Portfolio delegation and 401(k) plan participant responses to COVID-19

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Abstract

We analyze the behavior of 401(k) plan participants during the first quarter of 2020, when COVID-19 generated historic volatility, large negative returns, and significant unemployment. Only 2.1% of participants invested in TDFs made any changes to their portfolios, with even lower rates of change among those defaulted into robo-advised managed accounts, suggesting that delegation can decrease the likelihood of portfolio mistakes by less sophisticated participants. While 16.6% of non-delegated participants made portfolio changes, these changes were more likely among more sophisticated participants and appear not to have reduced participants' quarterly returns. Consistent with liquidity constraints, however, withdrawals spike following job loss.

1. Introduction

A common investment mistake is the behavioral tendency to shift wealth from risky to safe assets in volatile and declining markets (Ben-Rephael, Kandel, and Wohl, 2012; Friesen and Sapp, 2007). For example, Bucher-Koenen and Ziegelmeyer (2014) document that German households with lower levels of financial literacy were the most likely to sell equity at a loss during the global financial crisis of 2008 and 2009. The COVID-19 pandemic produced more extreme changes in U.S. stock prices over 22 trading days in late February and March 2020 than any other historical period (Baker, Bloom, Davis, Kost, Sammon, and Viratyosin, 2020). The 34% drop in the S&P 500 index between February 19 and March 23, 2020 is the most dramatic opportunity yet for researchers to study investor behavior following a spike in volatility and a sharp decline in asset markets.

In this paper, we analyze the behavior of 401(k) plan participants between December 31, 2019 and March 31, 2020. Our main research question is whether professionally managed retirement accounts insulate participants from the negative effects of sentiment-driven trading in retirement accounts. Although retirement savers may be less experienced and more prone to making investment mistakes than investment professionals, the majority of workers (59%) now delegate the management of their retirement portfolios through target date funds (TDFs) or robo-advised managed accounts (Vanguard, 2019).[1] These automated investment vehicles grew in popularity as default investment options in the years following the Pension Protection Act of 2006 (Balduzzi and Reuter, 2019; ICI, 2019). Prior research has demonstrated that TDFs are preferred by less financially sophisticated plan participants (Madrian and Shea, 2001; Mitchell and Utkus, 2012; Goda et al., 2019; Chalmers and Reuter, 2020). This self-selection arises the possibility that delegated portfolio management prevents those participants who are most likely to exhibit a behavioral

[1] A given TDF provides the same asset allocation to all participants of a similar age without regard for employee characteristics or risk preferences. When the target retirement date is distant, the allocation to equity is typically near 100%; as the target retirement date approaches, equity is replaced with debt, resulting in less market risk. The slope is known as the "glide path." Balduzzi and Reuter (2019) document significant heterogeneity in the glide paths of TDFs. Robo-advised "managed accounts" incorporate individual characteristics such as current wealth, salary, savings rate, employer contribution, gender, and existing pensions. The percent of employers offering a managed account option rose from 29% in 2011 to 66% in 2019 and assets increased from $108 billion in 2012 to $348 billion in 2019 (Cerulli, 2020).

trading response from trading during a financial crisis. Simultaneously providing the option for participants to self-manage a retirement portfolio preserves choice for more sophisticated investors who can select investments from a core menu that match their own preference, and who may be less likely to exhibit behavioral biases of their own (Campbell, 2016).

Prior studies of defined contribution trades find that participant investment changes are rare. For example, over a 52 month period, Agnew, Balduzzi, and Sunden (2003) find that 87.5% of the 401(k) plan participants in their sample make zero trades and 93.2% make no more than one trade. In another early study of self-directed plan participants, Mitchell, Mottola, Utkus, and Yamaguchi (2006) find that fewer than 20% make changes to their accounts in a 2-year period and that half of these participants make only a single trade. In more recent data, Vanguard (2019) finds that only 8% of participants initiate any trades within their accounts.

Despite low trading frequency, retirement plan participants control an increasingly large share of the market for financial assets. Defined contribution plan investors hold $8.2 trillion of the $21.1 trillion invested in U.S. mutual funds (and 53% of equity, hybrid and bond mutual fund assets), which represents 12% of total equity ownership and 60% of all retirement wealth (ICI, 2019). Furthermore, a significant negative economic event may motivate account changes by participants. Tamborini, Purcell, and Iams (2013) document that employees in industries negatively impacted by the 2007-2009 financial crises were more likely to decrease in contribution rates and increase plan withdrawals. Sialm, Starks and Zhang (2015a) document that outflows from equity mutual funds within DC plans are more sensitive to macroeconomic conditions than funds owned outside of retirement plans.

Investment mistakes made inside of retirement plans are likely to impact both when participants can afford to retire and the standard of living during retirement. Because TDFs played a much smaller role in 401(k) plans during the global financial crisis, the vast majority of TDF participants have only experience a bull market. A central policy question is whether the market turmoil induced by COVID-19 lead less sophisticated investor to abandon TDFs and even-newer robo-advised accounts for safer funds, thereby locking in market losses.

Analyzing 617,376 participants across 531 retirement plans, we ask which types of participants were the most likely to make changes to their retirement accounts, with a focus on the extent of portfolio delegation. We have four main findings. First, delegated participants are significantly less likely to make any changes to their retirement portfolios than non-delegated participants. This is true in the raw data, when we find that only 2.0% of delegated participants make any changes versus 16.6% of non-delegated participants. It remains true when we estimate probit regressions that control for a large set of participant characteristics and include either industry or plan fixed effects. The fact that participants who opt into or are defaulted into robo-advised managed accounts are both less likely to make portfolio changes than participants who invest in a single TDF suggests that increased levels of trust in customized portfolios is not driven by self-selection. The fact that delegated participants have average characteristics that would point to lower levels of financial sophistication suggests that increased delegation through the use of TDFs and managed accounts as default investment options, may limit the extent to which less sophisticated participants make mistakes. The fact that participants stuck with TDFs during the first bear market since 2009 suggests that TDFs will prove to be effective long-term investment vehicles.

Second, among the non-delegated participants, the likelihood of portfolio changes appears to be increasing in proxies for investor sophistication, such as salary, deferral rate, and account balance. In other words, the set of participants making changes to their retirement portfolios appear to be a relatively sophisticated subsample of a relatively sophisticated population.

Third, because our sample of retirement plans span 20 industries, we are able to document significant heterogeneity in job loss, changes in deferral rates, and withdrawal activity across industries, as well as in reliance upon delegation. While we generally find that participant decisions about loan activity and withdrawals are driven by the economic shock of job loss rather than the level of portfolio delegation, we find some evidence that reductions in deferral rates are least likely among participants invested solely in TDFs and participants defaulted into managed accounts, the two groups of participants that we estimate are the most likely to rely upon default deferral rates.

Finally, consistent with the idea that portfolio changes were disproportionately made by the most

sophisticated participants, we do not find any evidence that portfolio changes are associated with lower quarterly returns. While our need to estimate quarterly returns adds noise to this analysis, it appears unlikely that the participants making portfolio changes in response to COVID-19 (but who did not experience job loss) managed to liquidate plan assets at the bottom of the market.

The remainder of this paper is organized as follows. Section 2 describes our empirical setting, the characteristics of delegated and non-delegated participants, and univariate evidence on portfolio changes. Section 3 provides industry-level statistics on the use of delegation and on the frequency of job loss, plan withdrawals, and portfolio changes. Section 4 relates portfolio changes and other participant choices to delegation and a large set of participant characteristics. Section 5 contains our analysis of quarterly portfolio returns. Section 6 concludes.

2. Characteristics of delegated and non-delegated 401(k) plan participants

Our 401(k) plan sample includes 617,376 participants across 531 plans, offered by firms within 20 broad industries.[2] The data come from a single recordkeeper with a market share outside of the top ten. We observe participant portfolio allocations and balances on both December 31, 2019 and March 31, 2020, along with characteristics such as age, salary, plan tenure, gender (when reported), traditional and Roth employee deferral rates, and plan participation status. Collectively, these participants managed $75.0 billion on December 31, 2019 and $65.3 billion on March 31, 2020. As we describe below, we infer participant-directed portfolio changes from changes in allocations and (return-adjusted) changes in balances. So that we do not mistakenly attribute changes due to menu changes to plan participants, our sample excludes any plans that are flagged as having made menu changes during the first quarter of 2020. In addition, our measures of portfolio change exclude a small number of fund re-mappings that we identified within 35 plans. These re-mappings, often across different shares classes of the same fund, collectively impact 12,990

[2] We include all plan participants for whom plan tenure is nonnegative (i.e., excluding participants who were not yet eligible to join the plan on December 31, 2019), for whom age is between 20 and 75, and for whom the employee deferral rate is no higher than 30.0%. Collectively, these filters cause our sample size to decrease by 2.8% (from 635,116 to 617,375). In addition, we possess limited data on 9,446 participants who had positive account balances on December 31, 2019 but zero account balances on March 31, 2020.

(2.1%) participants.[3] Because we cannot observe investment choices within self-directed brokerage accounts (SDBA), our sample excludes any participants with a positive SDBA allocation or balance on December 31, 2019. However, because we are interested in measuring portfolio changes, we retain those participants with a positive SDBA allocation or SDBA balance on March 31, 2020.

We classify participants into five groups based on their allocations and balances on December 31, 2019. Three of these groups involve delegated portfolio management. The largest of the delegated groups consists of participants who allocate all of their contributions to a single target date fund (TDF) and who do not have a positive balance in any other fund. TDFs vary their asset allocation based on the number of years to a pre-specified target retirement year (e.g., Fidelity Freedom 2040 Fund). TDFs became the most popular default investment option within 401(k) plans in the years immediately following the passage of the Pension Protection Act of 2006 (ICI (2019), Balduzzi and Reuter (2020)).[4] "Pure TDF" participants account for 43.1% of our participant sample and 16.3% of plan assets. While it is likely that the majority of Pure TDF participants were defaulted into TDFs, this is not something that the recordkeeper tracks. The other two groups of delegated participants invest through robo-advised managed accounts (MA), either by choice or by default. Robo-advised managed account products are a natural extension of TDFs. They provide participants with portfolios that are customized with respect to the expected number of years to retirement, but also with respect to other sources of investor heterogeneity, such as the level and composition of other retirement assets (including expected Social Security benefits), and the level of risk aversion. Collectively, managed accounts account for 10.5% of plan participants and 7.7% of plan assets. We observe two participants who are defaulted into a MA for every one participant who opts into a MA. Across the three groups, delegated participants account for 53.6% of participants and 23.0% of plan assets.

The other two groups of participants manage their own retirement portfolios, at least in part. Self-directed (SD) participants, who allocate their contributions to one or more non-TDF option, account for

[3] Sialm, Starks, and Zhang (2015b) highlight the extent to which defined contribution flows are driven by plan sponsor decisions to add and remove funds from their menus.
[4] For example, Figure 8.14 of the 2019 Investment Company Institute Factbook report that the market share of TDFs rose from 19% in 2006 to 52% in 2016.

