PENSIM Analysis of Impact of Final Regulation on Defined-Contribution Default Investments

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PENSIM has been used by the Employee Benefits Security Administration of the Department of Labor (DOL) to estimate the economic impact of a proposed regulation regarding default investments for defined-contribution pensions regulated under Section 404 of ERISA. The full text of the proposed regulation and the results of DOL regulatory impact analysis will eventually appear in the *Federal Register*.

An earlier version of this document (Holmer 2006) was prepared to facilitate a review of the scientific methods and data used to conduct the regulatory impact analysis. Recent OMB guidelines require such a review for any regulation that has a major financial impact on society.

This document describes the final regulatory impact analysis that incorporates analytical suggestions made by the reviewers, an update of economic and demographic assumptions, and an expansion in the scope of the analysis initiated by DOL.

This document contains three sections.

The first section provides an introduction to PENSIM and points the reader to other documents that contain more detailed descriptions of model logic, data, and validation.

The second section describes the assumptions made in the PENSIM runs used in the final regulatory impact analysis.

The the third section describes the nature of the output generated from the PENSIM runs and points the reader to a separate document that contains the detailed output provided to DOL for the final regulatory impact analysis.

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1 Nature of PENSIM

PENSIM is a dynamic microsimulation model for analysis of the retirement income implications of government policies affecting employer-sponsored pensions. Its development and testing have been funded since 1997 by the Office of Policy and Research at the Employee Benefits Security Administration of the U.S. Department of Labor.

PENSIM uses discrete event simulation methods to generate a cohort sample of life histories that reflect the effects of both collective risks (asset return risk, inflation risk, etc.) and individual risks (mortality risk, disability risk, earnings risk, etc.). The likelihood and timing of simulated life events are represented by a variety of probability models, including hazard functions and multinomial logit models, that have been estimated using various survey data sets. Pension characteristics are imputed using a model estimated with 1996-98 establishment data from Bureau of Labor Statistics Employee Benefit Survey, which is now known as the National Compensation Survey. Simulated life histories contain information on educational attainment, disability, mortality, a complete job history that includes details on earnings and pension accumulation for each job, and a record of pension income in retirement. The simulated life histories have been subjected to a number of validation tests, the results of which suggest that samples of simulated life histories are realistic.

More information on the structure, validation, and ongoing development of PENSIM is available in *PENSIM Overview* (Holmer et al. 2007), which begins with a two page "Introduction" and a fifteen page "Thumbnail Sketch of PENSIM" before presenting comprehensive documentation and validation results.

The pension characteristics imputation model is fully documented in *Characteristics of Pension Plans in the United States, 1996–98* (Holmer and Janney 2003), which begins with a two page introductory chapter before discussing the estimation of the imputation model in detail.

An efficient approach to learning more about PENSIM is to read the two initial sections of the *Overview* mentioned above as well as the table of contents, and then read the "Data Analysis Agenda" chapter and table of contents in the *Characteristics* report. Reading that material will provide a road map that will allow the reader to navigate which ever parts of the detailed documentation are of interest.

2 Assumptions of Regulatory Analysis

This section describes the assumptions and methods used in the PENSIM runs. Most of the data and methods used in the runs are standard and documented in *PENSIM Overview* (Holmer et al. 2007). Only the assumptions particular to the PENSIM runs used in the regulatory analysis are described in this section.

The assumptions are discussed in two subsections. The first describes the characteristics of the PENSIM runs produced for the analysis, while the second describes the assumptions made about the impact of the proposed regulation.

The DOL approach to the impact analysis of the regulation on default investments is to analyze the effects of an increase in the prevalence of automatic-enrollment procedures in defined-contribution pension plans. The following two subsections provide details on how that analysis is conducted using PENSIM.

2.1 Characteristics of PENSIM Runs

Analysis of the effects of more plans adopting automatic-enrollment procedures is conducted using PENSIM runs that simulate a one-half percent sample of the cohort born in 1935 and in each subsequent year. Each cohort sample is spread across 500 stochastic macroeconomic scenarios in which the inflation rate and asset returns are varying from year to year.

The effects of more plans having automatic-enrollment procedures are measured in a cross-section sample of all those alive in 2034, when the oldest of the simulated cohorts will be 99 years old. Members of this cross-section sample who are age 65 or older are queried about their retirement income from pensions, and members of this cross-section sample who are employed are queried about their pensions on their current job. The retired subsample contains 378,350 simulated individuals and the employed subsample contains 784,791 simulated individuals. There are, of course, a few thousand simulated individuals who are in both subsamples and they are asked about both their current job and their retirement income.

