



**Defined Contribution
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The Impact of Auto-enrollment and Automatic Contribution Escalation on Retirement Income Adequacy

By Jack VanDerhei, Employee Benefit Research Institute, and Lori Lucas, Callan Associates

New Simulation Model

This *Research Report* expands upon earlier work by EBRI to provide the first results of a new simulation model that estimates the impact of changing 401(k) plan design variables and assumptions on retirement income adequacy. Previous research has demonstrated the large potential impact of auto-enrollment (AE) on retirement income adequacy. Until recently however, there was extremely limited evidence on the impact of automatic contribution escalation. This study is part of a larger joint project between Employee Benefit Research Institute (EBRI) and the Defined Contribution Institutional Investment Association (DCIIA).

Methodology

The definition of “success” for this analysis is a situation that produces a combined real replacement rate from Social Security and 401(k) projected balances of at least 80 percent. The analysis is limited to younger employees (with 31–40 years of 401(k) eligibility) and provides separate results for employees in the highest- and lowest-income quartiles.

Using this definition of success, the model is used to determine how success changes with:

- The maximum level of employee contributions allowed by the plan sponsor (6, 9, 12, and 15 percent of compensation).
- The annual increase in contributions (1 vs. 2 percent of compensation).
- Whether employees are assumed to opt out of the automatic escalation.
- Whether employees are assumed to remember/retain their previous level of contributions when they change jobs vs. reverting back to the plan’s initial default.

Importance of 401(k) Plan Design Factors

The results in this paper demonstrate the profound influence of plan design variables, as well as assumptions of employee behavior in auto-enrollment 401(k) plans. Even with a relatively simple definition of “success,” large differences in success rates can be seen, depending on which plan design factors and employee behavior assumptions are used:

- The probability of success for the lowest-income quartile increases from the baseline probability of 45.7 percent to 79.2 percent when all four factors are applied.
- The impact on the highest-income quartile is even more impressive, with an increase in the probability of success from 27.0 percent to 64.0 percent.



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Worker Contributions a Key Factor

When viewed in isolation, it is clear that the impact of increasing the limit on employee contributions is much greater than any of the other three factors. However, the importance of including one or more additional factors, along with the increase in the limit on employee contributions, can more than double the impact of increasing the limit by itself.

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Introduction

Previous research has demonstrated the large potential impact of auto-enrollment (AE) on retirement income adequacy. Until recently however, there was extremely limited evidence on the impact of automatic contribution escalation. VanDerhei (2010) provides stochastic simulations of the impact of AE and automatic contribution escalation for 401(k) participants of large sponsors. This *Issue Brief* expands upon that model to provide the first results of a new simulation model that estimates of the impact of changing 401(k) plan design variables and assumptions on retirement income adequacy. This study is part of a larger joint project between Employee Benefit Research Institute (EBRI) and the Defined Contribution Institutional Investment Association (DCIIA) that will include development of a plan-specific simulation model allowing additional plan design variables to be analyzed.

Background

Since 1996, EBRI and the Investment Company Institute (ICI) have collaborated in the collection of data on participants in 401(k) plans.¹ This database includes demographic information, as well as administrative data on annual contributions, plan balances, asset allocation, and loans. This information is disseminated via jointly published annual updates on “401(k) Plan Asset Allocation, Account Balances and Loan Activity.”² As of December 31, 2008, the database included individual information on:

- 24.0 million 401(k) plan participants, in
- 54,765 employer-sponsored 401(k) plans, holding
- \$1.092 trillion in assets.

Previous Simulation Results

VanDerhei and Copeland (2008) simulated the impact of 401(k) sponsors changing from voluntary to automatic enrollment; however, given the close proximity to the passage of the Pension Protection Act of 2006 (PPA) there was no way of knowing what the AE plan design parameters would look like. As a result, the PPA safe harbor provision was used as a prototype in the 2008 study. Moreover, there was no way of knowing the plan design parameters of 401(k) sponsors that would subsequently choose to adopt AE. As determined in a joint EBRI/Mercer study (VanDerhei, July 2007), there is a high correlation between those employers that choose to adopt AE for their 401(k) plans and those that froze/closed their defined benefit (DB) pension plans. Fortunately, EBRI was able to circumvent these limitations in late 2009 with data on actual retirement plan sponsor activity from Benefit SpecSelect™ (a trademark of Hewitt Associates LLC).

VanDerhei (2010) simulated the difference between AE and voluntary enrollment by comparing large 401(k) sponsors with actual plan design parameters. Figure 1 shows only post-2009 accumulations (and rollovers) and, as expected, the simulated balances (as a multiple of final earnings) would be minimal for older age cohorts. However, for those with a major portion of their careers remaining, the differences in additional accumulations due to auto-enrollment prove to be quite significant: When workers currently ages 25–29 are compared, the median 401(k) balances increase from approximately 1.5 times final earnings under voluntary enrollment to more than 6.0 times final earnings in the auto-enrollment scenario.



