JOURNAL OF INVESTMENT MANAGEMENT, Vol. 16, No. 3, (2018), pp. 31–45

www.joim.com

DEFINED CONTRIBUTION PENSION PLANS AND MUTUAL FUND FLOWS

Clemens Sialm[a], *Laura Starks*[a] *and Hanjiang Zhang*[b]

Defined contribution (DC) pension plans constitute an important component of mutual fund assets. Flows into DC plans depend on the decisions of plan sponsors and plan participants: The sponsors select the investment menus made available to employees and the participants decide how to allocate their retirement savings across the investment options. We examine the flows to mutual funds within DC pension plans and contrast these flows with flows from other mutual fund clienteles. We find that flows into funds from DC plans exhibit more performance sensitivity than do flows from non-DC investors.

1 Introduction

Retirement plans have become an important source of assets for the mutual fund industry with 46% of the $16.3 trillion in mutual fund assets deriving from IRAs and defined contribution (DC) plans at the end of 2016.[1] While IRA holders are typically direct mutual fund investors, the structure of DC plans leads to a different two-step decision process. That is, generally DC plan sponsors select the investment options offered on a menu for the DC plan participants who then choose in a second step the asset allocations across investment options for their own retirement accounts. This two-step process implies that mutual funds held in DC plans exhibit different flow patterns from mutual funds that are directly held by investors.

In an article published in the *Journal of Finance*, we show that these different patterns exist between flows from the two sources.[2] The mutual fund assets derived from the DC plans behave very differently from non-DC assets and not always in ways that would be expected. It has been well documented that participants in DC plans display inertia toward their retirement accounts, rarely adjusting their portfolio allocations, which suggests little flow movement in the mutual funds in which they have invested.[3] This behavior also suggests that these participants would not be discerning about their investment choices and might consequently fare worse than other mutual fund

[a]Department of Finance, McCombs School of Business, University of Texas at Austin, USA.
[b]Division of Finance and Management Science, Carson College of Business, Washington State University, USA.

investors. However, we provide evidence that the converse for both of these propositions holds since the DC participants' inertia is actually offset by the actions of their plan sponsors. That is, DC plan sponsors adjust the plan's menu of investment options, removing poorly performing funds and adding funds that have recently had better than average performance. When the funds are removed, participants' assets are usually transferred from the poorly performing funds to funds that have performed well recently. We find that the net flows of new money into mutual funds from DC plans are more volatile and exhibit more performance sensitivity than the flows from other mutual fund investors. Further, we provide evidence that these results can be attributed to the oversight and adjustments of plan sponsors.

In the research presented here we provide additional insights into the effects of DC plan assets on mutual funds by adding three more years of data and conducting additional analyses relative to our earlier paper (Sialm *et al.*, 2015b).

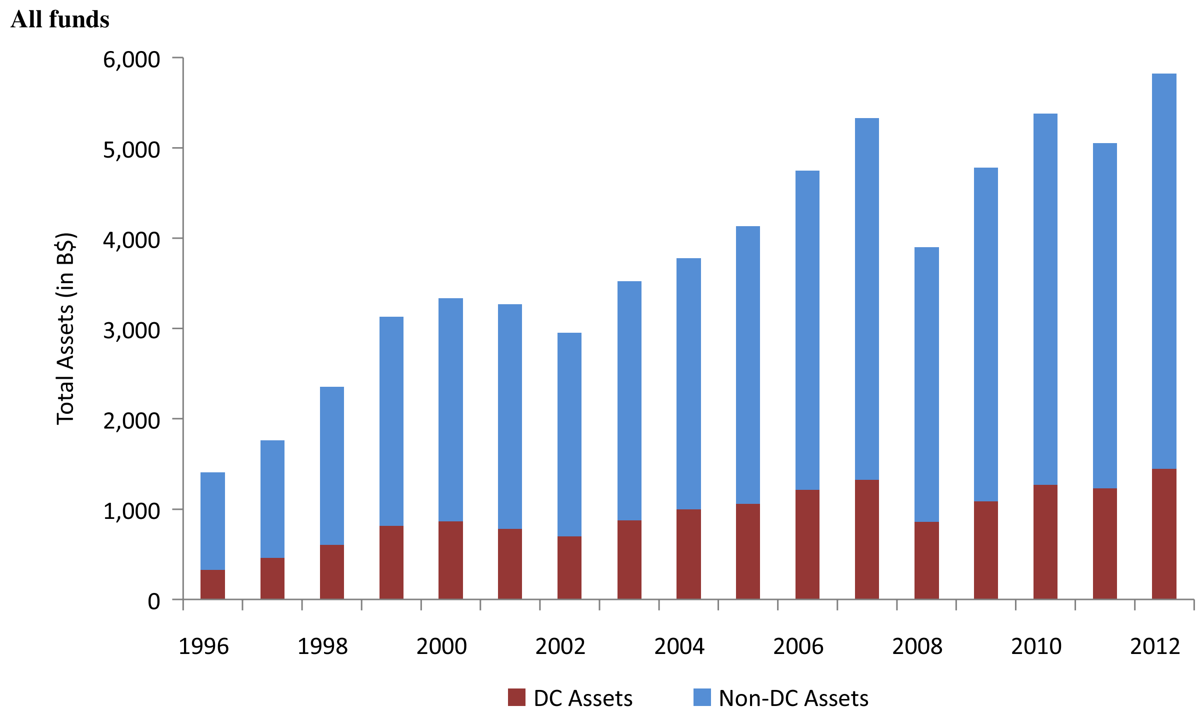
2 Data and summary statistics

In this section, we describe our data sources and report some summary statistics. We begin the analysis with annual surveys on DC retirement assets conducted by *Pensions & Investments* over the 1997 to 2013 time period.[4] These surveys detail the dollar amount of mutual fund assets held in DC retirement accounts. Although the mutual fund families are only asked to report for each asset class the amount of DC plan assets in their 12 funds with the most DC assets, these funds per family capture the majority of mutual funds in that family with DC assets.[5]

