Participant Reaction and The Performance of Funds Offered by 401(k) Plans

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ABSTRACT

This is the first study to examine both how well plan administrators select funds and how participants react to plan administrator decisions. We find that on average administrators select funds that outperform randomly selected funds of the same type. When administrators change offerings, they choose funds that did well in the past, but after the change deleted funds do better than added funds. Plan participants react strongly to past performance in their allocation decisions. This accentuates the changes in allocation caused by returns. Participant allocations do no better than naïve allocation rules such as equal investment in each offering.

In recent years there has been tremendous growth in the significance of defined-contribution pension plans, and particularly in one type of defined contribution plan: 401(k) plans. More than one-third of American workers are enrolled in 401(k) plans, and these plans have over one trillion dollars under management. In light of the size and importance of 401(k) plans, it is not surprising that a number of studies have examined certain aspects of these plans. Almost all of these studies examine the behavior of individuals given the characteristics of the plan they are offered. Examples of results of these studies include

1. Investors tend to spread their investment evenly over the choices they are offered. This is referred to as the "1/*N* Rule" (see Benartzi and Thaler (2001) and Liang and Weisbenner (2002)).

2. Investors over-invest in stock of the company for which they work (see Huberman and Sengmuller (2003), Agnew and Balduzzi (2002) and Benartzi (2001)).

3. Investors infrequently revise their allocations (Ameriks and Zeldes (2001), Madrian and Shea (2001), Agnew and Balduzzi (2003)).

4. Investors cluster their stock and bond transfers, and they are related to same-day returns (Agnew and Balduzzi (2003)).

5. Equity allocations are related to cohort and age (Ameriks and Zeldes (2001), Agnew and Balduzzi (2003)).

6. Investor choices are influenced by the default choice they are offered (Madrian and Shea (2001)).

All of these studies involved investor decisions given the choices that the plan administrator made with respect to the design of the plan.

Surprisingly, there has been very little research on the appropriateness of the choices offered by 401(k) plans. This is a key issue, for the plan participant can only choose from among

a set of investment choices which he or she is offered, and for over 60% of the participants the 401(k) offerings are their sole financial assets outside of a bank account.[1] In an earlier paper, Elton, Gruber and Blake (2005) examined whether the choices offered to participants included the right categories of investments. That paper left unexplored whether, given the categories of investments offered, the individual choices offered by plan administrators in each category were good investments *per se*, and plan participants' reactions to the choices.

The purpose of this article is twofold. First, to examine the performance of the individual investments selected by 401(k) plan administrators compared to the population of choices that were available. We examine this both from the set of choices available at any point in time for the plan as a whole and for the choices that are added and deleted. Second, given the choices offered, to explore aspects of participant reactions not studied before.

This paper is divided into four sections. In the first section we discuss the data used in this study. In the second section we compare for the plan as a whole the performance of choices offered to participants in 401(k) plans with a carefully matched sample of similar investments, the performance of funds added and deleted, and whether there are plan administrators who consistently offer their participants funds with superior performance. In the third section we explore participants' reactions to the choices offered. The final section presents our major conclusions.

I. DATA

The major source of our data is the 11-K filings for 401(k) plans with the Securities and Exchange Commission. 11-K filings are required to be filed every year for all 401(k) plans that

[1] Investment Company Institute (2000). This study reports that more than 60% of 401(k) plan participants have no other security investments (stocks, bonds, etc.) other than a bank account.

offer company stock as an investment choice for plan participants. We initially gathered data on all 401(k) plans that filed 11-K reports in 1994 and used publicly available mutual funds as choices offered to participants. We traced the sample through 1999.[2] From the sample, we excluded plans where the participant flows could not be identified, usually because the flows were aggregated or because the plan merged. We also excluded plans that offered non-public stock or bond funds. Finally, we excluded plans that had less than four years of contiguous data or where the plan was a duplicate of another plan offered by the same company. This left us with a sample of 43 plans. As shown in Table I, we had 289 plan years for the 43 plans, or an average of approximately six years for every plan.[3] Over these 289 plan years, 215 funds were added and 45 were dropped. This represents close to one addition per year and as many dropped funds as there were plans. Examining the 43 plans reveals that 35 plans added at least one fund and 14 plans dropped at least one fund. From the 11-K filings we were able to determine the investment choices that were offered by each plan in our sample, the amount invested by participants in each choice as of each 11-K reporting date, the allocation of new money over each year, and the reallocation across existing accounts.

We utilize three other types of data. First, for mutual funds and company stocks, we obtain monthly returns from CRSP.[4] Second, we obtain monthly returns on indexes from CRSP,

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[2] We were unable to collect SEC 11-K data beyond 1999 due to changes in SEC electronic filing requirements. There were too few companies reporting data to start earlier than 1994.

[3] The funds came from 40 different mutual fund families. The average number of total offerings was 8, which is consistent with the findings of Elton, Gruber and Blake (2005). The average number of mutual fund offerings was 4.7. The difference in these numbers is due to the presence of GICs, money market funds, company stocks and stable value funds.

[4] We compare the performance of 401(k) plan offerings to the performance of randomly selected funds. When we randomly selected funds, we selected only funds with over $15 million in assets. This is realistic, since funds selected by 401(k) plans are larger than this. The selection rule also eliminates the bulk of the bias embedded in the CRSP data (see Elton, Gruber and Blake (2001)).

Ken French's web site, and Morningstar. Finally, for the risk-free interest rate, we employ the 30-day T-bill rate provided by CRSP.

II. PERFORMANCE

We examine three aspects of performance in this section of the paper: whether 401(k) plans offer superior-performing mutual funds, whether they improve performance when they change offerings, and whether some plan administrators are better than others. The first issue we address is the performance of the funds selected by the plan administrators.

A. Fund Performance

How well do the funds selected by plan administrators perform compared to what they could have selected? To analyze this we first compute alphas on the funds that were offered to participants. Alpha is a measure of the return the participant earns above or below what she would have earned if she had simply held a passive portfolio of indexes with the same risk.

Alpha is estimated from the following regression:

$$R_{it} - R_{Ft} = \alpha_i + \sum_j \beta_{ij} I_{jt} + \varepsilon_{it}$$

Where

1. R_{it} is the total return on mutual fund *i* in period *t*;
2. β_{ij} is the sensitivity of fund *i* to index *j*;
3. R_{Ft} is the riskless rate in *t*.
4. ε_{it} is the residual for fund *i* in period *t*.
5. I_{jt} in period *t* is either the return on the index, if it is the difference between two return series, or the return above the riskless rate if it is a single return series.

The overwhelming evidence is that alpha on average is negative for mutual funds.[5] Thus a negative alpha on average for offerings of 401(k) plans is not inconsistent with plan administrators picking better performing mutual funds. Therefore, to evaluate the alpha on the funds in a plan we will compute for each fund in the plan a "differential alpha," which is the difference between alpha on each fund in a plan and the average alpha on a random sample of similar funds. We define similar funds as funds in the same ICDI investment objective category of similar size. Adjusting for ICDI category controls for year-to-year variation in the performance of any category not captured by our performance model. Adjusting for the size of the mutual fund controls for any difference in fund performance due to the size of funds.[6] The differential alpha is the primary metric that we will use to judge the ability of pension fund administrators to select mutual funds with superior performance.

For purposes of specifying the appropriate indexes for defining alpha, mutual funds will be divided into three types: stock funds, bond funds and international funds. For stock funds we will use a five-index model, the S&P 500 index, both the Fama French small-minus-big ("SMB") index and high-minus-low ("HML") indexes, the Lehman Government/Credit index and the MSCI EAFE index. This is a similar framework to that used by Elton, Gruber and Blake (1996). Two indexes require some comment. First, the bond index is needed both because the stock category includes many funds that are combinations of bonds and stocks such as balanced and income funds, and because funds in the common stock categories such as aggressive growth or long-term growth often hold part of their portfolio in long-term bonds. Failure to include a bond

[5] See Blake, Elton and Gruber (1993), Elton, Gruber and Blake (1996), Grinblatt and Titman (1989), Jensen (1968), Sharpe (1966), and Wermers (2000).

