How Do Plan Demographic Characteristics Matter in the Retirement Income Security of 401(k) Plan Participants?

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Abstract

This paper examines the effects of plan demographic characteristics on participants' retirement income security through a multi-level empirical analysis and a simulation analysis. Using a large sample of 401(k) plans, the paper finds that plan demographics not only affect participant contribution rates but also interact with individual characteristics on participant contribution rates. Assuming that a 401(k) plan sponsor uses target-date funds (TDFs) as a default investment option, simulations show that participants' retirement income security can be significantly varied by the plan sponsor's TDF choices and that the variation differs across plans that have different plan demographics. However, the variation due to different TDF choices can be significantly reduced by a tailored automatic contribution arrangement that reflects plan demographics. The findings provide an implication for plan sponsors that are concerned about fiduciary responsibility while auto-enrolling participants in TDFs.

Keywords: Automatic contribution arrangement, plan demographics, target-date funds

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1. Introduction

Target-date funds (TDFs) have gained popularity as a default investment option in company-sponsored defined contribution plans (such as 401(k) plans) in the United States since the Pension Protection Act of 2006 (PPA).[1] At the same time, TDFs have been offered in the marketplace with an extensive array of equity glide paths (Balduzzi and Reuter, 2012).[2] The PPA requires a plan sponsor as a fiduciary acting solely in the best interest of plan participants (i.e., retirement income security) to prudently select and monitor the default investment option.[3] Those fiduciary duties, however, may be challenging to some plan sponsors—especially those that have limited resources in conducting a thorough selection process and ongoing monitoring activities or that expect substantial conversion costs when switching TDF families (GAO, 2011).[4] In order to improve participants' retirement income security, which is determined by not only investment returns but also contribution rates, these plan sponsors may instead want to use an automatic contribution arrangement, which can effectively increase participant contribution rates (Thaler and Benartzi, 2004; VanDerhei and Lucas, 2010).

Increasing participant contribution rates with an automatic contribution arrangement, however, does not seem simple. For an automatic contribution arrangement, plan sponsors are likely to adopt a qualified automatic contribution arrangement (QACA) because it provides a

[1] In the paper, a 401(k) plan sponsor refers to a company that sponsors 401(k) plans. A company sponsors a single or multiple 401(k) plans.
[2] TDFs have a common feature called "equity glide path," which indicates a pre-determined declining equity allocation as an investor approaches his/her retirement date. A fund family provides a bundle of TDFs based on its own equity glide path.
[3] For plan sponsors that select TDFs as a default investment option, the PPA provisions provide fiduciary responsibility relief for the plan sponsors. The provisions, however, do not relieve fiduciary obligations completely. For this matter, the PPA makes clear that "nothing in this [regulation] shall relieve a fiduciary from his or her duties under … ERISA to prudently select and monitor any qualified default investment alternative under the plan or from any liability that results from a failure to satisfy these duties, including liability for any resulting losses" (Code of Federal Regulations [CFR] Title 29 Part 2250.404c-5(b)(2)). Thus, the plan sponsors still have fiduciary duties for selecting and monitoring the default investment option.
[4] When a plan sponsor switches TDF families, substantial conversion costs may occur because most TDF families also play the role of a record-keeper. The conversion costs may include costs that arise from changes in computer systems, record-keeping, and payroll processes and from converting account balances (GAO, 2011).

safe harbor that allows plan sponsors to avoid required annual tests.[5] A QACA must include a schedule of default contribution percentages that start at a minimum of 3% of a participant's compensation and gradually increase by 1% each year to a maximum of 6 to 10%.[6] With a QACA, thus, plan sponsors can enhance participants' retirement income security by raising a maximum contribution rate (allowable up to 10%). However, it may not be easy to find out the maximum contribution rate that can effectively increase participants' retirement income security. For instance, if the maximum rate is too high relative to the current participant contribution rates, it would lower the participants' retirement income security by increasing opt-outs of those who have liquidity constraints (in particular, those with low income) (Thaler and Benartzi, 2004; VanDerhei, 2007). On the contrary, if the maximum rate is too low relative to the current participant contribution rates, it would lower the participants' retirement income security by anchoring participants' contribution rates at the lower rate (Madrian and Shea, 2001; Choi, Laibson, Madrian, and Metrick, 2004). Therefore, in order to improve participants' retirement income security with a QACA, it is crucial to identify the factors that plan sponsors should consider in determining a maximum level of employee contribution rates. This issue has not yet been examined in the literature.

Drawing on contextual effects addressed in the literature on social interactions (e.g., Manski, 1993, 2000), this paper examines whether plan demographics (i.e., plan-level demographic characteristics) affect participants' contribution rates and, thus, the effectiveness of

[5] When a plan meets QACA requirements (e.g., automatic employee contributions, employer matching contribution, uniformity, and notice requirements), the plan is deemed to satisfy annual actual deferral percentage (ADP) and actual contribution percentage (ACP) nondiscrimination testing requirements and is also exempt from top-heavy rules under Internal Revenue Code Section 416(g)(4)(H).

[6] In addition to automatic employee contributions, a QACA requires a plan sponsor to provide employer matching contributions. Under a QACA, an employer must match 100% of the first 1% of employee contributions and 50% of the next 5% of employee contributions, up to 6% of compensation, or provide employer non-elective contributions equal to at least 3% of compensation (CFR Title 26 Part 1.401(k)-3).

a QACA in increasing participants' retirement income security.[7] First, a large sample of 401(k) plans that this study uses makes it possible to define plan demographic characteristics. In this study, plans are characterized with plan-level salary and/or tenure: for example, low-, middle-, or high-income plans; short-, mid-, or long-tenure plans; a combination of the income and tenure plan characteristics. With a complete sample, this study finds that plan demographics have a significant effect on participants' contribution rates. For example, participants' contribution rates (as a percentage of salary) can differ by 1.53–3.02 percentage points for each age between 25 and 64, depending on what plan demographics they are exposed to. Second, from the simulations by plan demographic groups, the study finds that participants' retirement income security can be significantly varied by a plan sponsor's TDF choices and that the variation differs across plans that have different plan demographics. For example, the retirement income security of participants in low-income and short-tenure plans is more sensitive to a plan sponsor's TDF choices than that of those in other plan demographic groups. However, the variation due to different TDF choices of a plan sponsor, which may relate to its potential fiduciary risk, can be significantly reduced by a tailored QACA that reflects plan demographics. The findings provide an implication for plan sponsors that are concerned about fiduciary responsibility while auto-enrolling participants in TDFs.

This paper contributes to the literature in two ways. First, it extends previous research on defined contribution (DC) plan participants' saving behavior, by finding that plan demographics have a significant effect on participant contribution rates. This finding not only serves as

[7] In the literature, contextual interaction effects are distinguished from endogenous interaction effects (Manski, 1993, 2000). Contextual interaction effects indicate that individual decisions are affected by certain exogenous social contexts the individual is exposed to, whereas endogenous interaction effects indicate that individual decisions are affected by knowledge of peers' decisions. Because it seems unlikely that a participant directly observes the contribution rates of his/her coworkers in the same plan, the co-workers' influence on participant contribution rates is likely to occur in a form of contextual interaction effects.

evidence for contextual effects on retirement savings, but also gives plan sponsors an insight into designing an effective QACA for participants' retirement income security. Second, it sheds light on participant- and plan-level constraints on TDF choices for improving the retirement income security of DC plan participants. In a DC plan, participants are usually restricted to choose the TDFs provided by a fund family that a plan sponsor selects. A plan sponsor may also have constraints in choosing a TDF family because of its limited resources in a fund selection process or substantial conversion costs when switching fund families. This paper, taking into account both the participant- and the plan-level constraints, is distinct from most prior ones that examined TDFs from the perspective of individual investors who intend to minimize the risk of a shortfall in their retirement income without considering those restrictions (e.g., Bodie and Treussard, 2007; Gomes, Kotliko, and Viceira, 2008; Basu, Byrne, and Drew, 2011).

The remainder of the paper is organized as follows. Section 2 develops hypotheses on the effects of plan demographics on participant contribution rates, drawing on the literature on social interactions. Section 3 describes the data and sample and presents empirical research methodology and results. Section 4 presents simulation assumptions and results by plan demographics. The last section concludes with limitations and suggestions for future research.

2. Plan Demographics and Participant Contribution Behavior

When individuals make economic decisions, their decisions are affected by peer decisions or outcomes through social interactions (e.g., Manski, 2000).[8] In particular, when employees are in the same retirement plan provided by the same organization, their decisions may be influenced by decisions or outcomes of co-workers in the same plan. For decisions on

[8] For social interactions, Manski (2000) distinguishes preference and expectations interactions: preference interactions occur when a person's preference is affected by following the actions chosen by others (i.e., by "keeping up with the Joneses"), while expectations interactions occur when a person forms expectations of the outcomes that would follow from different actions (i.e., by "observational learning").

contribution rates, however, it seems unlikely that employees directly observe the contribution rates of their co-workers or find out the outcomes of the contribution rates such as retirement income security. Thus, the co-workers' influence on participant contribution rates is likely to occur in a form of contextual interaction effects (Manski, 1993, 2000). In other words, a participant's decision on contribution rate is likely to be influenced by certain exogenous social contexts that the individual is exposed to.

As exogenous social contexts affecting participants' contribution rates, this paper uses plan demographics (i.e., plan-level demographic characteristics) defined by the salary and/or tenure composition of a plan, drawing on the supposition from prior studies. For example, while Duflo and Saez (2002) examine endogenous peer effects on retirement plan participation, they indicate that the salary or tenure composition of a group can be related to contextual effects. Similarly, to control for potential peer effects on individual participation and contribution decisions in a retirement plan, Huberman, Iyengar, and Jiang (2007) use plan-level aggregate variables, such as average compensation and average tenure.

