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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 for 401(k) plans 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 although they do not outperform index funds of the same type. When administrators change offerings, they choose funds that did well in the past, but, after the change, added funds do no better than dropped funds. Plan participants in aggregate change their allocation decisions in a way that accentuates the changes in allocation caused by returns. The change in allocation due to the investment of new money and interfund transfers is about the same size, and in the same direction, as the change due to returns. Participant allocations in aggregate do no better than naïve allocation rules, such as equal investment in each offering.

JEL classification: G11; G14; G23; H31

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1. Introduction

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

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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) Individual participants tend to hold three to four funds independent of the number offered (Huberman and Jiang, 2006).
(2) In contrast to the above result, some researchers have presented evidence that suggests that investors tend to spread their investment evenly across the funds offered. This is referred to as the "$1/N$ Rule" (see Benartzi and Thaler, 2001; Liang and Weisbenner, 2002).
(3) Investors over-invest in stock of the company for which they work (see Huberman and Jiang, 2006; Huberman and Sengmuller, 2004; Agnew and Balduzzi, 2002; Benartzi, 2001).
(4) Investors infrequently revise their allocations (Ameriks and Zeldes, 2001; Madrian and Shea, 2001; Agnew and Balduzzi, 2002; Agnew et al., 2003; Mitchell et al., 2005a).
(5) Equity allocations are related to cohort and age (Ameriks and Zeldes, 2001; Agnew and Balduzzi, 2002).
(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 et al. (2006) examined whether the choices offered to participants included the right categories of investments. The authors show that approximately one half of the pension funds they examine do not offer sufficient categories of investments. That paper left largely unexplored whether, given the categories of investments offered, the individual choices offered by plan administrators in each category were good investments per se, and how plan participants reacted 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 dropped. Second, given the choices offered, to explore aspects of aggregate participant reactions not previously studied. As discussed in later sections of this paper, participant behavior has implications for plan design, investor education and where the administrator should allocate resources.

The remainder of this paper is divided into four sections. In the next section (Section 2), we discuss the data used in this study. In the third 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 dropped, and whether there are plan administrators who consistently offer their participants funds with superior performance. In

[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.

the fourth section we explore aggregate participants' reactions to the choices offered. The final section presents our major conclusions.

2. 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 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 (some of the 1994 reports include data for earlier years as well) and that used publicly available mutual funds as choices offered to participants. We traced the sample through 1999.[2] Many 11-K reports only contain data at some aggregate level (e.g., stocks, bonds, or Fidelity funds) rather than at the individual mutual fund level. Since we needed data at the individual fund level, we restricted our sample to 11-K reports that contained such data. From this sample, we excluded a few plans where the participant flows could not be identified, usually because the plan merged. We also excluded plans that offered non-public stock or bond funds. Finally, we excluded a few plans that had less than four years of contiguous data or where the plan was a duplicate of another plan already in our sample. This left us with a sample of 289 plan years.[3]

To gain some understanding of whether the plans in our sample are representative of firms filing 401(k) reports, we can compare the average plan assets of the average firms in our sample for the year 1998 with the average plan and size for 1998 found in a larger sample of 401(k) plan assets for plans filing 11-K reports (Liang and Weisbenner, 2002). For the 43 plans in our sample we found an average asset size in 1998 of $310 million, while, for the 667 plans in their 1998 sample, Liang and Weisbenner (2002) found an average asset size of $411 million. There does not seem to be a difference with respect to plan size.[4]

As shown in Table 1, the 289 plan years represented 43 plans, most of which had seven years of data.[5] Over these 289 plan years, 215 funds were added and 45 were dropped. This represents close to one addition per plan per year and as many dropped funds as there were plans. Examining the 43 plans reveals that 35 plans added at least one mutual fund and 14 plans dropped at least

[2] Data are not available beyond 1999 due to changes in SEC electronic filing requirements. There were too few companies reporting data to start earlier than 1994. The 1994 reports include data for 1993, and some provide data as far back as 1991, providing us with at least an extra year of data.

