Menu Effects and Retirement Saving: The Impact of Life Cycle Funds on 401(k) Plan Portfolios

Olivia S. Mitchell, Gary R. Mottola, Stephen P. Utkus and Takeshi Yamaguchi

This version December 9, 2008

This research is part of the NBER programs on Aging and Labor Economics and was undertaken pursuant to a grant from the US Social Security Administration (SSA) to the Michigan Retirement Research Center (MRRC). That research support is gratefully acknowledged along with that of the Pension Research Council at The Wharton School and Vanguard. The authors also acknowledge Vanguard's efforts in the provision of recordkeeping data under restricted access conditions. They benefited from the suggestions of Brigitte Madrian, Alexander Muermann, and Stephen Shore. Opinions, errors, and conclusions are solely those of the authors and do not represent the views of the SSA, any agency of the Federal Government, Vanguard, the MRRC, or any other institution with which the authors may be affiliated. ©2008 Mitchell, Mottola, Utkus and Yamaguchi. All rights reserved.

Menu Effects and Retirement Saving:
The Impact of Life Cycle Funds on 401(k) Plan Portfolios

Abstract

The introduction of Life Cycle funds into 401(k) pension plan menus offers a rich environment in which to assess how changing investment menus shapes workers' pension investment decisions. We show that when employers introduce life cycle funds which provide professional rebalancing for already-existing investment options this fundamentally alters employees' investment patterns. Using a unique new dataset on corporate defined contribution plans, we show that behavioral explanations do motivate worker investment patterns; those most swayed by changing the menu include low-wage workers and those thought to be least financially literate. Yet we also find that some new hires exert what appears to be rational choice in their portfolio allocations. We conclude that recent legislation encouraging employers to offer life cycle funds in their 401(k) portfolios will boost younger workers' equity exposure and curtail older workers' cash holdings. Our results speak to the emerging literature on "choice architecture" seeking to enhance the environment for financial decisionmaking.

Olivia S. Mitchell (corresponding author)
International Foundation of Employee Benefit Plans Professor
Professor of Insurance & Risk Management
Department of Insurance and Risk Management, The Wharton School, University of Pennsylvania
3620 Locust Walk, Suite 3000-SHDH, Philadelphia, PA 19104
Tel. 215-898-0424
mitchelo@wharton.upenn.edu

Gary R. Mottola
Researcher, Vanguard Center for Retirement Research
100 Vanguard Boulevard, M38
Malvern, PA 19355
Tel. 610-503-4808
gmottola@vanguard.com

Stephen P. Utkus
Principal, Vanguard Center for Retirement Research
100 Vanguard Boulevard, M38
Malvern, PA 19355
Tel. 610-669-6308
steve_utkus@vanguard.com

Takeshi Yamaguchi
Pension Research Council, The Wharton School, University of Pennsylvania
3620 Locust Walk, Suite 3000-SHDH
Philadelphia, PA 19104
tyamaguc@wharton.upenn.edu

Menu Effects and Retirement Saving: The Impact of Life Cycle Funds on 401(k) Plan Portfolios

Olivia S. Mitchell, Gary R. Mottola, Stephen P. Utkus and Takeshi Yamaguchi

Employees are increasingly asked to manage their own retirement portfolios. For instance in the US, some 60 million workers with 401(k) plans must decide how much to save and where to invest their company pension funds. But recent research has raised concerns about participants' inability to handle these key economic decisions in view of their behavioral biases and inertia, naive portfolio diversification, excessive reliance on conservative investment options, and financial illiteracy regarding basic investment concepts.[1] In fact, this tension prompted the 2006 Pension Protection Act (PPA) which allows the inclusion of professionally-managed and rebalanced options in 401(k) plans, as an alternative to requiring workers to manage their retirement accounts on their own.

Among the options authorized for such default investment as so-called Target-Maturity date (TM) Life Cycle funds, where the participant can simply select a fund geared to his expected retirement date (e.g. a 25-year old might elect the 2050 fund).[2] Thereafter, the fund manager takes over all responsibility for selecting asset holdings and rebalancing the portfolio over time. Typical TM funds invest more in equities for younger employees; as the target date nears, holdings are reduced toward a more conservative mix in what is known as the "equity glide path." For this reason, TM funds are riskier than the cash default investments that many employers offered previously in their 401(k) plans because of their equity concentration.

---

[1] Cf Lusardi and Mitchell (2007).

[2] In this paper we reserve the term "lifecycle fund" for the TM concept. The lifecycle concept is sometimes broadened to include risk-based static allocation (SA) funds, such as conservative, moderate or aggressive funds. SA funds are increasingly referred to as "lifestyle" funds.

The introduction of Life Cycle funds into 401(k) plans offers a rich decision-making environment in which to assess the role of rational and behavioral elements in worker portfolio allocations, as well as to evaluate the impact of federal policy encouraging the use of default portfolios. To assess these questions, this paper provides an empirical assessment of how more than a quarter-million 401(k) participants responded to the introduction of TM funds in some 250 plans. These plans offer substantial heterogeneity in the types of decision-making environments influencing portfolio decisions: in some cases, the TM funds were simply added to existing menus which illustrates workers' active portfolio choices. In other cases, the TM option was designed as a plan's default for participants who did not make an active investment choice.[3] And in still other cases, participants were automatically switched or "mapped" into the TM funds from prior risk-based or static allocation (SA) funds. As a result, we observe a rich combination of employer-designated default options, plan menu changes, and active choices by workers.

Three key findings emerge from our analysis. First, employers' decisions about 401(k) menus influence adoption rates and investment allocations, consistent with the view that "choice architecture" can shape peoples' economic decisions (Thaler and Sunstein 2008; Benartzi, Peleg and Thaler, 2007). But, second, menu and default effects do not explain all portfolio allocation decisions. Specifically, new plan entrants who encounter the TM options for the first time actively elect these professionally-managed funds, as do existing employees with low financial literacy characteristics. Third, and perhaps most interesting, participants who adopt the new fund choices experience changes in their retirement saving portfolios, even though the TM funds add

[3] Participant accounts may be invested in a default fund in three ways. First, in a plan with voluntary choice, participants may elect to contribute to the plan, but fail to make an investment election, and so will be invested in the default option. Second, the sponsor may require participants to make a separate investment election for non-matching employer contributions, such as a profit-sharing contribution, to the plan; participants who fail to make an election are invested in the default option. Third, the participant may be automatically enrolled in the plan and invested in the default fund.

no new asset classes to the plan menu. We find that adding TM funds reshapes the age distribution of equity exposure, eliminates extreme zero- or all-equity positions, and alters the portfolio share of idiosyncratic versus systematic risk in adopters' portfolios.

Our results imply that PPA-like regulation permitting plan sponsors to offer workers professionally-managed default investment funds will change 401(k) investment patterns. Nevertheless, the extent of the impact depends on how the funds are introduced. If Life Cycle funds are provided on a voluntary basis, there will be only gradual changes investment behavior as new hires elect them and as less financially literate employees are drawn to this investment solution. A more substantial behavioral change results when Life Cycle funds are designated as a company's default. And adoption rates will be still higher, and the rate of change in portfolios more dramatic, when an employer actively maps or shifts employees to the new default funds out of other investment holdings.

In what follows, we first briefly review relevant literature on 401(k) investment decision-making, and elicit several testable hypotheses from that literature. Next we describe our dataset and summarize the methodological approach. Subsequently we discuss who adopts life cycle funds and what impact Life Cycle adoption has on savers' portfolio characteristics. A final section concludes.

Related Studies and Hypotheses

Previous studies on 401(k) portfolio choice suggest that participants might have several different responses to the introduction of Target Maturity funds in a 401(k) plan menu. One – which we here we call the 'pure rational agent' hypothesis – is that participants will not respond to the introduction of TM funds, when they include a blend of asset classes previously available

to plan participants as separate investments.[4] A modest extension of this rational investor view admits that holding a TM fund reduces time and effort associated with ongoing rebalancing,[5] thus helping the rational investor execute his optimal age-based glide path with relatively low transactions costs.[6] In this case, TM fund adopters would be more likely to be high-income participants, other things equal. Furthermore, the rational agent adopting TM Funds would be anticipated to not change his portfolio risk and return characteristics, inasmuch as the TM fund's appeal is due to the convenience of age-based rebalancing and not to its underlying investment mix.