Plan demographics defined by the salary and/or tenure composition of a plan arguably influence the plan participants' contribution decisions. First, the salary composition of a plan may affect participants' contribution rates. Similar to individual decisions on retirement plan participation (Duflo andSaez, 2002), health insurance plans (Sorensen, 2006), and portfolio choice (Lu, 2011), individuals' contribution decisions may be influenced by the information and knowledge acquired through social interactions with co-workers. For example, compared with those with high income, those with low income would be less likely to share the information and knowledge about retirement savings with their co-workers because they are less likely to be financially literate and to desire to save for retirement (e.g., Hilgert, Hogarth, and Beverly, 2003;

Lusardi and Mitchell, 2007, 2011). Accordingly, when a participant is in a plan that has a large proportion of low-income employees, the participant would be less likely to increase his/her contribution rate through social interactions with his/her co-workers than when the participant would be in a plan that has a large proportion of high-income employees. In this way, plan-level income may positively affect participants' contribution rates.

Second, the tenure composition of a plan may affect participants' contribution rates. While observing co-workers' tenure, a participant may form expectations on his/her tenure and, thus, create a planning horizon for retirement savings. For instance, when a participant is in a plan that has a large proportion of short-tenure employees, he/she would be likely to expect a short tenure by observing his/her co-workers' tenure. A short expected tenure may increase his/her retirement planning costs; planning for the long-term usually requires substantial up-front investments of time and effort (Lusardi, 2003), and the individual has to reflect on the high probability of job changes, which makes the retirement planning more complicated. Facing the sizable planning costs, he/she is likely to have a short planning horizon (Caliendo and Aadland, 2007), which is likely to result in a lower savings rate (e.g., Ameriks, Caplin, and Leahy, 2003; Munnell, Sundén, and Taylor, 2003; Reis, 2006). Thus, when a participant is in a plan that has a large proportion of short-tenure employees, the participant would be less likely to increase his/her contribution rate because of his/her short expected tenure than when the participant would be in a plan that has a large proportion of long-tenure employees. In this manner, plan-level tenure may positively affect participants' contribution rates.

Third, when plan demographics are defined by the salary and tenure composition of a plan, the plan demographics effects on participants' contribution rates may be stronger than when plan demographics are defined by either the salary or tenure composition. For example, when a participant is in a plan that has a large proportion of low-income and short-tenure employees, the participant would be likely to have a lower contribution rate than when the participant is in a plan that has a large proportion of either low-income or short-tenure employees. The stronger plan demographics effects on participants' contribution rates can be inferred by adding two positive associations, discussed above, of (1) plan-level income and participant contribution rates and (2) plan-level tenure and participant contribution rates.

Fourth, plan demographics may interact with individual demographic characteristics on participants' contribution rates. Prior studies on the savings behavior of 401(k) plan participants document that participant contribution rates are positively associated with age, income, and tenure (e.g., Holden and VanDerhei, 2001; Madrian and Shea, 2001; Huberman et al., 2007). The effects of these individual demographic characteristics on participant contribution rates may be influenced by plan demographics. For example, when a participant is in a plan that has a large proportion of low-income and short-tenure employees, the positive effects of age, income, and tenure on his/her contribution rates would likely be attenuated by the plan's demographic characteristics, which can discourage sharing information and knowledge about retirement savings and lower his/her expected tenure with the current employer. In contrast, when a participant is in a plan that has a large proportion of high-income and long-tenure employees, the positive effects of the individual demographics on his/her contribution rates would likely be enhanced by the demographic characteristics of his/her co-workers, which can encourage his/her retirement savings.

3. The Effects of Plan Demographics on Participants' Contribution Rates: Sample, Methods, and Results

Sample and Descriptive Statistics

To determine a plan's demographic characteristics, a sample is constructed from one of the largest 401(k) databases at year-end 2007. A sample includes participants who are between age 20 and 75, have 1 to 40 years of tenure, and have a salary of between $2,500 and $500,000 in 2007.[9] The sample consists of 1,497,014 participants in 958 plans. Panel A of Table 1 presents the tertiles of salary and tenure of the sample. Plan demographics are determined by comparing a plan's median salary (tenure) and the tertiles of salary (tenure) (Panel A of Table 1). First, plans are categorized into three income groups: low-, middle-, and high-income, depending on whether a plan's median salary is less than or equal to $35,200 (low-income), between $35,201 and $63,600 (middle-income), or greater than $63,600 (high-income). Second, plans are also categorized into three tenure groups: short-, mid-, and long-tenure, depending on whether a plan's median tenure is shorter than or equal to 5.1 years (short-tenure), between 5.2 and 12.4 years (mid-tenure), or longer than 12.4 years (long-tenure). Finally, plans are further categorized into nine plan groups (Groups 1–9) by combining the three income and the three tenure groups.

[Table 1 here]

To examine the effects of plan demographics on participants' contribution rates, a subset of the sample is used because the sample does not include all the information necessary for the examination. At plan level, the subset includes only plans that have at least 25 participants and in which at least 75% of the participants contribute to their 401(k) accounts. At participant level, the subset includes participants who have a salary between $25,000 and $100,000. The lower bound of $25,000 is to control for part-time employees, while the upper bound of $100,000 is to control for highly compensated employees (HCEs).[10] In addition, the participants should have a

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[9] In the paper, all dollar amounts are in 2007 dollars, and tenure indicates the length of time with the current employer as of December 31, 2007.
[10] According to the Current Population Survey 2008 Annual Social and Economic Supplement, 85.3 percent of workers who earned less than $25,000 a year were part-time ones in 2007. Highly compensated employees (HCEs)

contribution rate greater than zero but less than or equal to 25% of salary, the upper limit which controls for outliers in the distribution of participant contribution rates. As a result, a complete sample consists of 373,163 participants in 612 plans, each of which has at least 10 observations.

Panel B of Table 1 presents descriptive statistics of the complete sample. Participants in low-income or short-tenure plans have lower contribution rates than those in other plans. For example, the average contribution rate of participants in low-income plans is 4.7% of salary, which is 1.6 percentage points (2.7 percentage points) lower than that of middle-income (high-income) plans. The average contribution rate of participants in short-tenure plans is 5.1% of salary, which is 1.0 percentage points (2.5 percentage points) lower than that of mid-tenure (long-tenure) plans. When plans are further categorized into the nine income-tenure groups, the differences in the average contribution rates become larger across the plan groups: for example, the average contribution rate of participants in low-income and short-tenure plans is 3.3% of salary, which is 2.9 percentage points (4.9 percentage points) lower than that of middle-income and mid-tenure (high-income and long-tenure) plans.

Model Specification

This section tests the hypotheses on plan demographics effects developed in the previous section. For the tests, this paper uses a hierarchical linear model (HLM), which is widely employed to analyze the data having a multi-level or hierarchical structure.[11] The data in the sample have a hierarchical structure: individuals ("level-1") are nested within plans ("level-2"). The study also attempts to analyze cross-level interaction effects of individual characteristics (level-1 variables) and plan demographics (level-2 variables) on participants' contribution rates. Thus, given the use of the hierarchical data and the interest in the cross-level interaction effects,

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in 2007 and 2008 were defined as those who earned greater than $100,000 in 2006 and 2007, respectively (Internal Revenue Service News Release IR-2005-120 (October 14, 2005) and IR-2006-162 (October 18, 2006)).

[11] See Hofmann (1997) for a detailed review on hierarchical linear models.

an HLM is preferred over other linear models with cluster effects, such as fixed-effect or random-effect models.[12]

The main model takes on the following form:

Individual level (level-1): $y_{ij} = \beta_{0j} + \beta'_{1j}X_{ij} + \varepsilon_{ij}$, (1)

Plan level (level-2): $\beta_{0j} = \gamma_{00} + \gamma'_{01}Z_j + \gamma'_{02}P_j + u_{0j}$, (2)

$$\beta_{1j} = \gamma_{10} + \gamma'_{11}Z_j + u_{1j} \quad (3)$$

where the indices *i* and *j* refer to individuals and plans, respectively.[13] The dependent variable (y_{ij}) is participant *i*'s contribution rate as a percentage of salary in plan *j*.

The level-1 model (at individual level) includes participant characteristics variables (X_{ij}) and an individual-level disturbance term (ε_{ij}).[14] The regression parameters β_{0j} and β_{1j} at individual level are not fixed but varied across plans.[15] The variation of the β-parameters is assumed to be affected by plan-level variables and disturbances (equations (2) and (3)). Individual participant characteristics (X_{ij}) include age (*Age*), length of tenure with the current employer (*Tenure*), annual compensation in \$1,000 (*Salary*), and loan balance in \$1,000 (*Loan balance*).[16] First, participants are likely to increase their contribution rates as they get older and approach their retirement years. Younger workers tend to consider retirement a vague and far-off

[12] This paper attempts to examine the effects of plan demographics, which are plan-level variables, on participants' contribution rates. With a fixed-effect regression, however, the effects cannot be estimated because plan-level variables are all cancelled out by the *within transformation* (also called fixed effects transformation) (Wooldridge, 2002). In addition, the paper attempts to examine whether the effects of individual characteristics on participants' contribution rates vary across plans. A random-effect regression allows only random intercepts at individual level, which are not able to capture varying *slopes* across plans. Thus, a random-effect regression is not appropriate, either.

