How good are the investment options provided by defined contribution plan sponsors?

Keith C. Brown*

Department of Finance B6600,
University of Texas,
Austin, TX 78712, USA
E-mail: kcbrown@mail.utexas.edu
*Corresponding author

W. Van Harlow

Putnam Investments,
One Post Office Square,
Boston, MA 02109, USA
E-mail: van_harlow@putnam.com

Abstract: We investigate the quality of the investment choices that sponsors of defined contribution plans offer to plan participants for their retirement portfolios. Using a unique database of over 30,000 plans, we calculate the performance of equity-oriented investment options that were included in plans compared to a sample of funds that were not. On average, plan options produce annualised risk-adjusted returns exceeding those of non-plan options by as much as 120 basis points, an outcome that is relatively insensitive to factor model specifications, time period, or investment style classification. This performance advantage is largely due to actively managed plan options; privately managed institutional funds do not appear to enjoy any incremental performance advantage relative to public mutual funds. We conclude that plan sponsors do appear to possess superior selection skills when designing the set of investment options offered to plan participants.

Keywords: defined contribution pension plans; investment performance; plan sponsors; active portfolio management.

Reference to this paper should be made as follows: Brown, K.C. and Harlow, W.V. (2012) 'How good are the investment options provided by defined contribution plan sponsors?', *Int. J. Portfolio Analysis and Management*, Vol. 1, No. 1, pp.3–31.

Biographical notes: Keith C. Brown is the University Distinguished Teaching Professor and Fayez Sarofim Fellow in the McCombs School of Business, University of Texas at Austin. He is also the Co-founder and Senior Partner of Fulcrum Financial Group, a portfolio management, business valuation, and investment advisory firm, as well as a consultant to several multinational investment management organisations. He currently serves as Advisor to the Board of Trustees of Teacher Retirement System of Texas and the Board of Directors of University of Texas Investment Management Company and his research publications have appeared in a number of finance and economics journals.

W. Van Harlow is Director of Investment Retirement Solutions at Putnam Investments and Director of Research for the Putnam Institute. Prior to Putnam, he held various positions with Fidelity Investments including Portfolio Manager, Director of Investment Risk Management and Director of Quantitative Research. More recently, he was President and Chief Investment Officer of Strategic Advisers, Inc. and Fidelity Asset Management Services. Before joining Fidelity, he was Vice President at Salomon Brothers Inc. as well as an Assistant Professor at the University of Arizona. He was a past Editor of the *Financial Analysts Journal*, and his research publications have appeared in numerous journals.

1 Introduction and summary

A notable trend in the management of retirement assets over the past two decades is the rapid ascent of defined contribution plans as a primary method by which retirement portfolio savings are accumulated. Given their popularity, it is not surprising that these investment vehicles – which include 401(k), 403(b), and 457 plans – have begun to receive considerable scrutiny from researchers. To date, the vast majority of this literature has been concerned with the way that plan participants choose their funds as well as with the subsequent investment performance of those funds. Several stylised facts summarise these findings. First, investors are typically either under- or over-allocated toward equity in their asset allocation decision and tend to trade or rebalance their portfolios on an infrequent basis (Agnew et al., 2003). Second, defined contribution participants also tend to invest too heavily in the stock of the company sponsoring the plan, which Huberman (2001) calls the "familiarity breeds investment" effect; see also Poterba (2003) and Brown et al. (2006). Finally, Huberman and Jiang (2006) document that plan participants tend to allocate their contributions evenly across the funds they select – the so-called '1/N' strategy – a portfolio formation decision that can be justified on a both an analytical (DeMiguel et al., 2009) and behavioural (Benartzi and Thaler, 2001) basis.

By contrast, far less is known about the motivations and decision-making abilities of the institutions that sponsor defined contribution plans. This is somewhat puzzling given Elton et al.'s (2006) observation that the participant portfolio choices are themselves a function of the fund choices offered by the plan sponsors. Thus, if the options made available to participants are either insufficient or otherwise lacking, it may be impossible for them to allocate their assets in an optimal manner. Indeed, in their study focusing on the 401(k) market, those authors concluded that just over half of the plans they examined offered an adequate set of mutual fund choices, which they defined as one capable of spanning the space delineated by eight asset- and style-class indexes.

Further, although the existing evidence is quite limited, it is not clear that the choices that 401(k) sponsors do offer to investors are superior to those that they do not. Elton et al. (2007) looked at the risk-adjusted performance of the publicly traded mutual funds selected by a small sample (i.e., 43) of plan sponsors over the period from 1994 to 1999 and provided mixed evidence regarding how these plan options fared relative to a set of passively and actively managed alternatives. Specifically, they found that the funds offered to plan participants outperformed a randomly selected set of style-matched funds, but produced negative alphas relative to the passive benchmark portfolios.[1] On the other hand, in a related study from the defined benefit plan literature, Goyal and Wahal (2008)

demonstrated that the decisions made by plan sponsors when hiring or firing active portfolio managers did not subsequently lead to superior performance. Further, Cohen and Schmidt (2009) have suggested that mutual fund companies appear to overweight the stock of plan sponsor companies in their family of portfolios in order to attract potential defined contribution business, a policy that could erode the overall performance to their non-plan investors.

Although the preceding findings are suggestive, they offer an incomplete picture of the design and investment performance of the menu of investment choices offered to participants in a defined contribution plan. In particular, a substantial amount of assets in these plans are not invested in publicly traded mutual funds. For instance, the Investment Company Institute (2011) reported that in 2010 only 56.0% of plan assets were held in mutual funds, with the majority of what remained invested in privately managed institutional portfolios or the sponsoring company's own stock. Thus, it is difficult to judge the quality of the retirement portfolio choices the sponsors provide to participants without examining the performance of these privately managed alternatives. Additionally, given the legal mandate that sponsors face to provide a diversified collection of alternatives to participants in the plans, it is likely that both the selection and composition of the active and passive management options differs from that found in a less restrictive investment environment.

In this paper, we extend the literature on the role played by the plan sponsor in the investment performance of a defined contribution plan in a number of ways. Our investigation is based on a unique dataset maintained by the largest plan administrator in the industry and consists of the investment options offered by more than 27,000 sponsors of over 30,000 plans during the period from January 2000 to June 2007. These investment options are delineated along several lines (e.g., equity investment style, passive vs. active management, private vs. public fund) that permit a number of new questions to be addressed. To facilitate this analysis, we also develop a sample of otherwise comparable investment vehicles that sponsors chose not to select as plan options. The investment returns generated by these non-plan options serve as an indirect assessment of the opportunity cost of the sponsors' selection skills inasmuch as they proxy for the next-best collection of investment choices that could have been offered to plan participants. Thus, our methodological design allows us to assess the ability of plan sponsors to create a superior menu of plan options from which the participants' retirement portfolio decisions are made.

Focusing on the equity-oriented funds that were either included or not included in a defined contribution plan, we develop and test four different hypotheses regarding the selection skills of plan sponsors. First, we posit that the investment options that sponsors offer to plan participants produce superior risk-adjusted returns relative to those options that are not selected for the plan. Second, we consider the possibility that it is the set of actively managed (i.e., non-index fund) options that determine any measurable performance differential between plan and non-plan options. Third, we argue that passively managed plan options may outperform passively managed non-plan options. Finally, within the set of actively managed plan options, we examine whether funds managed in private accounts outperform public mutual funds on a risk-adjusted basis.

To control for the possibility of model and time period misspecification, we calculate risk-adjusted performance statistics (i.e., alphas) for our plan and non-plan investment

option samples using three different variations of a multi-factor risk model and over three different sub-periods of the entire 90-month sample period. Our primary finding is that, on average, plan options significantly outperform non-plan options after controlling for risk and expenses. The mean alpha differential over the entire sample period was about 10 basis points per month, which compounds to more than 120 basis points per annum, net of fees. Based on substantial analysis designed to test the robustness of this result with respect to how alphas are measured and aggregated both within an annual cross section as well as over time, we find that the outcome holds, to slightly different degrees, across all equity style classes and sub-intervals of the overall sample period.

Further, we demonstrate that the set of actively managed investment funds is almost exclusively responsible for this performance differential; the separation between active plan and non-plan alphas was especially strong (i.e., about 20 basis points per month) during the weak equity market of 2000–2002. However, non-plan index funds produce slightly larger alphas than passively managed plan funds, particularly in the earliest sample sub-period. Finally, among the collection of actively managed products offered within the plan sample, there appears to be little difference in risk-adjusted performance between privately and publicly managed options when the funds are pooled on an equally weighted basis. However, when these alpha measures are calculated on a participant-weighted basis, the preponderance of the evidence points to a slight tendency for public mutual funds to produce superior returns relative to private institutional accounts. This is a surprising outcome given the a priori advantages that private account managers appear to enjoy in terms of lower expenses and more predictable cash flows. Overall, on the basis of the strength and consistency of these findings, we conclude that the sponsors of defined contribution plans possess legitimate selection skills that allow them to discriminate between potential portfolio options in a meaningful way.

The remainder of the paper is arranged as follows. In the next section, we discuss how a typical defined contribution plan is organised. In Section 3, we describe the data we use in the empirical analysis, while in the fourth and fifth sections we develop and test the hypotheses regarding plan sponsor behaviour. Section 6 provides a more detailed analysis of the cross-sectional differences in the actively managed portion of the plan option sample and Section 7 concludes the study.