39.5% of participants and 68.0% of plan assets. The remaining 6.9% of participants and 9.0% of plan assets are classified as "Mixed TDF" (Pagliaro and Utkus (2017)). While Mixed TDF participants allocate 100% of their contributions to a single TDF, they maintain positive balances in one or more additional funds, suggesting either that there were not defaulted into TDFs or that they have subsequently chosen to transfer some of their plan assets from TDFs into other funds.

We describe our sample in Table 1. On December 31, 2019, the average participant is 44.3 years old, with 7.1 years of plan tenure, an annual salary of $97,600, and an account balance of $113,600. Our sample is broadly consistent the sample described in Vanguard's *How America Saves 2019*.[5] Consistent with the aggregate statistics that we just cited and earlier research on the demand for TDFs (e.g., Utkus and Mitchell (2012), Chalmers and Reuter (2020)), delegated participants tend to be younger, with shorter plan tenures, lower salaries, and lower balances. For example, Pure TDF participants are significantly younger than SD participants (42.0 years old on December 31, 2019 versus 46.8), and their average account balance is considerably lower ($43,100 versus $195,500). The other groups fall between these two extremes, with Mixed TDF being the second oldest (45.4), with the second highest account balance ($147,500).

The average employee deferral rate is 5.4%; this rate is highest among SD participants (6.5%) and lowest among participants defaulted into a managed account (3.9%). We infer the default employee deferral rate within each plan from the median deferral rate of plan participants with a tenure of less than two years. The fraction of all participants whose individual saving rate matches the inferred default rate is 10.3%. It is highest for Pure TDF participants, many of whom appear to be accepting the default savings rate and the default investment option, and lowest for Mixed TDF participants. The fraction of participants with a positive Roth account balance is 17.7%; this fraction is much higher for SD participants and for those opting into the MA. The fraction of participants who rolled assets into their 401(k) account is 11.4%; it is also much higher for SD participants and for those opting into the MA. Overall, the differences in participant

[5] Vanguard reports a median age of 44, median plan tenure of 7 years, median participant income of $70,000, median participant account balance of $22,217, and average participant account balance of $92,148. Within our sample, median age is 43.7, median tenure is 5 years, median active participant income is $68,000, median active participant account balance is $31,399, and average active participant account balance is $119,097.

characteristics suggest that through some combination of self-selection and differential reliance upon defaults, the typical delegated participant is likely to be less financially sophisticated than the typical non-delegated participant (Chalmers and Reuter (2020)). Whether less sophisticated investors were willing to stick with delegated portfolios during the turbulent market of 2020Q1, and whether there were any differences in the behavior of TDF versus MA participants, are two of our research questions.

The fraction of plan participants classified as "active" at the end of 2019 is 81.9%. The fraction of participants classified as "active" on December 31, 2019 but "terminated" on March 31, 2020 is 3.3%. Changes in employee deferral rates are relatively common. The fact that increases are more common than decreases (11.8% versus 6.7%) may reflect plans automatically escalating participant deferral rates effective January 1, 2020. While we do not observe an auto-escalation flag from the recordkeeper, the vast majority of these increases (8.1% of the 11.8%) are exactly 1 percentage point. During the same period, 6.7% of participants reduced their deferral rate, with the largest decreases among those who opted into the managed account.

The fraction of participants with a positive loan balance on December 31, 2019 is 16.4% and, conditional on having a positive loan balance, the average ratio of loan balance to account balance is 17.6%. Less than 1% of participants take out a new loan between December 31, 2019 and March 31, 2020. Because we cannot directly observe partial withdrawals, we assume that they occur whenever the balance on March 31, 2020 is less than 50% of the balance on December 31, 2019. By this measure, the fraction of participants with a partial withdrawal is also less than 1%. The fraction of participants who withdraw their entire account balance is 1.4%. (Because we observe limited data on the 9,446 participants with positive account balances on December 31, 2019 and zero account balances on March 31, 2020, we exclude them from the five subsamples.) The gender variable is "Male" for 47.6% of participants, "Female" for 31.6%, and "Unknown" for the remaining 20.8%. It is much less likely to be unknown among MA participants.

The number of funds held varies significant across participant type. On December 31, 2019, the average SD participant has positive allocations to 6.2 funds and positive balances in 6.8 funds. For participants investing through a MA, both numbers are approximately twice as high, reflecting the fact that

the managed account product works by allocating dollars across funds on the plan menu. Based on our classifications, Pure TDF and Mixed TDF participants have a 100% allocation to a single TDF. However, for Mixed TDF participants the average number of funds with a positive balance is 2.9. Across all participant types, the numbers of funds with positive allocations and balances are quite similar when we hold participant type constant and follow participants forward from December 31, 2019 to March 31, 2020, suggesting a high level of inertia by participants.

The final set of rows calculate the fraction of each participant's portfolio that is allocated to equity. We assign a representative fraction of equity to each of the 84 Morningstar categories represented in the portfolio holdings data (summarized in Table OA1). We use these statistics to calculate allocation-weighted and balance-weighted measures of equity exposure on both December 31, 2019 and March 31, 2020. Of course, declines in the fraction of equity are to be expected given the poor relative performance of equity funds during the first quarter of 2020. To minimize the impact of fund returns on equity exposure, we also report balance-weighted fraction of equity after "deflating" each March 31 2020 balance by either the fund's quarterly return or the Morningstar category's quarterly return (when then fund's quarterly return is missing).[6] When focusing on allocation-weighted statistics, we find that average equity exposure decline 0.6% (from 74.5% to 73.9%). When comparing balance-weighted statistics in December 2019 to deflated balance-weighted statistics in March 2020, we also find that average equity exposure declines 0.6% (from 75.1% to 74.5%). These comparisons are consistent with the vast majority of participants making no changes to their portfolios during the first quarter of 2020.

2.1. Frequency of changes in participant type?

To begin to shed light on the extent of portfolio changes by 401(k) plan participants, in Table 2, we use the fund allocation and balance data available on December 31, 2019 and March 31, 2020 to identify transitions between participant types. We find that participant type is highly persistent over this quarter.

[6] We do not observe quarterly returns for the subset of investment options that are not mutual funds (e.g., collective investment trusts). We also do not observe the level or timing of any employee or employer contributions between December 31, 2019 and March 31, 2020.

Fewer than 2.0% of the delegated participants begin managing their own portfolios. This finding suggests that the vast majority of the younger, less sophisticated participants being defaulted into TDFs chose to stick with delegated management throughout the turbulent quarter. In contrast, approximately 5.8% of Mixed TDF participants change type, with 3.8% moving towards increased delegation and the other 2.0% moving to decreased delegation. Self-directed participants are the least likely to change type. Fewer than 0.5% of SD participants change type by enrolling in a managed account or allocating their contributions to a TDF.

2.2. Frequency of changes in fund allocations and fund balances?

In Table 3, we summarize the extent to which participants make changes to their fund allocations or fund balances. We consider four types of changes: changes in fund allocations that are accompanied by fund additions and/or removals; changes in fund allocations that are not accompanied by fund additions and/or removals; fund additions and removals that are not accompanied by changes in fund allocations; and (imputed) fund exchanges between the existing set of funds. We report the sum of these four changes for different subsamples of participants in column 2 (and we report the disaggregated statistics in Table OA2). Overall, we find that 8.7% of participants made changes to their portfolios during the first quarter of 2020.

Importantly, this average masks significantly heterogeneity across participant types. For delegated participants, the likelihood of any portfolio change ranges from 1.3% for participants defaulted into MA to 2.1% for participants investing entirely in a single TDF. Given the plausibly lower sophistication levels of the typical delegated participant, this inertia is likely to reflect high levels of trust in delegation, low levels of attention, or both. The fact that likelihood of any portfolio change is lower for the managed account products may suggest slightly higher levels of trust in a customized portfolio than a TDF. Nevertheless, the fact that the vast majority of TDF participants "stayed the course" during a quarter of unprecedented market volatility is encouraging evidence that TDFs may provide value during both up and down markets. In contrast, for non-delegated participants, the likelihood of portfolio changes jumps to 15.1% for SD participants and 22.7% for Mixed TDF participants.

The remaining columns of Table 3 shed light on the extent to which changes in fund allocations

and exchanges across funds changed the equity exposure of participants' portfolios. For example, column 6 reports the fraction of participants whose change in fund allocations or fund exchanges reduce the equity exposure of their portfolio 10 percentage points or more. To determine if fund allocations reduce the equity exposure by 10 percentage points or more, we compare the allocation-weighted fractions of equity using fund allocations on December 31, 2019 and March 31, 2020 and the assumed equity exposures in Table OA1. Because we use the same assumed fractions of equity on both dates, this measure will be zero if the participant does not make any allocation changes or if allocation changes are limited to funds with the same assumed fraction of equity. To determine if fund exchanges reduce the equity exposure by 10 percentage points or more, we compare the balance-weighted fraction of equity using actual fund balances on December 31, 2019 and quarterly-return-adjusted fund balances on March 31, 2020, and again using the assumed equity exposures in Table OA1. Based on these measures, we see that many of the portfolio changes are modest in size. While 16.6% of non-delegated participants make a change to their portfolios, only about half (8.7% equals 5.0% in column 4 plus 3.7% in column 5) result in equity exposure increasing or decreasing by more than five percentage point. Nevertheless, non-delegated participants remain significantly more likely than delegated participants to make large changes. For example, 5.2% of self-directed participants make a change of at least 20 percentage points (3.7% in column 8 plus 1.5% in column 9) versus 0.9% for Pure TDF (0.7% plus 0.2%).

3. Variation in participant choices and likelihood of economic shocks across industries?

To the extent that some industries experienced COVID-19-related economic downturns before others, we might expect to see differences in participant behavior across industries. In Table 4, we report selected summary statistics by industry. We assign each plan to an industry based on the first two digits of the firm's 6-digit NAICS. The two largest industries, in terms of number of firms and number of active participants, are Professional/Scientific and Manufacturing. However, we observe plans across a wide range of industries, including Construction, Food Services, and Retail Trade. As a simple way of capturing differences in participant sophistication across industries, we report the fraction of active participants within each industry that invest through TDFs or managed accounts. The fraction is relatively high for Food

Services, Health Care, and Retail Trade; it is lowest for Education (represented by one small plan), Public Administration, and Management.

Overall, 4.0% of participants transition from being "active" on December 31, 2019 to "terminated" on March 31, 2020. We cannot distinguish participants who quit their jobs from those who are fired. However, these separation rates vary across industries in ways that are likely to reflect variation in the extent of layoffs, from a low of 2.0% for Utilities to a high of 16.5% for Food Services. They also seem more likely to be impacting industries with less sophisticated participants; the correlation between the fraction of delegated participants and the average separation rate is positive (0.2657).

When we scale the number of new plan participants during the first quarter of 2020 by the number of active participants on December 31, 2019, the replacement rate averages 0.3%. Consistent with the unprecedented surge in COVID19-related unemployment claims during March 2020, the replacement rate is significantly lower than the separation rate within each industry. Consequently, there are fewer active plan participants within each industry on March 31, 2020 than on December 31, 2019.