The 6.0 multiple in Figure 1 might appear to be too small to reach conventional retirement income targets.³ Therefore, Figure 2 recasts the AE results from Figure 1 for just the youngest cohort and provides further breakouts by the number of years eligible for participation in a 401(k) plan as well as the relative income level. For those workers assumed to be eligible (whether or not they choose to participate) for more than 30 years, the median multiples range from approximately 7.6–8.5 times final salary, depending on salary level.

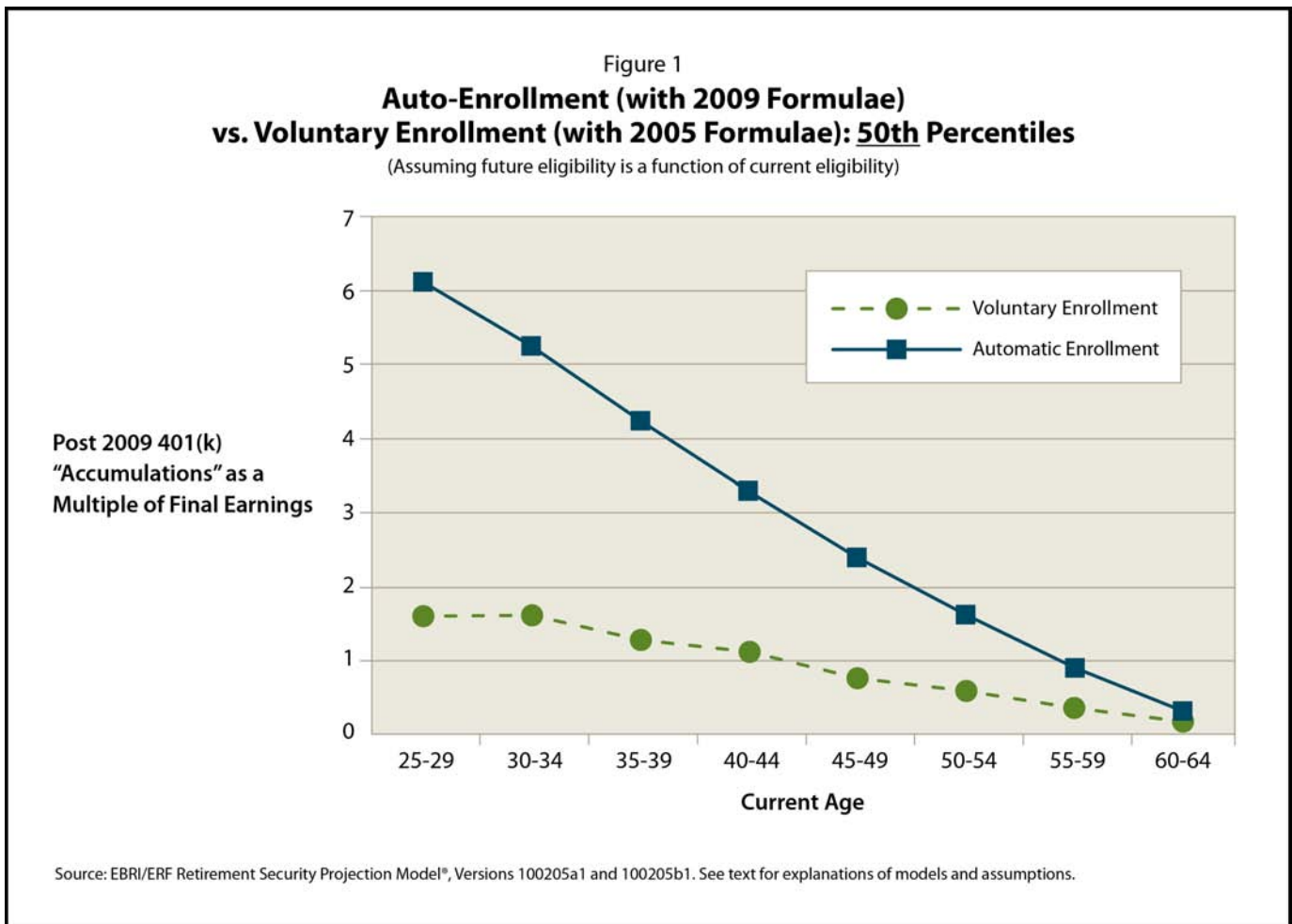
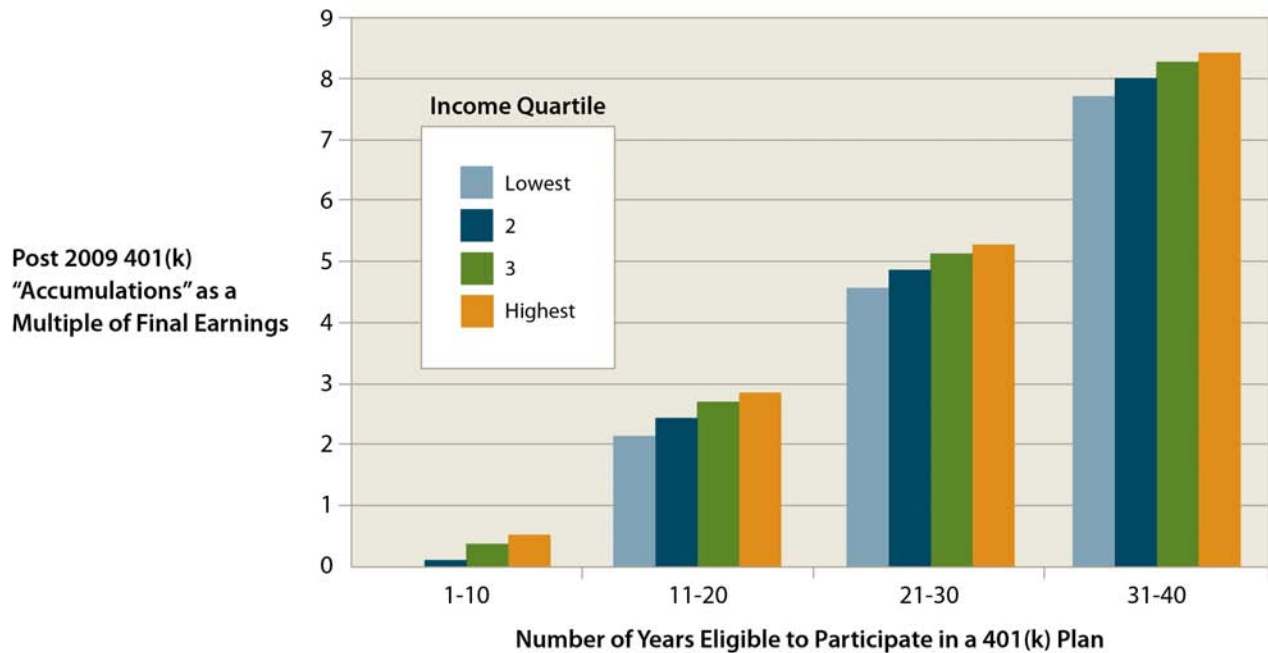