[3] The details behind our sample are as follows. There were 812 11-K filings in 1994. Of these, 102 were potentially useful. The principal reasons for a filing not being useful were that the company reported data at an aggregate level (e.g., bond funds) or the company did not identify the specific investment choices by name, only by type. In addition, some plans held non-public funds. Seventeen of the 102 plans were duplicates of others in the sample, resulting in 85 potential plans. We then traced these plans through to the end of the data set. Two were dropped because of inconsistent data across years that could not be reconciled, and 24 were dropped either because they aggregated data, they did not identify funds in subsequent years, or they added non-public funds. The sample contains pension funds from a diverse set of industries. The sample contains firms in all one-digit SIC codes except agriculture and public administration. At a three-digit level, one SIC group has four members and three groups have two. All other three-digit SIC codes have no more than one pension fund in our sample.

[4] The major reason our sample size is much smaller is because we required plans to identify the individual investment choices offered to participants; many plans did not. Since only plans offering company stock are required to file 11-K reports, our study represents a sample of this type of plan.

[5] 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 et al. (2006). 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.

Table 1
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.

one mutual 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 stock held by pension plans, we obtain monthly returns from CRSP.[6] Second, we obtain monthly returns on indexes from CRSP, 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.

3. Performance

We examine three aspects of performance in this section of the paper: whether, given the type of funds offered, 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.

3.1. 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:

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

[6] 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 et al., 2001).

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 period 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.[7] 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 and 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.[8] 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 et al. (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 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 Citigroup Non-Dollar World Government Bond index. The first three indexes are supported by the work of Blake et al. (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.

[7] See Blake et al. (1993), Elton et al. (1996), Grinblatt and Titman (1989), Jensen (1968), Sharpe (1966), and Chen et al. (2000).

[8] 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.

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 Citigroup 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 date of the 11-K report.

A few of the funds (5 out of 1396 that were held in our sample of plans) 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 betas. To compute an adjusted alpha we took a weighted average of the three year alpha on the fund plus average residuals over the relevant period (the period subsequent to the 11-K report and before the fund merged), 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. This involves an equal weighting of each fund in the plan. Second, we weight the funds unequally using the actual weights chosen by participants as shown in the 11-K statement. This is an appropriate criterion for plan administrators, if they forecast correctly which types of funds participants will invest in and allocate more of their effort to selecting individual funds of those types. 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 2 shows the results for three-year alphas, and Table 3 shows the results for one-year alphas.

Tables 2 and 3 present data on the selection ability of pension fund administrators.[9] First note that the alphas for the average plan are negative, consistent with results found for mutual funds in other studies. The magnitude of these negative alphas is larger than normal expenses for low-cost index funds, suggesting that performance would be improved if passive funds had been substituted for the active funds which were selected. However, examining differential alpha, 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 2 shows that, using equal weights for the funds in each plan, over a three-year period plan administrators had an average differential alpha over funds of the same type, size and risk of 4.3 basis points per month, or approximately 52 basis points per year. As shown in Table 3, over a one-year period the equal-weighted differential alpha is 3.5 basis points per month, or approximately 42 basis points per year. Both of these differential alphas 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 the one-year differential alpha is positive for 29 out of 43 plans.

[9] 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.

The last two columns of Table 2 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

Table 2
3-Year 401(k) plan performance results (monthly alphas)

Plan	No. of years	Using equal weights on funds in plan		Using participant weights on funds in plan	
		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%

(*continued on next page*)

Table 2 (*continued*)

Plan	No. of years	Using equal weights on funds in plan		Using participant weights on funds in plan	
		3-year Alpha	3-year Differential alpha	3-year Alpha	3-year Differential alpha
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 more 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.

weight the funds selected, and thus devoting more effort to 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.[10]

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.[11]

It is clear from these results that plan administrators possess some skill in selecting funds for their plans.[12] 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 participants in the aggregate fare appears to be the choices that the participants are offered.

