The Effect of Default Target Date Funds on Retirement Savings Allocations[*]

by

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Abstract

Defined contribution retirement plans increasingly use target date funds as the plan investment default with the intent of simplifying participant choices. Many plans also have a larger number of investment options than in the past. We analyze the effect of these investment menu changes on participant contribution allocations and equity exposure using a cross section of more than 600,000 TIAA participants. Prior to the adoption of target date defaults, most plans in the sample had money market defaults. Participants who joined plans with a money market default largely switched away from the default fund. These participants had substantial variation in the equity exposure for their contributions and, in 2012, allocated contributions to a median of three funds. Women had less equity exposure than men and contributed to more funds, and participants contributed to more funds if the plan offered more funds. Participants who joined a plan with target date defaults behaved differently, with more than two-thirds investing in a single fund, both sexes holding more in equity, women holding fewer funds and the same average equity as men, and with the size effect of the menu becoming insignificant.

I. Introduction

Defined Contribution (DC) plans have become the primary retirement plan for the majority of American workers.[1] Employees in these plans face a menu of investment alternatives and must decide whether to participate, how much to contribute, and how to allocate contributions among investment options. These decisions have profound effects on the ultimate values of their retirement portfolios. The investment menus and menu defaults are selected by plan sponsors, who have fiduciary responsibilities to participants. In recent years, fiduciaries have altered the structure of plans as regulations have changed:

1. There has been widespread adoption of "auto-enrollment" provisions, which specify default contributions and investment funds for new participants.

2. The Pension Protection Act of 2006 (PPA) created new guidelines for the default investment, which is the fund used for contributions if the participant makes no explicit choice. Prior to the PPA, money market funds were a common default. Following the adoption of the PPA, target date funds were widely adopted as defaults. Target date funds are auto-diversified funds-of-funds that reduce the percent of equity held in the fund over time.[2]

3. The adoption of "open architecture" investment menus allowed participants to select from a large number of funds, often offered by multiple fund providers.

In this paper, we examine how these changes affect participant contribution decisions, including the number of funds chosen and individual equity exposure, using data from a 2012 cross section of more than 600,000 TIAA participants working at 98 institutions. Prior to the adoption of target date defaults, money market defaults were common for participants in our sample. By 2012, participants who had

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[1] For private ERISA plans, see the Department of Labor's Abstract of 2012 Form 5500 Annual Reports (U.S. Department of Labor, Employee Benefits Security Administration 2015). Also see the National Compensation Survey (http://www.bls.gov/ncs/, access 2/26/2018).

[2] The PPA codified Qualified Default Investment Alternatives (QDIAs), which are defined in *29 CFR 2550.404c-5 - Fiduciary relief for investments in qualified default investment alternatives*. See https://www.law.cornell.edu/cfr/text/29/2550.404c-5. The QDIA definition is in section (e). The new regulations permitted diversified investments (either single investments or an investment service) and either age-based equity exposure to individuals or equity exposure appropriate to the participant group as a whole. See also https://www.dol.gov/agencies/ebsa/about-ebsa/our-activities/resource-center/fact-sheets/default-investment-alternatives-under-participant-directed-individual-account-plans, accessed 2/26/2018.

joined a plan with a money market default mostly invested in funds other than the default investment and had widely varying equity exposures in their contributions. By contrast, participants who had joined a plan with a target date default held a median of one fund, generally the default target date fund. Relative to using a money market default, participants using the default target date fund would increase their equity exposure because this investment fund was comprised of an underlying mix of equity and bond funds, with the portfolio weights dictated by the particular target date fund.[3]

The analysis in this paper contributes to the existing literature on retirement savings behavior, in particular the literature exploring behavioral dimensions of participant choices. The importance of defaults is a prominent result in the literature, but we find that participant adherence to defaults depends on the characteristics of the default, with many participants apparently finding a money market fund unsatisfactory as a sole retirement savings investment vehicle.

Separating participants into those who joined before and after target date funds became default investments, we examine three questions: First, how do the changes in default investments and available numbers of funds in the plan menu affect the number of funds used by participants? Second, what determines whether participants use target date funds? Finally, how do these regulatory and plan changes affect the percentages of equity in allocations? There are marked differences in behavior depending upon whether participants joined plans before or after target date funds became defaults.

We interpret our results as menu effects, which occur when investment choices are affected by differences in the presentation of economically similar investment alternatives. Menu characteristics include the default fund, the total number of funds, and the number of equity funds. To place our study in context, note that plan participants face three distinct decisions: (1) whether to participate and how much to contribute; (2) how to allocate their contributions (in particular, how many funds do participants use and how do they allocate their contributions across asset classes); and (3) how to allocate accumulated

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[3] For example, as of June 30, 2018, the TIAA-CREF Lifecycle 2050 Fund had a target allocation of approximately 91.75% to equity funds. This target allocation is further allocated to over 10 equity funds, with the top 10 fund allocations comprising about 93% of the equity allocation.

plan balances across funds and asset classes. In this paper, we address primarily the second issue, the allocation of contributions, which is a decision made when confronted with the plan menu.

The literature generally concludes that plan defaults matter. Madrian and Shea (2001) examine the effect of participation defaults, finding that the default choice of "participate" significantly increases employee participation in the retirement plan. They also find that participants accept the default fund allocation. Carroll, et al. (2009) and Choi, Laibson and Madrian (2009) verify the importance of defaults. Carroll, et al. (2009) also finds that requiring active participation decisions also raises participation. We do not study the participation question because many of the plans in our data often have automatic (mandatory) enrollment and we lack data on participation rates. However, we can study whether participants accept defaults and how allocations change with plan menus.

Our results for target date funds are partially in accord with the existing literature on defaults. With target date defaults, roughly two-thirds of new participants contribute only to a single fund, and they therefore allocate contributions in accordance with the equity percentage of that fund. Those who joined plans prior to the adoption of target date defaults, when money market funds were the most common default, allocate contributions to more funds and there is more cross-participant variation in equity contributions, with average equity contributions significantly below those of target date default participants. There are gender effects, with women contributing significantly more to equity after target date defaults than before and male-female disparities in equity percentage vanishing after target date defaults. The availability of target date funds within a plan seems less important than whether these funds are the default investment. This is evident in the relatively sparse use of target date funds in 2012 by participants who joined plans before they were a default.[4]

Importantly, this widespread acceptance of the default *does not* occur for participants who joined their plan before the adoption of target date defaults, when a money market fund was the typical default. More than 75% of these participants allocate nothing to the money market fund. The rest have customized

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[4] In our data, target date fund availability almost always coincides with their being the default. Only about 1% of our subjects joined plans where target date funds were available but not the default.

their allocations, suggesting that these participants viewed investing solely in the money market default as suboptimal for their portfolio allocation.

The economic consequence of different defaults is significant. Participants who joined plans post target date defaults tend to have a greater percentage allocation to equity. Because so many allocate to the same type of fund, there is less cross-sectional variation in equity percentage for this group. By contrast, those who joined under a money market default tended to customize their portfolios and there is a substantial cross-sectional variation in the equity percentage of their allocations. The dependence of equity exposure and the variation in equity exposure on the presence of a target date default is contrary to basic portfolio theory, which implies that plan participants should structure their portfolios' risk-return profiles and exposure to risk factors independently of the specific configuration of available portfolios in their plan investment menus, as long as the menus provide portfolios spanning basic asset classes. In particular, participants desiring target date fund characteristics in their allocations could have used equity and bond funds to create their own equivalents, reducing equity exposure with age. The fact that a target date fund default affects equity allocations is not surprising given existing evidence about defaults, but it highlights the important question of how participants make choices when offered a set of investment options. The behavior we document is strongly suggestive of an "endorsement effect" (e.g., Hirshleifer and Teoh (2003)), where labeling the target date fund as the default is perceived as certifying the value of target date funds. However, we also document the limits to default endorsement effects because participants who joined plans with a money market default tend to move away from that fund.

Behavioral factors associated with the plan menu other than default investments may influence choice. Iyengar and Lepper (2000) argue that a large number of choices can cause confusion and distraction. The large number of funds in some plans could, in theory, affect both the extent of participation (the amount invested) and the specific choice of funds. Iyengar, Huberman and Jiang (2004) do find that "choice overload" reduces participation rates, and Choi, Laibson and Madrian (2010) show that educated and informed participants can make errors even when simply choosing among different S&P 500 index funds. Huberman and Jiang (2006) use the same data as Iyengar, Huberman and Jiang

(2004) to examine investment choices, finding that if a plan offers at least 10 funds, the number of funds used is not sensitive to the number of funds offered and that the allocation of contributions to equity funds is not sensitive to the fraction of equity funds offered. This differs from Benartzi and Thaler (2001), who posit a 1/N effect, for which participants would invest in more funds if more funds are offered. Our results differ from both Benartzi and Thaler (2001) and Huberman and Jiang (2006) in finding a weak menu effect of approximately one extra fund held for every 28 additional funds offered to participants who joined plans prior to target date defaults. This effect vanishes, however, once there is a target date default. We also find that participants hold a greater percentage of equity when more equity funds are offered. This menu effect again almost vanishes when target date funds are adopted as the default.[5] Thus, we find weak menu effects before target date funds were a default, but a different and more pronounced menu effect afterwards: the target date fund default affects both the number of funds and the percentage of equity in contribution allocations.

Part of our analysis is also related to Mitchell and Utkus (2012), who examine asset allocations for participants who choose target date funds. Their sample has 2.2 million Vanguard participants in 401(k) plans over 8 years and they select their sample to include only plans introducing target date funds during the sample period, with records available both before and after the introduction. They find that participants who choose to allocate to target date funds, either partly or totally, increase the equity percentage in their contributions. In one part of our analysis, we ask who chooses target date funds. For those participants, there is also an obvious increase in equity allocations. However, in most of our analysis, we examine all plans in a year (including those without a target date fund) and participants (including those who are not allocating to a target date fund). Our main results are not conditioned on whether participants chose target date funds. Instead, we ask how target date fund availability and defaults affect participants who joined plans overall.

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[5] We note that, because the data are cross-sectional, we document these effects but cannot speak to causality.

Section 2 presents our data, which includes information on plans, participant demographics, and investment choices.[6] The plan data includes the structure of the investment menu at each institution, default provisions, contribution rules, and vesting rules. The participant data includes basic demographic information, contribution allocations, asset holdings, and each participant's quarterly personal rate of return. The data includes both participants who joined plans before and after target date funds became the default, as well as plans in which target date funds were not the default or were not even available by 2012. Thus, we can analyze allocations and fund choices across a wide range of available choice sets, including the number and types of funds offered and the significance of the default.

Section 3 presents our main results, focusing on three questions: how does the structure of investment menus affect the number of funds to which participants contribute, what determines the percentage of equity in contributions, and what are the determinants of target date fund investment? Regarding the number of funds, we perform an analysis similar to Huberman and Jiang (2006), adding the effects of having target date fund defaults on the investment menu. Across all groups, participants typically allocate to a small number of funds and invest significant fractions in equity.