2 Defined contribution plan organisation and the plan sponsor's decision

As provided for by the United States Congress in the Employee Retirement Income Security Act (ERISA) of 1974 and subsequent amendments (e.g., the Tax Reform Act of 1978, Pension Protection Act of 2006), defined contribution retirement plans represent multi-faceted arrangements between at least four economic agents: the plan participant, the plan sponsor, the plan administrator/service provider, and the plan investment managers. In a typical plan, a portion of an employee's (i.e., the plan participant) salary is deducted on a pre-tax basis by the employer (i.e., the plan sponsor) and earmarked for investment in the plan portfolio. Depending on the specific nature of the plan, these deductions are usually made on a voluntary basis by the participant and may be matched by additional contributions from the sponsor. These funds are then turned over to a third-party (i.e., the plan administrator/service provider), who provides an array of services to both the participant and the sponsor. The most important of these services are

1 the investment of the earmarked funds in a pre-selected set of alternative investment vehicles (i.e., the plan investment managers)

2 the administration (e.g., record-keeping, statement creation, check processing) of the plan for the sponsor on behalf of the participant

3 assisting the sponsor in providing financial information and investment guidance to the participant.[2]

A critical aspect of this network of relationships is that the plan participant is ultimately responsible for deciding how the plan assets are to be invested among the available investment alternatives. In fact, shifting the risk of the portfolio investment outcome to the participant is perhaps the main reason why the defined contribution form of retirement investing has become popular among plan sponsors. Still, as the party responsible for selecting the menu of investment options available to plan participants, the plan sponsor is a fiduciary under the plan. In order to limit the plan sponsor's fiduciary responsibility to just this selection of investment options – and not to the participant's ultimate investment among them – ERISA Section 404(c), as interpreted by regulations issued by the Department of Labor, generally requires the sponsor to diversify the set of plan choices by offering "…a participant or beneficiary an opportunity to choose, from a broad range of investment alternatives, the manner in which some or all of the assets in his account are invested (p. 490)." Over time, this requirement has come to be interpreted as an obligation to provide at least three investment choices that are

1 diversified and have materially different risk-return characteristics,

2 allow the participant to create an appropriate range of risk-return outcomes when used in combination with one another to form a retirement savings portfolio.

In practice, this interpretation suggests that equities, fixed-income, and cash equivalents be the three asset classes included in the minimum set of alternatives.[3]

Designing a defined contribution plan that simultaneously satisfies the fiduciary obligations of the sponsor while meeting the needs of the participants and controlling expenses is obviously a challenging task. For this reason, sponsors quite frequently engage an outside administrator/service provider to assist with this process, along with consultants that have no direct control over the management or administration of the assets. Drawn from a wide spectrum of the investment management industry (e.g., Fidelity Employer Services Company, Vanguard, TIAA-CREF, AIG-Valic, Charles Schwab, ING), these service providers are typically better equipped to assist the sponsor in creating a menu of investment alternatives that will address the range of financial situations faced by participants in the plan. Depending on the scope of the service provider's operations, the portfolios defining these investment choices can be managed by the internal staff of an affiliated division, by external managers and sub-advisors, or by some combination of the two. While the gamut of design features that fall within the plan administrator's influence is subject to negotiation with the sponsor, it often includes the number of plan investment choices, the asset classes covered by the choices, the specific investment vehicles representing the designated asset classes, and whether those investment vehicles are available from public (i.e., mutual fund) or private account managers. Thus, one of the principal criteria a plan sponsor will use to judge the performance of a service provider is the investment performance of any plan investment options that are managed by the service provider or its affiliates.

Table 1 Summary of defined contribution plan characteristics

Panel A: number of sponsors, participants, and investment options									
Year ending	*Number of sponsors*	*Number of plans*	*Total participants*	*Avg. participants per plan*	*Total assets ($ mil)*	*Avg. assets per plan ($ mil)*	*Total plan options*	*Avg. options per plan*	*Max (min) # of plan options utilised*
2000	21,460	23,973	8,394,395	350.16	494,754	20.64	315,752	14.71	305 (1)
2001	22,946	25,653	9,109,671	355.11	493,938	19.25	370,902	16.16	430 (1)
2002	23,707	26,421	9,581,385	362.64	455,194	17.23	413,818	17.46	471 (1)
2003	24,053	26,805	9,798,152	365.53	575,574	21.47	448,814	18.66	534 (1)
2004	24,882	27,764	10,326,808	371.95	661,042	23.81	500,650	20.12	583 (1)
2005	25,955	29,035	11,212,918	386.19	733,546	25.26	567,111	21.85	656 (1)
2006	27,359	30,634	12,464,411	406.88	877,412	28.64	635,215	23.22	696 (1)

Notes: This display summarises various characteristics describing the sample of defined contribution plans for the period from January 2000 to June 2007. Panel A lists year-end statistics regarding the number of sponsors, plans, participants, and assets under management in the sample, as well as the distribution of available plan options offered by the sponsors. Panel B lists percentage allocation statistics involving the asset classes and the nature of the fund management (i.e., active vs. passive, private vs. public).

Table 1 Summary of defined contribution plan characteristics (continued)

Panel B: Investment profile of plan options				
		Plan options (%)	*Plan participants (%)*	*Plan assets (%)*
Asset allocation				
Cash		14.99	14.21	17.88
Fixed income		13.78	7.94	5.83
US domestic stock		58.93	65.82	65.19
Global stock-ex US		12.29	12.03	11.10
Public vs. private management				
Cash		14.99	14.21	17.88
Mutual (public) funds		57.17	77.14	69.53
Institutional (private) funds		27.84	8.64	12.59
Cash		14.99	14.21	17.88
Fixed income	Public	7.88	6.60	4.27
	Private	5.90	1.34	1.56
US domestic stock	Public	40.41	59.44	55.06
	Private	18.52	6.38	10.13
Global stock-ex US	Public	8.88	11.11	10.20
	Private	3.42	0.92	0.90
Active vs. passive management				
Actively managed		92.61	95.55	95.00
Passively managed		7.39	4.45	5.00
Cash		14.99	14.21	17.88
Mutual funds	Active	56.06	74.71	67.71
	Passive	1.10	2.44	1.81
Institutional funds	Active	21.61	6.63	9.41
	Passive	6.02	2.01	3.18

Notes: This display summarises various characteristics describing the sample of defined contribution plans for the period from January 2000 to June 2007. Panel A lists year-end statistics regarding the number of sponsors, plans, participants, and assets under management in the sample, as well as the distribution of available plan options offered by the sponsors. Panel B lists percentage allocation statistics involving the asset classes and the nature of the fund management (i.e., active vs. passive, private vs. public).

3 Data description

3.1 Plan administrator data sample

Our primary source of information used in this study comes from the proprietary database of the largest workplace pension plan administrator and service provider in the world. The data consist of the relevant characteristics describing all of the defined contribution plans for which the company served as record-keeper for the period from January 2000 to June 2007. In particular, for each plan we obtained the following records at various points during the overall sample period:

1 the number of participants involved

2 the total assets under management

3 the total number, identities, and investment attributes (e.g., public vs. private fund, equity vs. fixed-income) of the investment options held by participants

4 monthly net-of-fee returns to all of the available investment options.

Table 1 summarises several of the salient characteristics of this defined contribution plan sample. In Panel A, we list year-end statistics regarding the number of sponsors, plans, participants, and assets under management in the sample, as well as the distribution of available plan options offered by the sponsors. By any measure, the collection is a large one, comprising over 27,000 plan sponsors, over 30,000 plans, 12.5 million participants, and total assets of almost $900 billion. More important for the present analysis is the fact that sponsors appear to offer plan participants a sizeable number of investment options. Across the entire sample, there were 635,215 total options (i.e., the sum of the number of investment alternatives across all plans) at the last reporting date, which corresponds to an average of 23.22 options per plan. Notice also that the mean number of options per plan increased steadily during the sample period from a starting point of fewer than 15 products.[4] Finally, the reported ranges of the minimum (one) and maximum (696) number of investment options that were actually held by participants within a plan suggest that there is a considerable degree of heterogeneity within the sample.[5]

Panel B of Table 1 provides a more detailed breakdown on the nature of the plan options that sponsors offer. Percentage allocation statistics are listed for three main divisions of the plan option sample according to

1 asset classes

2 whether the plan option was managed privately in an institutional account or in a public mutual fund

3 whether the plan option followed a passive or active investment mandate.[6]

Further, these allocation percentages are tabulated by

1 the number of plan options available

2 the percentage of plan participants selecting that option type

3 the percentage of total plan assets held in that option type.

For instance, 58.93% of plan options in the sample are US Domestic equity funds, which represented 65.82% of the investment positions held by the average plan participant and 65.19% of the total assets invested across the plan sample. There are three things of particular note about these statistics. First, US Domestic equity represents the dominant asset class, easily exceeding the combined allocations to the other alternatives. Second, publicly managed funds outnumber privately managed options by a ratio of about two to one (e.g., 57.17% to 27.84%). Finally, the vast majority of plan assets are actively managed, but a larger proportion of privately managed funds are passively invested.

3.2 Defining the plan investment option sample

For the purpose of analysing the comparative performance of plan and non-plan investment options, the most vital pieces of information contained in our database are the identity of the fund choices offered to plan participants, as well as the performance of those options over time. While we have monthly returns for all funds, the composition of each plan was available less frequently: namely, at the beginning of January 2000; July 2002; January 2005; and July 2007. This pattern of observations leads naturally to dividing the full 90-month sample period (i.e., January 2000 to June 2007) into three non-overlapping 30-month sub-periods:

1 January 2000 to June 2002

2 July 2002 to December 2004

3 January 2005 to June 2007.

Accordingly, we created three distinct plan option samples to coincide with each of the 30-month sub-periods. Notice that for any of the sub-periods, we are able to identify which plan options were available both at the beginning and at the end of the investment horizon (e.g., for the January 2000 to June 2002 period, we know the funds offered to plan participants on 1 January 2000 and 30 June 2002). Thus, it is possible to establish each plan option sub-sample using either the beginning-of-period or end-of-period collection of funds. While each approach has its advantages, we adopted the more conservative beginning-of-period method in order to avoid any look-ahead bias problems that could occur as a result of plan options being dropped during a given sample period. (We have duplicated the results of the entire study using the alternative end-of-period approach, which had virtually no impact on the findings we report in subsequent sections.)

3.3 Defining the non-plan investment option sample

In order to compare the quality of the plan option decisions made by our sponsor sample, we also constructed a collection of non-plan options. At the beginning of each sub-period, we constructed a representative set of investment alternatives that sponsors could have included in their plans, but chose not to. Since we did not have access to information concerning all of the private management options that sponsors may have considered before rejecting them, our non-plan option sample consists exclusively of publicly available mutual funds that were not included in any of the defined contribution plans for which our plan administrator served as a fiduciary during the sample period.

