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ABSTRACT

Demographic change can have an important effect on the stock of assets held in defined benefit pension plans. This paper projects the impact of changes in the age structure of the U.S. population between 2005 and 2040 on the stock of assets held by these plans. It projects the contributions to and withdrawals from these plans. These projections are combined with estimates of the future evolution of assets in 401(k)-like plans to describe the prospective impact of demographic change on the stock of assets in retirement plans. Information on demography-linked changes in asset demand is a critical input to evaluating the potential impact of population aging on asset returns.

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Many analysts have suggested that population aging will adversely affect the assets of baby boomers when they retire. They argue that when a large population cohort is working and accumulating resources for retirement, their demand for wealth is high, and this raises the price of financial assets and other stores of wealth. Conversely, when a large cohort retires, the argument suggests that cohort members are likely to sell their assets to finance consumption and thereby to drive down asset prices. This argument suggests that the rapidly increasing population of older people in the United States and around the world might lead to lower returns in financial markets in the decades ahead.

This paper examines the effect of population aging on the demand for financial assets in retirement saving plans, particularly defined benefit plans, in the United States. It is part of a larger project that aims to evaluate the potential empirical importance of demographic trends on financial market returns in the United States. Our analysis focuses on retirement saving programs because the future effect of demographic trends on financial asset demand is likely to be most pronounced in asset holdings in retirement saving plans. The inflows and outflows from these plans, particularly defined benefit plans, are sensitive to demographic trends. Thus a key stepping stone in understanding the effect of population age structure on asset returns is forecasting the effect of demographic trends on the net cash flows to retirement saving plans and the stock of assets in these plans.

Over the past two and a half decades there has been a fundamental change in saving for retirement in the United States. There has been a rapid shift from saving through employer-managed defined benefit (DB) pensions to defined contribution (DC) retirement saving plans that are largely controlled by employees. Just two or three decades ago, employer-provided DB plans were the primary means of saving for retirement in the United States. But since that time, 401(k) and other personal retirement accounts have become the principal form of retirement saving in the private sector. DB plans have remained an important form of retirement saving for federal employees and for state and local employees, although even for these employees personal retirement accounts are becoming increasingly important. More than 80 percent of private retirement plan contributions in 2000 and 2001 were to 401(k) and other personal accounts. Contributions to personal retirement plans accounted for only 12 percent of total contributions to Federal pension plans in 2000, but had increased to 17 percent by 2004. Thus to understand the effect of demographic trends on the demand for retirement assets in the coming decades it is important to evaluate the likely flows into and out of both 401(k) and DB plans.

In Poterba, Venti, and Wise (2006), we described the rise of 401(k) plans and the implications of this rise for the flow of assets into and out of 401(k) plans over the next four decades. In this paper we describe the decline in DB plans and assess its implications for the flow of assets into and out of DB plans over the next four decades. We then bring together projections of net pension flows to both DB and DC plans. Schieber and Shoven (1997) consider the implications of population aging for private pension fund saving and project saving as a percent of payrolls. Their projection method differs from ours, and it does not consider the rising importance of self-directed defined contribution plans.

There is a substantial and growing literature on the link between population age structure and returns in financial markets. The U.S. Government Accountability Office (2006) provides a recent review of related research. Several studies have used an overlapping-generations framework to explore the theoretical effects of a transitory increase in the population growth rate, a "baby boom," on the equilibrium rate of return. These studies, while based on stylized models, offer valuable insight on the direction of asset market effects. Other research has taken a more empirical approach and explored the reduced form relationship between summary measures of demographic structure and the returns to investors holding bonds and stocks. The existing findings, illustrated for example in Brooks (2002), Geanakoplos, Magill, and Quinzii (2004), and Poterba (2005), span a range of different potential outcomes. Most of the existing work adopts a closed-economy approach, either studying how a baby boom in a single economy will affect returns in that economy, or examining the correlation between a nation's population structure and financial market returns in that nation. Recent analyses, however, such as Boersch-Supan, Ludwig, and Winter (2005) and Krueger and Ludwig (2006), move beyond this setting and examine how demographic trends affect international capital flows as well as domestic asset markets.

Very few studies have used household-level data on asset accumulation to project future asset demand. This paper on DB plans and our companion paper on 401(k) plans begin with a disaggregated analysis of current asset flows in and out of the pension system and use these flows as a base to project pension assets in future years. These projections are a critical input to assessing the effect of demographically-induced asset flows on market rates of return.

This paper is divided into ten sections. In the first, we present a cohort description of the decline in the participation rate of <u>employed</u> persons in DB plans over the past two decades. Then we describe a series of analyses that provide the basis for projections of future assets in DB plans. We begin section two with a cohort description of the dollar amount of pension benefits received by persons over age 55, and we develop projections of DB benefits in the future. In section three, we present a parallel cohort description of the probability of receipt of DB benefits by persons over the age of 55. In section four we return to the estimation of DB participation during the working years. While in the first section we considered DB participation profiles for <u>employed</u> persons, here we consider analogous profiles for <u>all persons</u> in the population. The estimates obtained in this section are used to supplement the estimates obtained in section three to project benefits after retirement for all persons in the population. In section five, we combine the information described in the previous three sections to develop projections of the total value of DB benefits in future years. Section six presents projections of DB pension wealth for cohorts retiring between 1982 and 2040 and, for each cohort, compares DB wealth to projected 401(k) assets from Poterba, Venti, and Wise (2006). In section seven, we consider projections of the total value of assets in DB trust funds. Section eight brings together projections for both DB and 401(k) plans to explore the flow in and out of the pension system as a whole. It is the change in the assets in DB trust funds combined with the change in the assets in personal retirement accounts that may affect the rate of return on the investments of future generations of retirees. In section nine we discuss what our projections imply for the relative change in asset demand in the future. Section ten summarizes our findings.

1. Participation of Employees in DB Plans

DB participation data were obtained form the several waves of the Survey of Income and Program Participation (SIPP) for the years 1984, 1987, 1991, 1993, 1995, 1998, and 2003. Our analysis here and in subsequent sections is based on organization of the data by cohort. We sometimes define cohorts by the age of the cohort in 1984 and sometimes by the year in which the cohort attains age 65. When referring to the cohort age in 1984, the age is proceeded by "C." When referring to the year the cohort attains age 65, the year is proceeded by "A." Thus, C65 and A1984 identify the same cohort.