Our results on equity allocations confirm the importance of target date fund defaults. We find that a target date default raises the percentage contributed to equity by 13 percentage points on average and that most of the effects attributable to demographic variables are reduced or eliminated by target date defaults.

We also reproduce some of the findings in Mitchell and Utkus (2012). We find similar characteristics distinguish investors who are more likely to choose target date funds, with a target date default on joining the plan the dominant effect. Because we do not condition our sample on adoption of target date funds or their default status, we can document the effects of availability and default on the choices and equity exposures of participants.

Section IV offers concluding thoughts and possible future research directions.

II. Data

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[6] This covers 44.3% of the active participants in 2012.

A. Description

The cross-sectional data covers 645,197 participants and 1,073 DC plans at 98 large employers covered by the TIAA system in 2012. The data include participant demographics, asset holdings, contribution allocations and plan characteristics. DC plan types include 401(a), (h) and (k); 403(b) and 457(b) and (f) plans (the designations correspond to the relevant sections of the IRS code that allow for the plan). The number of active participants in a plan ranges from 1 to 26,615, with an average of 825 and median of 53 active participants. In many cases, participants can contribute to more than one plan (e.g., a "primary" retirement plan and a supplemental plan); there are 2,361 unique active plan combinations in the data. Table 1 shows the breakdown by statutory plan type, number of plans of each type and the number of participants in each plan type.[7]

Table 1: Number of Plans and Number of Participants Participating in each Plan Type

Plan Type	Number of Plans	Number of Participants		
		Mean	Median	Total*
401(a)	133	759	51	101,013
401(a)/414(h)(2)	253	801	25	202,718
401(k)	3	3,402	1,521	10,206
403(b) DC	210	1,641	222	344,622
403(b) TDA	291	720	87	209,531
457(b)	96	134	12.5	12,828
457(b) Private	53	78	43	4,157
457(f)	34	19	2	648
Overall	1,073	825	53	885,723

*There are 645,197 unique participants, but many participate in more than one plan, creating multiple observations. We aggregate across plans for a given participant, giving us 645,197 observations for the main analysis.

Our sample contains participants who contributed to one or more plans during 2012. We consider only plans to which the individual contributed during that year. Each participant can be in multiple plans; for example, employees could participate in a primary plan and a supplemental plan. Table 2 summarizes the number of plans in which employees participate. Fewer than 5% of employees participate in more

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[7] We identified default plans by examining the transaction records of participants. An investment in a default fund was labeled as such, permitting us to identify the default for that fund. We only required the record from a single participant contributing to the default fund in order to identify it.

than two plans, with 2/3 participating in exactly one. Of those participating in one plan, 95% are only in a

primary plan.[8]

Table 2: Number of Plan Combinations and Number of Participants Participating in each Combination.

Number of Plans in Combination	Combination Count	Participant Count	Cumulative Percentage of Participants
1	880	434,401	67.3%
2	974	182,709	95.6%
3	382	26,554	99.8%
4	99	1,474	100.0%
5	22	49	100.0%
6	3	10	100.0%
Total	2,360	645,197	100.0%

We define a participant "plan combination" as consisting of at least one plan (e.g., the employer's

"primary" retirement plan) and, for about one in three sample participants, includes two or more other

plans (e.g., a "supplementary" plan). In most of our analysis, we aggregate contributions across plans, i.e.

we work at the plan combination level. We do not know when participants joined their current institution,

but we know when they joined the plans to which they contributed in 2012, and we know the identity of

the default funds in each plan, both at the time they joined the plan and during 2012. In our analysis, we

partition participants into three groups: (1) those who joined the plans in the current plan combination

before any of their plans adopted target date funds as the default investment; (2) those who joined after

some, but not all, had adopted target date defaults; and (3) those who joined after all of the plans in their

combination had target date defaults. In each case, we determine whether the plan has a target date default

on the date at which the participant joined the plan. Thus, a given plan combination could have target date

defaults when joined for one participant and not for another. In addition, a participant may have joined a

plan before it had a target date default and had the plan subsequently change to a target date default.

For the year in which participants joined each plan in their current combination, Table 3 shows

whether: 1) target date funds were available in none, some but not all, or all of the plans in their

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[8] 412,312 participants are in a primary plan only, 65,855 are in one or more secondary plans, and 170,030 are in both primary and secondary plans.

combination; and 2) target date funds were the default in none, some but not all, or all of the plans in their combination. Ideally, we would like to separate the effects of a target date fund being a default from target date funds simply being available in a plan. Unfortunately, it is clear from the table that in the vast majority of cases when target date funds are available, they are also the default. There are nevertheless some participants who join plans when target date funds are available, but not the default. This will allow some analysis on the difference between target date availability and target date default.

Table 3: Target Date Fund Availability and Default Status at the Time Participants Joined Their Current Plan Combination

Target Date Fund Availability Status	Target Date Fund Default Status			
	No Plans	Some Plans	All Plans	Total
No Plans	379,251 (59%)	0 (0%)	0 (0%)	379,251 (59%)
Some Plans	1,467 (0%)	33,177 (5%)	0 (0%)	34,644 (5%)
All Plans	6,718 (1%)	154 (0%)	224,430 (35%)	231,302 (36%)
Total	387,436 (60%)	33,331 (5%)	224,430 (35%)	645,197 (100%)

It is important to note what our data does not include. We do not observe assets outside the retirement plan, although we do have an estimate of 9-digit zip-code level wealth from IXI. We do not have institution-level data apart from retirement plan information, so we do not know the participant's start date at the institution, specific job title, or educational background. We also do not have information about fund-level fees or the quality of information available to participants or whether there was educational material or a presentation to inform employees about their options. Finally, we do not have information about how participants have invested past contributions; rather, we look only at the flow of investments during 2012.

B. Hypotheses

Our principal question is to ask whether the adoption of default target date funds altered participant behavior. Because most participants could have created synthetic target date funds prior to their availability, our null hypothesis is that default target date funds do not change the economic characteristics of participant allocations. Our primary measures of participant behavior are the percentage of equity in investment allocations and the number of funds in which participants invest. The percentage

of equity is obviously economically important as it is a key determinant of portfolio risk and return. However, as noted in the introduction, the number of funds has been the subject of previous research, so we examine that as well for comparison purposes.

Throughout, we test whether the economic characteristics of participant investments are affected by plan menus. Most importantly, the equity allocation of investments should be the same whether or not there are target date defaults. Additionally, when there are no target date defaults, the number of funds invested in should be independent of the number offered.[9]

A natural concern is the possibility that available funds are insufficient to replicate a target date fund. All but 402 participants are in plans, and therefore plan combinations, with 10 or more funds, so this concern is not relevant.[10]

C. Summary Statistics

We now look at characteristics of the data, including the variables we use in subsequent analysis. In the definitions, the subscript t denotes a year, i denotes an individual, j an institution, and k the specific plan combination in which the individual participates at that institution. The base unit of analysis is the participant's plan combination, which is the set of plans in which an individual made contributions during 2012. Thus, different individuals at the same institution can be in different plan combinations and face investment menus with different characteristics. We consider the following variables in our analysis:

- NCHOSEN$_i$ the number of funds chosen by each participant for allocations.

- CONTRIBUTION$_i$ total contributions by an individual within a year across all plans in which they participate.

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[9] Obviously, with monitoring and trading costs (even if just psychological), a participant would tend to prefer a single fund that eliminated the need to actively manage a set of funds. So it would not be surprising to find that available target date funds reduced the number of funds in which a participant invests.

[10] Huberman and Jiang (2006) find that in plans with 10 or more funds, the number of funds contributed to is not affected by the number of funds, and equity contributions are not affected by the percentage of equity funds.

- %EQ$_i$ the proportion of current-year contributions that a participant invests in equity funds. Balanced funds count as ½ equity[11] and target date funds are given weights in proportion to the classification of funds held in the target date fund.

- NCHOICE$_k$ the number of funds offered by the participant's plan combination.

- %EQOffered$_k$ the proportion of equity funds out of all funds offered by a plan combination.

- COMP$_i$ the participant's annual compensation.

- PWEALTH$_i$ total investable assets in the participant's retirement plans.

- ZWEALTH$_i$ average wealth in the nine-digit zip code of the participant, a proxy for the participant's total wealth.[12]

- AGE$_i$, participant age in 2012, in years.

- TIAAYRS$_i$ total time for which the participant has had records kept by TIAA (this could be at multiple institutions).

- JOINYEAR$_i$ the year in which a participant joined a plan in which they actively invested in 2012.

- DEFAULT$_{i,kt}$ the default fund for individual i in plan k in year t, most commonly a money market default (MMD) or a target date default (TDF).

- FEMALE$_i$ dummy variable with women = 1.

- MATCHRATE$_{i,k}$ the ratio of the employer's contribution to the participant's contribution.

Table 4 presents data summaries for most of these variables. We present summary statistics both overall and for subsets of participants who (1) joined plans in their combination before any had target date defaults (60% of observations), (2) after all had target date defaults (35%), and (3) after some, but not all, had target date defaults (5%). Table 5 presents univariate difference in means t-test statistics between the overall sample and the subsets.

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[11] Following Huberman and Jiang (2006).
[12] We obtain zip code wealth from IXI Services' WealthComplete database.