[13] All the regressors, except for the binary variables, are grand-mean centered because grand-mean centering can reduce potential level-2 estimation problems due to multicollinearity (e.g., Cronbach, 1987; Hofmann and Gavin, 1998). In addition, because grand-mean centering and raw metric models provide the same expectations and dispersions for the dependent variable (Kreft, De Leeuw, and Aiken, 1995), grand-mean centering does not affect any multilevel association with the dependent variable and the regressors (e.g., Enders and Tofighi, 2007).

[14] The disturbance of ε_{ij} could be heteroskedastic across individuals, but (1) ε_{ij} and u_{0j} and (2) ε_{ij} and u_{1j} are assumed to be independent. Also, the disturbances of ε_{ij}, u_{0j}, and u_{1j} are assumed to be independent of the regressors.

[15] A general multilevel model assumes that the level-1 intercepts (β_{0j}) and slopes (β_{1j}) are varied across the level-2 groups (Hofmann, 1997).

[16] The model does not include gender because the 401(k) data that the study uses do not have gender information available.

event and think about it abstractly, while older ones tend to consider it a prominent concern and think about it with the specific steps needed to achieve a particular outcome (Montgomery, Szykman, and Agnew, 2012). Thus, age is expected to be positively related to participants' contribution rates. Second, as participants stay longer in a job, they are likely to increase their contribution rates because they become more knowledgeable about their retirement plans (e.g., Madrian and Shea 2001). Participants' contribution rates, however, tend to fall when they have long tenure with the current employer (Holden and VanDerhei, 2001).[17] To reflect this potential non-linear tenure effect on participants' contribution rate, the model includes tenure and its squared term. Third, participants are likely to increase their contribution rates as their salary grows. Participant contributions to 401(k) plans are generally on a pre-tax basis and, thus, participants with higher salary who are usually in a higher tax bracket have a greater incentive to contribute more to their accounts (Toder, Harris, and Lim, 2009). Last, participants may reduce their contribution rates when they have a 401(k) plan loan. Repayment of a loan may displace existing contributions because loan repayments are made with after-tax dollars, and the outstanding balance at the time of default is subject to the 10% early withdrawal penalty for participants under the age of 59½ (Beshears, Choi, Laibson, and Madrian, 2008). Thus, the model includes loan balance to reflect this potential crowd-out effect.

The level-2 models (at plan level) include plan demographics (Z_j), which are primary explanatory variables. Plan demographic characteristics are determined by comparing a plan's median salary and tenure with the tertiles of the salary and tenure distributions, respectively. Plans are first characterized as low-, middle-, and high-income based on their median salary. To

[17] Holden and VanDerhei (2001) reported an inverted-U shape relationship between tenure and contribution rates when age and salary are controlled for, using participant-level data from the 1999 Employee Benefit Research Institute/Investment Company Institute 401(k) database. They found that participants' contribution rates start to decrease when participants have about 18 years of tenure with the current employer.

indicate the three income plan groups, two binary variables (*Low-income* and *High-income*) are used with a reference group of *Middle-income*. Second, plans are characterized as short-, mid-, and long-tenure based on their median tenure. To indicate the three tenure plan groups, two binary variables (*Short-tenure* and *Long-tenure*) are used with a reference group of *Mid-tenure*. Last, plans in each income group are further characterized with their median tenure. Thus, plans are characterized as nine different income-tenure plan groups, which are indicated by eight binary variables with a reference category of *Middle-income* and *mid-tenure*.

The level-2 model (equation (2)) also contains plan-level variables (P_j) to control for any potential effects of plan design features on participants' contribution rates. Since the database that this study uses does not contain specific information on some plan design features, the model uses proxies, which are created by using the information on asset allocation from participants' accounts. First, for whether a plan provides an automatic enrollment or not, the model uses a proxy created by using an algorithm from Copeland (2011). The proxy is created by identifying participants who had less than two years of tenure (i.e., newly eligible participants) and had 90% or more of their account balance in TDFs. When those participants account for at least 60% of the participants who had less than two years of tenure in a plan, the plan is assumed as one that provides an automatic enrollment for participants.[18] Second, the model includes the availability of company stock in a plan menu. The existence of such an option is inferred from the fact that some participants invest in their company stock. Third, the model uses a proxy for whether a plan provides loans or not. When any participant in a plan has an outstanding loan balance at year-end 2007, the plan is regarded as one having a loan provision. Fourth, the model includes employer matching contributions. Because the database does not contain specific

[18] These criteria, however, are not able to identify plans where participants were automatically enrolled with a different default investment than TDFs.

information on employer matching contribution formulas, this study uses an aggregate employer match rate as a proxy, as in Soto and Butrica (2009) and VanDerhei (2009).[19] An aggregate employer match rate is calculated for each plan by dividing aggregate employer contributions by aggregate participant contributions. Fifth, the model includes the number of fund options in a plan, as in Mitchell, Utkus, and Yang (2007). As more funds are available in a plan menu, participants may increase their contributions because additional funds are more likely to meet participants' different investment needs. Last, the model includes plan size in terms of the number of participants in a plan as a plan-level control.

Hierarchical Linear Regression Results

Table 2 presents hierarchical linear regression results for the effects of plan demographics on participants' contribution rates. Results are reported with five different settings of plan demographics: Column (1) includes no plan demographics; Column (2) includes plan demographics defined by plan median salary; Column (3) includes plan demographics defined by plan median tenure; Column (4) includes plan demographics defined by plan median salary and tenure; Column (5) includes the cross-level interaction terms of individual characteristics and plan demographics. For the cross-level interaction terms, because of limited space, column (5) reports regression results for Groups 1 and 9, which have the most contrasting plan demographics with respect to the reference plan group (Group 5).[20] Each column represents a model that includes the disturbance term of u_{1j}.[21]

[Table 2 here]

[19] An aggregate employer match rate may not represent the true employer match rate either because of the possibility that some employees contribute beyond the maximum amount of compensation matched by the employer or because of the possibility of employers' non-elective contributions (VanDerhei, 2009).

[20] The full results of the cross-level interaction terms are available upon request.

[21] An inclusion of u_{1j} in the model is supported by the likelihood-ratio test results reported in Table 2. The likelihood-ratio tests compare the deviance statistics of a restricted model excluding u_{1j} and a more general one including u_{1j}, and the χ^2 statistics indicate that the addition of the disturbance term (u_{1j}) significantly contributes to the explanation of variation in the dependent variable.

First, individual demographic characteristics (i.e., age, tenure, and salary) and outstanding loan balances significantly influence participant contribution rates. A participant's contribution rate tends to rise as he/she gets older, has more income, stays longer in the current plan, or has less or no 401(k) loan balances. In addition, the magnitudes of the coefficients of the individual characteristics variables are very similar across different specifications. Thus, the results indicate that the individual demographic characteristics and outstanding 401(k) loan balances have significant and consistent effects on participants' contribution rates.

Second, some plan design features significantly affect participant contribution rates. When a plan offers an automatic enrollment feature, the participants' contribution rates tend to be decreased. This result is consistent with the findings of Madrian and Shea (2001), Choi et al. (2004), and Vanguard (2014). Participants tend to follow an automatic contribution arrangement provided under automatic enrollment, but many plans offering the arrangement set a default employee contribution rate as low as 3% of salary.[22] In contrast, when company stock is offered in a plan, the participants are likely to increase their contribution rates. This may result because they feel they know about the company and prefer to invest more in the familiar (Huberman 2001). The other plan design features, however, are not significantly related to participant contribution rates.[23]

Third, plan demographics have significant effects on participant contribution rates when the individual characteristics and the plan design features are controlled for (columns (2)-(4)). First, the participant contribution rates of low-income plans are 0.44 percentage point lower than

[22] Vanguard (2014) reports that 76% of the plans automatically enrolling employees use a default contribution rate of 3% or less in 2007.

[23] For the effects of employer matching contribution on participant contribution rates, the results reported in this paper are not different from those in prior studies. Prior studies provide mixed results for the employer matching contribution effects. For example, Cunningham and Engelhardt (2002) and Huberman et al. (2007) show that higher match rates increase participant contribution rates. On the contrary, Kusko, Poterba, and Wilcox (1998) report negative effects and Munnell et al. (2003) find no impact.

the contribution rates of the middle-income plans and 0.52 percentage point lower than the contribution rates of the high-income plans (column (2)). Second, the participant contribution rates of short-tenure or mid-tenure plans are 0.35 percentage points lower than the contribution rates of long-tenure plans (column (3)). Third, when plan demographics are defined by plan-level salary and tenure (column (4)), the plan demographic effects become stronger, as expected: for example, the participant contribution rates of low-income and short-tenure plans (Group 1) are 0.98 percentage points lower than the contribution rates of middle-income and mid-tenure plans (Group 5) or 1.78 percentage points lower than the contribution rates of high-income and long-tenure plans (Group 9).

Fourth, plan demographics interact with individual demographic characteristics for participant contribution rates (column (5)). First, the plan demographic groups show different curvatures of participant contribution rates with respect to age. For example, participant contribution rates start to increase at age 35 for Group 1, age 29 for Group 5, and age 27 for Group 9. Second, the plan demographic groups also show different curvatures of participant contribution rates with respect to tenure. For example, participant contribution rates start to decrease after 16 years of tenure for Group 1 and 21 years of tenure for Group 5 or 9. Third, the plan demographic groups show different effects of salary on participant contribution rates. For example, a $10,000 increase in salary is expected to raise contribution rates by 0.27 percentage points for Group 1 (p-value = 0.053) and 0.43 percentage points for Group 5 or 9. The increment in the contribution rate of Group 1 is 37% lower than that of Group 5 or 9. Last, based on the results reported in column (5), Figure 1 illustrates to what extent plan demographics can affect participant contribution rates for ages 25–64. For each plan group, participant contribution rates with an assumption of no loan balance are calculated by combining the regression results in column (5) and salary and tenure profiles using the average salary and tenure, respectively, of participants in Group 5 for each age between 25 and 64. The figure shows that participant contribution rates can differ by 1.53–3.02 percentage points for each age between 25 and 64, depending on what plan demographics the participants are exposed to.