[10] In an earlier study Elton et al. (2006) examine whether 401(k) pension plans offer participants an adequate number of choices. The advantage of the sample used in the earlier paper is that it covers a larger number of funds and plans than the sample used in this current paper. The major disadvantages are that the earlier sample's data were only available for one year, the data were self reported to a data purveyor, and the data contained no information on participant holdings or changes in those holdings. Despite the differences in the samples and the manner in which the data were aggregated, we could estimate differential alphas over a 27-month period for the earlier sample. The average differential alpha was 0.031, which is consistent with the 0.035 differential alpha for 1 year and 0.043 for 3 years found in this study.

[11] 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.

[12] 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.

Table 3
1-Year 401(k) plan performance results (monthly alphas)

Plan	No. of years	Using equal weights on funds in plan		Using participant weights on funds in plan	
		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%

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Table 3 (*continued*)

Plan	No. of years	Using equal weights on funds in plan		Using participant weights on funds in plan	
		1-year Alpha	1-year Differential alpha	1-year Alpha	1-year Differential alpha
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.

3.2. 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 dropped. 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 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 4 presents data on funds that were added or dropped for the one- and three-year periods prior to that change.[13] A fund is considered dropped at the beginning of the first year it does not appear in the 11-K annual statement; it is considered added at the end of the first year in which it appears in the 11-K annual statement. For measuring performance prior to a fund being added or dropped, we ran regressions ending one year prior to the fiscal year date in which the fund appeared or disappeared. The regression period covered a minimum of 18 months up to a maximum of 36 months.

From Table 4 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

[13] Several of the added and dropped funds shown in Table 1 were excluded due to insufficient data for accurately estimating alpha.

Table 4
Fund performance before and after being added or dropped (monthly data)

	Differential return	Alpha	Differential alpha
Panel A: Before Being Added or Dropped			
Added funds (193)			
1 year	0.251%	0.141%	0.115%
3 year	0.222%	0.190%	0.112%
Dropped funds (41)			
1 year	−0.024%	−0.137%	−0.077%
3 year	−0.028%	−0.124%	−0.119%
Added minus dropped funds			
1-year difference	0.275%	0.278%	0.192%
(*p*-value)	(0.000)	(0.000)	(0.001)
3-year difference	0.250%	0.314%	0.231%
(*p*-value)	(0.000)	(0.000)	(0.000)
Panel B: After Being Added or Dropped			
Added funds (193)			
1 year	0.008%	−0.142%	−0.022%
3 year	0.144%	0.010%	0.037%
Dropped funds (41)			
1 year	0.190%	−0.062%	0.086%
3 year	0.073%	−0.037%	0.014%
Added minus dropped funds			
1-year difference	−0.182%	−0.080%	−0.108%
(*p*-value)	(0.111)	(0.267)	(0.119)
3-year difference	0.071%	0.047%	0.023%
(*p*-value)	(0.285)	(0.558)	(0.739)

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

negative differential alphas both one year and three years before they were dropped. Except for the one year results for dropped funds, for both added and dropped funds the differential alphas are statistically significantly different from zero at the 5% level. Note that the difference in differential alpha between the added and dropped funds is statistically significant at the 1% level for the one- and three-year periods before the change. Also, the funds that were added have a differential alpha above those that were dropped of 23 basis points per month, or 276 basis points per year, for three years before the change and 19 basis points per month, or 228 basis points per year, for one year before the change. Table 4 also 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 monthly alpha is 1.8 basis points (significant at the 1% level). 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 4. Over three-year periods and one-year periods (starting in the month after the end of the fiscal year in which the fund appears or disappears), for all three measures of performance (differential return, alpha, and differential alpha), the performance of the added funds is no better than the performance of the dropped funds at any reasonable level of statistical significance, and none of the differential alphas are statistically significantly different from zero. Also note that the differential alpha of the added funds after they are added is worse than their performance before they are added, while the performance of the dropped funds is better after they were dropped compared to their performance before. These results are true for both the one- and three-year analyses, and the results are statistically significant at the 1% 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.