Table 4: Summary Statistics

Variable	Units	Statistic	Overall	Before any plans had a target date default	After some, but not all, plans had target date defaults	After all plans had target date defaults
				Participants who joined plans in their current combination:		
NCHOSEN	1	Mean	3.37	3.81	5.65	2.27
		Median	2	3.00	4.00	1.00
		Std.Dev.	3.32	3.20	4.67	2.91
		Obs.	645,197	387,436	33,331	224,430
%EQ	1%	Mean	67.99	62.63	61.43	77.12
		Median	73	63.20	64.40	80.40
		Std.Dev.	22.61	23.80	22.87	17.09
		Obs.	563,526	320,998	31,461	211,067
%EQOffered	1%	Mean	66.40	65.71	66.11	67.63
		Median	66	66.29	66.29	67.91
		Std.Dev.	6.48	7.10	5.30	5.24
		Obs.	645,197	387,436	33,331	224,430
CONTRI-BUTION	$1,000	Mean	10.64	12.07	18.33	7.02
		Median	7	8.61	12.36	4.38
		Std.Dev.	11.33	11.49	16.81	8.59
		Obs.	645,197	387,436	33,331	224,430
COMP	$10,000	Mean	6.67	7.25	8.60	5.29
		Median	6	6.29	6.96	4.19
		Std.Dev.	5.07	4.97	5.78	4.80
		Obs.	247,743	149,395	14,952	83,396
PWEALTH	$10,000	Mean	17.99	24.62	28.00	4.95
		Median	6	11.36	13.78	1.46
		Std.Dev.	34.39	39.53	41.30	13.41
		Obs.	637,116	383,737	33,146	220,233
ZWEALTH	$10,000	Mean	46.96	55.91	52.01	30.36
		Median	12	15.18	16.63	6.77
		Std.Dev.	125.14	140.65	121.06	90.02
		Obs.	618,171	374,042	32,506	211,623
FEMALE	0-1	Mean	0.53	0.52	0.55	0.55
		Median	1	1.00	1.00	1.00
		Std.Dev.	0.50	0.50	0.50	0.50
		Obs.	645,197	387,436	33,331	224,430
AGE	Years	Mean	48.40	52.05	51.93	41.57
		Median	49	52.88	52.70	39.79
		Std.Dev.	12.33	11.13	10.53	11.63
		Obs.	645,082	387,345	33,331	224,406
TIAAYRS	Years	Mean	12.73	16.24	16.75	5.79
		Median	11	14.40	15.40	3.60
		Std.Dev.	9.96	9.50	9.24	6.70
		Obs.	625,283	381,067	32,641	211,575
MATCHRATE	1%	Mean	183.42	194.04	215.49	159.13
		Median	160	160.00	170.00	114.00
		Std.Dev.	279.26	320.30	345.61	161.25
		Obs.	343,185	208,920	18,500	115,765
NCHOICE	1	Mean	38.45	37.13	43.51	39.98
		Median	36	35.00	39.00	36.00
		Std.Dev.	14.40	15.11	14.89	12.65
		Obs.	645,197	387,436	33,331	224,430
NPARTICIPANTS	1	Mean	273.39	358.07	239.98	412.32
		Median	7	16	9	21
		Std.Dev.	1075.10	1222.90	961.83	1316.31
		Obs.	2,360	1,762	768	1,313

Table 5: Difference in Means Test Statistics on Summary Variables Between the Overall Sample and Individual Sub-samples.

Variable	Statistic	In their current combination, participants who joined		
		Before any plans had a target date default	After some, but not all, plans had target date defaults	After all plans had target date defaults
NCHOSEN	Difference	0.44***	2.28***	-1.1***
	t-statistic	66.657	88.070	-148.473
	p-value	0.0000	0.0000	0.0000
%EQ	Difference	-5.36***	-6.56***	9.13***
	t-statistic	-103.688	-49.572	190.739
	p-value	0.0000	0.0000	0.0000
%EQOffered	Difference	-0.69***	-0.29***	1.23***
	t-statistic	-49.293	-9.691	90.002
	p-value	0.0000	0.0000	0.0000
CONTRI-BUTION	Difference	1.44***	7.69***	-3.62***
	t-statistic	61.819	82.563	-157.637
	p-value	0.0000	0.0000	0.0000
COMP	Difference	0.58***	1.93***	-1.38***
	t-statistic	35.090	39.954	-70.684
	p-value	0.0000	0.0000	0.0000
PWEALTH	Difference	6.62***	10***	-13.04***
	t-statistic	85.993	43.331	-252.273
	p-value	0.0000	0.0000	0.0000
ZWEALTH	Difference	8.95***	5.05***	-16.6***
	t-statistic	32.007	7.315	-65.803
	p-value	0.0000	0.0000	0.0000
FEMALE	Difference	-0.01***	0.01***	0.02***
	t-statistic	-10.674	4.748	13.711
	p-value	0.0000	0.0000	0.0000
AGE	Difference	3.65***	3.53***	-6.83***
	t-statistic	154.998	59.149	-235.895
	p-value	0.0000	0.0000	0.0000
TIAAYRS	Difference	3.51***	4.02***	-6.94***
	t-statistic	176.530	76.337	-360.377
	p-value	0.0000	0.0000	0.0000
MATCHRATE	Difference	10.62***	32.07***	-24.29***
	t-statistic	12.532	12.403	-36.139
	p-value	0.0000	0.0000	0.0000
NCHOICE	Difference	-1.32***	5.06***	1.53***
	t-statistic	-43.749	60.603	47.484
	p-value	0.0000	0.0000	0.0000
NPARTICIPANTS	Difference	84.68**	-33.41	138.93***
	t-statistic	2.315	-0.812	3.266
	p-value	0.0207	0.4170	0.0011

***, ** and * denote significance at the 99%, 95% and 90% levels of confidence, respectively.

Both the number of funds and the percentage of contributions allocated to equity are affected by plans having target date fund defaults. Across all participants, the average number of funds chosen is 3.37 with a median of two funds. Participants who joined before target date defaults hold an average of 3.81 funds and a median of 3, while those who joined after target date defaults average 2.2 funds with a median of 1. Investors on average allocate 68% of contributions to equity funds, but only 63% if they joined before any

plans had target date defaults and 77% if they joined after all plans had target date defaults. Participants who joined before any plans had target date defaults tend to have higher contributions,[13] larger compensation, larger total plan assets (PWEALTH), higher zip code average wealth (ZWEALTH) and higher match rates than participants who joined after all plans had target date defaults. These participants also had longer histories with TIAA (TIAAYRS) and were more likely to have web access to their accounts.

We make two additional observations about the data summarized in Table 4 and Table 5. First, there are only about 8,300 participants who joined plans offering a target date fund where a target date fund was not the default. This makes it difficult to examine the importance of target date availability versus a target date default. Second, participants in 2012 were likely either to have a money market default (if they did not have a target date default) or had a money market default prior to having a target date default. In 2012, 86,198 participants were in plans with a default investment that was not a target date fund. Of these, 83,643 had a money market default. For the remaining 564,141 participants in plans with a target date default, we are able to determine the previous default fund for 517,871 participants. Of these, 516,082 were in plans that had previously had money market defaults. Thus, money market defaults were the overwhelming alternative for participants who joined plans prior to target date defaults.

There are significant differences between our sample and that of Huberman and Jiang (2006), who use 2001 Vanguard data. The average number of choices available in a plan combination nearly triples, from 13.66 in Huberman and Jiang (2006) to 38.45 in our sample, and equity funds constitute about two-thirds of offered funds in both the TIAA and Vanguard data. Target date funds were not present in Huberman and Jiang (2006) and have now been overwhelmingly adopted as both an investment option and the plan default. There are also differences in the samples of participants. In 2012, TIAA participants are more likely to be women and tend to be older. The percentage of participants with Internet access (web access) to their retirement account also increased dramatically, more than doubling overall. The

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[13] Among TIAA participants, the contribution rate is significantly lower for participants who joined after target date funds became the default (7.02% of compensation), but those participants are on average at an earlier stage of their career.

contribution rate is significantly higher overall in the TIAA data (average contribution = 10.64% of average compensation) than Vanguard (5.2%).[14] Further, about two-thirds of participants' contributions go to equity in each data set.

III. Results

In this section, we investigate three questions:

1. How do target date fund defaults affect the number of funds chosen by participants?

2. To what extent do target date fund defaults lead to participants allocating some or all contributions to target date funds?

3. Do target date fund defaults significantly affect the average equity allocations of participants?

In answering these questions, we document that participants who join plans with a target date fund default contribute to fewer funds and are, in fact, significantly more likely to choose only target date funds for their allocations. We also find that, after target date funds become the default, participants on average contribute to funds which give them greater equity exposure, and there is less cross-sectional variation in contribution equity exposure across participants. Both equity exposure effects are significant across age groups and gender.

While it is not surprising that a target date default leads to more concentrated contributions with less variation across investors, it is not obvious that this should change equity exposure. Before the adoption of a target date default, investors could have selected any amount of equity exposure. After target date defaults, investors who selected the default could also have selected additional funds to alter the equity exposure of their overall allocations. The fact that the default altered average equity exposure suggests a strong behavioral effect associated with the design and default designation of target date funds.

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[14] There are a variety of reasons for this. Retirement packages may be more generous at TIAA employers. In some states, university employees are not covered by Social Security and larger contributions are needed to address this retirement gap. However, the point is that this is a large and economically significant investment for the participants.

A. Number of Funds Chosen

Figure 1 shows histograms of the number of funds chosen by participants who joined plans in their current combination before any plan had target date defaults; after some, but not all, had target date defaults; and after all had target date defaults. A target date default is associated with a dramatic shift in Figure 1. Participants who joined before any of their plans had target date defaults had median holdings of 3 funds, with 19% allocating to more than 5 funds. In contrast, for participants who joined after all their plans had target date defaults, 68% invested in 1 fund, with only 10% investing in more than 5 funds. It is difficult to draw conclusions about the small number of participants who faced some but not all target date defaults (the rightmost panel in Figure 1).
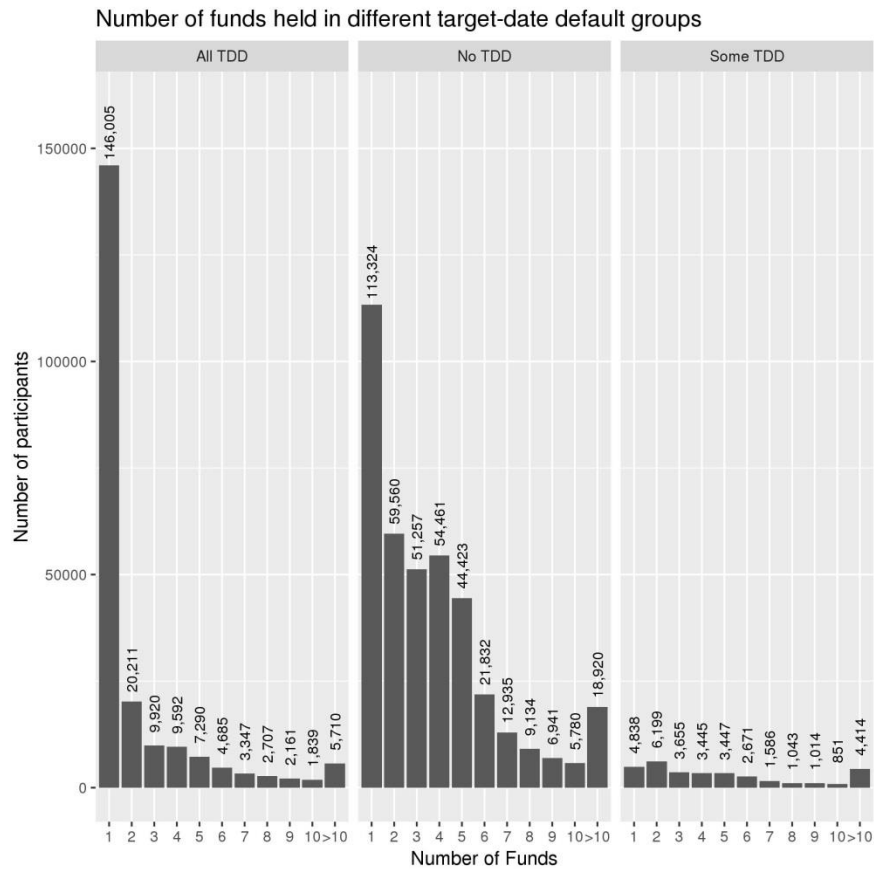
Figure 1: Bar plots of the numbers of participants who allocate to different numbers of funds based on whether there were target date defaults at the time the participant joined plans. The leftmost panel shows participants who joined plans in their combinations after all had target date defaults; the center panel, those who joined before any had target date defaults; and the rightmost, those who joined when some but not all had target date defaults.