While 401(k) plan participants may begin withdrawing cash to make up for reduced or lost wages, we observe relatively little such behavior during the first quarter of 2020. We estimate that only 0.7% of participants who are active on December 31, 2019 take a significant withdrawal from their account by March. The lowest withdrawal rates are 0.0% for Education and 0.3% for Public Administration; the highest is 3.7% for Construction. Another 0.8% of participants withdrawal all of their plan assets during 2020Q1. Because we are focusing on participants who were active on December 31, 2019 and because full withdrawals are only possible following job lose, this statistic implies that about one in five participants (0.8% scaled by 4.0%) who are terminated during the quarter withdrawal all of their plan assets. The fraction of participants taking partial or full withdrawals are also positive correlated with reliance on delegation (0.2903 and 0.3432, respectively).

As we saw in Table 1, employee deferral rates are more likely to increase during the first quarter of 2020 than to decrease, although this likely reflects increases due to automatic escalation. The fraction of participants decreasing their deferral rate by any amount is 8.0%, the fraction increasing by exactly one

percentage point is 9.7%, and the fraction increasing by more than one percentage point is 4.3%. The frequency of rate decreases is positive correlated with reliance on delegation (0.2550), but so is the frequency of rate increases of more than one percentage point (0.1700).

Finally, the fraction of active participants who make any change to their portfolios is 9.1%, which is slightly higher than the 8.7% for the full sample of active and inactive participants. While the likelihood of making any changes to portfolios varies significantly across industries, from a low of 2.8% for Construction to a high of 18.1% for Professional/Scientific, this can largely be explained by the differences in reliance upon delegation. The correlation between reliance on delegation within an industry and the likelihood of making any portfolio changes is strongly negative (-0.7741).

4. Predicting changes in plan participant behavior

We begin by asking how the likelihood of making portfolio changes varies with the extent of delegation and other participant characteristics and then consider choices related to loans, deferral rates, and withdrawals that may have been triggered by economic shocks.

4.1. Is delegation associated with fewer portfolio changes?

The univariate comparisons above reveal delegated participants are significantly less likely to make portfolio changes (or large changes in equity exposure) than non-delegated participants. At the same time, differences in the characteristics of delegated and non-delegated participants suggest significant sorting into delegation. To shed additional light on which participants were the most likely to make changes to their 401(k) portfolios during the first quarter of 2020, in Table 5, we use measures of delegation to predict the likelihood of portfolio changes while controlling for various participant characteristics.

We estimate a series of Probit regressions. The dependent variable in columns 1 through 3 equals one if participant i made any changes to her 401(k) account between December 31, 2019 and March 31, 2020, and zero otherwise. Each specification includes participant type fixed effects ("Pure TDF" is the omitted category), the full set of participant characteristics described in Table 1, and a full set of equity exposure category fixed effects based on fund balances on December 31, 2019 ("0-9%" is the omitted category). We also control for the predicted volatility of daily portfolio returns using initial fund balances

and daily returns throughout the quarter. Column 1 controls for the average level of the dependent variable in other plans within the same industry, excluding the participant i's plan. Column 2 adds industry fixed effects to control for any average industry-level shocks that drive portfolio changes and also controls for the average level of the dependent variable within participant i's plan, excluding participant i. Column 3 adds plan fixed effects to control for any average industry-level shocks that drive portfolio changes. Standard errors are clustered on plan. Across these columns, the unconditional likelihood of making any portfolio changes is 8.6%.

We find that the likelihood of making any changes tends to increase in account balance, salary, deferral rate, positive Roth account balances, and positive rollover balances, all of which are likely to be positively correlated with the level of participant sophistication. It also tends to increase by approximately 1.3 percentage points following job loss, highlighting the link between portfolio changes and individual economic shocks. With respect to portfolio composition on December 31, 2019, higher levels of equity exposure tend to be associated with lower likelihoods of making portfolio changes, while higher standard deviations of daily returns (measured within these categories) tend to be associated with slightly higher likelihoods of making portfolio changes. The predictive power of other participant changes (in column 2) may reflect peer effects within the plan, fund re-mappings that we failed to identify when analyzing changes within plans, or both.

The fact that pseudo-R2 nearly doubles when we include the industry fixed effects (from 0.1476 to 0.2841) reflects the systematic differences in the likelihood of portfolio changes across industries that we observe in Table 4. The magnitudes of the marginal effects associated with Mixed TDF and Self-directed participants both decrease when we include the industry fixed effects, but do not change much more when we include the plan fixed effects. Importantly, after including all of these controls, we continue to find statistically and economically significant differences in the likelihood of portfolio changes across participant types.

Focusing on the participant type dummy variables in column 3, which focuses on variation across participant types within plans, we find that managed account participants are 2.3-2.4 percentages points

less likely to make any portfolio changes than Pure TDF participants (both differences statistically significant at the 1-percent level). These estimates suggest that managed accounts may be even more effective than TDFs in allowing participants to weather volatile markets. The fact that the estimates are quite similar for those who are defaulted into managed accounts and those who opt into these products helps to allay concerns about these differences are driven by self-selection into managed accounts. (In none of the specifications can we reject the hypothesis that participants defaulted into managed accounts are more or less likely to make portfolio changes than participants opting into managed accounts.) Everything else equal, we also find that Self-directed and Mixed TDF participants are 9.8 and 15.1 percentage points more likely than Pure TDF participants to make portfolio changes.

The remaining columns predict more extreme portfolio changes. Column 4 focus on participants who increase or decrease their equity exposure by 10 percentage points or more, while column 5 uses the threshold of 20 percentage points or more. The means of the dependent variables fall from 8.3 percentage points to 3.6 percentage points and 2.7 percentage points, respectively. The marginal effects on the various participant characteristics are qualitatively similar to those in column 3. Two notable exceptions are the change in the sign of the marginal effect on participant age (from negative and statistically significant to positive and statistically significant), and the emergence of a slight gender divide. In the spirit of Barber and Odean (2001), males are 26 to 31 basis points more likely to make a large change and females are 26 to 43 basis points less likely to make a large change. Again, however, we continue to find that managed account participants are less likely to make portfolio changes than Pure TDF participants, and that non-delegated participants are more likely to do so.

4.2. The limited role of delegation in explaining other participant choices

In Table 6, we analyze four additional choices that participants may have made in response to the COVID-19 shock: increased loan activity, decreased deferral rates, made a partial withdrawal, or made a full plan withdrawal. To the extent that these choices are triggered by economic shocks rather than by broad market returns or volatility, we do not expect them to be systematically related to the level of delegation, except insofar as industries with different levels of reliance on delegation are differentially impacted by

COVID-19 during the first quarter of 2020. The probit specifications are similar to those estimated in Table 6. By including industry fixed effects, we control for average differences in participant choices across industries. All plan-level measures exclude the choices of participant i.

The dependent variable in column 1 equals one if participant i increases her plan loan balance, either by increasing the balance on an outstanding loan or by opening a new loan, and zero otherwise. Because loans are generally only available to active participants, we limit the sample to participants who are active on both December 31, 2019 and March 31, 2020. We also exclude a small number of plans for which there are no positive loan balances on December 31, 2019, to eliminate plans that do not offer access to 401(k) plan loans. Within this sample, only 2.3% of participants increased their loan activity. The single best predictor of increased loan balances during the first quarter of 2020 is a pre-existing loan balance, which may capture pre-existing liquidity constraints. The marginal effect is 3.7 percentage points and statistically significantly different from zero at the 1-percent level. Increased loan activity within the plan by other participants has a positive and statistically significant marginal effect, suggesting correlated loan-seeking behavior within plans, perhaps because of common economic shocks with firm, but the effect is economically modest because the standard deviation of this measure is only 1.5 percentage points. Differences in choices across participant types are even smaller. For example, everything else equal, Self-directed participants are 11 basis points less likely to increase their loan balances (statistically significant at the 5-percent level but economically insignificant).

In column 2, we switch our focus to reductions in participant deferral rates. To eliminate the mechanical relationship between job turnover and deferral rates going to zero, we limit the sample to participants who are active throughout the first quarter of 2020 and have a positive deferral rate on December 31, 2019. Here, we find evidence that delegation matters. Pure TDF participants (omitted category) and those defaulted into managed accounts are the least likely to reduce their deferral rates, as are those participants who appear to have accepted the defaulted deferral rate within their plan. Other predictors include pre-existing loan balances, which point to pre-existing liquidity constraints, but also higher salaries, rollover balances, and Roth balances, which point to higher levels of sophistication.

We predict partial plan withdrawals in column 3 and full plan withdrawals in column 4. In column 3, the sample includes all active and inactive participants during the quarter except for those who withdrawal all of their account assets. In column 4, we expand the sample to includes these additional participants, but are forced to reduce our set of independent variables because we lack data on how these participants were invested on December 31, 2019 and several other variables. As we document in Table 1, both outcomes are rare. We infer a significant plan withdrawal when the account balance on March 31, 2020 is less than 50% of the balance on December 31, 2019. The dependent variable equals one for 0.8% of the participants in column 3 and for 1.4% of the participants in column 4. In both specifications, the single best predictor of a withdrawal is separation from the firm. The marginal effect is 5.1 percentage points with respect to partial withdrawals and 19.5% with respect to full withdrawals. In other words, approximately 20% of newly terminated participants remove all plan assets and another 5% remove some plan assets. (Participants terminated before December 31, 2019 are the omitted category.) To the extent that terminated participants were liquidating plan assets at deflated equity prices to finance these withdrawals, the economic shocks driving withdrawals also served to lock in the (temporary) market losses.

5. Are portfolio changes associated with higher or lower quarterly returns?

In Table 7, we compare the quarterly returns of participants who do and do not make changes to their portfolios. We consider three definitions of portfolio changes. The first definition includes any changes to fund allocations, fund additions and removals, and other imputed fund exchanges, the second definition captures increases or decreases in equity exposure of 10 percentage points or more, and the third definition captures situations where Mixed TDF and SD participants become managed account or Pure TDF participants.

We do not directly observe quarterly returns. Our dependent variable is the percentage change in participant *i*'s account balance between December 31, 2019 and March 31, 2020. To account for the impact of equity exposure on realized returns, we include balanced-weighted equity exposure decile fixed effects. To account for average differences in the (unobserved-to-us) level of employer contributions across plans, we include two fixed effects for each plan, one for active participants and the other for inactive participants.

To account for the impact of ongoing employee contributions, we control for the predicted contribution amount over the quarter (monthly salary times employee deferral rate times three) scaled by the account balance on December 31, 2019. We include one set of predicted contributions for participants who are active through March 31, 2020 (because they are likely to make contributions all three months) and another set for participants who are terminated between December 31, 2019 and March 31, 2020 (because they are unlikely to make contributions all three months). We also directly control for job loss during the quarter. Finally, in the specifications that pool Mixed TDF and SD participants, we include a dummy variable to test whether Mixed TDF participant earn systematically different quarterly returns than SD participants. With the goal of minimizing noise, we limit the sample to those participants for whom we do not infer any plan withdrawal (by eliminating participant observations with a quarterly return below -50%), with a December 31, 2019 balance of more than $1,000, with a contribution-implied return of less than 25%, and an estimated quarterly return that is below 100%.[7] To allow for correlated quarterly returns within plan, we cluster standard errors on plan.

