

Plan Demographics, Participants' Saving Behavior, and Target-Date Fund Investments

By Youngkyun Park, EBRI

EXECUTIVE SUMMARY

This analysis explores (1) whether plan demographic characteristics would affect individual participant contribution rates and target-date fund investments and (2) equity glide paths for participants in relation to plan demographics by considering target replacement income and its success rate.

PLAN DEMOGRAPHIC CHARACTERISTICS IN PARTICIPANT CONTRIBUTION RATES: This study finds empirical evidence that 401(k) plan participants' contribution rates differ by plan demographics based on participants' income and/or tenure. In particular, participants in 401(k) plans dominated by those with low income and short tenure tend to contribute less than those in plans dominated by participants with high income and long tenure. Future research will explore how participant contribution behavior may also be influenced by incentives provided by employers through matching formulae.

PLAN DEMOGRAPHIC CHARACTERISTICS IN TARGET-DATE FUND INVESTMENTS: The study also finds empirical evidence that participants' investments in target-date funds with different equity allocations differ by plan demographics based on participants' income and/or tenure. In particular, target-date fund users with 90 percent or more of their account balances in target-date funds who are in 401(k) plans dominated by low-income and short-tenure participants tend to hold target-date funds with lower equity allocations, compared with their counterparts in plans dominated by high-income and long-tenure participants. Future research will focus on the extent to which these characteristics might influence the selection of target-date funds by plan sponsors.

EQUITY GLIDE PATHS: Several stylized equity glide paths as well as alternative asset allocations are compared for participants at various starting ages to demonstrate the interaction between plan demographics and equity glide paths/asset allocations in terms of success rates in meeting various replacement income targets. The equity glide path/asset allocation providing the highest success rate at a particular replacement rate target will vary with the assumed starting date of the participant (see Figure 17). Given the highly stylized nature of the simulations in this *Issue Brief*, it is important to note that the results are not intended to provide a single equity glide path solution in relation to plan demographics. Instead, they serve as a framework to be considered when plan sponsors make a selection concerning which target-date funds to include in their plan.

IMPORTANCE OF PARTICIPANT CONTRIBUTION RATES: This analysis finds that although target-date funds with different equity glide paths affect the retirement income replacement success rate, participant contribution rates corresponding to different plan demographic characteristics have a stronger impact.

AUTO FEATURES OF THE PPA: This *Issue Brief* provides a stylized study using observed contribution rates as of the 2007 plan year. However, with the passage of the Pension Protection Act of 2006 and its likely impact on plan design in the future (increased utilization of automatic enrollment and automatic contribution escalations), it is likely that contribution rates among the participants may become more homogenous. In such a scenario, it may be more likely that a single equity glide path would meet a wide range of demographic profiles.

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Plan Demographics, Participants' Saving Behavior, and Target-Date Fund Investments

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Introduction

Target-date mutual funds have been designated as one of the qualified default investment alternatives (ODIAs) under the Pension Protection Act of 2006 (PPA) by Department of Labor regulations. As a result, these funds have been added to an increasing number of 401(k) plans by plan sponsors. Target-date funds have a common feature of a pre-determined declining equity exposure as the participant approaches the target retirement date. In practice, there are sometimes significant differences in the equity glide paths chosen by different fund families and offered by different plans (Copeland, 2009).

Plan sponsors and administrators are looking for target-date funds that will help them achieve their retirement plan objectives. Demographic characteristics of plan participants (or plan demographics) would be one of the factors that needs to be considered in the choice, because plan demographics would influence participants' saving and investment behavior. For example, whether a majority of participants have low or high income and/or whether a majority of participants have short or long tenure in the plan would affect the plan participants' contribution rates and target-date fund investments. However, few studies consider the effects of plan demographics on participants' contribution rates and target-date fund investments.

Taking into account plan demographics, this *Issue Brief* explores equity glide paths for certain types of participants in meeting their target replacement income. To do this, the analysis first examines whether plan demographics would affect participants' saving behavior for retirement (i.e., contribution rate) and target-date fund investments (i.e., investments in target-date funds with different equity allocations). Based on empirical findings, this analysis examines the distribution of success rates when target-date funds are utilized to achieve various target replacement rates (when combined with assumed Social Security benefit levels). Finally, through several counterfactual experiments,¹ several stylized equity glide paths as well as alternative asset allocations are compared for participants at various starting ages to demonstrate the interaction between plan demographics and equity glide paths/asset allocations in terms of success rates in meeting various replacement income targets. Given the highly stylized nature of the simulations in this *Issue Brief*, it is important to note that the equity glide paths/asset allocations providing the highest success rates in the counterfactual experiments are not intended to provide a single equity glide path solution in relation to plan demographics. Instead, they could work as a framework to be considered when plan sponsors make a selection for which target-date funds to be included in their plan.

This study finds empirical evidence that 401(k) plan participants' contribution rates and target-date investments differ in the demographics of participants in the plan by income and/or tenure. In particular, participants in plans dominated by those with low-income and short-tenure tend to have lower contribution rates than those in plans dominated by middle-income and mid-tenure or high-income and long-tenure participants. With respect to investments, target-date fund users with 90 percent or more of their account balances in target-date funds, who are in low-income and short-tenure plans, tend to have target-date funds with lower equity allocations in their early- or mid- working career (e.g., up to age 54) than those in their counterpart groups.

With counterfactual experiments to determine the impact of different equity glide paths/asset allocations on retirement success rates over various coverage periods, computer simulation results show the impact of various capital market assumptions on asset returns and volatility. It should be noted that, although target-date funds with different equity glide paths affect the retirement success rate, *participant contribution rates* (corresponding to different plan demographic characteristics) have a stronger impact. In other words, the differences in the *equity glide paths* of target-date funds would have a second order effect on the retirement success rate, compared with *participant contribution rates*.

After a brief discussion of the methodology of this analysis, the following sections present empirical findings using the data from the EBRI/ICI Participant-Directed Retirement Plan Data Collection Project (hereafter, "EBRI/ICI database"), report simulation and counterfactual experiment results, and a conclusion.

401(k) Account Balance and Plan Demographics

401(k) account balances at retirement are generally determined by three factors:

- Years contributing.
- Amount contributed.
- Investment returns.

To simplify the process of estimating 401(k) accumulations over a lifetime working career, this analysis assumes that participants contribute to a 401(k) account continuously from age 25 to 64, and retire at age 65 (i.e., on their 65th birthday). Furthermore, in order to control for the effects of various investments (e.g., equity funds, bond funds, and company stock) on 401(k) accumulations, participants are assumed to invest only in target-date funds offered by the plan sponsor. Thus, given investment returns of target-date funds, 401(k) account balances can be determined by contribution rates and target-date fund choices.

It is known that the amount contributed is affected by age and income (Holden and VanDerhei, 2001), and generally tends to rise with age and income. A positive relationship between participant contribution rates (as a percentage of salary) and age is expected for two reasons: (1) a life-cycle pattern of saving (younger people save less, older people tend to save more) and (2) a shorter planning horizon as a participant ages (older people tend to save at a higher rate since they know they have less time). For example, younger people may save less because their living expenses are higher relative to income than for older people, and are likely to consider retirement a far-off event. Holden and VanDerhei, 2001). The participant contribution rate also tends to be positively related to income: 401(k) contributions are generally on a pre-tax basis and, thus, participants with higher income who are usually in a higher tax bracket would have a greater incentive to contribute more to their accounts.

However, positive relationships between contribution rates and age and salary are not linear. For example, a positive relationship between contribution rates and age would be expected to strengthen at age 50 or older because of the catch-up contributions provided under Economic Growth and Tax Relief Reconciliation Act of 2001. In contrast, a positive relationship between contribution rates and salary would weaken in the higher salary ranges because of the maximum contribution limits imposed under the Internal Revenue Code (IRC).

Participants' choice of target-date funds is affected by their age and income, and is constrained by the plan sponsor's selection of target-date fund options. Due to the limited information about plan sponsors in the EBRI/ICI database, this study focuses on participants' utilization of target-date funds. Except for the selection of target-date funds by plan sponsors, participants' choice of target-date funds would be a function primarily of:

- First, the investors' age, because a target-date fund year usually matches an investor to a fund that has the closest date to the investor's expected year of retirement. For example, older participants about to retire would select a target-date fund with a date closer to the current year (e.g., 2010 funds), while younger participants whose retirement is far off would select a target-date fund with a later date (e.g., 2050 funds).
- Second, the investors' income, because the level of risk that participants are willing to face is positively related to their income level (see, e.g., Schwabish and Topoleski, forthcoming; Blasi, Kruse, and Markowitz, 2008).² For example, a low-income participant who is willing to take less risk may select a 2020 target-date fund, instead of a 2030 fund. Target-date funds with dates far into the future generally have greater equity allocations.

Thus, target-date fund investments by a participant would be a function of the investor's age and income.

Demographic characteristics of plan participants also affect the individual participant contribution rates and target-date fund investments, as peer effects have an influence on participants' savings behavior and investment decisions (see, e.g., Madrian and Shea, 2000; Duflo and Saez, 2002). For example, when a participant would be in a plan dominated by those with low income, he or she might tend to contribute less and/or choose target-date funds with lower equity allocations than when they would be in a plan dominated by those with high income. Thus, plan demographics as well as participants' age and income would influence participants' contribution rates and target-date fund choice, both of which would determine 401(k) account balances in a given set of portfolio returns of target-date funds.

Empirical Findings: Participants' Contribution Rates and Target-Date Fund Investments

This section discusses 401(k) plan participants' contribution rates and target-date fund investments in relation to plan demographic characteristics, using the 2007 EBRI/ICI database.

Plan Demographics and Plan Classification

To define plan demographics, two factors are considered: participants' income and tenure.³ Based on the information on participants' salary and tenure from the EBRI/ICI database, plans are classified by whether plans are dominated by participants having certain types of participant demographic characteristics, such as low income or short tenure. Specifically, plans are classified by the following procedure:

- First, a sample is constructed with the complete information on participant demographic characteristics, such as age, tenure, and salary, and participant contributions from the 2007 EBRI/ICI database. The sample includes only participants ages 25 to 64, because this study focuses on participants' saving and investment behavior during their full working career. The resulting sample includes about 2 million *active* participants who contribute to their retirement accounts.
- Second, participants are classified into three categories based on the quartiles of the distributions of salary and tenure (see Figure 1). For example, a participant with an annual salary of less than or equal to \$34,000 is considered to be one with low-income; a salary of \$34,000–80,000 is considered middle-income; and a salary of greater than \$80,000 considered high-income. On the other hand, a participant with four years or less of job tenure is considered short-tenured; between four and 16 years is considered mid-tenured; and longer than 16 years is considered long-tenured.
- Last, plans are assigned to three groups based on (1) whether plans are dominated by participants with low, middle, or high income; and (2) whether plans are dominated by participants with short, mid, or long tenure. A "dominant" group in a plan is defined only when the group participants account for more one-third of the plan participants.⁴ Thus, plans in the sample are classified into three groups based on dominant groups of the plans with respect to salary and tenure (see Figure 2).

Plan Demographics and Participants' Contribution Rates

As noted earlier, demographic characteristics of plan participants (or plan demographics) affect individual participant contribution rates, as peer effects influence participants' savings behavior (e.g., Madrian and Shea, 2000). Because two factors—participants' income and tenure—are used to define plan demographics, an empirical analysis starts with whether plan demographics based on participants' income and tenure are associated with participant contribution rates (i.e., the ratio of participant contributions to salary).

Figure 3 presents participant contribution rates with respect to age and salary by plan demographics, based on participants' income in the plan. The figure shows that participant contribution rates rise with age and income, as expected. The upper panel (with respect to age) indicates that participants in the plans dominated by those with high income tend to contribute, on average, more than participants in the plans dominated by those with low or middle

Figure 1
Distribution of Salary and Tenure in the Sample

Salary:		
Quartile 1 (Low income) Salary ≤ \$34,000	Quartiles 2 and 3 (Middle income) >\$34,000–\$80,000	Quartile 4 (High income) Salary > \$80,000
Tenure:		
Quartile 1 (Short-tenured) Tenure ≤ 4 years	Quartiles 2 and 3 (Mid-tenured) >4–16 years	Quartile 4 (Long-tenured) Tenure > 16 years

Source: Sample from the 2007 EBRI/ICI Participant-Directed Retirement Plan Data Collection Project.

Figure 2
Plan Classifications, by Salary and Tenure

	Plan Classifications, by Salary	
	Number of Plans	Number of Participants
Plans dominated by participants with <i>low</i> income	642	356,930
Plans dominated by participants with <i>middle</i> income	2,574	1,294,642
Plans dominated by participants with <i>high</i> income	499	321,186
Nonclassified groups	225	3,016
Total	3,940	1,975,774
	Plan Classifications, by Tenure	
	Number of Plans	Number of Participants
Plans dominated by participants with <i>short</i> tenure	904	178,494
Plans dominated by participants with <i>mid</i> tenure	2,534	1,446,885
Plans dominated by participant with <i>long</i> tenure	360	348,289
Nonclassified groups	142	2,106
Total	3,940	1,975,774

Source: Sample from the 2007 EBRI/ICI Participant-Directed Retirement Plan Data Collection Project.

income. There is a significant difference in contribution rates (about 3–4 percentage points) between the plans dominated by those with low income and the plans dominated by those with high income. It is also noteworthy that participant contributions increase sharply after age 50. The increases may result from the catch-up contribution allowed under the IRC at age 50 and above. The lower panel (with respect to salary) also illustrates that participants in plans dominated by those with high income tend to contribute, on average, more than participants in plans dominated by those with low income. The average difference between the plans dominated by those with low income and high income is about 1–2 percentage points. Participant contribution rates in the plans dominated by participants with middle and high income seem to take a hump shape, with a peak of \$100,000–\$120,000 in income, which is likely related to the maximum contribution limit.⁵

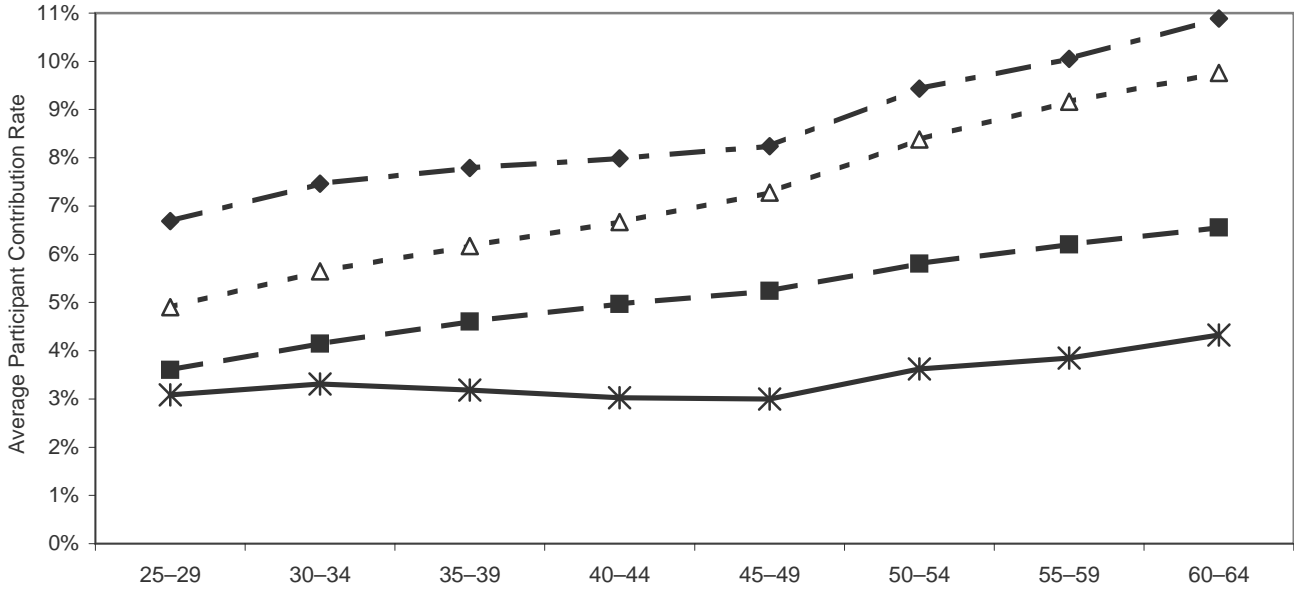
Participant contribution rates also differ by plan demographics based on participants' tenure in the plan, as shown in Figure 4. The figure illustrates that participants in plans dominated by those with long tenure tend to contribute more than those in plans dominated by short-tenure participants. The average difference between plans dominated by those with short and long tenure is about 1–2 percentage points. The patterns of participant contribution rates with respect to age and salary are similar to those of plan demographics based on participants' income in the plan.

As long as participant contribution rates are associated with plan demographics categorized by income and tenure (as shown in Figures 3 and 4), both income and tenure should be considered to define plan demographics. In this case, the sample is divided into nine groups based on both income and tenure categories, as in Figure 5. Groups I, V, and IX are focused, because they provide the most contrasting results.

