Exhibit 10 Return Model Regression Results

Months After Management Change	36	12	6	3	1
(Intercept)	<i>0.042</i>	<i>0.007</i>	<i>0.004</i>	<i>0.002</i>	<i>0.058</i>
	55.884	29.557	28.338	26.148	20.709
Manager Change					
Management Change 3 Mo	-0.001	0.001	0.000	0.000	0.008
	-0.478	0.457	-0.393	0.459	0.321
Management Change 6 Mo	0.001	0.001	0.000	0.000	0.004
	0.293	0.771	0.529	-0.606	0.152
Management Change 12 Mo	-0.001	0.001	0.000	0.000	-0.002
	-0.650	1.580	0.311	0.779	-0.076
Management Change 24 Mo	<i>0.007</i>	<i>0.002</i>	<i>0.001</i>	0.001	0.019
	3.744	3.321	3.120	1.973	1.434
Manager Change Interactions					
Alpha:Management Change 3 Mo	<i>0.000</i>	<i>0.005</i>	<i>0.003</i>	<i>0.002</i>	<i>0.068</i>
	5.700	5.837	4.952	5.057	3.639
Alpha:Management Change 6 Mo	0.000	0.001	0.000	0.000	0.004
	0.004	1.192	-0.957	0.495	0.288
Alpha:Management Change 12 Mo	0.000	0.000	<i>0.001</i>	0.000	0.023
	1.083	0.681	2.329	1.348	1.278
Alpha:Management Change 24 Mo	<i>0.000</i>	-0.001	<i>-0.001</i>	<i>0.000</i>	-0.012
	-2.585	-1.511	-2.427	-2.096	-1.589
AUM:Management Change 3 Mo	<i>0.000</i>	<i>-0.002</i>	-0.001	<i>-0.001</i>	<i>-0.034</i>
	-3.225	-2.904	-1.447	-2.912	-2.956
AUM:Management Change 6 Mo	0.000	0.000	0.000	0.001	0.013
	-0.956	0.139	1.053	1.809	0.923
AUM:Management Change 12 Mo	0.000	0.000	0.000	0.000	-0.009
	-0.390	-0.704	-0.743	-1.526	-0.883
AUM:Management Change 24 Mo	<i>0.000</i>	0.000	0.000	0.000	0.007
	-4.220	0.216	0.804	1.540	0.896
Industry Experience:Management Change 3 Mo	0.000	0.000	0.000	0.000	0.000
	-0.027	-0.547	-1.223	-0.067	0.047
Industry Experience:Management Change 6 Mo	0.000	0.000	0.000	0.000	0.006
	-1.080	0.074	0.486	0.108	0.336

Exhibit 10 Return Model Regression Results Continued

Months After Management Change	36	12	6	3	1
Industry Experience:Management Change 12 Mo	0.000	0.000	0.000	0.000	-0.020
	-0.561	-0.954	-0.231	-0.307	-1.435
Industry Experience:Management Change 24 Mo	0.000	0.000	0.000	0.000	-0.005
	2.448	0.046	-0.675	-0.963	-0.870
Complete Team Change:Management Change 3 Mo	0.002	0.002	0.000	0.000	-0.009
	0.887	2.333	0.363	-0.699	-0.411
Complete Team Change:Management Change 6 Mo	0.003	0.001	0.001	0.000	0.001
	1.678	1.884	2.238	1.151	0.057
Complete Team Change:Management Change 12 Mo	-0.001	0.001	0.000	0.000	0.009
	-0.654	1.434	1.143	1.232	0.736
Complete Team Change:Management Change 24 Mo	0.002	0.002	0.000	0.000	-0.008
	1.551	3.744	1.76	-0.096	-0.918
r-squared	0.6%	0.6%	0.5%	0.6%	0.6%

Source: Morningstar, Inc. Data as of Dec. 31, 2016.

Exhibit 11 Growth Rate Model Regression Results

Months After Management Change	36	12	6	3	1
(Intercept)	53.225	53.744	52.595	51.869	51.119
	50.105	73.076	71.423	69.873	69.120
Manager Change					
Management Change 3 Mo	-1.685	-2.637	-2.379	-2.547	-2.003
	-3.354	-5.425	-4.684	-5.128	-4.390
Management Change 6 Mo	-0.469	-1.612	-1.368	-1.181	-1.002
	-0.850	-2.674	-2.247	-1.992	-1.822
Management Change 12 Mo	-1.415	-2.420	-2.355	-1.939	-1.976
	-3.147	-5.243	-4.984	-4.175	-4.293
Management Change 24 Mo	-1.850	-3.238	-2.875	-2.847	-2.294
	-4.130	-8.798	-7.569	-7.411	-6.252

Source: Morningstar, Inc. Data as of Dec. 31, 2016.