Further, to help manage the scope of the analysis, we only considered mutual funds with a US equity-oriented objective.

Specifically, on each selection date, we screened the entire mutual fund database maintained by Morningstar, Inc. for all US domestic equity funds that were available for purchase by retail customers. To insure that each potential non-plan fund truly followed an equity investment mandate, we imposed the additional inclusion criteria that it produced a coefficient of determination of at least 75% when its returns were evaluated by the risk factor model described in the next section. Only those funds that did not appear on the beginning-of-period plan option list for a given performance measurement horizon were included in the final non-plan option sample.[7] Morningstar also provided monthly net-of-fee returns for these funds, along with various other data concerning the funds' relevant characteristics (e.g., investment objective, style class).

4 The quality of plan option selections: testable hypotheses and methodology

4.1 Testable hypotheses

The underlying motivation for this study is to investigate whether the investment choices that sponsors select are superior to those that they do not. The literature provides some evidence on both sides of the question of whether fiduciaries in the institutional environment do possess meaningful manager selection skills. On one hand, Parwada and Faff (2005) studied investment management mandates in the defined benefit pension market and found that those mandates were substantially more likely to be awarded to managers exhibiting superior past performance relative to their peers. Thus, given the tendency for asset manager performance to persist in the mutual fund industry (e.g., Brown and Goetzmann, 1995), it is reasonable to expect that the options provided to plan participants might represent a superior set of investment choices. On the other hand, Goyal and Wahal (2008) showed that defined benefit plan sponsors who follow a 'return chasing' strategy of hiring (terminating) investment managers following periods of abnormally good (poor) performance do not deliver superior excess returns subsequently. Additionally, Carhart (1997) showed that apparent persistence in mutual fund performance is likely to be an artefact of a misspecified model of return expectations. This debate frames the following testable hypothesis:

Hypothesis 1 The investment options that defined contribution plan sponsors offer to participants produce superior risk-adjusted returns relative to otherwise comparable options that are not selected for the plan.

Defined contribution plan sponsors offer participants options that are managed on both a passive (i.e., indexed) and active basis. While we do not address the 'passive vs. active' management debate directly, it is relevant to consider whether the actively managed options offered in a plan have superior investment characteristics relative to those active funds the sponsor did not select. Since there is substantial evidence that active fund managers exhibit genuine proficiency in security selection (e.g., Chen et al., 2000; Baker et al., 2010), the question becomes whether plan sponsors are able to identify and select those skilful managers (and avoid those that are not) when creating the menu of plan options. Similarly, although both the nature of the investment problem and the tighter fee

structures make it less likely that indexed products will exhibit significant differences from one another (e.g., Guedj and Huang, 2009), it is still interesting to consider whether passively managed plan options outperform comparable non-plan ones. Thus, two additional hypotheses that we test are:

Hypothesis 2 The actively managed investment options that plan sponsors offer to participants produce superior risk-adjusted returns relative to otherwise comparable actively managed options that are not selected for the plan.

Hypothesis 3 The passively managed investment options that plan sponsors offer to participants produce superior risk-adjusted returns relative to otherwise comparable passively managed options that are not selected for the plan.

Finally, there are several a priori reasons to expect that there might be differences in the returns generated by privately managed plan options and public funds operating in otherwise identical investment environments. For example, the Pension and Welfare Benefits Administration (1998) notes that private managers typically charge measurably lower fees (e.g., a difference of 50 basis points per annum), owing largely to the lower account servicing expenses they incur by managing the assets of a single client rather the voluminous number of commingled accounts that describe the typical public mutual fund. Further, it is also likely that managers of privately negotiated accounts will have more predictable fund inflows from participant salary contributions, which in turn could lead to lower liquidity costs (i.e., 'cash drag') in the on-going management of the invested capital. Finally, it is possible that private managers face a markedly different set of investment restrictions than those imposed on managers in the public fund market and that these differences could affect investment performance (e.g., Almazan et al., 2004). The net effect of these discrepancies leads to the following prediction:

Hypothesis 4 The privately managed investment options that plan sponsors offer to participants produce superior risk-adjusted returns relative to otherwise comparable publicly managed options.

4.2 Measuring abnormal investment performance

To compare the relative investment performance for our samples of plan and non-plan options, we estimate several versions of the following four-factor risk model adapted from Fama and French (1993) and Carhart (1997):

$$\left(R_{jt} - RF_t\right) = \alpha_j + b_{j1}\left(R_{mt} - RF_t\right) + b_{j2}SMB_t + b_{j3}HML_t + b_{j4}MOM_t + \varepsilon_{jt} \qquad (1)$$

where, for each month t, $(R_{jt} - RF_t)$ and $(R_{mt} - RF_t)$ are the excess returns to the j^{th} investment option and the market portfolio, respectively; *SMB* is the difference in returns between portfolios of small and large capitalisation firms; *HML* is the difference in returns between portfolios of stocks with the highest and lowest book-to-market ratios; and *MOM* is the difference between the returns to portfolios of stocks with the largest and smallest returns during the previous 11 months [see Jegadeesh and Titman (1993) for the motivation for including price momentum effects].[8] Specifically, within a given time horizon, we estimate three different α (i.e., alpha) coefficients for each plan and non-plan investment alternative using:

1 a one-factor version of equation (1) with ($R_{mt} - RF_t$) as the independent variable

2 a three-factor version with ($R_{mt} - RF_t$), *SMB*, and *HML*

3 the full four-factor version.

Given our sample formation process, we calculated risk-adjusted performance statistics over the January 2000 to June 2002, July 2002 to December 2004, and January 2005 to June 2007 sub-periods. We also examine behaviour over the complete January 2000 to June 2007 period by combining the respective risk-adjusted performance measures from the three sub-periods into a single comprehensive sample.

We imposed two additional conditions on the empirical analysis. First, we only calculated alphas for those plan options that followed a US domestic equity mandate. Thus, we do not address in the study the quality of the fixed-income or cash-equivalent options that plan sponsors chose. Second, in order to generate equivalent sample sizes for each of the three forms of the risk factor model used to calculate alphas, the R^2 inclusion rule described earlier for building the non-plan option comparison sample was based on the three-factor version only.[9]

5 The quality of plan option selections: empirical results

5.1 Full sample results

In assessing the quality of the plan options that sponsors offer to their defined contribution plan participants, there are two questions that need to be addressed. First, does the total set of potential plan options from which sponsors make their ultimate menu selections produce returns that meet or exceed expectations? Second, do the funds that sponsors actually include in their plans outperform funds that were not selected? While answering the second question is the primary focus of this investigation, it is also useful to consider whether plan participants are being well served on an absolute basis as well as a relative one, after allowing for plan fees.

5.1.1 In-sample alpha difference tests

The first two panels of Table 2 list

1 the mean alpha

2 the median alpha

3 the percentage of positive alphas within the respective sample stratification.

Alphas are tabulated separately for each form of the factor model discussed above and differences in the performance statistics between plan and non-plan options, as well as p-values indicating the statistical significance of those differentials, are also reported.[10] (Notice in this display that we refer to these performance statistics as 'in-sample' alphas, which highlights the fact they are measured over the same time period used to estimate the risk parameters themselves.) Panel A analyses sponsor selection skill over the full 90-month sample period while Panel B provides a breakdown of performance during each 30-month sub-period.

Table 2 Risk-adjusted performance of plan and non-plan investment options: full sample results

Option description	*Obs.*	*One-factor model*			*Three-factor model*			*Four-factor model*		
		Mean	*Median*	*% Pos.*	*Mean*	*Median*	*% Pos.*	*Mean*	*Median*	*% Pos.*
Panel A: In-sample alphas; full period (January 2000 to June 2007)										
Alpha: all options	10,536	–0.0275	–0.0794	39.76	–0.1132	–0.0928	36.13	–0.1091	–0.0913	36.33
Alpha: plan options	1,488	–0.0130	–0.0382	43.78	–0.0307	–0.0268	44.36	–0.0271	–0.0245	44.49
Alpha: non-plan options	9,048	–0.0299	–0.0900	39.10	–0.1268	–0.1072	34.78	–0.1225	–0.1046	34.99
Difference		0.0169	0.0518	4.68	0.0961	0.0804	9.58	0.0954	0.0801	9.50
p-value		*0.2692*	*0.0001*	*0.0006*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*
Panel B: In-sample alphas; three sub-periods										
(i) January 2000 to June 2002										
Alpha: plan options	216	0.3875	0.2089	65.39	0.0993	0.1261	61.57	0.0995	0.1147	59.72
Alpha: non-plan options	2,928	0.1539	0.0155	51.08	–0.0944	–0.0151	48.36	–0.0911	–0.0282	47.47
Difference		0.2336	0.1934	14.31	0.1937	0.1412	13.21	0.1906	0.1429	12.25
p-value		*0.0001*	*0.0002*	*0.0001*	*0.0001*	*0.0001*	*0.0002*	*0.0001*	*0.0004*	*0.0005*
(ii) July 2002 to December 2004										
Alpha: plan options	535	–0.0310	–0.0356	46.36	–0.1272	–0.0873	34.02	–0.1277	–0.0902	33.46
Alpha: non-plan options	3,706	–0.1022	–0.1334	35.20	–0.2042	–0.1925	23.45	–0.2026	–0.1909	23.45
Difference		0.0712	0.0978	11.16	0.0770	0.1052	10.57	0.0749	0.1007	10.01
p-value		*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*
(iii) January 2005 to June 2007										
Alpha: plan options	737	–0.1129	–0.0585	35.82	0.0013	–0.0143	46.81	0.0088	–0.0079	48.03
Alpha: non-plan options	2,414	–0.1412	–0.0977	30.61	–0.0471	–0.0576	35.71	–0.0377	–0.0514	37.57
Difference		0.0283	0.0392	5.21	0.0484	0.0433	11.10	0.0465	0.0435	10.46
p-value		*0.0173*	*0.0001*	*0.0079*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*
Panel C: Out-of-sample aggregated alphas; truncated full period (January 2002 to June 2007)										
Alpha diff: [plan – non-plan]	60	0.0653	0.0315	65.00	0.0640	0.0449	71.67	0.0643	0.0418	71.67
p-value		*0.0006*	*0.1228*	*0.0201*	*0.0004*	*0.0444*	*0.0008*	*0.0008*	*0.0286*	*0.0008*

Notes: In-sample risk-adjusted performance (i.e., alpha) statistics are reported for the complete collection of plan and non-plan investment options over the period January 2000 to June 2007 (Panel A) and three sub-periods: (i) January 2000 to June 2002; (ii) July 2002 to December 2004; and (iii) January 2005 to June 2007 (Panel B). Alphas were calculated relative to three versions of the factor model in (1): (i) a one-factor model using $(R_m - RF)$; (ii) a three-factor model using $(R_m - RF)$, SMB, and HML; and (iii) a four-factor model using $(R_m - RF)$, SMB, HML, and MOM. Statistics indicating the difference in performance between plan and non-plan options and the associated p-values are reported in the last two rows for each sample period. Panel C reports mean, median, and (% Positive) statistics for the differences between plan and non-plan option alphas estimated out-of-sample using a modified version of the Fama-MacBeth two-stage technique and aggregated over the 60 monthly cross-sections from July 2002 to June 2007.