All the PENSIM runs use macroeconomic and macrodemographic assumptions from the 2006 OASDI Trustees Report (unlike the analysis of the preliminary regulation, which used assumptions from the 2005 OASDI Trustees Report). Using Trustees Report assumptions, PENSIM life histories

have been shown to produce social security projections similar to those produced by the Congressional Budget Office (Holmer et al. 2007, pages 11–12). Among the 2006 OASDI Trustees Report assumptions are a long-run mean inflation rate of 2.8 percent and a long-run mean real rate of return on Treasury bonds of 2.9 percent. Annual fluctuations around these long-run mean values, as well as fluctuations in equity returns and Treasury bill spreads, are simulated using the vector-autoregressive VAR(2) model described in the *SSASIM Guide* (Holmer 2007a, pages 14–19). The assumed mean real Treasury bill yield is 1.3 percent, producing a spread to Treasury bonds that is equal to the average historical spread.

All the PENSIM runs assume that a broad index of equity returns vary from year to year, and that the time series of equity returns is uncertain. The uncertainty is represented by variation across 500 Monte Carlo scenarios. The 500 time series of equity returns is generated assuming a lognormal distribution with mean reversion as described in the *SSASIM Guide* (Holmer 2007a, pages 14–19). The lognormal mean and standard deviation of the gross return are assumed to be 0.0688 and 0.1807, which generate a sample geometric mean and standard deviation for the nominal rate of return equal to 7.841 percent and 20.22 percent, respectively. The twenty percent annual volatility is the same as reported for the years 1926–2005 by Ibbotson Associates in their *Stocks, Bonds, Bills, and Inflation: 2006 Yearbook*. Given the assumed inflation rate of 2.8 percent, the 7.841 percent nominal mean translates to a real mean of 4.9 percent, which represents a 2.0 percent real equity premium over the assumed mean real Treasury bond return. This assumed real equity premium is lower that the 3.5 percent value used by the SSA Office of the Chief Actuary in its analysis of social security account reforms. The 3.5 real equity premium assumption is based on projecting the historical premium into the future, an assumption that reviewers of the preliminary analysis criticized as unreasonable.

Company stock, which is the employer contribution in some plans, is assumed to have a rate of return equal to the broad index plus an annual random element that is drawn from a normal distribution with a mean of zero and a standard deviation of thirty-one percent, an assumption based on 1962–1995 results reported in Table 1 of David L. Ikenberry, Richard L. Shockley, and Kent L. Womack, "Why Active Fund Managers Underperform the S&P 500: The Impact of Size and Skewness," *Journal of Private Portfolio Management*, 1:13-26, Spring 1998.

All the PENSIM runs assume a full range of individual (or idiosyncratic)

risks in order to produce variation in life histories, but only the collective (or systemic) risk of uncertain inflation and asset returns. These individual and collective risks are jointly sampled, which means that each cohort sample consists of 500 small samples, each one of which contains a different group of individuals born in that year.

All the PENSIM runs use the same assumptions about waiting times between defined-contribution plan eligibility and participation under standard-enrollment procedures, and about waiting times between defined-contribution plan participation and active (that is, non-passive or non-default) participation under automatic-enrollment procedures. These waiting-time distributions are generated in PENSIM using hazard functions that have been calibrated to produce results that are similar to those reported in James J. Choi, David Laibson, and Bridgitte C. Madrian, "Plan Design and 401(k) Savings Outcomes," written for the *National Tax Journal* Forum on Pensions, June 2004. For more on the participation logic used in PENSIM, on the hazard functions, and on the results of a participation rate validation test, see section 2.2.2, section C.15, and section 10.1.1, respectively, in *PENSIM Overview* (Holmer et al. 2007).

All the PENSIM runs make the same assumptions about contributions among active (that is, non-passive or non-default) participants in defined-contribution plans. Active participants contribute a percent of earnings that rises with age and earnings as described in section C.16 of *PENSIM Overview* (Holmer et al. 2007).

All the PENSIM runs assume current-law pension policy as specified in the Pension Protection Act of 2006. This means that unlike the earlier analysis of the preliminary regulation, the current analysis assumes that maximum allowable pension contributions will continue to be indexed in 2011 and subsequent years.