To project DB participation in the future, or to predict DB participation in earlier years, we must make projections beyond the range of the observed SIPP data. The cohorts for which data are observed, and the ages for which data are observed, are shown in Table 1-1 below. The table also shows the cohorts, and ages, for which projections are made. Data for all years spanned by the SIPP surveys are available for cohorts C25 through C45. Data for some of the survey years are available for cohorts C9 to C24 and for cohorts C46 to C64. The cohorts for which some SIPP data are available are noted in bold in the table.

Figure 1-1 shows the data for selected cohorts. It is clear that the DB participation rate of employed persons declined consistently with successively younger cohorts. For example, at age 45, the participation rate of those who attained age 45 in 1984, the C45 cohort, was about 43 percent. But the participation rate of the C27 cohort, which attained age 45 in 2002, was about 29 percent. Comparisons at other ages show similar differences.

Table 1-1. Cohorts, observed data, and projected data for DB participation give employed			
Cohort defined by age in 1984	Age in 1984	Age in 2003	Cohort defined by year age 65 is attained
C-1	-1	18	A2050
C0	0	19	A2049
C1	1	20	A2048
…			
C8	8	27	A2041
C9	9	**28**	A2040
…			
C25	**25**	**43**	A2024
…			
C45	**45**	**63**	A2004
…			
C64	**64**	83	A1985
…			
C65	65	84	A1984
…			
C100	100	119	A1949

Not only is there a cohort effect, with younger cohorts having a successively lower participation rate at all ages, but there is also a within-cohort decline in the participation rate with age. The within-cohort decline with age for older cohorts is likely explained in part by retirement. DB plans typically provide incentives to retire early and DB participants on average retire earlier than persons without these plans; some participants may retire as early as age 55. But even for younger cohorts there is typically a within-cohort decline in DB participation rates with age.

Figure 1-1. DB participation rate of employed persons, selected cohorts

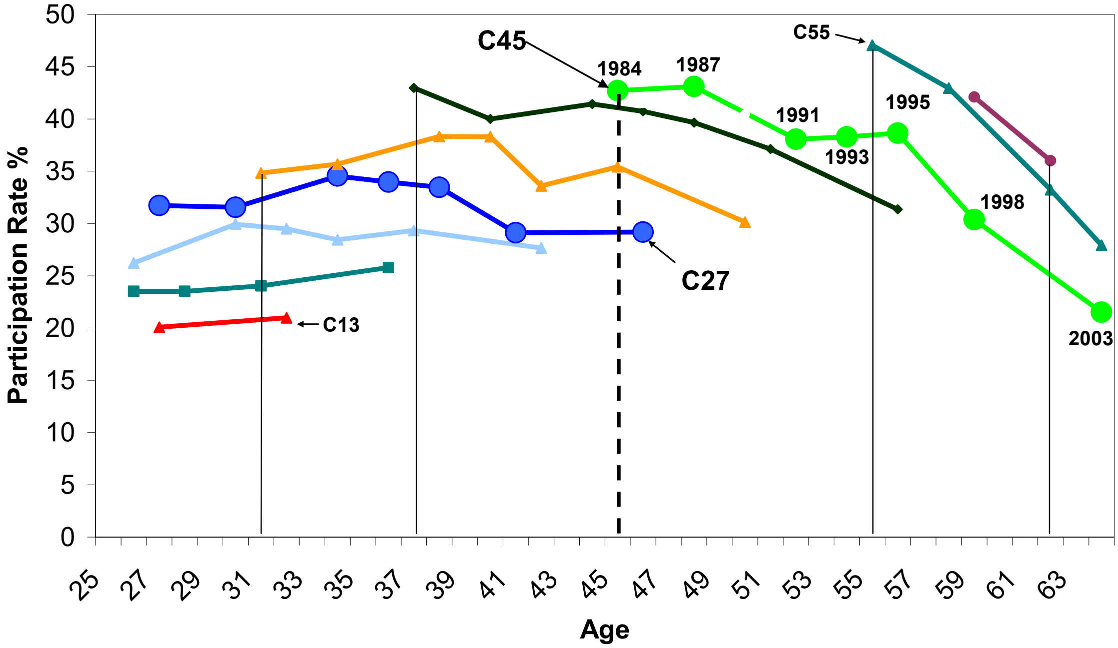
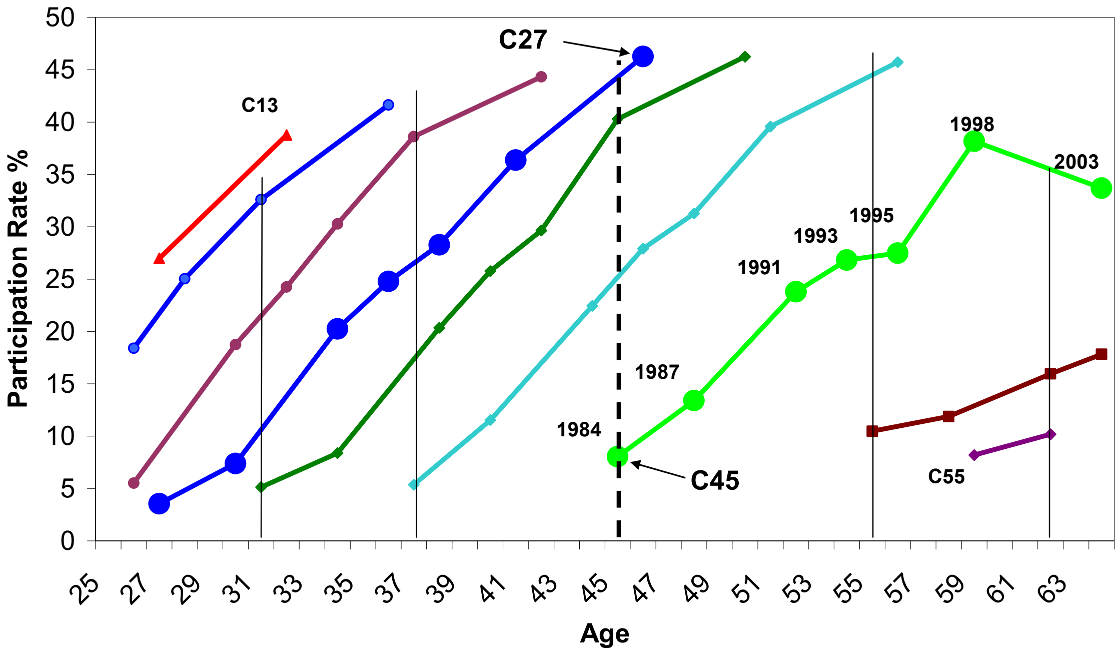