Within the pooled sample of managed account participants, we estimate that participants making portfolio changes earn quarterly returns that are 84 basis points lower than participants not making changes, but we cannot reject the null hypothesis of no difference in performance at conventional levels. Similarly, while we estimate that job loss is also associated with lower returns, this estimate also is not statistically distinguishable from zero.

For the third group of delegated participants, Pure TDF, we estimate that portfolio changers earn quarterly portfolio returns 2.2 percentage points *higher* than among non-changers with similar equity exposure (statistically significant at the 1-percent level), while those suffering job loss earn quarterly returns that are 1.5 percentage points lower. It is conceivable that the lower returns in the accounts of those losing jobs reflect employee and employer contribution reductions that are not fully captured by our predicted contribution measure and fixed effects. When we focus only on large portfolio changes we estimate that

[7] These filters reduce our sample by 2,583 participants, 7,211 participants, 7,958 participants, and 717 participants, respectively.

changes in either direction are associated with higher quarterly returns. Because we do not observe the dates on which portfolio changes are made, we do not know if changes in different directions occurred at different points in time and we do not know if intermediate changes were made during the quarter. We also are unable to adjust portfolio returns for changes in risk. Regardless, with the possible exception of managed accounts, we are not finding any evidence that portfolio changes are associated with lower returns.

Our findings for non-delegated participants, in columns 4 and 5, are broadly similar to our findings for Pure TDF participants. Namely, portfolio changes are associated with higher quarterly returns and job loss is associated with lower quarterly returns. However, within this sample, the higher returns appear to be driven by reductions in equity exposure. Finally, we estimate that increased delegation increases quarterly returns by 48 basis points relative to other portfolio changes, but the standard error is large. The fact that participants making portfolio changes appear not to have been harmed during the first quarter of 2020 is consistent with earlier finding that less sophisticated participants were less likely to make portfolio changes, especially those with delegated portfolio management.

6. Conclusion

We analyze 401(k) plan participant behavior during the first quarter of 2020, a quarter that was marked by historical levels of volatility and large negative returns as the COVID-19 pandemic impacted product markets and labor markets alike. Analyzing 617,376 participants across 531 plans in 20 industries, we ask which types of participants were the most likely to make changes to their retirement portfolios, with a focus on both the extent of portfolio delegation and individual economic shocks.

Consistent with several earlier studies, we find that the typical participant delegates all of her portfolio management to a TDFs or robo-advised managed account, and that these participants tend to be younger, with lower salaries, lower deferral rates, and lower account balances. Within this sample of plausibly less sophisticated participants, only 2.0% made any changes to their retirement portfolios and less than 1.0% made large changes to their equity exposure. Following the passage of the Pension Protection Act of 2006, which increased the use of TDFs as default investment options, U.S. equity markets experienced their longest bull market in history, increasing over 300% between March 2009 and December

2019. The low rate at which participants abandoned TDFs and managed accounts during the first quarter of 2020 suggests that participants are willing to stick with delegated investment options like TDFs even during volatile, down markets. The finding that both types of managed account participants were less likely to make portfolio changes than Pure TDF investors suggests that managed account participants may have higher levels of trust in portfolios because of the increased customization.

Among non-delegated participants, the likelihood of making portfolio changes is significantly higher, but tends to be positively correlated with proxies for investor sophistication. In other words, portfolio change was most likely among a relatively sophisticated subsample of a relatively sophistication group of participants. The notable exception is the increased likelihood of large portfolio changes by participants who experienced job loss during the quarter.

After documenting significant differences in the likelihood of delegation and job loss across industries during the first quarter of 2020, we analyze a broader set of participant choices. We find that partial and full withdrawals are primarily driven by job loss, but that Pure TDF participants and participants defaulted into managed accounts are the least likely to reduce their deferral rates. These are the two groups of participants who are the most likely to accept the plan's default deferral rate. We also find that within our sample of plans, there are 15 active participants who are terminated during the quarter for every one participant who becomes an active participant. To the extent that this pattern generalizes, it suggests that most of the withdrawals around job loss are unlikely to reflect rollovers into the 401(k) plans of new employers. Whether they reflect rollovers into checking accounts or IRAs, however, we cannot say. To the extent that participants were liquidating equity at deflated prices to finance liquid savings or consumption, these participants were locking in market losses.

When we estimate quarterly returns for participants without a partial or full withdrawal, we find that they tend to higher, rather than lower, following portfolio changes. The exception is a negative but statistically insignificant estimate for managed account participants, suggesting that robo-advised managed account participants are the least likely to benefit from managing their own portfolios.

References

Agnew, J., Balduzzi, P., Sunden, A., 2003. Portfolio choice and trading in a large 401(k) plan, *American Economic Review* 93(1), 193-215.

Baker, S.R., Bloom, N., Davis, S.J., Kost, K.J., Sammon, M.C., Viratyosin, T., 2020. The unprecedented stock market impact of COVID-19, NBER Working Paper No. 26945.

Balduzzi, P., Reuter, J., 2019. Heterogeneity in target date funds: Strategic risk-taking or risk matching? *Review of Financial Studies* 32(1), 300-337.

Barber, B., Odean, T., 2001. Boys will be boys: Gender, overconfidence, and common stock investment. Quarterly Journal of Economics 116(1), 261-292.

Ben-Rephael, A., Kandel, S., Wohl, A., 2012. Measuring investor sentiment with mutual funds flows, *Journal of Financial Economics* 104, 363-382.

Bucher-Koenen, T., Ziegelmeyer, M., 2014. Once burned, twice shy? Financial literacy and wealth losses during the financial crisis, *Review of Finance* 18, 2215-2246.

Campbell, J.Y., 2016. Restoring rational choice: The challenge of consumer financial regulation, *American Economic Review: Papers & Proceedings*, 106(5), 1-30.

Cerulli Associates. 2020. U.S. Managed Accounts 2019: The Challenge of New Platforms, accessed on June 6, 2020 at www.cerulli.com

Chalmers, J., Reuter, J., 2020. Is conflicted investment advice better than no advice? *Journal of Financial Economics* (forthcoming).

Friesen, G., Sapp, T.R.A. 2007. Mutual funds flows and investor returns: An empirical examination of fund investor timing ability, *Journal of Banking and Finance* 31(9), 2796-2816.

Goda, S.G., Levy, M., Manchester, C.F., Sojourner, A., Tasoff, J., 2019. Who is a passive saver under opt-in and auto-enrollment?, Working paper.

Madrian, B., Shea, D., 2001. The power of suggestion: inertia in 401(k) participation and savings behavior. Quarterly Journal of Economics 116, 1149–1187.

Pagliaro, C.A., Utkus, S.P., 2017. A different kind of target-date investor, Vanguard Center for Investor

Research. Institutional.vanguard.com

ICI, 2020. Investment Company Institute 2019 fact book: A review of trends and activities in the investment company industry, http://www.icifactbook.org.

Mitchell, O., Mottola, G.R., Utkus, S.P., Yamaguchi, T., 2006. The inattentive participant: Portfolio trading behavior in 401(k) plans, University of Michigan Retirement Research Center working paper.

Mitchell, O, Utkus, S., 2012, Target-date funds in 401(k) retirement plans, NBER Working paper 17911.

Sialm, C., Starks, L., Zhang, H., 2015a. Defined contribution pension plans: Mutual fund asset allocation changes, *American Economic Review: Papers & Proceedings* 105(5), 432-436.

Sialm, C., Starks, L., Zhang, H., 2015b. Defined contribution pension plans: Sticky or discerning money? Journal of Finance 70(2), 805-838.

Tamborini, C.R., Purcell, P., Iams, H.M. 2013. The relationship between job characteristics and retirement savings in defined contribution plans during the 2007-2009 recession, Monthly Labor Review, 136(5), 3-16.

Vanguard, 2019. How America saves 2019. Vanguard Center for Investor Research. Institutional.vanguard.com.

Table 1.

401(k) Participant characteristics by investor type.

This table reports summary statistics for the full sample and separately for five types of participants: opted into managed account, defaulted into managed account, 100% allocation to a single TDF and no other fund balances, 100% allocated to a single TDF but additional fund balances, and self-directed participants (who are enrolled in neither a managed account nor allocate 100% to a single TDF). Unless otherwise stated, all variables are measured on December 31, 2019. The full sample is limited to plan participants between the ages of 20 and 75 with a non-negative plan tenure on December 31, 2019 and a deferral rate that is no more than 30%. We lack a gender variable for 20.8% of participants. Because participant allocations across funds need not align with their balances, we report the numbers of funds with positive allocations and positive balances. The "% Equity" variables report equity exposures (reported in Table OA1) weighted by allocations to the fund or the fund's balance scaled by the account balance. In one case, we deflate the balances on March 31, 2020 using the fund (or category) return during 2020Q1, to minimize the impact of 2020Q1 returns on ending balances.