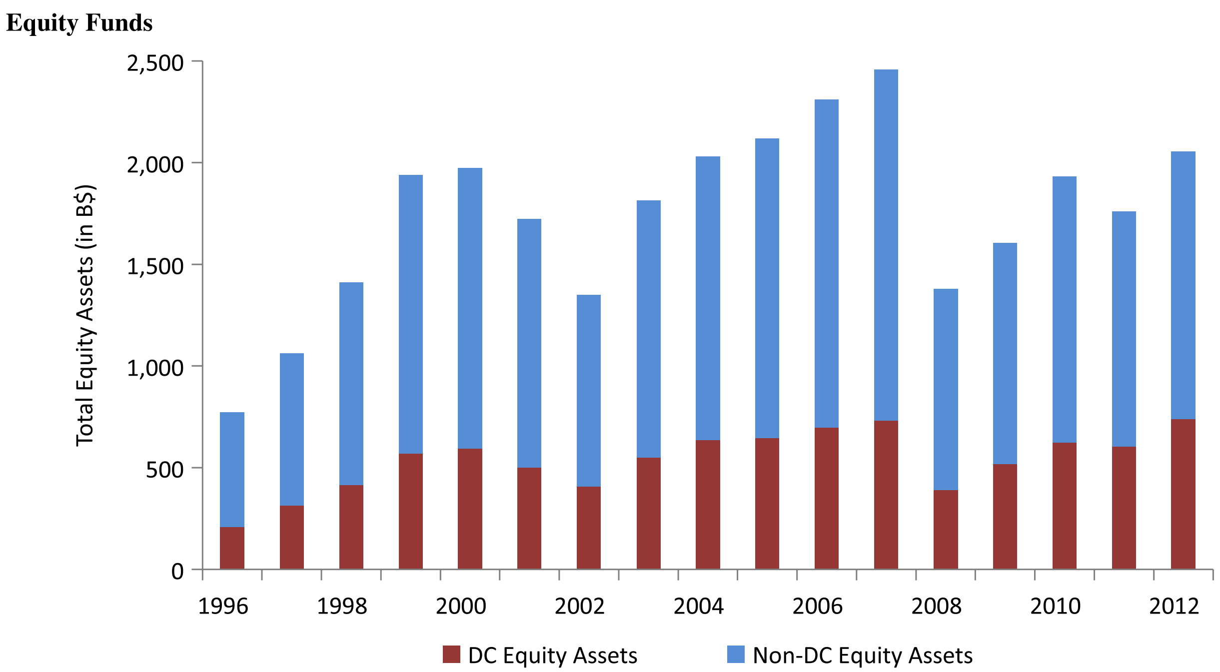
The growing importance of DC assets in these mutual funds can be seen in Figure 1, which demonstrates the annual values of total mutual fund assets and those mutual fund assets derived from DC plans over the 1996–2012 sample period. As shown, there exists strong growth in both total mutual fund assets and the portion that derives from DC accounts. Over this time period, the average growth rate of DC assets was 4% per year as compared to the average growth rate of non-DC assets at 2% per year. Further, the growth rate in DC assets was positive in every year with the exception of 2008. In contrast, the growth rate of non-DC assets is negative in 4 of the 16 years.

Figure 1 also indicates that DC plan influence has been particularly strong on equity mutual funds. On average, equity funds grew by 166% over the 1996–2012 period while the assets that derived from DC plans in these funds grew at an even faster rate of 256%. Thus, although in 1996, the DC plans constituted 27% of total assets under management in equity mutual funds, by 2012 they had become approximately 36% of those assets.[6]

In order to examine the differences in the DC and non-DC flows more thoroughly, we merge the DC assets data with data on mutual fund characteristics (fund returns, total assets under management, fees, and investment objectives) from the CRSP Survivorship Bias Free Mutual Fund database using fund ticker symbols and fund names. We also merge data from the Thomson Financial CDA/Spectrum holdings database using the MFLINKS file based on Wermers (2000) and available through Wharton Research Data Services (WRDS).[7] We focus in the remainder of our paper on equity funds because they constitute the mutual fund objective class most prevalent in DC menus.[8] We divide the equity mutual funds into three different groups according to their ratios of assets from DC plans. Specifically, we calculate the DC ratio, which is defined as the DC assets divided by the Total Net Assets (TNA) of a fund. Table 1 shows the characteristics of these three sets of funds. For each group, we



(a)



(b)

Figure 1 Defined contribution (DC) retirement plan assets in mutual funds.

This figure shows the total assets in mutual funds annually from 1996 to 2012 divided by whether they are DC assets or non-DC assets. (a) Includes all funds and (b) includes equity funds only.

Table 1 DC ratio summary statistics.

	Low-DC ratio	Mid-DC ratio	High-DC ratio
DC ratio (%)	5.63	20.85	52.82
Age since initiation (years)	16.58	18.44	15.25
Total Net Assets (B$)	1.95	4.54	5.41
Family total net assets (B$)	27.44	60.95	96.66
Expense ratio (%)	1.24	1.15	0.95
Turnover (%)	0.78	0.76	0.68
Number of stocks in portfolio	132.48	146.63	192.99

This table provides summary statistics for the sample of mutual funds over the 1996 to 2012 period divided by DC ratio quartiles. DC ratio is the percentage of fund assets held by DC accounts at the end of the year. The data on DC accounts are based on the annual surveys by *Pensions & Investments.* Fund size (total net assets), family size, age, expense ratio, turnover, monthly flows, standard deviation of flows, and number of stocks in portfolio are obtained from the CRSP mutual fund database.

calculate the annual cross-sectional averages of the mutual fund characteristics and then average across the sample period. In the lowest tercile of mutual funds, there are few assets from DC plans with an average of only 5.63%. In the second tercile the DC plan assets are higher at 20.85%, on average, of the mutual fund's assets. Finally the highest tercile has DC plan assets that average over half of the funds' assets at 52.82%. Table 1 indicates that funds with the highest amount of DC assets tend to be slightly younger funds, with more assets under management, and from the largest fund families. They also tend to have lower total expense ratios and portfolio turnover. These results suggest that DC pension plans consider newer investment styles, fund size, family size, the expense ratios their participants will encounter, and the funds' transaction costs as indicated by their portfolio turnover.