Table 6 presents censored normal regressions showing the determinants of the number of funds used by participants when allocating retirement investments.[15] Our baseline specification is:

$$NChosen_{i,j} = \sum_i \sum_k D_k \left(\gamma_k \, NChoice_j + \beta_{\{ik\}} Controls_{i,j} \right) + \varepsilon_{i,j} \tag{1}$$

where $NChosen_{i,j}$ is the number of funds used in allocations or holdings by individual i in plan combination j, $Controls_{i,j}$ is a vector of demeaned control variables and $\varepsilon_{i,j}$ is a residual error. The dummy variables D_k signify whether the participant joined after some or all plans had target date defaults. We estimate equation (1) using censored normal regression to account for the fact that a participant cannot allocate to less than 1 fund. The robust standard errors are clustered at the plan combination level to control for fixed effects.[16] Our control variables include both individual and plan-combination level attributes. At the individual level are CONTRIBUTION, ZWEALTH, FEMALE, AGE, and TIAAYRS.[17] Plan-combination level controls include MATCHRATE (the individual match rate from the employer, not the plan average) and NPARTICIPANTS (the number of plan combination participants as a proxy for plan size). Each control variable is demeaned by subtracting the overall sample average from the observation before including it in the regression. This allows us to interpret the intercept as the average number of funds held by the overall population average participant and the interaction terms as the effect of the target date defaults on the number of funds held by the average participant.[18]

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[15] The specification is similar to Huberman and Jiang's (2006) Table II, although the dependent variable is contribution allocations rather than holdings. We also differ from Huberman and Jiang (2006) in that we do *not* multiply coefficients and standard errors by 100.

[16] "Target date default" status is measured at the time the participant joins the individual plans in their plan combination. However, characteristics of the plan combination such as number of available funds are measured as of 2012, the year in which contributions are made. A given plan combination can thus include participants in all three target date default categories.

[17] We do not use compensation because it is highly correlated with contributions.

[18] For robustness checks, we ran additional (unreported) regressions with plan-level control variables including plan-level averages of contributions, zip code wealth, gender, age and tenure with TIAA. This led to no other significant differences in the regression coefficients or significance levels. We also controlled for plan level variables using institution fixed effects (i.e., institutional dummy variables). Institutional dummy variables are extremely highly correlated with the number of choices. This collinearity affected the significance of the number of choices (the effect was absorbed by the dummy variables), but led to no other significant differences in the regression coefficients or significance levels. In all cases, we duplicated the censored normal regressions with OLS regressions and found no significant differences in the regression coefficients or significance levels.

The first column in Table 6, Model 1, presents a baseline analysis across all participants. The intercept shows that the mean number of funds held is about 2. The number of funds available ranges from 1 to 84, averaging 38.5 and the 0.0236 coefficient on NCHOICE implies that participants will tend to hold one additional fund if 42 more are offered. While the coefficient is statistically significant, which contrasts with the results in Huberman and Jiang (2006), this is an economically small effect. On average, women invest in more funds, as do participants who contribute more, have less wealth, have been with TIAA longer, or have higher match rates. Again, the effects are small. A participant will tend to hold one additional fund, for example, if they contribute an additional $12,000/year to retirement plans.[19]

Columns two through four of Table 6 present the same regression as column one, adding dummy variables and interactions for joining the plan before or after the adoption of target date funds. Because of the small number of participants in the D1=1 case (where some but not all plans had target date defaults when joined), we will concentrate on the cases where none or all of the plans had target date defaults.

The most striking result of the target date default is on the number of funds held. Participants allocated to significantly fewer funds if they joined each plan in their combination after those plans had adopted target date defaults.[20] In interpreting the Model 2 regressions, the dummy intercepts are the mean number of funds held in that treatment for a participant with population average control variables.

The relationships of other coefficients across columns show other interesting results:

- With the exception of AGE and TIAAYRS, the results in column 2 are similar to those in column 1.

- For participants who joined plans before the introduction of target date fund defaults, the NCHOICE coefficient of 0.0359 implies the inclusion of one additional fund for every 28 more funds available. For workers who joined each plan in their combination after they had target date defaults, the menu

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[19] The individual elective contribution limit in 2012 was $17,000, with workers over age 50 eligible to contribute an additional $5,500. The 2012 total plan contribution limit (both employee and employer contributions) was $50,000.

[20] To show that this is a default effect and not just an availability effect, we ran similar regressions for participants who have no target date defaults, but may have target date funds available (i.e., column 1 of Table 3). The dummy variables are 1 if the participant has target date funds available in some but not all plans and 1 if the participant had target date funds available in all plans. In contrast to the significant target date default coefficient in Table 6, the coefficients on target date availability (in the absence of default) are insignificant.

size effect is entirely offset (compare the coefficients in Model 2 on NCHOICE and NCHOICE interacted with D2).

- The last column shows that other results are also generally offset or mitigated when there are target date defaults. Specifically, the net effect of funds offered on fund allocations is essentially zero, as are the net effects of wealth, age and the match rate. The effect of age is more than offset.

- Women invest in more funds when there is no target date default and fewer funds when there are target date defaults.[21]

- Participants who have more years with TIAA invest in more funds even if they joined their current plan combination after target date defaults. This may arise because they have prior experience with plans when target date funds were not defaults.

Overall, our results show a menu effect (number of choices) for participants who join plan combinations before the introduction of target date defaults. There are also significant variations in the number of funds used based on demographic and plan variables for participants who joined their plan combinations before their plans adopted target date defaults. Most of these effects are attenuated or effectively eliminated for participants who joined plans after target date defaults. The exception is for women, who select significantly more funds than men when joining before target date defaults and significantly less after.

While mitigating many other menu effects, target date fund defaults create a different and significant menu effect of their own: reducing the number of funds held considerably and more so for women than men.

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[21] This result is consistent with field (Sunden and Surette 1998) and experimental (McDonald and Rietz 2017) evidence that women diversify more in the sense that they tend to invest in more options.

Table 6: Determinants of Number of Funds Used for Allocations

The dependent variable, NCHOSEN, is the number of funds in which a participant chooses to invest all of his or her allocation. NCHOICE is the number of fund options available to employees in their plan combination. Definitions of control variables are the same as those in Table 4; all explanatory variables have their overall means subtracted from them. The wealth variable enters as a log. Model 1 only uses the baseline variables. Model 2 has two dummy interactions. The first equals 1 when the participant joined plans in the current combination after some but not all had target date defaults. The second equals 1 when the participant joined plans in the current combination after all had target date defaults. The regressions are censored normal regressions with NCHOSEN censored at 1 (the minimum number of funds that can be used for an allocation). Standard errors adjust for both heteroscedasticity and arbitrary correlation of error disturbances clustered at the plan combination level to control for plan level effects. "*," "**" and "***" indicate that the coefficient differs from 0 at the 90%, 95% and 99% level of confidence, respectively.

| Variable | Model 1: Baseline Using All Participants | Model 2: Baseline variables and interactions. D1=1 if participant joined plans in the current combination after some, but not all, had target date default options. D2=1 if the participant joined plans in the current combination after all had target date default options. | | |
		Baseline Coefficients	Interactions with D1	Interactions with D2
Intercept or Dummy Coefficient(s)	1.9694***	3.0682***	1.7250***	-2.5860***
	(0.1188)	(0.1255)	(0.2717)	(0.2494)
NCHOICE	0.0236***	0.0359***	0.0298*	-0.0363**
	(0.0076)	(0.0071)	(0.0161)	(0.0157)
CONTRIBUTION	0.0854***	0.0738***	-0.0451***	0.0611***
	(0.0061)	(0.0047)	(0.0070)	(0.0157)
LN(ZWEALTH)	-0.0382***	-0.0459***	0.0111	0.0520*
	(0.0149)	(0.0150)	(0.0320)	(0.0266)
FEMALE	0.2722***	0.2639***	-0.2419*	-0.5162***
	(0.0527)	(0.0499)	(0.1247)	(0.1210)
AGE	0.0002	-0.0313***	0.0016	0.0383***
	(0.0068)	(0.0081)	(0.0114)	(0.0068)
TIAAYRS	0.0903***	0.0180**	0.0332*	0.0937***
	(0.0081)	(0.0080)	(0.0177)	(0.0156)
MATCHRATE	0.0007***	0.0005**	0.0000	-0.0007
	(0.0002)	(0.0002)	(0.0003)	(0.0010)
NPARTICIPANTS	0.0000	0.0000	0.0000	0.0001
	(0.0000)	(0.0000)	(0.0001)	(0.0001)
N	593,130	593,119		
No. of Clusters	2,231	2,230		
R2	2.33%	4.67%		

B. The Target Date Fund Choice

Table 6 shows that after target date funds become plan defaults, participants tend to allocate to fewer funds. We now show that participants who joined their plan when money market funds were the default make little use of money market funds, but participants who joined after target date funds became the

default make heavy use of target date funds in their allocations, and a significant number use only target date funds.

Figure 2 presents boxplots showing the extent to which participants allocate to the fund which was the default when they joined their plan. The plots show, by age and gender, the distribution of the percentage allocated to either the target date or money market fund. The box displays the interquartile range, and the plots also show the median and the 5% and 95% quantiles. It is clear that most participants who joined plans when money market funds were the default (the bottom half of the figure) make little use of money market funds, with the vast majority making no contributions. In every age group save for those who are between 25 and 35, at least 75% of participants contribute zero to the default money market fund. In younger age groups, there is more allocation to the money market fund, with 25% of the youngest women allocating more than 75% of their contributions to the money market fund. At the same time, we note that at least 5% of participants age 50 and below allocate solely to the money market fund.