	Full sample N = 617,376		**Opted into MA** 3.5% participants 2.2% assets		**Defaulted into MA** 7.0% participants 4.5% assets		**Pure TDF** 43.1% participants 16.3% assets		**Mixed TDF** 6.9% participants 9.0% assets		**Self-directed** 39.5% participants 68.0% assets	
Participant characteristic	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Age	44.3	12.3	42.5	12.0	43.7	12.0	42.0	12.4	45.4	12.2	46.8	11.7
Salary ($000)	97.5	311.2	102.7	126.4	93.7	134.3	73.8	156.2	96.4	143.5	124.1	460.1
Balance ($000)	113.1	245.2	70.6	162.5	72.9	154.8	43.1	99.7	147.5	260.8	195.5	332.0
Plan tenure	7.1	7.3	4.6	6.3	6.6	6.8	4.9	5.6	9.2	7.3	9.5	8.2
Employee deferral rate	5.4%	5.6%	6.2%	5.5%	3.9%	4.4%	4.5%	4.4%	6.1%	6.2%	6.5%	6.5%
Deferral rate of 0%?	28.8%	45.3%	23.5%	21,909	34.4%	47.5%	26.0%	43.9%	29.9%	45.8%	30.0%	45.8%
Deferral rate match imputed default?	10.2%	30.3%	6.7%	25.0%	13.2%	33.8%	17.4%	37.9%	2.6%	15.9%	3.7%	18.8%
Roth balance?	17.7%	38.2%	29.0%	45.4%	13.8%	34.5%	10.0%	30.0%	15.5%	36.2%	26.2%	44.0%
Rollover into account?	11.4%	31.8%	15.0%	35.7%	8.1%	27.2%	7.4%	26.2%	12.1%	32.6%	16.0%	36.6%
Male?	47.6%	49.9%	42.7%	49.5%	46.1%	49.8%	45.4%	49.8%	55.2%	49.7%	49.4%	50.0%
Female?	31.6%	46.5%	53.0%	49.9%	52.7%	49.9%	31.1%	46.3%	28.9%	45.4%	27.0%	44.4%
Active on 12/31/19?	81.9%	38.5%	88.3%	32.2%	74.3%	43.7%	82.7%	37.8%	82.6%	37.9%	83.0%	37.6%
Active on 12/31/19 but terminated on 03/31/20?	3.3%	17.9%	3.0%	17.1%	2.8%	16.4%	3.5%	18.3%	2.2%	14.6%	2.3%	15.1%
Decrease deferral rate during 2020Q1?	6.7%	25.0%	10.8%	31.0%	6.1%	23.9%	6.1%	24.0%	5.9%	23.6%	7.2%	25.8%
Increase deferral rate during 2020Q1?	11.8%	32.3%	9.5%	29.4%	10.1%	30.2%	11.9%	32.3%	14.3%	35.0%	11.8%	32.2%
Increase deferral rate by 1% during 2020Q1?	8.1%	27.2%	6.0%	23.7%	7.9%	27.0%	8.9%	28.4%	9.8%	29.8%	7.1%	25.7%
Loan balance on 12/31/19?	16.4%	37.0%	11.9%	32.3%	14.4%	35.1%	14.8%	35.5%	20.7%	40.5%	18.2%	38.6%
Loan ratio (when positive on 12/31/19)	17.6%	14.7%	19.8%	16.0%	20.0%	15.4%	20.0%	14.9%	15.4%	13.3%	15.5%	14.2%
New loan during 2020Q1?	0.9%	9.2%	0.9%	9.7%	0.8%	8.9%	1.0%	9.8%	0.8%	8.6%	0.8%	8.6%
Partial withdrawal during 2020Q1?	0.8%	9.0%	1.0%	9.9%	0.8%	9.0%	0.7%	8.3%	0.8%	8.7%	0.9%	9.6%
Full withdrawal during 2020Q1?	1.4%	11.7%	0.0%	0.0%	0.0%	0.0%	0	0	0	0	0	0
Funds with a positive allocation on 12/31/19	4.4	5.1	12.7	3.6	14.2	3.6	1.0	0.0	1.0	0.0	6.2	4.5
Funds with a positive allocation on 03/31/20	4.4	5.0	12.6	3.8	13.9	4.1	1.0	0.4	1.0	0.6	6.2	4.5
Funds with a positive balance on 12/31/19	4.8	5.2	13.0	3.7	14.4	3.8	1.0	0.0	2.9	1.9	6.8	4.5
Funds with a positive balance on 03/31/20	4.8	5.1	12.8	3.8	14.1	4.2	1.0	0.5	3.0	2.0	6.8	4.5
% Equity using allocations on 12/31/19	74.5%	21.4%	76.0%	20.7%	70.4%	19.0%	75.9%	15.2%	72.5%	16.1%	74.0%	27.4%
% Equity using allocations on 03/31/20	73.9%	22.3%	74.7%	21.8%	69.0%	20.4%	75.7%	15.9%	72.0%	17.4%	73.1%	28.4%
% Equity using balances on 12/31/19	75.1%	21.0%	76.2%	20.2%	70.9%	18.5%	75.9%	15.4%	73.6%	18.2%	75.2%	26.5%
% Equity using return-adjusted balances on 03/31/20	74.5%	22.3%	75.9%	21.5%	70.3%	20.2%	75.6%	16.3%	73.5%	19.7%	74.1%	27.9%
% Equity using balances on 03/31/20	73.0%	22.7%	71.7%	22.6%	65.3%	21.3%	75.6%	16.3%	72.9%	20.0%	71.8%	28.3%

Table 2.

Transitions between participant types.

This table describes participant type transitions between December 31, 2019 and March 31, 2020. In addition, we report the fraction of participants who change type, change type in a manner that increases the level of portfolio delegation (e.g., transitioning from self directed to a managed account), and the fraction that have a positive self-directed brokerage account balance (SDBA) on March 31, 2020.

	Participant type on March 31, 2020						% of participant type who...		
Participant type on December 31, 2019	Defaulted into MA	Opted into MA	Pure TDF	Mixed TDF	SD	All	Change type	Increase delegation	Add SDBA
Defaulted into MA	42,727	0	0	0	555	43,282	1.28%	0.00%	0.05%
Opted into MA	0	21,529	0	10	370	21,909	1.73%	0.00%	0.05%
Pure TDF	0	90	260,921	2,284	2,546	265,841	1.85%	0.03%	0.06%
Mixed TDF	0	22	1,582	40,202	849	42,655	5.75%	3.76%	0.12%
Self-directed	0	623	107	294	242,665	243,689	0.42%	0.42%	0.20%
All	42,727	22,264	262,610	42,790	246,985	617,376	1.51%	0.44%	0.12%

Table 3.

Likelihood of participant-directed portfolio changes.

This table reports the likelihood of participant-directed portfolio changes by participant type. In addition to reporting the fracton of participants for whom we detect participant-directed changes in fund allocations and/or fund balances, we report the fraction of participants for whom the net change in equity exposure due to either changes in allocations or changes in fund balances is at least 5 percentage points, at least 10 percentage points, and at least 20 percentage points.

Participant type	Sample size	Any portfolio change	Decrease equity exposure >= 5 pp	Increase equity exposure >= 5 pp	Decrease equity exposure >= 10 pp	Increase equity exposure >= 10 pp	Decrease equity exposure >= 20 pp	Increase equity exposure >= 20 pp
	(1)	(2)	(4)	(5)	(6)	(7)	(6)	(7)
Defaulted into MA	43,282	1.28%	0.72%	0.34%	0.67%	0.28%	0.63%	0.19%
Opted into MA	21,909	1.73%	0.95%	0.45%	0.88%	0.36%	0.82%	0.23%
Pure TDF	265,841	2.10%	0.86%	0.60%	0.78%	0.41%	0.71%	0.16%
Mixed TDF	42,655	22.72%	3.01%	5.00%	2.46%	2.18%	1.97%	0.89%
Self-directed	243,689	15.51%	5.40%	3.45%	4.50%	2.52%	3.69%	1.50%
Delegated	331,032	1.97%	0.85%	0.56%	0.77%	0.39%	0.70%	0.17%
Mixed TDF and SD	286,344	16.58%	5.05%	3.68%	4.20%	2.47%	3.43%	1.41%
All	617,376	8.74%	2.79%	2.01%	2.36%	1.35%	1.97%	0.74%

Table 4.

Industry-level statistics on separations, withdrawals, deferral rates, and likelihood of portfolio changes.

This table reports selected summary statistics from Table 1 and Table 3 by industry. It focuses on participants who are active on December 31, 2019, but also reports the number of participants who become active by March 31, 2020 scaled by the number of active participants on December 31, 2019. Partial withdrawals, changes in deferral rates, and changes in portfolios are calculated for the subsample of participants without a complete withdrawal.

		Participants active on		Active 12/31/19 but terminated	Becomes active by	Withdrawal		Deferral rate			Any portfolio
Industry	Plans	12/31/19	Delegated?	by 03/31/20?	03/31/20?	Partial?	Full?	Decrease?	Increase by 1%?	Increase > 1%?	change?
Agriculture	3	923	73.3%	3.5%	0.0%	0.7%	0.3%	6.1%	3.5%	3.9%	3.5%
Arts/Entertainment	7	5,083	53.6%	4.0%	0.1%	0.6%	0.6%	7.5%	4.1%	3.7%	5.9%
Business Support	6	9,787	60.2%	3.2%	0.5%	0.8%	0.9%	18.0%	2.9%	2.7%	4.3%
Construction	12	6,614	55.0%	7.1%	0.2%	3.7%	0.6%	8.7%	14.1%	3.2%	2.8%
Education	1	30	0.0%	3.3%	0.0%	0.0%	0.0%	3.3%	3.3%	0.0%	16.7%
Finance and Insurance	63	81,107	49.8%	3.5%	0.1%	0.5%	0.6%	8.5%	9.0%	5.2%	7.8%
Food Services	4	1,361	65.4%	16.5%	0.4%	1.0%	3.2%	16.8%	2.1%	2.9%	3.3%
Health Care	75	52,494	75.7%	4.6%	0.4%	0.6%	0.7%	7.2%	6.9%	2.7%	3.7%
Information	8	6,455	61.9%	8.7%	0.1%	0.5%	1.8%	9.8%	1.9%	3.1%	4.3%
Management	7	5,478	36.5%	3.2%	0.1%	0.4%	0.6%	9.3%	12.9%	4.5%	4.5%
Manufacturing	110	108,460	47.7%	4.3%	0.3%	0.7%	0.8%	7.4%	14.5%	4.9%	10.2%
Mining/Oil/Gas	10	18,577	63.1%	2.3%	0.8%	0.6%	0.4%	5.6%	7.6%	4.2%	5.5%
Other Services	12	19,619	77.0%	4.4%	0.3%	1.4%	0.7%	5.4%	2.4%	1.9%	4.9%
Professional/Scientific	138	91,686	41.3%	4.1%	0.2%	0.8%	1.1%	8.3%	12.7%	4.9%	18.1%
Public Administration	2	3,564	28.4%	2.2%	0.0%	0.3%	0.2%	4.7%	2.9%	1.7%	11.6%
Real Estate	11	3,919	50.6%	3.3%	0.3%	0.4%	0.5%	7.7%	7.2%	5.0%	6.9%
Retail Trade	17	35,076	64.8%	5.3%	0.3%	0.8%	1.0%	7.0%	8.1%	2.9%	3.7%
Transportation/Storage	22	28,854	37.0%	2.5%	0.3%	0.5%	0.5%	10.4%	5.6%	6.0%	11.6%
Utilities	4	3,370	61.0%	2.0%	0.2%	0.4%	0.5%	9.3%	4.6%	6.2%	6.4%
Wholesale Trade	19	30,268	61.7%	3.3%	0.1%	0.5%	0.5%	7.4%	6.8%	3.1%	5.4%
All	531	512,725	53.3%	4.0%	0.3%	0.7%	0.8%	8.0%	9.7%	4.3%	9.1%

Table 5.

Predicting portfolio changes during 2020Q1.

This table reports marginal effects estimated via Probit. The dependent variable in columns (1), (2), and (3) equals one if participant i made any changes to her portfolio during 2020Q1, and zero otherwise. The dependent variable in column (4) equals one if participant i increased or decreased her exposure to equity by 10 or more percentage points (as indicated in columns (6) and (7) of Table 3), and zero otherwise. The dependent variable in column (5) is defined similarly, using a threshold of 20 percentage points. The "% Changes in industry" variable measures the average value of the dependent variable in all other plans within the same industry. The "% Changes in plan" variable measures the average value of the dependent variable within the plan, excluding participant i. Equity exposure fixed effects are based on fund balances on December 31, 2019. Columns (2), (4), and (5) include industry fixed effects. Column (3) replaces industry fixed effects with plan fixed effects. Coefficients and standard errors are multipled by 100, so that a marginal effect of 1.00 corresponds to an increase of one percentage point. Standard errors are clustered on plan and reported inside parentheses to the right of coefficients.