Figure 2
**Employees Currently Ages 25-29: Median 401(k) Accumulation
Multiples for Auto-Enrollment with 2009 Plan Formulae as a Function
of Salary Quartile and Number of Years Eligible for a 401(k) Plan**
(Total balances, baseline assumptions)



Source: EBRI/ERF Retirement Security Projection Model®, Versions 100205a4. See text for explanations of models and assumptions.

VanDerhei (2010) also modeled the following:

- Simulated balances that would be generated under the pre-2005 formulae.
- The portion of balances attributable to employer contributions (to test the assertion that increased probability of participation under AE will result in less generous employer contributions).
- Sensitivity analysis on:
 - Alternative (lower) rate-of-return assumptions.
 - Impact of cashouts.



- Limited to plan sponsors that froze or closed the DB plan to new employees between 2005 and 2009, inclusive.
- Impact of whether employee "remembers" level of contributions from previous 401(k) plan.

New Simulation Results

The basic objective of this report is an analysis of how the probability of “success” changes with different 401(k) plan design variables and assumptions. While the definition of success using this simulation model can be quite complex, this analysis starts out with a very simple definition for this initial application:⁴ namely, a 401(k) accumulation large enough that, when combined with the worker-specific benefits projected under Social Security, will provide a total real replacement rate of 80 percent. This is in the typical range of replacement rates suggested by many financial consultants.⁵

The percentage of earnings replaced by Social Security for scaled medium-earnings workers⁶ retiring at age 65 in 2050 is projected to be 36.3 percent.⁷ However, the Primary Insurance Amount (PIA) formula used to determine monthly Social Security retirement benefits skews the Social Security portion of the replacement rates heavily in favor of the lower paid.⁸ Therefore, a new component was added to the model to simulate each worker’s Average Indexed Monthly Earnings and the resulting PIA and replacement rate, assuming there are no statutory changes to the computation of Social Security retirement benefits by 2050.

The definition of “success” for this analysis is a situation that produces a combined real replacement rate from Social Security and 401(k) projected balances⁹ of at least 80 percent.¹⁰ The analysis is limited to younger employees (with 31–40 years of 401(k) eligibility) and provides separate results for employees in the highest- and lowest-income quartiles.