Active participants are assumed to invest all their plan assets (other than employer contributions made in company stock, which must be held in company stock until the employee is age 55 and is assumed to be held after age 55) using one of three investment styles: (a) all assets invested in a life-cycle fund, (b) half of assets invested in a life-cycle fund and half in a government-bond fund, and (c) all assets invested in a government-bond fund. (The life-cycle fund is assumed to invest only in government bonds and a broad equity index, with the bond allocation percent equaling the age of the individual holding the fund.) Each individual is assumed to follow the same investment style over a whole lifetime. The probability of an individual fol-

lowing style (a) is assumed to be 75 percent, style (b) 10 percent, and style (c) 15 percent. This assumed distribution of investment styles is based on an interpretation of the results shown in Sarah Holden and Jack VanDerhei, "401(k) Plan Asset Allocation, Account Balances, and Loan Activity in 2005" *ICI Research Perspective*, vol.12, no.1, August 2006, Figures 7-8 on page 7. The administrative fees associated with the life-cycle fund (LCF), the government-bond fund (GBF), and the money-market fund (MMF), which is sometimes a default investment under automatic-enrollment procedures, are assumed to be 75, 45, and 45 base points, respectively. These fees are based on findings in: (a) Munnell, Soto, Libby, and Prinzivalli, "Investment Returns: Defined Benefits vs 401(k) Plans," *Center for Retirement Research Issue Brief 52*, September 2006, Table 5 on page 5; and (b) Poterba, Rauh, Venti, and Wise, "Defined Contribution Plans, Defined Benefit Plans, and the Accumulation of Retirement Wealth," *NBER Working Paper 12597*, October 2006, page 17; and (c) *Fidelity+*, November 2006, pages 20–25. A description of all the investment options simulated in PENSIM is available in the *PENSIM Overview* (Holmer et al. 2007, pp. 14–15).

Individuals are assumed to use their imputed investment styles to allocate all the assets in their rollover accounts. The probability that an end-of-job vested balance will be rolled over into the retirement rollover account (rather than being cashed out) is determined by a rollover probability function that is described in section C.18 of the *PENSIM Overview* (Holmer et al. 2007). For more on the rollover account itself, consult section 2.2.6 in *PENSIM Overview* (Holmer et al. 2007). Note that a sensitivity test is conducted as part of the analysis in which it is assumed that the rollover probability is zero for all individuals who reach the end of their job and are still passive participants subject to the automatic-enrollment procedure's default contribution rate and investment option.

All the PENSIM runs make the same assumptions about withdrawals in retirement from the pension rollover account: the whole balance is used at first withdrawal age to buy an annuity whose payments are not inflation indexed. A married individual is assumed to buy a joint-and-50%-survivor annuity, while an unmarried individual is assumed to buy a single-life annuity. The annuity provider is assumed to charge gender-specific prices that produce enough revenue for the annuity provider to remain solvent while making the annuity payments (assuming zero administrative costs and profits) and to avoid cross subsidies between the genders. Annuity prices rise for younger birth cohorts because they have longer life expectancies than older birth

cohorts. For more on the timing of the first withdrawal from the rollover account, read section C.19 in *PENSIM Overview* (Holmer et al. 2007).

2.2 Assumptions about Regulatory Impact

All the PENSIM runs used in the analysis share the characteristics discussed above, but differ in their assumptions about the prevalence and nature of automatic-enrollment procedures. In each run, the details of automatic-enrollment procedures are assumed to be unchanged in every year after the plan sponsor introduces automatic-enrollment for new employees. In all the runs, DOL has assumed that the prevalence of automatic-enrollment procedures is zero up through 1998, and then the probability that a new employee will be covered by a plan with automatic-enrollment procedures is assumed to rise linearly to 35 percent in 2006. In the pre-regulation baseline runs DOL assumes that the prevalence of automatic-enrollment procedures remains at 35 percent in all years after 2006. In the "low-impact" runs, DOL assumes that the prevalence of automatic-enrollment procedures rises to 50 percent in 2009, while the "high-impact" assumption is that the regulation induces a rise to 65 percent in 2009. After 2009, DOL assumes that the prevalence of automatic-enrollment procedures for new employees remains unchanged at its 2009 level.

All the PENSIM runs assume that automatic-enrollment procedures are included only in savings and thrift (as defined by the Bureau of Labor Statistics in the National Compensation Survey) defined-contribution plans sponsored by private-sector employers who match employee contributions. The focus on private-sector plans is appropriate because ERISA regulations do not apply to government-sponsored plans. The focus on savings and thrift plans, which represent the vast majority of all defined-contribution plans, is appropriate because the primary focus of the regulation is on plans that require contributions from employee earnings for participation.