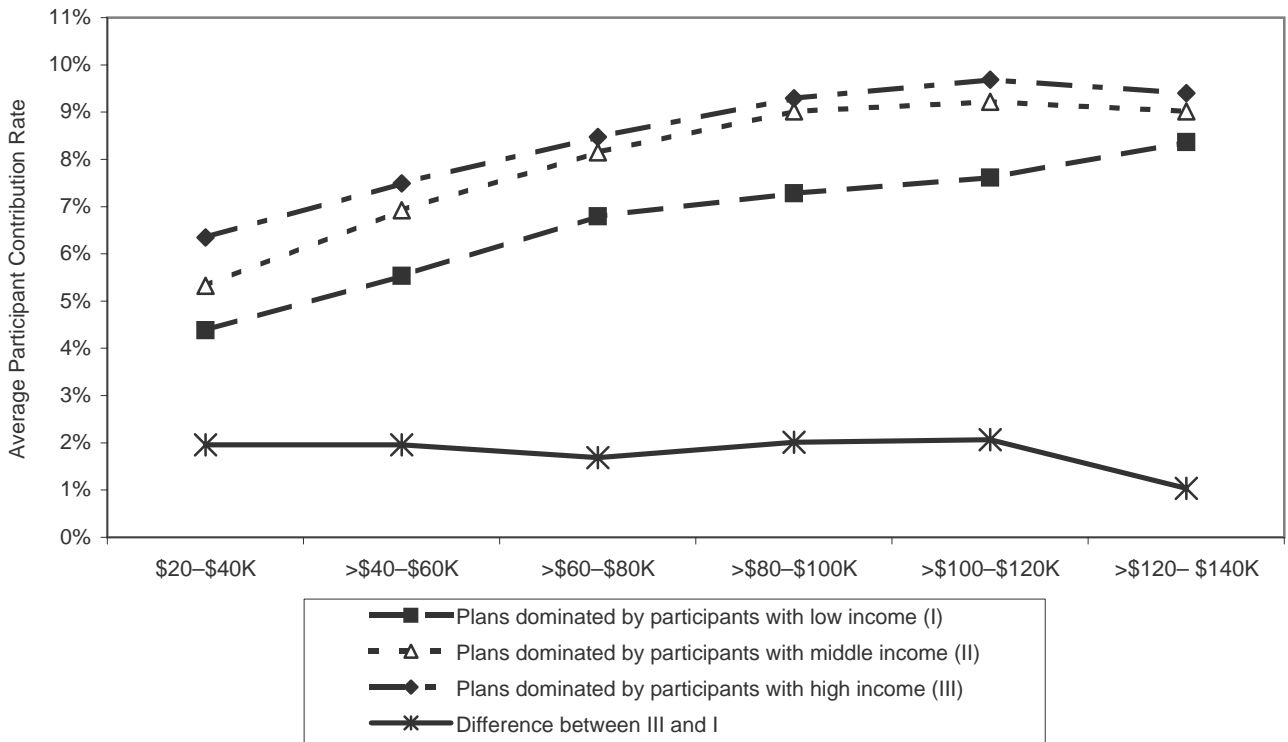
Participant contribution rates with respect to age and salary differ in plan demographics based on participants' income and tenure. Figure 6 presents participant contribution rates with respect to age and salary in Groups I, V, and IX. The last panel indicates the mean difference in the average participant contribution rates between Groups I and IX. When

Figure 3
Participant Contribution Rate by Plan Demographics
(Based on Participants' Income), by Age and Salary

By Age

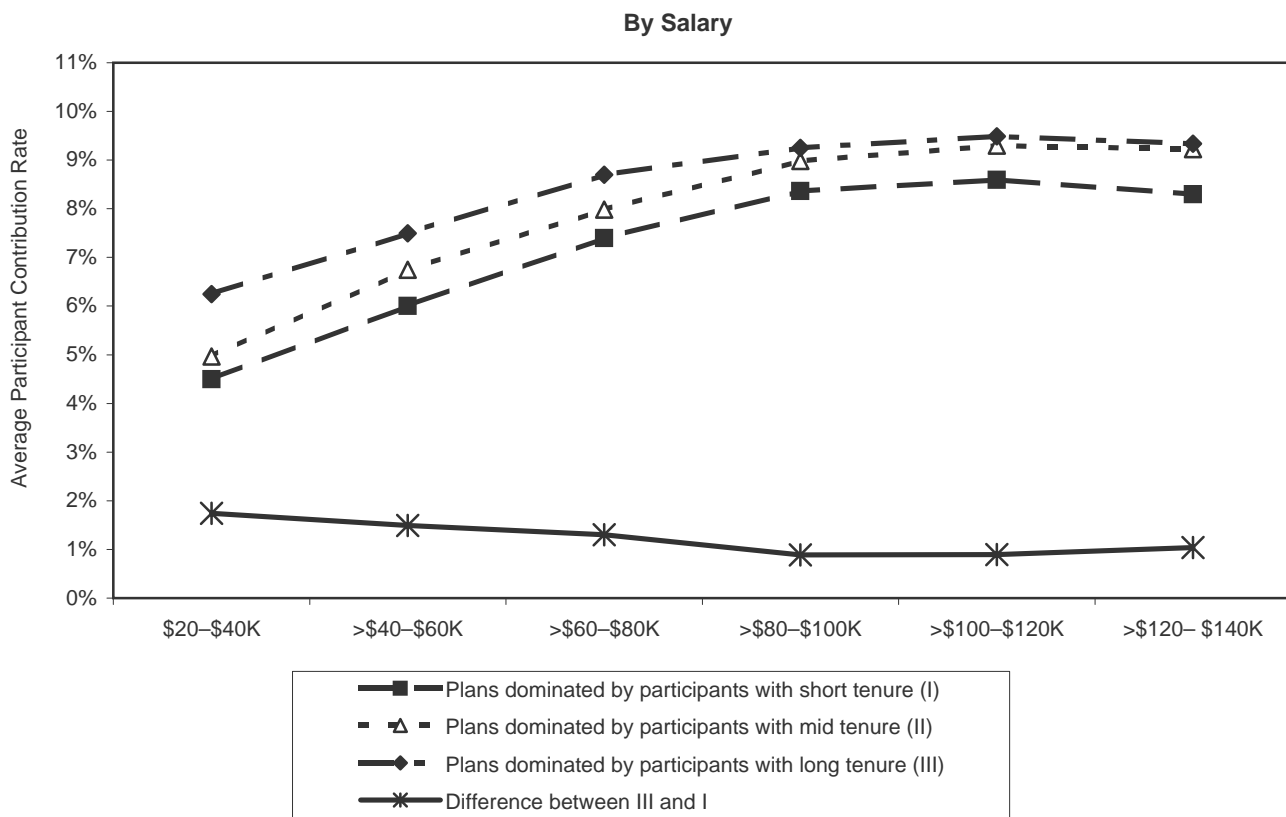
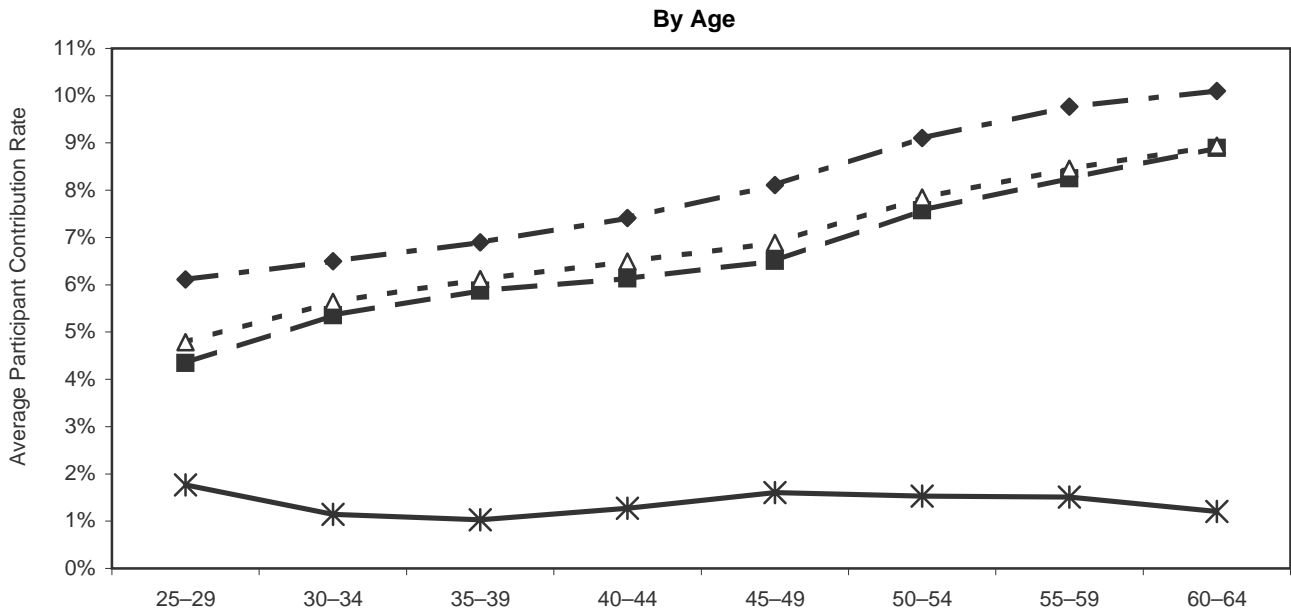


By Salary



Source: Sample from the 2007 EBRI/ICI Participant-Directed Retirement Plan Data Collection Project.

Figure 4
**Participant Contribution Rate by Plan Demographics
 (Based on Participants' Tenure), by Age and Salary**



Source: Sample from the 2007 EBRI/ICI Participant-Directed Retirement Plan Data Collection Project.

Figure 5
Plan Classifications, by Income and Tenure

		Tenure		
		Short	Mid	Long
		(≤4 years)	(>4–16 years)	(>16 years)
Income (salary)	Low (≤\$34,000)	I (Low, Short)	II (Low, Mid)	III (Low, Long)
	Middle (>\$34,000–\$80,000)	IV (Middle, Short)	V (Middle, Mid)	VI (Middle, Long)
	High (>\$80,000)	VII (High, Short)	VIII (High, Mid)	IX (High, Long)
		Number of Plans	Number of Participants	
Group by Plan Demographics	Group I (Plans dominated by participants with Low Income and Short Tenure)	128	18,284	
	Group V (Plans dominated by participants with Middle Income and Mid-Tenure)	1,707	884,316	
	Group IX (Plans dominated by participants with High Income and Long Tenure)	50	53,883	

Source: Sample from the 2007 EBRI/ICI Participant-Directed Retirement Plan Data Collection Project.

participants are in plans dominated by those with low income and short tenure (Group I), they tend to contribute about 2–4 percentage points less than those in the plans dominated by participants with high income and long tenure (Group IX). For example, participants ages 45–49, with a salary of \$60,000–\$80,000, in a plan dominated by those with low income and short tenure, tend to contribute (on average) 2.2 percentage points less than those in a plan dominated by high-income and long-tenure participants. The lower contribution rates in the plans dominated by those with low income and short tenure is consistent across age and salary groups. The results presented in the last panel suggest that plan demographics significantly affect participants' saving behavior, as peer effects do (e.g., Madrian and Shea, 2000).⁶

Plan Demographics and Target-Date Fund Investments

Since peer effects are known to have an impact on 401(k) plan participants' investment decisions (Duflo and Saez, 2002), plan demographics also would be expected to have an impact on participants' target-date fund investments. To examine this, the study focuses only on *pure target-date fund holders*, which is defined as plan participants holding target-date funds which account for 90 percent or more of their account balances. By examining only pure target-date fund holders, this study is able to control for potential interactions of target-date fund investments and other fund investments in the plan menu.⁷ Pure target-date fund holders account for about a third (33 percent) of those using target-date funds in the sample.

Because pure target-date fund holders may hold one or more target-date funds in their accounts, target-date funds chosen by the participants are converted to a *balance-weighted* equity allocation. For example, if a participant holds only one 2045 fund, which holds 90 percent of its assets in equities, the participant's equity allocation would be 90 percent. However, if a participant equally invests in 2030 and 2045 funds which hold 80 percent and 90 percent in equities, respectively, the participant's equity allocation would be 85 percent.

Figure 6
Average Participant Contribution Rates, by Plan Demographics
(Based on Participants' Income and Tenure)

Group I: Plans Dominated by Participants With Low Income and Short Tenure

Age \ Salary	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
\$20-\$40K	3.1%	3.4%	3.8%	4.3%	4.3%	5.0%	5.4%	6.2%
>\$40-\$60K	3.8	4.1	3.9	4.8	5.3	6.2	6.8	7.2
>\$60-\$80K	4.5	4.9	5.1	5.7	6.1	6.3	6.5	7.9
>\$80-\$100K	5.1	5.8	5.4	6.0	5.4	6.9	7.3	8.1
>\$100-\$120K	6.1	5.3	5.5	5.7	5.8	6.8	8.9	9.6
>\$120-\$140K	5.0	5.4	5.5	5.0	5.6	7.5	5.8	8.1

Group V: Plans Dominated by Participants With Middle Income and Mid Tenure

Age \ Salary	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
\$20-\$40K	4.0%	4.4%	4.7%	5.2%	5.7%	6.2%	6.8%	7.7%
>\$40-\$60K	5.1	5.4	5.8	6.3	7.0	8.1	9.0	10.1
>\$60-\$80K	6.6	6.6	6.8	7.2	7.7	8.9	9.9	10.9
>\$80-\$100K	7.1	7.6	7.9	8.1	8.5	9.9	10.9	11.9
>\$100-\$120K	7.0	8.1	8.2	8.3	8.5	10.0	10.9	11.6
>\$120-\$140K	7.5	7.8	8.1	8.2	8.3	9.9	10.5	11.0

Group IX: Plans Dominated by Participants With High Income and Long Tenure

Age \ Salary	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
\$20-\$40K	4.9%	5.4%	5.7%	6.2%	6.7%	7.5%	7.9%	8.9%
>\$40-\$60K	5.6	5.9	5.9	6.3	7.6	8.7	8.8	9.7
>\$60-\$80K	7.0	6.7	6.8	7.5	8.2	9.2	9.8	10.8
>\$80-\$100K	8.3	7.6	7.8	8.3	8.9	9.4	10.1	11.4
>\$100-\$120K	7.9	8.4	8.3	8.9	9.3	10.2	10.4	11.2
>\$120-\$140K	9.1	8.4	8.5	8.5	9.1	9.9	10.4	11.3

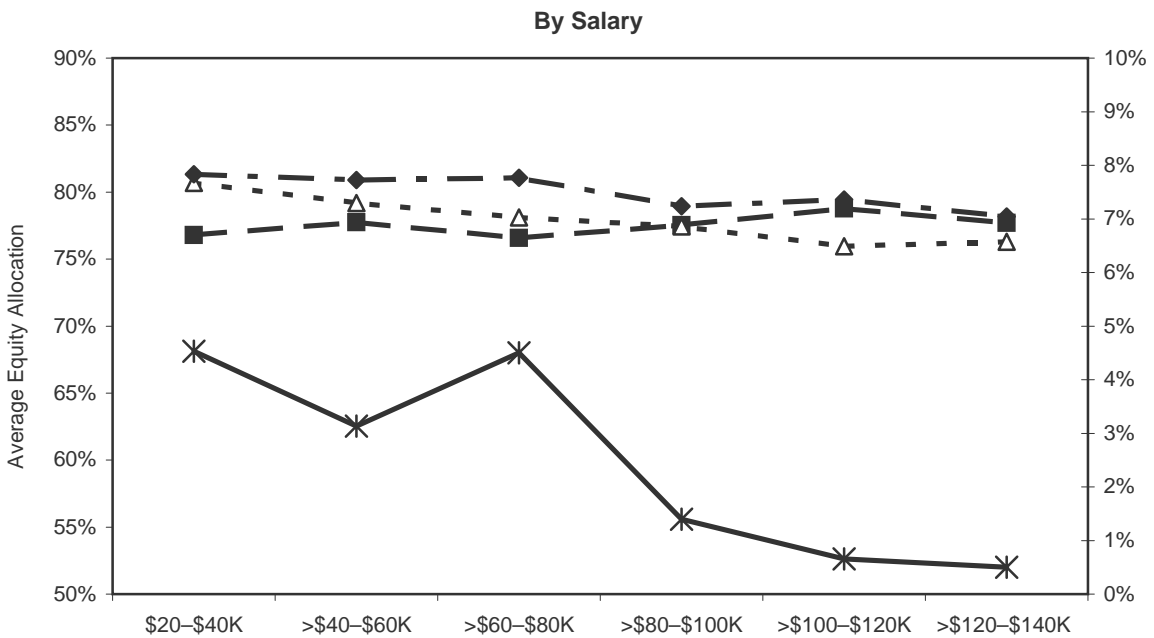
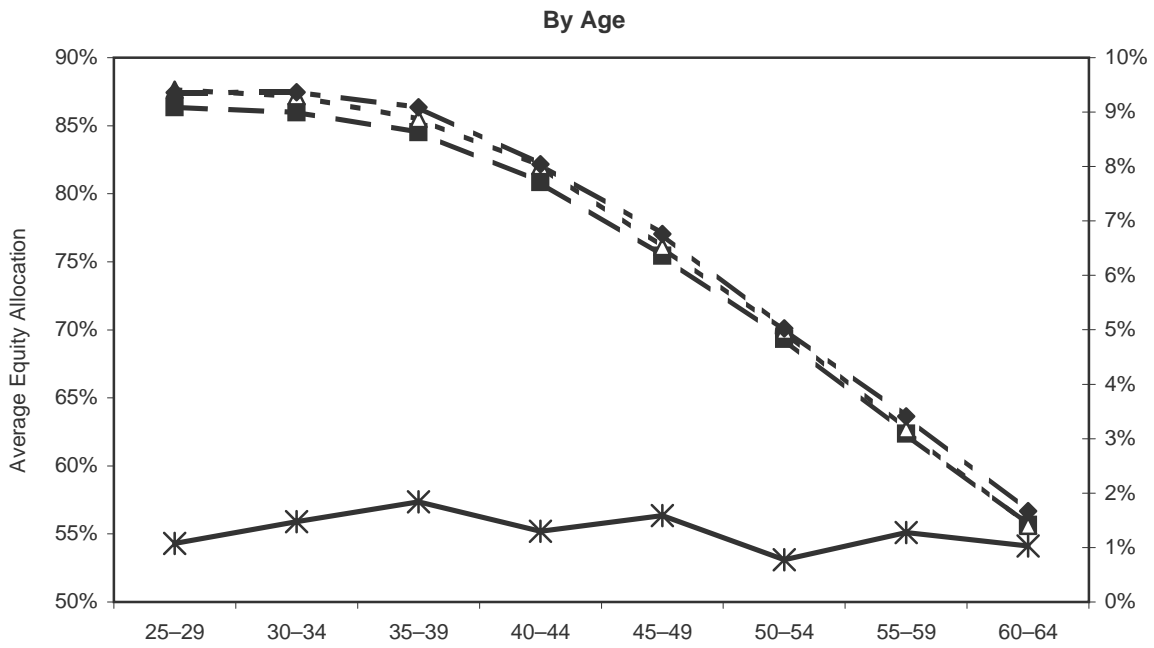
Mean Difference in Employee Contribution Rates Between Groups I and IX*