Using this definition of success, the model is used to determine how success changes with:

- The maximum level of employee contributions allowed by the plan sponsor (6, 9, 12 and 15 percent of compensation).
- The annual increase in contributions (1 vs. 2 percent of compensation).
- Whether employees are assumed to opt out of the automatic escalation.
- Whether employees are assumed to remember/retain their previous level of contributions when they change jobs vs. reverting back to the plan’s initial default.

Figure 3 demonstrates that the success rates for the real 80 percent combined replacement rate for the highest-income quartile employees vary from as low as 27.0 percent to a high of 64.0 percent. The lowest rates are experienced by employees who do not “remember” their previous contribution rates when they change jobs, have a stochastic opt-out of the automatic escalation, and participate in plans that limit the automatic contributions to 6 percent of compensation and increase the contributions by 1 percent per year (the “all-pessimistic” assumption scenario).

In contrast, the highest rates are experienced by employees who do “remember” their previous contribution rates when they change jobs, do *not* opt-out of the automatic escalation, and participate in plans that allow the automatic



contributions to increase to 15 percent of compensation and increase the contributions by 2 percent per year (the “all-optimistic” assumption scenario).

Similar information is provided for the lowest-income quartile employees. As expected, the success rates are somewhat higher, given the larger Social Security replacement rates for this group, varying from 45.7 percent to 79.2 percent.

The relative importance of each of the factors described above is presented in Figure 4. Each bar portrays the increased probability of success relative to the all-pessimistic assumption scenario. The first four sets of bars (one for the lowest-paid quartile and one for the highest-paid quartiles) show the marginal impact of each factor alone.¹² It is clear that when considered in isolation, three of the four factors investigated have only a minimal impact. The increase on the limit in employee contributions is much more substantial (either 14.1 or 16.4 percentage point increase in probability); however, this factor by itself still accounts for less than half of the impact of adding all four factors at once (bottom row of bars).

Although the 80 percent combined real replacement rates provided in Figure 3 may provide a useful range of success rates in general, plan sponsors undoubtedly will have plan-specific (or even cohort- or participant-specific) targets as part of their overall strategic planning for retirement plan design. Therefore, Figure 5 provides a series of cumulative distribution functions (CDFs) that will allow the plan sponsor to choose from a large number of potential thresholds for measuring success.

A CDF describes the probability that a value (in this case the simulated multiple of final earnings at retirement age) will be a value less than x. For example, Figure 5 focuses on the two extreme combinations of plan design variables and employee behavior assumptions mentioned above. The two bottom lines show the results for the highest- and lowest-salary quartiles under the most optimistic combinations (i.e., employees who do “remember” their previous contribution rates when they change jobs, do not opt-out of the automatic escalation, and participate in plans that allow the automatic contributions to increase to 15 percent of compensation and increase the contributions by 2 percent per year), while the two top lines provide the results for the highest- and lowest-salary quartiles under the most pessimistic combinations (i.e., employees who do not “remember” their previous contribution rates when they change jobs, have a stochastic opt-out of the automatic escalation, and participate in plans that limit the automatic contributions to 6 percent of compensation and increase the contributions by 1 percent per year).

If one was interested in determining the range in success rates for a combined real replacement rate greater than 75 percent, for example, looking at the grid at the bottom of Figure 5 shows that 17 percent of the lowest-income quartile under the most optimistic combination of assumptions would have a combined real replacement rate of less than or equal to 75 percent. Therefore, approximately 83 percent¹³ of these individuals would be successful in achieving that target.

Figure 5 demonstrates very clearly that the importance of plan design parameters and/or assumptions with respect to employee behavior depends on what target the plan sponsor chooses. At very low multiples of final earnings, the spread between success rates for optimistic vs. pessimistic scenarios is quite low. For example, at a combined real replacement rate of only 45 percent, the difference in success rates for the highest-income quartile is 13 percentage points, compared with only 1 percentage point for the lowest-income quartile. When the combined real replacement rate target increases to 80 percent, the spread between the all-optimistic and all-pessimistic assumption scenarios become considerable: 33 percentage points for the lowest-income quartile and 37 percentage points for the highest-income quartile.