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.[14] Since this involved replacing an entire portfolio with another portfolio, an aggregate measure of performance is appropriate. To measure overall performance we calculated future Sharpe ratios for each plan using both equal weights and participant weights. Table 5 shows results both for one-year and three-year Sharpe ratios, assuming equal weights. Under either set of weights, the past Sharpe ratios are higher for the portfolio of added funds than for the portfolio of dropped

Table 5
Sharpe ratios of 401(k) plans that changed all fund offerings in a given year (monthly data)

	Before change	After change
Added		
1 year	0.325	0.393
3 year	0.309	0.223
Dropped		
1 year	0.283	0.479
3 year	0.257	0.253

Notes: Average Sharpe ratios are based on equal amount invested in each fund in a plan for a given year. Future 3-year Sharpe ratios are calculated over 36-month periods starting in the month following the fiscal year end (FYE) in which the fund was added or dropped; future 1-year Sharpe ratios are calculated over 12-month periods starting in the month following the FYE in which the fund was added or dropped. Past 3-year Sharpe ratios are calculated over 36-month periods ending in FYE month; past 1-year Sharpe ratios are calculated over 12-month periods ending in the FYE month.

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

funds, while, after replacement, the future Sharpe ratios are higher for the portfolio of dropped funds than for the funds that replaced them.[15]

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.

3.3. 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 6. To construct Table 6, 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 6 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 Table 6 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

Table 6
Predictability of future performance from past performance (past and future performance quartiles)

		Future performance quartiles				Average future differential alpha
		1 (lowest)	2	3	4 (highest)	
Past performance quartiles	1 (lowest)	0.338	0.265	0.235	0.162	−0.024%
	2	0.203	0.297	0.216	0.284	0.040%
	3	0.162	0.203	0.419	0.216	0.063%
	4 (highest)	0.254	0.254	0.197	0.296	0.061%

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.)

[15] Table 5 shows results where each fund in a plan was equally weighted; the results were very similar when funds were weighted using participant allocations.

from holding the bottom quartile of plans 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.[16]

While there is some predictability of future performance of plans from past performance, most of that comes from bad plan performance predicting bad plan performance.[17]

4. Aggregate 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 how participants behave in the aggregate given the choices they are offered. The advantage of our study is that we have information on participant behavior for a number of years and for plans offered by many different fund families. The disadvantage is that we analyze aggregate behavior rather than the behavior of particular participants. In this section we examine four issues that have not been examined before:

(1) How important are contributions, fund returns and transfers in determining changes in aggregate investment weights?
(2) Do participants in aggregate use contributions and transfers to restore their original weights, or do they accentuate the change in weights caused by investment returns?
(3) How do participants in aggregate react to new investment choices being offered?
(4) Do participants in aggregate make their contributions and transfers in a manner that improves their 401(k) performance?

In each of the sections that follow we discuss why the analysis we present is useful. However, before doing so we will present one example of the usefulness of our analysis.

In Section 4.4, we examine whether the actual allocation of all dollars in a plan outperforms simply assuming equal dollars are placed in each investment choice in the plan. This does not assume that any plan participant does this, but looks at the results of the collective decisions of all plan participants. Anticipating our results for the moment, the fact that the actual allocation of participant dollars does no better than the most naïve diversification rule of putting equal dollars in each investment choice means that participants' investments in aggregate add no information

[16] Some of the persistence in plan performance could be due to mutual fund persistence. Most of the bad future performance and persistence comes from the bottom decile. 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, dummy variables for the presence of money market funds and GICs, and a dummy variable representing whether or not the company offering the plan was a high-tech or financial firm. None of the variables' coefficients were close to being statistically significant except for the high-tech/financial firm dummy, which was significant at the 10% level.

[17] Research has shown that bad-performing mutual funds in one period tend to be bad-performing funds in the next period. Recall, however, that we are examining predictability of plans that are portfolios of funds, which, on average, outperform random selection. For this group, it is not clear without empirical evidence that bad performance of plans predicts future bad performance of plans.

to the decisions of plan administrators. This suggests that the individual choices offered by a plan administrator in the plan are very important because participants as a whole do not seem to be able to evaluate them. This is of key importance to plan administrators. This does not mean that using individual participant data is not important. Using individual participant data would allow identification of types of participants that are making better or worse choices and may yield insight on how to improve the process.