The mean alpha statistics for the total sample of potential plan options shown in Panel A suggest that factor model selection does appear to matter. There is a sizeable gap between the average monthly alphas from the one-factor market model (i.e., –2.75 basis points) and the three- and four-factors versions of the Fama-French model (i.e., –11.32 and –10.91 basis points, respectively). Comparable gaps exist for the other two alpha summary statistics, suggesting that the one-factor risk model may be setting return expectations too low relative to the true level of risk that exists within the set of equity funds from which plan sponsors could choose. Regardless of the model specification, however, both the mean and median alpha statistics are negative and the proportion of potential plans producing a positive alpha never exceeds 40%. This implies that the overall set of potential plan options generated returns that fell short of expectations, but it is interesting to note that the level of annualised shortfall is within the range of the funds' expense ratios. Further, these findings are also consistent with the percentage of all retail mutual funds that are capable of producing positive alphas relative to a multi-factor risk model (see, for instance, Harlow and Brown, 2006).

Of course, the more relevant issue involves examining the difference in the alphas generated by the set of alternatives that sponsors chose compared to those they did not. On this matter, the evidence in Panel A appears to be quite persuasive. For each factor model, plan sponsors consistently selected funds that produced, on average, the largest risk-adjusted returns. For example, using the three-factor model to describe return expectations, the mean monthly in-sample alpha for the set of actual plan options was 9.61 basis points higher than that for the non-plan sample, which translates into a compounded annual advantage of 1.22%. This outcome was confirmed by the four-factor model that accounts for return momentum effects and, to a modestly reduced extent, by the median alpha differential statistics. Additionally, the significant difference in the (% Pos.) measure (e.g., 44.36% vs. 34.78% for the three-factor model) indicates that this mean alpha advantage is not being driven by a few outliers. Consequently, these data represent an initial indication that plan sponsors may possess selection skills in discriminating among the best set of available investment options.

The sub-period breakdown shown in Panel B of Table 2 produces a similar picture. In all three 30-month intervals, the plan option sample outperforms the non-plan sample on a risk-adjusted basis irrespective of which metric is used. This performance advantage is particularly strong during the general equity market decline that occurred in the first sub-interval (i.e., January 2000 to June 2002), which suggests that plan sponsors may be especially good at selecting funds that control downside risk on a relative basis. This notion is corroborated by the fact that more than three out five of the plan options during this period beat expectations [i.e., (% Pos.) coefficients ranging from 59.72% to 65.39%], whereas no more than about 50% of the non-plan funds were able to do the same. The mean and median alpha differentials were significantly positive in the other sub-periods as well, so it also appears that sponsors were capable of selecting funds that outperformed in rising markets. Collectively, these findings provide considerable support for our first hypothesis.

5.1.2 Alternative aggregation and out-of-sample alpha tests

The analysis so far strongly suggests the relative outperformance of the plan option sample, but it is possible that the experimental design influenced that outcome for two reasons:

1 our method of aggregating alpha statistics across the entire sample period is but one of several techniques that could have been employed

2 these risk-adjusted performance statistics were estimated simultaneously with the factor model on which they were based.

As a robustness test, we implemented an alternative methodological approach designed to produce out-of-sample estimates of abnormal performance and then aggregate the cross section of those statistics in a different manner using a modified form of the Fama-MacBeth (1973) two-stage approach:

1 For each plan and non-plan option *j*, we estimated the set of factor loadings $\{b_{jkt}\}$ for (1) as of month t using the most recent 30 months of return data (e.g., in June 2002, parameters were estimated using data from January 2000 to June 2002).

2 These estimated loadings were used in conjunction with the actual factor returns in month $t + 1$ to create an estimate for the expected return to the j^{th} option in month $t + 1$ [i.e., $E(R_{jt+1})$].

3 The out-of-sample estimate of abnormal performance for option j in month $t + 1$ was then calculated as $\widehat{\alpha}_{jt+1} = R_{jt+1} - E\left(R_{jt+1}\right)$.

4 The first three steps were repeated for each month between July 2002 (i.e., the first month for which $\widehat{\alpha}_j$ can be estimated) and June 2007 by rolling the 30-month estimation window forward one month at a time. For each available plan and non-plan option, this procedure created as many as 60 separate monthly $\widehat{\alpha}_j$ forecasts, depending on data availability.

5 For both the plan and non-plan option samples, separate month *T* forecasts of the aggregate abnormal performance – call them $\widehat{\alpha}_{PT}$ and $\widehat{\alpha}_{NPT}$ – were created as equally weighted portfolios of the available options in each respective sample. The month T difference between the aggregated out-of-sample alpha forecasts in the plan and non-plan samples (i.e., $[\widehat{\alpha}_{PT} - \widehat{\alpha}_{NPT}]$) was computed for each of the 60 months between July 2002 to June 2007.

6 We then tested for the statistical significance of the mean, median, and proportion of positive values in the set of 60 monthly values for $[\widehat{\alpha}_{PT} - \widehat{\alpha}_{NPT}]$.[11]

Panel C of Table 2 summarises the one-, three- and four-factor model results. These aggregated findings corroborate the conclusion that the investment options chosen by plan sponsors produce superior net-of-expense, risk-adjusted returns. The overall mean of the 60 cross-sectional values of $[\widehat{\alpha}_{PT} - \widehat{\alpha}_{NPT}]$ ranged from 6.40 basis points per month (for the three-factor model) to 6.53 basis points (for the one-factor model), with all three average out-of-sample alpha differential estimates being highly statistically reliable. Additionally, the median values of these alpha differential distributions tell a similar, if somewhat attenuated, story in terms of both the directional effect and significance.

Perhaps an even more telling indication of the performance advantage enjoyed by the plan option sample over the non-plan option sample is the percentage of the 60

aggregated alpha differentials that were positive: the portfolio of investment options chosen by plan sponsors produced a larger alpha value than the comparable non-plan alpha in roughly seven out of ten cases. Further, the reported *p*-values indicate that each of these (% Pos.) alpha differential statistics exceeds its null hypothesis level of 50% by a reliable margin. Thus, the findings in Panel C make it unlikely that the earlier results are spurious due to how risk-adjusted performance was calculated or aggregated over time.

5.2 Factor-matching tests

The difference tests reported in Table 2 implicitly assume that the plan and non-plan option samples load on the various risk factor models in the same way. To guard against the possibility that this assumption is contaminating the results, we performed two additional robustness tests comparing the performance of the two samples using a more precise method of matching investment options by their factor exposures. First, we sort all of the plan options (1,488 observations) and non-plan options (9,048 observations) into risk factor 'bins' and assess the relative performance of each subgroup. In the second test, we match each plan option with a specific non-plan 'nearest neighbour' according the similarity of their respective factor exposures and then calculate the risk-adjusted return differentials of those matched pairs. Each of these robustness tests was conducted using the in-sample performance statistics described earlier.

5.2.1 Factor bin sorts

We placed every investment option in each sample division into one of 16 distinct factor-matched bins according to whether its beta exposures from the four-factor version of (1) fell above or below the median value for the entire sample. For example, an option included in a plan having an above-median ($R_m - RF$) beta, below-median SMB beta, below-median HML beta, and above-median MOM beta would be placed in the [High ($R_m - RF$), Low SMB, Low HML, High MOM] factor-matched bin within the plan option sample.[12] After filling each bin in this manner, we then calculated the bin-specific mean alpha, median alpha, and (% Pos. Alpha) performance statistics, as well as the differences in those respective values between the plan and non-plan samples. For the purpose of this sorting procedure, factor betas were measured over the entire 90-month sample period.

Panel A of Table 3 lists the frequencies and risk-adjusted performance differentials for each of the 16 factor-match bins. Notice that the plan and non-plan options appear to sort in a roughly similar manner. Using the total sample ratio of 16.59% (i.e., 1,488 ÷ 9,048) as the expected frequency of plan options to non-plan options that occur in each bin, the chi-square statistic testing for bin uniformity is 11.22, which has an associated *p*-value of only 0.7369. Still, the bin frequency range of 10.57% to 23.86% indicates some amount of dispersion in how the extreme observations in these samples are divided. For the four bins with the largest relative concentrations of plan options, three have low SMB exposures, three have low HML exposures, and three have high MOM exposures. However, the broad nature of the sorting routine we employ makes it impossible to infer if this was an intentional part of the sponsors' selection process.