All the PENSIM runs assume that employee participation probabilities in these plans are somewhat higher under automatic-enrollment procedures than under standard-enrollment procedures. The participation probability increase caused by automatic-enrollment procedures is assumed to be such that the overall participation probability would rise from about 68 percent when none of these plans have automatic-enrollment procedures to about 90 percent when all of these plans have automatic-enrollment procedures. This DOL assumption reflects evidence reported in James J. Choi, David Laibson,

and Bridgitte C. Madrian, "Plan Design and 401(k) Savings Outcomes," written for the *National Tax Journal* Forum on Pensions, June 2004.

In addition to variation in the prevalence of automatic-enrollment procedures, the PENSIM runs use different assumptions about the default contribution rate and default investment fund under automatic-enrollment procedures. The default investment is either a life-cycle fund (as defined above) or a money-market fund, whose assets are Treasury bills. The PENSIM runs use different assumptions provided by DOL about what fraction of the new employees are covered by plans where the default investment is a life-cycle fund or a money-market fund.

The impact analysis of the final regulation consists of comparing the results for employed and elderly individuals in a pre-reform and a post-reform run as shown in Table 1, where the PENSIM runs being compared are described in Table 2 on page 10. Be sure to read Table 2 first to understand some of the terms used in Table 1.

Table 1: ***Run Comparisons Used in Analysis of Final Regulation***. *See table on next page for detailed specification of each run.* ***RO*** *denotes rollover behavior which can be standard (std) or alternative (alt).* ***DCR%*** *denotes default contribution rate under automatic-enrollment procedures.*

Run Comparison	Comparison Description
Post-Reform with only LCF being in safe harbor:	
401 → 402	std-RO low-impact analysis
401 → 403	std-RO high-impact analysis
405 → 406	alt-RO low-impact sensitivity test
407 → 408	std-RO low-impact escalating DCR% sen.test with full part.effect
409 → 410	std-RO low-impact escalating DCR% sen.test with half part.effect
Post-Reform with both MMF and LCF being in safe harbor:	
401 → 412	std-RO low-impact analysis
401 → 413	std-RO high-impact analysis

There are two sets of run comparisons that make up the impact analysis: the first set assumes that the final regulation will provide safe-harbor protection for plans with automatic-enrollment procedures only if they have a life-cycle fund as the default investment, while the second set assumes that the final regulation with provide safe-harbor protection for plans that adopt either a life-cycle fund or a money-market fund as the default investment.

Table 2: ***Runs Used in Impact Analysis of Final DOL Regulation***. *Table headings are as follows.* ***Prev%*** *denotes the percent of new employees with automatic-enrollment procedures after 2009.* ***LCF%*** *denotes that percent of new employees in plans with automatic-enrollment procedures that have the life-cycle fund as the default investment.* ***DCR%*** *denotes the default contribution rate in plans with automatic-enrollment procedures.* ***Part*** *denotes the automatic-enrollment participation rate effect on individual behavior: "full" assumes a rise from 68 to 90 percent as discussed in the text above, while "half" assumes a rise from 68 to 79 percent.* ***RO*** *denotes the assumed rollover behavior: "std" assumes all participants have rollover probability determined by the PENSIM rollover probability function, while "alt" assumes that those who are passive participants at job end have a zero rollover probability and that active participants at job end have standard rollover probabilities.*

	Automatic-Enrollment			Behavior		
Run	Prev%	LCF%	DCR%	Part	RO	Description
Pre-Reform:						
401	35	50	3.0	full	std	std-RO baseline
405	35	50	3.0	full	alt	alt-RO baseline
407	35	50	4.5	full	std	escalating-DCR% baseline F
409	35	50	4.5	half	std	escalating-DCR% baseline H
Post-Reform with only LCF being in safe harbor:						
402	50	100	3.0	full	std	std-RO low-impact run
403	65	100	3.0	full	std	std-RO high-impact run
406	50	100	3.0	full	alt	alt-RO sensitivity run
408	50	100	4.5	full	std	escalating-DCR% sen.run F
410	50	100	4.5	half	std	escalating-DCR% sen.run H
Post-Reform with both MMF and LCF being in safe harbor:						
412	50	50	3.0	full	std	std-RO low-impact run
413	65	50	3.0	full	std	std-RO high-impact run

The baseline (or pre-reform) runs all assume that half the plans have a life-cycle fund (LCF) as the default and the other half have a money-market fund (MMF) as the default investment under automatic enrollment. The first set of post-reform runs (runs 402, 403, 406, 408, and 410) assumes all plans with automatic-enrollment procedures have a LCF default. The second set of post-reform runs (runs 412 and 413) assumes that half the plans with automatic-enrollment have a LCF default and that the other half have a MMF default.