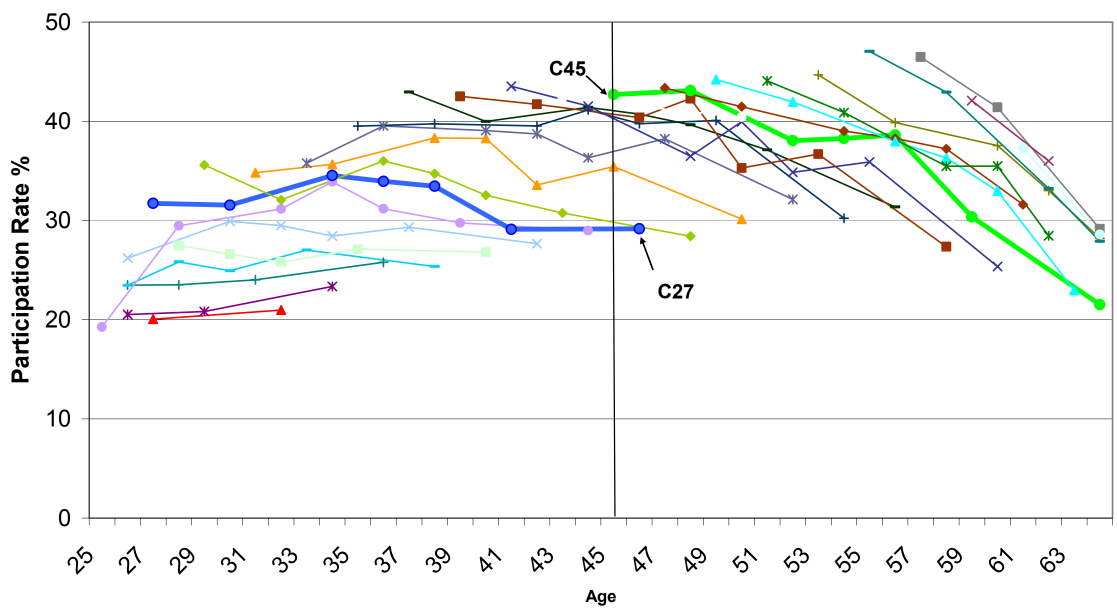
Figure 1-2. 401(k) participation rate of employed persons, selected cohorts



For, comparison, similar cohort data for 401(k) plans and other personal retirement plans are shown in Figure 1-2. At age 45, the 401(k) participation rate of the cohort that attained age 45 in 1984 was only 8 percent. But the participation rate of the cohort that attained age 45 in 2002 was about 47 percent.

Figure 1-3 shows DB participation rates for every other cohort. Again, it is clear that with few exceptions, the data show consistently lower participation rates with successively younger cohorts.

Figure 1-3. DB Participation Rate for Employees, Every Other Cohort



Because we rely on the SIPP data, we have compared the SIPP participation rates by age with rates by age from the Bureau of Labor Statistics. The comparisons are shown in Table 2 below. The SIPP data pertain to all employees age 25 to 64, including persons employed in private sector firms, self-employed persons, and persons in federal, state, or local government employment. The BLS data pertain to employees of all ages, but exclude the self-employed and federal employees. Thus the comparison is imperfect. For the four years that a direct comparison can be made the data show that the SIPP estimates are below the BLS estimates as might be expected given the differences in the coverage of the two series. All three series show the same downward trend over time.

Table 1- 2. DB participation rate by age, based on SIPP and BLS, for employed persons age 25 to 64.

Year	BLS private firms	BLS private and state and local	SIPP
1984	-	-	39.4
1985	-	-	-
1986	-	-	-
1987	-	-	36.8
1988	-	-	-
1989	-	-	-
1990	35	43	-
1991	34	41	34.9
1992	32	40	-
1993	28	37	34.2
1994	28	36	-
1995	-	35	31.6
1996	27	35	-
1997	-	35	-
1998	-	30	29.9
1999	21	-	-
2000	19	-	-
2001	-	-	-
2002	-	-	-
2003	20	-	26.1

Source: Wiatrowski (2005)

The cohort data shown in Figures 1-1 and 1-2 allow comparisons between the participation rates of some cohorts at a given age—say 45—but these data alone do not allow comparisons that include very young or very old cohorts who were not represented in the SIPP data. For example, we can not compare the participation rates at age 45 of cohorts C55 and C13—marked in Figure 1-1. To do this we need to project forward the future participation rates of younger cohorts at older ages and project backwards the participation rates of older cohorts at younger ages.

We have made these projections by fitting the cohort data and then using the estimated parameters to predict outside range of the observed data, while relying on estimated cohort effects. The detailed estimates are not shown in the paper but are available on request. The data represented in Figures 1-1 to 1-3 above are based on employed persons. As explained below, we need to develop estimated based on the percent of all persons who are covered by a DB plan. These projections are explained in section four.

2. DB Pension Benefits of Recipients and Projections

We now begin a series of analyses that provide the basis for projections of future assets in DB plans. We begin in this section with a cohort description of the dollar amount of DB benefits received by all persons over 55 and then describe how we project benefit amounts in the future. In section three, we present a parallel description of the percent of older persons that receives DB benefits.

Data on DB benefits received by retirees, like the participation data for employed persons shown above, are obtained from SIPP waves for the years 1984, 1987, 1991, 1993, 1995, 1998, and 2003. And, as with the participation data, we first present a cohort description of the observed data. We then fit the observed data and use the fitted model to project benefits outside the range of the observed data. Table 2-1 describes the observed data and the cohorts for which data must be projected. We obtain data on benefits received for persons aged 55 to 85. Some SIPP data are available for cohorts C36 to C67. Benefits received for younger cohorts—C-47 to C35—and for older cohorts—C68 to C102—must be projected. The numerical amounts Table 2-1 show monthly pension benefits observed in the SIPP. An “X” indicates that a pension benefit amount is not observed in the SIPP and that the amount must be estimated. Partial data are available for cohorts C36 to C48. Cohort C36 was age 55 in 2003 and thus SIPP data are available for only one year (2003) for this cohort. For successively older cohorts through C48, data are available for more years. Beginning with cohort C55—that was age 55 in 1984—data are available for all seven years that the SIPP data are available. Complete data are available for all cohorts through C66, that was age 85 in 2003, the last year of SIPP data. For cohorts C67 through C85, successively fewer years of data are observed in the SIPP. Cohort C85 was age 85 in 1984 and thus SIPP data for this cohort are only available in that year.

Table 2-1. More detailed description of cohort data and projections for the amount of DB pension benenfit received.