Behavior with respect to target date funds is the opposite. Through age 60, for both men and women, the median holding of the target date default fund is 100%. For the youngest participants, those in the 25-30 age group, at least 75% allocated only to the target date fund. As the participant population ages, their mean investment in the target date fund declines. One possible explanation for this is that the change in the equity percentage over time is not optimal for participants. In fact, we see in the next section that equity percentages show roughly the same pattern over time as target date fund holdings, suggesting that the pattern in Figure 2 accompanies a move away from equity as participants grow older.
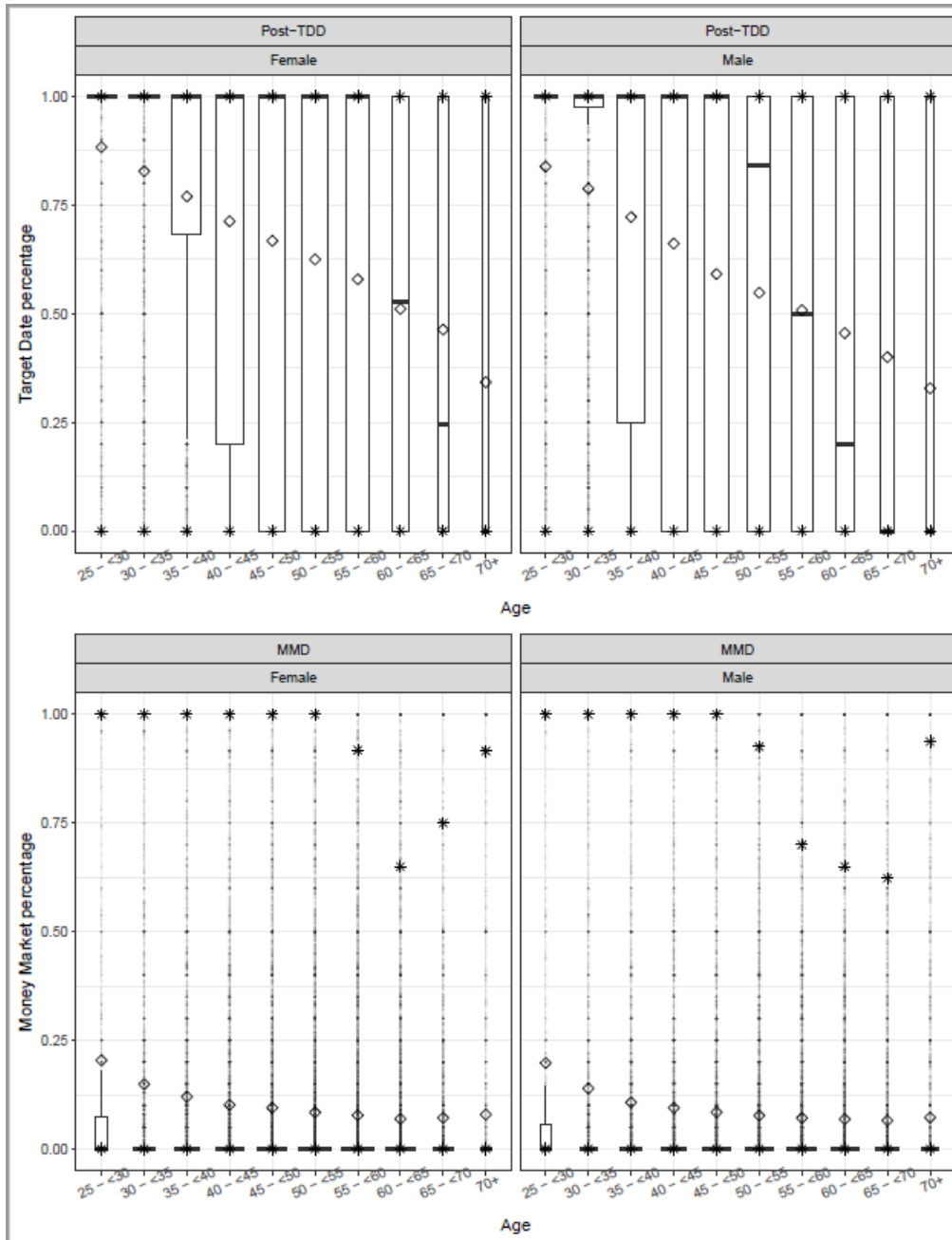
Figure 2: Boxplots of the fraction of target date funds in allocations, for participants who joined plans with a target date default (top), and the fraction of money market funds in allocations for participants who joined plans with a money market default (bottom), by gender and age. The width of each box is proportional to the square root of the number of observations in that group. The white box is the interquartile range, the black bar in the middle is the median, the diamond is the mean, and the stars ("*") denote the 5% and 95% quantiles. When no box is visible, at least 75% of the allocation is either 100% or 0%, as indicated by the black bar.

Table 7: Percentages of Participants who Allocated 0% and 100% to Target Date and Money Market Funds and Average Percentage Allocations to Target Date and Money Market Funds Conditional on the Default Fund Type when Joined and Gender

| | | | | Percent of Participants with | | |
Default Fund when Joined	Fund Type	Parti-cipant Gender	Number of Participants	0% Allocation to Fund Type	100% Allocation to Fund Type	Average % Allocation to Fund Type
Target Date Fund	Target Date	Female	136,562	24.2%	67.3%	71.2%
Target Date Fund	Target Date	Male	111,966	29.3%	60.6%	64.9%
Target Date Fund	Money Market	Female	136,562	93.8%	1.8%	2.6%
Target Date Fund	Money Market	Male	111,966	93.3%	2.1%	3.0%
Money Market	Money Market	Female	204,140	81.0%	6.9%	9.8%
Money Market	Money Market	Male	180,368	83.1%	5.9%	8.6%

Table 7 provides some additional summary statistics for the data presented in Figure 2. For participants who joined when money market funds were the default, allocations to money market funds for men and women averaged 8.6% and 9.8%. About 6% and 7% of men and women, respectively, allocated exclusively to money market funds, while 83% and 81% of men and women allocated nothing to money market funds. For participants who joined when target date funds were the default, even fewer allocated exclusively to money market funds (about 2% of men and women), and most allocated nothing (93% and 94% of men and women). Average allocations to money market funds fell to around 3% each. In contrast, 61% and 67% of men and women allocated exclusively to target date funds; 29% and 24% do not allocate to target date funds at all; and target date funds averaged 65% and 71% of allocations. From Figure 2 and Table 7, it is clear that default effects alone cannot explain the behavior of participants in selecting fund allocations.[22]

Finally, it is interesting to note that in both the money market and target date plots, the plots for men and women are similar, but women seem slightly more affected by defaults. For both money market and target date defaults, more young women invest solely in those defaults.

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[22] Plans have switched over time from money market to target date defaults. This raises the possibility that the patterns in Figure 2 could be due to drift over time, with participants who encountered money market defaults early drifting away from the default, and target date defaulters not having had time for drift to occur. Figure 6 shows that the target date default remains dominant even when controlling for the year in which participants joined the plan. Thus, drift does not explain the patterns in Figure 2.

Table 8 presents the result of logit models explaining (1) when participants choose to allocate at least some (or all) of their primary plan contributions to target date funds and (2) when participants choose to allocate all of their primary plan contribution to target date funds. For this part of the analysis, we restrict the sample to (1) primary plans and (2) participants who have target date fund options available in their primary plan (even when they are not the default). Both restrictions avoid situations where participants may have wanted to allocate to (or only to) target date funds in some or all of their plans but could not do so. Overall, 37.50% of participants who have a target date fund option allocate at least some of their contribution to target date funds and 31.24% allocate contributions exclusively to target date funds.

To determine the factors driving the target date fund choice, we compute the marginal effects of each variable on the probability of allocating some or all contributions to target date funds assuming mean values for all variables. The dominant factor determining whether a participant allocates to a target date fund is whether a target date fund was the default investment when they joined the retirement plan. If a target date fund was the default, the probability of a participant allocating all contributions to a target date fund increases by 24.8 percentage points according to the marginal effects (shown in bold italics in the table).[23] And the probability of allocating at least some contributions to a target date fund goes up 37.0 percentage points.

The average plan with a target date fund option has about 40 funds. There is a small effect of number of funds offered: each additional fund offered increases the probability of choosing some target date funds by 34 basis points (0.34%) according to the marginal effect. There is no significant effect for target date-fund-only participants.

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[23] The marginal effects are bold and italicized in the table and give the partial derivative of the probability of the independent variable being 1 with respect to a change in the independent variable.

Table 8: Logit models explaining target date fund choices

The dependent variables in the two models equal 1 if the participant had some (or all) primary plan contributions being allocated to target date funds (Model 1) or allocated exclusively to target date funds (Model 2) in their primary plans. NCHOICE is the number of fund options available to employees in their plan combination. Definitions of control variables are the same as those in Table 4. The Target Date Default when Joined Dummy equals 1 if the participant joined his or her primary plan after it had a target date default. This variable is interacted with gender and TIAAYRS. The models are run only using primary plan data for participants who have a target date option in their primary plan (even if it is not the default). Standard errors adjust for both heteroscedasticity and arbitrary correlation of error disturbances clustered at the plan combination level to control for plan level effects. "*," "**" and "***" indicate that the coefficient differs from 0 at the 90%, 95% and 99% level of confidence, respectively. Odds ratios and marginal effects (at means) are shows in italics and bold italics respectively.

Variable	Statistic	Model 1: Some Target Date Funds in Allocation		Model 2: Only Target Date Funds in Allocation	
Intercept	Coef. (Std. Err.)	1.2056***	(0.3152)	0.9965***	(0.3238)
	*Odds Ratio & **Marginal Effect***	*3.3389*	*N/A*	*2.7088*	*N/A*
NCHOICE	Coef. (Std. Err.)	-0.0165**	(0.0074)	-0.0085	(0.0061)
	*Odds Ratio & **Marginal Effect***	*0.9836*	***-0.0034***	*0.9916*	***-0.0013***
CONTRIBUTION	Coef. (Std. Err.)	-0.0278***	(0.0081)	-0.0421***	(0.0075)
	*Odds Ratio & **Marginal Effect***	*0.9726*	***-0.0058***	*0.9588*	***-0.0065***
LN(ZWEALTH)	Coef. (Std. Err.)	0.0054	(0.0079)	0.0011	(0.0077)
	*Odds Ratio & **Marginal Effect***	*1.0055*	***0.0011***	*1.0011*	***0.0002***
FEMALE	Coef. (Std. Err.)	0.0141	(0.0453)	0.0394	(0.0560)
	*Odds Ratio & **Marginal Effect***	*1.0142*	***0.0029***	*1.0402*	***0.0061***
AGE	Coef. (Std. Err.)	-0.0276***	(0.0021)	-0.0244***	(0.0022)
	*Odds Ratio & **Marginal Effect***	*0.9727*	***-0.0057***	*0.9759*	***-0.0038***
TENURE	Coef. (Std. Err.)	-0.1303***	(0.0147)	-0.1559***	(0.0184)
	*Odds Ratio & **Marginal Effect***	*0.8778*	***-0.0270***	*0.8556*	***-0.0240***
Target Date Default when Joined Dummy	Coef. (Std. Err.)	1.7831***	(0.3354)	1.6135***	(0.3318)
	*Odds Ratio & **Marginal Effect***	*5.9480*	***0.3699***	*5.0202*	***0.2481***
Target Date Default Female Interaction	Coef. (Std. Err.)	0.0385	(0.0602)	0.0368	(0.0678)
	*Odds Ratio & **Marginal Effect***	*1.0393*	***0.0080***	*1.0374*	***0.0057***
Target Date Default Tenure Interaction	Coef. (Std. Err.)	0.0112	(0.0199)	-0.0008	(0.0226)
	*Odds Ratio & **Marginal Effect***	*1.0112*	***0.0023***	*0.9992*	***-0.0001***
MATCHRATE	Coef. (Std. Err.)	-0.0003	(0.0002)	-0.0004	(0.0003)
	*Odds Ratio & **Marginal Effect***	*0.9997*	***-0.0001***	*0.9996*	***-0.0001***
NPARTICIPANTS	Coef. (Std. Err.)	0.0018	(0.0022)	0.0008	(0.0013)
	*Odds Ratio & **Marginal Effect***	*1.0018*	***0.0000***	*1.0008*	***0.0000***
N		488,475		488,475	
Clusters		432		432	
Pseudo R2		25.66%		30.28%	