[Figure 1 here]

In sum, the results presented in this section show that plan demographics have a significant effect on participants' contribution rates and that they interact with individual demographic characteristics for participants' contribution rates, supporting the hypotheses in Section 2. The findings, thus, suggest that plan demographics should be considered in examining participants' contribution behavior in 401(k) plans. This suggestion can also be applied to plan sponsors as fiduciaries that seek an effective automatic contribution arrangement for participants' retirement income security.

4. Plan Demographics and Automatic Contribution Arrangements: A Simulation Approach

A plan sponsor acting solely in the best interest of participants (i.e., retirement income security) is required to establish a process for comparing and selecting TDFs when it adopts the funds as a default investment option (Department of Labor, 2013). To improve participants' retirement income security, plan sponsors that have limited sources in fulfilling the fiduciary duties may instead rely on a QACA, which is effective in increasing participants' contribution rates (Thaler and Benartzi, 2004) and, thus, their retirement income security. In order to make a QACA effective, however, the plan sponsors should establish an appropriate maximum level of employee contribution rates. For doing this, the plan sponsors need to first find out plan-level factors that are closely related to participants' contribution behavior. The previous section shows that plan demographics are crucial in understanding participants' contribution behavior. This section, assuming that a plan sponsor uses TDFs as the plan default investment option, examines (1) how much participants' retirement income security can be varied by a plan sponsor's TDF choices and (2) whether the variation—in particular, the downside risk—can be reduced by a QACA that reflects the plan demographics. Thus, for plan sponsors that are concerned about fiduciary responsibility from their TDF selections, simulation results may provide an insight into how plan demographics should be taken into account in designing an effective QACA.

For the examination, Monte Carlo simulations are conducted, using first empirically estimated participant contribution rates based on the results from the previous section and then different automatic contribution escalation arrangements under a QACA. Simulations are focused on three plan groups, low-income and short-tenure (Group 1), middle-income and mid-tenure plans (Group 5), and high-income and long-tenure plans (Group 9), because these plan groups show the most significant and contrasting effects of plan demographics on participant contribution rates (column (4) in Table 2).

Simulation Assumptions

For a discussion of participants' retirement income security, the simulation employs a representative participant for each plan group. A representative participant is a male, is 25 years old in 2007, and plans to retire on his 65th birthday. He is continuously employed and contributes to his 401(k) account until retirement.

401(k) accumulation. Account balances at retirement are determined by three factors: years contributing, amount contributed, and investment returns. First, a representative participant continuously contributes to a 401(k) account for 40 years without any withdrawals from the account.

Second, a representative participant makes contributions as a percentage of salary at the beginning of the year for ages 25−64, following the contribution rates that are empirically estimated by combining (1) the regression results reported in column (5) of Table 2 and (2) the estimated salary and tenure of his plan group at each age between 25 and 64.[24] The employee contribution rates, however, are estimated by assuming that a plan provides neither an automatic enrollment feature nor company stock as an investment option for the representative participant. While the representative participant contributes to the 401(k) account, he receives employer matching contributions with a single-tier formula of $0.50 per dollar up to 6% of salary, which is popular among 401(k) plan sponsors (Vanguard, 2014).

Third, a representative participant invests only in TDFs, which are provided by his plan sponsor, until retirement. The plan sponsor selects TDFs that follow one of three equity glide paths defined by the 2009 *Morningstar Lifetime Allocation Indexes*: Aggressive, Moderate, and Conservative.[25] Following the *Morningstar Indexes*, TDFs have seven underlying assets: U.S. Equity, Non-U.S. Equity, U.S. Bond, Non-U.S. Bond, Commodities, Treasury Inflation Protection Securities (TIPS), and Cash. Table 3 presents a set of expected returns, standard deviations, and correlations of the assets and inflation.[26] Based on the assumptions on TDFs and long-term capital markets, fund returns are generated annually, which follow a joint log-normal independent and identical distribution. Then net fund returns are calculated by assuming different annual expense ratios for TDFs that follow different equity glide paths. Simulations

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[24] For each plan group, salary and tenure profiles for ages 25–64 are estimated by using five-year moving averages of the average salary and tenure, respectively, at each age.

[25] The *Morningstar Lifetime Allocation Indexes* cover most TDF equity glide paths in the market (Charlson and Lutton, 2012). This study uses the 2009 *Morningstar Indexes* (active dates: June 2008–June 2009) because the index dates are close to year-end 2007, which the study uses as a base year. The *Morningstar Indexes* are annually released with updated asset allocations.

[26] The capital market assumptions in Table 3 are part of the JP Morgan Asset Management long-term capital market assumptions as of November 30, 2009. This paper employs the assumptions as a baseline because they are used by many institutional investors including pension plans that use them in developing and supporting the plans' expected return assumptions (Lester and Santiago 2009).

assume that TDFs following an aggressive equity glide path have an annual expense ratio of 115 basis points (bps), the funds following a moderate equity glide path an expense ratio of 102 bps, and the funds following a conservative equity glide path an expense ratio of 86 bps (Charlson, Herbst, Liu, Lutton, and Rekenthaler, 2009).[27]

[Table 3 here]

Retirement income adequacy. A representative participant is assumed to have two retirement income sources, Social Security benefits and 401(k) accumulations, and to fully annuitize his 401(k) accumulations at retirement. A representative participant aims at a replacement rate (defined by a fraction of pre-retirement income replaced by retirement income) based on his final five-year average salary. As a target replacement rate, he uses the total replacement rate of a single worker estimated by Palmer (2008).[28] Table 4 presents the final five-year average salary, which is used as pre-retirement income, and target replacement rates for the representative participants of Groups 1, 5, and 9. The Social Security benefits of the representative participants, which are estimated with their salary profiles for ages 25–64, replace 50.8% of the pre-retirement income for Group 1, 44.0% for Group 5, and 40.4% for Group 9.[29] Then 401(k) account balances cover the remaining *real* replacement rates, which are 31.2% for Group 1, 36.0% for Group 5, and 40.6% for Group 9.[30] Because Social Security benefits are

[27] TDFs following an aggressive equity glide path tend to have a higher expense ratio due to active fund management than the funds following the other equity glide paths (Yang and Lutton, 2014). From the distribution of asset-weighted average expense ratios of 48 fund families surveyed by the Morningstar in 2009, thus, simulations use the 3rd quartile expense ratio (115 bps), the median expense ratio (102 bps), and the 1st quartile expense ratio (86 bps) for TDFs that follow aggressive, moderate, and conservative equity glide paths, respectively.

[28] Palmer (2008) provides different total replacement rates by pre-retirement earnings levels, the total replacement rates which are referenced in many other studies on retirement income adequacy (e.g., VanDerhei, 2004; Munnell and Soto, 2005; Brady, 2010; MacDonald and Moore, 2011).

[29] Social Security benefits are estimated by using *Anypia Social Security Benefit Calculator* (version 2012.3), which is available from a website of the Social Security Administration. Social Security benefits are computed with an "intermediate" set of assumptions.

[30] Like Social Security benefits, 401(k) accumulations intend to replace the pre-retirement income in *real* terms. Real replacement rates of 401(k) accumulations are estimated by assuming that a representative participant purchases a *single* life real annuity, which has a price of 15.265, at his 65th birthday. The real annuity price is

determined by the pre-retirement income, simulations focus on whether or not the representative participants achieve the target replacement rates of 401(k) accumulation, which can be varied by their TDF investments.

[Table 4 here]

Automatic contribution escalation. In addition to the empirically estimated participant contribution rates under voluntary enrollment as a baseline, simulations consider five different automatic contribution escalation arrangements under a QACA. For an auto-escalation arrangement, a plan sponsor should provide a schedule of default contribution percentages that start at a minimum of 3% of a participant's compensation and gradually increase by 1% each year to a maximum of 6 to 10%. Following these employee contribution schedules, simulations use five auto-contribution arrangements that commonly have a 3% default contribution rate and a 1% annual automatic contribution increase, but they have five different maximum levels of employee contribution rates: 6% (often called "safe harbor minimum"), 7%, 8%, 9%, and 10% (often called "safe harbor maximum") of salary. In addition, once a representative participant reaches a limit of automatic contribution increases allowed, the participant maintains the maximum level of participant contribution rates until retirement, even when he changes jobs.[31] Job changes, however, are assumed to occur only within the same *plan group*. For employer matching contribution, simulations use a safe harbor employer matching contribution arrangement specified by the Internal Revenue Service: employer contributions of 100% of the

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calculated based on (1) the Annuity 2000 Mortality Table published by the Society of Actuaries and (2) an assumption of a long-term *real* interest rate of 2.9%. The real interest rate is projected by the Board of Trustees, Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds with intermediate-cost assumptions in 2013.