[6] The adjustment for size and category is performed by taking a random sample of 100 funds (or the maximum available if there are less than 100) in the same ICDI category, dividing this sample into deciles based on size, and comparing the fund's alpha with the average alpha from the size decile (in its ICDI category) into which the fund falls.

index imputes to alpha any return on long bonds different from the riskless rate. The other non-standard index is the international index. During the period of this study many stock funds included international stocks in their portfolio, usually in the form of ADRs. Again, failure to include an international index would cause fund alphas to be a function of their international holdings.

For bond funds we will use a four-index model, the Lehman Government/Credit index, the Lehman Fixed-Rate Mortgage-Backed Securities index, the Credit Suisse/First Boston High-Yield index, and the Salomon Brothers Non-Dollar World Government Bond index. The first three indexes are supported by the work of Blake, Elton and Gruber (1993). The addition of the international index is needed to capture the tendency of some bond funds to include international bonds in their portfolio over this period.

Finally, for international funds we will use a five-index model consisting of the S&P 500 index (since international funds often hold U.S. securities), three MSCI indexes (Europe, Pacific and Emerging Markets), and the Salomon Brothers Non-Dollar World Government Bond index.

We computed monthly alphas for one and three years following the date of each 11-K report. Using subsequent return data to evaluate performance eliminates the bias that results from using data prior to the 401(k) report since, as shown later, plans add new funds after periods of superior past performance. Thus, evaluation using the period prior to the report would pick up return not available to participants (if the fund was newly added) and would bias 401(k) plans' relative alphas upward. Three-year alphas are estimated over the 36 months following the fiscal year end. For 1-year alphas, we took the fund's 3-year alpha and added to it the average monthly residual over the 12 months following the end of the fiscal year.

A couple of the funds did not have three years of monthly data subsequent to the 11-K report, due to merging. In these cases we used the last three years of monthly returns (up to the time the fund merged) to estimate 3-year alphas. To compute alpha we took a weighted average of the alpha on the fund over the relevant period (the period subsequent to the 11-K report and before the fund merged) using the parameters estimated over the three years, and the mean alpha for the fund's ICDI category for the period after it merged to the end of the three years. This assumes the plan administrator added a fund with average performance of the same ICDI type when the fund ceased to exist.

To compute the alpha on a plan from fund alphas we will use two different weighting schemes. First, we examine the average performance of each plan administrator.[7] Second, we weight the funds unequally using the actual weights chosen by participants as shown in the 11-K statement. These weights are determined by dividing the amount invested in any fund by plan participants by the aggregate amount invested in all funds in the plan. Table II shows the results for three-year alphas, and Table III shows the results for one-year alphas.

Table II and Table III present data on the selection ability of pension fund administrators.[8] First note that the alphas for the average plan are negative, consistent with results found for mutual funds in other studies. However, it is clear from these tables that pension fund administrators have selected mutual funds for their participants that are better than a set of randomly chosen mutual funds of the same type, size and risk. Examining Table II shows that, using equal weighs for the funds in each plan, over a three-year period plan administrators had

[7] One justification for this is that Benartzi and Thaler (2001) and Liang and Weisbenner (2002) show that equal investment in each investment choice (the 1/*N* rule) is common for participants.

[8] All of the tables were re-computed excluding index funds. The results were virtually unchanged. Short-term debt funds (e.g., money market funds) are excluded from our analysis.

an average differential alpha over funds of the same type, size and risk of 4.3 basis points per month, while as shown in Table III, over a one-year period the equal-weighted differential alpha is 3.5 basis points per month. Both of these are statistically significantly different from zero at the 5% level. In addition, the three-year differential alpha is positive for 30 out of 43 plans and is significantly different from zero at the 1% level, and the one-year differential alpha is positive for 29 out of 43 plans.

The last two columns of Table II weight the performance of any fund in a plan by the fraction of assets participants place in that fund. This weighted performance is a result of both the funds offered to plan participants by plan administrators and the choices among those funds made by participants in the plan. Using participants' actual weights is a relevant alternative to equal weighting. Perhaps management is selecting funds based on forecasts of how participants will weight the funds selected, and thus spending effort on selecting funds expected to be heavily invested in. The numeric results change very little by using participant weights rather than equal weights. With participant weighting, the average three-year differential alpha drops from 4.3 basis points to 3.7 basis points and is positive for 32 of 43 plans, while the one-year differential alpha increases from 3.5 to 4.1 basis points and is positive for 33 plans. When we compare the results using participant weighting with the results using $1/N$ weighting, we find no differences that are statistically significant. Thus there is no evidence that participants' asset-allocation decisions change the conclusion that the choice of funds made by administrators is better than random selection.

When computing differential alpha we matched each mutual fund with the average alpha for the same size decile and the same ICDI investment objective category. The size adjustment was imperfect. The mutual funds held by plan administrators were about three times as big as the

average size fund in the same decile. Mutual fund fee schedules are such that fees tend to fall as funds increase in size. Since we are looking at after-fee performance, the reduced fees improve alpha, *ceteris paribus*. The fee difference between mutual funds selected by plan administrators and the random funds in the same size decile and ICDI category is 1.9 basis points. This accounts for much of the performance difference.[9]

It is clear from these results that plan administrators possess some skill in selecting funds for their plans.[10] Furthermore, since participant investment allocation in aggregate seems to neither add to nor subtract from the performance attributed to plan administrators, the key element in how well the average participant fares appears to be the choices that the participants are offered.

B. Performance of Additions and Deletions

Pension fund administrators change the investment choices offered to participants with surprising frequency. This is particularly true with respect to the inclusion of new mutual funds. Across the 289 fund years in our sample there were 215 mutual funds added to the offerings and 45 funds deleted. The pattern of deletions is interesting. First, very often, dropping a fund seems to be part of a more general change in direction for a plan rather than an isolated decision on the performance of a single fund. In only six cases was a single fund dropped from a plan. In the other 39 incidents of dropped funds, two or more funds were dropped from a plan simultaneously. In fact, for 24 of the 45 funds that were dropped, the plan that held them dropped all the funds in the plan simultaneously. Second, in many cases dropping a fund did not seem to

[9] Finer size adjustment is not possible, since plan administrators frequently select the largest fund in an ICDI category and the vast majority of the time select funds from the largest size decile.

[10] Part of the skill may be in selecting lower cost funds. Another possible explanation is that funds made available for 401(k) plans are lower cost funds.

be motivated by a desire to pick a better manager of the same type, since 20 dropped funds were not replaced with funds in the same category and, for 15 of those 20 cases, the ICDI category of the dropped fund was completely eliminated from the plan.

Many of the additions seem to be motivated by a desire to add a new type of fund. Of the 215 funds added to plans over our sample period, 146, or over half, were selected from an ICDI investment objective category not held by the plan at the time of the addition.

What are the characteristics of funds that are added and deleted? Panel A of Table IV presents data on funds that were added or dropped for the one- and three-year periods prior to that change.[11] A fund is considered dropped at the date of the first year it does not appear in the 11-K annual statement. It is considered added at the date of the first year in which it appears in the 11-K annual statement. These are annual reports. Thus up to one year of data which we are treating as occurring prior to the change could have in fact occurred after the change.

From Table IV we see that funds that were added have non-negative differential alphas for both one year and three years prior to the change. In contrast, funds that were dropped have negative differential alphas both one year and three years before they were dropped. Based on differential performance, management seems to be reacting very strongly to past performance in making decisions. While the difference in differential alpha in the added and dropped funds is statistically significant at the 1% level for the one- and three-year periods before the change, the three-year results are economically much more significant. The funds that were added have a differential alpha above those that were dropped of 19 basis points per month for three years before the change and 11 basis points per month for one year before the change.[12] Table IV also

[11] For 14 of 215 added funds and one of the dropped funds three years of history were not available, so these are excluded. In addition, one of the added funds was a sector fund for which we did not calculate alphas.

shows results for alpha and differential return. We see that, for both of these other measures, the sample of added funds has much better past performance than the sample of dropped funds. The decision to add or drop funds would seem to be made, at least in part, on the basis of past performance.