Table 3 Factor-matched performance comparison of plan and non-plan investment options

Panel A: Factor-sorted bins of plan and non-plan option samples

Factor-sort bin				*Plan obs.*	*Non-plan obs.*	*% (Plan/non-plan) obs.*	*Mean alpha*		*Median alpha*		*% Pos. alpha*	
(R_m – RF)	*SMB*	*HML*	*MOM*				*Diff.*	*p-value*	*Diff.*	*p-value*	*Diff.*	*p-value*
Low	Low	Low	Low	96	623	15.41	0.0444	*0.0866*	0.0256	*0.0274*	8.66	*0.1141*
Low	Low	Low	High	110	540	20.37	0.0711	*0.0012*	0.0618	*0.0001*	19.28	*0.0002*
High	Low	Low	Low	136	570	23.86	0.0335	*0.2596*	0.0265	*0.0001*	–10.16	*0.0078*
High	Low	Low	High	77	558	13.80	0.0711	*0.0431*	0.0991	*0.0023*	9.71	*0.0408*
Low	Low	High	Low	154	1,010	15.25	0.0822	*0.0008*	0.0659	*0.0003*	15.34	*0.0004*
Low	Low	High	High	73	364	20.06	0.0612	*0.1312*	0.0273	*0.0013*	3.18	*0.6129*
High	Low	High	Low	61	577	10.57	0.0963	*0.0214*	0.0577	*0.0047*	0.51	*0.9251*
High	Low	High	High	36	283	12.72	0.0047	*0.9203*	0.0547	*0.0740*	-6.56	*0.3239*
Low	High	Low	Low	31	174	17.82	0.2035	*0.0295*	0.1910	*0.0032*	26.59	*0.0058*
Low	High	Low	High	126	588	21.43	0.1993	*0.0001*	0.1255	*0.0001*	21.09	*0.0001*
High	High	Low	Low	55	397	13.85	0.1412	*0.1424*	0.1493	*0.4724*	9.18	*0.1876*
High	High	Low	High	163	1,024	15.92	0.1142	*0.0160*	0.1458	*0.0140*	11.87	*0.0039*
Low	High	High	Low	93	676	13.76	0.1383	*0.0069*	0.1191	*0.0003*	15.89	*0.0033*
Low	High	High	High	81	529	15.31	0.2211	*0.0015*	0.1353	*0.0123*	18.67	*0.0010*
High	High	High	Low	91	524	17.37	–0.0658	*0.2923*	0.0173	*0.7209*	–14.09	*0.0089*
High	High	High	High	105	611	17.86	0.0963	*0.0870*	0.1035	*0.0005*	12.13	*0.0170*
				1,488	9,048							
					Average:	16.59	0.0945		0.0878		8.83	

Notes: In-sample risk-adjusted performance (i.e., alpha) statistics are reported for the full collection of plan options and non-plan investment options over the period January 2000 to June 2007. In Panel A, both the entire plan and non-plan samples are sorted into 16 bins according to whether their beta exposures from the four-factor version of equation (1) fall above or below the sample median for a given risk factor. Differences in (i) mean alpha, (iii) median alpha, and (iii) percentage of positive alphas are listed for each factor-matched bin along with the p-values indicating the statistical significance of those differentials. In Panel B, each plan option is compared with its 'nearest neighbour' non-plan option, defined as the alternative whose factor beta estimates most closely match those of the respective plan option. The display lists the risk-adjusted return differentials (i.e., plan option minus non-plan neighbour) that fall at various breakpoints of the frequency distribution, as well as the mean value and percentage of positive differentials. Matched-pair frequency distributions are also shown for the three sub-periods of the full sample.

Table 3 Factor-matched performance comparison of plan and non-plan investment options (continued)

Panel B: Risk-adjusted return differentials for plan option and 'nearest neighbour' non-plan options

Sample period	*Obs.*	*Return differential frequency distribution*									*Mean*	*% positive differentials*
		Min	*5%*	*10%*	*25%*	*50%*	*75%*	*90%*	*95%*	*Max*		
January 2000 to June 2007	1,488	–3.6742	–0.4234	–0.2364	–0.0550	0.0219	0.1295	0.3352	0.5448	3.2493	0.0397	61.76
p-value											*0.0001*	*0.0001*
(i) January 2000 to June 2002	216	–2.5222	–0.9991	–0.6051	–0.1614	0.0235	0.2767	0.8247	1.2311	3.2493	0.0726	58.80
p-value											*0.1057*	*0.0097*
(ii) July 2002 to December 2004	535	–3.6742	–0.3803	–0.2266	–0.0624	0.0217	0.1507	0.3350	0.4879	1.3568	0.0364	59.81
p-value											*0.0077*	*0.0001*
(iii) January 2005 to June 2007	737	–1.0263	–0.3113	–0.1738	–0.0402	0.0218	0.0984	0.2550	0.3890	1.2964	0.0324	64.04
p-value											*0.0001*	*0.0001*

Notes: In-sample risk-adjusted performance (i.e., alpha) statistics are reported for the full collection of plan options and non-plan investment options over the period January 2000 to June 2007. In Panel A, both the entire plan and non-plan samples are sorted into 16 bins according to whether their beta exposures from the four-factor version of equation (1) fall above or below the sample median for a given risk factor. Differences in (i) mean alpha, (iii) median alpha, and (iii) percentage of positive alphas are listed for each factor-matched bin along with the p-values indicating the statistical significance of those differentials. In Panel B, each plan option is compared with its 'nearest neighbour' non-plan option, defined as the alternative whose factor beta estimates most closely match those of the respective plan option. The display lists the risk-adjusted return differentials (i.e., plan option minus non-plan neighbour) that fall at various breakpoints of the frequency distribution, as well as the mean value and percentage of positive differentials. Matched-pair frequency distributions are also shown for the three sub-periods of the full sample.

Whether using the mean or median, the alpha difference statistics show a remarkable degree of consistency across the 16 factor-matched bins. All but one of the bin-specific differentials for both performance measures are positive, and they are statistically significant at the 5% level in nine (mean alpha) and 13 (median alpha) cases, respectively. (The mean alpha differential in the [High, High, High, Low] bin is insignificantly negative.) Further, notice that the respective sample-wide weighted averages for these statistics match or exceed the 8.0 - 9.5 basis point values reported in Table 2. Additionally, the next-to-last column on Table 3, Panel A shows that the plan option sample produced a higher percentage of positive alphas in 13 of the 16 bins. Taken together, these factor-matched findings once again provide strong confirmation regarding the investment superiority of the plan option sample and allow us to state more confidently that the selection skills demonstrated by plan sponsors are not driven by a limited number of factor-related investment strategies.

5.2.2 Matched-pair analysis

A different way of performing this factor-matching comparison is to pair each plan option with its single most comparable alternative in the non-plan sample, where these 'nearest neighbours' are defined by the proximity of their respective risk exposures. An advantage of this refinement is that it offers a better measure of the potential opportunity cost imposed on the plan participant by the sponsor's selection process (i.e., the return produced by a non-plan option with similar risk characteristics). Accordingly, we focus on the risk-adjusted return differentials produced across the entire matched pair sample.

To accomplish this, we matched all plan options in the sample with a specific non-plan option as follows. Starting with a randomly selected plan option, we searched the non-plan option sample for the fund that minimised the sum of the absolute values of the differences in the factor loadings computed by (1), or:

$$\min \sum_{i=1}^{4} \left| \left(b_{i,plan} - b_{i,non\text{-}plan} \right) \right| \tag{2}$$

Repeating this process for all 1,488 plan options – which entailed approximately 13.5 million (i.e., 1,488 × 9,048) comparisons – yielded the final collection of factor-matched pairs.[13] For each pairing, a risk-adjusted return differential was then computed by subtracting the estimated in-sample alpha for the non-plan neighbour from its counterpart in the plan option sample.

Panel B of Table 3 reports the mean value of these matched-pair return differentials, the percentage of positive differences (i.e., $\alpha_{j.plan} > \alpha_{j,non\text{-}plan\ neighbour}$), and various values defining the frequency distribution. Separate findings are shown for the entire sample period and each of the three sub-periods. Both the mean and median alpha differentials are positive in all of the various time horizons (e.g., 7.26 and 2.35 basis points per month, respectively, for the January 2000 to June 2002 sub-period). While these reported alpha differential values are somewhat reduced relative to when the plan option sample was compared to the entire non-option sample, this more severe way of controlling for risk still produces statistically and economically significant levels of outperformance.

Further, the fact that the mean alpha differential exceeds the median value in each period implies that the matched-pair return distribution is positively skewed, suggesting that sponsors were able to include a disproportionate share of big 'winners' – or avoid the

inclusion of big 'losers' – among their plan option menus. This skewness is also indicated by alpha differentials at each percentile break above the median exceeding (in absolute terms) their corresponding values below the median to differing degrees (e.g., for the entire sample period, the respective observations at the 75th and 25th percentiles are 12.95 and –5.50 basis points, whereas the absolute gap between 33.52 and –23.64 basis points at the 90th and 10th percentiles is considerably wider). Finally, and perhaps most telling, more than three in five (e.g., 61.76% in the full sample period) of the plan options generated higher risk-adjusted returns than their factor-matched nearest neighbours in the non-plan sample. This is a strong indication that plan sponsors were consistently able to select plan options that covered their net-of-fee opportunity costs, as measured by the return produced by their matched pairs.

5.3 Active vs. passive management results

Table 4 refines the analysis of the preceding section by focusing on the set of actively managed funds maintained within the total investable option universe. Notice that the vast majority of the funds in both the total universe (10,368 of 10,536) and plan option (1,350 of 1,488) samples are indeed actively managed. Thus, it is not surprising that the differences in mean and median alphas generated by active plan and non-plan options are quite similar to those for the entire sample. It does appear to be the case, however, that these differentials are slightly larger in the active sample: for instance, the mean three-factor monthly alpha differences in Panel A for the active and total samples were 9.86 and 9.61 basis points, respectively. Further, the ability of plan sponsors to discriminate among funds able to beat return expectations appears to be greater as well; the difference in the (% Pos.) statistic between the plan and non-plan options using the three-factor model is 11.14% for active funds versus 9.58% for all funds. This pattern is reflected across all factor model variations, as well as in each of the sub-periods shown in Panel B. Further, the out-of-sample alpha analysis in Panel C confirms the pattern of plan option superiority for the 60 monthly cross sections. Thus, consistent with our second hypothesis, we conclude that the actively managed funds that sponsors select for their plans do outperform the set of non-plan options, after controlling for both risk and fees.