Cohort

Age	A2096 C-47	…	A2014 C35	A2013 C36	A2012 C37	…	A2008 C41	A2007 C42	…	A2001 C48	…	A1994 C55	…	A1983 C66	A1982 C67	…	A1973 C76	A1972 C77	…	A1965 C84	A1964 C85	A1965 C86	…	A1947 C101	A1947 C102
55	X		X	1613	X		1325	X		813		661		X	X		X	X		X	X	X			
56	X		X	X	1624		x	1313		x		x		X	X		X	X		X	X	X			
57	X		X	X	X		x	x		1065		778		X	X		X	X		X	X	X			
58	X		X	X	X		x	x		x		752		X	X		X	X		X	X	X			
59	X		X	X	X		x	x		1375		x		X	X		X	X		X	X	X			
60	X		X	X	X		1592	x		x		x		X	X		X	X		X	X	X			
61	X		X	X	X		X	1555		x		x		X	X		X	X		X	X	X		X	X
62	X		X	X	X		X	X		1139		856		X	X		X	X		X	X	X		X	X
63	X		X	X	X		X	X		x		x		X	X		X	X		X	X	X		X	X
64	X		X	X	X		X	X		x		879		X	X		X	X		X	X	X		X	X
65	X		X	X	X		X	X		x		x		X	X		X	X		X	X	X		X	X
66	X		X	X	X		X	X		x		938		499	X		X	X		X	X	X		X	X
67	X		X	X	X		X	X		1152		x		x	478		X	X		X	X	X		X	X
68	X		X	X	X		X	X		X		x		558	x		X	X		X	X	X		X	X
69	X		X	X	X		X	X		X		839		562	518		X	X		X	X	X		X	X
70	X		X	X	X		X	X		X		x		x	546		X	X		X	X	X		X	X
71	X		X	X	X		X	X		X		x		x	x		X	X		X	X	X		X	X
72	X		X	X	X		X	X		X		x		x	x		X	X		X	X	X		X	X
73	X		X	X	X		X	X		X		x		588	x		X	X		X	X	X		X	X
74	X		X	X	X		X	X		X		953		x	559		X	X		X	X	X		X	X
75	X		X	X	X		X	X		X		X		689	x		X	X		X	X	X		X	X
76	X		X	X	X		X	X		X		X		x	633		375	X		X	X	X		X	X
77	X		X	X	X		X	X		X		X		756	x		x	378		X	X	X		X	X
78	X		X	X	X		X	X		X		X		x	718		470	x		X	X	X		X	X
79	X		X	X	X		X	X		X		X		x	x		415	450		X	X	X		X	X
80	Partial data for cohorts C36 to C48											X		757	x		x	467		X	X	X		X	X
81	Complete (all SIPP survey years) for cohorts C55 to C66											X		x	724		x	X		X	X	X		X	X
82	Partial data for cohorts C67 to C85											X		x	X		x	X		X	X	X		X	X
83	x, x, x interpolated between observed data											X		x	X		457	X		X	X	X		X	X
84	X projected data											X		x	X		x	X		303	X	X		X	X
85	X		X	X	X		X	X		X		X		756	X		452	X		X	307	X		X	X
86	X		X	X	X		X	X		X		X		X	X		X	X		X	X	X		X	X
87	X		X	X	X		X	X		X		X		X	X		X	X		X	X	X		X	X
…																								X	X
99	X		X	X	X		X	X		X		X		X	X		X	X		X	X	X		X	X
100	X		X	X	X		X	X		X		X		X	X		X	X		X	X	X		X	X

By fitting the observed data on the receipt of benefits, we can interpolate values for years between the years for which data are available. In addition, the model used to fit the data can be used to project benefits for cohorts outside of the range of the observed data. The cohorts and ages for which such projections must be made are indicated by "X" in Table 2-1. We project benefits received back to A1947 because members of this cohort attain age 100 in 1982 and may thus be receiving benefits in the initial year (1982) of our DB asset projections. We project benefits received forward as far out as 2096 to allow calculation of employer DB pension liabilities, described below.

Figure 2-1 shows the actual data for the monthly level of benefits for selected cohorts. The data are for all persons age 55 to 85 and include persons who are receiving benefits from federal or state and local retirement programs, as well as from private sector pensions plans.[1] Two features of the data stand out. One is that benefits of younger cohorts are much greater than benefits of older cohorts. For example, the benefit at age 60 for the cohort that attained that age in 1984 was about $600 per month; the benefit for the cohort that attained age 60 in 2003 was about $1,600 per month (circled in the figure). The other feature of the data is that within-cohort benefits increase with age. In part this results from the indexing of benefits from some DB plans, especially federal and state and local plans. In addition, private employer plans, which are typically not indexed, sometimes grant cost-of-living increases on an *ad hoc* basis after retirement.

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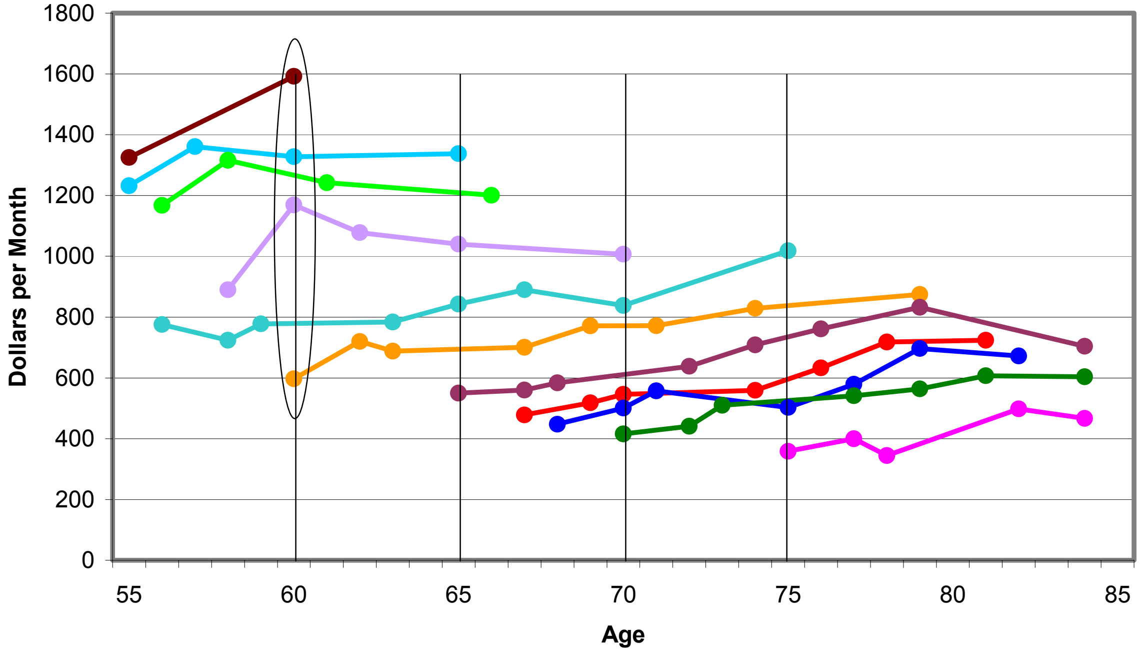
[1] The level of DB benefits received is derived from SIPP data on receipt of income from the following sources: pension from company or union; Federal Civil Service or other federal civilian employee pension; U.S. Military retirement pay; National Guard or reserve Forces retirement; state government pension; local government pension; U.S. government railroad retirement; veterans compensation or pension. We have assumed that all monthly income received from these sources is DB income although it is possible that withdrawals DC assets may be included.