Since plans frequently add new types of funds, it is interesting to examine whether plan administrators are adding "hot" investment objectives (types). Anytime a fund was added to a plan, we calculated the alpha for the random sample from the ICDI category the fund was in for that year. This is compared to the average alpha over the total random sample (all types) for that year. Over the three years prior to the addition, the average difference in alpha is 0.018% (significant at the 1% level), and over one year it is 0.008%. Plan administrators are adding an ICDI investment objective category that performed better in the past than the average category.

A logical question to ask is how well funds do after they are added or dropped. These results are presented in the lower panel of Table IV. Over three-year periods for all three measures of performance (differential return, alpha, and differential alpha), the performance of the added funds is better than the performance of the dropped funds. However, the reverse is true over one year. None of these differences are statistically significant at the 5% level.

For further evidence we examined two specific sub-samples. First we examined the 26 cases where a 401(k) plan deleted a fund and replaced it with a fund with an identical objective. In this sub-sample, the deleted funds outperform the funds they replace by an average of 20 basis points per month over the next three years, and by an average of three basis points per month over the first year; neither of these differences are significant at the 5% level.

[12] This difference probably arises because management pays attention to the longer time horizon, but it could be due in part to the fact that the one-year period can contain from 1 to 12 months of data after the addition or deletion takes place.

Second, we examined the sub-sample of the nine plans that changed virtually all of their offerings by dropping funds from one fund family and adding funds from a new fund family.[13] Table V shows the results. Over the future one-year period, both the alpha and differential alpha of the dropped funds are higher than those of the added funds, using either equal weights or the weights that participants actually held in the plan, with the reverse being the case over the three-year period. Again, none of the differences are statistically significant. In these nine cases the plans changed virtually all of the funds offered to participants. Thus, it also makes sense to examine performance of the overall portfolio.

To measure overall performance we calculated future Sharpe ratios for each plan using the two different weighting schemes. Table V shows results both for one-year and three-year Sharpe ratios. Under either set of weights, the future Sharpe ratios are higher for the portfolio of dropped funds than for the funds that replaced them. Again, none of the differences are statistically significant.

We also examined the performance of the added and deleted sample for the one and three years before they were added. As shown in Table V, the results are similar to the results found for the larger group. Over both the one-year periods and the three-year periods the dropped funds did significantly worse than the added funds.

The overall pattern is clear. Plan administrators add funds that have done well in the past and drop funds that have performed poorly. However, when examining future performance the dropped funds seem to perform no worse than the added funds.

[13] In two of the cases, a plan replaced all but one fund; in all other cases, all funds were replaced.

C. Identification of Superior Plan Administrators

Having shown that, on average, plan administrators select funds that perform better than average holding constant the ICDI classification and size, we now examine whether past performance allows us to identify plans that have superior performance in the future.

Before doing so we examine whether, for the entire sample of plans, certain plan administrators show performance that is different from other plan administrators at a statistically significant level. An analysis of variance test was performed using the entire history for all funds. The results showed a probability less than 0.01 (*p*-value of 0.0013) that there was no difference in the ability of individual plan administrators.

We now turn to an examination of whether good performance of a plan in one period predicts good performance in a second. In order to have non-overlapping periods we will confine the analysis to one-year alphas. We will continue to use the performance metric we have described as most relevant: differential alpha. The results are shown in Table VI. To construct Panel A of Table VI for each year from 1991 through 1998, the 401(k) plans in our sample were ranked and divided into four equal groups based on past one-year differential alphas. For each year the fraction of plans that stay in their quartile or migrate to each of the other quartiles is calculated. The overall results are shown in Table VI along with the actual average differential alpha that occurred in the year after the ranking. If there was no persistence, the diagonal elements should all be equal to 0.25. Examining Panel A of Table VI shows that they are all above 0.25 and they average 0.3375. We can get a better idea of the persistence of this performance by examining the differential alpha that would have been earned in the subsequent year by holding plans in each quartile. The differential alpha from holding the bottom quartile of funds is –0.024 or approximately –0.29 basis points per year, while for the top quartile it is 0.061

basis points or approximately 0.74 basis points per year. The difference is statistically significant at the 0.01 level. Differences in future differential alphas between the top 3 quartiles are insignificant.

Panel B of Table VI presents analogous results for a different classification of plans. Here, plans were divided into two groups according to whether the plans had differential alphas larger than zero or less than or equal to zero. We do not expect the probabilities to be equal to 0.50 in each cell in this table because plans on average have positive differential alphas going forward. We have 114 plan years with forward results less than or equal to zero and 173 plan years above zero; thus the probability of a positive alpha is 0.6028. The transition matrix shows that past one year differential alphas contain no information about whether a plan will have positive differential alpha in the following year. However, despite this, holding a plan with positive differential alpha does lead to a higher differential alpha in the next year. Plans with negative differential alphas produce subsequent differential alphas of 0.026 or approximately 31 basis points per year, while those with positive differential alphas produce subsequent differential alphas at 0.047 or approximately 56 basis points per year. The difference in differential alpha between these two groups is not statistically significant at the 5% level. Thus, while earlier we found evidence of predictability in the tails, when we examine predictability of positive and negative differential alpha, we find no significant difference.

As a final step we examined whether better performance was associated with plan characteristics. If it were, we could identify plans that would perform well in the future. To examine this we regressed the average alpha for a plan on the log of the average dollar size of the plan, the average number of choices every year, the average number of changes in choices every year, the average new cash flows divided by the size of the plan, and dummies for the presence

of a money market fund and a GIC. Size might be correlated with the amount of effort expended in searching out funds and with the sophistication of the manager employed. The number of choice changes every year might again be an indicator of the attention given to the plan and plan administrators' sophistication, since more choices likely improve the participants' chances of obtaining efficient portfolios. Average new cash as a percentage of assets is an indicator of the eagerness of plan participants to invest in the plan. Finally, the presence of GICs and money market funds are measures of the sophistication of the plan administrator, since these should be choices available to participants. We do not present the results, because none of the variables were significant at the 5% level, and the overall test of the model was not statistically significant.

While there is some predictability of future performance of plans from past performance, most comes from bad performance predicting bad performance.

III. PARTICIPANT BEHAVIOR

In the prior section of this paper we examined the ability of plan administrators to select and offer to participants mutual funds that outperformed random selection of mutual funds of the same type. In this section we exploit the same data to examine participant behavior given the choices they are offered. The advantage of our data is that we have information on aggregate participant behavior for a large number of plans with very different performance over a large number of years. The disadvantage is that we analyze aggregate behavior rather than the behavior of particular participants. In this section we will examine the following issues:

1. How important are contributions, fund returns and transfers in determining changes in investment weights?
2. Do participants use contributions and transfers to restore their original weights, or do they accentuate the change in weights caused by investment returns?

3. What explains the pattern of participant contributions and transfers?
4. How do participants react to new investment choices being offered?
5. Do participants make their contributions and transfers in a manner that improves their 401(k) performance?
6. How does the form of the matching contribution affect participant behavior?

A. Importance of Fund Returns, Participant Contributions and Transfers in Changing Investment Proportions

The proportion invested in each fund in any 401(k) plan can change from the beginning to the end of the year. The change in investment weights comes about because of different returns on different funds, the contribution of the employer and employee, and inter-fund transfers. In this section we explore how great the change in investment weights is from each of these three sources. We examine each separately. To examine the magnitude of the change in weights due to each of these sources for any plan, let

X_{it} = the fraction of the participants' savings invested in asset i at time t

C_{it} = the dollar amount of employee and employer contributions into asset i between time t and $t+1$

T_{it} = the dollar amount of transfers into or out of asset i between time t and $t+1$

R_{it} = the return from unrealized and realized capital gains and dividends on asset i from time t to $t+1$

D_{it} = the dollars invested in asset i at time t

Let us turn to the examination of the change in weights due to return. If capital gains (realized and unrealized) and dividends were the only source of the change in dollars invested in asset *i,* the dollars invested in asset *i* at time *t*+1 would be

$$D_{it+1}^{R} = D_{it}(1+R_{it}) \qquad (1)$$

The change in weights in asset *i* from *t* to *t*+1 due to investment return would be

$$\Delta X_{it}^{R} = \frac{D_{it}(1+R_{it})}{\sum_{j=1}^{N} D_{jt}(1+R_{jt})} - \frac{D_{it}}{\sum_{j=1}^{N} D_{jt}} \qquad (2)$$

where *N* is the total number of investment choices in the plan.