An alternative hypothesis regarding the effect of Life Cycle fund introduction flows from the behavioral economics literature, which suggests that workers' portfolio choices respond to the "choice architecture" embodied in employers' 401(k) menu designs (Benartzi, Peleg and Thaler, 2007).[7] A common explanation for such effects is inertia;[8] that is, participants appear to "go with the flow" and tend not to make active investment choices in 401(k) plans. In the

[4] Tang and Mitchell (2008) show that indeed the TM funds offered were spanned by already-existing individual funds.

[5] Within the 401(k) plans in our study, participants incur no brokerage commission or other market-related transaction costs (as well as no taxes) when switching among funds, and so transaction costs are related solely to time and effort.

[6] Prior studies disagree as to whether rational investors will select age-based portfolio allocation patterns. Samuelson (1969) and Merton (1969) argued that constant equity exposure would be optimal given standard risk aversion and iid asset returns. Viceira (2001) showed that equity allocations will optimally decline with age, if one allows for illiquid human capital and borrowing constraints; Viceira (2007) notes that the "age-based" approach to investing is most appropriate for workers whose labor earnings volatility is low and relatively uncorrelated with equity. Recent work by Bodie and Treussard (2007) and Horneff et al. (2007) recommends a "hump-shaped" pattern of equity exposure by age due to changes in human capital over the lifetime. Empirical studies on equity allocations by age come to mixed conclusions: Ameriks and Zeldes (2004) discern little age-based variation in equity exposure in a sample of relatively highly-paid educators, while Agnew, Balduzi and Sunden (2003) find that equity allocations decline by about one percent per year of age, in their study of a single corporate-sector 401(k) plan.

[7] Previous literature suggests that participants tend to spread their money evenly across fund offerings (Benartzi and Thaler, 2001; Huberman and Jiang, 2006) and are influenced by the overall fraction of equities in the menu (Bernartzi and Thaler, 2001; Brown, Liang and Weisbenner, 2006). Retirement plan menus also shape outcomes when participants are offered too many choices and either fail to participate or opt for more familiar (i.e., conservative) investments (Iyengar, Huberman and Jiang, 2004; Iyengar and Jiang, 2006).

[8] Inertia in the retirement savings context is reported by O'Donoghue and Rabin (1999; 2001); Madrian and Shea (2001); Ameriks and Zeldes (2004); Agnew, Balduzzi, and Sunden (2003); and Mitchell, Mottola, Utkus, and Yamaguchi (2006a and 2006b), among others.

present context, we can study this hypothesis by evaluating whether introducing Life Cycle funds reshape portfolios purely due to sponsor menu effects. This is elicited most cleanly when plan sponsors designate TM funds as the plan 'default' investment portfolio for new hires and in some cases for existing employees 'mapped' into TM funds. The menu effect would also imply that, holding other things constant, introducing TM funds will result in altered portfolio risk/return characteristics for those employees defaulted into the new investment options.

A related hypothesis regarding Life Cycle fund adoption may be drawn from the literature on financial illiteracy and participant decision-making. Prior studies show that many 401(k) participants believe they are inexperienced in making investment decisions (Fontaine, 2006; Vanguard, 2003), are unfamiliar with common financial concepts (Lusardi and Mitchell, 2007), and regularly misunderstand investments, believing, for instance, that money market funds include stock investments or that employer stock is safer than a diversified equity portfolio (John Hancock, 2002). More broadly, a broad group of lower-income and lower-wealth households fail to hold any equity at all, although many economic models contend that they would be better off with at least a small equity position (Campbell 2006).[9] In the present context, since financial literacy is the lowest among young, low wage, low wealth and female employees,[10] the introduction of professionally-invested TM funds would likely be most attractive to these workers, where adoption of such funds would be hypothesized to alter portfolio mixes most.

[9] Adopting too-conservative portfolios can be costly, reducing expected real returns by as much as 350 basis points per year for younger and less affluent participants (Mottola and Utkus, 2007).

[10] A direct test of the role of financial literacy would require actual data on both adopters and nonadopters financial abilities; lacking this, we can indirectly associate literacy with demographic characteristics found in other studies to proxy for financial knowledge and experience.

Data Set and Descriptive Statistics

To assess whether and how the introduction of Life Cycle funds alters workers' pension investment patterns, we investigate a unique panel dataset covering 258 defined contribution plans drawn from Vanguard's 401(k) recordkeeping system. The sample used to explore adoption patterns includes over 252,000 active participants in plans that introduced TM funds during 2003-05;[11] all participants entering and leaving the plans due to normal workforce turnover are included. Variables available for empirical analysis include a wealth of detail on participant 401(k) account balances, investment holdings and account contributions[12], as well as key socioeconomic characteristics including age, sex, household income, and non-retirement financial wealth.[13] Also available are important features about each plan's offered investment menu, including the number and types of investment funds offered and other plan design details. In addition our data set includes monthly returns for all investments offered in our plans over an eight-year period (including the three-year period under analysis as well as the five years preceding it). This dataset is thus far richer than other research studies which have relied on experimental findings, aggregate plan flows, small plan samples, or cross-sectional-only data. In addition, to examine changes in portfolios, we evaluate the subset of about 25,000 TM adopters which includes all participants who elected at least one TM fund and whom we observe both one month prior to and six months after the fund is introduced.[14]

---

[11] Active 401(k) participants are those who are currently contributing to their employer's retirement plan.
[12] We focus our portfolio analysis on 401(k) contributions rather than fund balances because contributions are more reflective of forward-looking intentions and unbiased by prior holdings.
[13] Household income is imputed based on zip codes as is non-retirement financial wealth, and is provided by the IXI Company.
[14] Because we observe participants six months after TM funds are offered, both the full sample and subset of adopters include only plans which introduced TM funds by June 2005. The TM adopter subset has 7 fewer plans because these had no TM adopters as of December 2005. Of the 252,000 participants in the full dataset, 189,968 were included in their plan both one month before and six months after the TM funds were introduced.

Table 1 summarizes characteristics of the plans and covered workers. There is substantial diversity by age, income, 401(k) account balance, and non-retirement financial wealth across the quarter-million participants in the 258 plans evaluated. Overall, almost 10 percent of the full sample adopts Target Maturity date funds when these are introduced. TM adopters tend to be younger, more female, and earn less than the full sample (compare Columns 1 and 2); they also have lower 401(k) balances. Nearly one in five TM participants in the full sample is a new hire (new entrant). Almost half (44 percent) of those selecting TM funds are "pure" adopters and direct their entire contributions to TM funds; the remaining 56 percent are "mixed" adopters and contribute to TM funds along with other investment options (Columns 3 and 4).[15] Pure adopters are younger and more female, as compared to mixed adopters, and they have lower 401(k) balances and non-retirement financial wealth; by comparison, mixed adopters tend to be older, more affluent males.

Table 1 here

Table 2 outlines the key attributes of the Life Cycle funds introduced by employers in the dataset over the period under study. As indicated, each fund is named according to its target maturity date, and each involves different mixes of passively-managed US equity, international equity (both developed and emerging markets), and US high-quality bond funds. Panel A indicates that total equity exposure in the funds for younger participants is 89 percent (2035 and 2035 Funds) versus 29 percent for older participants in the Income Fund intended for those in their 60s and beyond. Panel B of Table 2 depicts how TM funds were introduced. In some cases TM funds were introduced *de novo*; this was true for almost half (45 percent) of the plans and participants, but only 14 percent of the TM adopters were in this class. Just over half the plans

[15]Over 95% of pure adopters contribute to only one TM fund; mixed adopters contribute to 4.5 funds on average.

(55 percent) had previously offered static allocation (SA) or risk-based funds: 32 percent of the sponsors added TM funds to the menu that included pre-existing SA funds, while 22 percent of the employers switched or "mapped" the plans from SA to TM funds (16 percent of the plans in all). In the case of mapping from SA to TM funds, sponsors could either switch all participant SA balances and contributions into the new TM funds, or allow existing balances to remain undisturbed while switching future contributions into TM funds. In both cases the new TM allocations would reflect the sponsor's decision to move the money, rather than representing an active employee election. Finally, in some cases, the employer designated the new TM funds as the plan default. The default option influences mainly new hires who would either be automatically enrolled, or who enrolled on a voluntary basis but failed to make an active investment choice. Overall, 86 percent of the TM adopters were in plans where the employer switched from SA to TM funds.