Figure 3

Success Rates of Achieving an 80 Percent Real Replacement Rate from Social Security and 401(k) Accumulations Combined Under Various Assumptions

Lowest Quartile								
6.0%				9.0%				
Auto Escalation Delta	Don't Remember	Don't Remember	Remember	Remember	Don't Remember	Don't Remember	Remember	Remember
	Don't Opt Out	Opt Out	Don't Opt Out	Opt Out	Don't Opt Out	Opt Out	Don't Opt Out	Opt Out
1.0%	46.5%	45.7%	48.5%	47.5%	59.2%	56.4%	63.2%	59.4%
2.0%	47.5%	47.0%	48.9%	48.3%	62.1%	60.6%	64.2%	62.5%

Lowest Quartile								
12.0%				15.0%				
Auto Escalation Delta	Don't Remember	Don't Remember	Remember	Remember	Don't Remember	Don't Remember	Remember	Remember
	Don't Opt Out	Opt Out	Don't Opt Out	Opt Out	Don't Opt Out	Opt Out	Don't Opt Out	Opt Out
1.0%	66.7%	61.0%	71.8%	65.1%	70.4%	62.1%	76.6%	66.8%
2.0%	70.6%	68.0%		70.6%	75.5%	71.4%	79.2%	74.7%

Highest Quartile								
6.0%				9.0%				
Auto Escalation Delta	Don't Remember	Don't Remember	Remember	Remember	Don't Remember	Don't Remember	Remember	Remember
	Don't Opt Out	Opt Out	Don't Opt Out	Opt Out	Don't Opt Out	Opt Out	Don't Opt Out	Opt Out
1.0%	27.4%	27.0%	28.6%	28.2%	35.9%	34.1%	39.4%	37.1%
2.0%	27.9%	27.6%	28.9%	28.6%	38.6%	37.8%	41.0%	39.9%

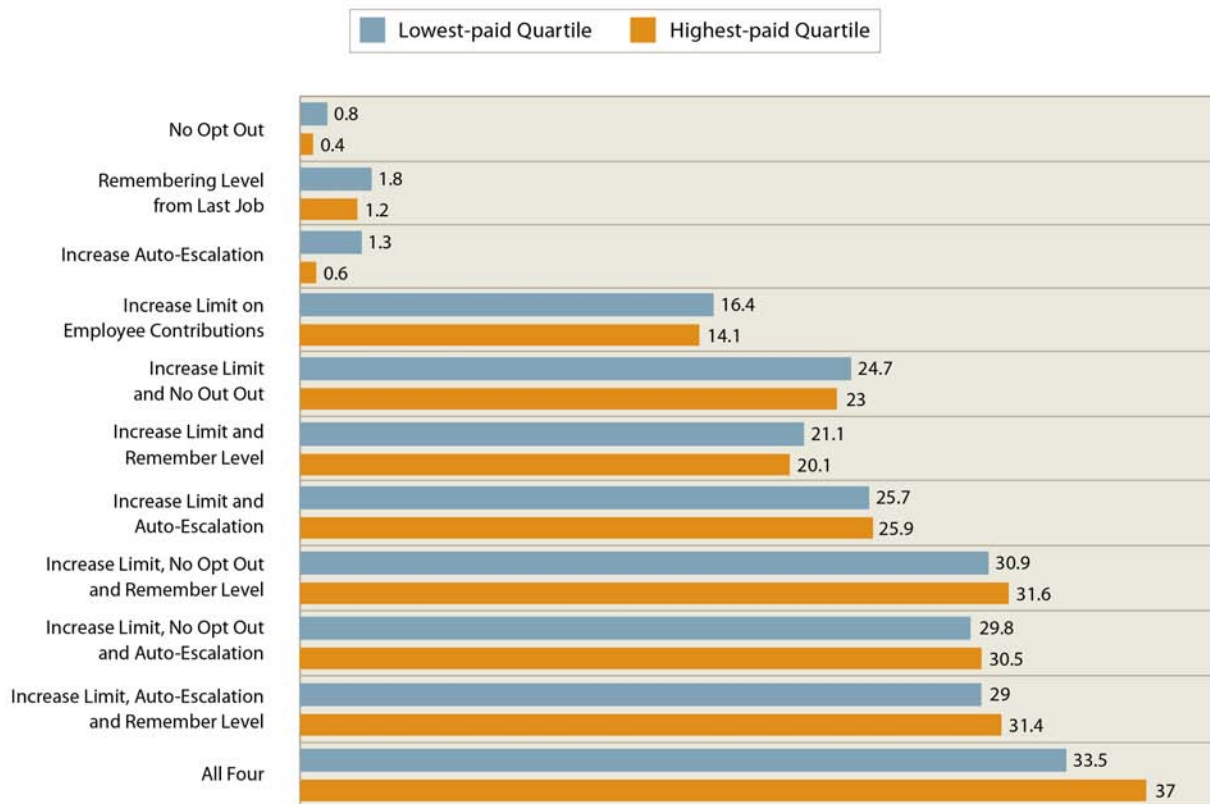
Highest Quartile								
12.0%				15.0%				
Auto Escalation Delta	Don't Remember	Don't Remember	Remember	Remember	Don't Remember	Don't Remember	Remember	Remember
	Don't Opt Out	Opt Out	Don't Opt Out	Opt Out	Don't Opt Out	Opt Out	Don't Opt Out	Opt Out
1.0%	43.7%	38.8%	50.1%	43.6%	50.0%	41.1%	58.6%	47.1%
2.0%	49.1%	46.9%		50.4%	57.5%	52.9%	64.0%	58.4%

Source: EBRI/ERF Retirement Security Projection Model®, Versions 100810a1 - 100810a16.
*See VanDerhei (2007) for distribution of opt-out rates from the Retirement Confidence Survey.