3 Flow–performance sensitivity

We employ two different methods for considering the magnitude of the funds' DC assets and flows. In the first method, we employ changes in DC assets from the *Pensions & Investments* data to calculate the annual percentage of flows into each fund from DC plans. We then take the difference between the funds' total assets and the DC assets to calculate the annual flows from non-DC assets for each fund and accordingly calculate the annual percentage changes in the non-DC assets. As pointed out further below, an advantage of this method is that since we have the same fund with DC flows and non-DC flows, we are controlling for all of the other differences across funds.[9]

In the second method, we focus on the percentage of assets from DC pension plans in each fund (the fund's DC ratio) and divide the funds into three groups by their DC ratios. We then analyze flows to each group of mutual funds.

3.1 Separating DC and non-DC flows

Using the definitions of flows from the first method, we examine the percentage flows from DC and non-DC assets separately and how these flows are related to the funds' previous return performance. Thus, we calculate the flow–performance sensitivity for each type of flow. We seek to determine whether the flow–performance sensitivity of DC assets differs from that of non-DC assets because of the potential difference in who is making the decisions on the mutual fund selections. Due to previous findings on the inertia in plan participants' allocation decisions, one could expect the DC asset flows to exhibit lower flow–performance sensitivity than the flows from investors who hold mutual funds directly (outside of retirement accounts) because the latter would change their holdings more frequently in the face of differences in fund return performance.

Alternatively, one could expect a higher flow–performance sensitivity if DC plan sponsors or their participants change their asset allocations based on prior fund performance more frequently than do the non-DC investors who hold the funds directly. We may expect this latter relationship to be stronger because DC plan sponsors tend to be diligent about monitoring their plan's menu of investment options, often adjusting the plan's menu by removing poorly performing funds. Typically, when an investment option is moved from the menu, the plan sponsor also moves their participants' assets from that fund to a higher performing replacement fund. This activity will strengthen the flow–performance sensitivity of funds with high amounts of DC assets.

To examine the flow–performance sensitivity of the changes in funds' DC and non-DC assets, we compute the annual percentage net flows (growth rates of new money) of DC and non-DC assets, separately, for each fund in our sample. We then estimate the relation of the fund's annual net flows with the fund's relative performance rank over the previous year. We first use the percentile performance rank a particular fund obtains as compared to all equity funds in the sample during a specific performance evaluation period with the rank of 0.01 being the worst performance and 1.00 being the best performance. We also control for the following fund characteristics: the logarithms of total DC and non-DC assets in the fund in the previous year, the lagged logarithm of the fund family total net assets, the logarithm of the amount of time since the fund's initiation, the fund's lagged expense ratio, the lagged annual turnover of the fund, the monthly return volatility over the prior year, the average contemporaneous flow of funds in the same style category, and year fixed effects.

Using this specification of percentile ranks for each fund, we calculate separate asset growth rates for DC assets and non-DC assets and display the results in Figure 2. The dots represent the average flows for each of the 100 performance groups in which the remaining covariates are evaluated at their sample means. The diamonds correspond to DC flows and the circles correspond to non-DC flows. The solid curves represent the least-squares cubic relations.

During our sample period, DC plans experienced rapid growth, which translated into rapid growth for the mutual funds in which these plans invested. Consequently, the curve for the DC assets is generally higher than the curve for the non-DC assets throughout the curves' range. Recall that since we have split all funds into their DC versus non-DC flows, the figure uses exactly the same set of funds in the two curves, so any differences between funds are filtered out. That is, the figure provides a comparison between flows from the different clienteles for identical funds, (e.g., same performance, same management team, same portfolio, and same age). Thus, the 100 fund-percentile portfolios in Figure 2 are exactly identical for the DC and non-DC samples. The DC asset curve shows more flow–performance sensitivity than does the non-DC asset curve, which is close to linear. That is, the DC asset curve shows more fund inflows for the highest performance (on the right side of the curves) and more fund outflows for the lowest performance (on the left side of the curves). It should also be noted that given the significant growth in DC assets over