Within each set of post-reform runs, there are two basic runs that represent the low-impact and high-impact effect of the regulation in increasing the prevalence of automatic-enrollment procedures. The basic low-impact analysis involves comparing baseline run 401 with post-reform runs 402 and 412, while the basic high-impact analysis involves comparing baseline run 401 with post-reform runs 403 and 413.

The remaining run comparisons represent sensitivity tests in which some of the assumptions used in the basic analysis are varied to determine the sensitivity of the impact results. In the run 405–406 comparison, the basic assumption concerning end-of-job balance rollover behavior is changed so that plan participants who are still passive participants never rollover any of the account balance.

In the remaining sensitivity runs, the basic assumption of a fixed three percent default contribution rate is replaced with the assumption that all plans with automatic-enrollment procedures adopt an escalating default contribution rate that starts at three percent in the first year of an individual's plan eligibility and then rises by one percentage point in each subsequent year until it reaches a maximum of six percent of earnings. An analysis of the statistical distribution of years since plan eligibility among passive participants (who are subject to the plan's default contribution rate) shows that the weighted average contribution rate among all passive participants under this escalating schedule would be 4.5 percent of earnings. In these sensitivity runs, an escalating default contribution rate regime is approximated by a fixed 4.5 percent default contribution rate.

In the run 407–408 comparison, the 4.5 percent default contribution rate assumption is meant to approximate the adoption of an escalating default contribution rate, but assumes that the participation-rate-increasing effect of automatic-enrollment procedures observed under a lower fixed default contribution rate regime would be undiminished. The notion that a substantial increase in default salary reduction would produce the same sized participa-

tion increases seems doubtful, but we are unaware of any scientific evidence that speaks to this issue. Given the lack of scientific evidence, an alternative sensitivity test — the run 409–410 comparison — adds the arbitrary assumption that, when the default contribution rate rises to 4.5 percent of earnings, the size of the automatic-enrollment induced increase in the participation rate is one-half as large as when it is assumed that the default contribution rate is 3.0 percent.

3 Results of Regulatory Analysis

A standard set of statistics are tabulated for each of the ten PENSIM run comparisons included in Table 1 on page 9. The tabulated statistics are presented in a five-page report for each run comparison. A report for each of the ten run comparisons is included in a companion document (Holmer 2007b). The rest of this section explains the statistics that appear in the reports.

The first two pages in each report present aggregate pension accumulation statistics based on the results of a survey questionnaire administered in 2034 to each simulated individual who is employed. The information gathered in this survey can be aggregated to produce statistics on pension participation, contributions, account balances (with monetary amounts expressed in 2006 dollars). The net gain (expressed in percentage terms) is shown in the column with the `%chg` heading. The net percentage gain figure is more accurate using the rounded `PRE` and `POST` amounts in hand calculations. The balance subtotals for passive participants are shown inside the square brackets and the right side of the page. The total (non-percentage) net gains are decomposed into their positive and negative subtotals in the middle panel of the page, where the difference in the "positive impact" and "negative impact" statistics is equal to the corresponding pre-post difference, apart from rounding error. At the bottom of each of these pages is a tabulation of the number, average age, and average earnings of active and passive participants.

The third page in each report presents aggregate rollover and cashout statistics for all private-sector job-endings in the year before the cross-section survey is conducted at the start of 2034 where the employer offers a DC savings-thrift plan. This page shows the relative number of cashouts and rollovers as well as the aggregate and average balances involved in cashouts and rollovers. In addition, information about the average age, job duration, and job earnings of the cashout and rollover job-endings is presented.

The final two pages in each report present distributional statistics on pension income received by a sample of simulated individuals who are at least 65 years old in 2034. Statistics on pension income received from all types of pensions are tabulated for those individuals even if they were still employed (with monetary amounts expressed in 2006 dollars).

First Report Page. The first page presents the standard set of aggregate pension accumulation statistics for the whole population.

Second Report Page. The second page presents the standard set of aggre-

gate pension accumulation statistics for the subset of the population who are employees at small firms (with 1–99 employees) at the time of the survey.

Third Report Page. This page presents statistics about job-endings in the year before the survey with an emphasis on measuring the volume of cashouts and rollovers.

Fourth Report Page. This is the first of the two pages with distributional statistics on pension income among the elderly. This page presents statistics on the size distribution of regulation-induced gains and losses in pension retirement income.

Fifth Report Page. This is the second of the two pages with distributional statistics on pension income among the elderly. This page presents the average size of regulation-induced gains and losses in each lifetime earnings quartile.

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