Figure 4
Increase in Probability of Success* from Modifying Plan Design
Features of Automatic Escalation and Employee Behavior

(Total balances, baseline assumptions)



Source DBRI/ERF Retirement Security Projection Model, Versions 100810a1 - 100810a16.

*"Success" is defined as achieving an 80 percent real replacement rate from Social Security and 401(k) accumulations combined as defined in the text. The population simulated consists of workers currently ages 25-29 who will have more than 30 years of simulated eligibility for participation in the 401(k) plan. Workers are assumed to retire at age 65 and all 401(k) balances are converted into a real annuity at an annuity purchase price of 18.62.



While success rates of 79.2 percent for employees in the lowest-income quartile as shown in Figure 3 are certainly noteworthy, those familiar with 401(k) plans will undoubtedly question the likelihood of escalating these employees to a 15 percent contribution rate. Therefore, two alternative limits of employee contribution rates (9 and 12 percent) are graphed in Figure 6. Moving the maximum employee contribution rate down to 12 percent lowers the success rate for the lowest-income quartile employees to only 73.5 percent, and moving it even lower to 9 percent still results in a success rate of 64.2 percent (equivalent to the success rate for the highest-income quartile with a maximum contribution rate of 15 percent).

While the higher success rates for employees in the lowest-income quartile (relative to those in the highest-income quartile) will come as no surprise to those familiar with the manner in which Social Security retirement benefits are computed, the difference between the two employee groups in the marginal increase in success rates resulting from increasing the maximum employee contribution rate may not be as obvious. Given the relatively low success rates for both groups of employees with a 6 percent maximum employee contribution rate (48.9 percent for the lowest-income quartile and 28.9 percent for the highest-income quartile), an increase of 3 percent of compensation in the maximum employee contribution rate will result in a significant increase in success rates for both groups (15.3 percentage points for the lowest-income quartile and 12.1 percentage points for the highest-income quartile). The next 3 percent increase in contributions (from 9 percent to 12 percent) still provides a 12.0 percentage point increase in success rates for the highest-income quartile (compared with only a 9.3 percentage point increase for the lowest-income quartile). The final increase (from 12 percent to 15 percent of compensation) still provides an 11.0 percentage point increase for the highest-income quartile but, given the relatively large success rates for the lowest-income quartile at 12 percent (73.5 percent), this results in an increase of only 5.7 percentage points.

These results are not suggesting that plan sponsors should attempt to put different constraints on 401(k) participants based on their relative income levels (even if such practice were legal). However, it is clear that given a specific plan-wide success rate target, sponsors can use different communication strategies for their employees: i.e., those with lower incomes (and hence higher likely replacement rates from Social Security) can be shown how escalating their contributions to a level that may be more affordable, given their disposable income, would still result in success rates equivalent to employees with higher income contributing at a higher level.

Summary

The results in this paper demonstrate the profound influence of plan design variables, as well as assumptions of employee behavior in auto-enrollment 401(k) plans. Even with a relatively simple definition of “success,” large differences in success rates can be seen, depending on which plan design factors and employee behavior assumptions are used:

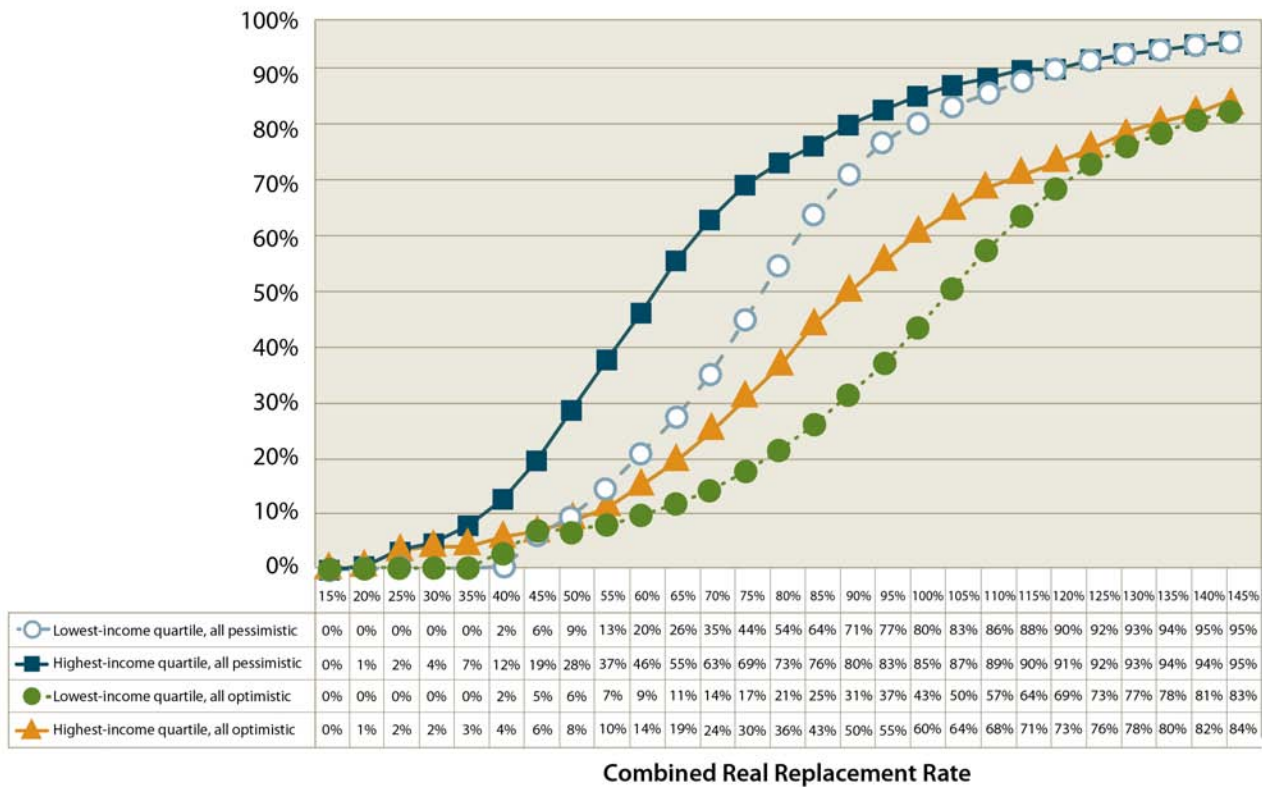
- The probability of success for the lowest-income quartile increases from the baseline probability of 45.7 percent to 79.2 percent when all four factors are applied.
- The impact on the highest-income quartile is even more impressive, with an increase in the probability of success from 27.0 percent to 64.0 percent.

When viewed in isolation, it is clear that the impact of increasing the limit on employee contributions is much greater than any of the other three factors. However, the importance of including one or more additional factors, along with the increase in the limit on employee contributions, can more than double the impact of increasing the limit by itself.



This suggests that additional analysis of the influence of plan design variables on optimizing employee results is warranted. The next step in this project will include development of a plan-specific simulation model that will allow additional plan design variables.

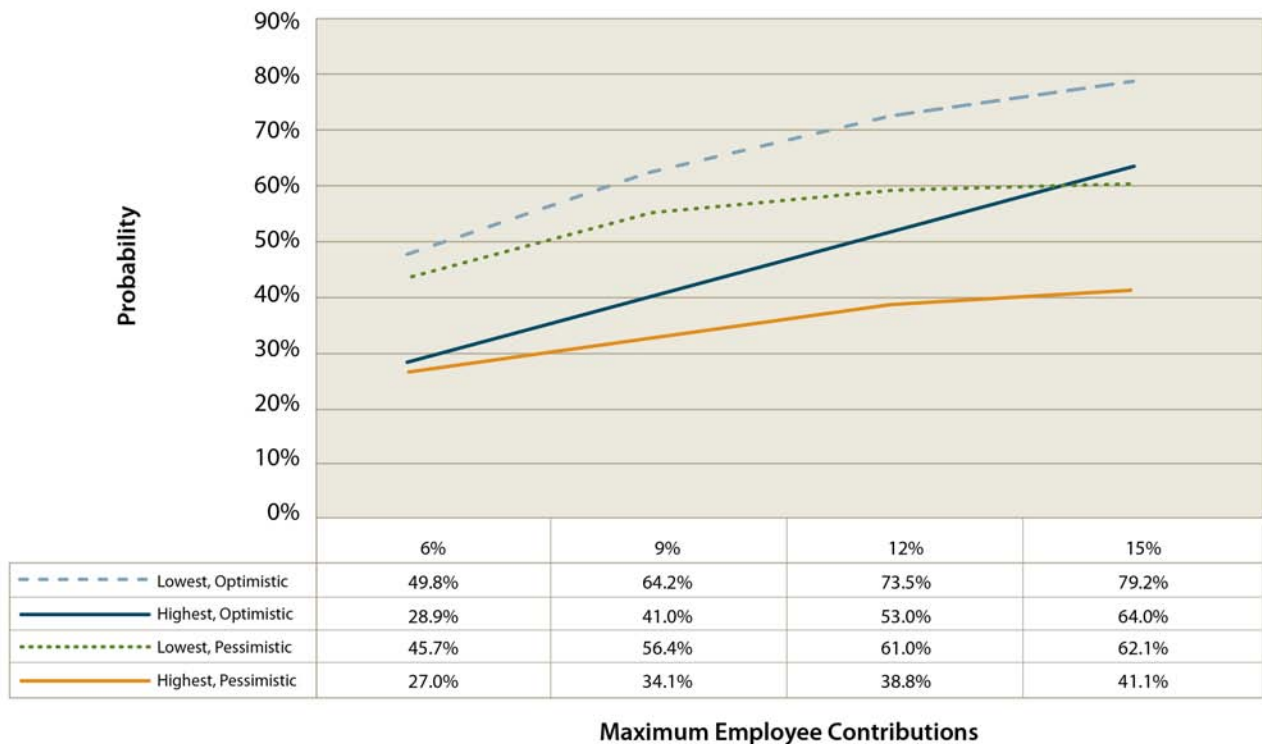
Figure 5
CDFs* of the Two Extreme Combinations of Design Variables and Employee Response Assumptions for Employees Currently Ages 25-29 and Assumed 31-40 Years of Eligibility, High- vs. Low-salary Quartiles