Age \ Salary	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
\$20-\$40K	1.8%	2.0%	1.9%	1.9%	2.4%	2.5%	2.5%	2.6%
>\$40-\$60K	1.9	1.7	2.0	1.5	2.3	2.4	2.0	2.5
>\$60-\$80K	2.5	1.9	1.8	1.8	2.2	2.8	3.3	2.9
>\$80-\$100K	3.2	1.8	2.4	2.3	3.5	2.5	2.8	3.3
>\$100-\$120K	1.8	3.1	2.9	3.2	3.5	3.4	1.6	1.6
>\$120-\$140K	4.1	3.0	2.9	3.5	3.5	2.4	4.6	3.2

Source: Sample from the 2007 EBRI/ICI Participant-Directed Retirement Plan Data Collection Project.

* Figures in this panel are obtained by subtracting the figures of Group I from those of Group IX. Minor discrepancies exist due to rounding.

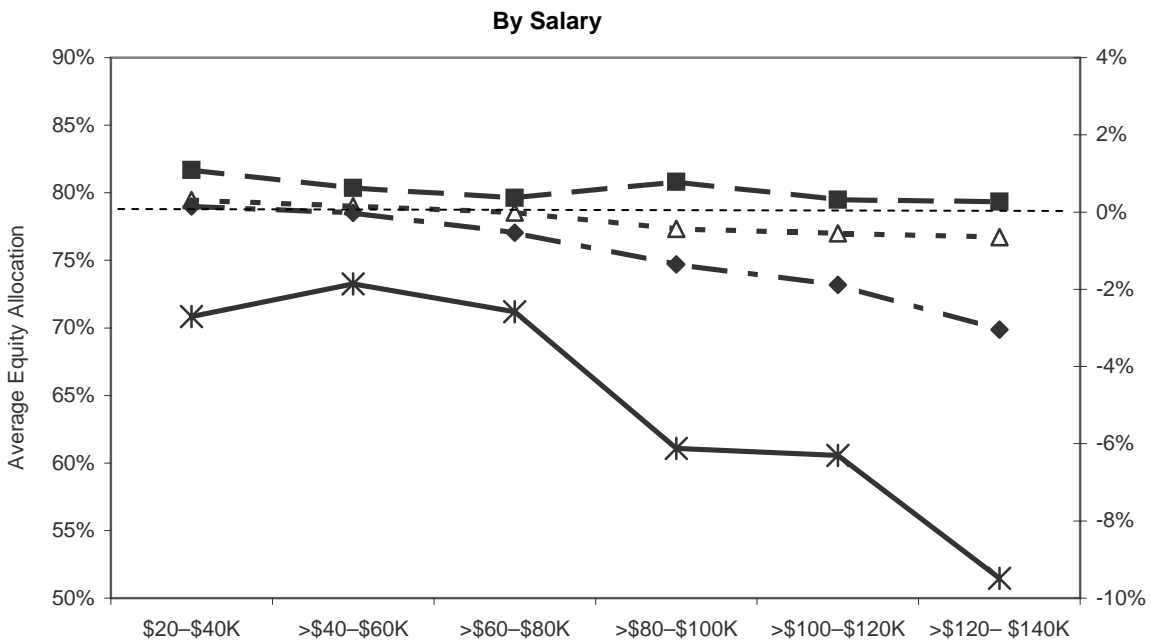
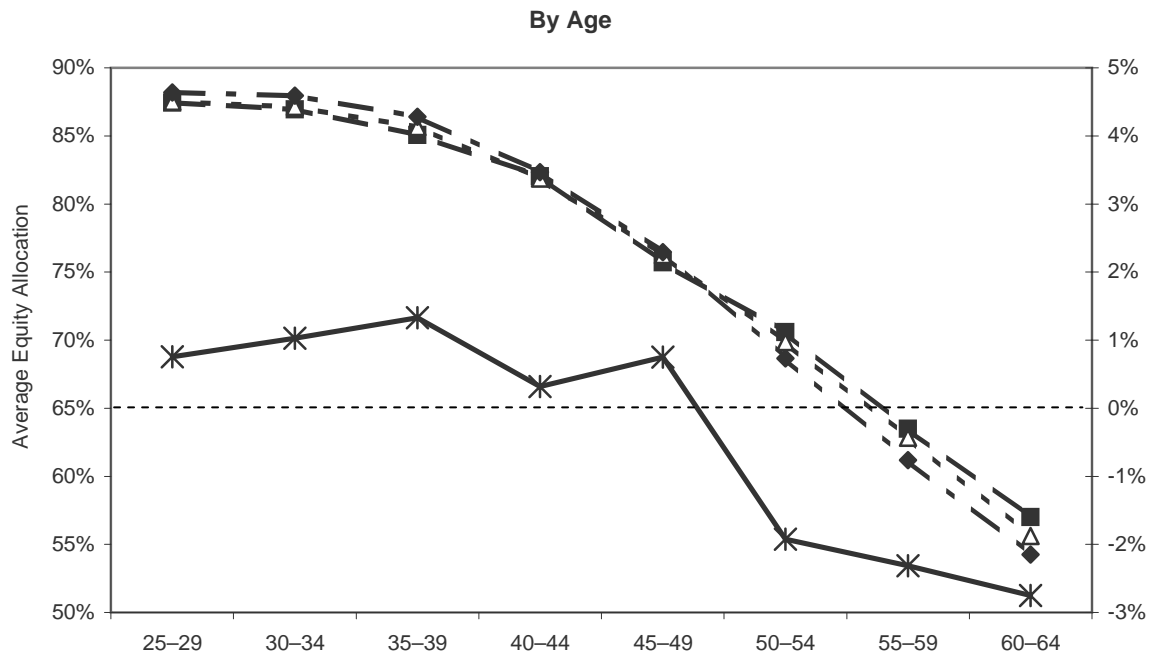
Figure 7
**Equity Allocation of Pure Target-Date Fund Users,
 by Plan Demographics (Based on Participants' Income)**



■— Plans dominated by participants with low income (I)
 -▲- Plans dominated by participants with middle income (II)
 ◆- Plans dominated by participants with high income (III)
 *— Difference between III and I (right scale)

Source: Sample from the 2007 EBRI/ICI Participant-Directed Retirement Plan Data Collection Project.

Figure 8
**Equity Allocation of Pure Target-Date Fund Users,
 by Plan Demographics (Based on Participants' Tenure)**



■— Plans dominated by participants with short tenure (I)
 ▲— Plans dominated by participants with mid tenure (II)
 ◆— Plans dominated by participants with long tenure (III)
 *— Difference between III and I (right scale)

Source: Sample from the 2007 EBRI/ICI Participant-Directed Retirement Plan Data Collection Project.

Participants in plans dominated by those with high income tend to hold target-date funds with higher equity allocations than those in the plans dominated by participants with low income, but the differences in equity allocations between two groups are small (e.g., on average 1–3 percentage points). Figure 7 presents the average equity allocation of pure target-date fund holders with respect to age and salary by plan demographics, based on plan participants' income. The upper panel indicates that the difference in the average equity allocation between groups dominated by participants with low income and those with high income is about 1–2 percentage points across age groups. The lower panel indicates that the difference in the average equity allocation between the two groups is 3–5 percentage points up to a salary of \$80,000, and about 1 percentage point over \$80,000.

However, when plans are classified by participants' tenure, the average equity allocation of pure target-date fund holders by age and salary shows different patterns from those based on participants' income. Figure 8 presents the average equity allocation by age and salary. The upper panel illustrates that participants in plans dominated by those with long tenure tend to hold target-date funds with higher equity allocations than participants in plans dominated by those with short tenure, up to age 49. However, at age 50 and older, a change occurs. Participants in plans dominated by those with short tenure tend to hold target-date funds with higher equity allocations.

The lower panel shows a different pattern of average equity allocation among the three groups from the previous ones: Participants in short-tenure plans tend to hold target-date funds with higher equity allocations, compared with participants in long-tenure plans. However, this pattern may not represent the average equity allocation of the entire age group. For example, in plans dominated by those with *short tenure*, most participants with higher income (greater than \$80,000) would likely be 40–44 years old, when considering that their average equity allocation is about 80 percent (see the upper panel of Figure 8). Thus, in order to find whether plan demographics would be associated with participants' equity allocation, both age and salary need to be taken into account at the same time.

As in Figure 6, Figure 9 highlights three groups: Group I (plans dominated by participants with low income and short tenure), V (plans dominated by participants with middle income and mid tenure), and IX (plans dominated by participants with high income and long tenure). Figure 9 presents the median equity allocation of pure target-date fund holders with respect to age and salary in Groups I, V, and IX. The last panel indicates the difference in the median equity allocation between Groups I and IX.^{8, 9}

Regarding equity allocations of pure target-date fund holders, their age drives changes, but salary does not. In a given age group, the equity allocation of target-date fund holders varies little with respect to salary. This is consistent regardless of plan demographics. However, with respect to plan demographics, there is significant difference in the equity allocations between Groups I and IX. In particular, when participants are in plans dominated by those with low income and short tenure (Group I), they tend to hold target-date funds with lower equity allocations than participants in high-income and long-tenure plans (Group IX) up to age 54. For participants of Group I, holding target-date funds with lower equity allocations may be related to their having less "risk capacity"—participants in low-income, short-tenure plans may have less risk capacity because their income over a lifetime working career is less predictable compared with those in the other group (Group IX).¹⁰ Besides their potential lower risk capacity, the participants' holding target-date funds with lower equity allocations may result from the selection of target-date funds offered by plan sponsors, but this needs further study.¹¹

However, a change occurs at around age 54 and older. Participants that age in plans dominated by those with low income and short tenure (Group I) tend to hold target-date funds with higher equity allocations than those of the counterpart group (Group IX). This may reflect a change in asset allocation strategies of participants in low-income, short-tenure plans. At age 55 and older, they may want to take a little more risk in an effort to increase their account balances, but this also needs further research.

Overall empirical results support the point that participants' saving behavior (meaning their contribution rate) and target-date fund investments differ by plan demographics—which suggests plan demographics should be taken into account when examining the impact of different equity glide paths on the retirement success rate.

Figure 9
Median Equity Allocation of Pure Target-Date Fund Users, by Plan Demographics
(Based on Participants' Income and Tenure)

Group I: Plans Dominated by Participants With Low Income and Short Tenure

Age \ Salary	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
\$20-\$40K	84.8%	84.0%	84.0%	78.0%	78.0%	67.0%	67.0%	53.0%
>\$40-\$60K	87.0	84.0	78.5	78.0	78.0	67.0	67.0	60.4
>\$60-\$80K	N/A	84.0	78.0	78.0	78.0	67.0	67.0	63.1
>\$80-\$100K	N/A	N/A	N/A	78.0	N/A	N/A	N/A	N/A
>\$100-\$120K	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
>\$120-\$140K	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Group V: Plans Dominated by Participants With Middle Income and Mid-Tenure

Age \ Salary	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
\$20-\$40K	89.2%	89.2%	89.3%	86.0%	78.5%	70.8%	63.1%	54.3%
>\$40-\$60K	89.2	89.2	89.3	86.0	78.5	70.8	63.1	54.3
>\$60-\$80K	89.2	89.2	89.3	86.0	78.5	70.8	63.1	54.3
>\$80-\$100K	89.2	89.2	89.3	86.0	78.5	70.8	63.1	54.3
>\$100-\$120K	89.2	89.2	89.3	86.0	78.5	70.8	63.1	54.3
>\$120-\$140K	89.2	89.2	89.3	79.1	78.5	70.8	63.1	54.3

Group IX: Plans Dominated by Participants With High Income and Long Tenure

Age \ Salary	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
\$20-\$40K	89.2%	89.2%	89.3%	86.0%	78.5%	70.8%	63.1%	N/A
>\$40-\$60K	89.2	89.3	89.3	86.0	78.5	70.8	63.1	54.3%
>\$60-\$80K	89.2	89.3	89.3	82.1	78.5	63.1	63.1	54.3
>\$80-\$100K	89.3	89.3	89.3	86.0	78.5	63.1	63.1	56.5
>\$100-\$120K	N/A	89.3	89.3	78.5	78.5	70.8	63.1	63.1
>\$120-\$140K	N/A	N/A	86.6	78.5	78.5	63.1	63.1	N/A

Difference in the Median Equity Allocation Between Groups I and IX*

Age \ Salary	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
\$20-\$40K	4.4%	5.2%	5.3%	8.0%	0.5%	3.8%	-3.9%	N/A
>\$40-\$60K	2.2	5.3	10.8	8.0	0.5	3.8	-3.9	-6.1%
>\$60-\$80K	N/A	5.3	11.3	4.1	0.5	-3.9	-3.9	-8.8
>\$80-\$100K	N/A	N/A	N/A	8.0	N/A	N/A	N/A	N/A
>\$100-\$120K	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
>\$120-\$140K	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Source: Sample from the 2007 EBRI/ICI Participant-Directed Retirement Plan Data Collection Project.

* Figures in this panel are obtained by subtracting the figures of Group I from those of Group IX. Minor discrepancies exist due to rounding.

Simulation: Plan Demographics and 401(k) Accumulations

To find whether pure target-date fund holders would achieve their target replacement income at retirement, this analysis simulates 401(k) accumulations based on the empirical findings of participant contribution rates and target-date investments by different plan demographics. Simulations are conducted for three groups—Groups I, V, and IX—which have different plan demographic characteristics.

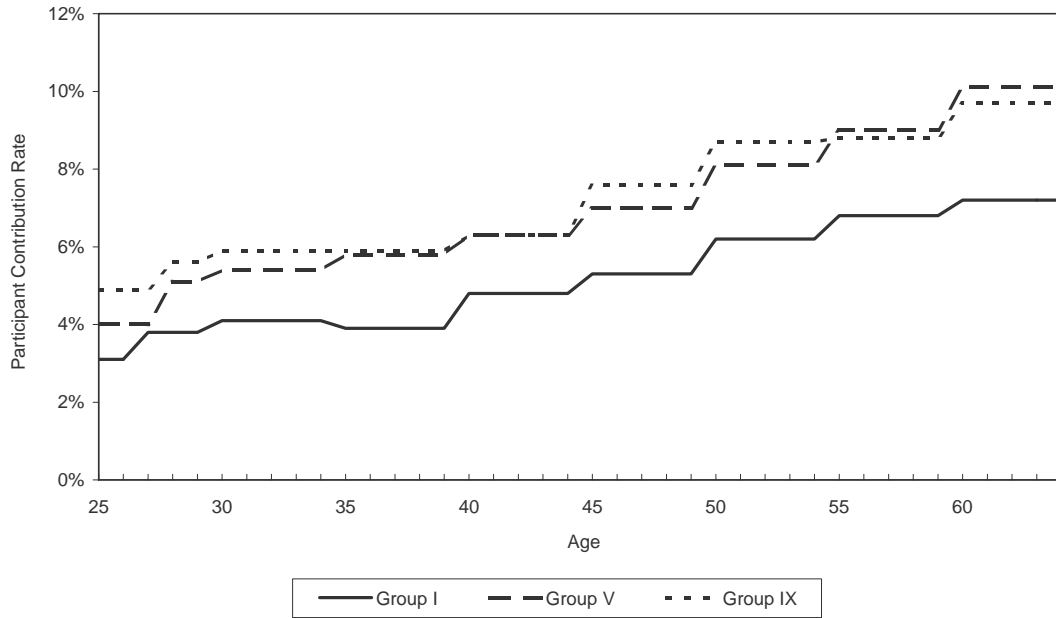
To simulate 401(k) accumulations at retirement, a hypothetical participant is assumed to be 25 years old in 2007 and planning to retire on his or her 65th birthday. The hypothetical participant is also assumed to start his or her career with a salary of \$36,056 in 2007 dollars, which is the median salary of participants at age 25 in the sample. The same starting salary (at age 25) is used to see if plan demographics are associated with 401(k) accumulations over a lifetime working career. The hypothetical participant works and contributes to his retirement account continuously for 40 years. Finally, the hypothetical participant is assigned to one of the three groups that have different plan demographic characteristics. Thus, the hypothetical participant in each group has the same age, retires at the same age (the 65th birthday), and has the same starting salary (\$36,056 in 2007 dollars).