Table 2 here

Pre/Post Impact of Menu Changes: Descriptive Outcomes

Table 3 describes investment attributes of TM adopters' portfolios "before" and "after" the TM funds were added to the menu, specifically, one month prior to adoption (time *t-1)* and six months later (time *t+6*). Panel A summaries the allocation of participant contributions by major asset class, including cash (money market or guaranteed investment contracts), bonds, balanced or Life Cycle funds, US equities, employer stock, and international equities. Overall, TM adopters held more cash, bonds, and equity funds before the introduction of the TM funds; afterwards, their balanced and Life Cycle holdings rose by 12 percent. It is also interesting that many TM adopters contributed to balanced or SA Life Cycle funds even before the new menus

were introduced; these funds accounted for 79 percent of pure adopters' and 35 percent of mixed adopters' contributions. Consequently, this finding points to the importance of controlling on the prior presence of the pre-existing menu design in order to evaluate the impact of TM funds on participant behavior. Pure TM adopters were cut their cash position by almost five percent and their pure US equity holdings by 11 percent, and they increased by 21 percent their ownership of balanced funds; the impact was smaller for mixed TM adopters.

Table 3 here

Panel B of Table 3 displays three portfolio attributes measured for TM adopters, again on a pre/post basis. The first attribute is the percent of the total portfolio held in equity,[16] where we see that before the menu changed, the average TM adopter directed two-thirds of his contributions to equities. Post-menu change, equity allocations rose by 1.4 percent for all adopters, with pure adopters devoting somewhat less and mixed adopters somewhat more to equity.

The second column of Panel B illustrates how the participants' portfolios changed in terms of the overall systematic or risk-adjusted return. Systematic returns refer to the sum of the risk-free rate during the period, r_f, and each participant's factor return, or $r_{i,t}^e$. Factor returns are computed using a three-factor model based on US equities, US bonds and international equities because, as noted earlier, the TM funds in our dataset are composed of index-based funds mirroring these three asset classes.[17] The risk-free rate is added to the participant's factor return

[16] Equity allocation is equal to the percentage of contributions directed to US equity funds, international equity funds, company stock, and a percentage of balance/lifecycle funds. The equity percentage for balanced/lifecycle funds was calculated based on each fund's investment policies and varies from fund to fund.

[17] To calculate portfolio returns we construct a risk-loading matrix for all *k* investment options in our dataset by regressing the excess return (over Treasury bill returns) for each of the *k* assets in our universe on three market indices: the value-weighted CRSP portfolio, the Lehman Brothers Aggregate Bond Index (LBA), and the Morgan Stanley Capital International (MSCI) Europe, Australia and Far East (EAFE) Index. The systematic return for each

(and annualized) to arrive at the returns shown in column 2 of Panel B. The results show that expected returns rise across the board for all adopters as well as for pure and mixed adopters (before controlling on other factors including time effects; we say more on this below). Also the difference in returns between pure and mixed adopters is small. For example, on a "before" basis, mixed adopters held 15 percent more equity than pure adopters' (70.7 is 15 percent higher than 61.4), but their returns were only two percent higher (6.52 is two percent greater than 6.38). This suggests that those who later became pure TM investors had successfully constructed more efficient portfolios with lower equity exposure but similar expected returns, mainly through SA and balanced fund holdings.[18]

A third portfolio attribute reported in Table 3 is the ratio of idiosyncratic portfolio risk as a fraction of total portfolio variance, $NSR/TV_{i,t}$.[19] This measure describes how much of portfolio variance is explained by nonsystematic or non-market factors. By definition, nonsystematic risk should be zero when all of a participant's contributions are directed to index-

401(k) investment option is simply its factor exposure times the average factor returns over the period; the participant's factor return is simply the weighted average return of his or her factor exposures over the period. The mean returns of our three factors (CRPS, LBA and EAFE) over the 96-month period are given by: $\bar{r}_f = (\bar{r}_{CRSPRF,t}, \bar{r}_{LBARF,t}, \bar{r}_{MSCIRF,t})$. The systematic return associated with the *k*th asset is its factor exposure times the average factor returns over the 96 months, namely: $r_k^e = b_k' \bar{r}_f$. The *i*th participant's excess return reported in Panel B of Table 3 is $r_i^e = \sum_{k=1}^{N} \omega_{k,t} r_k^e$, where $\omega_{i,k,t}$ is the weight of the *k*th fund in the *i*th participant's contributions made in month *t*.

[18] Virtually all of the SA funds in our sample included broad exposure to US and international equities, as well as US bonds. Many of the balanced funds did as well, although some were exclusively US-focused.

[19] $NSR/TV_{i,t} = \hat{\Sigma}_i^{idio} / \hat{\Sigma}_i$. We estimate the variance-covariance matrix for all assets $\hat{\Sigma}$, which in turn is used to estimate the total portfolio variance for the *i*th participant, $\hat{\Sigma}_i$. $\hat{\Sigma} = \hat{\mathrm{B}}' \hat{\Sigma}_f \hat{\mathrm{B}} + \hat{D}$, where $\hat{D}$ is a diagonal matrix with elements computed as the square of the $\hat{\varepsilon}_k$ estimated in equation (2). The asset variance can be decomposed into systematic risk, $\hat{\Sigma}^{sys} = \hat{\mathrm{B}}' \hat{\Sigma}_f \hat{\mathrm{B}}$ and idiosyncratic risk $\hat{D}^{idio}$. Individual portfolio variance can be decomposed into its systematic and idiosyncratic component: $\hat{\Sigma}_i = \omega_{i,k,t}' \hat{\Sigma} \omega_{i,k,t} = \omega_{i,k,t}' (\hat{\Sigma}^{sys} + \hat{D}^{idio}) \omega_{i,k,t} = \hat{\Sigma}_i^{sys} + \hat{\Sigma}_i^{idio}$.

based TM funds. Not surprisingly, this measure of risk is eliminated for pure TM adopters and it falls substantially for mixed adopters.

Who Adopts TM Funds? A Multivariate Analysis

To explore the "treatment effect" associated with TM fund introduction, we estimate the probability of Life Cycle adoption, $LCAdopter_{i,j,t}$ which refers to the probability that the *i*th participant holds a TM fund in the *j*th plan in month *t.* The multivariate model is as follows:

$$LCAdopter_{i,j,t} = \alpha PARTICIPANT + \beta PLAN + \gamma TREATMENT + \upsilon_i + \tau_t + \omega_j + \varepsilon_{i,j,t} \qquad (1)$$

where the dependent variable $LCAdopter_{i,j,t}$ takes a value of 1 if the participant invests in a TM fund in month *t*, and 0 otherwise. The mean value of this variable is 15.1%.[20] The *PARTICIPANT* vector includes a *New Entrant* identifier indicating whether the participant entered the plan after the TM funds were offered (0 otherwise). The *TREATMENT* vector measures aspects associated with the way in which TM funds were introduced. The *Default* indicator indicates whether the new TM funds were designated as the default investment option. We also add a term interacting *Default* and *New Entrant* which indicates the effect of new plan entrants being defaulted into the TM funds.[21] In addition we control on the number of months since TM funds were introduced (and that same variable squared) to indicate the time path of impact of TM adoption. The model also incorporates participant characteristics including age, income, sex, and non-retirement financial wealth. To control on cross-plan differences, the *PLAN* vector indicates the number of fund choices on offer, a dummy indicating company stock is

[20] The mean value of lifecycle adoption is not 10% (in Table 1, 24,612 TM adopters divided by 252,980 participants) because the measure here is weighted by the number of months that TM funds were offered. For example, if TM funds were offered in a given plan during 18 months of our analysis period, and a participant in that plan contributed to those funds over nine months, his adoption rate would be 50%.