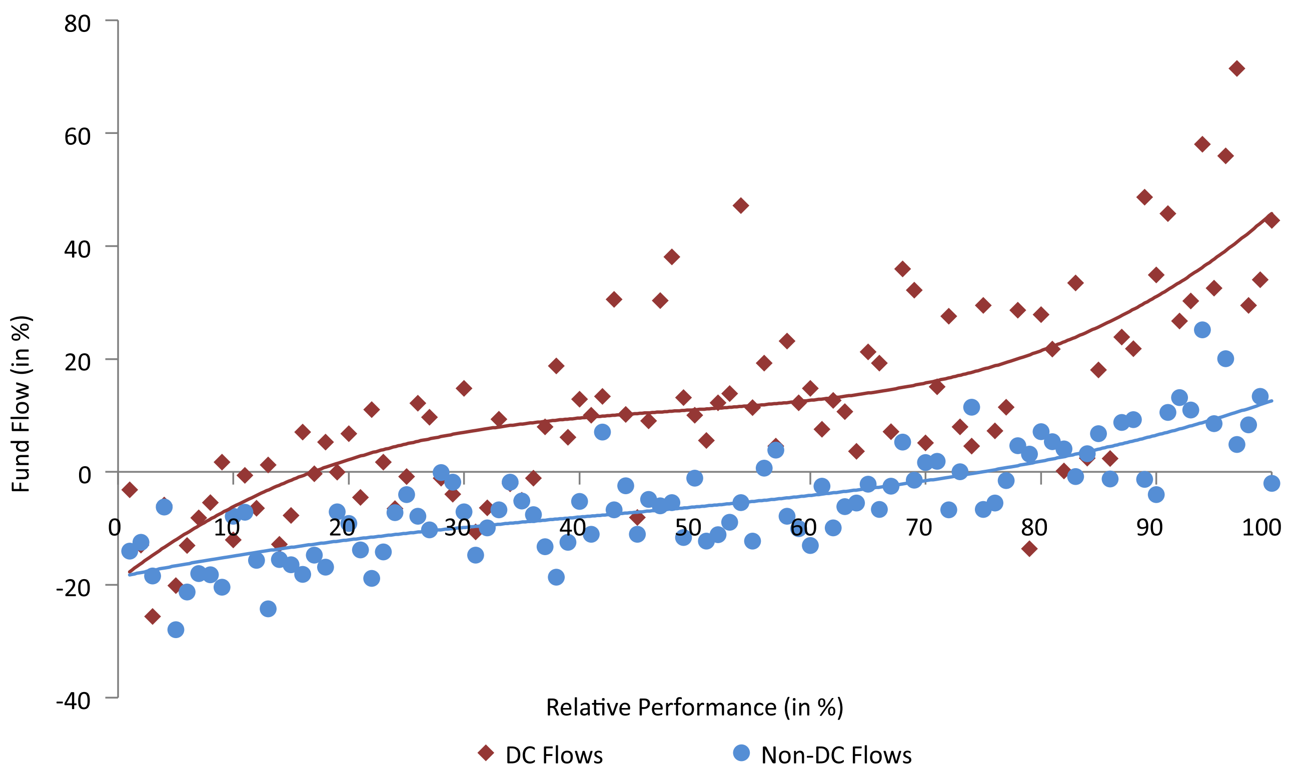


Figure 2 Flow–performance relation for percentile performance portfolios of DC and non-DC assets.
This figure shows the flow–performance relation for DC and non-DC assets in mutual funds. The dots represent the average flows for 100 performance groups, where the remaining covariates are evaluated at their sample means. Diamonds correspond to DC flows and circles correspond to non-DC flows. The solid curves show the least-squares cubic relations.

the time period, the small difference between the DC and non-DC flows in the bottom deciles of funds means that poor performance has particularly adverse effects. The poorly performing funds are losing out on the rapid growth in assets from DC plans that better-performing funds are experiencing.

We also estimate an alternative nonlinear functional form, a continuous piecewise linear specification following Sirri and Tufano (1998) where $Low_{f,t}$ captures the performance ranks of funds within the lowest quintile of returns, $Mid_{f,t}$ captures the ranks from the three middle quintiles and $High_{f,t}$ represents the ranks for the highest quintile of returns.[10] Table 2 shows the results of these panel regressions. In the first two columns, we report the coefficient estimates for the DC and non-DC percentage flows. In the third column we report the coefficient estimates for a regression in which the dependent variable equals the difference between the DC and the non-DC percentage flows. We report the standard errors, clustered at the fund level, in parentheses. The findings are striking in that the DC flow–performance relations for extreme performance quintiles are both economically and statistically significant. For the lowest and highest performance quintiles the DC and non-DC asset flows are significantly related to the performance of the funds, but as the difference shows, the sensitivity in each case is much higher for the DC flows. For the middle three quintiles of performance, although both DC and non-DC flows show significant sensitivity to performance, there is little difference between the two types of flows.

Table 2 Piecewise linear regressions of DC and non-DC flows on fund performance.

	DC flows	Non-DC flows	Difference in flows
Low performance	1.035***	0.316**	0.719***
	(0.273)	(0.137)	(0.278)
Mid performance	0.223***	0.216***	0.007
	(0.066)	(0.032)	(0.069)
High performance	1.531***	0.607***	0.923**
	(0.370)	(0.162)	(0.365)
Volatility of return	−0.069	−0.626**	0.557
	(0.754)	(0.303)	(0.695)
Log family size	0.041***	0.037***	0.004
	(0.011)	(0.006)	(0.010)
Log DC size	−0.124***	−0.004	−0.120***
	(0.013)	(0.006)	(0.012)
Log non-DC size	0.046***	−0.049***	0.095***
	(0.011)	(0.009)	(0.014)
Expense ratio	−0.370	−0.190	−0.180
	(0.440)	(0.209)	(0.387)
Log fund age	−0.057***	−0.019*	−0.039*
	(0.021)	(0.010)	(0.020)
Fund turnover	−0.004	−0.016**	0.013
	(0.018)	(0.008)	(0.016)
Style flow	0.566**	0.145	0.421*
	(0.223)	(0.117)	(0.237)
Observations	4,387	4,387	4,387
R-squared	0.111	0.108	0.065
Number of years	15	15	15

This table summarizes piecewise linear panel regressions of DC and non-DC asset flows into mutual funds based on fund performance for all funds. *Low*, *Mid*, and *High* represent the funds' ranked return performance, where $Low_{f,t} = \min(Rank_{f,t}, 0.2)$, $Mid_{f,t} = \min(Rank_{f,t} - Low_{f,t}, 0.6)$, and $High_{f,t} = (Rank_{f,t} - Low_{f,t} - Mid_{f,t})$. The regressions also include lagged fund characteristics and the contemporaneous flows to funds of the same style as control variables and time fixed effects. Standard errors are reported in parentheses and adjusted for clustering at the fund level. *, **, and *** denote estimates that are statistically different from zero at the 10%, 5%, and 1% significance levels, respectively.

The flow–performance relation for the DC assets in mutual funds shown in Table 2 differs substantially from the previous literature. Previous studies have found that mutual fund flows in general exhibit a convex flow–performance relation.[11] We find that the flows from DC plans are convex on the upside and concave on the downside, which appears to be the consequence of monitoring of mutual fund performance by the plan participants and sponsors, resulting in a more sensitive flow–performance relation for extreme performers. Sialm *et al.* (2015b) provide evidence that the sensitivity is largely due to changes in the investment options menu by the plan sponsors,

Table 3 Piecewise linear regressions of DC and non-DC flows on fund performance for funds divided at the median.