Parameters for Simulation: Salary Growth Path, Contributions, and Investments

To simulate 401(k) account balances at retirement, certain assumptions need to be made on salary growth path, contributions, and investments until retirement (i.e., for 40 years):

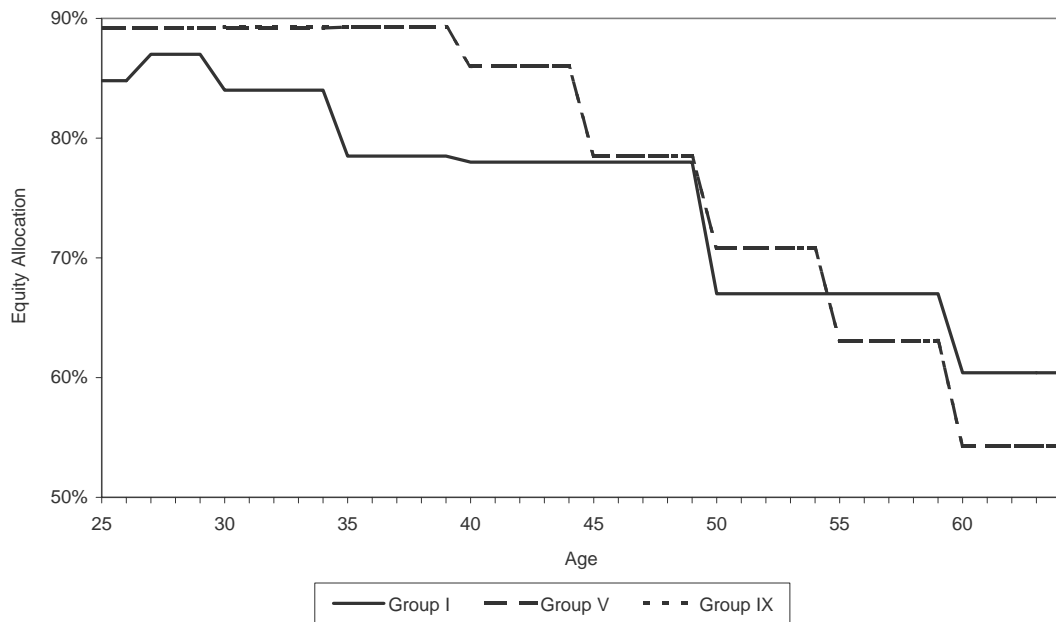
- First, the hypothetical participant in each group is assumed to follow the empirical salary growth path of each group over his or her lifetime working career. In other words, a salary growth path of each group obtained from the cross-sectional 2007 data is used as a salary growth path of the hypothetical participant in each group over the lifetime working career.¹²
- Second, the hypothetical participant in each group is assumed to contribute at the beginning of the year based on age and salary, following average participant contribution rates for each group presented in Figure 6. Figure 10 illustrates participant contribution rate paths of three hypothetical participants over their lifetime working careers. The contribution rate paths represent stepwise increases in the participant contribution rate, instead of fixed-rate or smoothing increases over the lifetime career. The stepwise-increasing participant contribution path might be close to the saving behavior of “real participants” when taking into account 401(k) plan participants’ inertia in terms of saving behavior.¹³ With respect to plan demographics, the hypothetical participant of Group I contributes 1.5–2.5 percentage points less than the hypothetical participant of Group IX over a working career. For the employer matching contribution, a single-tier formula of \$0.50 per dollar on 6 percent of salary is used, which is popular among 401(k) plan sponsors (Vanguard, 2008).
- Third, since this study focuses on pure target-date fund holders, the hypothetical participant in each group is assumed to invest only in target-date funds throughout his or her lifetime working career. In particular, the hypothetical participant in each group is assumed to follow the median (balance-weighted) equity allocation of the group with respect to age and salary (presented in Figure 9). Figure 11 illustrates the equity allocation paths of three hypothetical participants over their lifetime working careers. While an equity allocation path of Group V is very close to that of Group IX, the hypothetical participant of Group I chooses target-date funds with lower equity allocations for the first 30 years in his or her career than the counterpart of Group IX. However, a change occurs at age 54, which reflects the empirical finding (from Figure 9) that participants age 55 and older in plans dominated by those with low income and short tenure (Group I) tend to hold target-date funds with higher equity allocations than those of the counterpart groups (Groups V and IX).
- Last, to simplify the simulations for 401(k) accumulations, all target-date funds are assumed to have three asset classes: U.S. equity, non-U.S. equity, and fixed income. The equity portfolio in target-date funds is constructed with a 67 percent/33 percent mix of U.S. equity and non-U.S. equity. The three asset classes are assumed to have the expected rate of returns, standard deviation, and correlations shown in Figure 12, which follows a study by Gardner and Fan (2006). Target-date fund returns are net of expenses. Target-date funds are assumed to have an annual expense ratio of 80 basis points.¹⁴

Figure 10
**Participant Contribution Rate Paths of Hypothetical
 Participants, by Plan Demographics**



Source: Sample from the 2007 EBRI/ICI Participant-Directed Retirement Plan Data Collection Project.

Figure 11
**Equity Allocation Paths of Hypothetical
 Participants, by Plan Demographics**



Source: Sample from the 2007 EBRI/ICI Participant-Directed Retirement Plan Data Collection Project.
 Note: An equity allocation path of Group V is very close to that of Group IX.

Figure 12
Asset Class Return, Volatility, and Correlation

	Expected Return	Standard Deviation	Correlation Matrix	U.S. Equity	Non-U.S. Equity	Fixed Income
U.S. equity	8.9%	18.0%	U.S. equity	1		
Non-U.S. equity	8.9	19.1	Non-U.S. equity	0.54	1	
Fixed income	6.3	2.9	Fixed income	0.26	0.21	1

Source: Grant Gardner and Yuan-An Fan, *Russell's Approach to Target-Date Funds: Building a Simple and Powerful Solution to Retirement Saving*, August 2006.

Target Replacement Income at Retirement

Target replacement income at retirement indicates 401(k) accumulations at age 65.¹⁵ As a target replacement income, this study uses an 81 percent replacement rate in relation to final five-year average salary from 401(k) accumulations, following an AON Consulting study on replacement ratios (2008). The AON study provides a set of total replacement ratios that are required to maintain a person's pre-retirement standard of living. Total replacement ratios are described in the range of \$20,000–\$90,000 with increments of \$10,000. Several studies (including the AON study) suggest that the replacement rate needed to provide the same standard of living (after adjusting for taxes, savings, and age-specific expenditure patterns) in retirement that was experienced in the years immediately preceding retirement will vary with the level of pre-retirement income. For purposes of this *Issue Brief*, the final five-year average salaries of the hypothetical participants are \$48,000–\$55,000 (in 2007 dollars); therefore, an 81 percent replacement rate was used corresponding to the suggested level for an employee with \$50,000 in pre-retirement income in the 2008 AON study.

To find a replacement rate from 401(k) accumulations, the replacement rate from the Social Security benefit is subtracted from the total replacement rate (81 percent). The replacement rate from Social Security is obtained by calculating a Social Security benefit for a person who has the same earnings history as the hypothetical participant in each group. Social Security benefits of the hypothetical participants would replace 42 percent (Group I), 40 percent (Group V), and 38 percent (Group IX) of the pre-retirement income, respectively. Therefore, 401(k) accumulations would need to replace 39 percent (Group I), 41 percent (Group V), and 43 percent (Group IX) of the pre-retirement income of the participants, respectively. Target replacement rates later extend to a range of 30 to 60 percent to examine the impact of different equity glide paths on the retirement success rate for the hypothetical participant in each group. Real replacement rates are used in the study by assuming that the hypothetical participant in each group purchases a single life *real* annuity at the 65th birthday, which provides a certain replacement rate of the final five-year average salary.¹⁶

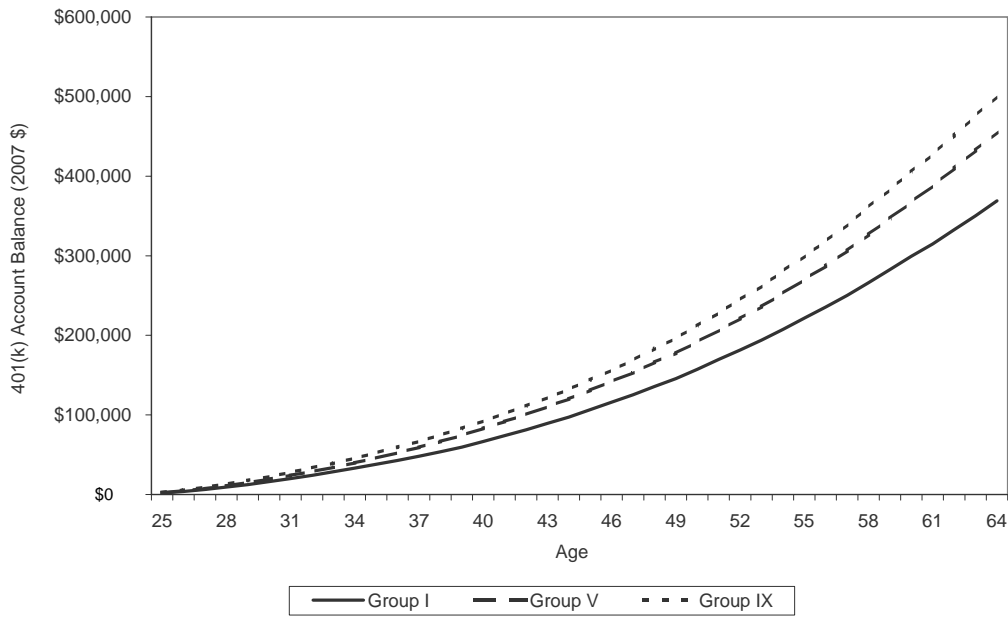
Simulation Results

This simulation calculates 10,000 separate lifetime scenarios using Monte Carlo models.¹⁷ Figure 13 presents the median 401(k) accumulations for the hypothetical participants of three groups by plan demographics. The three hypothetical participants contribute for 40 years with the same starting salary of \$36,056 (in 2007 dollars) starting at age 25. However, their 401(k) accumulations at the end of age 64 are quite different.

For example, in terms of the median account balance, the hypothetical participant in Group I would have about \$370,000 (in 2007 dollars), while the hypothetical participant in Group IX would accumulate about \$501,000 (in 2007 dollars).¹⁸ The difference in the median 401(k) account balances between Groups I and IX reaches about \$132,000 in 2007 dollars. In a given set of portfolio returns of target-date funds, the differences in 401(k) accumulations of the three hypothetical participants come from different contribution rates and different target-date fund investments (i.e., investments in target-date funds with different equity allocations) over a lifetime working career.

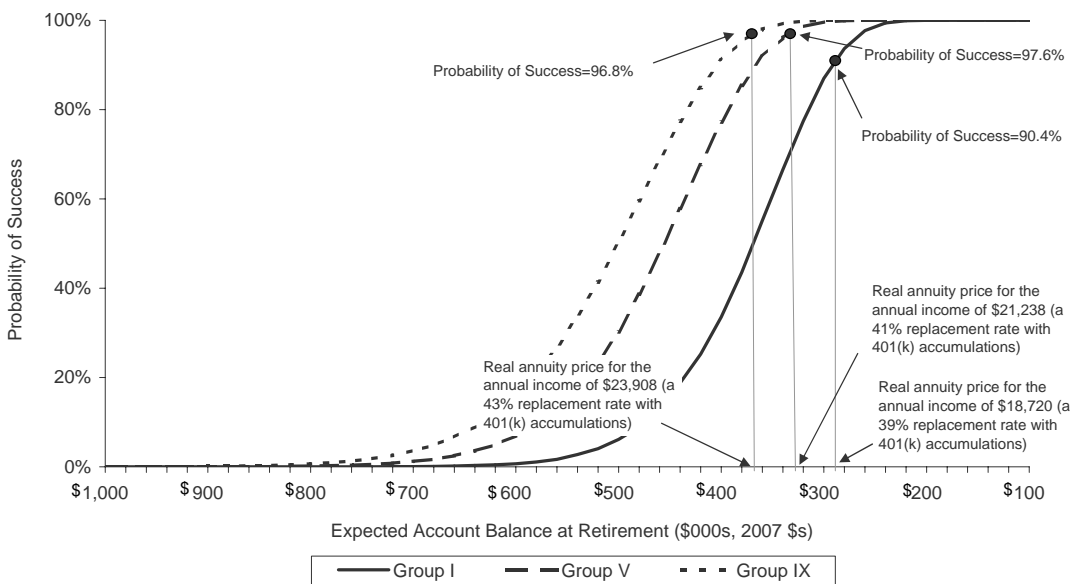
The hypothetical participant of Group IX has a higher probability of having sufficient account balances at retirement than the hypothetical participants of the counterpart groups (Groups I and V). Figure 14 illustrates the distribution of success rates in meeting the expected account balance at retirement (i.e., the 65th birthday). The distribution of the success rate of Group I is dominated by that of Group V, or IX in the range of \$220,000–\$920,000. The success rate of the hypothetical participant in Group I is consistently over 13 percentage points lower than that of the participant in Group V, or IX in the range of \$300,000–\$500,000.

Figure 13
Median 401(k) Accumulations of Hypothetical Participants, by Plan Demographics



Source: Simulations using the 2007 EBRI/ICI Participant-Directed Retirement Plan Data Collection Project.

Figure 14
Distribution of Success Rate in Meeting the Expected Account Balance at Retirement (Turning Age 65)



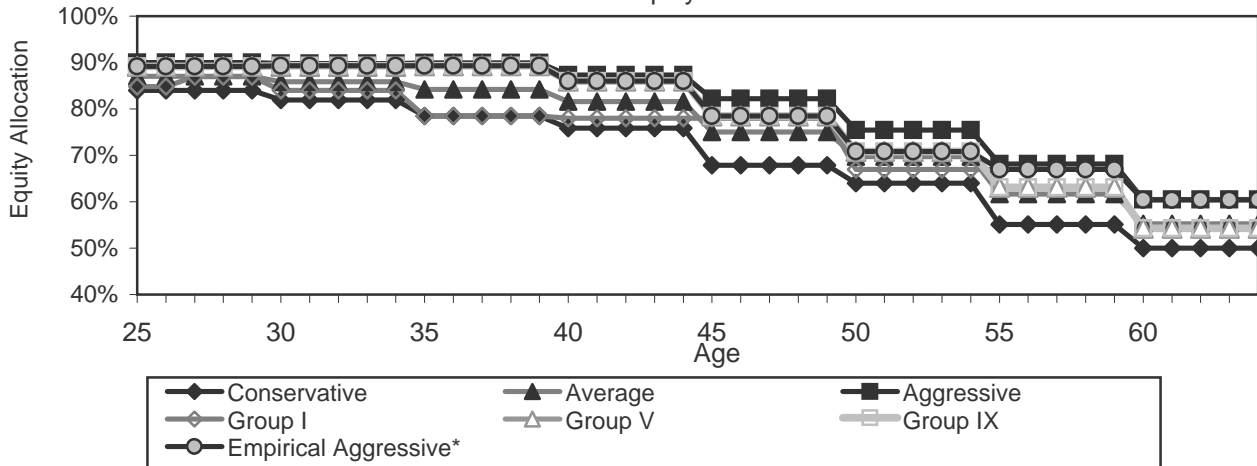
Source: Simulations using the 2007 EBRI/ICI Participant-Directed Retirement Plan Data Collection Project.

Figure 15
Equity Glide Paths: Conservative, Average, Aggressive,
Groups I, V, IX, and Empirical Aggressive

Panel A: Asset Allocation Paths

Portfolio	Years to Retire	Equity (U.S. Equity and Non-U.S. Equity)	Fixed Income
Conservative	40	84.0%	16.0%
	30	78.5	21.5
	20	67.9	32.1
	10	55.1	44.9
	5	50.0	50.0
Average	40	87.0	13.0
	30	84.2	15.8
	20	75.1	24.9
	10	61.6	38.4
	5	55.3	44.7
Aggressive	40	90.0	10.0
	30	89.9	10.1
	20	82.2	17.8
	10	68.1	31.9
	5	60.5	39.5
Group I	40	84.8	15.2
	30	78.5	21.5
	20	78.0	22.0
	10	67.0	33.0
	5	60.4	39.6
Group V	40	89.2	10.8
	30	89.3	10.7
	20	78.5	21.5
	10	63.1	36.9
	5	54.3	45.7
Group IX	40	89.2	10.8
	30	89.3	10.7
	20	78.5	21.5
	10	63.1	36.9
	5	54.3	45.7
Empirical Aggressive*	40	89.2	10.8
	30	89.3	10.7
	20	78.5	21.5
	10	67.0	33.0
	5	60.4	39.6

Panel B: Equity Glide Paths



Source: Simulations using the 2007 EBRI/ICI Participant-Directed Retirement Plan Data Collection Project, and author's calculations using the information on target-date funds in the market.