As summarised by our third hypothesis, it is also possible that the passively managed investment alternatives offered to plan participants outperform those that sponsors considered but rejected. While quite mixed, the findings reported in Table 5 ultimately suggest that this is not likely to be true. However, considerable caution is warranted when drawing any definitive conclusions due to the substantially smaller sample sizes – particularly for the non-plan index fund sample – involved in the analysis. For the entire sample period (Panel A), the difference in mean in-sample alphas between plan and non-plan passively managed funds is actually negative for the three- and four-factor models (i.e., –3.42 and -3.11 basis points, respectively) although neither differential was meaningfully different from zero. The sub-period results listed in Panel B confirm the insignificance of these performance differentials over time. Further, index funds included as plan options were typically able to produce returns that meet or exceed expectations about 25% of the time. If nothing else, this underscores the effect that expenses have on investment products that follow a passive mandate. While the out-of-sample alpha differential findings in Panel C vary greatly by factor model they do suggest a positive and meaningful separation in performance between plan and non-plan passive funds that favours the former when the multi-factor return-generating models are used.

Table 4 Risk-adjusted performance of plan and non-plan investment options: actively managed options

Option description	*Obs.*	*One-factor model*			*Three-factor model*			*Four-factor model*		
		Mean	*Median*	*% Pos.*	*Mean*	*Median*	*% Pos.*	*Mean*	*Median*	*% Pos.*
Panel A: In-sample alphas; full period (January 2000 to June 2007)										
Alpha: all options	10,368	–0.0272	–0.0797	39.97	–0.1143	–0.0942	36.24	–0.1101	–0.0921	36.44
Alpha: plan options	1,350	–0.0051	–0.0269	45.68	–0.0285	–0.0193	45.93	–0.0246	–0.0153	46.07
Alpha: non-plan options	9,018	–0.0305	–0.0901	39.12	–0.1271	–0.1074	34.79	–0.1229	–0.1048	35.00
Difference		0.0254	0.0632	6.56	0.0986	0.0881	11.14	0.0983	0.0895	11.07
p-value		*0.1145*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*
Panel B: In-sample alphas; three sub-periods										
(i) January 2000 to June 2002										
Alpha: plan options	209	0.3925	0.2269	66.67	0.0979	0.1259	61.72	0.0982	0.1187	59.81
Alpha: non-plan options	2,918	0.1524	0.0155	51.08	–0.0952	–0.0158	48.25	–0.0919	–0.0288	47.36
Difference		0.2401	0.2114	15.59	0.1931	0.1417	13.47	0.1901	0.1475	12.45
p-value		*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0003*	*0.0002*	*0.0001*	*0.0008*	*0.0005*
(ii) July 2002 to December 2004										
Alpha: plan options	485	–0.0285	–0.0288	47.01	–0.1303	–0.0873	35.05	–0.1307	–0.0902	34.43
Alpha: non-plan options	3,695	–0.1023	–0.1334	35.19	–0.2045	–0.1934	23.49	–0.2029	–0.1915	23.49
Difference		0.0738	0.1046	11.82	0.0742	0.1061	11.56	0.0722	0.1013	10.94
p-value		*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*
(iii) January 2005 to June 2007										
Alpha: plan options	656	–0.1097	–0.0491	38.26	0.0065	–0.0082	48.93	0.0148	0.0010	50.31
Alpha: non-plan options	2,405	–0.1413	–0.0907	30.68	–0.0470	–0.0574	35.80	–0.0376	–0.0510	37.67
Difference		0.0316	0.0416	7.58	0.0535	0.0492	13.13	0.0524	0.0520	12.64
p-value		*0.0117*	*0.0001*	*0.0002*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*
Panel C: Out-of-sample aggregated alphas; truncated full period (January 2002 to June 2007)										
Alpha diff: [plan – non-plan]	60	0.0639	0.0446	66.67	0.0625	0.0500	68.33	0.0634	0.0503	71.67
p-value		*0.0005*	*0.2097*	*0.0098*	*0.0005*	*0.0237*	*0.0043*	*0.0015*	*0.0382*	*0.0008*

Notes: In-sample risk-adjusted performance (i.e., alpha) statistics are reported for the complete collection of plan and non-plan investment options that were actively managed over the period January 2000 to June 2007 (Panel A) and three sub-periods: (i) January 2000 to June 2002; (ii) July 2002 to December 2004; and (iii) January 2005 to June 2007 (Panel B). Alphas were calculated relative to three versions of the factor model in (1): (i) a one-factor model using ($R_m - RF$); (ii) a three-factor model using ($R_m - RF$), SMB, and HML; and (iii) a four-factor model using ($R_m - RF$), SMB, HML, and MOM. Statistics indicating the difference in performance between plan and non-plan options and the associated p-values are reported in the last two rows for each sample period. Panel C reports mean, median, and (% Positive) statistics for the differences between plan and non-plan option alphas estimated out-of-sample using a modified version of the Fama-MacBeth two-stage technique and aggregated over the 60 monthly cross-sections from July 2002 to June 2007.

Table 5 Risk-Adjusted performance of plan and non-plan investment options: passively managed options

Option description	*Obs.*	*One-factor model*			*Three-factor model*			*Four-factor model*		
		Mean	*Median*	*% Pos.*	*Mean*	*Median*	*% Pos.*	*Mean*	*Median*	*% Pos.*
Panel A: In-sample alphas; full period (January 2000 to June 2007)										
Alpha: all options	168	–0.0491	–0.0718	26.79	–0.0458	–0.0772	29.76	–0.0465	–0.0794	29.76
Alpha: plan options	138	–0.0894	–0.0685	25.36	–0.0519	–0.0766	28.99	–0.0520	–0.0794	28.99
Alpha: non-plan options	30	0.1362	–0.0886	33.33	–0.0177	–0.0892	33.33	–0.0209	–0.0795	33.33
Difference		0.0468	0.0201	–7.97	–0.0342	0.0126	–4.34	–0.0311	0.0001	–4.34
p-value		*0.0022*	*0.4218*	*0.3730*	*0.3283*	*0.6879*	*0.6379*	*0.3715*	*1.000*	*0.6379*
Panel B: In-sample alphas; three sub-periods										
(i) January 2000 to June 2002										
Alpha: plan options	7	0.2440	–0.0590	28.57	0.1436	0.1419	57.14	0.1387	0.1120	57.14
Alpha: non-plan options	10	0.6101	0.3166	50.00	0.1345	0.1266	80.00	0.1261	0.1004	80.00
Difference		–0.3661	–0.3756	–21.43	0.0091	0.0153	–22.86	0.0126	0.0116	–22.86
p-value		*0.3941*	*0.7782*	*0.3914*	*0.9519*	*0.4990*	*0.3234*	*0.9307*	*0.4990*	*0.3234*
(ii) July 2002 to December 2004										
Alpha: plan options	50	–0.0556	–0.1312	40.00	–0.0970	–0.0897	24.00	–0.0986	–0.0899	24.00
Alpha: non-plan options	11	–0.0773	–0.1624	36.36	–0.1160	–0.1093	9.09	–0.1145	–0.1103	9.09
Difference		0.0217	0.0312	3.64	0.0190	0.0196	14.91	0.0159	0.0204	14.91
p–value		*0.7392*	*0.7866*	*0.8246*	*0.7567*	*0.1114*	*0.2783*	*0.7978*	*0.1114*	*0.2783*
(iii) January 2005 to June 2007										
Alpha: plan options	81	–0.1391	–0.0680	16.05	–0.0410	–0.0711	29.63	–0.0397	–0.0773	29.63
Alpha: non-plan options	9	–0.1294	–0.0821	11.11	–0.0668	–0.1056	11.11	–0.0697	–0.1084	11.11
Difference		–0.0097	0.0141	4.94	0.0258	0.0345	18.52	0.0300	0.0311	18.52
p–value		*0.8978*	*0.2945*	*0.6998*	*0.4712*	*0.7268*	*0.2419*	*0.4190*	*0.7268*	*0.2419*
Panel C: Out-of-sample aggregated alphas; truncated full period (January 2002 to June 2007)										
Alpha diff: [plan – non-plan]	60	0.0448	–0.0032	48.33	0.0905	0.0479	61.67	0.1158	0.1025	65.00
p–value		*0.5257*	*0.3502*	*0.7963*	*0.0216*	*0.3061*	*0.0707*	*0.0068*	*0.2591*	*0.0201*

Notes: In-sample risk-adjusted performance (i.e., alpha) statistics are reported for the complete collection of plan and non-plan investment options that were passively managed over the period January 2000 to June 2007 (Panel A) and three sub-periods: (i) January 2000 to June 2002; (ii) July 2002 to December 2004; and (iii) January 2005 to June 2007 (Panel B). Alphas were calculated relative to three versions of the factor model in (1): (i) a one-factor model using $(R_m - RF)$; (ii) a three-factor model using $(R_m - RF)$, SMB, and HML; and (iii) a four-factor model using $(R_m - RF)$, SMB, HML, and MOM. Statistics indicating the difference in performance between plan and non-plan options and the associated p-values are reported in the last two rows for each sample period. Panel C reports mean, median, and (% Positive) statistics for the differences between plan and non-plan option alphas estimated out-of-sample using a modified version of the Fama-MacBeth two-stage technique and aggregated over the 60 monthly cross-sections from July 2002 to June 2007.

The overall inference that can be drawn from the combined results listed in Table 4 and Table 5 is that sponsors do appear to be adept at selecting actively managed funds to offer to participants in their defined contribution plans, but that they show no consistently demonstrable skills when choosing among the set of available index fund alternatives. As such, in addition to finding support for our second hypothesis, we also reject our third proposition that the passively managed plan funds produce better risk-adjusted returns than otherwise comparable non-plan index funds. This might not be an unexpected outcome: the potential value added to the plan participant in having sponsors spend their time analysing active funds rather than passive ones is undoubtedly greater. Based on this evidence, we can therefore narrow our earlier conclusion regarding the superior fund selection skills of the sponsors in our sample to include just those potential plan options that have an active management mandate.