[31] Alternatively, when a representative participant changes jobs, the participant would be assumed to start over from a new plan's initial default contribution rate such as 3% of salary. However, few empirical studies examine how participants react to automatic contribution escalations when they change jobs. Further, the database this study uses does not have the information on participants' reactions to different auto-escalation arrangements. Thus, this study simply assumes that, once a representative participant reaches a maximum level of employee contribution rates, he *maintains* the maximum level until retirement.

first 1% deferred and 50% of the next 5% deferred, up to 6% of salary (CFR Title 26 Part 1.401(k)-3(k)(2)).

Simulation Results

Simulation results are presented for low-income and short-tenure (Group 1), middle-income and mid-tenure (Group 5), and high-income and long-tenure (Group 9) plan groups. Results focus on the probability of success when the representative participants aim at a target replacement rate and up to +/- 3 percentage points of the target rate. The probability of success is defined as the number of runs for which a representative participant achieves a target replacement rate (i.e., a target 401(k) account balance) out of 10,000 simulation runs.

Table 5 presents the probabilities of success for the representative participants of the three plan groups when they follow the empirically estimated contribution rates of their own plan groups. s_A, s_M, and s_C indicate the probability of success that a representative participant achieves a replacement rate when he uses TDFs that follow aggressive (Aggr), moderate (Modr), and conservative (Cons) equity glide paths, respectively. Simulation results show that success rates differ across the TDF equity glide paths. For example, the representative participant of Group 1 has success rates of 74%, 72%, and 59% at the target replacement rate of 82% when he invests in the TDFs following aggressive, moderate, and conservative equity glide paths, respectively. The success rates differ by about 15 percentage points across the TDF equity glide paths. For the other plan groups (Groups 5 and 9), success rates also differ across the fund equity glide paths. For example, the success rates of Group 5 differ by 8 percentage points at the target replacement rate of 80% and the success rates of Group 9 by about 4 percentage points at the target replacement rate of 81%. In addition, the difference in success rates across the TDF equity glide paths becomes smaller for lower replacement rates but larger for higher replacement rates. The results reported in Table 5, thus, indicate that participants' retirement income security can be significantly varied by a plan sponsor's TDF choices.

[Table 5 here]

To measure the extent to which success rates can be affected by the TDF equity glide paths, the maximum variation in success rates (*Diff*) is calculated by using $Diff = Max(s_A, s_M, s_C) - Min(s_A, s_M, s_C)$ where $Max(s_A, s_M, s_C)$ and $Min(s_A, s_M, s_C)$ indicate the highest and the lowest success rates at a target account balance, respectively. For a range of +/- 3 percentage points of the target replacement rates, Figure 2 shows that the three plan groups have different sensitivities of success rates to TDF choices. For a range of +/- 3 percentage points of the target replacement rates, the variation of success rates of Group 1 is, on average, 1.7 times larger than that of Group 5 and 3.3 times larger than that of Group 9. This indicates that the retirement income security of participants in Group 1 is more sensitive to a plan sponsor's TDF selection than that of those in Group 5 or 9.

[Figure 2 here]

Since a plan sponsor's TDF choice can significantly affect the participants' retirement income security (as shown in Table 5 and Figure 2), a plan sponsor as a fiduciary may want to reduce the potential downside risk on retirement income from its TDF selection. For doing this, a plan sponsor may attempt to increase the lowest success rate by adopting an automatic contribution arrangement. Because plan sponsors may be more concerned about lower success rates, the downside risk is defined by $Downside\ risk = -\ln\big(Min(s_A, s_M, s_C)\big)$ for $0 \leq Min(s_A, s_M, s_C) \leq 1$, which places more weights on lower success rates.

Figure 3 illustrates how the downside risk on retirement income from TDFs can be changed at a target replacement by adopting the five different auto-escalation arrangements for each plan group. First, for Group 1 (Panel A), when the representative participant follows "Auto-escalation to 6%," the downside risk is drastically reduced by 98% to 0.03 from 0.60. When the representative participant further follows "Auto-escalation to 7%" or higher, the downside risk is continuously reduced but additional reductions are marginal. Second, for Group 5 (Panel B), the downside risk is reduced when the representative participant follows the auto-escalation to 6%. However, the largest reduction occurs when he follows "Auto-escalation to 7%." When he follows the auto-escalation to 7%, the downside risk is reduced by 69% (from 0.22 to 0.07). In terms of the success rate, the auto-escalation to 7% increases the lowest success rate from 0.80 to 0.93. Last, for Group 9 (Panel C), when the representative participant follows the auto-escalation to 6 or 7%, the downside risk is rather increased compared to when he follows the estimated contribution rates of his plan group under voluntary enrollment (denoted by "Estimated contribution"). The downside risks with the auto-escalation to 6% and 7% are increased by 5.4 times and 2.7 times, respectively. The downside risk, however, is lowered with the largest drop when he follows "Auto-escalation to 9%." The downside risk is decreased by 57% to 0.07 from 0.16, which is under voluntary enrollment. When the representative participant further follows "Auto-escalation to 10%," the downside risk is continuously reduced but additional reduction is less substantial. The results for Group 9 indicate that, when automatic employee contribution rates under automatic enrollment result in lower contribution rates than participants would have otherwise chosen, the participants are not able to accumulate retirement wealth as much as when they were not subject to automatic enrollment. This is consistent with the findings of Madrian and Shea (2001) and Choi et al. (2004).

[Figure 3 here]

In sum, the simulation results in this section show that participants' retirement income security can be significantly varied by a plan sponsor's TDF choices (Table 5) and that the variation can differ across plans that have different plan demographics (Figure 2). The downside risk on retirement income from a plan sponsor's TDF choices, however, can be significantly reduced by a QACA where the maximum of employee contribution rates is determined by taking into account plan demographics (Figure 3). For example, if a plan sponsor in Group 1 (low-income and short-tenure plans) adopts an auto-escalation to 6% and if the participants follow the pre-determined contribution schedule, the downside risk on retirement income is significantly reduced and, thereby, the participants' retirement income security becomes less dependent on the plan sponsor's TDF choices. However, if a plan sponsor in Group 9 (high-income and long-tenure plans) adopts an auto-escalation to 6% or 7%, which is a lower contribution rate than participants would have chosen under voluntary enrollment, and if the participants anchor their contribution rates to this auto-escalation arrangement, the downside risk is rather increased and, thereby, their retirement income security becomes more dependent on the plan sponsor's TDF choices.

Robustness Check: Alternative Capital Market Assumptions

Since the simulation results may be affected by capital market assumptions, this subsection examines whether the findings above are robust to different long-term capital market assumptions. For robustness check, simulations use alternative capital market assumptions that have the same expected returns and correlations as the baseline but 10% higher volatility, which intends to reflect more volatile economies.[32] Figure 4 presents simulation results with the alternative assumptions for Groups 1, 5, and 9. Because of the higher volatility of the expected returns, simulation results show higher downside risks for the three plan demographic groups.

[32] For inflation, simulations use the same expected inflation rate and its volatility as the baseline.

However, the patterns of decreasing the downside risk for the five auto-escalation arrangements are similar to those under the baseline assumptions. For example, the downside risk on retirement income is significantly reduced when Group 1 follows the auto-escalation to 6%, Group 5 the auto-escalation to 7%, and Group 9 the auto-escalation to 9%. In particular, when the representative participant of Group 9 follows the auto-escalation to 6% or 7%, the downside risk is significantly increased. This is consistent with the results with the baseline assumption.

5. Conclusion

This paper examined how much participants' retirement income security can be varied by a plan sponsor's TDF choices in a context where participants are restricted to select the TDFs provided by a plan sponsor. It also attempted to see whether the downside risk on retirement income from a plan sponsor's choice, which may be related to a plan sponsor's fiduciary responsibility, can be reduced by a QACA. In the examination, plan demographic characteristics were taken into account, focusing on the effects of plan demographics on participant contribution rates and their interaction effects with individual characteristics on participant contribution rates.

First, the paper finds that plan demographics have a significant effect on participant contribution rates and that they also interact with individual demographic characteristics for participant contribution rates, using a large sample of 401(k) plans at year-end 2007. For plans that have different plan demographics, for example, participants' contribution rates can differ by 1.53–3.02 percentage points for each age between 25 and 64 even when individual demographic characteristics and plan design features are controlled for. The findings suggest that plan demographics should be considered in examining participants' contribution behavior in 401(k) plans and, thus, in establishing a QACA for enhancing participants' retirement income security.

Second, the paper finds from the simulations by plan demographic groups that participants' retirement income security can be significantly varied by a plan sponsor's TDF choices and that the retirement income security of participants in low-income and short-tenure plans is more sensitive to a plan sponsor's TDF selection than that of those in other plan demographic groups. For the downside risk on retirement income from a plan sponsor's TDF choices, a QACA can significantly reduce the risk, but it should reflect the plan demographics in determining a maximum level of employee contribution rates. Otherwise, participants' retirement income security is likely to depend largely on the plan sponsor's TDF selection.

There is, however, a caveat to the simulation results: that participants' retirement income security may be overestimated. The simulation was not able to consider (1) participants' behavior on pre-retirement withdrawals and (2) participants' different reactions to an auto-escalation arrangement because the database that the study uses has no information on both factors. However, the effects of both factors on participants' retirement income security may differ across plan demographic groups. Thus, future research is called for to investigate participants' behavior on pre-retirement withdrawals and their reactions to an auto-escalation arrangement—in particular, when they change jobs—by plan demographic groups.