The sum of the change in weights across all the choices in a plan must add to zero. Thus, to see how important returns are to the change in the allocation across choices, we take the absolute value of the sum of ΔX_{it}^{R} for each plan divided by two, i.e., for any plan *P*:

$$\Delta X_{Pt}^{R} = \sum_{i=1}^{N} \left| \frac{\Delta X_{it}^{R}}{2} \right| \qquad (3)$$

This summation is the aggregate increase (or decrease) in weights for the plan.[14] On average, across our 228 plan years the change in weights due to investment returns was 4.51% with a median of 3.79%.

The second way weights can change is through contributions and transfers. In an analogous manner we compute what the ending amount would be in each choice if the only flow came from contributions and transfers. The form analogous to equation (1) is

$$D_{it+1}^{C+T} = D_{it} + C_{it} + T_{it} \qquad (4)$$

[14] All calculations only include assets that exist over the year, and the X_is are scaled to add to one.

And, paralleling equation (2) and equation (3),

$$\Delta X_{it}^{C+T} = \frac{D_{it} + C_{it} + T_{it}}{\sum_{j=1}^{N}\left(D_{jt} + C_{jt} + T_{jt}\right)} - \frac{D_{it}}{\sum_{j=1}^{N} D_{jt}} \qquad (5)$$

$$\Delta X_{Pt}^{C+T} = \sum_{i=1}^{N}\left|\frac{\Delta X_{it}^{C+T}}{2}\right| \qquad (6)$$

The change in weights if contributions and transfers were the only sources of change average 4.62% with a median of 3.77%. Thus contributions and transfers were equally important as investment returns in changing investment weights.

In an analogous manner we separated out transfers from contributions. Transfers were the largest component causing allocation changes. Transfers caused an average of 3.85% change in allocation with a median of 3.07% while contributions were 2.11 with a median of 1.63. Transfers were much more important than contributions in determining the change in allocation of plan participants and were almost as important as returns.[15]

In the prior analysis we treated each choice as a separate investment. Alternatively, we could group choices by investment category and examine changes in weights across categories. With this classification, transfers or changes in contributions within a category would cancel out. We used the following categories: company stock, fixed interest funds (GICS, money market, stable value), stock mutual funds, bond funds, balanced funds, and international mutual funds. When classifying by category the average weight change due to returns was 4.4% while that due to contributions and transfers was 3.9%, and with a median of 3.6% and 3.0%. Computing change

[15] Transfers can be both positive and negative at the participant level. We only have aggregate data which reflects a netting out. Thus transfers are likely to be more important in explaining changes in weights at the participant level than our numbers reflect.

in weights at the category level rather than the asset level shows that returns are slightly more important than contributions plus transfers in causing changing weights. As in the case of individual assets, transfers are about twice as important as contributions in accounting for changes in asset allocation.

B. Participants' Reaction to Return

In this section we examine whether participants change their allocations in a way that accentuates or decreases the change in allocation due to returns. By focusing on the changes in allocation made by participants compared to the change in allocation due to returns during the same period of time, we can test several alternative hypotheses: do participants ignore the change in allocation due to change in return when making their decisions, do they attempt to restore weights toward starting values by decreasing their contribution to choices which have had unusually high returns, or do they tend to put more money in the categories with high returns, thereby amplifying the impact of returns on relative investment weights?[16]

Modern investment theory would suggest that, absent an ability to forecast returns, participants should maintain roughly the same investment proportions from year to year. Thus, if participants' allocation decisions do not tend to restore the original weights, either they are acting non-optimally or they believe high returns on an investment choice in a current period predicts high returns next period.

In order to study this, we use two variables: changes in investment proportions due to contributions and transfers, ΔX_{it}^{C+T}, and changes due to returns ΔX_{it}^{R} (equation (2) and equation (5) in the prior subsection).

[16] In a later section we explore the impact of lagged returns on participant investment decisions as well as the ability of these decisions to forecast future returns.

We examine the relationship between ΔX_{it}^{C+T} and ΔX_{it}^{R} in two ways: one ignoring the size of the change (only considering the sign) and one incorporating the size of the change. In Table VII, for each choice that had a positive (non-positive) change in participant allocation due to contributions and transfers in a year, we tabulate whether it had either a positive or non-positive change in allocation due to return. We tabulate this across 228 sample fiscal years containing 1,643 investment allocations. It is clear from this table that participants allocate their contributions and transfers in a way that causes their investment weights to change in the same direction as return.[17]

The next step was to estimate the relationship between the change in weight due to contribution and transfer and the change in weights due to return. The following regression was performed separately for each plan:

$$\Delta X_{it}^{C+T} = \alpha_i + \beta_i \Delta X_{it}^{R} + \varepsilon_{it}$$

The observations for this regression include all years for each choice in a plan. One observation is left out in a plan each year because of over-identification, since the sums of both the left-hand variables and the right-hand variables have to equal zero in each year.

We first performed the regression omitting company stock. When we examine this relationship we find that the beta is positive for 36 out of 41 plans. The results are statistically significant different from zero at the 5% level in 24 cases out of 41. All of these cases are positive. Across all 41 cases, the average coefficient of determination is 0.17 and the average beta is 0.57. Thus, participants make contributions and transfers that further change the allocation caused by returns by about 57%. When we include company stock as an account, the results are similar. The betas are positive in 28 out of 41 cases, and they are statistically

[17] Using a chi-square test, the hypothesis of no relationship between the change in weights due to contributions and transfers and the change in weights due to returns is rejected at the 0.01 level of significance.

significantly different from zero in 20 out of 41 cases, with two cases significant with a negative sign.

The analysis above was repeated where the unit of observation was category of choices (e.g., company stock, fixed-interest funds, stock funds, bond funds, international funds) rather than individual choices. The results showed a stronger relationship between the change in weights and past relative return. The results in total indicate that the decisions of participants in aggregate accentuated the change in yearly asset proportions that were caused by the returns on different types of investment choices. Participants increase their allocations in the best performing choices and decrease in the worst performing choices.

C. What Explains the Pattern of Participant Contributions and Transfers?

Participants, through their choices of contributions and transfers, change the percentages they hold in each of the choices they are offered. These changes can reflect expectations about relative returns in the future, or they can be in reaction to past performance of the assets in their portfolio or characteristics of the plans. In Section E we examine whether these changes improve the performance of their portfolio. In this section we try to explain the pattern of the deviations of contributions and transfers from equal investment by using past relative return and plan characteristics.

The deviation from equal investment for fund *i* is:

$$\frac{C_{it} + T_{it}}{\left(\frac{1}{N}\right)\sum_{j=1}^{N}\left(C_{jt} + T_{jt}\right)} \qquad (7)$$

Each plan was analyzed separately with all funds and years for a plan used as observation.[18] We found that deviations from 1/*N* were positively related to past return. We used as a measure of

past return the three-year average of past return on a fund in a plan divided by the average three years of past returns for all funds in a plan.[19] We examined the 30 plans for which there were more than 15 observations. Of these**,** 16 beta coefficients were significant at the 1% level. All but one were significantly positive. The average significant beta with past returns was 0.90 with an average R^2 of 0.29. Thus participants allocate more in choices that have higher than average past returns. Separating plans into those where company contributions were in the form of stock from those where they were not did not show any difference in results.