	Small funds			Large funds		
	DC flow	Non-DC flow	Difference	DC flow	Non-DC flow	Difference
Low performance	1.118**	0.346	0.772	1.009***	0.275**	0.735**
	(0.479)	(0.261)	(0.489)	(0.277)	(0.114)	(0.290)
Mid performance	0.291**	0.245***	0.046	0.188***	0.197***	−0.008
	(0.124)	(0.061)	(0.133)	(0.066)	(0.031)	(0.071)
High performance	1.971***	0.683***	1.288**	0.692*	0.439***	0.252
	(0.600)	(0.260)	(0.575)	(0.352)	(0.155)	(0.363)
Volatility of return	−1.448	−0.980*	−0.468	1.608**	−0.023	1.631***
	(1.284)	(0.548)	(1.204)	(0.659)	(0.248)	(0.628)
Log family size	0.039**	0.046***	−0.008	0.026**	0.010	0.016
	(0.019)	(0.009)	(0.018)	(0.011)	(0.007)	(0.010)
Log DC size	−0.145***	−0.009	−0.136***	−0.087***	0.004	−0.091***
	(0.019)	(0.008)	(0.018)	(0.014)	(0.007)	(0.014)
Log non-DC size	0.046***	−0.064***	0.110***	0.032***	−0.027	0.059***
	(0.018)	(0.012)	(0.020)	(0.012)	(0.017)	(0.018)
Expense ratio	−0.233	0.365	−0.598	−0.085	−0.916***	0.831**
	(0.695)	(0.331)	(0.592)	(0.390)	(0.213)	(0.389)
Log fund age	−0.095**	−0.039**	−0.055	−0.019	−0.003	−0.015
	(0.039)	(0.019)	(0.037)	(0.021)	(0.010)	(0.021)
Fund turnover	0.019	−0.011	0.030	−0.065***	−0.019*	−0.047**
	(0.024)	(0.010)	(0.021)	(0.021)	(0.010)	(0.020)
Style flow	0.420	−0.030	0.450	0.615***	0.292**	0.323
	(0.380)	(0.201)	(0.410)	(0.216)	(0.137)	(0.236)
Observations	1,980	1,980	1,980	2,407	2,407	2,407
R-squared	0.106	0.101	0.066	0.070	0.108	0.047
Number of years	15	15	15	15	15	15

This table summarizes piecewise linear panel regressions of DC and non-DC asset flows into mutual funds based on fund performance for funds divided at the median into two size groups. *Low*, *Mid*, and *High* represent the funds' ranked return performance, where $Low_{f,t} = \min(Rank_{f,t}, 0.2)$, $Mid_{f,t} = \min(Rank_{f,t} - Low_{f,t}, 0.6)$, and $High_{f,t} = (Rank_{f,t} - Low_{f,t} - Mid_{f,t})$. The regressions also include lagged fund characteristics and the contemporaneous flows to funds of the same style as control variables and time fixed effects. Standard errors are reported in parentheses and adjusted for clustering at the fund level. *, **, and *** denote estimates that are statistically different from zero at the 10%, 5%, and 1% significance levels, respectively.

suggesting that they are the major monitors of the fund performance.

We also consider how the flow–performance sensitivity of DC assets and non-DC assets changes across different size mutual funds. Table 3 reports the results from the regressions where we divide funds by size at the median. The size regressions indicate that DC flows into both large and small funds exhibit flow–performance sensitivity but the differences between the DC and non-DC flows in their sensitivity to performance are driven more by large funds for the flow differences in the low-performance quintile funds and

Table 4 Piecewise linear regressions of funds divided by DC ratios on fund performance.

	Low-DC ratio tercile	Mid-DC ratio tercile	High-DC ratio tercile
Low performance	0.018	0.027**	0.043**
	(0.013)	(0.013)	(0.017)
Mid performance	0.027***	0.021***	0.018***
	(0.003)	(0.003)	(0.002)
High performance	0.045***	0.062***	0.056***
	(0.016)	(0.013)	(0.013)
Volatility of return	−0.088***	−0.043	0.036
	(0.025)	(0.031)	(0.029)
Expense ratio	−0.032*	−0.020	−0.042***
	(0.018)	(0.016)	(0.015)
Log fund size	−0.003***	−0.002***	−0.002***
	(0.001)	(0.001)	(0.000)
Log family size	0.001**	0.002***	0.001***
	(0.001)	(0.001)	(0.000)
Log fund age	−0.003***	−0.003***	−0.002*
	(0.001)	(0.001)	(0.001)
Turnover	−0.000	−0.002***	−0.001
	(0.001)	(0.001)	(0.001)
Style flow	0.127*	0.280***	0.284***
	(0.072)	(0.071)	(0.066)
Observations	27,345	27,490	27,426
R-squared	0.084	0.077	0.054
Number of months	192	192	192

This table summarizes piecewise linear panel regressions of fund flows on fund performance for three different groups of funds based on their levels of DC ratios, where DC ratio 3 has the highest amount of DC assets and DC ratio 1 has the lowest. *Low*, *Mid*, and *High* represent the funds' ranked return performance, where $Low_{f,t} = \min(Rank_{f,t}, 0.2)$, $Mid_{f,t} = \min(Rank_{f,t} - Low_{f,t}, 0.6)$, and $High_{f,t} = (Rank_{f,t} - Low_{f,t} - Mid_{f,t})$. The regressions also include fund characteristics as control variables (lagged one year), the contemporaneous flows to funds of the same style and time fixed effects. Standard errors are reported in parentheses and adjusted for clustering at the fund level. *, **, and *** denote estimates that are statistically different from zero at the 10%, 5%, and 1% significance levels, respectively.

by small funds for the flow differences in the high-performance quintile funds. This differentiation makes sense as relatively larger funds are more likely to be already included on the DC plan menus and will thus be more sensitive to outflows from poor performance. In a similar vein, relatively smaller equity funds are less likely to be already included to a large extent on DC plan menus and consequently will be more sensitive to high performance and being added to the plan menus.

3.2 *Aggregate fund flows by DC ratio*

An alternative method to study the flow–performance relation across funds with different clienteles is to analyze the total flows of mutual funds with differing proportions of assets from DC pension plans instead of separating DC and non-DC flows as we did in the previous section.

Using the three sets of funds, we again consider the flow–performance sensitivity through the regression specifications. Table 4 reports the flow–performance panel regression results for each of the groups. One problem of this specification, as is evident from Table 1, is that the DC proportion tends to be relatively small for the typical funds. For example, even for the high-DC tercile only half of the assets are held in DC accounts. In addition, the DC ratio may be correlated with other fund characteristics (which can affect the flow–performance sensitivity).