Despite the above caveat, this study provides an implication for plan sponsors that are concerned about fiduciary responsibility while auto-enrolling participants in TDFs. A QACA can reduce the potential fiduciary risk related to their TDF choices. However, because of different savings behavior by plan demographics, an auto-escalation arrangement can result in different effects on participants' retirement income security. Thus, plan sponsors should take account of plan demographics in placing an auto-escalation arrangement into a QACA (e.g., in determining a maximum level of employee contribution rates). Then the QACA not only can increase the participants' retirement income security but also can reduce the plan sponsor's potential fiduciary risk related to its TDF selections.

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Table 1. Plan Demographics and Descriptive Statistics

Panel A. Plan Demographics: Plan Classification Based on Participant Salary and Tenure

		Tenure		
		Short-tenure (≤5.1 years)	Mid-tenure (>5.1–12.4 years)	Long-tenure (>12.4 years)
	Low-income (≤$35,200)	Group 1	Group 2	Group 3
Salary	Middle-income >$35,200–$63,600)	Group 4	Group 5	Group 6
	High-income (>$63,600)	Group 7	Group 8	Group 9

Note: Plans are assigned to plan-level demographic groups by comparing the median salary (tenure) of a plan with the tertiles of the salary (tenure) distribution from a sample of 1,497,014 participants in 958 plans at year-end 2007. The first tertile of salary is $35,200 and the second tertile is $63,600. The first tertile of tenure is 5.1 years and the second tertile is 12.4 years.

Panel B. Descriptive Statistics by Plan Demographic Groups

		Income plan groups			Tenure plan groups		
	Sample	Low-income	Middle-income	High-income	Short-tenure	Mid-tenure	Long-tenure
Number of plans	612	69	401	142	121	398	93
Number of participants	373,163	68,188	218,435	86,540	31,453	271,826	69,884
Individual-level (mean)							
Contribution rate (%)	6.21	4.67	6.23	7.39	5.05	6.01	7.52
Age (years)	43.5	42.5	43.7	43.9	39.8	43.2	46.4
Tenure (years)	11.4	10.3	11.2	12.8	5.6	10.7	17.1
Salary ($000s)	53.0	40.7	52.3	64.6	53.0	51.0	60.8
Loan balance ($000s)	4.5	3.5	4.2	6.1	1.9	4.2	6.9
Plan-level (mean)							
Auto-enrollment (Yes=1)	0.186	0.20	0.18	0.15	0.20	0.17	0.16
Company stock offered (Yes=1)	0.14	0.07	0.11	0.28	0.08	0.14	0.24
Loan offered (Yes=1)	0.99	0.99	0.99	0.99	0.99	0.99	1.00
Employer match rate (%)	43.3	52.4	39.3	50.3	39.3	43.8	46.6
Number of funds offered	22.3	20.8	22.2	23.2	22.1	22.3	22.1
Plan size (no. of participants)	2,182	6,032	1,451	2,378	699	2,616	2,256

Table 1. (*continued*)

	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9
Number of plans	14	45	10	77	275	49	30	78	34
Number of participants	8,618	59,207	363	13,466	173,703	31,266	9,369	38,916	38,255
Participant level (mean)									
Contribution rate (%)	3.34	4.86	5.84	5.26	6.22	6.71	6.33	6.84	8.20
Age (years)	39.7	42.8	47.1	40.5	43.4	46.6	38.8	43.0	46.1
Tenure (years)	6.1	10.9	14.6	5.8	10.6	17.0	4.8	10.4	17.2
Salary ($000s)	45.2	40.1	39.2	50.5	52.4	52.4	63.8	61.7	67.8
Loan balance ($000s)	1.2	3.8	2.0	2.4	3.9	6.5	1.8	5.9	7.4
Plan level (mean)									
Auto-enrollment (Yes=1)	0.21	0.20	0.20	0.19	0.18	0.16	0.20	0.13	0.15
Company stock offered (Yes=1)	0.07	0.09	0.00	0.39	0.12	0.16	0.20	0.24	0.41
Loan offered (Yes=1)	1.00	0.98	1.00	1.00	0.99	1.00	0.97	0.99	1.00
Employer match rate (%)	49.3	57.5	33.8	36.9	40.4	36.7	40.8	47.7	64.5
No. of funds offered	20.2	21.2	19.9	22.1	22.1	22.5	23.1	23.8	22.2
Plan size (no. of participants)	1,612	8,732	69	428	1,616	2,131	969	2,614	3,079

Note: Entries at individual and plan levels indicate average values of the variables. All dollar amounts are expressed in 2007 dollars.

Table 2. Hierarchical Linear Regression Results on Participant Contribution Rates

Variable	(1)	(2)	(3)	(4)	(5)[a]
Individual-Level					
Age	0.071***	0.072***	0.071***	0.072***	0.070***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Age^2	0.003***	0.003***	0.003***	0.003***	0.002***
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Tenure	0.045***	0.046***	0.045***	0.046***	0.047***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)
$Tenure^2$	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Salary ($000s)	0.041***	0.041***	0.041***	0.041***	0.043***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Loan Balance ($000s)	-0.037***	-0.038***	-0.037***	-0.038***	-0.042***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.006)
Plan-Level					
Plan design features					
Auto-enrollment (Yes=1)	-0.336**	-0.269*	-0.331**	-0.281**	-0.305**
	(0.148)	(0.146)	(0.147)	(0.143)	(0.141)
Company stock offered	0.526***	0.356**	0.484***	0.354**	0.350**
(Yes=1)	(0.146)	(0.154)	(0.142)	(0.150)	(0.153)
Loan offered (Yes=1)	-1.235	-1.174	-1.295	-1.198	-1.214
	(0.987)	(1.044)	(1.007)	(1.051)	(1.036)
Employer match rate	0.157*	0.138	0.148*	0.123	0.125
	(0.082)	(0.088)	(0.083)	(0.090)	(0.089)
No. of funds offered	0.004	0.001	0.005	0.002	0.002
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Plan size (no. of participants)	-0.001	0.003	-0.001	0.002	0.002
	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)
Plan demographics					
Low-income		-0.441*			
		(0.232)			
High-income		0.515***			
		(0.131)			
Short-tenure			0.066		
			(0.149)		
Long-tenure			0.350**		
			(0.167)		
Group 1				-0.981***	-1.208**
(Low-income, Short-tenure)				(0.355)	(0.598)
Group 2				-0.219	-0.398
(Low-income, Mid-tenure)				(0.297)	(0.353)
Group 3				-0.146	-0.146
(Low-income, Long-tenure)				(0.488)	(0.709)
Group 4				0.193	0.401
(Middle-income, Short-tenure)				(0.182)	(0.266)
Group 6				0.241	-0.067
(Middle-income, Long-tenure)				(0.258)	(0.283)
Group 7				0.455*	0.769*
(High-income, Short-tenure)				(0.252)	(0.448)

Table 2. (*continued*)

Variable	(1)	(2)	(3)	(4)	(5)[a]
Group 8				0.515***	0.555***
(High-income, Mid-tenure)				(0.162)	(0.203)
Group 9				0.804***	1.026***
(High-income, Long-tenure)				(0.209)	(0.245)
Cross-Level Interaction: Individual-Level Variables and Plan Demographics					
Age × Group 1					-0.028*** (0.008)
Age^2 × Group 1					0.0002 (0.001)
Tenure × Group 1					0.013 (0.022)
$Tenure^2$ × Group 1					-0.003*** (0.001)
Salary × Group 1					-0.016* (0.008)
Loan Balance × Group 1					0.027 (0.025)
Age × Group 9					0.010** (0.005)
Age2 × Group 9					0.001 (0.001)
Tenure × Group 9					0.003 (0.017)
Tenure2 × Group 9					-0.0004 (0.001)
Salary × Group 9					-0.001 (0.006)
Loan Balance × Group 9					-0.013 (0.014)
Reference plan group		Middle-income	Mid-tenure	Group 5 (Middle-income and mid-tenure)	Group 5 (Middle-income and mid-tenure)
Controls for plan design features [b]	Yes	Yes	Yes	Yes	Yes
Residual variance at participant level (σ^2)	14.140	14.141	14.140	14.141	14.141
Residual intercept variance at plan level (τ_{00})	3.047	2.937	3.048	2.941	2.987
Pseudo R^2 (individual-level) [c]	0.107	0.107	0.107	0.107	0.107
Pseudo R^2 (plan-level) for intercept [d]	0.160	0.190	0.160	0.189	0.177
Number of plans	612	612	612	612	612
Number of participants	373,163	373,163	373,163	373,163	373,163
Model specification test (u_{1j})					
χ^2 statistic (d.f.)	9931.10 (27)	9914.27 (27)	9929.21 (27)	9910.96 (27)	7837.05 (27)
P-value	<0.001	<0.001	<0.001	<0.001	<0.001

Table 2. (*continued*)

Note: Entries corresponding to independent variables are estimations of the fixed effects with robust standard errors, which are reported in parentheses. All the regressors, except for binary variables, are grand-mean centered. * Statistical significance at the 10% level; ** statistical significance at 5% level; *** statistical significance at 1% level.

[a] Cross-level interaction estimates are reported only for Groups 1, 5, and 9 because of limited space. The full cross-level interaction estimates are available upon request.

[b] Plan design control variables include the availability of company stock as an investment option, the number of funds offered, aggregate employer match rate, and plan size in terms of the number of participants.

[c] Pseudo R^2 (individual-level) = (σ^2 of null model – σ^2 of current model) / σ^2 of null model, where σ^2 of null model is 15.827.

[d] Pseudo R^2 (plan-level) for intercept = (τ_{00} of null model – τ_{00} of current model) / τ_{00} of null model, where τ_{00} of null model is 3.627.