Source: EBRI/ERF Retirement Security Projection Model, versions 100810a1–100810a16.
*Cumulative distribution functions.



Figure 6
**Success Rates of Achieving a Combined 80% Real Replacement
Rate from Social Security and 401(k) Accumulations, as a Function
of Maximum Employee Contributions**



Source: EBRI/ERF Retirement Security Projection Model, versions 100810a1–100810a16.

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Endnotes

- ¹ The EBRI/ICI Participant-Directed Retirement Plan Data Collection Project (the EBRI/ICI 401(k) database) is the largest, most representative repository of information about individual 401(k) plan participant accounts (www.ebri.org/pdf/briefspdf/EBRI_IB_10-2009_No335_K-Update.pdf).
- ² See VanDerhei, Holden and Alonso (2009) for the most recent report from year-end 2008 data. The update for year-end 2009 data is currently scheduled for November 2010.
- ³ It is important to note that this models all U.S. workers. As a result, the balances will be significantly smaller than simulation models of those current 401(k) participants (Holden and VanDerhei, 2002) or those eligible for participation (Holden and VanDerhei, 2005).
- ⁴ See VanDerhei and Copeland (2003) for a detailed explanation of the EBRI Retirement Security Projection Model.™ When all the elements of the accumulation model (e.g., defined benefit, Social Security, net housing equity) are included, the stochastic decumulation model can project probabilities of retirement income adequacy under a number of different targets. The earlier results were recently updated (VanDerhei and Copeland, 2010).
- ⁵ See VanDerhei (September 2004) for a discussion of replacement rates.
- ⁶ Defined as an employee with career-average earnings at about 100 percent of the average wage index (AWI).
- ⁷ 2009 OASDI Trustees Report, Table VI.F10—Annual Scheduled Benefit Amounts for Retired Workers.
- ⁸ For example, career-average earnings at about 45 percent of the national average wage index (AWI) are projected to have real replacement rates of 49.0 percent, while career-average earnings at about 160 percent of the AWI are projected to have real replacement rates of 30.1 percent.
- ⁹ 401(k) projected balances include any balances that originated in a 401(k) plan that have been rolled over to an IRA.
- ¹⁰ An annuity purchase price of 18.62 for a male age 65 was used for the conversion of the account balances to a real annuity. Similar analysis for females will be added in a future publication.
- ¹¹ Employees were assumed to either (1) not opt out or (2) opt out at rates described in VanDerhei (September 2007).
- ¹² For example, the 0.4 percentage point increase for the highest-paid quartile for the impact of not opting out is derived from taking the difference of the 27.4 percent in the upper right hand corner of Figure 3 and the 27.0 percent from the all-pessimistic assumption scenario for the highest-paid quartile.
- ¹³ 100 percent minus 17 percent.
- ¹⁴ The primary insurance amount (PIA) is the benefit a person would receive if he/she elects to begin receiving retirement benefits at his/her normal retirement age. For an individual who first becomes eligible for old-age insurance benefits or disability insurance benefits in 2010, his/her PIA will be the sum of:
 - (a) 90 percent of the first \$761 of his/her average indexed monthly earnings, plus
 - (b) 32 percent of his/her average indexed monthly earnings over \$761 and through \$4,586, plus
 - (c) 15 percent of his/her average indexed monthly earnings over \$4,586.See www.ssa.gov/OACT/COLA/piaformula.html for more information.
- ¹⁵ All reports are available at <http://www.ebri.org/publications/ib/> or <http://www.ebri.org/publications/notes/>