* The empirical aggressive equity glide path (or the equity glide path of the outer boundary equity allocation) takes an equity allocation path of Group IX up to age 54 and an equity allocation path of Group I after age 55 and older.

The hypothetical participant in each group has a high probability of having sufficient account balances to purchase the single-life real annuity at age 65. For example, the three hypothetical participants have a greater than 90 percent success rate. The success rates, however, would be overstated, because the hypothetical participants in the study are assumed to contribute to retirement accounts continuously for 40 years. Real participants may take loans against 401(k) account balances, reduce or suspend their contributions to the plans, and/or make near-retirement age withdrawals (which they are allowed to do without tax penalty starting at age 59½).¹⁹ Thus, the greater likelihood that participants experience these events over a lifetime working career is more likely to shift the distribution of the success rate (presented in Figure 14) to the right (or downward).

Overall simulation results indicate that participants in plans dominated by those with low income and short tenure (Group I) are expected to have a lower success rate in meeting the target replacement income at retirement than those of the counterpart plans (i.e. plans dominated by participants with middle income and mid tenure (Group V) and high income and long tenure (Group IX)).

In the next section, several counterfactual experiments are conducted to investigate the impact of different equity glide paths on retirement success rates for hypothetical participants at different starting ages for various groups which vary in terms of income paths and contribution rates over time.

Counterfactual Experiments

Four counterfactual experiments are conducted with the three groups (Groups I, V, and IX). In each experiment, changes in the success rates are examined for expected account balances at retirement. The experiments include four cases: the hypothetical participant in each group takes the equity allocation paths of (1) conservative, (2) average, (3) aggressive portfolios, and (4) the outer boundary equity allocation of the three groups (or the *empirical* aggressive glide path). Based on actual target-date funds in the marketplace in 2007, the equity glide paths of conservative, average, and aggressive portfolios are constructed over a lifetime working career.²⁰ The equity glide path of the outer boundary equity allocation (or the empirical aggressive glide path) takes an equity allocation path of Group IX up to age 54 and an equity allocation path of Group I after age 55 and older (see Figure 11). Because counterfactual experiments focus on investigating the impact of different equity glide paths on retirement success rates (as defined in this *Issue Brief*) for stylized participants, each participant's contribution rate path is given by his or her own group path.

Figure 15 illustrates equity glide paths of conservative, average, and aggressive portfolios, Groups I, V, IX, and the empirical aggressive portfolio.²¹ The equity allocation path of Group I is closer to the conservative equity glide path than the aggressive glide path, except for ages 45–49 and 55–64. The equity allocation path of Group IX is closer to the aggressive equity glide path up to age 59. The empirical aggressive glide path is close to but lower than the aggressive equity glide path over a lifetime working career.

Figure 16 presents the probability of success in meeting the expected account balance at retirement and the expected account balance with certain success (or failure) rates at retirement. In Panels A to C, the first column indicates 401(k) accumulations at retirement (i.e., the 65th birthday) in 2007 dollars. The second and third columns indicate real replacement rates with 401(k) accumulations and both 401(k) accumulations and Social Security benefits, respectively. The fourth through eighth columns present the probabilities of success in meeting the expected account balance, when the hypothetical participants take their own equity allocation paths (the empirical aggressive, the conservative, the average, and the aggressive equity glide paths), in a row. The last column indicates a choice among three alternative equity glide paths (conservative, average, and aggressive glide paths), with a criterion of which glide path would have a higher probability of success when it is taken by the participant in the group.

The results of Panels A to C indicate that the conservative glide path has the higher probability of success for lower account balances, while the aggressive glide path has the higher probability of success for higher account balances. However, it should be noted that the differences in the success rates are small between different glide paths in many cases (e.g., at maximum about 9 percentage points in the range of \$200,000-\$500,000). When focusing on expected account balances with a specific failure rate (or 1 *minus* a success rate), the conservative equity glide path provides

Figure 16

Probability of Success In Meeting the Expected Account Balance at Retirement

Panel A: Group I

401(k) Accumulation at Retirement (\$000s, 2007 \$s)	Real Replacement Rate (with 401(k) accumulations and Social Security) ^a		Probability of Success				Choice (I to III)	
	27%	69%	Taking the equity allocation path of Group I	Taking the empirical aggressive equity glide path	Taking the conservative equity glide path (I)	Taking the average equity glide path (II)		Taking the aggressive equity glide path (III)
200			100.0%	100.0%	100.0%	100.0%	100.0%	b
220	30	72	99.9	99.9	100.0	99.9	99.9	Conservative
240	32	74	99.4	99.6	99.8	99.6	99.4	Conservative
260	35	77	97.7	98.0	98.8	98.1	97.3	Conservative
280	38	80	93.7	94.5	95.2	94.4	93.2	Conservative
300	40	82	87.0	88.1	88.4	87.6	86.3	Conservative
320	43	85	77.4	78.8	78.1	78.0	77.7	Conservative
340	46	88	66.6	68.0	64.9	66.1	66.9	Aggressive
360	48	90	55.2	56.7	51.2	54.1	56.2	Aggressive
380	51	93	43.6	44.9	38.5	42.0	45.4	Aggressive
400	54	96	33.6	35.1	27.0	31.9	35.7	Aggressive
420	56	98	25.2	26.2	18.7	23.3	27.4	Aggressive
440	59	101	18.8	19.5	12.3	16.5	20.4	Aggressive
460	62	104	13.1	14.0	7.8	11.3	15.1	Aggressive
480	64	106	8.9	9.5	4.9	7.6	10.8	Aggressive
500	67	109	6.1	6.6	2.9	5.2	7.6	Aggressive

Source: Simulations using the 2007 EBRI/ICI Participant-Directed Retirement Plan Data Collection Project.

^a For the hypothetical participant of A59 Group I, Social Security would replace 42% of the preretirement income (\$48,000, the final five-year average salary). A 42% replacement rate is obtained by calculating Social Security benefit for a person who has the same earnings history as the participant of Group I.

^b A choice is not made, because the probability of success is the same among at least two equity glide paths.

[continued next page]

Figure 16 (continued)

401(k) Accumulation at Retirement (\$000s, 2007 \$s)	Real Replacement Rate (with 401(k) accumulations and Social Security) ^a		Probability of Success				Choice (I to III)
	25%	65%	Taking the equity allocation path of Group V	Taking the empirical aggressive equity glide path	Taking the conservative equity glide path (I)	Taking the average equity glide path (II)	
200			100.0%	100.0%	100.0%	100.0%	b
220	27	67	100.0	100.0	100.0	100.0	b
240	30	70	100.0	100.0	100.0	100.0	b
260	32	72	100.0	100.0	100.0	100.0	b
280	35	75	99.9	99.9	100.0	99.9	Conservative
300	37	77	99.7	99.5	99.8	99.5	Conservative
320	40	80	98.6	98.1	98.9	98.3	Conservative
340	42	82	96.1	95.5	96.4	95.4	Conservative
360	45	85	91.9	90.9	91.9	90.8	Conservative
380	47	87	85.4	84.7	84.7	84.2	Conservative
400	50	90	77.2	76.8	75.3	75.7	Average
420	52	92	67.7	67.9	64.6	66.0	Aggressive
440	55	95	57.9	58.5	53.4	56.0	Aggressive
460	57	97	47.6	49.2	42.1	46.0	Aggressive
480	60	100	38.7	40.1	32.8	37.2	Aggressive
500	62	102	30.2	32.4	24.4	28.9	Aggressive

Source: Simulations using the 2007 EBRI/ICI Participant-Directed Retirement Plan Data Collection Project.

^a For the hypothetical participant of Group V, Social Security would replace 40% of the preretirement income (\$51,800, the final five-year average salary). The 40% replacement rate is obtained by calculating Social Security benefit for a person who has the same earnings history as the participant of Group V.

^b A choice is not made, because the probability of success is the same among at least two equity glide paths.
[continued next page]

Figure 16 (continued)

Panel C: Group IX

401(k) Accumulation at Retirement (\$000s, 2007 \$s)	Real Replacement Rate (with 401(k) accumulations and Social Security) ^a		Probability of Success				Choice (I to III)
	23%	61%	Taking the equity allocation path of Group IX	Taking the empirical aggressive equity glide path	Taking the conservative equity glide path (I)	Taking the average equity glide path (II)	
200	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	b
220	100.0	100.0	100.0	100.0	100.0	100.0	b
240	100.0	100.0	100.0	100.0	100.0	100.0	b
260	100.0	100.0	100.0	100.0	100.0	100.0	b
280	100.0	100.0	100.0	100.0	100.0	100.0	b
300	99.9	100.0	99.9	99.9	99.9	99.9	b
320	99.8	99.8	99.7	99.7	99.9	99.6	Conservative
340	99.4	99.4	99.2	99.2	99.5	99.3	Conservative
360	98.0	98.0	97.6	97.6	98.2	97.6	Conservative
380	95.3	94.7	94.7	94.7	95.5	94.7	Conservative
400	91.0	90.1	90.1	90.1	90.8	89.9	Conservative
420	84.9	84.4	84.4	84.4	84.1	83.7	Conservative
440	77.4	77.4	77.0	77.0	75.5	75.7	Average
460	68.7	68.5	68.5	68.5	65.5	66.9	Aggressive
480	59.6	59.6	60.2	60.2	55.2	57.6	Aggressive
500	50.3	51.7	51.7	51.7	44.5	48.5	Aggressive

Source: Simulations using the 2007 EBRI/ICI Participant-Directed Retirement Plan Data Collection Project.

^a For the hypothetical participant of Group IX, Social Security would replace 38% of the preretirement income (\$55,600, the final five-year average salary). The 38% replacement rate is obtained by calculating Social Security benefit for a person who has the same earnings history as the participant of Group IX.

^b A choice is not made, because the probability of success is the same among at least two equity glide paths.

Panel D: Expected Account Balance at Retirement, by Success (Failure) Rates and Equity Glide Paths

Group by Plan Demographics	Equity Glide Path	Success Rate (Failure Rate)				
		80% (20%)	70% (30%)	60% (40%)	50% (50%)	
Group I	Conservative	\$317,000	\$332,000	\$347,000	\$362,000	
	Average	316,000	333,000	351,000	367,000	
	Aggressive	315,000	334,000	353,000	371,000	
Group V	Conservative	391,000	410,000	428,000	446,000	
	Average	390,000	411,000	432,000	452,000	
	Aggressive	389,000	412,000	436,000	458,000	
Group IX	Conservative	431,000	451,000	471,000	490,000	
	Average	400,000	430,000	452,000	497,000	
	Aggressive	428,000	454,000	479,000	503,000	

Source: Simulations using the 2007 EBRI/ICI Participant-Directed Retirement Plan Data Collection Project.

Note: The expected account balances at retirement are denoted in 2007 dollars.

greater 401(k) accumulations with *lower* failure rates, while the aggressive equity glide path provides greater 401(k) accumulations with *higher* failure rates. Panel D illustrates that the hypothetical participants who take the conservative equity glide path would achieve greater 401(k) accumulations at retirement with a 20 percent or less failure rate, while those who take the aggressive equity glide path would achieve greater 401(k) accumulations at retirement with a 30 percent or more failure rate.

When the hypothetical participants purchase real annuities at retirement which provide the total real replacement rate of 81 percent along with Social Security benefits, the *conservative* equity glide path has the higher probability of success than the other glide paths (Panel A of Figure 17). For example, when the hypothetical participant of Group I takes the conservative equity glide path, the retirement success rate is over 92 percent. This is about 2 percentage points higher than the probability of success that the participant takes under the aggressive equity glide path to meet the target replacement income. Similarly, for the hypothetical participants of Groups V or IX, the conservative equity glide path is chosen over the aggressive equity glide path by the margin of about 2 percentage points. The results, however, are obtained by assuming that the hypothetical participants start to contribute at age 25 for 40 years. If the participants start to contribute later in their working career (e.g., at age 45), the aggressive equity glide path has a higher probability of success over the conservative glide path in order to meet the target replacement income (Panel C of Figure 17). For all the three groups, the aggressive equity glide path has the higher probability of success by 5–7 percentage points compared with the conservative equity glide path. Thus, the results presented in Figure 17 indicate that the equity glide paths with the highest success rates will vary with the age at which the participant is assumed to start contributing.

In order to find what glide path would achieve a higher success rate around the real annuity prices, the success rate of a hypothetical participant of Group I is examined, because the participant of Group I expects a higher success rate by taking alternative equity glide paths than what participants of the other groups do (see Panels A, B, and C of Figure 16). This examination is conducted on the assumption that the hypothetical participant starts to contribute at age 25 for 40 years.²² Figure 18 depicts changes in the probability of success in meeting the expected account balance of \$200,000–\$400,000 (in 2007 dollars) at retirement. A change in the probability of success is calculated by subtracting the success rates of Group I from the success rates of alternative equity glide paths. The conservative equity glide path performs better for the lower account balances than the other glide paths, while the aggressive glide path (including the *empirical* aggressive glide path) performs better for the higher account balances. Thus, the counterfactual experiments using four different equity glide paths (conservative, average, aggressive, and empirical aggressive) for three different starting ages simulate the impact of different equity glide paths on the stylized individuals. Similar findings are also obtained from the counterfactual experiments of Groups V and IX.²³

It should be noted that, although target-date funds with different equity glide paths affect the success rate for meeting target replacement income, *participant contribution rates* corresponding to *plan demographic characteristics* have a stronger impact on the success rate. In other words, the differences in the equity glide paths of target-date funds would have a second-order effect on the retirement success rate compared to participant contribution rates. For example, an increase or decrease in the success rate by adopting different equity glide paths is limited to 7 percentage points in either direction (see Figures 16, 17, and 18), while different participant contribution rates corresponding to plan demographic characteristics affect the success rate by 13–44 percentage points for account balances \$300,000–\$500,000 (see Figures 14 and 16).

Alternative Assumptions on Asset Class Returns and Volatilities

In the previous section, simulation results indicated that an equity glide path concerning plan demographics depends on target replacement income and its risk (in terms of failure rate). This section examines whether the finding is consistent when using different assumptions of asset class returns and volatilities. In particular, equity glide paths for the hypothetical participants of the three groups are investigated under the assumptions of (1) lower returns and volatility and (2) the historical returns and volatility of asset classes.

Figure 17

Probability of Success in Meeting Target Replacement Income at Retirement

Panel A: Starting to Contribute at Age 25 and Purchasing Real Annuity at Age 65

Real Replacement Rate With 401(k) Accumulations	Real Replacement Rate with 401(k) accumulations and Social Security ^a	Real Annuity Price (2007 \$) ^b	Probability of Success						Choice (I to III)
			Taking the equity allocation path of each own group	Taking the empirical aggressive equity glide path	Taking the conservative equity glide path (I)	Taking the average equity glide path (II)	Taking the aggressive equity glide path (III)		
Group I	39%	81%	\$291,000	90.4%	91.2%	92.1%	91.0%	89.9%	Conservative
Group V	41	81	330,000	97.6	97.0	97.9	97.1	96.1	Conservative
Group IX	43	81	371,000	96.8	96.2	97.1	96.2	95.2	Conservative

Panel B: Starting to Contribute at Age 35 and Purchasing Real Annuity at Age 65

Real Replacement Rate With 401(k) Accumulations	Real Replacement Rate with 401(k) accumulations and Social Security ^a	Real Annuity Price (2007 \$) ^b	Probability of Success						Choice (I to III)
			Taking the equity allocation path of each own group	Taking the empirical aggressive equity glide path	Taking the conservative equity glide path (I)	Taking the average equity glide path (II)	Taking the aggressive equity glide path (III)		
Group I	39%	81%	\$291,000	70.8%	71.2%	70.5%	70.5%	70.4%	^c
Group V	41	81	330,000	85.0	84.5	85.3	84.2	83.0	Conservative
Group IX	43	81	371,000	79.7	79.1	79.5	78.7	77.8	Conservative

Panel C: Starting to Contribute at Age 45 and Purchasing Real Annuity at Age 65

Real Replacement Rate With 401(k) Accumulations	Real Replacement Rate with 401(k) accumulations and Social Security ^a	Real Annuity Price (2007 \$) ^b	Probability of Success						Choice (I to III)
			Taking the equity allocation path of each own group	Taking the empirical aggressive equity glide path	Taking the conservative equity glide path (I)	Taking the average equity glide path (II)	Taking the aggressive equity glide path (III)		
Group I	39%	81%	\$291,000	25.0%	25.3%	19.3%	22.9%	26.3%	Aggressive
Group V	41	81	330,000	38.8	40.4	35.4	38.4	40.6	Aggressive
Group IX	43	81	371,000	34.7	36.8	31.4	34.5	37.1	Aggressive