[21] Not all new entrants are new hires. Many of the plans in our sample allow immediate eligibility for the plan to new hires though a minority imposes a six- or twelve-month waiting period.

available in the 401(k) plan, and an indicator of loan availability. For reasons noted above, we also control on *SA_Before* which indicates whether static allocation funds had been previously offered. The econometric models correct for plan-level heteroskedasticity (ν_i), time fixed effects (τ_t), and industry fixed effects, along with missing data controls.

Table 4 reports estimates of the multivariate Probit model that indicates the factors linked to TM adoption. Our key observation is that sponsor-driven menu changes profoundly influence participation adoption, consistent with a behaviorally-motivated employer menu hypothesis. When the employer designates TM funds as the default investment, this boosts the likelihood of participants adopting TM by 10.9 percentage points or about 75 percent of the pre-TM mean. We describe this as the "PPA effect," indicative of how much participation in TM funds will increase as a result of sponsor decisions to select a TM default fund under the Pension Protection Act. The default effect for new participants is even higher, indicating that newly eligible employees are 3.4 percentage points more likely to elect TM funds when the employer offers these as the default investment. Familiarity is also important, as participation rates rise over time, by 2 percentage points within a year of offering the TM funds.

Table 4 here

While sponsor decisions are important drivers of TM adoption, there is also evidence of participants making their own portfolio choices. A group displaying active decision-making is the new plan entrants, who are 7.1 percentage points or 50 percent more likely to adopt TM funds after controlling for menu effects. In our view, new entrants who are *not* defaulted into TM funds are likely making independent portfolio choices upon encountering the 401(k) menu for the first time. On the other hand, TM funds are also more likely to be adopted by participants with characteristics typically associated with low levels of financial literacy: the young, lower

paid, and female participants, as well as those with low 401(k) balances and low levels of non-financial retirement wealth (Lusardi and Mitchell, 2007). By their very simple design, TM funds eliminate the need for such employees to seek and process information, replacing the need for complex portfolio selection by virtue of electing only one's expected retirement date.

Our findings are not consistent with the rational investor hypothesis holding that high-income participants would select these funds due to the opportunity costs associated with rebalancing; instead, middle and high-income participants have about the same patterns. Interestingly, offering more funds in the 401(k) menu slightly reduces participation in TM funds. The effect is small (having 10 additional funds means a two percentage point lower chance of holding TM funds) but it does offer some modest support for the view that participant holdings are influenced the fraction of the plan investment menu represented by a given fund option. The largest marginal effects are associated with the prior availability of SA funds in the plan menu; the presence of such funds, whether through mapping by the sponsor or awareness of such funds by participants, raises TM adoption by more than double (16.9 versus the dependent variable mean of 15 percentage points).

Next, we seek to disentangle differences between pure versus mixed Life Cycle adopters. Table 5 reports marginal effects calculated from a multinomial Logit model where the dependent variable is equal to 1 if the participant is a mixed adopter; 2 if he is a pure adopter; and 0 if he is a nonadopter (the reference group). As before, menu effects are quite substantial: defaulting employees into TM funds increases the chances of being a pure adopter by five percentage points, a two-thirds increase from the 8.6 percentage point mean; the default effect on mixed adoption is positive but quantitatively smaller. New entrants are even more powerfully swayed by the menu in place, by another 1.6 percentage point probability of being a pure adopter on top

of the regular default effect. Again familiarity is important: the chance of being a pure adopter rises over time, while it falls slightly for mixed adopters. Newly eligible participants are especially liable to be pure TM adopters; pure adopters are also more likely to be female, younger, lower income, and have lower 401(k) and non-retirement wealth than nonadopters. This pattern is consistent with the view that this group is most in need of professional financial advice due to low financial literacy. Mixed adopters are likely to be younger and female, but they also tend to be middle income and middle-wealth participants, compared to non-adopters; these results are therefore conflicting. On the one hand, mixed adopters may be engaged in naïve diversification by allocating only a portion of their contributions to the "one-stop shopping" fund solution. On the other hand, mixed adopters are more affluent, and so are more likely to be more financially literate. Mixed adoption could be evidence of a more sophisticated approach to investing. [22] We also see that if SA funds had been previously offered, employees are more likely to elect TM funds as part of a mixed investment strategy than to adopt them as a pure strategy (5.0 v.s 3.8 percentage points).

Table 5 here

To summarize, the evidence thus far suggests that several factors influence 401(k) plan participant investment patterns. Most importantly, employer-driven menu patterns do shape workers' investment choices in their 401(k) portfolios, providing support for the behavioral hypothesis. New hires are most heavily influenced by the default menu. On the other hand, a substantial group of participants does actively elect TM funds when offered, namely participants

[22] For example, mixed adopters may only want to have a portion of their portfolio to be automatically rebalanced, or they may be engaging in a "core/satellite" strategy of having the lifecycle fund as a core holding, supplemented by satellite funds.

who appear to be less financially literate. There is little support for the view that affluent participants facing high time costs for rebalancing are keen to adopt Life Cycle funds.

Portfolio Effects of Adding Life Cycle Funds

Next we turn to an assessment of how Life Cycle fund adopters' portfolios change when Life Cycle funds are introduced into their portfolios. Using a difference-in-difference approach, each participant is observed one month before and six months after adopting the TM fund. Three dependent variables are of particular interest, namely the participant's percentage allocation to equities, his portfolio's systematic returns, and his share of nonsystematic risk as a percent of total portfolio variance (NSR/TV). Each of these dependent variables is summarized in a vector we term $PORTFOLIO_{i,j,t}$, taking the following form:

$$PORTFOLIO_{i,j,t} = \alpha PARTICIPANT + \beta PLAN + \gamma TREATMENT + \upsilon_i + \tau_t + \omega_j + \varepsilon_{i,j,t}. \quad (2)$$

Model A includes just these terms; Model B adds interaction terms (*INTERACTION*) to test whether specific groups display differential treatment patterns when Life Cycle funds are introduced. For example, *LC_Treat*Young* allows us to examine the differential impact of TM treatment on participants under age 35. We exclude the *DEFAULT* and *NEW ENTRANT* treatment variables since for this analysis, all participants are observed both before and after the Life Cycle treatment effect.

Table 6 summarizes estimates for the equity allocation models, differentiating results for pure and mixed adopters. The variable *LC_Treat* in Model A captures the simple change in equity allocation after controlling for differences in participant and plan features, timing and industry fixed effects, and plan-level heteroskedasticity. In Model A, all else constant, pure adopters devote less to equity (1.8 percentage points) but no change is seen for mixed adopters.

Model B adds treatment interactions for participant and plan characteristics, the most important of which is with respect to age. Now it is clear that for pure and mixed adopters, younger workers invest more in equity after TM funds are introduced (*LC_Treat + LC_Treat*Young*), while middle-aged and older people reduce their equity share. Figure 1 summarizes the age effects; the old-young difference increases by 8-10 percentage points. It is worth noting that the changes in equity shares by age remains meaningful for mixed adopters, who on average direct one-third of their portfolio contributions to TM funds.