Figure 2-1. DB benefit reciept for selected cohorts



We fit the cohort data on benefits with the following specification:

$$B_{ac} = \alpha_{a\le 60}A_1 + \alpha_{60<a\le 65}A_2 + \alpha_{65<a\le 70}A_3 + \alpha_{70<a\le 75}A_4 + \\ \alpha_{>75}A_5 + \\ \sum_{c=1971}^{2013} c_c C_c$$

Here, B is the dollar amount of monthly pension benefits and cohorts are defined by the year the cohort attains age 65--the C_c indicator variable--and the variables A_1 through A_5 specify age as piecewise linear with break points at 60, 65, 70 and 75.

The parameter estimates are presented in Appendix Table 1. We use the estimated parameters from this specification to project benefits forward for the younger cohorts and to project benefits backward for the older cohorts. There are at least two years of observed SIPP data for cohorts as old as A1970 (observed at age 79 in 1984 and age 82 in 1987). There are not enough SIPP observations to reliably estimate cohort effects for cohorts younger than A2012. We obtain benefit estimates for cohorts attaining age 65 prior to 1970 by shifting the A1970 benefit profile by according to the Social Security Administration's average wage index. That is, we assume that the pension benefit growth paralleled wage growth between 1949 and 1970. We only use benefits received in calendar years 1982 and later. For cohort A1970, for example, we use estimates beginning at age 77, in 1982. We use the wage index to estimate cohort effects for cohorts that retired before 1970, but we only project for older ages (after 1982) for each cohort.

The more important projections are for cohorts younger than the A2012 cohort. Which specific extrapolation to use, however, is open to question. The following figures show some of the relevant data. Figure 2-2 shows the estimated cohort effects for cohorts A1982 to A2012. An exponential fit over all of the cohort effects—with an R^2 value of 0.99--suggests that on average benefits increase by 4.5 percent with each successively younger cohort. But the figure also shows that the rate of change in the cohort effects may have declined over time. The estimated rate of change was only 2.94 percent for the A2003 to A2012 cohorts. (The cohort effects for these years are circled in Figure 2-2.)

Figure 2-3 shows a different view of the data, beginning with the change in the estimated cohort effects from one cohort to the next younger cohort. It is clear that the percent changes vary substantially from one cohort to the next. The figure also shows the four-year moving average of these changes. It is clear from the moving average that the average change from one cohort to the next younger cohort was close to 5 percent over most of the period but declined to close to 1 percent around 2006. The figure also shows the Social Security average wage index over the years 1982 to 2003. These data suggest a noticeable correspondence between the four-year moving average of the change in the estimated cohort effects and the wage index. After 2003, the SSA assumes a wage increase of 3.9 percent annually. On average the change in the cohort effects was only about 2.9 percent over these years.

Figure 2-2. Estimated cohort effect from benefit regression by year cohort attainsa age 65

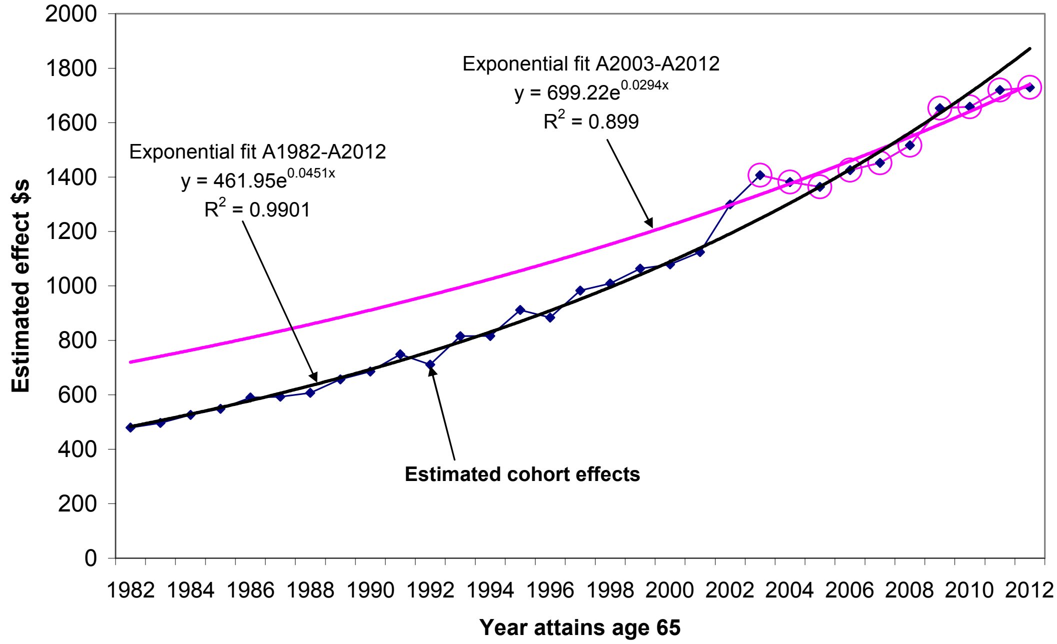
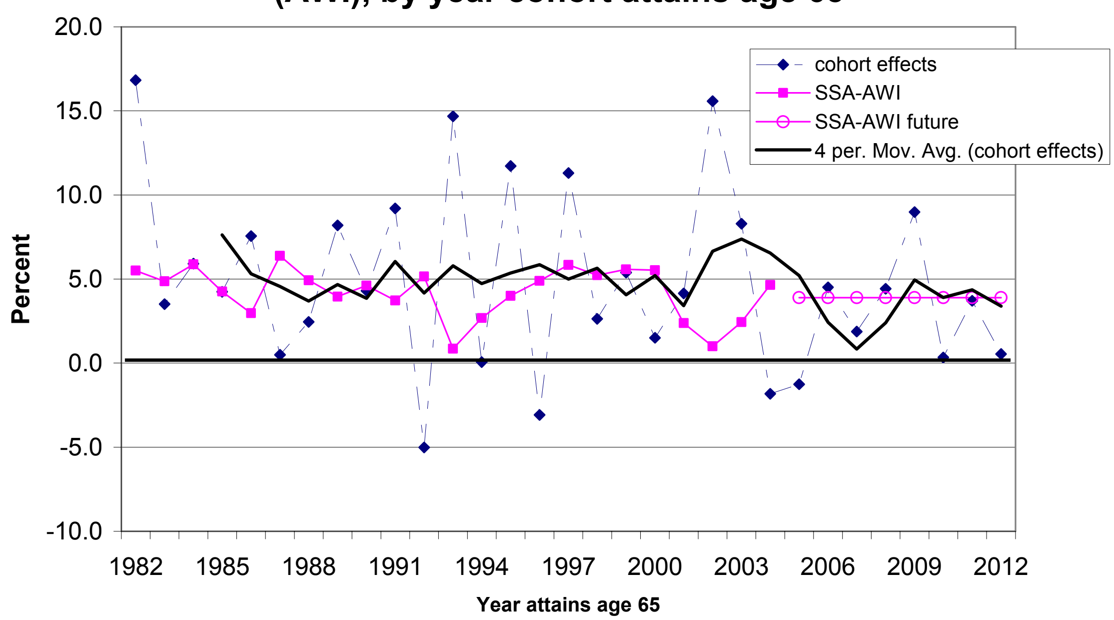