6 Public vs. privately managed plan options: cross-sectional differences

Hypothesis 4 stated that managers of privately held accounts would generate superior risk-adjusted returns relative to otherwise comparable public funds, due to the ex ante advantages they enjoy (e.g., lower expenses, more predictable cash inflows). To test this supposition formally, Table 6 reports statistics summarising the alpha differentials between the privately and publicly managed funds constituting the set of actively managed plan options. For the sake of brevity, the display only lists findings for the entire sample period, but pools the risk-adjusted performance statistics in two different ways:

1 equally weighted abnormal returns

2 participant-weighted abnormal returns.

As before, both in-sample alphas and out-of-sample aggregated alpha differentials are calculated for the public and private active plan option subsamples.[14]

Panel A shows the set of performance measures pooled on an equally weighted basis. This portfolio formation method implicitly assigns the same level of importance to each plan option regardless of the degree to which participants actually invest in it. The in-sample alpha results (Panel A.1) indicate little difference in performance between actively managed private and public funds. In fact, the three- and four-factor versions of equation (1) lead to insignificant average performance differentials of approximately minus one basis point per month, with only modest differences in the (% Pos.) variable. Conversely, the one-factor model produces a slightly positive (although insignificant) performance advantage for the public funds over private managers. The out-of-sample aggregated alpha differential results (Panel A.2) –particularly the mean and (% Pos.) statistics – do indicate a slight positive performance increment generated by privately managed accounts. However, most of these alpha differentials remain statistically insignificant. Thus, the evidence in Panel A does not provide strong support for an investment advantage enjoyed by either management type and, as such, fails to support the superiority of privately managed accounts.

Table 6 Risk-adjusted performance of actively managed plan options: public vs. private funds

Option description	*Obs.*	*One-factor model*			*Three-factor model*			*Four-Factor model*		
		Mean	*Median*	*% Pos.*	*Mean*	*Median*	*% Pos.*	*Mean*	*Median*	*% Pos.*
Panel A: Equal-weighted averages										
A.1: In-sample alphas; full period (January 2000 to June 2007)										
Alpha: all active options	1,350	–0.0051	–0.0269	45.68	–0.0285	–0.0193	45.93	–0.0246	–0.0153	46.07
Alpha: active public	1,003	–0.0022	–0.0432	43.42	–0.0308	–0.0225	46.76	–0.0274	–0.0230	46.26
Alpha: active private	347	–0.0137	0.0070	52.16	–0.0220	–0.0161	43.52	–0.0165	–0.0116	45.53
Difference		0.0115	–0.0502	–8.74	–0.0088	–0.0064	3.24	–0.0109	–0.0114	0.73
p-value		*0.6756*	*0.0034*	*0.0049*	*0.6817*	*0.4935*	*0.2961*	*0.6077*	*0.1522*	*0.8146*
A.2: Out-of-sample aggregated alphas; truncated full period (January 2002 to June 2007)										
Alpha differential: [active public – active private]	60	–0.0815	–0.0621	40.00	–0.0505	–0.0444	45.00	–0.0476	–0.0268	41.67
p-value		*0.1041*	*0.0484*	*0.1213*	*0.1876*	*0.1757*	*0.4386*	*0.2223*	*0.1306*	*0.1967*
Panel B: Participant-weighted averages										
B.1: In-sample alphas; full period (January 2000 to June 2007)										
Alpha: active public	1,003	–0.0125	–-0.0662	44.53	0.0102	0.0515	58.50	0.0168	0.0568	58.15
Alpha: active private	347	–0.0048	–0.0195	47.17	–0.0089	–0.0160	43.81	–0.0032	–0.0098	46.36
Difference		–0.0077	–0.0467	–2.64	0.1101	0.0675	14.69	0.0200	0.0666	11.79
p-value		*0.8773*			*0.6420*			*0.6146*		
B.2: Out-of-sample aggregated alphas; truncated full period (January 2002 to June 2007)										
Alpha differential: [active public – active private]	60	–0.0356	–0.0295	48.33	0.0208	0.0324	56.67	0.0227	0.0282	56.67
p-value		*0.3310*	*0.1774*	*0.7963*	*0.5214*	*0.4311*	*0.3017*	*0.5076*	*0.6989*	*0.3017*

Notes: Risk-adjusted performance (i.e., alpha) statistics are reported for the sample of actively managed plan investment options according to whether the fund was (i) privately managed in an institutional account; or (ii) managed in a public fund. In-sample alphas were computed over the full period from January 2000 to June 2007 while out-of sample alphas were generated using a modified version of the Fama-MacBeth two-stage technique and aggregated over the 60 monthly cross sections from July 2002 to June 2007. All alphas were calculated relative to one-, three- and four-factor versions of the model in (1). Summary performance measures were pooled in two ways: (i) equally weighted (Panel A); and (ii) participant-weighted (Panel B. Mean, median, and (% Positive) statistics indicating the difference in performance between public and private active plan options and the associated p-values are reported in the last two rows for the in-sample alphas; similar statistics are reported for the out-of-sample alpha differential between public and private active funds.

In fact, if the performance statistics are tabulated on the basis of how the typical plan participant actually allocates within the plan (Panel B), the preponderance of the evidence appears to be more consistent with the alternative story that mutual fund managers produce slightly better risk-adjusted returns than private managers. For example, when either multi-factor version of the risk model is employed to calculate in-sample alphas (Panel B.1), the median performance differential in favour of mutual funds is about seven basis points per month. Further, more than half of the public managers produced positive alphas, while more than half of the private managers failed to do so (e.g., 58.50% positive alphas in mutual funds vs. 43.81% in institutional accounts using the three-factor model in the asset-weighted sample).[15]

Additionally, both the mean and median out-of-sample alpha differentials (Panel B.2) from the multi-factor versions of equation (1) are positive – with a single exception – although at far more modest and insignificant levels. Generally, slightly more than half of these performance differentials are positive (e.g., 56.67% of the out-of-sample differentials exceed zero, using the three- and four-factor models). Consequently, compared to the mixed evidence from the equally weighted sample, the participant-weighted findings suggest that plan participants are able to identify the better funds when deciding where they should actually invest their money. Thus, not only do the earlier results indicate that plan sponsors exhibit positive manager selection skills when choosing their plan option menus, but it may also be the case the investors who use those menus to allocate their retirement savings exhibit positive selection skills of their own.

It is tempting on the basis of the findings in the bottom panel of Table 6 to conclude that the typical manager of a public plan fund possesses somewhat elevated security skills relative to the typical private plan fund manager. However, there are at least two reasons that argue against that judgment. First, the statistical evidence is not especially strong; in fact, the alpha differentials from the one-factor model actually contradict that conclusion.[16] Second, even if these performance statistics capture legitimate return differentials, it is possible that they merely reflect disparities in the operating conditions or investment restrictions imposed on public and private accounts, rather than disparate levels of investment prowess. Although our data do not permit us to differentiate between those possibilities directly, it is nonetheless true that defined contribution plan participants do not appear to be incrementally benefited by their selection of private fund managers, in contrast to the prediction of Hypothesis 4.[17]

7 Concluding comments

Although the size and scope of the market for retirement assets has fostered a considerable amount of research, the vast majority of that literature has been concentrated on the portfolio choices that investors make as well as the investment performance associated with those decisions. Of course, the choices that participants make are a direct function of the set of alternatives they are offered, but far less is known about the motivation and performance of the sponsors who provide those choices. In this paper we posit and test several hypotheses concerning the quality of the investment options that sponsors made available to their participants compared to those that they did not. Using a comprehensive and proprietary database maintained by the largest service provider in the defined contribution industry, we demonstrate that the investment options included in

plans outperform an otherwise comparable set of non-plan alternatives by an average of 1.22% on an annualised basis, an incremental amount that is both net of fees and adjusted for risk. This performance advantage is:

1 spread fairly uniformly across equity style classes

2 is not particularly sensitive to the nature of the risk-adjustment process

3 was present, albeit in different degrees, across all sub-intervals of the overall sample period.

Further, we show that the sources of this outperformance are the actively managed funds that sponsors select and, to a far lesser extent, the public fund products they choose, despite the apparent advantages that privately managed accounts appear to enjoy. We conclude that plan sponsors possess genuine selection skills with regard to the menu of investment options they offer to their participants.

Our analysis also suggests some potentially fruitful directions for future research. We have concentrated on the equity fund selections made by plan sponsors, which is likely to be the asset class for which there is the largest possible benefit in deploying superior selection skills. Even so, the same set of hypotheses that we test in this study could be applied to fixed-income, cash-equivalent, or even life-cycle and tactical asset allocation funds. Further, it would be interesting to consider how frequently sponsors feel compelled to adjust the set of available plan options and what the economic and behavioural determinants underlying that decision might be.

Beyond that, it is possible that cross-sectional variations in the set of plan options offered by sponsoring firms are related to differences in various dimensions summarizing their corporate profiles (e.g., industry affiliation, market capitalisation, employee base). Said differently, do General Electric, Microsoft, and Whole Foods Market face comparable decisions when designing their defined contribution plans? In this context, it may be the case that the need to hedge labour income risk influences the selection process. Finally, it is likely that managers in the defined contribution market are subject to the same sort of agency problems of the type identified by Brown et al. (1996) and it would be useful to consider how those incentives might impact performance, particularly with regard to differences between funds available to the general public and those accounts that are privately managed. However, these issues are well beyond the scope of the present investigation and will be left for future consideration.

Acknowledgements

We are grateful for the comments of Bing Han, Jay Hartzell, Jennifer Huang, Joachim Inkmann, John Kimpel, Clemens Sialm, Laura Starks, Sheridan Titman and Hanjiang Zhang. We would also like to thank Jim Laiosa for his invaluable computational assistance. We have benefited from the contributions of seminar participants at the University of Texas and the Financial Management Association-Europe meetings. The opinions and analyses presented herein are those of the authors and do not necessarily represent the views of Putnam Investments.

References

Agnew, J., Balduzzi, P. and Sunden, A. (2003) 'Portfolio choice and trading in a large 401(k) plan', *American Economic Review*, Vol. 93, pp.193–215.