Table 6 and Figure 1 here

Not only does the overall allocation to equity change when TM funds are introduced, but the distribution also becomes less dispersed as shown in Figure 2 for both plans offering TM funds *de novo* (top panel) and those offering SA funds previously (bottom panel). (Corresponding statistics measuring the dispersion of equity allocations are presented in the Appendix.) When TM funds are offered *de novo,* participants had previously clumped their equity holdings at two focal points, namely 0 and 100 percent, with another group holding a mid-range of equities (61-65 percent, a typical allocation in many balanced funds). After the new funds are offered, adopters' portfolios now concentrate around the five key target percentages embodied in the main TM fund offerings. (Of the six funds offered, two had near-identical asset allocations.) In fact, the cross-sectional standard deviation of equity allocations among pure adopters falls by half, from 34 to 16 percent, after TM funds are offered. For mixed adopters, here too, the zero and all-equity allocations are mostly eliminated, though the changes are

attenuated. Overall, the standard deviation of equity allocation distributions for adopters falls by one-quarter.[23]

Figure 2 here

Next we analyze expected returns and risk characteristics before and after TM funds are offered. Table 7 reports results for Models A and B, similar to those in Table 6. The first two columns show that pure adopters can anticipate returns to rise by 19-21 basis points per year when they shift to an all-TM portfolio. Also interesting are the changes by age, with young pure adopters seeing expected returns rise by an annualized 13 basis points (.0019-.0013). By contrast, older pure adopters can expect lower returns by 25 basis points (.0019-.0011) per year, partly due to their having more cash at older ages.[24] For mixed adopters, depicted in the next two columns of Table 7, changes in returns are not statistically significant. The second half of Table 7 indicates how portfolios nonsystematic risk share (NSR) changes when TM funds are introduced. Not surprisingly, it virtually disappears for pure adopters, who move all of their contributions to an all-index life cycle fund. Specifically for pure adopters, nonsystematic risk accounts for 6 percentage points of total variance before TM fund adoption; the marginal effect of shifting to TM funds is a negative 5.1 percentage points. The NSR share falls less for younger participants (-2.9 percentage points) than for older participants (-5.2 percentage points). Changes for mixed adopters are more notable: after investing in TM funds, their NSR risk share declines by over 40 percent (a marginal effect of -8.3 on a mean of 19.9 percentage points). Accordingly, even affluent mixed adopters who use TM funds for only part of their portfolios

[23] Similar results ensue in the case where SA funds had been offered previously, although the results are not surprisingly smaller.

[24] Pure TM investors generally liquidate cash investments and shift their fixed income to bonds. Cash investments have zero excess returns by definition, while over our study period, bonds earned excess returns of 23 basis points per month. Our younger pure adopters moved from a cash exposure of 3% to 0% when moving to TM funds, while older participants moved from 9% to 0%. For mixed adopters, younger participants reduced equity holdings slightly, from 8% to 6%, while older participants moved from 11% to 9%.

can experience a meaningful reduction in nonsystematic risk exposure.

Table 7 here

Overall, these results strengthen the conclusion that menu effects are a potent factor shaping investor behavior. Introducing TM funds does not expand the range of capital market assets that plan participants can elect, but they result in substantive changes to portfolio and return characteristics. That is, equity allocations change materially by age as a result of sponsor menu changes, for both pure and mixed TM adopters. Pure adopters see expected systematic returns rise, while both pure and mixed adopters see a large decline in the portfolio share of idiosyncratic risk. These results suggest that TM funds may help those laboring under financial illiteracy constraints, perhaps by eliciting or making more obvious the notion of age-based equity variation. They also confirm behavioral menu-driven effects where introducing new Life Cycle funds triggers changes in the risk and return characteristics of participants' portfolios.

Discussion and Conclusions

In recent years, sponsors have expanded their use of Life Cycle funds within 401(k) plans in an effort to improve 401(k) portfolio outcomes. At the same time, federal retirement policy through the 2006 Pension Protection Act is encouraging greater reliance on risky default investments for participants, including TM Life Cycle funds. TM-type funds have been proposed for the Federal Thrift Savings Plan for federal government employees, some state defined contribution schemes, and even a defined contribution model under the US Social Security system. Other countries including Chile already offer target maturity-type funds in their national defined contribution systems.

Our analysis of the introduction of such funds into 401(k) plans allows us to assess worker portfolio allocations in a rich decision-making environment, including sponsor-initiated default choices, menu changes, and active choice by workers. We show that, while behavioral models of decision-making do help explain 401(k) portfolio allocations, there are also elements of rational and information cost-constrained choice. That is, sponsor-initiated menu changes have a powerful effect on investor behavior, particularly when the TM funds are designated as the default, or when the sponsor chooses to map participants from other options to the TM funds. When an employer selects TM funds as the default investment, this substantially boosts the likelihood of participants adopting such funds and increases the chances of being a "pure" rather than combining TM funds with other types of funds in a mixed strategy. These results are consistent with a behavioral hypothesis regarding the effect of menu design and employer decisions on participant portfolios.

At the same time, many plan participants do make active choices about their pension investments, so menu and default effects are an incomplete explanation for 401(k) allocation choices. Specifically, new entrants to 401(k) plans making active choices are more likely to adopt TM funds. In addition, a particular subset of existing workers – younger, less affluent, and female participants – appear to elect Life Cycle funds because of their essential simplicity, consistent with a model of choice constrained by information costs. Switching to Life Cycle funds from other portfolios also materially changes workers' pension plan investment patterns. Specifically, it narrows the distribution of equity exposure, eliminating all or nothing equity portfolios, while enhancing the age distribution of equity exposure. Further, it reduces participants' portfolio idiosyncratic risk. These results further strengthen the diagnosis of both behavioral and information-cost or literacy-constrained models among TM fund adopters, but

they do not support the view that high-wage employees seeking to avoid transaction costs will engage in such portfolio activity.

Our findings imply that strategies for improving portfolio allocations such as default fund rules proposed under the Pension Protection Act will vary in efficacy and speed depending on the path taken. How quickly 401(k) participant investment patterns over time will depend on how the funds are introduced, and also the composition of each firm's workforce. Providing TM funds on a voluntary basis alone changes plan investment behavior only gradually, via new plan entrants (where the rate of change will depend on workforce turnover), and via low-literacy participants drawn voluntarily to this new investment solution. If an employer designates Life Cycle funds as a default, it will further raise adoption. And if the employer shifts or maps participants from their existing portfolios to something like an age-based Life Cycle fund, this will result in the largest and most rapid change in portfolio characteristics.[25]

Ultimately, this evidence underscores the fact that even with sponsor-driven menu effects and default decisions, active decision-making by workers remains important as well. While the US 401(k) system is gradually shifting toward greater reliance on default investment choices, it remains the case that many millions of existing participants do make investment choices on their own. Therefore it is not sponsor-selected investment menus alone that will determine 401(k) pension plan portfolio allocations.

[25] Sponsors forfeit so-called optional 404(c) fiduciary protection when undertaking such mapping, though it remains an appropriate strategy if the plan fiduciary judges such a move to be in the best interests of plan participants.

References

Agnew, Julie, Pierluigi Balduzzi, and Annika Sunden. 2003. "Portfolio Choice and Trading in a Large 401(k) Plan," *American Economic Review*, 93(1): 193-215.

Ameriks, John and Stephen Zeldes. 2001. "How Do Household Portfolio Shares Vary with Age?" TIAA-CREF Institute Working Paper 6-120101.Working Paper.

Benartzi, Shlomo and Richard H. Thaler. 2001. "Naïve Diversification Strategies in Defined Contribution Savings Plans." *American Economic Review.* March. 91(1): 79-98.

Benartzi, Shlomo and Richard H. Thaler. 2002. "How Much Is Investor Autonomy Worth?" *Journal of Finance*. August. 57(4): 1593-1616.

Benartzi, Shlomo, Ehud Peleg, and Richard H. Thaler. 2007. "Choice Architecture and Retirement Savings Plans." Working paper. http://ssrn.com/abstract=999420.

Bodie, Zvi and Jonathan Treussard. 2007. "Making Investment Choices as Simple as Possible: An Analysis of Target Date Retirement Funds." Boston University Working Paper.

Brown, Jeffrey R., Nellie Lang and Scott Weisbenner. 2007. "Individual Account Investment Options and Portfolio Choice: Behavioral Lessons from 401(k) Plans." NBER Working Paper 13169 June.

Campbell, John Y. 2006. "Household Finance" *Journal of Finance.* August 61: 1553-1604.

Choi, James J., David Laibson, Brigitte C. Madrian, and Andrew Metrick. Forthcoming. "Saving for Retirement on the Path of Least Resistance." Ed McCaffrey and Joel Slemrods, eds., *Behavioral Public Finance.*

Fontaine, Thomas J. 2005. *Target-Date Retirement Funds: A Blueprint for Effective Portfolio Construction*. Global Investment Research Report. New York: AllianceBernstein L.P.

Horneff, Wolfram J. Raimond H. Maurer, Olivia S. Mitchell, and Michael Z. Stamos. 2007. "Asset Allocation and Location over the Life Cycle with Survival-Contingent Payouts." Pension Research Working Paper. Philadelphia, PA: The Wharton School. Forthcoming.

Huberman, Gur and Wei Jiang. 2006. "Offering vs. Choices in 401(k) Plans: Equity Exposure and Number of Funds." *Journal of Finance.* XLI(2): 763-801.