Figure 2-3. Percent change in estimated benefit cohort effect versus the Social Security average wage index (AWI), by year cohort attains age 65



Based on these data we have assumed that for younger cohorts benefits will increase at 3.9 percent for each successively younger cohort, the same as

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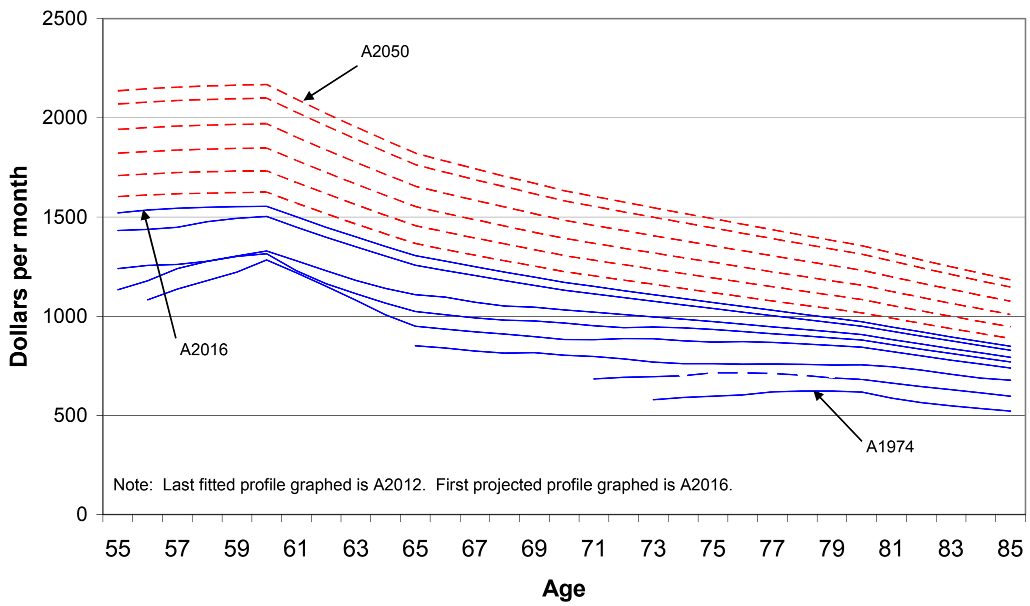
the SSA intermediate assumption for the average wage index. Figure 2-4 shows benefit profiles for selected cohorts, including projected profiles for cohorts A2013 to A2050 (dashed lines in the figure) and the fitted cohort profiles for cohorts A1974 to A2012 (solid lines). Profiles for cohorts older than A1974 are not shown (these cohorts are relatively unimportant because our projection of DB assets begins in 1982). All profiles are in year 2000 dollars. The benefit model parameter estimates show that cohort age profiles in current dollars are slightly upward sloping, perhaps due to the indexing of government pensions and ad hoc cost of living increases for other pension benefits. The age profiles in 2000 dollars in the figure slope downward, however.

Figure 2-4. Fitted and projected benefit profiles, selected cohorts (in year 2000 dollars)