Table 3. Long-Term Capital Market Assumptions: Returns, Volatility, and Correlations

			Correlation coefficients							
	Expected Return	Std Dev.	U.S. Equity	Non-U.S. Equity	U.S. Bond	Non-U.S. Bond	Comm	TIPS	Cash	Inflation
U.S. Equity	8.69%	16.25%	1.00							
Non-U.S. Equity	8.91%	16.00%	0.88	1.00						
U.S. Bond	4.57%	3.75%	-0.03	-0.11	1.00					
Non-U.S. Bond	7.98%	10.25%	0.55	0.53	0.51	1.00				
Commodities (Comm)	8.35%	17.25%	0.29	0.30	0.08	0.29	1.00			
TIPS	5.22%	6.75%	0.05	-0.06	0.78	0.50	0.33	1.00		
Cash	3.50%	0.50%	-0.02	0.02	0.06	-0.06	0.00	0.01	1.00	
Inflation	3.26%	1.50%	0.04	0.02	-0.23	0.02	0.26	0.09	0.09	1.00

Note: This table presents a set of expected returns, standard deviations, and correlations of seven assets and inflation. Entries in the table are part of JP Morgan Asset Management long-term capital market assumptions as of November 30, 2009.

Table 4. Target Replacement Rates of Social Security Benefits and 401(k) Accumulation by Plan Demographic Groups

	Group 1 (low-income and short-tenure)	Group 5 (middle-income and mid-tenure)	Group 9 (high-income and long-tenure)
Final 5-year average salary	$42,680	$53,480	$69,820
Target total replacement rate (real)	82.0%	80.0%	81.0%
Replacement rate of Social Security	50.8%	44.0%	40.4%
Replacement rate of 401(k) accumulation (in terms of account balances)	31.2% ($203,000)	36.0% ($294,0000)	40.6% ($433,000)

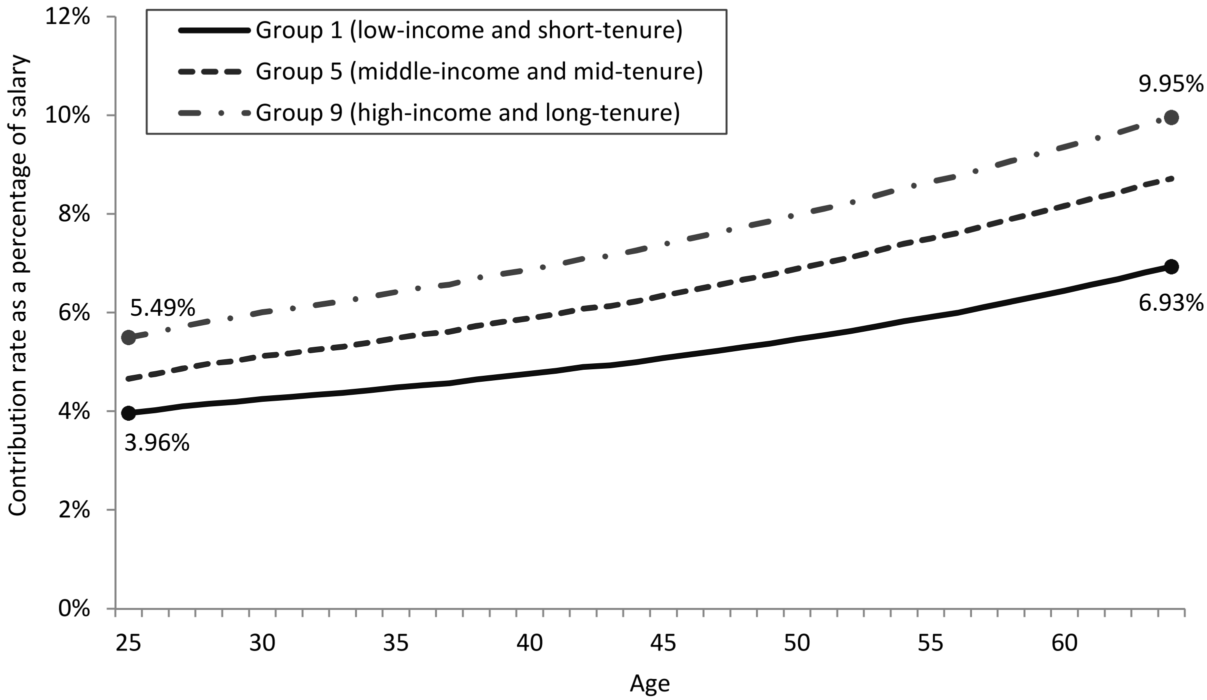
Note: This table presents the replacement rates of Social Security benefits and of 401(k) accumulations that the representative participants of Groups 1, 5, and 9 target. The final 5-year average salary is used as pre-retirement income. All dollar amounts are expressed in 2007 dollars.

Table 5. Probability of Success by Plan Demographic Groups for Different Replacement Rates and Target-Date Funds

Replacement rate	Group 1 (low-income and short-tenure)			Group 5 (middle-income and mid-tenure)			Group 9 (high-income and long-tenure)		
	Aggr (s_A)	Modr (s_M)	Cons (s_C)	Aggr (s_A)	Modr (s_M)	Cons (s_C)	Aggr (s_A)	Modr (s_M)	Cons (s_C)
-3%	0.875	0.889	0.854	0.912	0.929	0.916	0.946	0.964	0.961
-2%	0.832	0.844	0.785	0.882	0.898	0.867	0.929	0.945	0.936
-1%	0.784	0.780	0.685	0.847	0.859	0.807	0.903	0.920	0.899
Target	0.737	0.717	0.591	0.804	0.809	0.727	0.879	0.893	0.856
+1%	0.681	0.638	0.475	0.766	0.755	0.644	0.845	0.857	0.799
+2%	0.628	0.570	0.381	0.721	0.697	0.559	0.811	0.816	0.738
+3%	0.565	0.494	0.286	0.680	0.637	0.472	0.781	0.775	0.669

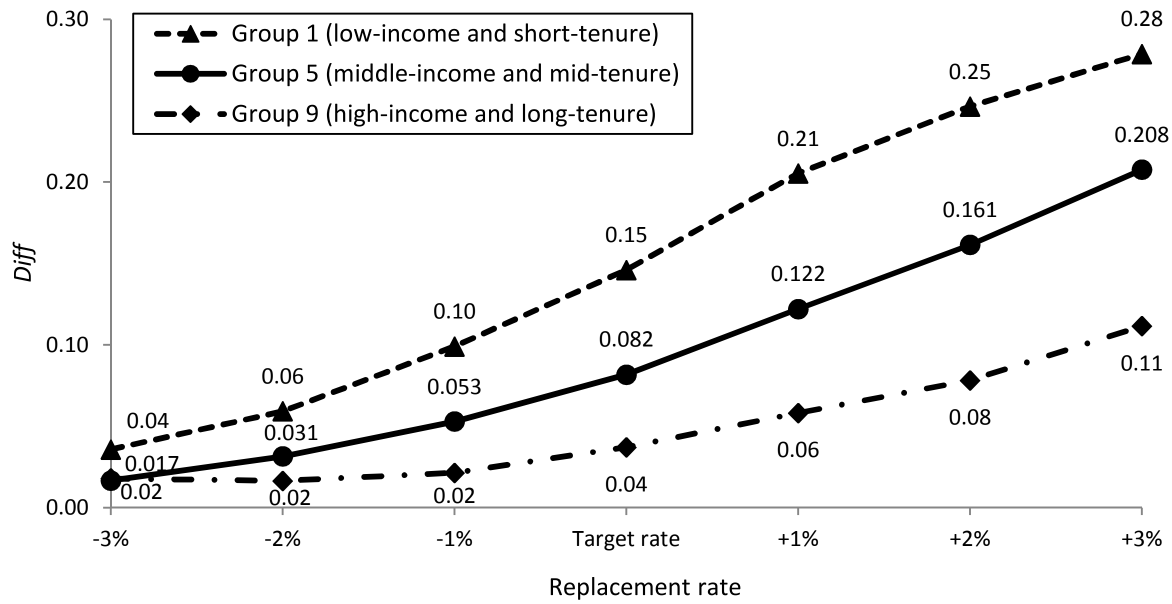
Note: This table presents the probability of success that a representative participant of a plan group achieves a target replacement rate when he uses TDFs that follow aggressive, moderate, and conservative equity glide paths. Group 1 indicates low-income and short-tenure plans, Group 2 middle-income and mid-tenure plans, and Group 3 high-income and long-tenure plans. Aggr, Modr, and Cons indicate aggressive, moderate, and conservative equity glide paths, respectively. s_A, s_M, and s_C indicate the probability of success when a representative participant uses TDFs that follow aggressive, moderate, and conservative equity glide paths, respectively. Target replacement rates are 82% for Group 1, 80% for Group 5, and 81% for Group 9.