ICI. 2007. "The US Retirement Market, 2006." *ICI Research Fundamentals.* Washington DC: Investment Company Institute. 16(3).

Iyengar, Sheena, Gur Huberman and Wei Jiang. 2004. "How Much Choice is Too Much? Contributions to 401(k) Retirement Plans." In *Pension Design and Structure: New Lessons from Behavioral Finance,* Olivia S. Mitchell and Stephen P. Utkus, eds. Oxford: Oxford University Press: 83-96.

Iyengar, Sheena, and Wei Jiang. 2006. "The Psychological Costs of Ever Increasing Choice: A Fallback to the Sure Bet." Working paper.

John Hancock. 2002. *Eight Defined Contribution Plan Survey.* John Hancock Financial Services, Boston, MA.

Lusardi, Annamaria and Olivia S. Mitchell. 2007. "Baby Boomer Retirement Security: The Role of Planning, Financial Literacy and Housing Health. *Journal of Monetary Economics.* 54(1) January: 205-224.

Madrian, Brigitte, and D.F. Shea. 2001. "The Power of Suggestion: Inertia in 401(k) Participation and Savings Behavior." *Quarterly Journal of Economics* 116: 1149-1525.

Merton, Robert C. 1969. "Lifetime Portfolio Selection under Uncertainty: The Continuous Time Case." *Review of Economics and Statistics* 51. 247-257.

Mitchell, Olivia S., Gary R. Mottola, Stephen P. Utkus, and Takeshi Yamaguchi. 2006a. "The Inattentive Participant: Portfolio Trading Behavior in 401(k) Plans." Pension Research Council Working Paper 2006-05. Philadelphia, PA.: Wharton School.

Mitchell, Olivia S., Gary R. Mottola, Stephen P. Utkus and Takeshi Yamaguchi. 2006b. "Winners and Losers: 401(k) Trading and Portfolio Performance." Pension Research Council Working Paper 2006-26. Philadelphia, PA.: Wharton School.

Mottola, Gary R. and Stephen P. Utkus. 2007. "Red, Yellow and Green: A Taxonomy of 401(k) Portfolio Choices." Pension Research Council Working Paper 2007-14. Philadelphia, PA.: Wharton School.

O'Donoghue, Ted, and Matthew Rabin. 1999. "Procrastination in Preparing for Retirement." In Henry Aaron, ed., *Behavioral Dimensions of Retirement Economics*. Brookings Institution Press and Russell Sage Foundation.

O'Donoghue, Ted, and Matthew Rabin. 2001. "Choice and Procrastination," *Quarterly Journal of Economics.* Feb 2001. 121-160.

Samuelson, Paul A. 1969. "Lifetime Portfolio Selection by Dynamic stochastic Programming." *Review of Economics and Statistics.* 51: 239-246.

Tang, Ning and Olivia S. Mitchell. 2008. "The More the Better: Characteristics and Efficiency of 401(k) Investment Menus." Pension Research Council Working Paper. Philadelphia, PA.: Wharton School.

Thaler, Richard and Cass Sunstein. 2008. *Nudge: Improving Decisions About Health, Wealth, and Happiness*. New Haven: Yale University Press.

Vanguard, 2002. *Vanguard Participant Monitor.* Malvern, PA.: Vanguard Center for Retirement Research.

Vanguard. 2003. *Participant Report Card for June 2003*. Malvern, PA.: Vanguard Center for Retirement Research.

Vanguard, 2006. *Early Adoption of the Roth 401(k).* Malvern, PA: Vanguard Center for Retirement Research.

Viceira, Luis M. 2001. "Optimal Portfolio Choice for Long-Horizon Investors with Nontradable Labor Income. *Journal of Finance.* 56: 433-70.

Viceira, Luis M. 2007. "Life Cycle Funds." Harvard Business School Working Paper.

Table 1. Participant and Plan Characteristics: Plans Introducing Target Maturity Date Funds

			TM Adopters Only	
	Full Sample *(Offered TM)*	**Adopter Sample** *(Adopted TM)*	**Pure TM Adopters**	**Mixed TM Adopters**
	1	*2*	*3*	*4*
401(k) Balance ($ av.)	64,065	50,032	34,289	62,240
Age (%)				
Young (< 35)	0.254	0.278	0.327	0.241
Middle (35-55)	0.590	0.592	0.551	0.625
Old (> 55)	0.156	0.129	0.123	0.135
Sex (%)				
Male	0.453	0.413	0.313	0.491
Female	0.261	0.303	0.326	0.285
Income (%)				
Low (< $62.5K)	0.194	0.228	0.253	0.209
Medium ($62.5-$87.5K)	0.391	0.394	0.442	0.357
High (> $87.5K)	0.415	0.377	0.304	0.434
Tenure (%)				
New Hire	0.183	na	na	na
401(k) balance ($ av.)	64,065	50,032	34,289	62,240
Non-ret. Financial Wealth (%)				
Poor (< $7.3K)	0.423	0.413	0.442	0.391
Average ($7.3-$61K)	0.349	0.367	0.356	0.376
Rich (> $61K)	0.228	0.219	0.202	0.233
Plan Feature (% of participants)				
Employer Stock Offered	0.308	0.264	na	na
Loan Offered	0.669	0.619	na	na
N Funds Offered (mean)	34.2	33.0	na	na
Sample				
N Plans	258	251	228	234
N Participant Accounts	252,980	24,612	10,750	13,862

Note: Participant characteristics measured at 12/05 for full sample and six months after TM introduction for Adopter sample.

Table 2. Characteristics of Life Cycle Funds Introduced

A. Portfolio Mix of Life Cycle Funds by Target Date

	% US equities	% inter-national equities	% domestic bonds	TOTAL	*% total equities*
2045 Fund	71%	18%	11%	100%	*89%*
2035 Fund	71%	18%	11%	100%	*89%*
2025 Fund	63%	16%	21%	100%	*79%*
2015 Fund	50%	13%	37%	100%	*63%*
2005 Fund	35%	9%	56%	100%	*44%*
Income Fund	24%	5%	71%	100%	*29%*

Note: As of 9/07

B. Introduction Patterns of Life Cycle Funds

	Plans		Participants		TM adopters	
	N	*%*	*N*	*%*	*N*	*%*
1. Introduced TM *de novo*	117	0.45	113,560	0.45	3,541	0.14
2. Added TM to SA	83	0.32	99,201	0.39	12,509	0.51
3. Switch from SA to TM	58	0.22	40,219	0.16	8,562	0.35
Total	258	1.00	252,980	1.00	24,612	1.00

Table 3. Contribution Allocations and Portfolio Risk/Return Characteristics Pre/Post Introduction of TM Funds: All Adopters, Pure TM Adopters, and Mixed TM Adopters

A. Contribution Allocations

		Cash (MM, GIC)	Bond	Balanced & Life Cycle	US Equity	Company Stock	Inter-national Equity
All TM Adopters	Before	7.1%	5.2%	54.2%	27.9%	2.7%	2.9%
	After	3.7%	3.6%	66.1%	21.7%	2.3%	2.7%
	Change	*-3.4%*	*-1.7%*	*11.9%*	*-6.2%*	*-0.4%*	*-0.3%*
Pure TM	Before	4.9%	2.9%	79.4%	11.3%	0.5%	0.9%
Adopters	After	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%
	Change	*-4.9%*	*-2.9%*	*20.6%*	*-11.3%*	*-0.5%*	*-0.9%*
Mixed TM	Before	8.7%	7.0%	34.7%	40.8%	4.3%	4.5%
Adopters	After	6.5%	6.3%	39.8%	38.6%	4.0%	4.8%
	Change	*-2.2%*	*-0.7%*	*5.1%*	*-2.2%*	*-0.3%*	*0.2%*

B. Portfolio Characteristics

		Equity Allo-cations	Syste-matic Returns	NSR/TV*
All TM Adopters	Pre	66.6%	6.46%	13.8%
	Post	68.1%	6.70%	10.0%
	Change	*1.4%*	*0.24%*	*-3.8%*
Pure TM	Pre	61.4%	6.38%	6.0%
Adopters	Post	62.4%	6.63%	0.9%
	Change	*1.0%*	*0.25%*	*-5.0%*
Mixed TM	Pre	70.7%	6.52%	19.9%
Adopters	Post	72.5%	6.76%	17.1%
	Change	*1.8%*	*0.24%*	*-2.8%*

Note: * NSR/TV refers to portfolio nonsystematic risk as a percent of total variance; see text.