D. Allocation to New Investment Choices

There are 215 mutual funds added and 45 funds deleted over the 289 plan years. In this section we will explore the allocation of money to the new funds. Since different plans offer different numbers of investment choices, we will analyze the allocation relative to what it would be if the participant put the same percentage in each fund. We will analyze this both including and excluding company stock, since for many plans the company contribution is in the form of company stock. Table VIII shows the median allocation (equation (7) in the prior subsection) for one to four years after the addition of a new fund when allocation to company stock is excluded. We get similar results if company stock is included.[20]

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[18] Only mutual funds and company stock choices are included in this analysis, because monthly compounded annual returns were not available for the other types of choices. We also excluded any remaining fiscal year where a plan offered only one mutual fund (in addition to company stock); this resulted in 5 of the 43 plans being dropped entirely, leaving us with 38 remaining plans. We examined several firm variables across the 38 plans. None of the firm variables (such as a dummy if the plan had more than one fund of the same type, a dummy if the fund was a new type or a dummy if there was prior allocation to the fund) showed statistical significance.

[19] If the average of the 3-year returns across all funds in a given plan and fiscal year were negative, the meaning of the ratio could be misleading; there were no such cases in our sample.

[20] Note that the sum of T_{it} does not necessarily equal zero, since there can be transfers into or out of company stock that are not included in the summation. In addition, note that some funds were not included because they were added in the last year for which we have data.

Over all funds, the median contribution and transfers to a new fund is about 83% of the contribution to the average fund. Over all years and funds for only 28% of the plan years was the contribution and transfer into the new fund above the average for a fund in the plan. If the fund being added was in the same category as an existing fund, then participants put more than 100% of the average in the new fund. We split this case into two subcategories: one where a fund of that type was dropped at the same time a fund was added, and one where the fund was a net addition to the choices of that type. When a fund was a replacement, participants put much more than 1/*N* in the new fund. When a fund was a net addition, the participants initially put less than 1/*N* in the fund, though by the third year the amount placed in the fund had risen to more than 1/*N*. If the fund added was a new category of fund, the allocation was less than 60% of average. Participants are more cautious about investing in new types of funds.

Many plans add more than one new fund. For these plans, we compared the allocation in aggregate to what it would be if participants allocated 1/*N* on average to each new fund. The amount in aggregate was about equal to 1/*N* times the number of funds. Thus, when a plan adds more than one fund, the allocation to the new funds is higher than when a plan adds just one fund. Participants seem to pay more attention to reallocation when multiple funds are added at the same time.

Finally, we examined whether new funds had more transfers than old accounts, and found that they had about 5% more transferred in, though the total of contributions and transfers was less than 1/*N*.

The prior analysis provides one explanation for the mixed results on the 1/*N* rule. Most studies of the 1/*N* rule examine asset holdings at a point in time. Since flow into new funds is at a rate below 1/*N*, and since new choices start with zero investment, a plan that adds new

investment choices will show strong deviation in participant proportion from the 1/*N* rule. A researcher looking at proportions at a point in time for a plan where the investment choices were introduced at different times could observe deviations from 1/*N* in current participant proportions even if participants direct flows at a rate of 1/*N* in each investment choice.

E. How Well Do Participants Do in Allocating Assets?

Earlier we examined how well plan administrators do in selecting the investment choices offered to participants. In this section we examine how well participants do in allocating their investments across the investment choices they are offered.

This raises the general problem of selecting criteria for judging performance. There are two criteria that are relevant. If the participant holds assets outside of the retirement plan, then the relevant criterion would be the alpha produced by the retirement portfolio.[21] However, as discussed in Elton, Gruber and Blake (2005), many participants have virtually all of their savings in their retirement account, and these participants care about diversifiable as well as non-diversifiable risk. For these participants, the relevant measure is the Sharpe ratio on their overall investments in the pension plan.

Given either of these measures, how do we know whether participants have done well or poorly? We will analyze this by comparing results given the participants' investment weights with three naïve investment strategies and by examining the impact of participant action over time on the retirement account.

1. Comparison with Naïve Strategies

[21] Earlier we employed differential alpha rather than alpha. Here we employ alpha because we are concerned with participant ability to allocate among choices, and we are comparing the performance of the chosen portfolio with naïve alternatives.

We will compare participants' decisions with several naïve strategies. The first is to assume the participant puts an equal amount of money in each investment choice in a plan. This is the 1/*N* rule, which has been widely discussed in the literature and certainly represents the simplest mechanical rule the participant could follow. Another naïve rule we examine is a slightly more sophisticated version of the 1/*N* rule – place an equal amount of investment in each category of investment. The categories we used were bond funds, stock funds, international funds, balanced funds and company stock. The last naïve rule we examine assumes that the participant invests equally in the top half of the choices offered. The ranking device we use to select the top half is the investment choice's alpha over the past three years divided by the standard deviation of the residuals.[22] We now turn to an examination of the performance results of each portfolio selection rule.

a. Sharpe Ratios

In order to compute Sharpe ratios for each selection rule, we formed portfolios at the end of each plan year using participant weights and each of the three naïve strategies discussed above. We then looked at the monthly return from holding each portfolio over the following year. For each plan, by repeatedly applying this procedure, we have a series of monthly returns from 24 months to 96 months, depending on the availability of plan and fund data.

Panel A in Table IX shows the average Sharpe ratio for each of the four strategies across the 38 plans as well as the number of times each naïve strategy outperforms the participant's portfolio.[23] From Table IX it is clear that none of the naïve strategies have performance that

[22] See Elton, Gruber and Blake (1996) for evidence that the past value of this criterion has predictive power for mutual funds in general.

[23] We lose several fiscal year observations because of insufficient data, namely because only one fund was offered and/or only one year of data. This reduction in the sample also causes slight differences in some of the alpha results reported in Panel B of Table 9 from those reported earlier in Table 3.

differs from the performance obtained using participant weights at a statistically significant level on the basis of either a matched pair *t* test or a binomial test. However, placing 1/*N* in each investment choice outperforms participant portfolios for 31 out of 38 plans, and the results are close to statistically significant at the 0.05 level.[24]

Examination of the Sharpe ratio would suggest that participants in aggregate bring no special expertise to bear in choosing among investment choices and that the most naïve rule of all, putting equal amounts in each investment choice, does at least as well and probably better than participants' choices.

b. Excess Risk-Adjusted Return

If the participant has assets outside of a plan, then he or she may be more concerned with alpha (return after correction for systematic risk). Alpha is defined in earlier sections of this paper. The results from examining portfolio alphas are presented in Panel B in Table IX, Parts 1 and 2. Part 1 of Panel B presents the results when a company's own stock is included as an investment choice; Part 2 of Panel B presents the results when a company's own stock is excluded as an investment choice.

It is clear from this table, whether we include or exclude company stock, that the participants' weighting produces a lower alpha than any of the naïve portfolio selection rules. Once again, with one exception, the differences in alpha are not significant at the 5% level. The exception is where employing past alphas in the weighting leads to a portfolio that outperforms other rules.[25]

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[24] These tests were repeated, leaving out the companies' own stocks as an investment category. The tests are less relevant in this case, because the Sharpe ratio assumes that the portfolio being evaluated is the total holdings of a participant. Nevertheless, for completeness we examined this case. There were no substantial changes in the results.

2. Measuring the Performance of the Change in Weights

An alternative way to measure participant performance is to examine the impact of participants' changes in allocation over time.

For each year *t* of a plan we computed the weights at the beginning of the year (old portfolio) and the end of the year (new portfolio). The ending year weights incorporate any changes in participant allocations over the year. If a fund was dropped or added during the year, it was excluded from the computation of both the beginning and ending weights. All weights were scaled to add to one.

To measure the change in Sharpe ratio we computed a return series using the weights on the old and new portfolio. We applied the relevant weights to the monthly return series in the year after the new portfolio was formed. This gave us two sequences of monthly returns where the weights change annually, one using the beginning-of-year weights and one using the end-of-year weights. For each of these series we computed the Sharpe ratio for the new portfolio minus the old portfolio. The average difference in Sharpe ratios (0.008) is insignificantly different from zero, as is the number of plans (22 out of 38) where the new weights are better than the old.