Whereas the low and the mid-DC ratio terciles exhibit a monotonic and slightly convex flow–performance relation, the highest DC ratio tercile exhibits a non-monotonic flow–performance relation. Consistent with the results from Table 1, we find that flows of mutual funds with a high proportion of DC assets tend to be more sensitive to extreme performance. We obtain these results despite the fact that high DC funds tend to be larger funds, which have relatively less sensitive flow–performance relations.

We also find that the expense ratio shows a statistically significant negative impact on the flows of the highest DC funds, suggesting that the sponsors and participants of DC plans tend to avoid funds with relatively high expense ratios.

4 Performance predictability

Our flow–performance tests using DC versus other flows in Table 2 and using flows into mutual funds divided by their DC assets in Table 4 show that the DC plan sponsors and participants are more likely to leave funds with poor performance and enter funds with higher performance. In this section we ask whether this behavior is justified by superior subsequent fund performance.

Although theoretically flows should not predict future abnormal performance in a competitive environment with rational fund investors (Berk and Green, 2004), existing empirical evidence finds predictability in mutual fund flows. The direction of the predictability appears to depend on the horizon examined. Gruber (1996) and Zheng (1999) find positive predictability over short horizons, while Frazzini and Lamont (2008) document negative predictability over long horizons.

To study whether mutual fund flows from DC or non-DC investors can predict funds' long-term future performance, we run annual performance predictability regressions. We employ a number of different measures of mutual fund return performance: raw fund return per month, style-adjusted return (where we subtract the mean return of funds in the same style classification based on the fund holdings), and alphas based on the Capital Asset Pricing Model and the Carhart (1997) model. We also include the DC ratio as an independent variable to capture whether funds with higher amounts of DC assets in general have greater future performance, controlling for annual flows. The remaining control variables are the return over the prior year, the logarithm of the total assets of a fund, the logarithm of family size, the logarithm of fund age, the expense ratio, and turnover. The specifications also include year fixed effects and cluster the standard errors by fund.

We present the results of these regressions in Table 5 and find that flow predictability of fund performance differs between DC and non-DC flows. No significant relation exists between the flows from DC investors and the following year's performance. In contrast, we find a negative relation between flows from non-DC investors and

Table 5 Return predictability regressions.

	Raw performance	Style-adjusted performance	CAPM-adjusted performance	Carhart-adjusted performance
DC flow	−0.261	−0.251	−0.135	−0.064
	(0.167)	(0.161)	(0.139)	(0.111)
Non-DC flow	−1.300***	−1.373***	−1.251***	−0.656***
	(0.371)	(0.363)	(0.326)	(0.225)
DC ratio	1.459***	0.942	0.287	0.038
	(0.619)	(0.590)	(0.577)	(0.700)
Return over past year	0.089***	0.091***	0.108***	0.125***
	(0.022)	(0.020)	(0.019)	(0.015)
Log size	−0.701***	−0.779***	−0.669***	−0.273***
	(0.141)	(0.137)	(0.124)	(0.087)
Log family size	0.278***	0.363***	0.285***	0.162**
	(0.136)	(0.132)	(0.129)	(0.081)
Log fund age	−0.097	0.051	−0.030	0.187
	(0.263)	(0.253)	(0.226)	(0.154)
Expense ratio	−0.009	−0.224	−0.321	−0.697***
	(0.370)	(0.332)	(0.320)	(0.217)
Turnover	−0.254	−0.307	−0.188	−0.438***
	(0.216)	(0.197)	(0.188)	(0.150)
Observations	5,320	5,287	5,143	5,143
R-squared	0.022	0.023	0.029	0.044
p-Value for F-test DC flow = non-DC flow	0.013**	0.004***	0.002***	0.028**

This table summarizes a regression of funds' long-term future performance on mutual fund flows from DC and non-DC investors and additional control variables. The table uses four different performance measures. Standard errors are reported in parentheses and adjusted for clustering at the fund level. The regressions also include time fixed effects. *, **, and *** denote estimates that are statistically different from zero at the 10%, 5%, and 1% significance levels, respectively.

the future performance. The results of an F-test (reported in the last row of the table) for the difference in the coefficients on DC flows and non-DC flows indicate significant differences for all of the performance measures at the 5% significance level or better.

The fact that DC flows show insignificant performance predictability results suggests that the plan sponsors (often assisted by consultants) are able to avoid the worse performing funds providing protection for their investors. These results are also consistent with Berk and Green's (2004) theoretical model.

We find that raw returns are positively and significantly related to the DC ratio. However, for the adjusted returns (i.e., style-adjusted returns and CAPM and Carhart alphas), we do not find a significant impact on the DC ratio on future returns. These results are consistent with Sialm and Starks (2012), who find generally insignificant differences in the returns of the highest versus lowest DC ratio funds no matter which risk-adjusted performance measure is employed. Thus, there exists little difference across the risk-adjusted performance of funds whether they have large amounts of DC assets or not.

5 Conclusions

In this paper, we have shown that assets flowing into mutual funds from DC retirement plans have grown significantly faster than assets flowing into mutual funds from other sources. In fact over our sample period the percentage of flows from DC plans was twice as large. We also find that the DC plan sponsors tend to select larger funds in larger fund families. The result that the DC assets are more prominent in funds with lower expense ratios and lower portfolio turnover suggests that DC plan sponsors take fund fees and fund trading costs into consideration when selecting the funds for the menu from which plan participants make their individual investment choices.

Further, mutual fund flows derived from DC retirement plans have different sensitivities to performance than flows derived from other sources (such as investors who invest directly in mutual funds or those who invest through their financial advisers). In particular, DC flows are more sensitive to both high and low relative return performance, moving into funds with higher recent performance and out of funds with lower recent performance. These results provide evidence that plan sponsors and their participants have more flow–performance sensitivity than do other investors in mutual funds.

We also find that although the flows from the DC retirement plans exhibit flow–performance sensitivity for both large and small funds, the differences between the DC and non-DC flows in their sensitivity to performance appear to be driven more by large funds for outflows driven by funds' poor performance and by small funds for the inflows driven by funds' superior performance. This is the expected pattern if plan sponsors are monitoring their participants' funds and removing poorly performing existing funds from their menus and choosing newer (smaller) funds with new investment styles to add to the menu.