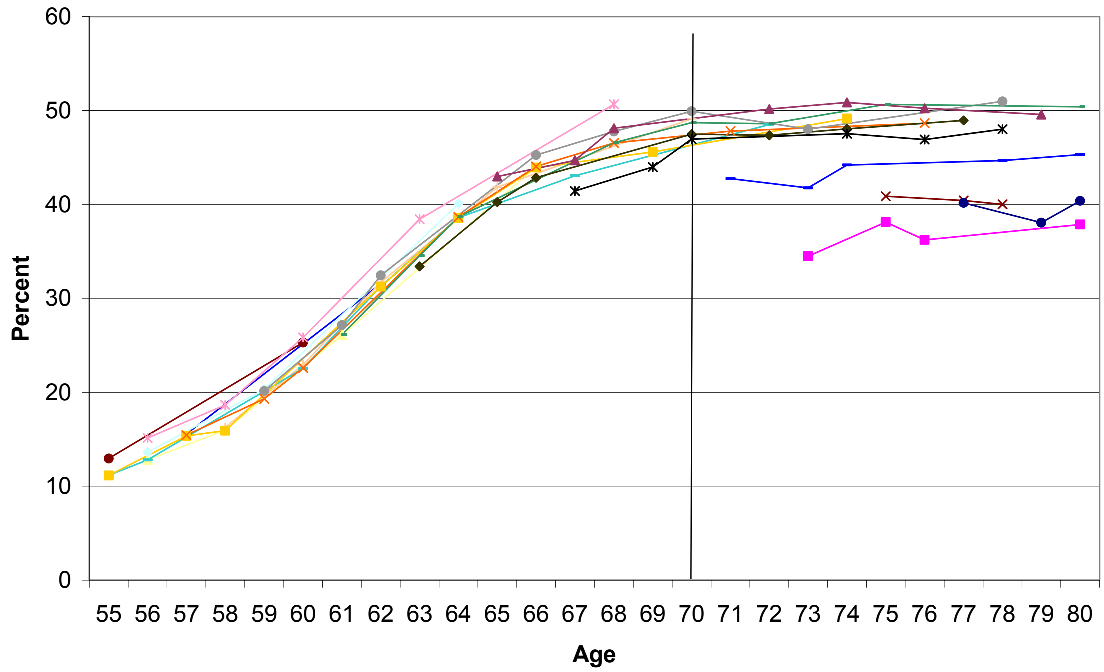


3. Receipt of DB Pension Benefits

In the previous section, we discussed the dollar amount of the DB benefits of persons who received DB benefits at each age. To obtain an estimate of the total dollar amount of DB benefits, we need also to determine the proportion of persons who receive benefits at each age. We now consider the probability of benefit receipt.

We begin with cohort data on the percentage of persons receiving DB benefits at each age. Figure 3-1 shows data for selected cohorts (essentially every other cohort). Two features of the data are evident. First, the cohort effects are rather small, with the exception of the older cohorts. In other words, the profile of benefit receipt by age is about the same for all the cohorts represented in the SIPP data (with the exception of the oldest cohorts). For example, among cohorts observed at age 70, the probability of receipt of benefits ranges from about 45 percent for the youngest cohort to 49 percent for the oldest cohort. Second, the age at which the maximum percent of persons receive benefits is about 70.

Figure 3-1. Percent receiving DB benefits, selected cohorts



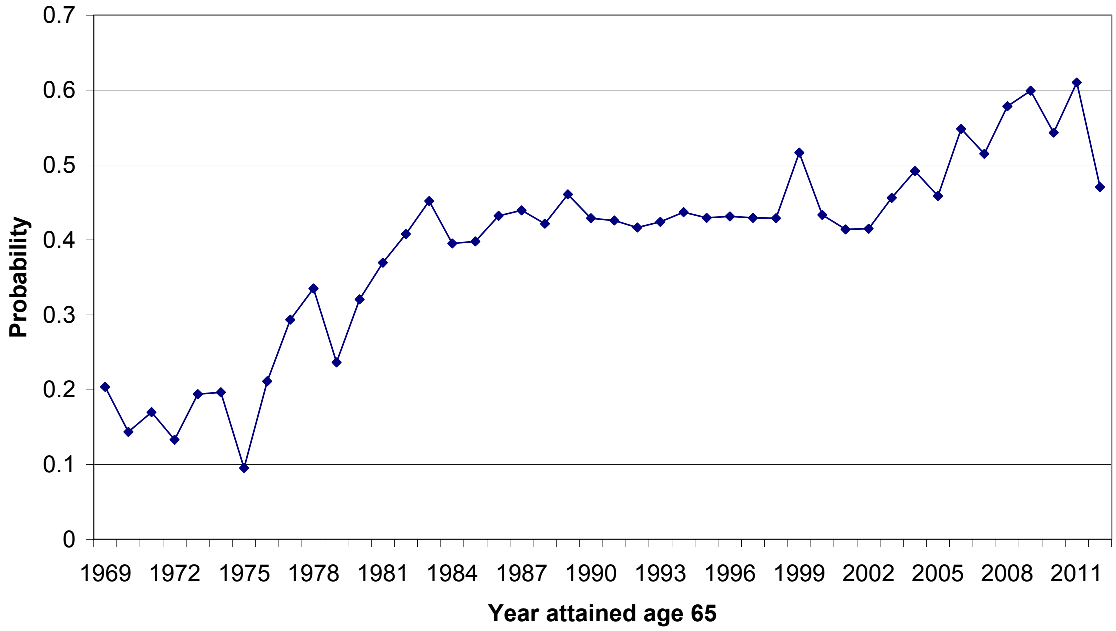
To project benefit receipt for future (younger) cohorts that are not observed in the SIPP data we assume the age-benefit-receipt profile shown in Figure 3-1 continues to apply. However, we allow this profile to shift (downward) for younger cohorts. We first estimate age and cohort effects for cohorts observed in the SIPP. Then we predict benefits for younger cohorts, assuming that--except for the cohort effects--the age-benefit-receipt profile is the same for younger cohorts as it has been for older cohorts observed in the SIPP.

We fit the benefit receipt data using a probit model and a piecewise linear specification for age like the one presented above. The sample consists of the same persons age 55 to 85 used in the previous section to estimate the level of benefits. The specification is

$$
\begin{aligned}
R_{ac} = {} & \alpha_{a\le 60}A_1 + \alpha_{60<a\le 65}A_2 + \alpha_{65<a\le 70}A_3 + \alpha_{70<a\le 75}A_4 + \\
& \alpha_{75<a}A_5 + \\
& \sum_{c=1969}^{c=2012} c_c C_c
\end{aligned}
$$

where R is the receipt of benefits and cohorts are defined by the age the cohort attains age 65. The estimated cohort effects are shown in Appendix Table 2. Figure 3-2 shows that the estimated cohort effects are essentially unchanged for cohorts that attained age 65 between 1982 and 2003. The cohort effects were smaller but increasing for cohorts that attained age 65 between 1969 and 1981. The larger cohort effects for cohorts that attained age 65 in 2004 and later years are based on very few SIPP observations and pertain only to persons who were receiving benefits at young ages. For example, data for the A2004 cohort are only observed through age 64 and for the A2012 cohort only for age 56.

Fig. 3-2 Cohort effects for the receipt of benefits by year attained age 65



Because we cannot reliably estimate cohort effects for cohorts younger that A2003, we assume that the benefit receipt rates of successively younger cohorts follow the same pattern as the DB participation rates of these same cohorts when they were in the labor force. The assumption is that if fewer persons in a particular cohort participated when young, then fewer persons will receive benefits after retirement. We do this by first calculating the maximum DB participation rate over ages 25-64 for each cohort. We use this maximum rate to predict benefit receipt when the cohort is retired. We use cohort-to-cohort changes in the maximum DB participation rate, and the 2003 fitted age-benefit receipt profile, to project benefit receipt for cohorts A2004 through A2060. Before presenting these projections, we describe the population-based DB participation rates that are required to make the calculations.