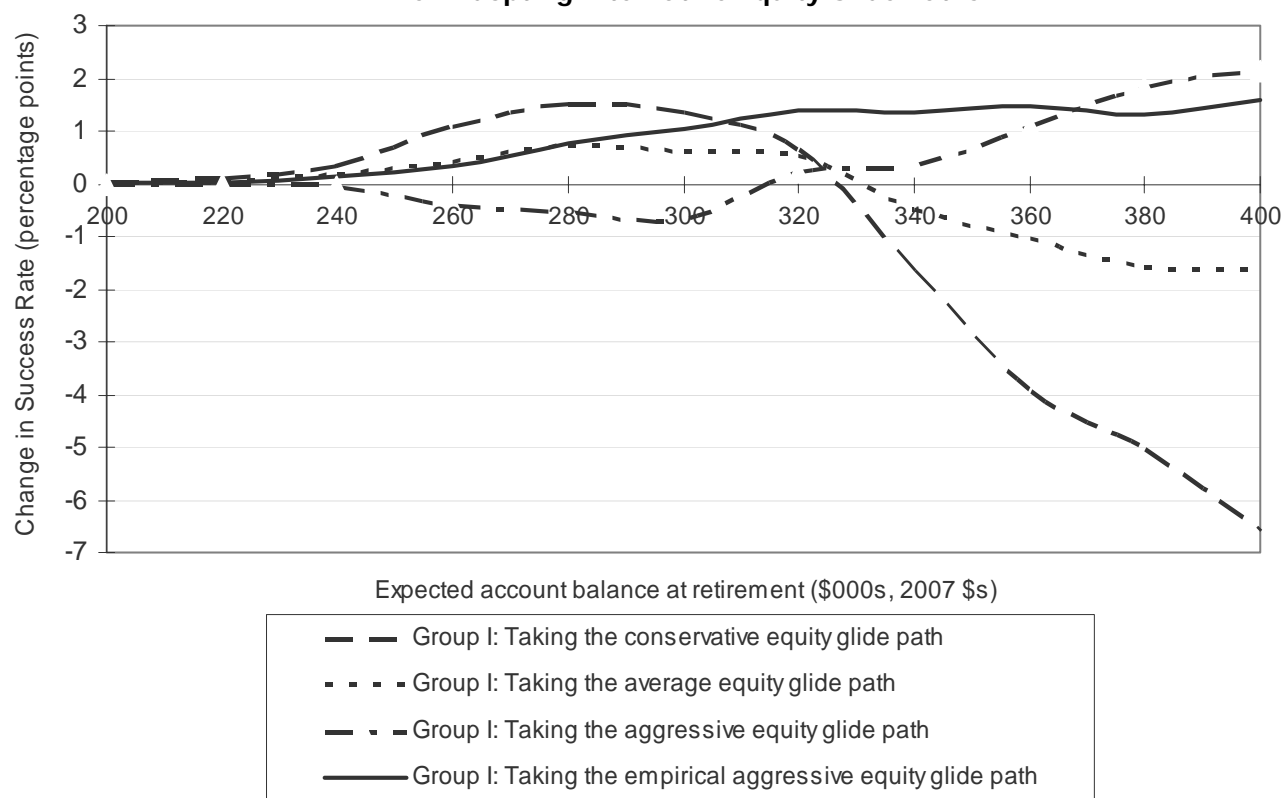
Source: Simulations using the 2007 EBR/ICI Participant-Directed Retirement Plan Data Collection Project.

^a Social Security replaces 42% of the preretirement income (\$48,000) of Group I, 40% of the preretirement income (\$51,800) of Group V, and 38% of the preretirement income (\$55,600) of Group IX. The replacement rates are obtained by calculating Social Security benefit for a person who has the same earnings history as the hypothetical participant in each group.

^b A single life real annuity provides a real replacement income of the final five-year average salary. The real annuity price is calculated by assuming a 5 percent return and a 2.5 percent inflation rate and by using the life expectancy of a male age 65 from Individual Annuity 2000 Table.

^c A choice is not made, because the probability of success is the same among at least two equity glide paths.

Figure 18
**Change in the Probability of Success of Group I
 When Adopting Alternative Equity Glide Paths**



Source: Simulations using the 2007 EBRI/ICI Participant-Directed Retirement Plan Data Collection Project.
 Note: Social Security would replace 42% of the preretirement income (\$48,000, the final five-year average salary) of the hypothetical participant of Group I.

Lower Returns and Volatilities

Unlike the capital market assumptions presented in Figure 12 (or baseline assumptions), this section assumes lower returns and volatility of U.S. equity, non-U.S. equity, and fixed income assets, while keeping correlations between the classes unchanged. Specifically, the returns and volatilities of U.S. equity, non-U.S. equity, and fixed income assets are decreased by 50 percent, 50 percent, and 40 percent, respectively, but the coefficient of variation (i.e., standard deviation divided by expected return) in each asset class is not changed (see Panel A of Figure 19).

Simulation results using the lower returns and volatilities are similar to those of the baseline assumptions. The results again indicate that the conservative glide path has the higher probability of success in *lower* account balances, while the aggressive glide path have the higher probability of success in *higher* account balances (Panels B, C, and D of Figure 19). The differences in the success rates are also small between different equity glide paths in many cases (e.g., at maximum about 6 percentage points in the range of \$100,000–\$300,000). Despite similar simulation results between the two different assumptions, the results are slightly different with respect to Group I. For example, in account balances where the probability of success is greater than or equal to 50 percent when the hypothetical participant takes the equity glide path of his or her group, the conservative glide path (assuming lower return and volatility) performs better than that of the baseline assumptions. Figure 20 illustrates changes in the probability of success of Group I by taking four different glide paths under two different assumptions. The shaded areas indicate account balances where the probability of success is greater than or equal to 50 percent, when the participant takes the original glide path of Group I. The conservative glide path under the alternative assumption has the higher success rate, at maximum, by

Figure 19
Probability of Success in Meeting the Expected Account Balance at Retirement: Alternative Assumptions on Return and Volatility

Panel A: Asset Class Return, Volatility, and Correlation

	Expected Return	Standard Deviation	Correlation Matrix	U.S. Equity	Non-U.S. Equity	Fixed Income
U.S. Equity	4.45%	9.00%	U.S. equity	1		
Non-U.S. Equity	4.45	9.55	Non-U.S. equity	0.54	1	
Fixed Income	3.80	1.75	Fixed income	0.26	0.21	1

Source: Author's calculations, and Grant Gardner and Yuan-An Fan. *Russell's Approach to Target-Date Funds: Building a Simple and Powerful Solution to Retirement Saving*, August 2006.

Panel B: Group I

401(k) Accumulation at Retirement (\$000s, 2007 \$s)	Real Replacement Rate (with 401(k) accumulations)	Real Replacement Rate (with 401(k) accumulations and Social Security) ^a	Probability of Success				Choice (I to III)
			Taking the equity allocation path Group I	Taking the empirical path of aggressive equity glide path	Taking the conservative equity glide path (I)	Taking the average equity glide path (II)	
100	13%	55%	100.0%	100.0%	100.0%	100.0%	b
110	15	57	100.0	100.0	100.0	100.0	b
120	16	58	100.0	100.0	100.0	100.0	b
130	17	59	100.0	100.0	100.0	100.0	b
140	19	61	99.9	99.9	100.0	99.9	b
150	20	62	98.8	98.9	99.6	99.2	Conservative
160	21	63	93.9	94.2	96.2	94.8	Conservative
170	23	65	81.5	82.0	83.9	82.4	Conservative
180	24	66	62.2	62.9	62.1	62.3	Aggressive
190	25	67	41.0	41.1	37.2	39.4	Aggressive
200	27	69	23.2	23.4	18.3	21.4	Aggressive
210	28	70	11.3	11.4	7.0	9.7	Aggressive
220	30	72	4.5	4.5	2.1	3.6	Aggressive
230	31	73	1.5	1.5	0.5	1.1	Aggressive
240	32	74	0.4	0.4	0.1	0.3	Aggressive
250	34	76	0.1	0.1	0.0	0.1	Aggressive
260	35	77	0.0	0.0	0.0	0.0	Aggressive
270	36	78	0.0	0.0	0.0	0.0	Aggressive
280	38	80	0.0	0.0	0.0	0.0	b
290	39	81	0.0	0.0	0.0	0.0	b
300	40	82	0.0	0.0	0.0	0.0	b

Source: Simulations using the 2007 EBR/ICI Participant-Directed Retirement Plan Data Collection Project.

^a For the hypothetical participant of Group I, Social Security would replace 42% of the pretirement income (\$48,000, the final five-year average salary). The 42% replacement rate is obtained by calculating Social Security benefit for a person who has the same earnings history as the participant of Group I.

^b A choice is not made, because the probability of success is the same among at least two equity glide paths. (continued)

Figure 19 (continued)

Panel C: Group V

401(k) Accumulation at Retirement (\$000s, 2007 \$s)	Real Replacement Rate (with 401(k) accumulations and Social Security) ^a		Probability of Success				Choice (I to III)	
	12%	52%	Taking the equity allocation path of Group V	Taking the empirical aggressive glide path	Taking conservative equity glide path (I)	Taking average equity glide path (II)		Taking aggressive equity glide path (III)
100	12%	52%	100.0%	100.0%	100.0%	100.0%	100.0%	b
110	14	54	100.0	100.0	100.0	100.0	100.0	b
120	15	55	100.0	100.0	100.0	100.0	100.0	b
130	16	56	100.0	100.0	100.0	100.0	100.0	b
140	17	57	100.0	100.0	100.0	100.0	100.0	b
150	19	59	100.0	100.0	100.0	100.0	100.0	b
160	20	60	100.0	100.0	100.0	100.0	100.0	b
170	21	61	100.0	100.0	100.0	100.0	100.0	b
180	22	62	99.9	99.8	100.0	99.8	99.7	Conservative
190	24	64	98.9	98.4	99.4	98.7	98.0	Conservative
200	25	65	95.4	94.1	96.2	94.7	93.1	Conservative
210	26	66	86.0	84.4	86.7	85.2	83.5	Conservative
220	27	67	71.4	70.7	71.3	70.5	69.8	Conservative
230	29	69	52.8	52.9	51.2	52.2	53.1	Aggressive
240	30	70	34.4	35.7	31.2	34.1	36.2	Aggressive
250	31	71	20.5	22.2	16.9	20.1	23.1	Aggressive
260	32	72	10.5	12.4	7.8	10.7	13.5	Aggressive
270	34	74	4.7	6.0	3.1	4.8	6.9	Aggressive
280	35	75	1.9	2.8	1.0	1.8	3.4	Aggressive
290	36	76	0.7	1.1	0.2	0.7	1.4	Aggressive
300	37	77	0.2	0.4	0.1	0.2	0.5	Aggressive

Source: Simulations using the 2007 EBR/ICI Participant-Directed Retirement Plan Data Collection Project.

^a For the hypothetical participant of Group V, Social Security would replace 40% of the preretirement income (\$51,800, the final five-year average salary). The 40% replacement rate is obtained by calculating Social Security benefit for a person who has the same earnings history as the participant of Group V.

^b A choice is not made, because the probability of success is the same among at least two equity glide paths.

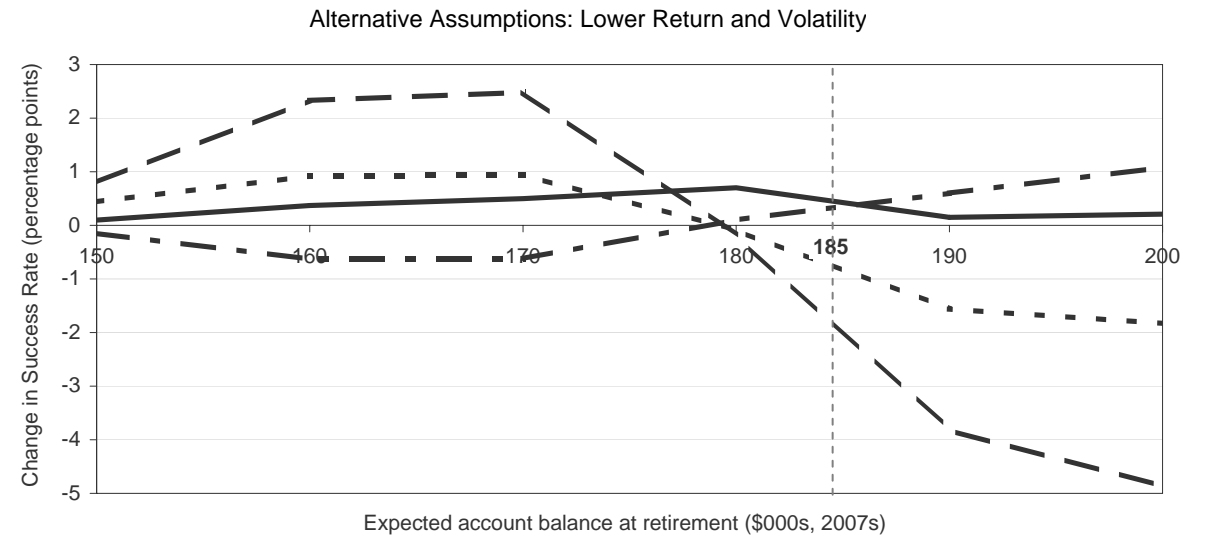
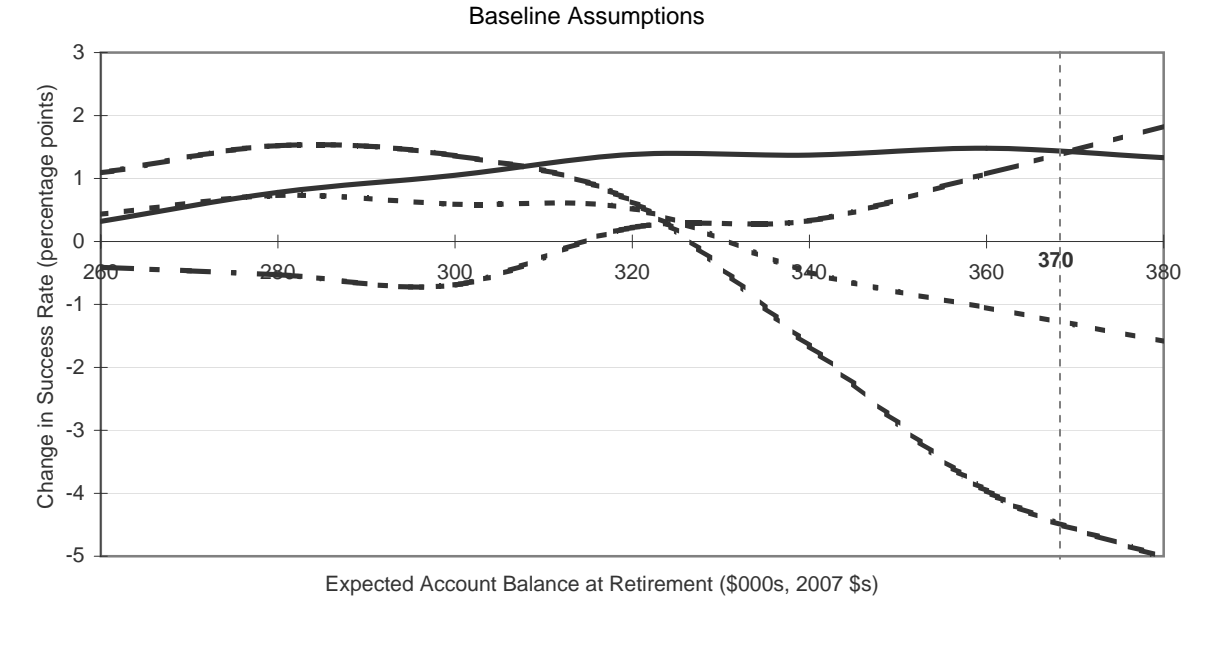
(continued)

Figure 19 (continued)

401(k) Retirement (\$000s, 2007 \$s)	Real Replacement Rate (with 401(k) accumulations and Social Security) ^a		Probability of Success				Choice (I to III)	
	12%	50%	Taking the equity allocation path of Group IX	Taking the empirical aggressive glide path	Taking conservative equity glide path (I)	Taking average equity glide path (II)		Taking aggressive equity glide path (III)
100			100.0%	100.0%	100.0%	100.0%	100.0%	b
110	13	51	100.0	100.0	100.0	100.0	100.0	b
120	14	52	100.0	100.0	100.0	100.0	100.0	b
130	15	53	100.0	100.0	100.0	100.0	100.0	b
140	16	54	100.0	100.0	100.0	100.0	100.0	b
150	17	55	100.0	100.0	100.0	100.0	100.0	b
160	19	57	100.0	100.0	100.0	100.0	100.0	b
170	20	58	100.0	100.0	100.0	100.0	100.0	b
180	21	59	100.0	100.0	100.0	100.0	100.0	b
190	22	60	100.0	99.9	100.0	100.0	99.9	b
200	23	61	99.7	99.5	99.9	99.7	99.4	Conservative
210	24	62	98.3	97.8	98.9	98.1	97.2	Conservative
220	25	63	94.2	92.9	95.1	92.9	92.0	Conservative
230	27	65	85.0	83.5	85.8	84.1	82.3	Conservative
240	28	66	71.3	70.6	71.1	70.4	69.7	Conservative
250	29	67	54.3	54.3	52.5	53.5	54.2	Aggressive
260	30	68	37.0	38.3	34.0	36.7	38.7	Aggressive
270	31	69	23.2	25.2	19.9	23.0	25.9	Aggressive
280	32	70	13.2	15.2	10.1	13.2	16.2	Aggressive
290	34	72	6.7	8.2	4.5	6.7	9.3	Aggressive
300	35	73	3.0	4.0	1.7	3.2	4.7	Aggressive

Source: Simulations using the 2007 EBR/ICI Participant-Directed Retirement Plan Data Collection Project.
^a For the hypothetical participant of Group IX, Social Security would replace 38% of the preretirement income (\$55,600, the final five-year average salary). The 38% replacement rate is obtained by calculating Social Security benefit for a person who has the same earnings history as the participant of Group IX.
^b A choice is not made, because the probability of success is the same among at least two equity glide paths.