To measure the change in alpha due to the participant's change in weights, we computed the alpha in year *t*+1 on the new and old portfolios. Alpha is the alpha on a three-year regression using data starting at the beginning of year *t*+1 plus the year *t*+1 average monthly residuals.[26] Measuring performance as the difference between the performance of the old and new portfolios closely parallels the measure developed by Grinblatt and Titman (1989 and 1993). We computed

[25] This is consistent with previous portfolio selection rules in the literature. See, for example, Elton, Gruber and Blake (1996). The reason this rule does not do better when comparing using Sharpe ratios is because the portfolios selected by this rule tend to have higher residual risk.

[26] If we did not have a full three years subsequent to year *t*, we still used three years of data to estimate alpha going back in time as far as necessary.

this measure using only mutual fund choices and using mutual fund choices along with company stock. The alpha on the new portfolio minus the old portfolio both with company stock as an investment choice (0.032) and without company stock as an investment choice (0.004) indicates that the new portfolio has higher alpha than the old portfolio. However, neither of the differences is close to statistically significant. Furthermore, the magnitude of the entry with company stock as an investment choice is mostly determined by a single plan year where the company stock for that plan more than tripled and the shareholders had increased their investment in the prior year.

F. The Effect of Company Contributions in the Form of Company Stock

There are 14 plans where all or almost all of the company contributions are in the form of company stock in every year.[27] There are five plans where in some years the company contributions are in the form of company stock and in other years they are not, and 22 plans where the contributions are across all categories.

In all plans, participants in the aggregate had a median investment in company stock larger than they did in other accounts. However, the form of the contribution clearly affected the amount invested in company stock. If the company's contribution was in the form of company stock, the participants held in company stock a median of 2.76 times the average amount invested in all funds. If the company always allocated its contributions across all accounts, the participants held in company stock a median 1.31 times the average amount invested in other investment choices.

Even when the company's contribution was in the form of company stock, participants still added additional money to the stock account. Their contributions and transfers (separate

[27] We used contributions of more than 70% as a definition of a company making contributions in the form of company stock. However, in almost all cases it was 100%.

from company contributions) have a median value of 43% of the average amount added to all accounts. This is less than the 74% added by participants in plans where company contributions were not limited to company stock. Thus, participants as a group invest more in company stock than other investment choices, and if the company's contribution is in the form of company stock, participants still add a significant amount to company stock.

V. CONCLUSIONS

The actions of plan administrators are vitally important to plan participants, since for over 60% of the plan participants, the 401(k) plan assets represent their sole financial assets outside of a bank account. In addition, for many plan participants that have other investments, the 401(k) investment represents the majority of their financial wealth. In this study we examined both how well plan administrators select funds given that they wish to offer funds of a certain ICDI investment objective classification and how participants react to the decisions of plan administrators.

Looking first at the actions of plan administrators, we find that on average they select funds that underperform passive portfolios with the same risk but outperform randomly selected funds from the same ICDI category. Plan administrators show less skill in replacing or adding funds. Managers add funds that have performed well in the past and drop funds that have performed poorly. In addition, the funds they add are in ICDI categories that have performed well in the past relative to other ICDI categories (hot sectors). However, after the plans make a change, the preponderance of evidence is that deleted funds did better than added funds, although the differences are not statistically significant. This is true whether we examine the overall sample, the sub-sample of plans where the added fund is in the same classification as the deleted fund, or the sub-sample of plans that changed all their funds at once.

There seem to be differences in skill at selecting funds by plan administrators. This is true when we examine performance over the full period. It is also apparent when we examine whether past performance of plans predicts future performance. Similar to prior studies, the principal predictive power is with the poorer performing plans. Bad performance predicts bad performance.

We next turned to the decisions of plan participants given the choices they are offered. We started by examining the source of changes in participant allocation. We found that the sum of transfers and contributions was almost exactly equal to the impact of returns in determining the change in participant weights. Surprisingly, the change in weights due to transfers was more than twice as strong as the influence of contributions and close to the influence of returns.

Participants change their allocations depending on past and current returns on their choices. Participants increase their allocation to funds that have done well in the past and in the concurrent period. Since participant allocations to better-performing funds increase simply due to relative returns, a greater allocation of contributions and transfers to these funds accentuates the effect of returns on asset allocation. Plans where matching contributions are in the form of company stock result in participants having almost three times as much invested in company stock as they do in the average account. For plans where company contributions are in the form of company stock, participants still make substantial transfers and contributions into company stock. Participants put less into new offerings than they do into established offerings, especially if the new offering is a type of fund not offered before.

Finally, we examine whether in the aggregate plan participants allocate investments in a manner that leads to better performance than simply investing equally in each fund offered. We find no evidence to support participant allocations being superior or inferior to equal investment

allocations. Thus the principal factor affecting the performance of participant 401(k) portfolios is the set of investment choices offered.

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Table I

401(k) Plan Sample

Number of 401(k) Plans	43
Number of Plan Years	289
Number of Unique Funds Held	141
Number of Funds Initially Held	116
Number of Funds Added	215
Number of Funds Deleted	45

Note:
This table shows the number of 401(k) plans in the sample, the total number of plan fiscal years in the sample, the number of unique mutual funds held across all plans in the sample, the total number of funds held by the 43 sample plans in the first year each plan enters our sample, the number of funds added by the sample plans, and the number of funds dropped by the sample plans.

Table II
3-Year 401(k) Plan Performance Results (Monthly Alphas)

		Using Equal Weights on Funds in Plan		Using Participant Weights on Funds in Plan	
Plan	No. of Years	3-year Alpha	3-Year Differential Alpha	3-year Alpha	3-Year Differential Alpha
1	8	0.075%	0.169%	0.117%	0.202%
2	7	0.025%	0.074%	0.032%	0.121%
3	7	0.039%	0.099%	0.028%	0.096%
4	8	-0.091%	-0.036%	-0.208%	-0.126%
5	6	-0.035%	0.097%	-0.051%	0.093%
6	7	-0.076%	-0.002%	-0.050%	0.023%
7	5	-0.070%	0.012%	-0.080%	0.014%
8	7	0.092%	0.115%	0.126%	0.142%
9	8	-0.064%	-0.011%	-0.064%	-0.029%
10	7	0.057%	0.111%	0.062%	0.094%
11	4	-0.070%	0.053%	-0.079%	0.033%
12	6	0.021%	0.075%	0.002%	0.055%
13	7	-0.058%	-0.014%	-0.124%	-0.083%
14	8	-0.036%	-0.014%	-0.061%	-0.004%
15	7	0.020%	0.088%	-0.009%	0.083%
16	7	-0.071%	-0.018%	-0.056%	0.016%
17	7	-0.055%	0.019%	-0.070%	0.008%
18	8	0.059%	0.109%	0.005%	0.089%
19	8	-0.072%	-0.013%	-0.084%	-0.041%
20	4	-0.049%	0.074%	-0.052%	0.119%
21	5	-0.020%	0.106%	-0.019%	0.113%
22	5	0.043%	0.190%	0.107%	0.271%
23	4	-0.481%	-0.333%	-0.399%	-0.254%
24	5	-0.002%	0.165%	-0.012%	0.163%
25	7	0.120%	0.152%	0.129%	0.166%
26	7	0.034%	0.088%	0.006%	0.081%
27	7	-0.001%	-0.030%	-0.021%	0.017%
28	8	0.111%	0.161%	-0.012%	0.071%
29	4	0.002%	0.103%	-0.032%	0.097%
30	6	-0.164%	-0.038%	-0.164%	-0.038%
31	4	0.170%	0.029%	0.170%	0.029%
32	8	-0.043%	0.006%	-0.045%	0.000%
33	8	0.078%	0.141%	0.087%	0.137%
34	8	0.035%	0.081%	-0.031%	0.019%
35	7	0.061%	0.099%	0.077%	0.151%
36	7	-0.128%	-0.017%	-0.115%	-0.010%
37	8	-0.054%	0.006%	-0.047%	0.003%
38	9	-0.055%	0.056%	-0.035%	0.072%
39	8	0.053%	0.119%	-0.020%	0.065%
40	8	-0.003%	0.051%	-0.056%	0.030%
41	8	-0.068%	-0.018%	-0.148%	-0.099%
42	7	-0.001%	0.027%	-0.074%	-0.003%
43	5	-0.464%	-0.295%	-0.570%	-0.396%
Average	6.721	-0.026%	0.043%	-0.043%	0.037%
Two-Tail *p*-Value		0.161	0.009	0.034	0.040