Almazan, A., Brown, K., Carlson, M. and Chapman, D. (2004) 'Why constrain your mutual fund manager?', *Journal of Financial Economics*, Vol. 73, pp.289–321.

Baker, A., Logue, D. and Rader, J. (2005) Managing Pension and Retirement Plans: A Guide for Employers, Administrators, and Other Fiduciaries, Oxford University Press, New York.

Baker, M., Litov, L., Wachter, J. and Wurgler, J. (2010) 'Can mutual fund managers pick stocks?: Evidence from their trades prior to earnings announcements', *Journal of Financial and Quantitative Analysis*, Vol. 45, pp.1111–1131.

Benartzi, S. and Thaler, R. (2001) 'Naïve diversification strategies in defined contribution savings plans', *American Economic Review*, Vol. 91, pp.79–98.

Brown, J., Liang, N. and Weisbenner, S. (2006) '401(k) matching contributions in company stock: costs and benefits for firms and workers', *Journal of Public Economics*, Vol. 90, pp.1315–1346.

Brown, K., Harlow, V. and Starks, L. (1996) 'Of tournaments and temptations: an analysis of managerial incentives in the mutual fund industry', *Journal of Finance*, Vol. 51, pp.85–110.

Brown, S. and Goetzmann, W. (1995) 'Performance persistence', *Journal of Finance*, Vol. 50, pp.679–698.

Carhart, M. (1997) 'On persistence in mutual fund performance', *Journal of Finance*, Vol. 52, pp.57–82.

Chen, H., Jegadeesh, R. and Wermers, R. (2000) 'The value of active mutual fund management: an examination of the stockholdings and trades of mutual fund managers', *Journal of Financial and Quantitative Analysis*, Vol. 35, pp.343–368.

Cohen, L. and Schmidt, B. (2009) 'Attracting flows by attracting big clients', *Journal of Finance*, Vol. 64, pp.1225–1252.

Cronqvist, H. and Thaler, R. (2004) 'Design choices in privatized social security systems: learning from the Swedish experience', *American Economic Review*, Vol. 94, pp.425–428.

DeMiguel, V., Garlappi, L. and Uppal, R. (2009) 'Optimal versus naïve diversification: how inefficient is the *1/N* portfolio strategy?', *Review of Financial Studies*, Vol. 22, pp.1915–1953.

Elton, E., Gruber, M. and Blake, C. (2006) 'The adequacy of investment choices offered by 401(k) plans', *Journal of Public Economics*, Vol. 90, pp.1299–1314.

Elton, E., Gruber, M. and Blake, C. (2007) 'Participant reaction and the performance of funds offered by 401(k) plans', *Journal of Financial Intermediation*, Vol. 16, pp.249–271.

Fama, E. and French, K. (1993) 'Common risk factors in the returns on bonds and stocks', *Journal of Financial Economics*, Vol. 33, pp.3–53.

Fama, E. and MacBeth, J. (1973) 'Risk, return, and equilibrium: Empirical tests', *Journal of Political Economy*, Vol. 81, pp.607–636.

Goyal, A. and Wahal, S. (2008) 'The selection and termination of investment management firms by plan sponsors', *Journal of Finance*, Vol. 63, pp.1805–1847.

Guedj, I. and Huang, J. (2009) 'Are ETFs replacing index mutual funds?', University of Texas working paper.

Harlow, V. and Brown, K. (2006) 'The right answer to the wrong question: identifying superior active portfolio management', *Journal of Investment Management*, Vol. 4, pp.15–40.

Huberman, G. (2001) 'Familiarity breeds investment', *Review of Financial Studies*, Vol. 14, pp.659–680.

Huberman, G. and Jiang, W. (2006) 'Offering versus choice in 401(k) plans: equity exposure and number of funds', *Journal of Finance*, Vol. 61, pp.763–801.

Investment Company Institute (2011) *The Investment Company Fact Book*, Vol. 51, pp.1–236.

Jegadeesh, N. and Titman, S. (1993) 'Returns to buying winners and selling losers: implications for stock market efficiency', *Journal of Finance*, Vol. 48, pp.65–91.

McGill, D., Brown, K., Haley, J. and Schieber, S. (2005) *Fundamentals of Private Pensions*, 8th ed., Oxford University Press, New York.

Parwada, J. and Faff, R. (2005) 'Pension plan investment management mandates: an empirical analysis of manager selection', *Journal of Financial Services Research*, Vol. 27, pp.77–98.

Pension and Welfare Benefits Administration (1998) *Study of 401(k) Plan Fees and Expenses*, US Department of Labor contract report.

Poterba, J. (2003) 'Employer stock and 401(k) plans', American *Economic Review*, Vol. 93, pp.398–404.

Notes

1 Elton et al. (2007) also documented that plan funds outperformed non-plan, non-index funds by roughly the amount of the fee differential (1.9 basis points) that existed between the two samples, raising the possibility that the 'skill' plan sponsors possess simply amounts to selecting lower-cost funds.

2 The preceding description is an overview of an extremely complex subject and is merely intended to focus the discussion on the specific issue at hand; for more details, see Baker et al. (2005).

3 Formally, a fiduciary in this context is any entity that has control over the management of an employee benefit plan or its assets. Although compliance with Section 404(c) allows the plan sponsor to avoid being responsible for the ultimate investment decisions of the plan participants (i.e., choosing one investment option over another available one), they still have fiduciary responsibility for selecting the menu of available plan options. Further, under ERISA, all actions taken by a fiduciary must be for the exclusive benefit of plan participants and beneficiaries and fiduciaries must exercise the care, skill, and diligence that would be used by a reasonably prudent person familiar with such matters. See McGill et al. (2005) for a more complete discussion of both the responsibilities of fiduciaries and the rights of participants in the pension plan market.

4 It is not universally accepted that more is better than fewer when it comes to the number of investment alternatives included in a retirement plan. Cronqvist and Thaler (2004) suggest that having to select among a large number of options can make an already complex portfolio choice problem unduly complicated for many unsophisticated participants.

5 Recall that the plan administrator performs a separate and very different function than the plan investment managers. Although the reported data are provided by a single service provider, they represent the combined efforts of scores of different money management institutions. In fact, portfolio managers not employed by the investment arm of this service provider control 74.04% of all the plan options contained in the sample – both public funds and private accounts – a figure consistent with that organisation's market share in the money management industry as a whole. To insure that no implicit conflict of interests exist in our sample, we have replicated the entire empirical analysis described below with the subset of plan options created by removing all funds associated with the service provider. This adjustment had no material impact on the findings or conclusions.

6 More formally, an institutionally managed (i.e., private) account is defined as any plan option that is not available to retail investors in the form of a public mutual fund or closed-end fund. While investment managers can provide both private and public versions of the same portfolio strategy, the management of these options may differ in material ways, such as portfolio turnover and rebalancing policies. However, the institutionally managed account will typically have lower fees due to the economies of scale related to a larger investment position and relationship with the plan sponsor in a single account rather than in large numbers of retail accounts.

7 It is entirely possible that some of the funds included in our non-plan option sample were available choices in other defined contribution plans for which the service provider supplying our data was not the record-keeper. However, this possibility does not conflict with the fact these funds were not selected as options by the sponsors that we actually investigate. Consequently, there is no overlap between the investment options we placed in our plan and non-plan samples.

8 The factor return data required for the estimation of equation (1) were obtained from Ken French and Eugene Fama via the website http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

9 We have also produced a full set of the findings discussed in the next section using the three different non-plan option samples that result from applying the '$R^2 > 0.75$' inclusion rule independently to each of the three versions of equation (1). Although this procedure generated slightly different non-plan sample sizes, it had no appreciable impact on the reported outcomes.

10 The mean alpha differential test was conducted as a standard difference-in-means t-test, adjusting for the unequal sizes of the plan and non-plan sub-samples. The median alpha differential tests were conducted using the Mann-Whitney procedure. The (% Pos.) differential test was conducted as a chi-squared test on the difference in proportions in two samples.

11 To minimise the impact of outliers in this relatively small set of observations, we Winsorized the data distribution at the 90% level [i.e., the bottom (top) three observations in the rank-ordered distribution were set equal to the fourth-from-bottom (-top) observation] before performing the mean value significance test.

12 Due to correlation among the factor loadings, it is unlikely that this sorting procedure will ever produce bins of equal size in any given sample. That is, if low-SMB beta options in the non-plan sample also tend to have low MOM factor exposures, the [Low SMB, Low MOM] bins will be more heavily populated than the [High SMB, High MOM] bins. Thus, this sorting method controls for differences that may exist in the factor loading patterns of the plan and non-plan samples.

13 Two other details of this matching process are worth noting. First, the sequential selection of nearest neighbours from the non-plan option sample was done with replacement, which eliminated the possibility that the results could be influenced by where the selection procedure started in the plan option sample. Second, we also repeated the entire matching process using a variation of (2) that minimised the sum of the squared deviations in plan and non-plan factor loadings, which produced no material difference in the findings relative to those reported in Panel B of Table 3.

14 For the out-of-sample alpha differentials, the three ways of pooling risk-adjusted performance affected the way in which the monthly cross-sectional portfolios were formed (i.e., Step 5 of the modified Fama-MacBeth procedure in Section 5.1.2 was replicated using participant-weighted portfolios in addition to equally weighted ones.)

15 We also calculated the performance statistics in Table 6 on the basis of how total plan assets are allocated across the entire sample. These asset-weighted average results are quite similar to the participant-weighted averages reported in Panel B and are therefore not listed in the display.

16 Because the participant-based pooling methods in Panel B.1 represents a weighted average, notice that it is only possible to calculate p-values for the mean in-sample alpha difference tests, which have been appropriately adjusted for each weighting scheme.

17 Although not reported here, we have also examined the role played by other potential cross-sectional determinants for plan option performance, including the total market value of holdings in a particular option (MKTVAL), the number of distinct plans holding an option (PLANFRQ), and the number of participants across all plans who select an option (PARTFRQ). In general, we found statistically significant correlations between ALPHA and both MKTVAL (0.1078) and PLANFRQ (0.0886), suggesting that participants tend to invest in those funds producing the best performance.