Figure 20
**Change in the Probability of Success of Group I
 Using Different Assumptions on Return and Volatility**



- Group I: Taking the conservative equity glide path
- · · Group I: Taking the average equity glide path
- · - Group I: Taking the aggressive equity glide path
- Group I: Taking the empirical aggressive equity glide path

Source: Simulations using the 2007 EBRI/ICI Participant-Directed Retirement Plan Data Collection Project.
 Note: Account balances are shaded where the probability of success is greater than or equal to 50% under the original equity glide path of Group I.

2.5 percentage points (in the lower panel), whereas the conservative glide path under the baseline assumption has the higher success rate, at maximum, by 1.5 percentage points (in the upper panel).

Historical Returns and Volatilities

Lastly, equity glide paths are explored in relation to plan demographics by using historical return and volatility in asset classes. To do this, money market and stable value funds are taken into account, as well as three different target-date funds having different equity glide paths (conservative, average, and aggressive glide paths). Due to the limited availability of data on stable value funds, the simulation uses the most recent 20-year returns and volatility. Panel A of Figure 21 presents returns, volatilities, correlations between asset classes for the period of 1989 to 2008, and annual expense ratios for simulations.²⁴ Like the previous simulations, the equity portfolio in target-date funds is constructed with a 67 percent/33 percent mix of U.S. equity and non-U.S. equity.

Similar to the findings from the previous simulations, equity glide paths with the highest success rates will vary with the target replacement income. Panels B, C, and D of Figure 21 present the probability of success for meeting the expected account balance at retirement by adopting five different investment options: three target-date funds with conservative, average, aggressive glide paths, money market fund, and stable value fund. The last columns of the panels indicate a choice among five options by comparing the probabilities of success. An option is selected with a higher probability of success.

Simulation results indicate that stable value funds, or the conservative equity glide path, perform better in the lower account balances than the other equity glide paths, while the aggressive equity glide path performs better in the higher account balances.

Conclusion

Plan sponsors and administrators offering target-date funds to their participants will likely have a number of objectives they are attempting to satisfy simultaneously. One of these may be to provide an equity glide path and/or asset allocation that under certain assumptions will likely provide stylized participants with an account balance at retirement that will be sufficient (when combined with assumed Social Security benefits) to provide at least a threshold income replacement rate. Demographic characteristics of plan participants (or plan demographics) may be one of the factors that would be considered in the choice, because plan demographics would influence participants' saving and investment behavior. Plan demographics in this study are defined by using two factors: participants' income and tenure—specifically whether the plan is dominated by participants with low or high income and short or long tenure.

Since peer effects have an influence on 401(k) plan participants' saving behavior and investment decisions, plan demographics are closely related to participants' saving behavior (i.e., contribution rates) and target-date fund investments. The empirical evidence suggests that participants' contribution rates and target-date fund investments differ in relation to plan demographics. In particular, participants in plans dominated by those with low income and short tenure tend to contribute less than those in the plans dominated by participants with middle income and mid tenure or high income and long tenure. With respect to target-date fund investments, target-date fund users with 90 percent or more of their account balances in target-date funds, who are in low-income, short-tenure plans, tend to have target-date funds with lower equity allocations in their early- or mid- working career (e.g., up to age 54) than those in their counterpart groups. This might be related to less "risk capacity" of the participants in plans dominated by low income and short tenure. Participants in these plans may have less risk capacity because their income over lifetime working career may not be so predictable. This also may result from the selection of target-date funds by plan sponsors, but needs further study.

To examine whether pure target-date fund users (those with 90 percent or more of their account balances in target-date funds) would achieve their target replacement income at retirement, 401(k) accumulations are simulated based on the empirical findings of participant contribution rates and the equity allocations of target-date funds with respect to the different plan group demographics. The simulation results suggest that participants in plans dominated by those

with low income and short tenure (Group I) are expected to have a significantly lower success rate in meeting the target replacement income at retirement than those of the counterpart plans (i.e. plans dominated by participants with middle income and mid tenure (Group V) and by those with high income and long tenure (Group IX)).

Lastly, in order to compare equity glide paths in relation to plan demographics with a higher chance of meeting the target replacement income, counterfactual experiments are conducted by using different equity glide paths: conservative, average, aggressive, and the empirical aggressive equity glide paths. Findings are examined with different assumptions on asset class returns and volatilities. Simulation results from the counterfactual experiments indicate that equity glide paths for participants by plan demographics vary in target replacement income, risk (in terms of failure rate), and capital market assumptions on asset returns and volatility. It is worth noting that, although target-date funds with different equity glide paths affect the retirement success rate, *participant contribution rates* corresponding to different plan demographic characteristics have a stronger impact on the retirement success rate.

Different contribution rates corresponding to different demographic profiles may suggest different equity glide paths of target-date funds, depending on the objectives. This *Issue Brief* provides a highly stylized study using observed contribution rates as of the 2007 plan year. However, with the passage of the Pension Protection Act of 2006 and the likely impact on plan design in the future (increased utilization of automatic enrollment and automatic contribution escalations) it may become more likely that contribution rates among the participants are more homogenous. In such a scenario it may be more likely that a single equity glide path would meet a wide range of demographic profiles.

There is one caveat to the simulation results. The results presented here would overstate the 401(k) accumulations and the success rate to meet a target replacement income, because the simulations do not reflect participant behavior on loans against 401(k) account balances and pre-retirement withdrawals. Even more importantly, the simulation models assume continuous participation. According to a recent study on 401(k) plan participants' loan activity in 2007, about 18 percent of eligible 401(k) plan participants have loans and participants borrow about 12 percent of account balances (VanDerhei, Holden, Alonso, and Copeland, 2008). Furthermore, one study of on pre-retirement distributions (Lester and Santiago, 2007) documented that after age of 59½ (when participants are no longer subject to tax penalties), about 15 percent of participants withdraw, on average, about 25 percent of their account balances. Participants' loan activities and pre-retirement withdrawals may differ in relation to plan demographics, as do their contribution rates and target-date fund investments.

Thus, future research will include participant behavior on loans and pre-retirement withdrawals by plan demographics in the simulations. The inclusion of participant behavior on loans and pre-retirement withdrawals would be likely to reduce the likelihood of success in meeting target replacement income.

Figure 21
Probability of Success In Meeting the Expected Account Balance at Retirement:
Using Historical Data from 1989 to 2008

Panel A: Asset Class Return, Volatility, and Correlation

Annualized Return	Standard Deviaton	Correlation Matrix	U.S. Equity	Non-U.S. Equity	Fixed Income	Money Market	Stable Value
8.43%	20.16%	U.S. equity	1				
3.14	21.13	Non-U.S. equity	0.73	1			
7.43	5.31	Fixed income	0.25	-0.16	1		
2.82	1.26	Money market	0.17	0.08	0.15	1	
6.17	1.37	Stable value	0.30	-0.18	0.53	0.51	1

Source: Standard & Poor's, Morgan Stanley Capital International, Barclays Capital, and Hueler Analytics.

Note: S&P 500 Index is used for U.S. equity, MSCI EAFE Index for Non-U.S. equity, and Barclays U.S. Aggregate Index for fixed income. Hueler Analytics Stable Value data are used for stable value funds.

Panel B: Group I (Final five-year average salary: \$48,000)

401(k) Accumulation at Retirement (\$000s, \$2007)	Real Replacement Rate (with 401(k) Accumulations and Social Security) ^a	Probability of Success						Choice (I to V)
		Target-date fund					Stable Value Fund (V)	
		Target-date fund with a <i>conservative</i> equity glide path (I)	Target-date fund with an <i>average</i> equity glide path (II)	Target-date fund with an <i>aggressive</i> equity glide path (III)	Money Market Fund (IV)			
100	55%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	b
110	57	100.00	100.00	100.00	100.00	100.00	100.00	b
120	58	100.00	100.00	100.00	100.00	100.00	100.00	b
130	59	100.00	100.00	100.00	100.00	100.00	100.00	b
140	61	100.00	100.00	99.97	100.00	100.00	100.00	b
150	62	100.00	99.99	99.91	99.68	100.00	100.00	b
160	63	100.00	99.92	99.74	44.32	100.00	100.00	b
170	65	99.93	99.74	99.27	0.25	100.00	100.00	Stable
180	66	99.80	99.30	98.65	0.00	100.00	100.00	Stable
190	67	99.40	98.65	97.01	0.00	100.00	100.00	Stable
200	69	98.74	97.05	94.61	0.00	100.00	100.00	Stable
210	70	97.09	94.49	91.68	0.00	100.00	100.00	Stable
220	72	94.42	91.17	87.54	0.00	100.00	100.00	Stable
230	73	90.90	86.97	82.94	0.00	100.00	100.00	Stable
240	74	86.12	81.77	78.02	0.00	100.00	100.00	Stable
250	76	80.73	76.41	72.15	0.00	100.00	100.00	Stable
260	77	74.46	70.04	66.27	0.00	100.00	100.00	Stable
270	78	67.45	63.44	60.21	0.00	100.00	100.00	Stable
280	80	60.27	56.78	54.06	0.00	99.54	100.00	Stable
290	81	53.33	50.64	48.25	0.00	86.63	100.00	Stable
300	82	46.78	44.81	43.29	0.00	39.73	100.00	Conservative
310	84	40.52	38.95	37.85	0.00	6.14	100.00	Conservative
320	85	34.28	33.39	32.84	0.00	0.18	100.00	Conservative
330	86	28.74	28.61	28.65	0.00	0.00	100.00	Conservative
340	88	24.39	24.50	24.88	0.00	0.00	100.00	Aggressive
350	89	19.98	20.83	21.44	0.00	0.00	100.00	Aggressive
360	90	16.38	17.01	18.10	0.00	0.00	100.00	Aggressive
370	92	13.28	14.28	15.32	0.00	0.00	100.00	Aggressive
380	93	10.55	11.78	12.88	0.00	0.00	100.00	Aggressive
390	94	8.44	9.52	10.81	0.00	0.00	100.00	Aggressive
400	96	6.62	7.74	8.93	0.00	0.00	100.00	Aggressive
410	97	5.06	6.25	7.44	0.00	0.00	100.00	Aggressive
420	98	3.94	5.06	6.14	0.00	0.00	100.00	Aggressive
430	100	3.10	3.99	5.00	0.00	0.00	100.00	Aggressive
440	101	2.41	3.19	4.22	0.00	0.00	100.00	Aggressive
450	102	1.95	2.65	3.49	0.00	0.00	100.00	Aggressive
460	104	1.46	2.07	2.80	0.00	0.00	100.00	Aggressive
470	105	1.17	1.65	2.36	0.00	0.00	100.00	Aggressive
480	106	0.83	1.35	1.88	0.00	0.00	100.00	Aggressive
490	108	0.58	1.04	1.52	0.00	0.00	100.00	Aggressive
500	109	0.41	0.81	1.29	0.00	0.00	100.00	Aggressive

Source: Simulations using the 2007 EBRI/ICI Participant-Directed Retirement Plan Data Collection Project.

^a For the hypothetical participant in Group I, Social Security would replace a 42% of the preretirement income (\$48,000, the final five-year average salary). The 42% replacement rate is obtained by calculating Social Security benefit for a person who has the same earnings history as the participant of Group I.

^b A choice is not made, because the probability of success is the same among at least two equity glide paths.

(continued)

Figure 21 (continued)

Panel C: Group V (Final five-year average salary: \$51,800)

401(k) Accumulation at Retirement (\$000s, \$2007)	Real Replacement Rate (with 401(k) accumulations and Social Security) ^a	Probability of Success					Choice (I to V)
		Target-date fund with a <i>conservative</i> equity glide path (I)	Target-date fund with an <i>average</i> equity glide path (II)	Target-date fund with an <i>aggressive</i> equity glide path (III)	Money Market Fund (IV)	Stable Value Fund (V)	
100	52%	100.00%	100.00%	100.00%	100.00%	100.00%	b
110	54	100.00	100.00	100.00	100.00	100.00	b
120	55	100.00	100.00	100.00	100.00	100.00	b
130	56	100.00	100.00	100.00	100.00	100.00	b
140	57	100.00	100.00	100.00	100.00	100.00	b
150	59	100.00	100.00	100.00	100.00	100.00	b
160	60	100.00	100.00	100.00	100.00	100.00	b
170	61	100.00	100.00	99.99	100.00	100.00	b
180	62	100.00	100.00	99.96	100.00	100.00	b
190	64	100.00	99.97	99.88	98.32	100.00	b
200	65	100.00	99.92	99.72	44.88	100.00	b
210	66	99.93	99.79	99.35	1.21	100.00	Stable
220	67	99.87	99.53	98.89	0.00	100.00	Stable
230	69	99.67	99.05	98.03	0.00	100.00	Stable
240	70	99.22	98.23	96.46	0.00	100.00	Stable
250	71	98.57	96.74	94.28	0.00	100.00	Stable
260	72	97.16	94.71	91.83	0.00	100.00	Stable
270	74	95.09	92.09	88.73	0.00	100.00	Stable
280	75	92.55	88.79	85.08	0.00	100.00	Stable
290	76	88.99	85.12	81.13	0.00	100.00	Stable
300	77	85.07	80.74	77.06	0.00	100.00	Stable
310	79	80.50	76.13	72.18	0.00	100.00	Stable
320	80	75.32	71.19	67.33	0.00	100.00	Stable
330	81	69.94	65.63	62.37	0.00	100.00	Stable
340	82	64.14	60.44	57.29	0.00	99.99	Stable
350	83	58.42	54.92	52.39	0.00	98.22	Stable
360	85	52.55	50.01	47.80	0.00	82.45	Stable
370	86	47.42	45.17	43.58	0.00	42.87	Conservative
380	87	42.11	40.41	39.34	0.00	10.68	Conservative
390	88	36.86	35.72	34.98	0.00	0.91	Conservative
400	90	32.21	31.38	31.14	0.00	0.02	Conservative
410	91	27.85	27.80	27.92	0.00	0.00	Aggressive
420	92	24.16	24.40	24.81	0.00	0.00	Aggressive
430	93	20.72	21.33	21.98	0.00	0.00	Aggressive
440	95	17.52	18.32	19.23	0.00	0.00	Aggressive
450	96	14.83	15.70	16.67	0.00	0.00	Aggressive
460	97	12.40	13.48	14.56	0.00	0.00	Aggressive
470	98	10.24	11.50	12.56	0.00	0.00	Aggressive
480	100	8.52	9.63	10.93	0.00	0.00	Aggressive
490	101	6.96	8.14	9.39	0.00	0.00	Aggressive
500	102	5.60	6.86	7.98	0.00	0.00	Aggressive

Source: Simulations using the 2007 EBRI/ICI Participant-Directed Retirement Plan Data Collection Project.

^a For the hypothetical participant in Group V, Social Security would replace 40% of the preretirement income (\$51,800, the final five-year average salary).

The 40% replacement rate is obtained by calculating Social Security benefit for a person who has the same earnings history as the participant of Group V.

^b A choice is not made, because the probability of success is the same among at least two equity glide paths.