Figure 1. Participant Contribution Rates for Ages 25–64 by Plan Demographic Groups



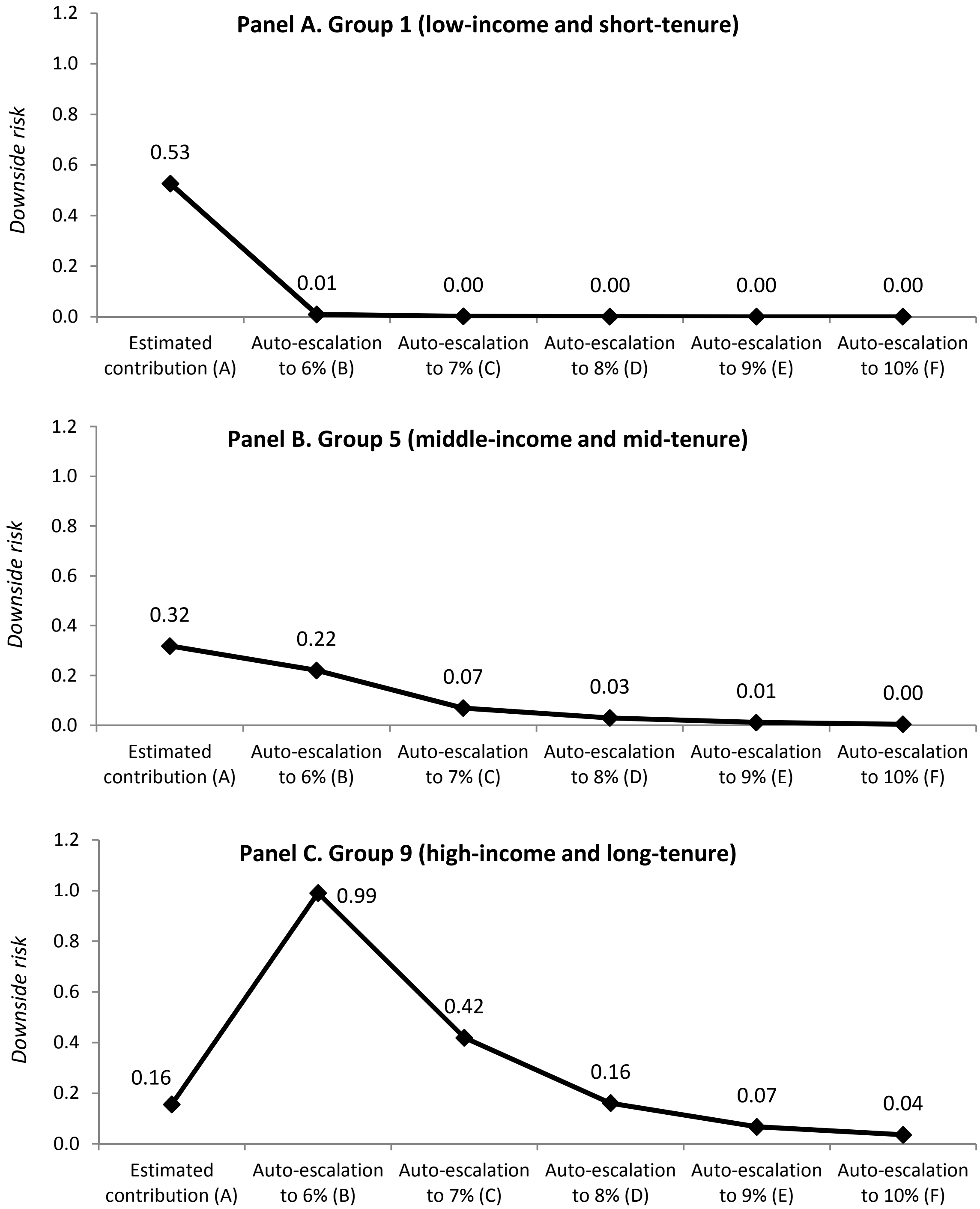
Note: This figure illustrates participant contribution rates for ages 25–64 by three plan demographic groups: group 1 (low-income and short-tenure), group 5 (middle-income and mid-tenure), and group 9 (high-income and long-tenure). For each plan group, participant contribution rates are calculated by combining the regression results in column (5) of Table 2 and salary and tenure profiles using the average salary and tenure, respectively, of participants in Group 5 for each age between 25 and 64, with an assumption of no loan balance.

Figure 2. Potential Variation of Retirement Income Security from Different Target-Date Funds by Plan Demographic Groups



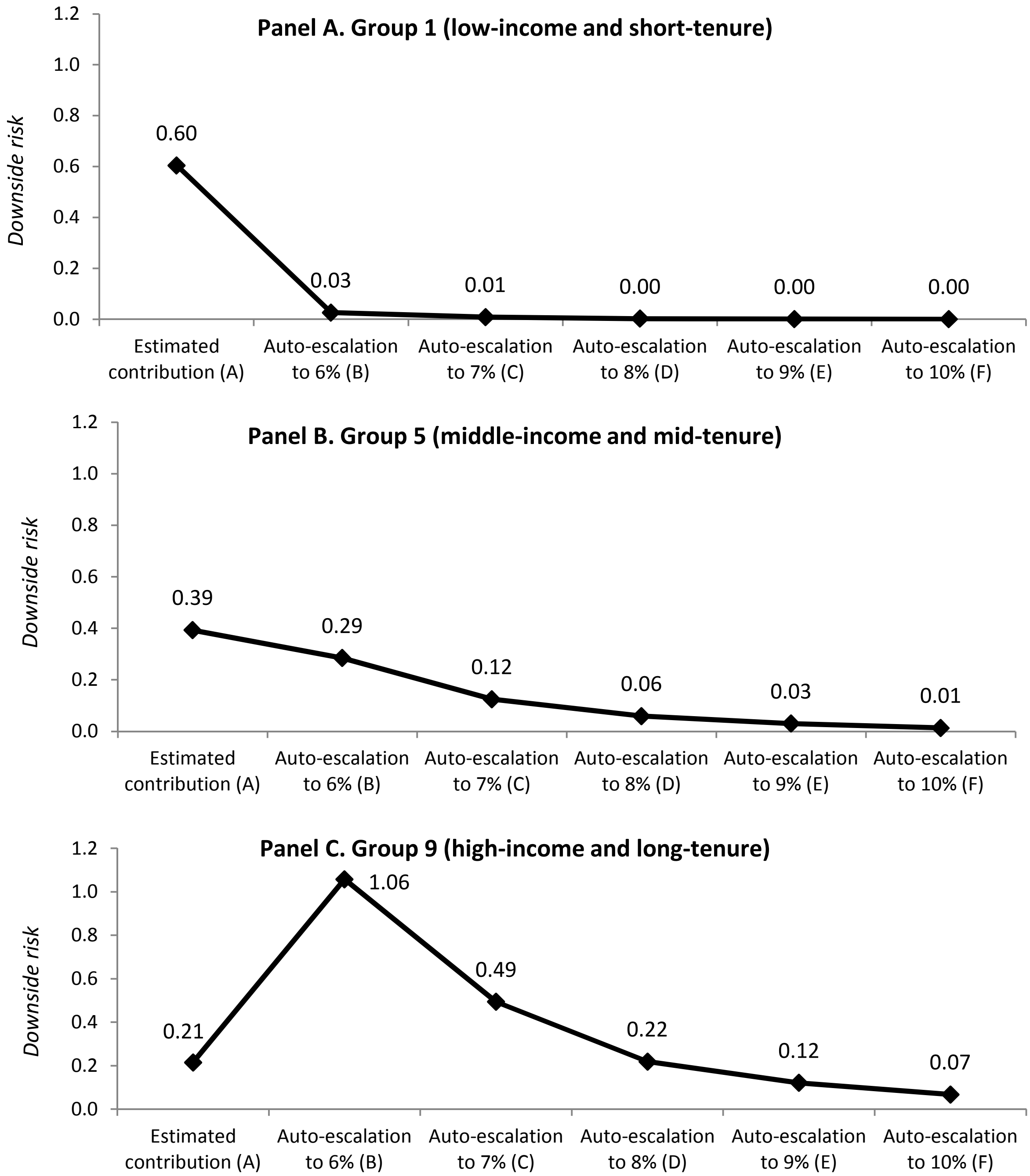
Note: This figure presents the potential variation of retirement income security from target-date funds (TDFs) that have three different equity glide paths. Y-axis indicates $Diff = Max(s_A, s_M, s_C) - Min(s_A, s_M, s_C)$ where s_A, s_M, and s_C denote the probability of success that a representative participant achieves a target replacement rate when he uses TDFs that follow aggressive, moderate, and conservative equity glide paths, respectively. Target replacement rates are 82% for Group 1, 80% for Group 5, and 81% for Group 9. $Max(s_A, s_M, s_C)$ and $Min(s_A, s_M, s_C)$ are calculated with the success rates reported in Table 5.

Figure 3. Downside Risk on Retirement Income from Different Target-Date Funds and Automatic Contribution Escalation Arrangements by Plan Demographic Groups



*Note***:** This figure presents the downside risk on retirement income from different target-date funds (TDFs) and automatic contribution escalation arrangements by plan demographic groups. Y-axis indicates $Downside\ risk = -\ln\left(Min(s_A, s_M, s_C)\right)$ where s_A, s_M, and s_C denote the probability of success that a representative participant achieves a target replacement rate when he uses TDFs that follow aggressive, moderate, and conservative equity glide paths, respectively. Target replacement rates are 82% for Group 1, 80% for Group 5, and 81% for Group 9.

Figure 4. Robustness Check for the Downside Risk on Retirement Income, Using Alternative Capital Market Assumptions



Note: This figure presents the downside risk on retirement income from different target-date funds (TDFs) and automatic contribution escalation arrangements by plan demographic groups, using alternative capital market assumption. The alternative capital market assumptions have the same expected returns and correlations as the baseline but 10% higher volatility. Y-axis indicates $Downside\ risk = -\ln\left(Min(s_A, s_M, s_C)\right)$ where s_A, s_M, and s_C denote success rates that a representative participant achieves a target replacement rate when he uses TDFs that follow aggressive, moderate, and conservative equity glide paths, respectively. Target replacement rates are 82% for Group 1, 80% for Group 5, and 81% for Group 9.