4.1. 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 interfund transfers. In this section we explore how great the change in investment weights is from each of these three sources. We examine each separately as well as a combination of transfers and contributions. These are combined because these changes, unlike changes due to return, are under the control of participants and plan administrators. 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

$$D^R_{it+1} = D_{it}(1 + R_{it}). \tag{1}$$

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

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

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^R_{it} for each plan divided by two, i.e., for any plan P:

$$\Delta X^R_{Pt} = \sum_{i=1}^{N} \left| \frac{\Delta X^R_{it}}{2} \right|. \tag{3}$$

This summation is the aggregate increase (or decrease) in weights for the plan.[18] 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 Eq. (1) is

$$D_{it+1}^{C+T} = D_{it} + C_{it} + T_{it}. \tag{4}$$

And, paralleling Eq. (2) and Eq. (3),

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

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

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 change in allocation of 3.85% with a median of 3.07%, while total contributions averaged 2.11% with a median of 1.63% and participant contributions averaged 1.84% with a median 1.60%. We report the numbers for participant contributions and employer contributions separately because the allocation of employer contributions is sometimes determined by the plan itself. Transfers were much more important than contributions in determining the change in allocation of plan participants and were almost as important as returns.[19]

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%, with respective medians of 3.6 and 3.0%. Computing change 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 with individual assets, transfers are about twice as important as contributions in accounting for changes in asset allocation.

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

[19] 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. The fact that participant contributions are important in affecting allocation can be due to two effects: changes in the allocation of continuing participants and differences in the contributions of both new participants and departing participants from the mean. Other studies (e.g., Huberman and Sengmuller, 2004) have pointed out that individual participants change their allocations infrequently, which suggests that participant turnover is an important determinant of participant allocations. However, the importance of transfers suggests that employees make active decisions with respect to their pension portfolio composition.

Mitchell et al. (2005b) have shown that transfers of the average participant in a 401(k) are a lot smaller than transfers in their brokerage account. We make a different comparison to judge importance. We look at the effect on asset allocation within the 401(k) account. Viewed this way, transfers are very important.[20]

We have now reestablished that contributions and transfers and returns are important influences in determining changes in aggregate investor allocation. Next we examine whether they tend to reinforce each other or cancel each other out in determining the change in weights.

4.2. Participants' reaction to return in the aggregate

In this section we examine whether participants in aggregate change their allocations in a way that accentuates or decreases the change in allocation due to returns over the same period.[21] 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 examine whether participants in aggregate change their allocations to restore weights toward starting values by decreasing their contributions to choices which have had unusually high returns, or whether they tend to put more money in the categories with high returns, thereby amplifying the impact of returns on relative investment weights.[22]

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 a high return on an investment choice in a current period predicts a high return next period.

If the dollars invested by the aggregate participants follow return in a way that accentuates the effect of returns on portfolio weights, management clearly has to devote more resources to education. 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} (Eqs. (2) and (5) in the prior subsection).

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 7, 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 1643 investment allocations. It is clear from this table that participants in aggregate allocate their contributions and transfers in a way that causes their investment weights to change in the same direction as return.[23]

[20] Mitchell et al. look at the behavior of the average investor. When we are looking at aggregate data we are implicitly weighting each investor by the fraction their plan assets represent of total plan assets. We are looking at the behavior of the average dollar in a plan, not the average investor.

[21] The variable we use to examine participants' actions is participant plus company contributions and participant transfers. We refer to this as "participant allocation," since company contributions can be changed due to participant transfers.

[22] Agnew and Balduzzi (2005) study participants' reactions to daily returns. Here we are studying reactions over the year. There is a related literature on mutual funds that investors swap poor-performing funds for good-performing funds. Our analysis is different because we are examining changes in aggregate investor weights.

[23] 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.

Table 7
Sources of changes in participant allocations

	$\Delta X^R > 0$	$\Delta X^R \leqslant 0$
$\Delta X^{C+T} > 0$	541	381
$\Delta X^{C+T} \leqslant 0$	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 1683 observations, of positive and non-positive changes in allocation due to returns and contributions plus interfund transfers.