(continued)

Figure 21 (continued)

Panel D. Group IX (Final five-year average salary: \$55,600)

401(k) Accumulation at Retirement (\$000s, \$2007)	Real Replacement Rate (with 401(k) accumulations and Social Security) ^a	Probability of Success					Choice (I to V)
		Target-date fund with a <i>conservative</i> equity glide path (I)	Target-date fund with an <i>average</i> equity glide path (II)	Target-date fund with an <i>aggressive</i> equity glide path (III)	Money market fund (IV)	Stable value fund (V)	
100	50%	100.00%	100.00%	100.00%	100.00%	100.00%	b
110	51	100.00	100.00	100.00	100.00	100.00	b
120	52	100.00	100.00	100.00	100.00	100.00	b
130	53	100.00	100.00	100.00	100.00	100.00	b
140	54	100.00	100.00	100.00	100.00	100.00	b
150	55	100.00	100.00	100.00	100.00	100.00	b
160	57	100.00	100.00	100.00	100.00	100.00	b
170	58	100.00	100.00	100.00	100.00	100.00	b
180	59	100.00	100.00	100.00	100.00	100.00	b
190	60	100.00	100.00	99.99	100.00	100.00	b
200	61	100.00	100.00	99.94	100.00	100.00	b
210	62	100.00	99.97	99.88	92.20	100.00	b
220	63	100.00	99.92	99.72	28.12	100.00	b
230	65	99.94	99.81	99.40	0.50	100.00	Stable
240	66	99.90	99.60	98.99	0.00	100.00	Stable
250	67	99.75	99.20	98.23	0.00	100.00	Stable
260	68	99.40	98.65	97.03	0.00	100.00	Stable
270	69	98.90	97.50	95.16	0.00	100.00	Stable
280	70	98.02	95.71	93.21	0.00	100.00	Stable
290	72	96.44	93.80	90.64	0.00	100.00	Stable
300	73	94.40	91.15	87.43	0.00	100.00	Stable
310	74	91.91	87.91	84.15	0.00	100.00	Stable
320	75	88.49	84.47	80.44	0.00	100.00	Stable
330	76	84.84	80.38	76.64	0.00	100.00	Stable
340	77	80.69	76.20	72.01	0.00	100.00	Stable
350	79	75.87	71.65	67.59	0.00	100.00	Stable
360	80	71.02	66.49	63.00	0.00	100.00	Stable
370	81	65.63	61.71	58.53	0.00	100.00	Stable
380	82	60.15	56.63	53.82	0.00	99.51	Stable
390	83	55.04	51.94	49.50	0.00	92.73	Stable
400	84	49.94	47.42	45.49	0.00	65.36	Stable
410	85	44.99	43.10	41.71	0.00	27.13	Conservative
420	87	40.40	38.71	37.62	0.00	5.82	Conservative
430	88	35.56	34.44	33.60	0.00	0.41	Conservative
440	89	31.29	30.45	30.32	0.00	0.00	Conservative
450	90	27.34	27.33	27.52	0.00	0.00	Aggressive
460	91	24.03	24.22	24.63	0.00	0.00	Aggressive
470	92	20.86	21.33	21.93	0.00	0.00	Aggressive
480	94	17.90	18.60	19.56	0.00	0.00	Aggressive
490	95	15.29	16.14	17.04	0.00	0.00	Aggressive
500	96	13.11	14.01	15.06	0.00	0.00	Aggressive

Source: Simulations using the 2007 EBRI/ICI Participant-Directed Retirement Plan Data Collection Project.

^a For the hypothetical participant in Group IX, Social Security would replace 38% of the preretirement income (\$55,600, the final five-year average salary). The 38% replacement rate is obtained by calculating Social Security benefit for a person who has the same earnings history as the participant of Group IX.

^b A choice is not made, because the probability of success is the same among at least two equity glide paths.

Appendix

Salary Growth Paths of Hypothetical Participants

For simulations on 401(k) accumulations, the hypothetical participant in each group is assumed to follow the empirical salary growth path of each group over his lifetime working career. In other words, a salary growth path of each group obtained from the cross-sectional data 2007 is used as a salary growth path of a hypothetical participant over lifetime working career. The assumption would raise one question: whether or not the cross-sectional pattern of salary growth would represent the pattern of wage growth over time.

To see if the cross-sectional patterns of salary growth rates of three hypothetical participants reflect that of real wage growth over time, the real wage growth rate of a hypothetical worker at age 25 in 2007 is calculated by using the national average wage index (AWI) of Social Security Administration (SSA) and SSA's age-scaled factors for medium earners (see Clingman and Nichols, 2008). The age-scaled factors take into account both the variations in earnings by age and the probabilities that workers may have years with zero earnings.

The cross-sectional patterns of salary growth rates from three groups (Groups I, V, and IX) are similar to the pattern of real wage growth over time. Figure A-1 presents the median wage growth rates across ages from three different groups and the hypothetical age-scaled medium earner from SSA. The wage growth rates are averaged for each age group (in the x-axis). Although the hypothetical medium earner from SSA has higher growth rates in the first 20 years and greater drops at age 55 and older than the participants of the three groups, there is little significant difference in the patterns of the wage growth rates between them. Similar patterns of inflation-corrected earnings between the hypothetical participants of the three groups and the hypothetical medium earner from SSA are also found in Figure A-2. Figure A-2 illustrates the real earnings profiles (in 2007 dollars) of the three hypothetical participants following the wage growth rates of each group with a salary of \$35,056 at age 25 and the hypothetical age-scaled medium earner with earnings of \$26,062 at age 25.²⁵ The inflation-corrected earnings of the age-scaled medium earner are computed by using the projected consumer price index (CPI) from the 2008 annual report of OASDI Trust Funds.²⁶ The figure indicates that the real earnings profiles (in 2007 dollars) of the three hypothetical participants are similar to that of the hypothetical age-scaled medium earner, although the real earnings profile of the age-scaled medium earner tends to be a little more volatile over working career.

Appendix
Figure A-1
Average Wage Growth Rates, by Plan Demographics

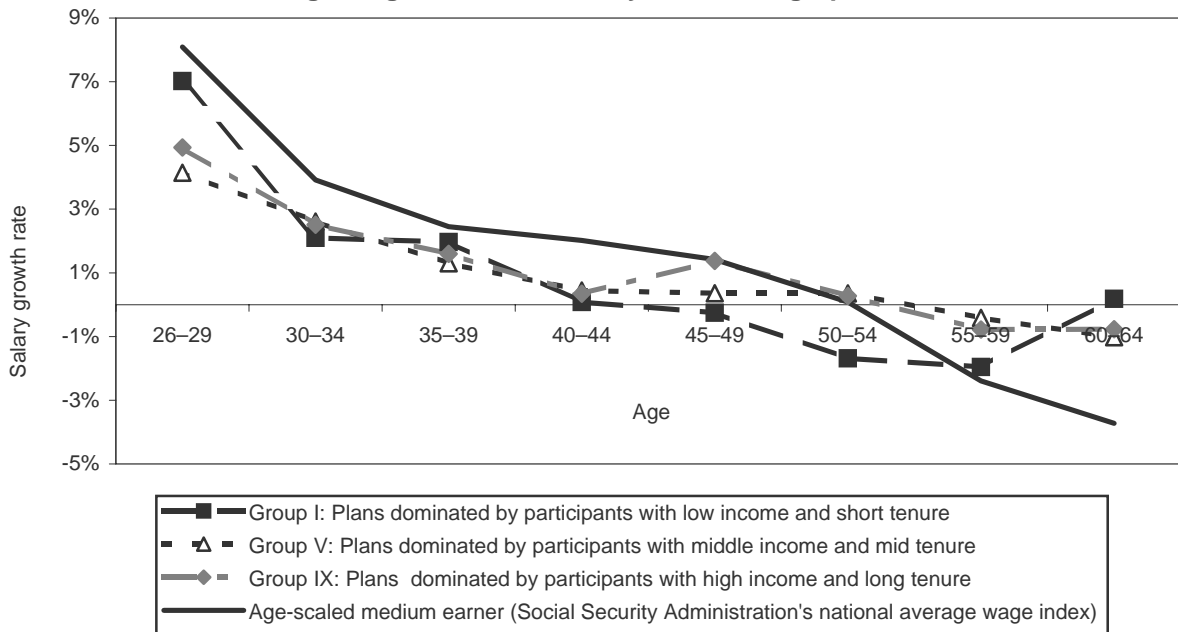
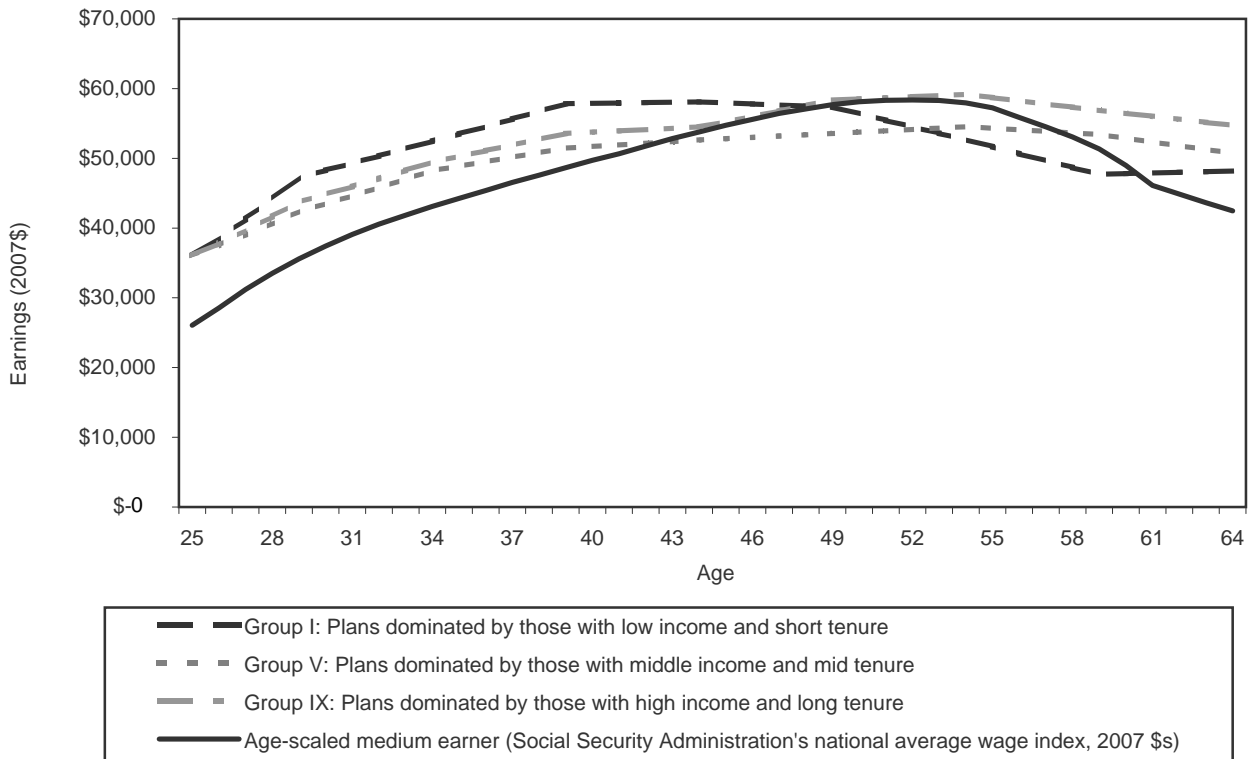


Figure A-2
Real Earnings Profiles (2007 \$s) of Hypothetical Participants (with a Salary of \$35,056) and Age-Scaled Medium Earner



Source: Simulations using the 2007 EBRI/ICI Participant-Directed Retirement Plan Data Collection Project and author's calculations by using a study of Clingman and Nichols (2008), "Scaled Factors for Hypothetical Earnings Examples Under the 2008 Trustees Report Assumptions," *Actuarial Note*, no. 2008.3 (Social Security Administration, August 2008).

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Endnotes

¹ *Counterfactual experiments* (contrary to established fact) describe how an observed effect might vary under different sets of conditions, and speculate what might have happened if observed facts had been different. For economic studies, they typically utilize computer simulation models to run a variety of statistical “what-if” scenarios.

² Schwabish and Topoleski (forthcoming), using the 2004 Survey of Consumer Finances, documented that about 67 percent of the participants in the first (lowest) income quintile responded “not willing to take any financial risks,” compared to 7 percent of the fifth (highest) income quintile. Using the employee surveys of the NBER Shared Capitalism dataset (including 41,206 employees), Blasi, Kruse, and Markowitz (2008), also found that those with low earnings are more likely to say they are risk averse.

³ Since the EBRI/ICI database does not provide the information on participants’ financial income and turnover of participants in a plan, salary is used as a proxy for income and the length of time in the current plan (or tenure) as a proxy for turnover. More participants with short tenure in a plan would represent the higher turnover of participants in the plan or indicate a new plan.

⁴ If a plan has no dominant group, the plan is not classified into any groups. For example, when a plan has two groups which account for over one-third of the plan participants but the same magnitude, the plan is regarded as having no dominant group. The plan is excluded from further analyses.

⁵ The maximum contribution limit for 401(k) plans (IRC §402(g)(1)) was \$15,500 in 2007.

⁶ Plan design features (e.g., employer matching contribution) and automatic enrollment and automatic contribution escalations under the PPA would affect the different patterns of participant contribution rates by plan demographics, which needs further research.

⁷ Some target-date fund users invest in other funds offered by the plan sponsor (see Copeland, 2009).

⁸ Since the average equity allocation of target-date funds would be affected by outliers, the median equity allocation of pure target-date fund holders is constructed with respect to Groups I, V, and IX.

⁹ The difference in the median equity allocations between Groups I and V is similar to that of Groups I and IX, because the equity allocation of Group V with respect to age and salary is similar to that of Group IX. To simplify comparisons between the three groups, Groups I and IX are focused and Panel D describes the difference in the equity allocations between the two groups.

¹⁰ See Appendix Figure A-1. Participants in the plans dominated by those with low income and short tenure (Group I) face sharp drops in the wage growth rates during the first 15 years of their career and negative growths in their 50s. In contrast, the participants in Groups V and IX experience slow decreases in the wage growth rates up to age 54 and negative (but modest) growth rates after age 55. Whether or not participants would get steady income over lifetime working career may be related to different “risk capacity” of the participants, which would determine target-date fund investments (Idzorek, 2008). For example, an investor who has steady income over his or her working career, if all things are equal, would select a target-date fund with a more aggressive glide path, whereas one with “not-so-steady” income would select a target-date fund with a more conservative glide path. Different risk capacity related to different patterns of the wage growth rates in the three groups may explain our empirical findings that the participants of Group I tend to choose target-date funds with lower equity allocations compared with those of Groups V and IX up to age 54.

¹¹ A future study will include whether the participants’ selection of target-date funds with lower equity allocations (in Group I) comes from their preference or the selection of target-date funds by plan sponsors.

¹² See Appendix, for more details on the application of the cross-sectional salary growth path to the salary growth path of the hypothetical participant over lifetime working career.

¹³ Participants would not increase their contribution rates every year. For example, according to a study of JPMorgan (Lester and Santiago, 2007), only 15 percent of the participants, on average, make changes to their contribution rates every year between 2001 and 2006.

¹⁴ The expense ratios of target date funds in 2007 seem to hover around 80 basis points. For example, according to a study of Israelsen, Nagengast, and Surz (2008), the median expense ratio of 2010 funds is about 74 basis points, 2015 funds about 74 basis points, 2020 funds about 82 basis points, 2025 funds about 77 basis points, 2030 funds about 86 basis points, 2035 funds about 81 basis points, and 2040 and later funds about 83 basis points. The average of the median expense ratios is about 80 basis points, which is used for simulations in the study.

¹⁵ The current study does not include other private sources such as defined benefit (DB) pension plans. However, whether or not the hypothetical participant has a DB plan might affect simulation results presented in the study.

¹⁶ The real annuity price is calculated by assuming a 5 percent return and a 2.5 percent inflation rate and by using the life expectancy of a male aged 65 from Individual Annuity 2000 Table. *Life Insurers Fact Book 2008* (by American Council of Life Insurers) provides Individual Annuity 2000 Table.
<http://www.acli.com/ACLI/Tools/Industry+Facts/Life+Insurers+Fact+Book/GR08-108.htm>

¹⁷ The simulated target-date fund returns are generated annually, which follow a joint log-normal independent and identical distribution. The return of each asset class (US equity, Non-US equity, and fixed income) is assumed to follow a geometric Brownian motion.

¹⁸ In the article the account balances in 2007 dollars are calculated by using a 2.5 percent inflation rate.

¹⁹ For more details, see Lester, Anne, and Katherine Santiago. *Insights: Ready! Fire! Aim? 2007* (JPMorgan Asset Management, March 2007).

²⁰ In the experiments the hypothetical participants hold target-date funds over their lifetime working career as follows. The participants choose a 2045 fund at ages 25-29, a 2040 fund at ages 30-34, a 2035 fund at ages 35-39, a 2030 fund at ages 40-44, a 2025 fund at ages 45-49, a 2020 fund at ages 50-54, a 2015 fund at ages 55-59, and a 2010 fund at ages 60-65. This assumption reflects the consistency of equity glide paths, which is an industry norm (Gardner and Fan, 2006). The consistency means that a single glide path must be used for all target dates. For example, the glide path for a 2015 fund is the same as the glide path of the final years of a 2045 fund.

²¹ For simplicity, equity glide paths of conservative, average, and aggressive portfolios are referred to in this article as conservative, average, and aggressive equity glide paths, respectively.

²² For example, for the hypothetical participant of Group I, the conservative glide path increases the success rate at maximum by 1.5 percentage points and the aggressive glide path does at maximum by 2.2 percentage points. In contrast, for the participants of Groups V and IX, the conservative glide path increases the success rate at maximum by 0.3 and 0.2 percentage points, respectively, while the aggressive glide path increases the success rate at maximum by 2.9 and 1.1 percentage points.

²³ The findings can be inferred from the simulation results of Groups V and IX reported in Figure 16.

²⁴ S&P 500 Index is used as a proxy for US equity, MSCI EAFE Index for non-US equity, and Barclays U.S. Aggregate Index for fixed income. For return and volatility of stable value funds, the Hueler Analytics Stable Value Pooled Fund Comparative Universe is used. For the annual expense ratio of money market and stable value funds, the average expense ratio is used from some funds in the market. The expense ratio of the target-date funds is the average of the median expense ratios, which is the same as used in the previous simulations. A future *EBRI Notes* article will provide additional sensitivity analysis about the expense ratio of funds.

²⁵ The earnings of \$26,062 at age 25 are obtained by multiplying the national average wage index for 2007 (\$40,405.48) by the age-scaled factor (0.645 at age 25).

²⁶ Board of Trustees, Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds. *The 2008 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds*. (U.S. House Document 110-104, April 10, 2008).

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