Older participants, those who have been with TIAA longer, and those with larger contributions are

less likely to choose target date funds. Alternatively, younger, shorter-tenure participants and those with

smaller contributions are more likely to allocate contributions to target date funds and are more likely to be target date-fund-only participants.[24]

Women are also more likely to allocate contributions only to target date funds. The marginal effect shows that the probability a women is a target date-fund-only contributor is 1.17 percentage points higher than a man if both joined after target date funds became the default (which is statistically significant with $\chi^2(1)$=4.25, p-value=0.0393) and 0.61 percentage points higher than a man if they both joined before (which is statistically insignificant).

C. Equity Exposure

Having a target date fund as the default option for retirement plans has the potential to alter the asset allocations of plan participants. Figure 3 presents boxplots showing equity allocations for participants in different age groups, faceted by gender and whether participants joined plans before or after target date defaults. The plots show the interquartile range (the box) and the 5% and 95% quantiles (the stars). Figure 3 shows dramatic differences, in both the average equity allocation and the variability of equity allocations, for participants who joined plan combinations with different defaults.

The effect of adopting target date fund defaults is most pronounced for the youngest investors, and there is also an effect associated with gender. Women in the 25 to 30 age group invested, on average, 53.2% of contributions in equity funds if they joined plans in their combination before any had target date defaults. This increases to an average allocation of 83.3% if they joined plans in their combination after they all had target date defaults.[25] While the increase for men is slightly smaller, it is also significant and large: increasing from 59.5% to 82.0% after the adoption of target date fund defaults.[26] Because the target date fund reduces equity allocations as participants age, these differences are relatively smaller for older participants but consistently significant for both genders and all age groups. The smallest differences are

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[24] This finding is consistent with qualitative analysis in Richardson and Bissette (2014).

[25] t-stat. = 75.52, p-value = 0.0000.

[26] t-stat. = 43.55, p-value = 0.0000.

in the 70+ age group, in which women increased equity allocations by 6.1 percentage points and men by

5.0 percentage points, after target date funds were defaults in all plans joined.[27]

Figure 3 also illustrates a reduction in the variability of equity allocation across participants when

target date funds are the default investment. Again, this effect is greatest for younger participants. For

participants in the 25-30 year age group, the cross-sectional standard deviation in equity allocations falls

by close to half (from 37.5% to 18.8% for women and from 36.4% to 20.5% for men). The plot also

shows the 5% and 95% quantiles. Prior to target date defaults, at least 5% of participants had no equity

exposure in their contributions. Following the adoption of the target date default, the 5% quantile is an

equity allocation of 25% or greater for the youngest participants.

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[27] Women: t-stat. = 14.39, p-value = 0.0000. Men: t-stat. = 4.58, p-value = 0.0000.
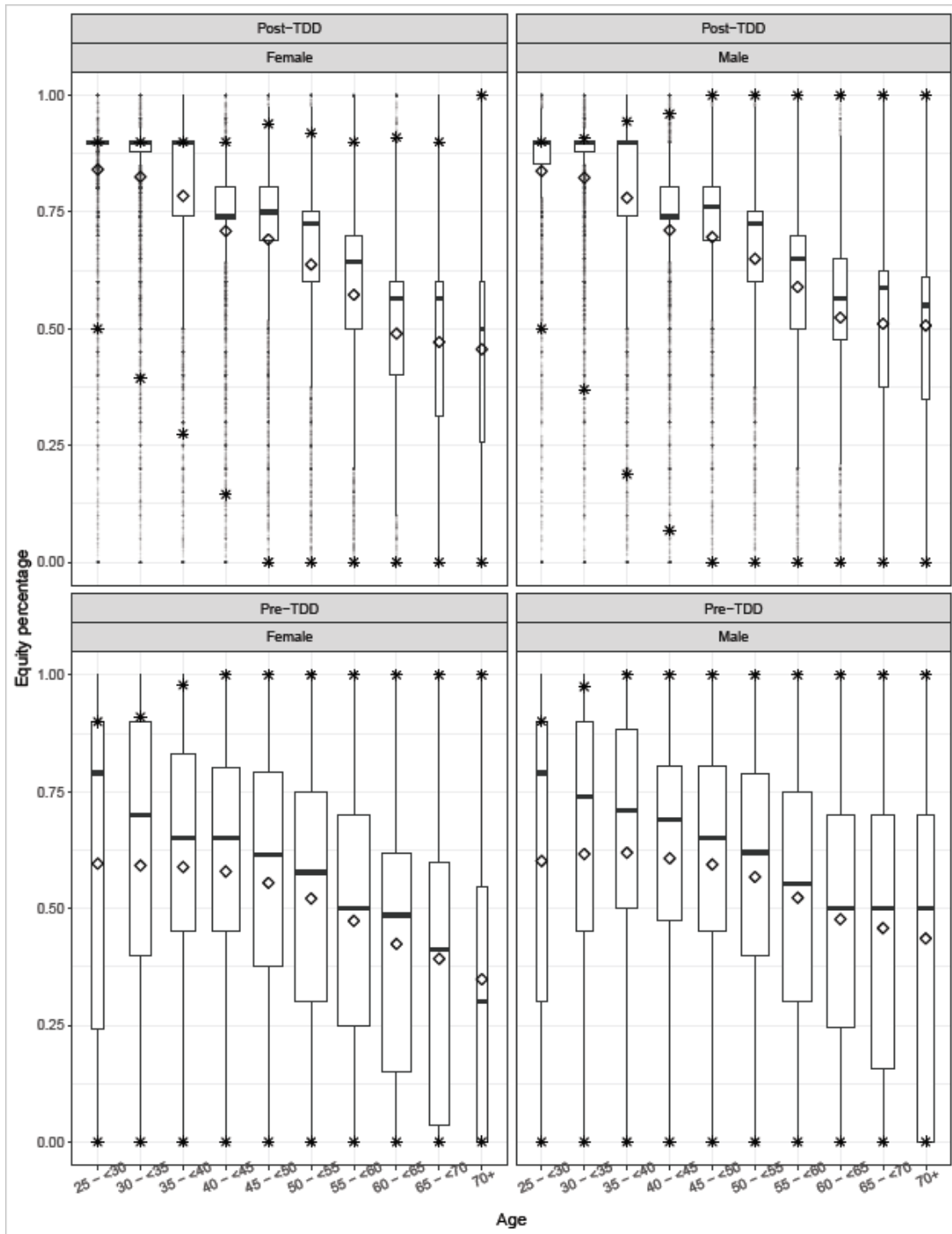
Figure 3: Boxplots of the percentage of equity in contributions, by gender and age, for participants who joined plans in their combination after all had target date defaults (top) and no plans had target date defaults (bottom). The width of each box is proportional to the square root of the number of observations in that group. The white box is the interquartile range, the black bar in the middle is the median, the diamond is the mean, and the stars ("*") denote the 5% and 95% quantiles.

In the middle-aged groups with the largest numbers of participants, the median difference between pre- and post-target date default is less pronounced, but the difference in variability remains. Interestingly, fewer female participants allocate 100% to equity after target date funds are the default.

These findings are consistent with three effects: (1) participants are more likely to choose target date funds if they join plans after target date fund defaults are in place; (2) the presence of target date fund defaults leads to higher average equity allocations; and (3) target date fund defaults reduce individual variability, acting as a single-factor model where "one size fits all" for everyone in an age cohort.

In Table 9, we present regressions examining the effects of the investment menu and defaults on participant equity allocations. We find significant menu effects, especially with respect to target date defaults. As before, we control for a range of demographic, income, wealth, and retirement plan information. We estimate a variant of equation (1) using Powell's (1984) Censored Least Absolute Deviation (CLAD) regression, bootstrapped standard errors with plan-combination level sampling units (the analog of clustering by plan combination). The dependent variable is the percentage of each participant's allocation that is invested in equity. The independent variables of interest are the percentage of funds in the participant's plan menu that are equity funds and the presence of a target date default, which we introduce, as before, by adding interaction terms reflecting whether participants joined after some or all of their plans had target date defaults. To permit ease of interpretation of intercepts and dummy coefficients as reflecting "average" participants, we subtract the overall mean from each independent variable before generating interactions.[28]

In Model 1, we run a baseline for all participants. The Model 1 intercept shows that the average overall participant allocated about 66% of contributions to equity. Model 2 uses baseline variables and interacts them with two dummy variables: D1 = 1 if participants joined plans in their current combination after some, but not all, had target date defaults; D2 =1 if participants joined all plans in their current combination after they had target date defaults. Model 2 shows that the average overall participant would

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[28] For robustness checks, we ran additional (unreported) regressions with plan-level control variables including plan-level averages of contributions, zip code wealth, gender, age and tenure with the TIAA, finding similar results. The CLAD procedure fails to converge using institutional fixed effects.

have allocated 59.48% to equity if they had joined before any plans in their combination had target date defaults. Controlling for other factors, it also shows that a participant who is average in all other respects allocated 6.88 percentage points more to equity if they joined plans in their combination after some, but not all, had target date defaults and 13.09 percentage points more to equity for an average participant who joined all plans in their combination after they had target date defaults.

It is instructive to compare the results in Table 9 with those from Table 4. In Table 4, the median equity allocation is 63.2% for those joining a plan prior to a target date default and 80.4% for those joining after a target date default. The populations in these subsamples are different, however. In particular, those joining plans after target date defaults are, on average, 10 years younger than those joining before target date defaults (41.57 vs. 52.05 years of age, respectively). Table 9 tells us that, controlling for age and other differences, the effect of switching to a target date default for a participant who is average with respect to all characteristics results in an equity allocation increase of 13.09%. This is less than the difference in Table 4 but still economically and statistically significant. We can reconcile the discrepancies by considering other variables. For example, from Table 8, the net effect of age on equity percentage with a target date default is -0.77. With a 10-year difference in age between the two groups, the net difference is about 20%, greater than the difference in Table 4.