Notes: This table shows plan performance results using weighted averages of monthly alphas calculated over a 3-year regression period. One weighted average uses equal weights in all choices in a given plan's fiscal year; the other weighted average uses participant's actual weights at the end of a given fiscal year. For each fiscal year in a plan and for each fund in the plan for that year, a fund's 3-year alpha is the intercept from a 36-month multi-index regression of the fund's monthly excess returns on a set of indices determined by the fund's type (stock, bond or international), starting in the month following the fiscal year end. (See text for regression model details.) Differential alpha is the fund's alpha minus the average alpha of funds in the matched size decile from a random sample of funds with the same investment objective as plan's fund.

Table III
1-Year 401(k) Plan Performance Results (Monthly Alphas)

		Using Equal Weights on Funds in Plan		Using Participant Weights on Funds in Plan	
Plan	No. of Years	1-year Alpha	1-Year Differential Alpha	1-year Alpha	1-Year Differential Alpha
1	8	-0.052%	0.104%	-0.047%	0.119%
2	7	-0.051%	0.081%	-0.044%	0.123%
3	7	-0.044%	0.100%	-0.030%	0.123%
4	8	-0.171%	-0.074%	-0.345%	-0.202%
5	6	-0.062%	0.066%	-0.090%	0.055%
6	7	-0.080%	0.055%	-0.056%	0.099%
7	5	-0.204%	0.012%	-0.111%	0.087%
8	7	0.017%	0.101%	0.006%	0.102%
9	8	-0.133%	-0.033%	-0.177%	-0.080%
10	7	0.003%	0.104%	0.032%	0.111%
11	4	-0.163%	-0.013%	-0.174%	-0.035%
12	6	-0.058%	0.101%	-0.058%	0.105%
13	7	-0.140%	-0.020%	-0.258%	-0.126%
14	8	-0.089%	-0.011%	-0.111%	0.008%
15	7	-0.022%	0.101%	-0.035%	0.121%
16	7	-0.143%	-0.008%	-0.083%	0.089%
17	7	-0.130%	0.020%	-0.111%	0.066%
18	8	-0.021%	0.091%	-0.029%	0.119%
19	8	-0.093%	-0.014%	-0.064%	0.034%
20	4	-0.054%	0.036%	-0.041%	0.084%
21	5	-0.025%	0.062%	-0.024%	0.069%
22	5	-0.113%	0.199%	-0.109%	0.223%
23	4	-0.453%	-0.420%	-0.300%	-0.270%
24	5	-0.014%	0.135%	-0.014%	0.143%
25	7	0.049%	0.141%	0.050%	0.161%
26	7	-0.020%	0.127%	-0.039%	0.130%
27	7	0.001%	0.035%	-0.019%	0.098%
28	8	0.037%	0.166%	-0.040%	0.130%
29	4	-0.021%	0.076%	-0.002%	0.111%
30	6	-0.138%	-0.059%	-0.138%	-0.059%
31	4	0.228%	0.106%	0.228%	0.106%
32	8	-0.122%	-0.023%	-0.165%	-0.036%
33	8	0.004%	0.104%	-0.010%	0.105%
34	8	0.012%	0.079%	-0.081%	-0.005%
35	7	-0.019%	0.079%	-0.023%	0.132%
36	7	-0.155%	0.006%	-0.173%	0.020%
37	8	-0.106%	-0.003%	-0.092%	0.018%
38	9	-0.102%	0.005%	-0.058%	0.041%
39	8	0.019%	0.146%	-0.036%	0.135%
40	8	-0.014%	0.083%	-0.081%	0.057%
41	8	-0.169%	-0.061%	-0.310%	-0.190%
42	7	-0.133%	-0.017%	-0.136%	0.025%
43	5	-0.492%	-0.255%	-0.576%	-0.365%
Average	6.721	-0.080%	0.035%	-0.093%	0.041%
Two-Tail *p*-Value		0.000	0.038	0.000	0.029

Notes: This table shows plan performance results using weighted averages of monthly alphas over a 1-year period. To obtain 1-year monthly alphas for each fiscal year in a plan and for each fund in the plan for that year, the intercept from a 36-month multi-index regression of the fund's monthly excess returns on a set of indices determined by the fund's type (stock, bond or international), starting in the month following the fiscal year end, is added to the average monthly residual over the first 12 months of the regression period. One weighted average uses equal weights in all choices in a given plan's fiscal year; the other weighted average uses participant's actual weights at the end of a given fiscal year. Differential alpha is the fund's alpha minus the average alpha of funds in the matched size decile from a random sample of funds with the same investment objective as plan's fund.

Table IV

Fund Performance Before and After Being Added or Dropped (Monthly Data)

Panel A: Before Being Added or Dropped

Added Funds (200)	Differential Return	Alpha	Differential Alpha
1 year	0.140%	-0.039%	0.000%
3 year	0.186%	0.070%	0.055%
Dropped Funds (44)			
1 year	0.032%	-0.215%	-0.112%
3 year	-0.042%	-0.193%	-0.139%
Added minus Dropped Funds			
1-Year Difference	0.108%	0.176%	0.112%
(*p*-Value)	(0.089)	(0.001)	(0.018)
3-Year Difference	0.228%	0.263%	0.194%
(*p*-Value)	(0.000)	(0.000)	(0.000)

Panel B: After Being Added or Dropped

Added Funds (214)	Differential Return	Alpha	Differential Alpha
1 year	0.006%	-0.131%	0.004%
3 year	0.139%	0.015%	0.053%
Dropped Funds (43)			
1 year	0.183%	-0.063%	0.087%
3 year	0.073%	-0.039%	0.016%
Added minus Dropped Funds			
1-Year Difference	-0.177%	-0.068%	-0.083%
(*p*-Value)	(0.102)	(0.324)	(0.209)
3-Year Difference	0.066%	0.054%	0.037%
(*p*-Value)	(0.300)	(0.483)	(0.569)

Notes:

For each plan year in which a fund is added or dropped, "before" and "after" performance measures are calculated going backward or forward from the month in which the fund is added or dropped.

The differences in the number of added and dropped funds in the "before" and "after" samples are due to insufficient data for some funds in the sample groups.

Differential return is each fund's average monthly return minus the average monthly return of a random sample of funds with the same investment objective.

Alpha is the intercept from a multi-index regression of the fund's monthly excess returns on a set of indices determined by fund's type (stock, bond or international). (See text for regression model details.) The 1-year alpha is the fund's 3-year alpha plus the average monthly residual over the relevant period.

Differential Alpha is each fund's alpha minus the average alpha of funds in the matched size decile from a random sample of funds with the same investment objective.