Dependent variable	Any changes in allocations and/or fund exchanges?						Abs(Change) >= 10 pp		Abs(Change) >= 20 pp	
	(1)		(2)		(3)		(4)		(5)	
Defaulted into MA?	-1.41 **	(0.68)	-0.33	(0.44)	-2.38 ***	(0.53)	-0.79 ***	(0.17)	-0.39 ***	(0.13)
Opted into MA?	-1.36	(0.89)	-1.50 *	(0.71)	-2.28 ***	(0.58)	-0.59 **	(0.23)	-0.21	(0.20)
Mixed TDF?	28.20 ***	(7.74)	14.43 ***	(3.45)	15.07 ***	(3.71)	1.80 ***	(0.51)	0.91 ***	(0.25)
Self-directed?	13.56 ***	(2.65)	9.43 ***	(0.70)	9.79 ***	(0.72)	3.10 ***	(0.21)	2.10 ***	(0.12)
% Changes in industry	0.13	(0.13)								
% Changes in plan			0.31 ***	(0.01)			0.26 ***	(0.02)	0.21 ***	(0.02)
Active?	1.15 *	(0.56)	2.31 ***	(0.52)	2.14 ***	(0.52)	0.64 ***	(0.09)	0.34 ***	(0.08)
Terminated during 2020Q1?	1.46 **	(0.63)	1.37 **	(0.64)	1.19 **	(0.54)	1.18 ***	(0.52)	1.31 ***	(0.50)
Male?	2.10 *	(1.35)	-0.11	(0.35)	0.32	(0.55)	0.31 ***	(0.10)	0.26 ***	(0.07)
Female?	0.34	(1.15)	-1.16 ***	(0.30)	-0.83 *	(0.49)	-0.43 ***	(0.09)	-0.26 ***	(0.07)
Ln Plan tenure	-1.58 ***	(0.35)	-1.02 ***	(0.21)	-1.03 ***	(0.20)	-0.50 ***	(0.08)	-0.35 ***	(0.04)
Ln Balance	0.56 ***	(0.18)	0.45 ***	(0.12)	0.47 ***	(0.12)	0.43 ***	(0.04)	0.38 ***	(0.03)
Ln Salary	-0.23	(0.35)	0.38 ***	(0.13)	0.39 ***	(0.13)	0.18 ***	(0.05)	0.12 ***	(0.04)
Ln Age	-1.72 **	(0.71)	-0.94 *	(0.49)	-1.08 **	(0.46)	0.78 ***	(0.24)	0.78 ***	(0.14)
Employee deferral rate	0.12 ***	(0.04)	0.10 ***	(0.02)	0.11 ***	(0.02)	0.06 ***	(0.01)	0.04 ***	(0.01)
Deferral rate 0%?	0.08	(0.61)	0.59 **	(0.27)	0.68 ***	(0.23)	0.47 ***	(0.10)	0.36 ***	(0.07)
Default deferral rate?	0.22	(0.69)	0.09	(0.48)	0.18	(0.52)	-0.04	(0.15)	-0.17 *	(0.10)
Roth?	1.12 **	(0.53)	1.43 ***	(0.23)	1.47 ***	(0.21)	0.73 ***	(0.07)	0.45 ***	(0.05)
Rollover into account?	0.57 *	(0.33)	0.33	(0.31)	0.35	(0.28)	0.19 **	(0.08)	0.15 ***	(0.05)
Loan?	0.24	(0.38)	0.32 **	(0.14)	0.41 ***	(0.12)	0.35 ***	(0.09)	0.37 ***	(0.07)
Daily std. dev. during 2020Q1	3.05 *	(1.89)	-0.46	(1.22)	-0.17	(1.07)	0.44 **	(0.21)	0.68 ***	(0.14)
Equity exposure = 10-19%	3.37 ***	(1.54)	5.86 ***	(1.57)	5.60 ***	(1.56)	2.89 ***	(0.63)	0.42 *	(0.26)
Equity exposure = 20-29%	1.19	(1.75)	4.61 ***	(1.66)	4.14 ***	(1.53)	2.30 ***	(0.47)	0.41 *	(0.23)
Equity exposure = 30-39%	-0.84	(2.02)	3.04 *	(1.96)	2.92 **	(1.80)	0.71 **	(0.34)	-0.26	(0.16)
Equity exposure = 40-49%	-2.81	(1.78)	1.31	(1.83)	1.07	(1.65)	-0.32	(0.28)	-0.79 ***	(0.12)
Equity exposure = 50-59%	-3.36	(1.92)	0.97	(2.10)	0.64	(1.83)	-0.70 **	(0.26)	-1.07 ***	(0.11)
Equity exposure = 60-69%	-4.78 **	(1.67)	-0.34	(2.20)	-0.51	(1.89)	-1.27 ***	(0.26)	-1.42 ***	(0.11)
Equity exposure = 70-79%	-5.23 *	(1.90)	0.11	(2.75)	-0.47	(2.24)	-1.40 ***	(0.30)	-1.57 ***	(0.11)
Equity exposure = 80-89%	-7.16 *	(3.80)	0.04	(3.15)	-0.62	(2.69)	-2.23 ***	(0.46)	-2.77 ***	(0.29)

Equity exposure = 90-100%	-7.54	**	(3.11)	-0.31	(3.52)	-1.10	(2.89)	-2.46 ***	(0.41)	-2.50 *** (0.25)
Industry fixed effects?	--			Yes		--		Yes		Yes
Plan fixed effects?	--			--		Yes		--		--
Observed probability	8.62			8.62		8.63		3.62		2.67
Predicted probability	5.46			4.46		4.12		2.12		1.51
Sample size	616,412			616,501		615,874		616,501		616,501
Pseudo-R2	0.1476			0.2841		0.2979		0.1321		0.1222

Table 6.

Predicting plan withdrawals and increased loan activity during 2020Q1.

This table relates participant type to other portfolio choices during 2020Q1. We report marginal effects estimated via Probit. The dependent variable in column (1) equals one if participant i increased her loan balance or initiated a new loan during 2020Q1, and zero otherwise. The sample is limited to participants who are active at the beginning and end of 2020Q1, and to plans in which at least one participant had a positive loan balance on December 31, 2020. The dependent variable in column (2) equals one if participant i reduced her deferral rate by at least one percentage point during 2020Q1. The sample is limited to participants who are active at the beginning and end of 2020Q1, and who have a positive deferral rate on December 31, 2020. The dependent variable in columns (3) equals one if participant i made an (imputed) partial withdrawal from her account during 2020Q1, and zero otherwise. The dependent variable in column (4) equals one if participant i withdraws all plan assets during 2020Q1, and zero otherwise. The limited set of independent variables reflects the limited data that we possess on participants who have an account balance of $0 at the end of 2020Q1. In particular, we can control for neither participant type nor equity exposure categories. Equity exposure fixed effects in the other columns are based on fund balances on December 31, 2019. All specifications include industry fixed effects. Coefficients and standard errors are multipled by 100, so that a marginal effect of 1.00 corresponds to an increase of one percentage point. Standard errors are clustered on plan and reported inside parentheses to the right of coefficients.

Dependent variable	Increase loan balance or new loan?		Decrease deferral rate?		Partial withdrawal?		Full withdrawal?	
	(1)		(2)		(3)		(4)	
Defaulted into MA?	0.08	(0.09)	0.35	(0.27)	0.04	(0.09)		
Opted into MA?	0.11	(0.10)	2.21 ***	(0.28)	0.27 ***	(0.13)		
Mixed TDF?	-0.06	(0.10)	0.79 ***	(0.30)	0.08	(0.09)		
Self-directed?	-0.11 **	(0.05)	1.47 ***	(0.14)	0.14 ***	(0.03)		
% Outcome within plan	0.39 ***	(0.02)	0.58 ***	(0.04)	0.10 ***	(0.01)	0.02 ***	(0.01)
Active?					-0.71 ***	(0.13)	-2.80 ***	(0.19)
Terminated during 2020Q1?					5.09 ***	(0.95)	19.50 ***	(1.04)
Male?	-0.01	(0.07)	-0.10	(0.24)	0.02	(0.04)		
Female?	-0.10	(0.08)	0.32	(0.25)	-0.05	(0.04)		
Ln Plan tenure	-0.11 ***	(0.04)	-0.54 ***	(0.12)	0.12 ***	(0.02)	-0.05 ***	(0.02)
Ln Balance	0.01	(0.03)	-0.37 ***	(0.08)	-0.14 ***	(0.02)	-0.04 ***	(0.01)
Ln Salary	-0.26 ***	(0.05)	1.13 ***	(0.18)	0.01	(0.02)	0.01 *	(0.00)
Ln Age	0.11	(0.14)	-2.88 ***	(0.22)	0.85 ***	(0.07)	0.16 ***	(0.05)
Employee deferral rate	-0.06 ***	(0.01)	0.37 ***	(0.03)	0.01 ***	(0.00)	0.00	(0.00)
Deferral rate 0%?	-0.75 ***	(0.05)			0.04	(0.05)	0.09 ***	(0.03)
Default deferral rate?	-0.73 ***	(0.13)	-1.94 ***	(0.15)	-0.22 ***	(0.03)	-0.13 ***	(0.04)
Roth?	0.31 ***	(0.06)	4.71 ***	(0.20)	0.07 **	(0.03)		
Rollover into account?	-0.08	(0.07)	0.53 ***	(0.14)	0.09 **	(0.04)		
Loan?	3.74 ***	(0.30)	3.87 ***	(0.17)	0.75 ***	(0.09)		

Equity exposure = 10-19%	-0.17		(0.24)	0.34		(0.51)	0.25	(0.21)
Equity exposure = 20-29%	0.16		(0.26)	0.49		(0.49)	0.04	(0.09)
Equity exposure = 30-39%	-0.42	**	(0.18)	0.55		(0.39)	0.00	(0.07)
Equity exposure = 40-49%	-0.65	***	(0.11)	0.26		(0.32)	0.08	(0.06)
Equity exposure = 50-59%	-0.32	**	(0.13)	0.78	***	(0.32)	-0.04	(0.05)
Equity exposure = 60-69%	-0.04		(0.14)	0.78	***	(0.30)	-0.20 ***	(0.04)
Equity exposure = 70-79%	0.07		(0.13)	0.87	***	(0.28)	-0.14 ***	(0.04)
Equity exposure = 80-89%	0.13		(0.13)	1.27	***	(0.29)	-0.10 **	(0.05)
Equity exposure = 90-100%	-0.22		(0.13)	1.06	***	(0.29)	-0.03	(0.05)
Industry fixed effects?	Yes			Yes			Yes	Yes
Observed probability	2.32			6.02			0.81	1.38
Predicted probability	1.70			4.46			0.40	0.13
Sample size	474,844			422,406			616,513	625,959
Pseudo-R2	0.0838			0.1585			0.1624	0.3735

Table 7.

Are portfolio changes associated with lower realized quarterly returns?