Table 9 also shows significant plan investment menu effects before target date funds become defaults. Offering more equity funds significantly increased equity allocations for participants overall and for those who joined the plans before adoption of a target date fund default. This effect is significantly mitigated for participants who joined after adoption of target date fund defaults. However, offering the target date fund default has its own effect: significantly increasing equity allocations.

Target date fund defaults mitigate several demographic effects that are evident before target date fund defaults. Participants who made larger contributions and those who lived in greater average wealth neighborhoods tended to invest more in equity if they joined plans before the target date fund defaults, but not after. Women, older participants, and those with fewer years of tenure in the TIAA system allocate

less to equity if they joined before target date fund defaults. However, these effects are mitigated or

reversed for participants who joined after target date fund defaults.

Table 9: Determinants of the Equity Allocations of Participants

The independent variable, % Equity, is the percentage of current-year dollar contributions by a participant that are allocated to equity, where equity funds are classified as 100% equity, balanced funds are classified as 1/2 equity and target date funds are classified according to the weighted average of classifications of funds held by the target date fund. % Equity Offered is the number of equity funds divided by the number of funds offered by the participant's plan combination. (Balanced and target date funds are counted fractionally as above.) Other variables are as defined in Table 4. Model 1 only uses the baseline variables. Model 2 has two dummy interactions. The first equals 1 when the participant joined plans in the current combination after some, but not all, had target date defaults. The second equals 1 when the participant joined plans in the current combination after all had target date defaults. Independent variables are demeaned by subtracting their overall average from each observation before interactions. Estimates are obtained through censored median regression (Powell 1984) to account for the constraint that %EQ falls within [0,100%]. Bootstrapped standard errors are sampled by plan combination sampling units to adjust for both heteroscedasticity and differences between variances within plans. ** indicates that the coefficient is different from 0 at the 5% significance level under the empirical bootstrapped confidence intervals.

Variable	Model 1: Baseline using all participants	Model 2: Baseline variables and interactions. D1 = 1 if participant joined plans in the current combination after some, but not all, had target date default options. D2 =1 if the participant joined plans in the current combination after all had target date default options.		
		Baseline Coefficients	Interactions with D1	Interactions with D2
Intercept and Dummy Coefficients	66.29** (0.57)	59.48** (1.07)	6.28** (1.44)	13.09** (1.16)
% Equity Offered	0.32** (0.10)	0.38** (0.13)	-0.38** (0.17)	-0.33** (0.15)
NCHOICE	0.12** (0.04)	0.13 (0.06)	-0.07 (0.07)	-0.06 (0.06)
CONTRIBUTION	0.02 (0.02)	0.09** (0.03)	-0.07 (0.04)	-0.09** (0.04)
LN(ZWEALTH)	0.37** (0.06)	0.99** (0.12)	-0.31 (0.18)	-0.98** (0.13)
FEMALE	3.41** (0.56)	-7.10** (2.06)	4.77 (3.16)	7.14** (2.18)
AGE	-0.88** (0.02)	-0.97** (0.07)	-0.10 (0.08)	0.20** (0.08)
FEMALE x AGE	-0.13** (0.01)	0.05 (0.04)	-0.06 (0.06)	-0.06 (0.04)
TIAAYRS	-0.22** (0.04)	0.24** (0.08)	-0.15** (0.09)	-0.38** (0.09)
MATCHRATE	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
NPARTICIPANTS	-0.00 (0.00)	-0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
N	592,765	592,765		
Initial Sampling Units	2,220	2,219		
Pseudo R2	13.11%	16.01%		

The overall pattern of equity exposure is consistent with Figure 3. The intercepts show that participants who joined after the introduction of target date fund defaults tend to have higher equity exposure. The coefficients on the baseline gender variables show that women who joined before target date fund defaults held, on average, lower equity exposures than men. However, the gender interaction coefficients indicate that men and women who joined after the introduction of target date fund defaults had similar equity exposures. The coefficients on the baseline age variables show that participant equity exposure declines with age. But, the age interaction coefficient indicates that the age-related reduction in equity is slower for participants who joined after target date defaults. Overall, this leads to higher equity exposures for participants who joined after target date defaults, regardless of age.

The results are consistent with the adoption of target date fund defaults mitigating many investment menu effects but creating a new and significant menu effect: investing in the target date fund alone. This (1) significantly increases average equity allocations for participants, (2) reduces equity allocations more slowly with age, and (3) gets participants of similar age to allocate contributions to equity in similar proportions regardless of individual circumstances.

IV. Conclusions

Current retirement investment menus generally provide substantially more choice to participants than in the past, with many plans offering multiple funds across various asset classes. Almost all plans also offer target date funds, an auto-diversified investment solution that allocates contributions across a pre-determined mix of underlying mutual funds, with the allocation to equity funds shrinking as a participant ages. Using a cross section of more than 600,000 TIAA participants working at one of 98 large employers, we analyzed the effect of investment menu design on participant contribution allocations and equity exposure. Participants choose contribution allocations in one or more plans in which they participate (i.e., a "plan combination," for example a primary and supplemental plan). We study three distinct groups of participants: (1) participants who joined plans in their current combination before any of the plans had target date fund defaults, (2) those who joined after some, but not all, combination plans

had target date fund defaults, and (3) those who joined after all combination plans had target date fund defaults. Participants in the first group allocate contributions to larger numbers of funds, are less likely to use target date funds when they become available, and hold significantly less equity than participants in the third group. Their allocations also appear more varied and prone to plan investment menu effects (e.g., more funds offered lead to more funds chosen and more equity exposure leads to higher equity allocations). These effects are mitigated for participants who join after target date defaults. However, target date fund defaults have their own effects. Participants who join after target date defaults are significantly more likely to invest only in a single target date fund. As a result, target date only participants tend to hold substantially more types of mutual funds because target date funds are comprised of dozens of underlying mutual funds. And given a typical target date glide path, they allocate significantly more to equity (especially women), and show less variability in their equity allocations. While all older participants decrease equity exposure, those who joined after target date fund defaults allocate more to equity than their pre-default peers, regardless of age.

While we document the impact of target date funds, the welfare effects are unclear. Target date funds offer a simple solution, but they typically only use a single factor, age, in setting the equity allocation. They do not account for in differences in income, wealth, risk aversion, and life expectancy. In particular, the higher equity exposure associated with target date fund defaults leads to higher expected returns, but also to greater portfolio volatility.

It is important to note that this is more than a simple default effect driven by participants who do not make an active choice. We do not observe an analogous default effect associated with money market fund defaults. For participants who join when money market funds are defaults, most make an active contribution allocation choice and there is considerable cross-sectional variance in equity allocation. This shows up clearly in Figure 3 when one realizes that money market funds were the default in the overwhelming number of cases for participants who joined before target date defaults. This is further documented in the appendix, which contains a similar figure with only participants in plans where we can confirm that the pre-target date default fund was indeed a money market fund. Thus, our effects are not

driven by a default effect alone, but a combination of the default and apparent participant preferences for the default.

Nevertheless, because participants could have made similar investments before and after target date defaults, the significant menu effects we document suggest behavioral explanations. We plan a future study with more details specifically to try to shed light on behavioral effects.

Finally, an important policy issue we do not address is the optimality of the allocation policy in target date funds, i.e., the decline in equity percentage over time. A rigorous analysis of investment policy in the retirement portfolio must consider both assets held outside the retirement portfolio as well as the effects of future labor income and the correlation with asset returns. We do not study this issue, but two recent papers bear on this issue. Guvenen, et al. (2017) study the risk of earnings in different professions and find that health and educational institutions have GDP betas closest to zero of the industries they examine. This suggests that a declining percentage of equity over time is likely to be most appropriate for the industry we study. Dahlquist, Setty and Vestman (2017) point out a different consideration, which is that low market returns reduce the value of savings, increasing the relative value of future labor income. An increased equity percentage optimal in the fund following a market decline might therefore be optimal.

Appendix

We have seen that: 1) participants with a target date default largely accept the default and 2) participants with a money market default do not accept the money market default. Target date funds were almost never available when money market funds were the default, but money market funds continued to be available after target date funds became the default. Figure 4 examines money market fund holdings for those who joined when the target date fund was a default. Allocation to the money market fund is predominantly zero across the board, with mean allocations under 10% and only a few individuals allocating substantial amounts.
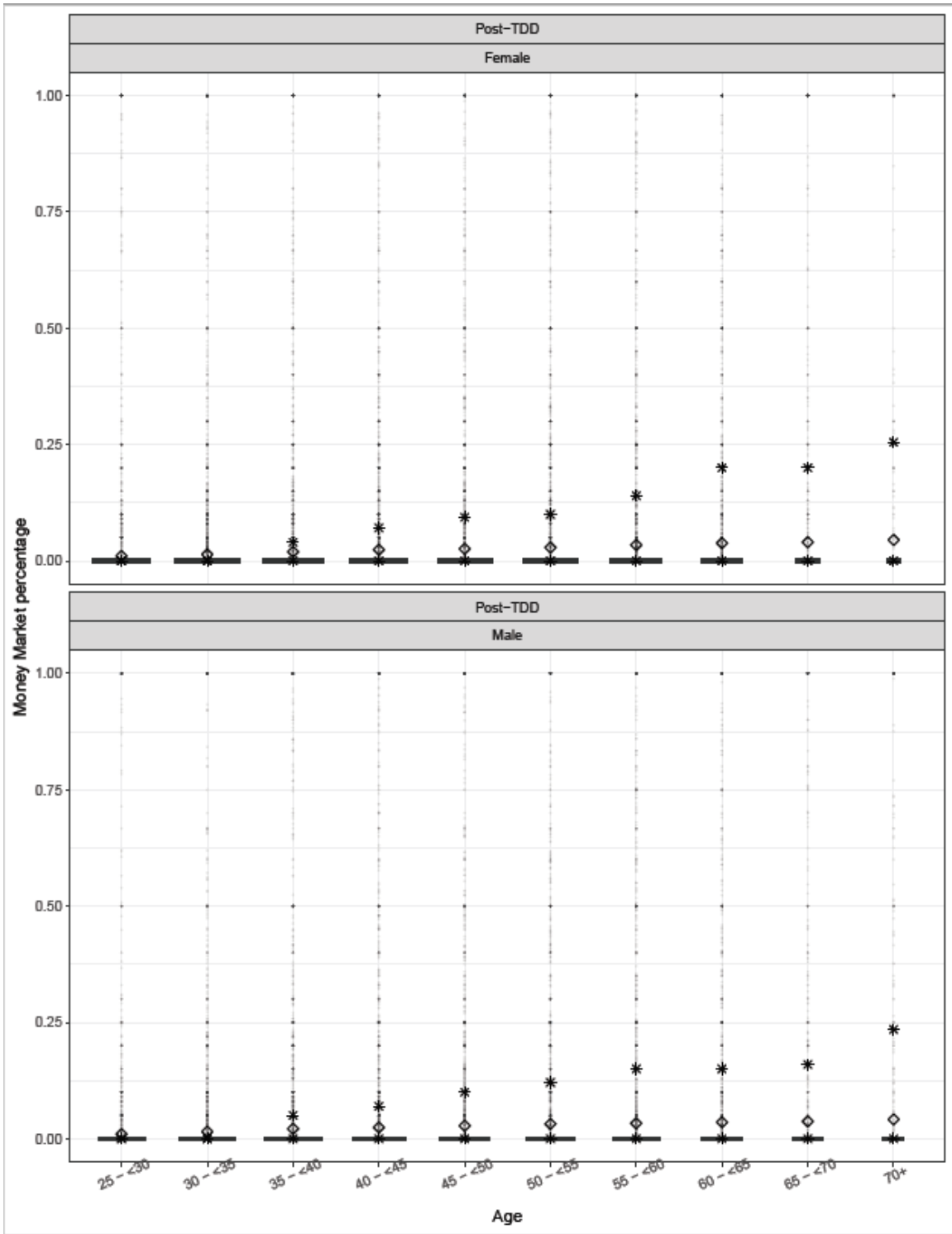
Figure 4 Boxplots of the percentage allocated to the money market fund for those for whom the target date fund is available as a default. The horizontal bar in each plot is the median. The interquartile range is never visible in these plots, meaning that at least 75% of participants in every age category hold none of the money market fund. In every case, at ages less than 65 and for both genders, the median holding of the money market fund is zero and the 95% quantile is 20% or less.