Table V

Performance of 401(k) Plans that Changed All Fund Offerings in a Given Year (Monthly Data)

	Past Performance			Future Performance					
	Using Equal Weights on Funds in Plan			Using Equal Weights on Funds in Plan			Using Participant Weights on Funds in Plan		
	Alpha	Diff. Alpha	Sharpe Ratio	Alpha	Diff. Alpha	Sharpe Ratio	Alpha	Diff. Alpha	Sharpe Ratio
Added									
1 Year	-0.065%	-0.003%	0.325	-0.222%	-0.103%	0.393	-0.204%	-0.030%	0.406
3 Year	0.049%	0.061%	0.309	-0.026%	0.028%	0.223	0.001%	0.065%	0.246
Dropped									
1 Year	-0.212%	-0.110%	0.283	-0.090%	0.043%	0.479	-0.099%	0.035%	0.492
3 Year	-0.167%	-0.109%	0.257	-0.093%	-0.003%	0.253	-0.099%	-0.020%	0.257
1-Year Difference	0.147%	0.107%	0.042	-0.132%	-0.146%	-0.086	-0.105%	-0.065%	-0.086
(*p*-Value)	(0.041)	(0.063)	(0.181)	(0.262)	(0.194)	(0.220)	(0.414)	(0.627)	(0.203)
3-Year Difference	0.216%	0.170%	0.052	0.067%	0.031%	-0.030	0.100%	0.085%	-0.011
(*p*-Value)	(0.000)	(0.000)	(0.064)	(0.487)	(0.712)	(0.261)	(0.422)	(0.444)	(0.679)

Notes: Participant-weighted averages are value-weighted averages based on percentage of total plan amount invested in each fund in a plan for a given year.

Future 3-year alpha is intercept from multi-index regression over 36-month period starting in month following FYE month that fund was added or dropped; future 1-year alpha is future 3-year alpha plus average monthly residual over the 12-month period starting in month following FYE month that fund was added or dropped. Past 3-year alpha is intercept from multi-index regression over 36-month period ending in FYE month; past 1-year alpha is past 3-year alpha plus average monthly residual over the 12-month period ending in FYE month that fund was added or dropped. (See text for regression model details.)

Differential alpha is the fund's alpha minus the average alpha of funds in the matched size decile from a random sample of funds with same investment objective as plan's fund.

Future 3-year Sharpe ratios are calculated over 36-month period starting in month following FYE month that fund was added or dropped; future 1-year Sharpe ratios are calculated over 12-month period starting in month following FYE month that fund was added or dropped. Past 3-year Sharpe ratios are calculated over 36-month period ending in FYE month; past 1-year Sharpe ratios are calulated over 12-month period ending in FYE month.

p-values are from matched-pair *t* tests. Future performance *p*-values are from 2-tail tests; past performance *p*-values are from 1-tail tests.

Table VI

Predictability of Future Performance from Past Performance

Panel A: Past and Future Performance Quartiles

		Future Performance Quartiles				Average Future
		1 (lowest)	2	3	4 (highest)	Differential Alpha
Past	1 (lowest)	0.338	0.265	0.235	0.162	-0.024%
Performance	2	0.203	0.297	0.216	0.284	0.040%
Quartiles	3	0.162	0.203	0.419	0.216	0.063%
	4 (highest)	0.254	0.254	0.197	0.296	0.061%

Panel B: Past and Future Non-Positive and Positive Performance

		Future Performance		Average Future
		non-positive	positive	Differential Alpha
Past	non-positive	0.3960	0.6040	0.026%
Performance	positive	0.3986	0.6014	0.047%

Notes:
Plan performance for a given year is measured using the average 1-Year differential monthly alpha of the funds in the plan that year, where a fund's monthly differential alpha is the fund's 1-year monthly alpha minus the average 1-year monthly alpha of funds in the matched size decile from a random sample of funds with same investment objective as plan's fund.

The table shows both the probabilities of plans being in future performance groups, conditional on being in a past performance group, and the average future performance of plans in past performance groups.

All results are calculated over 287 plan years. (Two plan years in 1999 were dropped from sample of 289 plan years since only 2 plans were in 1999 sample.)

Table VII
Sources of Changes in Participant Allocations

	$\Delta X^R > 0$	$\Delta X^R \leq 0$
$\Delta X^{C+T} > 0$	541	381
$\Delta X^{C+T} \leq 0$	245	476

Notes:
ΔX^R is the change in the allocation for a given choice in a given fiscal year of a given 401(k) plan due solely to returns on the investment choice during the fiscal year.

ΔX^{C+T} is the change in the allocation for a given choice in a given fiscal year of a given 401(k) plan due solely to contributions and interfund transfers in the investment choice during the fiscal year.

The cells in the table show the numbers, out of 1,683 observations, of positive and nonpositive changes in allocation due to returns and contributions plus interfund transfers.

Table VIII
Allocations to New Investment Choices
(excluding company stock and employer contributions)

	1		2		3		4		5		6	
	All New Funds		New Fund of Existing Type		New Fund is a Replacement for a Fund of Same Type		New Fund is an Additional Fund of an Existing Type		New Fund of New Type		Multiple New Funds Offered	
Year	Obs	Median	Obs	Median	Obs	Median	Obs	Median	Obs	Median	Obs	Median
1	184	0.83	133	0.92	48	1.28	85	0.80	51	0.58	30	1.05
2	150	0.83	107	1.13	35	1.29	72	1.00	43	0.59	29	0.95
3	90	0.86	63	1.25	20	1.46	43	1.19	27	0.44	17	0.99
4	72	0.77	50	1.31	14	0.97	36	1.39	22	0.47	15	0.88

Notes:
Allocations are expressed as a fraction of the allocation that would prevail if the allocation to the new fund was equal to the average allocation across all funds in the plan that year. Columns 3 and 4 are breakdowns of column 2 into two subcategories.

Table IX
Participant Portfolio Performance versus Naïve Selection Rules

Panel A: Sharpe Ratios

Portfolio Selection Rule	Sharpe Ratio	*t* Statistic of Naïve Rule Minus Participant-Weights Rule Sharpe Ratios	Number of Plans where Naïve Rule Outperforms Participant-Weights Rule (Total 38 Plans)
Participant Weights	0.249		
1/*N* in Each Investment Choice	0.274	1.81	30
1/*N* in Top Half of Past Performance	0.251	0.13	19
1/*N* in Each Category	0.241	-0.51	20

Panel B: Alphas

Part 1: With Company Stock

Portfolio Selection Rule	Alpha	*t* Statistic of Naïve Rule Minus Participant-Weights Rule Alphas	Number of Plans where Naïve Rule Outperforms Participant-Weights Rule (Total 38 Plans)
Participant Weights	-0.078		
1/*N* in Each Investment Choice	-0.022	1.54	22
1/*N* in Top Half of Past Performance	0.071	2.01	23
1/*N* in Each Category	-0.001	1.63	20

Part 2: Excluding Company Stock

Portfolio Selection Rule	Alpha	*t* Statistic of Naïve Rule Minus Participant-Weights Rule Alphas	Number of Plans where Naïve Rule Outperforms Participant-Weights Rule (Total 38 Plans)
Participant Weights	-0.108		
1/*N* in Each Investment Choice	-0.093	1.02	21
1/*N* in Top Half of Past Performance	-0.061	2.37	26
1/*N* in Each Category	-0.083	1.47	24

Notes:
This table compares the performance over time using actual participant weights across investment choices in a given 401(k) plan to the performance using various "naïve" portfolio selection rules. Performance is measured using both Sharpe ratios and alphas. Monthly returns are used, with plan portfolios rebalanced every fiscal year. For Sharpe ratios, given a portfolio selection rule, starting in the month after the end of a plan's fiscal year, the end-of year weights are applied to the 12 monthly returns of the investment choices; the overall portfolio time series starting in the month following the end of a plan's first available fiscal year and ending 12 months after the end of a plan's last available fiscal year is then used to calculate a Sharpe ratio for the plan. For alphas, for each investment choice in a plan, a 36-month regression of the investment choice returns on a set of indices is run, starting in the month following the end of a plan's fiscal year. A "1-year" alpha is then calculated by adding the average of the first 12 monthly residuals to the intercept from the regression. Given a portfolio selection rule, the weights at the end of plan's fiscal year are applied to the 1-year alphas of the investment choices in the plan to obtain an overall portfolio 1-year alpha for the plan following the end of the fiscal year. The fiscal-year-portfolio 1-year alphas are then averaged across all available fiscal years to get an average 1-year alpha for a given plan. See the text for the regression models used.