In an alternative analysis, we examine differences in total flows for the mutual funds by dividing them into terciles that have differing proportions of assets from DC pension plans. Consistent with the earlier results from dividing flows, we find that, on average, flows of mutual funds with a high proportion of DC assets tend to be more sensitive to extreme performance.

We also examine whether mutual fund flows from DC or non-DC investors exhibit long-term predictability. Our results suggest that the DC investors have no predictability, either positive or negative, while the non-DC investors have significant negative predictability. These results suggest that through their monitoring and selection of menu choices, plan sponsors protect their participants from exhibiting dumb money tendencies. Overall, our results suggest that DC retirement plan sponsors play an important role in financial markets.

Appendix

The equations used in this paper are described in this Appendix.

Calculation of flows from DC plans and flows from non-DC assets

Using changes in DC plan assets in mutual funds as reported in the *Pensions & Investments* data, we calculate the annual percentage of flows into each fund from DC plans according to the following equation:

$$DC\ Flow_{f,t} = \frac{DC\ Assets_{f,t} - DC\ Assets_{f,t-1}(1 + R_{f,t})}{DC\ Assets_{f,t-1}(1 + R_{f,t})}, \tag{A.1}$$

where $DC\ Flow_{f,t}$ denotes the DC flows to fund f in year t based on the difference between the end-of-year DC assets in the fund less the product of the beginning-of-year DC assets and one plus the fund's return in that year. The denominator ensures that the fund flows never fall below -100%.

We then take the difference between the funds' total assets and the DC assets to calculate the $NonDC\ Assets_{f,t}$ defined as fund f's total assets at time t less the fund's DC assets at time t adjusted for the fund returns. Consequently, the flows from non-DC sources are captured in the following equation:

$$NonDC\ Flow_{f,t} = \frac{NonDC\ Assets_{f,t} - NonDC\ Assets_{f,t-1}(1 + R_{f,t})}{NonDC\ Assets_{f,t-1}(1 + R_{f,t})}. \tag{A.2}$$

To reduce the impact of outliers, we winsorize the extreme fund flows at the 2.5% level.

Flow–performance regression equations

The regression to determine the relation between fund flows and fund performance is as follows:

$$\begin{aligned} Flow_{f,t} = {} & f(Rank_{f,t-1}) + \beta_1 DC\ Size_{f,t-1} \\ & + \beta_2 NonDC\ Size_{f,t-1} \\ & + \beta_3 Fam\ Size_{f,t-1} + \beta_4 Age_{f,t-1} \\ & + \beta_5 Exp_{f,t-1} + \beta_6 Turn_{f,t-1} \\ & + \beta_7 Vol_{f,t-1} + \beta_8 SFlow_{f,t} + \beta_t \\ & + \varepsilon_{f,t}, \end{aligned} \tag{A.3}$$

where $Flow_{f,t}$ is either the DC or non-DC flows for fund f in period t as defined in Equations (A.1) and (A.2), $Rank_{f,t-1}$ is the fund's performance rank over the previous year, $DC\ Size_{f,t-1}$ and $NonDC\ Size_{f,t-1}$ are the logarithms of total DC and non-DC assets in fund f from year $t-1$, respectively, $Fam\ Size_{f,t-1}$ is the logarithm of the fund family's total net assets, $Age_{f,t-1}$ is the logarithm of the amount of time since fund f's initiation (as of the previous year), $Exp_{f,t-1}$ is the fund's total annual expense ratio from the previous year, $Turn_{f,t-1}$ is the lagged annual turnover of the fund's holdings, $Vol_{f,t-1}$ is the monthly return volatility over the previous year, $SFlow$ is the average contemporaneous flow of funds in the same style category, and $\beta_{f,t}$ is a fixed effect for year t.

We use two different methods to capture nonlinearities in the flow–performance relation. First, we estimate separate effects for each percentile:

$$f_1(Rank_{f,t}) = \sum_{j=1}^{100} \gamma_j I(100 \times Rank_{f,t} = j), \tag{A.4}$$

where $I(100 \times Rank = j)$ is an indicator variable that equals one if the performance rank of a specific fund falls in the jth percentile and zero otherwise. The coefficient γ_j captures the average flow of funds in the jth percentile if all other covariates of Equation (A.4) are equal to zero. In this specification we estimate 100 different performance-sensitivity coefficients γ.

In the second method to account for nonlinearities, we estimate an alternative nonlinear functional form, a continuous piecewise linear specification (Sirri and Tufano, 1998):

$$f_2(Rank_{f,t}) = \gamma_L Low_{f,t} + \gamma_M Mid_{f,t} + \gamma_H High_{f,t}, \tag{A.5}$$

where $Low_{f,t} = \min(Rank_{f,t}, 0.2)$, $Mid_{f,t} = \min(Rank_{f,t} - Low_{f,t}, 0.6)$, and $High_{f,t} = (Rank_{f,t} - Low_{f,t} - Mid_{f,t})$. The performance coefficients γ_L, γ_M, and γ_H capture the marginal flow–performance sensitivities in the bottom quintile, in the three middle quintiles, and in the top quintile, respectively.

Performance predictability regressions

To estimate the performance predictability, we run the following regression:

$$\begin{aligned} Perf_{f,t} = {} & \beta_1 DC\ Flow_{f,t-1} \\ & + \beta_2 NonDC\ Flow_{f,t-1} \\ & + \beta_3 Perf_{f,t-1} + \beta_4 Size_{f,t-1} \\ & + \beta_5 Fam\ Size_{f,t-1} + \beta_6 Age_{f,t-1} \\ & + \beta_7 Exp_{f,t-1} + \beta_8 Turn_{f,t-1} \\ & + \beta_9 DC\ Ratio_{f,t-1} + \beta_t \\ & + \varepsilon_{f,t}, \end{aligned} \tag{A.6}$$

where the $Perf_{f,t}$ is defined alternatively as the raw fund return per month, the style-adjusted return (where we subtract the mean return of funds in the same style classification based on the fund holdings), and the alphas based on the Capital Asset Pricing Model and the Carhart (1997) model. The other variables are defined as described above.

Notes

[1] 2017 Investment Company Factbook Tables 1, 63, and 64.

[2] Sialm *et al.* (2015b).