Table 4. Multivariate Probit Analysis of the Probability of Being a TM Adopter
(Dependent variable = 1 if TM Adopter, 0 else; mean = 15.1%)

	Mean	Coefficient		Marginal Effect
Lifecycle Treatment				
TM Default	11%	0.565	***	10.9%
New Entrant*Default		0.189	***	3.6%
Mos Since TM	9.3	0.011	***	0.2%
Mos**2 Since TM	120.7	0.000	***	0.0%
Socioeconomic Factors				
Young	23%	0.121	***	2.3%
Old	16%	-0.103	***	-2.0%
Male	45%	-0.067	***	-1.3%
Low_Income	20%	-0.029	***	-0.5%
High_Income	40%	-0.003		-0.1%
Poor_Wealth	38%	0.035	***	0.7%
Rich_Wealth	26%	-0.092	***	-1.8%
Log Balance	$ 9.8	-0.063	***	-1.2%
New Entrant	11%	0.342	***	6.6%
Plan Design				
SA_Before	61%	0.880	***	16.9%
Co. Stock Offered	26%	0.1011	***	1.9%
Loan Offered	59%	-0.0304		-0.6%
N Funds	38.9	-0.0112	***	-0.2%
Participant Clustering		Yes		
Time Fixed Effect		Yes		
Industry Fixed Effect		Yes		
Observations		3,178,373		
Number of Clusters		252,980		
-2LogL		2,692,640		
Pseudo-R Squared		11.62%		

Notes: ** Significant at the .05 level; *** Significant at the .01 level. Reference category middle income; middle wealth; female sex (missing variables also dummied).

Table 5. Marginal Effects from Multivariate Logit Model of the Probability of Being a Pure or Mixed TM Adopter (Reference Group: Non adopter; Pure adopters = 8.6%, Mixed adopters 7.7%)

		Pure Adopter	**Mixed Adopter**
	Mean	*Marginal Effect*	*Marginal Effect*
Lifecycle Treatment			
Default	10%	5.0% ***	1.6% ***
Default*New Entrant		1.6% ***	-1.0% ***
Time Count	8.6	0.4% ***	-0.1% ***
Time Count Squared	120.7	0.0% ***	0.0% ***
Socioeconomic Characteristics			
Young	24%	0.9% ***	0.5% ***
Old	16%	-0.5% ***	-0.7% ***
Male	43%	-0.9% ***	-0.2% ***
Low_Income	20%	0.2% **	-0.3% ***
High_Income	39%	-0.2%	0.0%
Poor_Wealth	38%	0.5% ***	0.0%
Rich_Wealth	25%	-0.8% ***	-0.4% ***
Log Balance	$ 9.8	-0.7% ***	0.0% **
New Entrant	11%	2.1% ***	1.5% ***
Plan Design			
SA_Before	57%	3.8% ***	5.0% ***
Co. Stock Offered	31%	-1.6% ***	1.2% ***
Loan Offered	61%	-1.2% ***	0.4% ***
N funds	37.6	-0.1% ***	0.0% ***
Participant Clustering		Yes	Yes
Time Fixed Effect		Yes	Yes
Industry Fixed Effext		Yes	Yes
Observations		3,178,373	3,178,373
Number of Clusters		252,980	252,980
-2LogL		3,354,106	3,354,106
Pseudo-R Squared		15.34%	15.34%

Note: See Table 4.

Table 6. Marginal Effects from Multivariate Model of TM Treatment Effects on Portfolio Equity Allocation: Pure and Mixed TM Adopters

	Pure Adopters		Mixed Adopters	
	Model A	*Model B*	*Model A*	*Model B*
Treatment				
LC_treat	-0.018 ***	-0.032 ***	-0.006	-0.013 **
LC_treat*Young		0.064 ***		0.043 ***
LC_treat*Old		-0.040 ***		-0.035 ***
LC_treat*Low_Income		0.000		0.004
LC_treat*High_Income		-0.004		0.000
LC_treat*Male		-0.016 ***		-0.008 ***
LC_treat*Poor_Wealth		0.019 ***		0.007
LC_treat*Rich_Wealth		-0.008		0.008
Socioeconomic Factors				
Young	0.006 ***	0.022 ***	0.052 ***	0.031 ***
Old	-0.105 ***	-0.085 ***	-0.078 ***	-0.060 ***
Male	0.010 **	0.019 ***	0.019 ***	0.023 ***
Low_Income	0.004	0.004	-0.015 ***	-0.017 ***
High_Income	0.001	0.004	0.006	0.007
Poor_Wealth	0.007	-0.005	-0.012 ***	-0.016 ***
Rich_Wealth	0.010 **	0.013 **	0.005	0.001
Log Balance	0.006 ***	0.005 ***	0.016 ***	0.016 ***
Plan Design				
SA_Before	-0.061 ***	-0.062 ***	0.005	0.004
Co.Stock Offered	-0.006	-0.004	0.022 ***	0.022 ***
Loan Offered	0.074 ***	0.074 ***	0.011	0.011
N Funds	0.005 ***	0.005 ***	0.000	0.000
Clustering at Participant-level	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes
Industry Fixed Effect	Yes	Yes	Yes	Yes
Observations	21,500	21,500	27,724	27,724
# of Participants	10,750	10,750	13,862	13,862
R Squared	19.3%	20.2%	5.7%	6.0%
Dependent Means				
Pre-treat	61.4%		70.7%	
Post-treat	62.4%		72.5%	
Unadjusted difference	1.0%		1.8%	

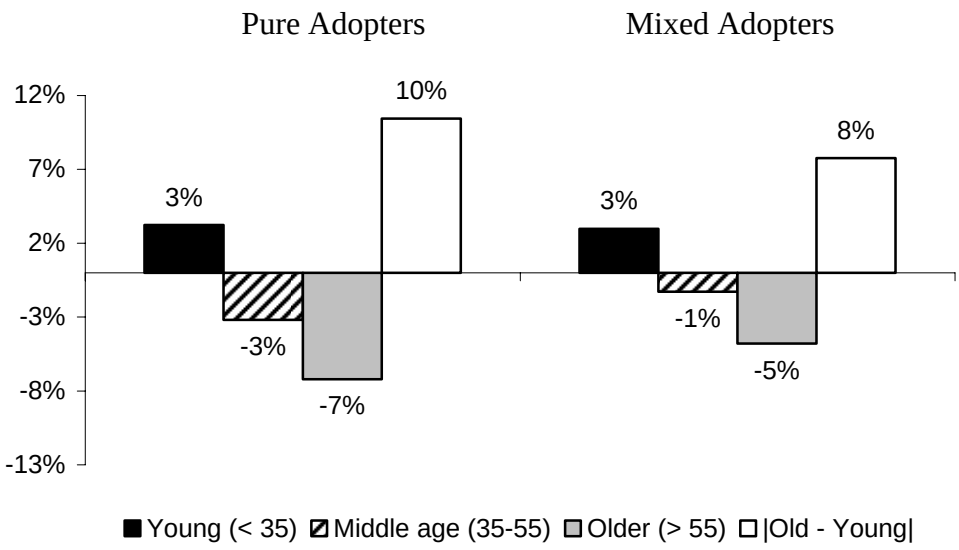
Note: See Table 3

Table 7. Marginal Effects of Multivariate Model of TM Treatment Effects on Portfolio Risk and Returns: Pure and Mixed TM Adopters