This table relates estimated participant quarterly returns during 2020Q1 to measures of portfolio change, job loss, and equity exposure (based on fund balances on December 31, 2019). The measures of portfolio changes are a dummy variable that equals one when the participant makes "any change" (column (3) in Table 3); a dummy variable that equals one when the exposure to equity decreases by 10 percentage points or more (based on either allocations or return-adjusted changes in account balances); a dummy variable that equals one when the exposure to equity increases by 10 percentage points or more (based on either allocations or return-adjusted changes in account balances); and a dummy variable that equals one when the participant transitions from Mixed TDF or SD to Pure TDF or MA. Our measure of job loss is whether a participant is classified as terminated during 2020Q1.We estimate separate specifications for three subsamples of participants (as classified on December 31, 2020): those invested through managed accounts; Pure TDF; and Mixed TDF plus Self-directed. Quarterly returns are inferred from changes in balances between December 31, 2019 and March 31, 2020. We control for the level of predicted retirement contributions during the quarter using annual salary and deferral rate data from December 31, 2019, scaled by the balance on December 31, 2019. We include one measure for participants who are still active on March 31, 2020 and another measure for participants who are terminated before March 31, 2020, to capture average differences in the level of participant contributions. We include plan fixed effects interacted with whether the participant is active on December 19, 2019 to control for variation in the level of employer contributions across active and inactive participants (which we do not directly observe). We include equity exposure category fixed effects based on fund balances on December 31, 2019. We exclude participants with full or (imputed) partial withdrawals (i.e., those with imputed returns below -50.0%). We also excluded participants for whom the estimated quarterly returns were likely to be particularly noise due to the timing and level of retirement contributions. Namely, we exclude participants with estimated quarterly returns in excess of 100.0%, participants for whom predicted portfolio contributions were likely to increase the estimated quarterly return by 25% or more, and participants with December 31, 2019 balances of $1,000 or less. Coefficients and standard errors are multipled by 100, so that a marginal effect of 1.00 corresponds to an increase of one percentage point. Standard errors are clustered on plan and reported inside parentheses to the right of coefficients.

	Imputed quarterly return									
	MA		Pure TDF				Mixed TDF and SD			
	(1)		(2)		(3)		(4)		(5)	
Any portfolio change?	-0.84	(0.53)	2.18 ***	(0.75)			1.51 ***	(0.21)		
Decrease exposure to equity by 10 pp?					1.16 **	(0.58)			2.71 ***	(0.61)
Increase exposure to equity by 10 pp?					2.30 ***	(0.69)			0.02	(1.00)
Increase delegation?							0.48	(1.67)		
Mixed TDF?							-0.20	(0.51)	-0.13	(0.60)
Terminated 2020Q1?	-1.03	(0.77)	-1.49 ***	(0.29)	-1.49 ***	(0.28)	-0.95 ***	(0.28)	-0.98 ***	(0.28)
Predicted contributions * Active 2020Q1?	1.33 ***	(0.09)	1.49 ***	(0.06)	1.49 ***	(0.06)	1.43 ***	(0.07)	1.44 ***	(0.07)
Predicted contributions * Terminated 2020Q1?	0.72 ***	(0.14)	0.80 ***	(0.07)	0.80 ***	(0.07)	0.77 ***	(0.06)	0.78 ***	(0.06)
Equity allocation = 10-19%	0.80 **	(0.39)					-3.79 ***	(0.29)	-3.79 ***	(0.33)
Equity allocation = 20-29%	-4.31 ***	(0.46)					-5.72 ***	(0.24)	-5.79 ***	(0.28)
Equity allocation = 30-39%	-6.02 ***	(0.68)	-10.68 ***	(3.49)	-10.93 ***	(3.44)	-8.21 ***	(0.25)	-8.31 ***	(0.27)
Equity allocation = 40-49%	-8.78 ***	(0.56)	-12.76 ***	(3.44)	-13.00 ***	(3.38)	-10.23 ***	(0.43)	-10.35 ***	(0.43)
Equity allocation = 50-59%	-11.00 ***	(0.64)	-14.73 ***	(3.46)	-14.97 ***	(3.41)	-12.91 ***	(0.43)	-13.02 ***	(0.43)
Equity allocation = 60-69%	-13.41 ***	(0.66)	-16.57 ***	(3.44)	-16.82 ***	(3.38)	-14.20 ***	(0.38)	-14.31 ***	(0.37)
Equity allocation = 70-79%	-15.17 ***	(0.65)	-17.75 ***	(3.43)	-18.00 ***	(3.37)	-16.51 ***	(0.24)	-16.63 ***	(0.22)
Equity allocation = 80-89%	-16.35 ***	(0.60)	-20.37 ***	(3.40)	-20.61 ***	(3.35)	-18.15 ***	(0.31)	-18.24 ***	(0.29)
Equity allocation = 90-100%	-18.59 ***	(0.83)	-19.25 ***	(3.44)	-19.49 ***	(3.38)	-19.02 ***	(0.52)	-19.16 ***	(0.57)
Constant	1.67 **	(0.77)	4.10	(3.41)	4.36	(3.36)	2.49 ***	(0.28)	2.70 ***	(0.32)

Plan fixed effects * Active?	Yes	Yes	Yes	Yes	Yes
Sample size	54,627	213,382	213,382	267,277	267,277
R2	0.398	0.516	0.516	0.535	0.535

Online Appendix for

Portfolio delegation and 401(k) plan participant responses to COVID-19

Table OA1

In Table OA1, we list each of the narrow investment Morningstar categories that are represented by participant holdings across the 531 plans, as well as company stock and self-directed brokerage accounts (SDBA). "Assumed % Equity" is the fund's assumed allocation to equity. These are based on historical averages for each category of mutual fund, through December 31, 2019, rounded to the nearest 5 percentage points. When calculating our measures of equity exposure, we use the same fraction for all funds with the same narrow investment category and for both December 31, 2019 and March 31, 2020. Calculating portfolio-level measures of equity exposure provides us with a coarse measure of portfolio risk that can easily be compared within and across participants, summarized in Table 1. The limitation is that assumed equity exposure ignores the fact that 100% invested in small-cap equity is riskier than 100% in large-cap equity, and it ignores variation in the riskiness of long-term corporate debt versus short-term government debt. Despite these limitations, the correlation between our assumed equity exposures, which and average fund-level returns during the first quarter of 2020 is -0.7495.

We report total assets under management and the fraction of assets under management within each narrow category, on both December 31, 2019 and March 31, 2020. Changes in AUM reflect the combined effect of new contributions, withdrawals, exchanges, and fund returns. The correlation between these category-level percentage changes in AUM and the average fund-level return within the category is 0.6929. The AUM in Personal Choice Retirement Accounts on December 31, 2019 is $0 because we exclude participants with positive account balances from our sample.

We also report the number of mutual funds and the total number of investment options within each category. The total number includes separate accounts and collective investment trusts, for which we lack return data. Approximately 70% of the 2,391 distinct investment options across the 531 plans are mutual

funds. (According to Figure 3.16 in the 2019 Investment Company Institute Factbook, 22% of assets in "large 401(k) plans" were held in collective investment trusts in 2017, up from 6% in 2000.) For the subset of mutual funds, we report the average return over the first quarter of 2020 and the cross-sectional standard deviation of quarterly returns. We also report the average after-fee return for mutual funds within the category. The correlation between our average fund-level returns and the category-level returns from Morningstar is 0.9811.

Table OA2

In Table OA2, we assign potential portfolio changes into four categories, which are mutually exclusive and sum to the probability of "any change." Column (4) reports the fraction of participants who made any changes to fund allocations and added balances to at least one new fund and/or removed balances from at least one prior fund. Column (5) reports the fraction of participants who made any changes to fund allocations without adding or removing any funds. Column (6) reports the fraction of participants who added balances to at least one new fund and/or removed balances from at least one prior fund without making any changes to fund allocations. After correcting for the small number of fund re-mappings, changes in fund allocations and fund additions and removals are unambiguous signals of participant-directed changes. Finally, column (7) reports the fraction of participants who are estimated to have made fund exchanges without adding or completely removing any funds. Because we do not directly observe any variable that flags partial exchanges, we infer these exchanges by comparing the actual balances of each fund on March 31, 2020 to predicted balances based on fund (or category) returns. To appear in column (7), the maximum difference between predicted and actual balances across all of the participant's funds must exceed 10%.

Table OA1.

Investment option summary statistics by narrow Morningtar category.

This table reports summary statistics for each of the 83 narrow Morningstar categories reflected in the menus of the 532 401(k) plans that we study, including our assumed allocation to equity (based on historical allocations rounded to the nearest 5 percentage points), AUM on December 31, 2019 and March 31, 2020, the number of options for which we observe fund-level returns, and the number of options for which we observe narrow category level returns. Only 1,661 of the 2,391 unique investment options are mutual funds. The assumed % equity for All options is the equal-weighted average across the 2,391 options.

Narrow Morningstar category	Broad category	Assumed % equity	AUM 12/31/19 ($ million)	AUM 3/31/20 ($ million)	AUM 12/31/19 (%)	AUM 3/31/20 (%)	Percentage change in AUM	Options with fund return	Average fund return	Standard deviation of fund return	Options with category return	Average category return
Target date 2000-2010	TDF	35	204.3	185.8	0.27%	0.28%	-9.07%	16	-8.52%	2.29%	38	-7.94%
Target date 2015	TDF	40	356.4	322.7	0.48%	0.49%	-9.48%	13	-9.29%	1.84%	33	-9.48%
Target date 2020	TDF	45	2131.4	1888.4	2.84%	2.89%	-11.40%	22	-10.66%	1.73%	48	-10.04%
Target date 2025	TDF	50	2635.2	2296.8	3.51%	3.52%	-12.84%	26	-12.33%	2.15%	57	-12.19%
Target date 2030	TDF	60	4309.2	3697.5	5.75%	5.66%	-14.19%	25	-14.81%	1.58%	57	-14.26%
Target date 2035	TDF	70	2779.4	2359.0	3.71%	3.61%	-15.13%	26	-16.66%	1.77%	58	-16.56%
Target date 2040	TDF	80	3654.0	3040.3	4.87%	4.65%	-16.80%	26	-18.66%	1.70%	58	-18.27%
Target date 2045	TDF	85	1793.0	1498.2	2.39%	2.29%	-16.44%	25	-19.57%	1.82%	57	-19.60%
Target date 2050	TDF	85	2150.8	1798.3	2.87%	2.75%	-16.39%	26	-20.14%	1.60%	57	-20.04%
Target date 2055	TDF	90	676.3	586.8	0.90%	0.90%	-13.23%	24	-20.04%	1.45%	56	-20.37%
Target date 2060+	TDF	90	216.4	201.0	0.29%	0.31%	-7.11%	24	-20.03%	1.40%	56	-20.71%
Target date retirement	TDF	30	439.0	412.3	0.59%	0.63%	-6.09%	16	-8.26%	2.43%	44	-7.27%
Allocation 15% to 30% equity	Allocation	15	55.2	51.4	0.07%	0.08%	-7.00%	5	-8.52%	5.61%	9	-8.58%
Allocation 30% to 50% equity	Allocation	35	117.2	114.6	0.16%	0.18%	-2.23%	16	-9.05%	1.98%	59	-12.21%
Allocation 50% to 70% equity	Allocation	60	1297.7	1105.8	1.73%	1.69%	-14.79%	38	-14.37%	3.31%	76	-14.74%
Allocation 70% to 85% equity	Allocation	75	320.4	255.9	0.43%	0.39%	-20.11%	11	-17.45%	1.08%	32	-19.68%
Allocation 85%+ equity	Allocation	95	13.2	10.6	0.02%	0.02%	-19.75%	3	-19.55%	3.32%	34	-22.79%
Tactical allocation	Allocation	50	33.0	28.4	0.04%	0.04%	-13.73%	1	-16.05%		3	-13.87%
World allocation	Allocation	50	89.6	74.9	0.12%	0.11%	-16.33%	14	-17.03%	5.13%	16	-17.47%
Large blend	US equity	100	10896.3	8809.0	14.53%	13.48%	-19.16%	71	-21.28%	4.56%	90	-20.92%
Large growth	US equity	100	5608.6	4730.1	7.48%	7.24%	-15.66%	97	-14.50%	5.41%	110	-15.48%
Large value	US equity	100	4223.5	3083.4	5.63%	4.72%	-26.99%	88	-26.57%	4.33%	103	-26.77%
Mid-cap blend	US equity	100	2106.1	1508.9	2.81%	2.31%	-28.36%	36	-27.85%	3.36%	43	-28.28%
Mid-cap growth	US equity	100	1428.6	1113.3	1.91%	1.70%	-22.07%	83	-19.92%	4.08%	92	-20.64%
Mid-cap value	US equity	100	960.1	666.1	1.28%	1.02%	-30.62%	56	-31.98%	4.63%	58	-32.53%
Small blend	US equity	100	3505.4	3363.9	4.67%	5.15%	-4.04%	65	-32.13%	3.18%	78	-32.37%
Small growth	US equity	100	1500.5	1150.8	2.00%	1.76%	-23.31%	92	-23.81%	4.03%	95	-24.59%
Small value	US equity	100	1063.4	659.2	1.42%	1.01%	-38.01%	59	-36.83%	4.39%	62	-36.89%
Diversified emerging markets	Intl equity	100	728.3	537.5	0.97%	0.82%	-26.20%	52	-24.83%	2.83%	53	-25.26%
Diversified Pacific/Asia	Intl equity	100	6.9	5.8	0.01%	0.01%	-16.42%	2	-19.99%	1.25%	2	-20.77%
Europe stock	Intl equity	100	0.1	0.0	0.00%	0.00%	-28.94%	1	-25.69%		1	-24.77%
Foreign large blend	Intl equity	100	2580.2	1957.5	3.44%	3.00%	-24.13%	52	-23.97%	3.94%	63	-23.39%
Foreign large growth	Intl equity	100	2039.9	1578.1	2.72%	2.42%	-22.64%	40	-18.87%	3.06%	44	-19.08%
Foreign large value	Intl equity	100	325.6	226.0	0.43%	0.35%	-30.60%	21	-28.72%	2.70%	22	-27.33%
Foreign small/mid blend	Intl equity	100	121.5	86.8	0.16%	0.13%	-28.56%	13	-30.19%	3.72%	13	-28.31%
Foreign small/mid growth	Intl equity	100	132.0	98.3	0.18%	0.15%	-25.52%	18	-24.14%	3.00%	19	-24.39%
Foreign small/mid value	Intl equity	100	21.2	14.0	0.03%	0.02%	-33.98%	3	-33.38%	1.32%	3	-30.40%
World large stock	Intl equity	100	454.8	352.9	0.61%	0.54%	-22.39%	30	-21.63%	5.11%	32	-21.05%
World small/mid stock	Intl equity	100	22.1	15.4	0.03%	0.02%	-30.46%	5	-23.00%	1.53%	5	-26.22%