Figure 5 shows equity percentages for those in plans with a target date default (top) vs. a money market fund default (bottom). This is a robustness test for Figure 3, which compared participants who joined under a target date default vs. those who joined before a target date default. Because the vast majority of plans had money market defaults before they had target date defaults, Figure 5 and Figure 3 are quite similar.
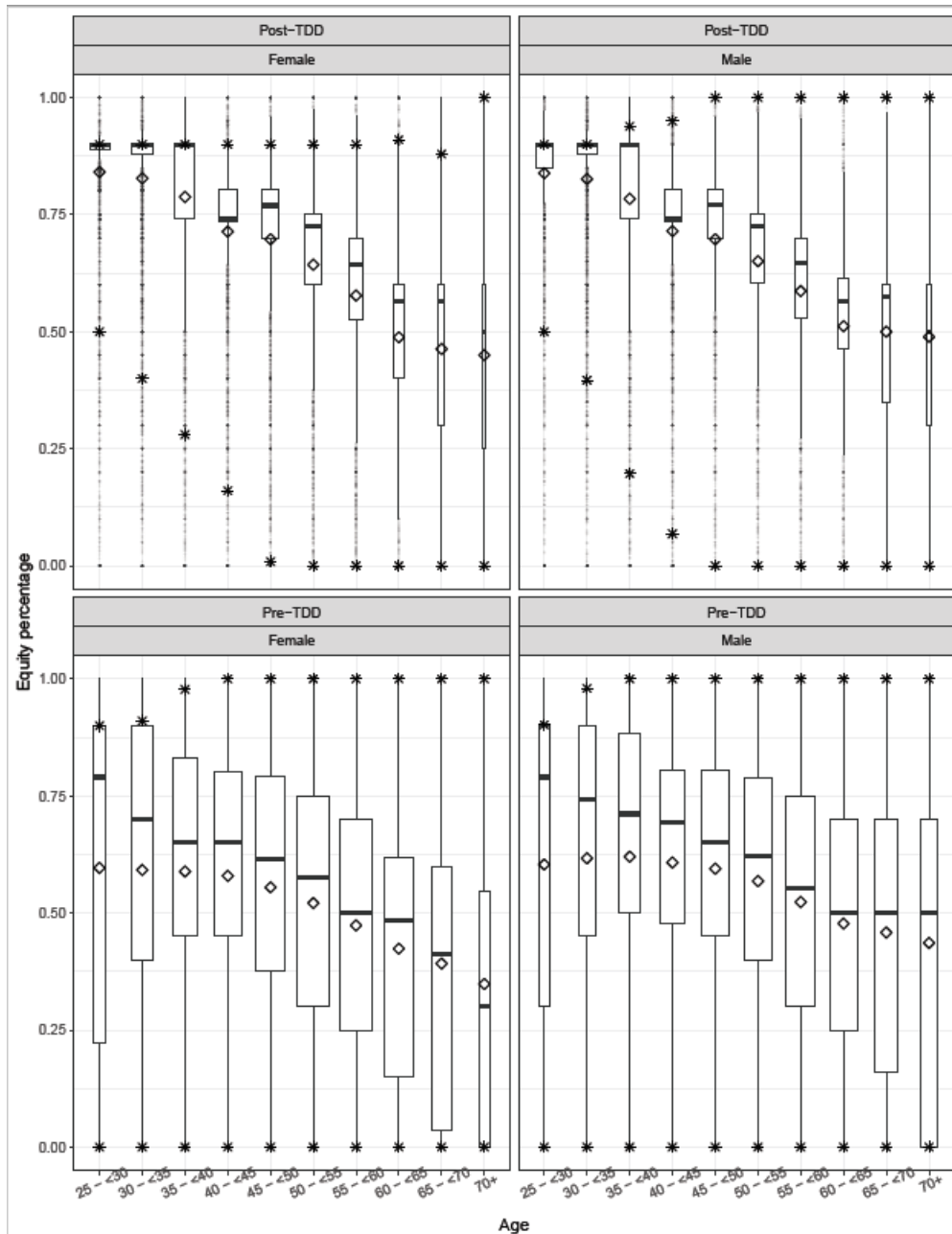
Figure 5: Boxplots of the percentage of equity in contributions, by gender and age, for participants who joined plan in their combination after all had target date defaults (top) and in plans with money market defaults (bottom). The width of each box is proportional to the square root of the number of observations in that group. The white box is the interquartile range, the black bar in the middle is the median, the diamond is the mean, and the stars ("*") denote the 5% and 95% quantiles.
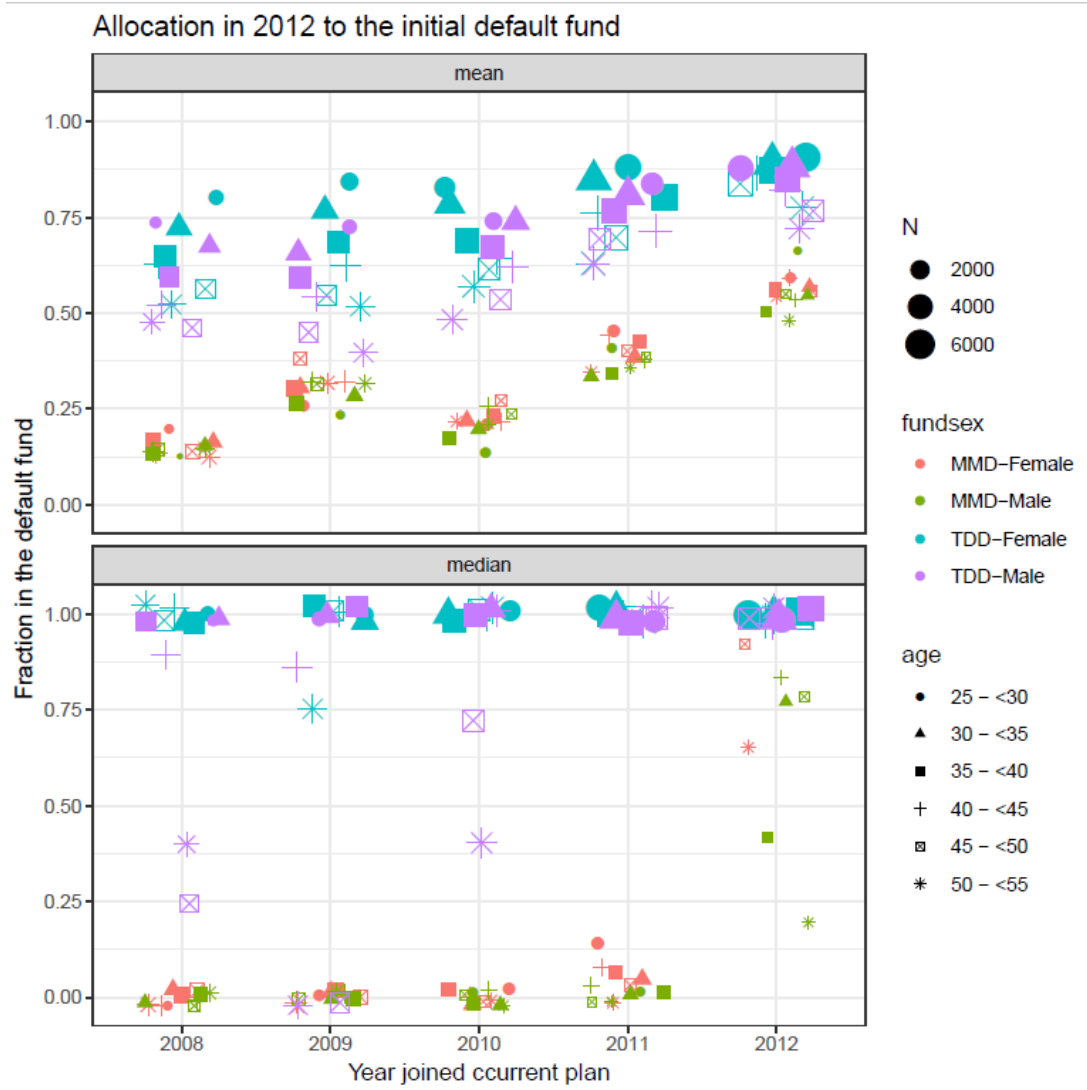
Figure 6: Mean and median allocations in 2012 to the fund that was the default when the participant joined the plan for ages less than 56. Points are jittered for clarity. For all years, mean allocations to the target date default exceed those for the money market default. For years after 2007 and before 2012, median allocations to the target date fund for target date defaulters were 100%, and to the money market fund for money market defaulters were mostly 0. The data represented here include both primary and secondary plans, so some individual participants are represented twice.

Figure 6 shows summary statistics for allocations in 2012 to the fund that was the default in the year the participant joined the plan, as a function of the year the participant joined. Three broad characteristics of the figure are salient. First, in almost every year and for every age group, the allocations to the target date fund by target date defaulters strictly exceed the allocations to the money market fund for money market fund defaulters. For most years, median allocations to the target date fund are 100% and median

allocations to the money market fund are zero. Second, for both, there is a general trend with mean

allocations to the default fund declining with time elapsed since joining the fund. Third, male and female

allocations are not identical but are generally similar.

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