	Returns				NSR/TV*			
	Pure Adopters		*Mixed Adopters*		*Pure Adopters*		*Mixed Adopters*	
	Model A	Model B	Model A	Model B	Model A	Model B	Model A	Model B
Treatment								
LC_treat	0.0021 ***	0.0019 ***	-0.0003	-0.0003	-0.051 ***	-0.039 ***	-0.083 ***	-0.075 ***
LC_treat*Young		-0.0006 ***		0.0002		0.010 ***		-0.002
LC_treat*Old		0.0006 **		-0.0011 **		-0.023 ***		-0.001
LC_treat*Low_Income		-0.0002		-0.0003		0.008 ***		0.005
LC_treat*High_Income		0.0000		-0.0005 **		0.000		0.001
LC_treat*Male		0.0011 ***		0.0000		-0.039 ***		-0.013 ***
LC_treat*Poor_Wealth		0.0005 ***		0.0003		-0.009 ***		-0.011 ***
LC_treat*Rich_Wealth		-0.0007 ***		0.0009 ***		0.009 ***		0.003
Socioeconomic Factors								
Young	0.0005 ***	0.0008 ***	0.0016 ***	0.0014 ***	0.000	-0.005 ***	0.004	0.004
Old	-0.0195 ***	-0.0023 ***	-0.0017 ***	-0.0012 ***	0.007 ***	0.018 ***	0.005	0.006
Male	0.0001	-0.0004 **	0.0010 ***	0.0010 ***	0.001	0.021 ***	0.002	0.009 **
Low_Income	0.0001	0.0002	-0.0003	-0.0001	-0.002	-0.006 **	0.010 ***	0.008
High_Income	0.0001	0.0001	0.0000	0.0002	-0.003	-0.002	0.004	0.004
Poor_Wealth	0.0002	-0.0001	-0.0006 ***	-0.0007 ***	-0.002	0.003	-0.014 ***	-0.009 **
Rich_Wealth	0.0002 **	0.0005 ***	0.0001	-0.0003	0.001	-0.003	-0.003	-0.005
Log Balance	0.0001 ***	0.0001 ***	0.0004 ***	0.0004 ***	0.003 ***	0.002 ***	0.005 ***	0.005 ***
Plan Design								
SA_Before	0.0011 ***	0.0011 ***	-0.0009 ***	-0.0009 ***	-0.074 ***	-0.075 ***	-0.055 ***	-0.055 ***
CS_Offer	0.0001	0.0001	0.0032 ***	0.0032 ***	0.035 ***	0.034 ***	0.068 ***	0.067 ***
Loan_Offer	0.0011 ***	0.0011 ***	0.0001	0.0001	-0.009 ***	-0.007 ***	-0.006	-0.006
Nfund	0.0001 ***	0.0001 ***	0.0000 **	0.0000	0.000	0.000 **	0.001 ***	0.001 **
Observations	21,500	21,500	27,724	27,724	21,500	21,500	27,724	27,724
# of Participants	10,750	10,750	13,862	13,862	10,750	10,750	13,862	13,862
R Squared	14.4%	14.8%	35.6%	35.6%	27.7%	29.2%	30.9%	31.0%
Dependent means								
Pre-treat	6.38%		6.52%		6.0%		19.9%	
Post-treat	6.63%		6.76%		0.9%		17.1%	
Unadjusted difference	0.25%		0.24%		-5.0%		-2.8%	

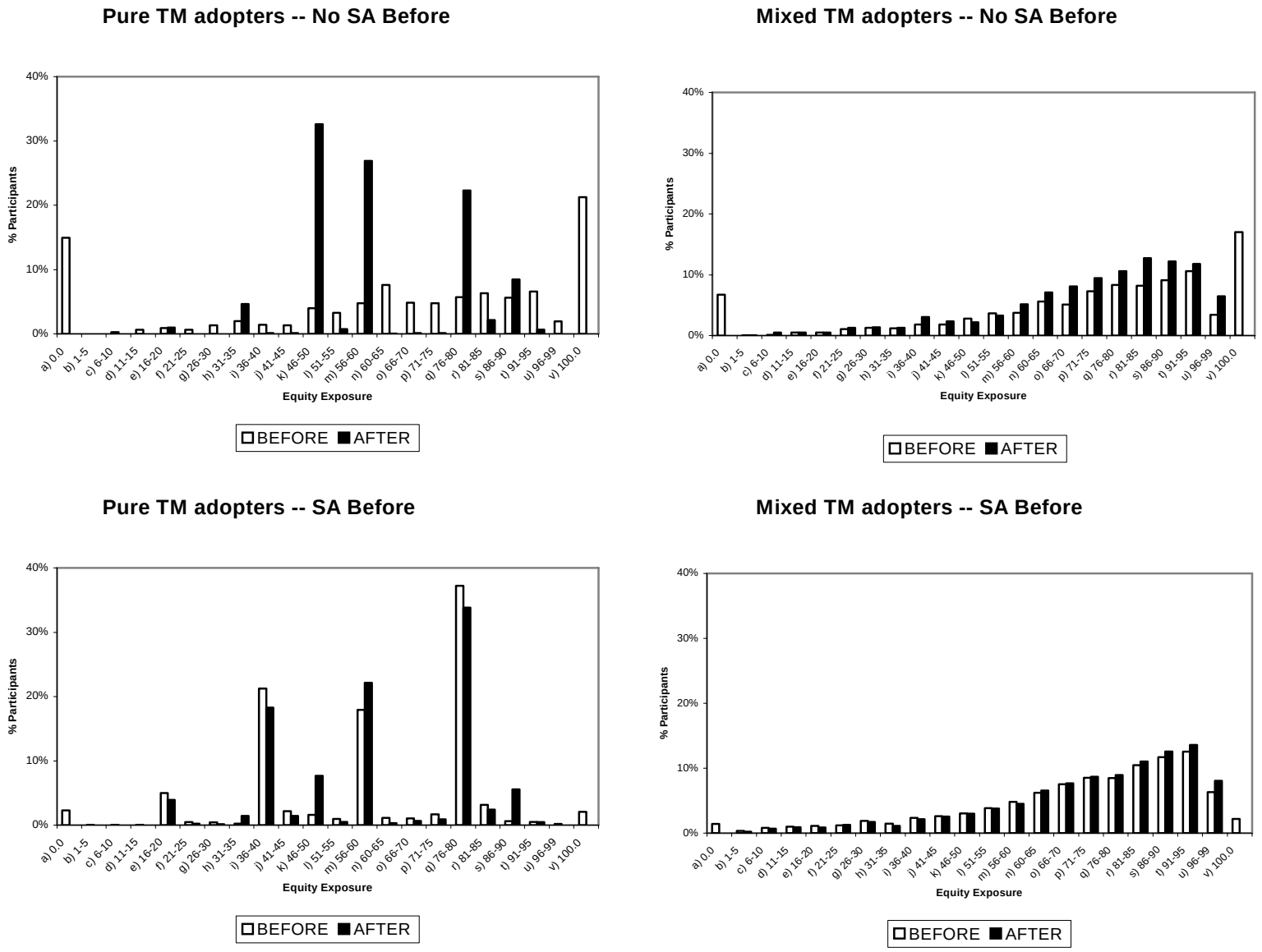
Note: See Table 3

Figure 1. Change in Equity Proportion After TM Fund Introduction: Patterns by Age for Pure and Mixed Adopters



Note: Authors' tabulations, see text.

Figure 2. Equity Allocations of TM Adopters: Before and After Adoption



Note: Authors' tabulations, see text

Appendix Table A1. Cross-sectional Variation in Equity Exposure

	Pure adopters		Mixed adopters		All adopters	
	Mean	*St. Dev.*	*Mean*	*St. Dev.*	*Mean*	*St. Dev.*
1. TM adopters / no SA before						
Before	64.2%	0.34	71.8%	0.28	68.0%	0.31
After	62.8%	0.16	72.6%	0.19	67.7%	0.18
% Change	*-2%*	*-53%*	*1%*	*-32%*	*-1%*	*-42%*
2. TM adopters / SA before						
Before	60.9%	0.22	70.6%	0.23	66.4%	0.23
After	62.4%	0.19	72.5%	0.21	68.2%	0.21
% Change	*2%*	*-14%*	*3%*	*-9%*	*3%*	*-9%*
3. All TM adopters						
Before	61.4%	0.24	70.7%	0.24	66.6%	0.24
After	62.4%	0.18	72.5%	0.2	68.1%	0.2
% Change	*2%*	*-25%*	*3%*	*-17%*	*2%*	*-17%*