Communications	Sector	100	0.1	0.0	0.00%	0.00%	-34.35%	1	-18.62%		1	-17.59%
Consumer cyclical	Sector	100	0.2	0.1	0.00%	0.00%	-32.59%	1	-23.07%		1	-26.33%
Consumer defensive	Sector	100	0.3	0.0	0.00%	0.00%	-90.53%	1	-14.11%		1	-17.30%
Energy limited partnership	Sector	100	1.1	0.7	0.00%	0.00%	-38.24%	1	-49.32%		1	-50.29%
Equity energy	Sector	100	2.2	1.3	0.00%	0.00%	-41.87%	5	-45.00%	9.07%	5	-53.36%
Equity precious metals	Sector	100	0.9	0.6	0.00%	0.00%	-37.25%	2	-14.80%	6.04%	2	-25.96%
Financial	Sector	100	82.1	84.6	0.11%	0.13%	3.08%	1	-34.99%		2	-34.67%
Global real estate	Sector	100	129.9	88.5	0.17%	0.14%	-31.89%	18	-27.12%	2.98%	18	-26.19%
Health	Sector	100	39.8	34.2	0.05%	0.05%	-13.94%	5	-12.01%	1.18%	5	-13.94%
Industrials	Sector	100	0.6	0.4	0.00%	0.00%	-30.45%	2	-28.26%	0.54%	2	-28.47%
Infrastructure	Sector	100	0.0	0.0	0.00%	0.00%	-18.00%	1	-22.77%		1	-21.41%
Natural resources	Sector	100	0.8	0.3	0.00%	0.00%	-58.57%	4	-35.79%	6.31%	4	-33.28%
Real estate	Sector	100	423.6	322.1	0.56%	0.49%	-23.97%	29	-24.12%	1.75%	32	-26.35%
Technology	Sector	100	92.8	82.3	0.12%	0.13%	-11.27%	13	-12.45%	4.17%	13	-14.39%
Utilities	Sector	100	1.8	1.4	0.00%	0.00%	-22.04%	3	-15.52%	1.93%	3	-15.51%
Long-short equity	Alternative	60	12.5	9.7	0.02%	0.01%	-21.78%	6	-17.87%	3.88%	6	-12.40%
Managed futures	Alternative	50	1.3	1.6	0.00%	0.00%	20.36%	3	-1.31%	9.18%	3	0.03%
Market neutral	Alternative	50	0.7	0.7	0.00%	0.00%	-1.00%	1	-2.39%		1	-4.07%
Multialternative	Alternative	50	3.5	3.3	0.00%	0.00%	-7.26%	5	-5.43%	5.15%	5	-9.71%
Options-based	Alternative	90	12.3	10.3	0.02%	0.02%	-16.26%	2	-7.46%	3.61%	2	-12.93%
Commodities broad basket	Commodities	20	47.9	34.0	0.06%	0.05%	-29.01%	9	-28.05%	6.20%	10	-24.72%
Commodities precious metals	Commodities	0	7.4	8.3	0.01%	0.01%	11.65%	3	-3.93%	16.45%	3	-3.93%
Bank loan	Taxable bond	0	17.5	14.5	0.02%	0.02%	-17.35%	4	-13.51%	2.02%	4	-12.45%
Corporate bond	Taxable bond	0	25.0	22.6	0.03%	0.03%	-9.82%	2	-3.26%	3.92%	2	-4.74%
Emerging markets bond	Taxable bond	0	13.4	10.7	0.02%	0.02%	-20.39%	9	-14.70%	2.40%	9	-14.59%
Emerging markets local-currency bond	Taxable bond	0	8.8	6.2	0.01%	0.01%	-30.35%	2	-17.39%	3.59%	2	-13.98%
High yield bond	Taxable bond	0	185.0	157.7	0.25%	0.24%	-14.77%	41	-13.62%	2.43%	41	-12.70%
Inflation-protected bond	Taxable bond	0	536.0	563.6	0.71%	0.86%	5.15%	24	0.55%	1.69%	28	-0.16%
Intermediate core bond	Taxable bond	0	2987.5	3252.6	3.98%	4.98%	8.88%	29	2.36%	1.46%	44	1.57%
Intermediate core-plus bond	Taxable bond	0	2406.5	2521.4	3.21%	3.86%	4.77%	49	-0.12%	2.26%	53	-1.10%
Intermediate government	Taxable bond	0	172.0	182.3	0.23%	0.28%	5.98%	28	5.41%	2.12%	28	4.23%
Long government	Taxable bond	0	1.0	2.7	0.00%	0.00%	171.43%	2	21.54%	0.99%	2	20.48%
Long-term bond	Taxable bond	0	7.1	8.4	0.01%	0.01%	17.67%	2	4.19%	3.01%	2	-0.63%
Multisector bond	Taxable bond	0	166.5	153.3	0.22%	0.23%	-7.93%	17	-9.74%	2.99%	17	-8.95%
Nontraditional bond	Taxable bond	0	46.5	41.6	0.06%	0.06%	-10.54%	14	-5.94%	1.84%	14	-7.55%
Preferred stock	Taxable bond	0	2.7	2.4	0.00%	0.00%	-10.63%	1	-13.51%		1	-17.90%
Short government	Taxable bond	0	159.0	176.9	0.21%	0.27%	11.22%	10	2.63%	1.10%	10	2.15%
Short-term bond	Taxable bond	0	366.3	406.4	0.49%	0.62%	10.96%	34	-2.10%	2.62%	34	-2.14%
Stable value	Taxable bond	0	3792.6	4580.9	5.06%	7.01%	20.78%	0			87	0.56%
Ultrashort bond	Taxable bond	0	11.9	11.6	0.02%	0.02%	-1.99%	3	-0.72%	1.25%	3	-1.76%
World bond	Taxable bond	0	60.9	62.0	0.08%	0.09%	1.83%	12	-7.75%	5.37%	13	-5.02%
World bond-USD hedged	Taxable bond	0	87.4	86.4	0.12%	0.13%	-1.22%	10	-1.89%	2.85%	10	-1.86%
Money market - taxable	Money market	0	845.4	1134.0	1.13%	1.74%	34.13%	7	0.31%	0.03%	25	0.25%
Prime money market	Money market	0	161.0	208.0	0.21%	0.32%	29.14%	4	0.37%	0.03%	5	0.28%
Company stock		100	3.0	2.4	0.00%	0.00%						
Loan fund		0	1063.7	1074.7	1.42%	1.64%						
Personal choice retirement account		0	0.0	84.4	0.00%	0.13%						
All Options		68.2	74,985.1	65,337.3	100.00%	100.00%		1,661	-18.47%	10.82%	2,391	-17.30%

Table OA2.
Likelihood of participant-directed portfolio changes.

This table reports the likelihood of participant-directed portfolio changes by participant type. Column (3) reports the likelihood of any change. For participants investing through a managed account, column (3) reports the fraction who stop using the managed account product during 2020Q1. For all other participants, column (3) reports the sum of the likelihoods in columns (4) through (7). Column (4) contains the fraction of participants who changed fund allocations and also added or removed funds. Column (5) contains the fraction of participants who changed fund allocations without adding or removing any funds. Column (6) contains the fraction of participants who added or removed funds without changing fund allocations. Column (7) contains the fraction of participants that neither added nor removed funds nor made any changes to their fund allocations, but for whom we infer a fund exchange.

Participant type	Sample size (1)	No change (2)	Any portfolio change (3)	Change in allocations and fund add/drop (4)	Change in allocations without fund add/drop (5)	Fund add/drop without changes in allocations (6)	Other imputed fund exchanges (7)
Defaulted into MA	43,282	98.72%	1.28%				
Opted into MA	21,909	98.27%	1.73%				
Pure TDF	265,841	97.90%	2.10%	1.01%	0.08%	1.00%	0.00%
Mixed TDF	42,655	77.28%	22.72%	1.87%	0.33%	13.41%	7.12%
Self-directed	243,689	84.49%	15.51%	5.11%	2.96%	5.00%	2.44%
Delegated	331,032	98.03%	1.97%	1.09%	0.07%	0.80%	0.00%
Mixed TDF and SD	286,344	83.42%	16.58%	4.63%	2.57%	6.25%	3.13%
All	617,376	91.26%	8.74%	2.73%	1.23%	3.33%	1.46%