[3] See, for example, Benartzi and Thaler (2001), Madrian and Shea (2001), Choi *et al.* (2002), Agnew *et al.* (2003), Duflo and Saez (2003), Huberman and Jiang (2006), and Brown *et al.* (2007).

[4] Other studies that have employed this data include Christoffersen *et al.* (2006), Sialm and Starks (2012), Christoffersen and Simutin (2016), Doellman *et al.* (2016), Pool *et al.* (2016), and Sialm *et al.* (2015a, 2015b).

[5] The surveys conducted from 1997 to 2011 asked funds to provide information on their DC assets at the end of the prior year (i.e., from 1996 to 2010). The surveys conducted in 2012 and 2013 asked funds to provide information on their DC assets at the end of June of the corresponding years (i.e., in 2012 and 2013). We assume in our analyses that the DC values for all years are taken at the end of the prior calendar year. Some families provide information on more than 12 funds in a category. More information about the *Pensions & Investments* survey is available at their website: http://www.pionline.com.

[6] Data sources: Investment Company Institute and *Pensions and Investments.*

[7] For more information on the data and our empirical process, see Sialm *et al.* (2015b).

[8] According to the 2015 Deloitte 14th Annual Defined Contribution Benchmarking Survey, 88% (78%) of the plan sponsors offer actively managed (passively managed) domestic equity and 85% (62%) offer actively managed (passively managed) global/international equity.

[9] The equations for these calculations are provided in the Appendix.

[10] The formal specification is given in the Appendix.

[11] See, for example, Chevalier and Ellison (1997), Sirri and Tufano (1998), Huang *et al.* (2007), and Kim (2011).

References

Agnew, J., Balduzzi, P., and Sunden, A. (2003). "Portfolio Choice and Trading in a Large 401(k) Plan," *American Economic Review* **93**, 193–215.

Benartzi, S. and Thaler, R. (2001). "Naïve Diversification Strategies in Defined Contribution Savings Plans," *American Economic Review* **91**, 79–98.

Ben-Rephael, A., Kandel, S., and Wohl, A. (2012). "Measuring Investor Sentiment with Mutual Fund Flows," *Journal of Financial Economics* **104**, 363–382.

Berk, J. C. and Green, R. C. (2004). "Mutual Fund Flows and Performance in Rational Markets," *Journal of Political Economy* **112**, 1269–1295.

Brown, J. R., Liang, N., and Weisbenner, S. (2007). "Individual Account Investment Options and Portfolio Choice: Behavioral Lessons from 401(k) Plans," *Journal of Public Economics* **91**, 1992–2013.

Carhart, M. M. (1997). "On Persistence in Mutual Fund Performance," *The Journal of Finance* **52**, 57–82.

Chevalier, J. and Ellison, G. (1997). "Risk Taking by Mutual Funds as a Response to Incentives," *Journal of Political Economy* **105**, 1167–1200.

Choi, J. J., Laibson, D., Madrian, B. C., and Metrick, A. (2002). "Defined Contribution Pensions: Plan Rules, Participant Decisions, and the Path of Least Resistance," In *Tax Policy and the Economy* **16**, James M. Poterba, ed. (Cambridge, MA: MIT Press).

Christoffersen, S., Geczy, C., Musto, D., and Reed, A. (2006). "Cross-Border Dividend Taxation and the Preferences of Taxable and Non-Taxable Investors: Evidence from Canada," *Journal of Financial Economics* **78**, 121–144.

Christoffersen, S. and Simutin, M. (2017). "On the Demand for High Beta Stocks: Evidence from Mutual Funds," *The Review of Financial Studies* **30**, 2596–2620.

Doellman, T. W., Ryngaert, M. D., and Sardarli, S. H. (2016). "The Impact of Defined Contribution Investments on Mutual Fund Flows," Working Paper.

Duflo, E. and Saez, E. (2003). "The Role of Information and Social Interactions in Retirement Plan Decisions: Evidence from a Randomized Experiment," *The Quarterly Journal of Economics* **118**, 815–842.

Frazzini, A. and Lamont, O. A. (2008). "Dumb Money: Mutual Fund Flows and the Cross-Section of Stock Returns," *Journal of Financial Economics* **88**, 299–322.

Gruber, M. J. (1996). "Another Puzzle: The Growth in Actively Managed Mutual Funds," *Journal of Finance* **51**, 783–810.

Huang, J., Wei, K. D., and Yan, H. (2007). "Participation Costs and the Sensitivity of Fund Flows to Past Performance," *Journal of Finance* **62**, 1273–1311.

Huberman, G. and Jiang, W. (2006). "Offering versus Choice in 401(k) Plans: Equity Exposure and Number of Funds," *Journal of Finance* **61**, 763–801.

Kim, M. S. (2011). "Changes in Mutual Fund Flows and Managerial Incentives," Working Paper, University of New South Wales.

Madrian, B. and Shea, D. F. (2001). "The Power of Suggestion: Inertia in 401(k) Participation and Savings Behavior," *Quarterly Journal of Economics* **116**, 1149–1187.

Pool, V. K., Sialm, C. and Stefanescu, I. (2016) "It Pays to Set the Menu: Mutual Fund Investment Options in 401(k) Plans," *The Journal of Finance* **71**, 1779–1812.

Sialm, C. and Starks, L. (2012). "Mutual Fund Tax Clienteles," *The Journal of Finance* **67**, 1397–1422.

Sialm, C., Starks, L., and Zhang, H. (2015a). "Defined Contribution Pension Plans: Mutual Fund Asset Allocation Changes," *The American Economic Review* **105**, 432–436.

Sialm, C., Starks, L. T., and Zhang, H. (2015b). "Defined Contribution Pension Plans: Sticky or Discerning Money?" *The Journal of Finance* **70**, 805–838.

Sirri, E. and Tufano, P. (1998). "Costly Search and Mutual Fund Flows," *Journal of Finance* **53**, 1589–1622.

Zheng, L. (1999). "Is Money Smart? A Study of Mutual Fund Investors' Fund Selection Ability," *Journal of Finance* **54**, 901–933.

Keywords: DC pension plans; mutual funds; fund flows; flow-performance sensitivity; fund performance predictability