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 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 from contributions and transfers and concurrent 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.

Why should a plan administrator care about how participants react to differential returns on the investment choices? Modern investment theory suggests that investment weights should remain constant or change slowly over time. The fact that participants in aggregate use contributions and transfers to accentuate the change in weights caused by returns suggests that this is one area where education is important, at least for a large number of participants.

4.3. 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 the average contribution and transfer to all of the funds a plan offers. 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 8 shows the median transfers and contributions to a new fund expressed as a fraction of the contributions and transfers to the average fund 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.[24]

Over all funds, the median contribution and transfers to a new fund is about 83% of the contribution and transfers 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. When a fund is replaced with a new fund of the same type, some plans have an automatic transfer from the old fund to the new fund unless the participant specifies otherwise. Therefore, 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 in the new fund. When a fund was a net addition, the participants initially put less than average in the new fund, though by the third year the amount placed in the fund had risen to more than the new flows into the average fund. 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.

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 into the average fund.

Why might a plan administrator care about how investors react to new investment choices? Plan administrators have to decide where to allocate their time and effort. Depending on how investors react to new investment choices, plan administrators may wish to devote more or less resources to the selection of new choices.

4.4. How well do participants do in allocating assets?

Earlier we examined how well plan administrators do in selecting the investment choices offered to participants. Their performance was judged both on average and using investor weights. In this section we examine how well participants in aggregate do in allocating their investments across the investment choices they are offered.

We will analyze this by comparing results given the participants' average investment weights with three naïve investment strategies. The first is to assume the participants put an equal amount of money in each investment choice in a plan. This represents the simplest mechanical rule participants could follow, and in the absence of any other information would lead to maximum diversification. Another naïve rule we examine is a slightly more sophisticated version of diversification: 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 participants invest equally in the top half of the choices offered. The ranking device we use to select the top half is the alpha over the past three

[24] 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.

Table 8
Allocations to new investment choices (excluding company stock and employer contributions)

Year	1 All new funds		2 New fund of existing type		3 New fund is a replacement for a fund of existing type		4 New fund is an additional fund of an existing type		5 New fund of new type	
	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
2	150	0.83	107	1.13	35	1.29	72	1.00	43	0.59
3	90	0.86	63	1.25	20	1.46	43	1.19	27	0.44
4	72	0.77	50	1.31	14	0.97	36	1.39	22	0.47

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 9
Participant portfolio performance versus naïve selection rules

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

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 alphas. Monthly returns are used, with plan portfolios rebalanced every fiscal year. 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.

years divided by the standard deviation of the residuals.[25] We now turn to an examination of the performance results (alpha) produced by each portfolio selection rule.

The results are presented in Table 9. The most interesting aspect of this table is that all three naïve strategies produce an alpha that is no lower than that earned by the plan participants. While the alphas are higher for each naïve rule, the difference is statistically significant at the 5% level in only one case. The best performing of the naïve rules was the one that selected choices on the basis of past alpha over residuals.

Aggregate allocation by plan participants produces results that are no better and appear to be worse than naïve strategies. This means that the performance of the choices offered to participants is extremely important because participants in aggregate do not add value by their decision-making.

5. 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 a previous study, we examined whether plan administrators offered participants the right categories of funds. In this study, we examine 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. A large part of this outperformance comes from selecting funds with lower expenses. Plan administrators show less skill in replacing or adding funds. Managers

[25] See Elton et al. (1996) for evidence that the past value of this criterion has predictive power for mutual funds in general.

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 added funds did no better than dropped funds. There seem to be differences in skill at selecting funds by plan administrators; past performance of plans predicts future performance. The principal predictive power is with the poorer performing plans.

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 almost twice as strong as the influence of contributions and close to the influence of returns. Participants increase their allocation to funds that have done well 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. 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 to equal investment allocations. Participants in the aggregate show no skill in differentiating among investment choices. Thus the principal factor affecting the performance of participant 401(k) portfolios is the set of investment choices offered.

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