Exhibit 11 Growth Rate Model Regression Results Continued

Months After Management Change	36	12	6	3	1
Fund Characteristics					
Trailing 12 Mo Gross Excess Return	<i>0.153</i>	<i>0.144</i>	<i>0.146</i>	<i>0.144</i>	<i>0.140</i>
	11.452	16.323	16.905	17.025	16.983
Assets Under Management	<i>-0.060</i>	<i>-1.816</i>	-0.851	-0.174	0.504
	-4.509	-3.725	-1.695	-0.338	0.966
Net Expense Ratio	<i>-0.150</i>	<i>-8.724</i>	<i>-8.628</i>	<i>-8.453</i>	<i>-8.198</i>
	-45.009	-44.340	-43.751	-43.254	-42.131
Manager Change Interactions					
Alpha:Management Change 3 Mo	<i>0.048</i>	<i>3.384</i>	<i>3.286</i>	<i>3.572</i>	<i>3.185</i>
	8.000	10.025	9.867	10.263	9.830
Alpha:Management Change 6 Mo	<i>0.019</i>	0.684	0.772	0.545	0.476
	2.701	1.387	1.509	1.083	1.041
Alpha:Management Change 12 Mo	<i>0.022</i>	<i>0.778</i>	<i>0.656</i>	<i>0.692</i>	0.456
	4.591	2.545	2.135	2.278	1.624
Alpha:Management Change 24 Mo	<i>0.028</i>	<i>1.202</i>	<i>1.347</i>	<i>1.265</i>	<i>1.236</i>
	5.759	4.921	5.409	5.139	5.450
AUM:Management Change 3 Mo	<i>-0.066</i>	<i>-2.958</i>	<i>-3.084</i>	<i>-3.025</i>	<i>-3.059</i>
	-10.104	-11.182	-10.785	-10.833	-11.068
AUM:Management Change 6 Mo	<i>-0.043</i>	<i>-1.320</i>	<i>-1.493</i>	<i>-1.403</i>	<i>-1.269</i>
	-6.654	-4.207	-4.604	-4.351	-3.846
AUM:Management Change 12 Mo	<i>-0.038</i>	<i>-1.214</i>	<i>-1.227</i>	<i>-1.488</i>	<i>-1.203</i>
	-7.300	-5.455	-5.254	-6.555	-4.931
AUM:Management Change 24 Mo	<i>-0.054</i>	<i>-1.821</i>	<i>-2.130</i>	<i>-2.054</i>	<i>-2.281</i>
	-10.281	-10.134	-11.173	-10.741	-11.730
Industry Experience:Management Change 3 Mo	0.000	0.291	0.181	0.159	0.037
	0.052	1.090	0.704	0.568	0.143
Industry Experience:Management Change 6 Mo	0.001	<i>0.813</i>	<i>0.889</i>	<i>0.684</i>	<i>1.060</i>
	0.216	2.409	2.652	2.129	2.855
Industry Experience:Management Change 12 Mo	-0.003	-0.285	-0.462	-0.363	-0.449
	-1.230	-1.117	-1.766	-1.419	-1.728

Source: Morningstar, Inc. Data as of Dec. 31, 2016.

Exhibit 11 Growth Rate Model Regression Results Continued

Months After Management Change	36	12	6	3	1
<i>Manager Change Interactions</i>					
Industry Experience:Management Change 24 Mo	-0.002	-0.102	-0.034	0.023	0.047
	-0.862	-0.564	-0.182	0.118	0.236
Complete Team Change:Management Change 3 Mo	<i>3.001</i>	<i>6.670</i>	<i>6.498</i>	<i>5.644</i>	<i>4.502</i>
	4.876	14.333	14.274	12.883	10.121
Complete Team Change:Management Change 6 Mo	<i>2.193</i>	<i>5.062</i>	<i>4.733</i>	<i>4.444</i>	<i>3.635</i>
	4.344	11.271	10.995	10.862	8.410
Complete Team Change:Management Change 12 Mo	<i>2.647</i>	<i>5.968</i>	<i>6.079</i>	<i>5.758</i>	<i>5.323</i>
	7.001	18.623	20.648	18.607	17.845
Complete Team Change:Management Change 24 Mo	<i>3.355</i>	<i>6.203</i>	<i>6.317</i>	<i>6.305</i>	<i>5.983</i>
	8.044	25.133	25.138	25.828	25.541
r-squared	13.1%	10.6%	10.4%	10.0%	9.5%

Source: Morningstar, Inc. Data as of Dec. 31, 2016.

Exhibit 12 Coefficient Multiplication Factors for Chart Displays

Variable	Distribution Change (IQR)
Management Change 3 Mo	1
Management Change 6 Mo	1
Management Change 12 Mo	1
Management Change 24 Mo	1
Trailing 12 Mo Gross Excess Return	50
Assets Under Management	50
Net Expense Ratio	50
Alpha:Management Change 3 Mo	61
Alpha:Management Change 6 Mo	61
Alpha:Management Change 12 Mo	62
Alpha:Management Change 24 Mo	63
AUM:Management Change 3 Mo	42
AUM:Management Change 6 Mo	42
AUM:Management Change 12 Mo	42
AUM:Management Change 24 Mo	41
Industry Experience:Management Change 3 Mo	88
Industry Experience:Management Change 6 Mo	97.25
Industry Experience:Management Change 12 Mo	94
Industry Experience:Management Change 24 Mo	94
Complete Team Change:Management Change 3 Mo	1
Complete Team Change:Management Change 6 Mo	1
Complete Team Change:Management Change 12 Mo	1
Complete Team Change:Management Change 24 Mo	1

Source: Morningstar, Inc.

References

Our methodology uses the regression approach pioneered in Fama and MacBeth (1973) to easily calculate standard errors that correct for correlation across assets. Furthermore, using the approach found in Fama and MacBeth (1973), we are able to easily build models in which the independent variables change over time.

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