4. Population-Based DB Participation Rates

The previous two sections have developed projections for the level of benefits (conditional on receipt) and for the probability of receiving DB benefits after retirement. As noted above, the probability of receiving benefits cannot reliably be estimated for cohorts retiring after 2003 using the SIPP data. These cohorts are not observed after age 55 in the data. However, these same cohorts are observed at younger ages when they are in the labor force. We infer the probability of benefit receipt after retirement from the DB participation rates of these cohorts when they were in the labor force. This section develops estimates of DB participation that are closely related to those presented in section one for <u>employed</u> persons. Here we consider the participation rate of <u>all persons in the population</u> because we will use our estimates to infer benefit receipt for all retirees (not just those who were employed).

The employment-based participation rates and the population-based rates can differ substantially. To see this, note that the percent of population that participates in a DB plan at age a is given by

$$\left(\frac{DB}{P}\right)_a = \left(\frac{E}{P}\right)_a \Pr[DB_a \mid E_a]$$

where E is employment and P is population and a denotes age. Table 4-1 shows the probability that a person has a DB plan given that the person is employed and the employment to population ratio for each year of SIPP data availabile between 1984 and 2003. These data show that the last term, $\Pr\left[DB_a \mid E_a\right]$, has declined between 1984 and 2003, but the fraction of the population employed $\left(\frac{E}{P}\right)_a$ increased between 1984 and 1998 but fell in 2003.[2] The percentage of employed persons participating in a DB plan declined from 39.4 percent to 29.7 percent over this period.

[2] The employment to population ratio for persons 16 and over reported by the BLS shows an increase from 59.5% in 1984 to 64.1% in 1998 and then a drop to 62.3% in 2003. The SIPP data we use are for ages 25 to 64.

Table 4-1. DB participation and ratio of employment to population, all persons age 25-64			
Year	DB participation given employment	Employment to population ratio	(DB participation) x (Employment to population ratio)
1984	39.4	0.752	29.6
1987	36.8	0.767	28.2
1991	34.9	0.778	27.2
1993	34.2	0.771	26.4
1995	31.6	0.777	24.6
1998	29.9	0.778	23.3
2003	29.7	0.763	22.7

Source: Authors calculations from SIPP surveys.

The overall effect of these trends is that cohort effects are smaller when <u>all</u> persons are used as the base than when <u>employed</u> persons are used as the base. This can be seen by comparing Figure 1-1 with Figure 4-1, which are shown together just below. For example, at age 45 the difference in the participation rates of cohorts 27 and 45 is about 13 percentage points based on those employed but only about 10 percentage points based on all persons.

As with the participation based on employed persons, we fit the population-based participation data using a probit model with this specification:

$$
\begin{aligned}
DB(Pop)_{ac} = {} & \alpha_{a\leq 30}A_1 + \alpha_{30<a\leq 35}A_2 + \alpha_{35<a\leq 40}A_3 + \alpha_{40<a\leq 45}A_4 + \\
& \alpha_{45<a\leq 50}A_5 + \alpha_{50<a\leq 55}A_6 + \alpha_{55<a\leq 60}A_7 + \alpha_{60<a}A_8 + \\
& \sum_{c=9}^{c=65} c_c C_c
\end{aligned}
$$

The estimated cohort effects from this specification (defined here by age in 1984) are shown in Figure 4-2, while the complete estimation results are shown in Appendix Table 3.

Selected fitted cohort profiles together with the corresponding cohort data are shown in Figure 4-3. We judge that the fitted profiles represent the data quite well. We then use the model estimates to predict population-based participation rates at all ages (25 to 64) for each of the cohorts for which we are able to estimate cohort effects. These predictions are shown (as solid lines) in Figure 4-4 for selected cohorts. We predict at all ages for each cohort because we want to determine the age at which the participation rate is at a maximum for each of the cohorts. The use of this calculation is explained below. Predicting at older ages for the younger cohorts suggests that by the time these cohorts reach retirement age, their participation in DB plans will be very low. For example, based on these predictions the DB participation rate of persons in the C11 cohort will be only 8.8 percent when that cohort attains age 55 (cohort C11 attains age 65 in 2038).

Figure 4-1. DB participation rate for all persons, selected cohorts

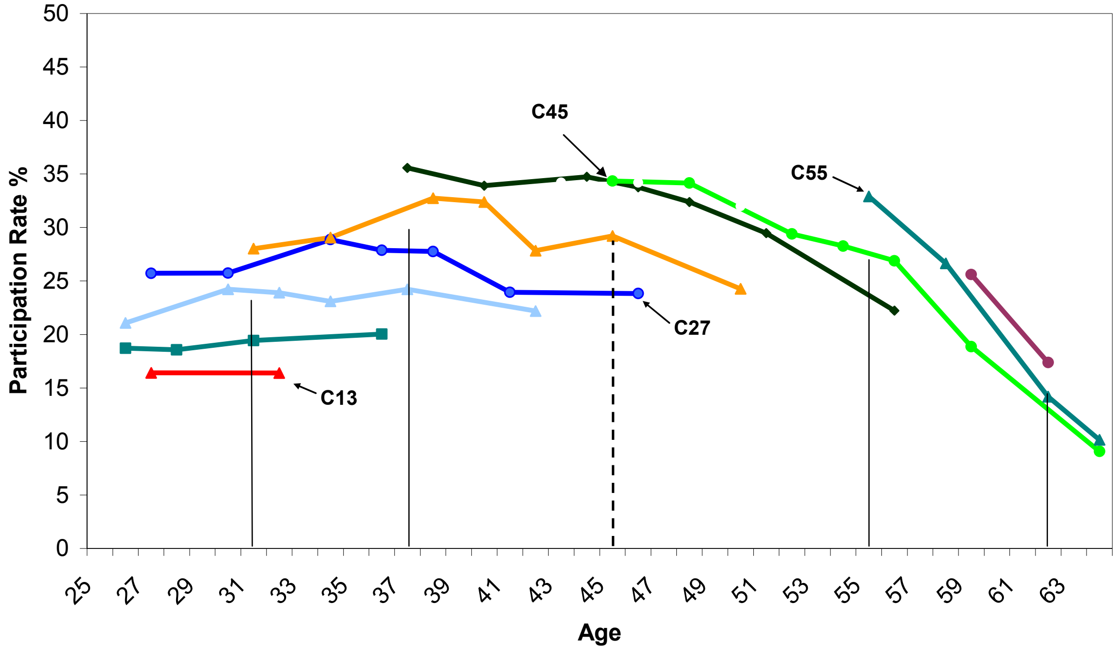


Figure 1-1. DB participation rate of employed persons, selected cohorts

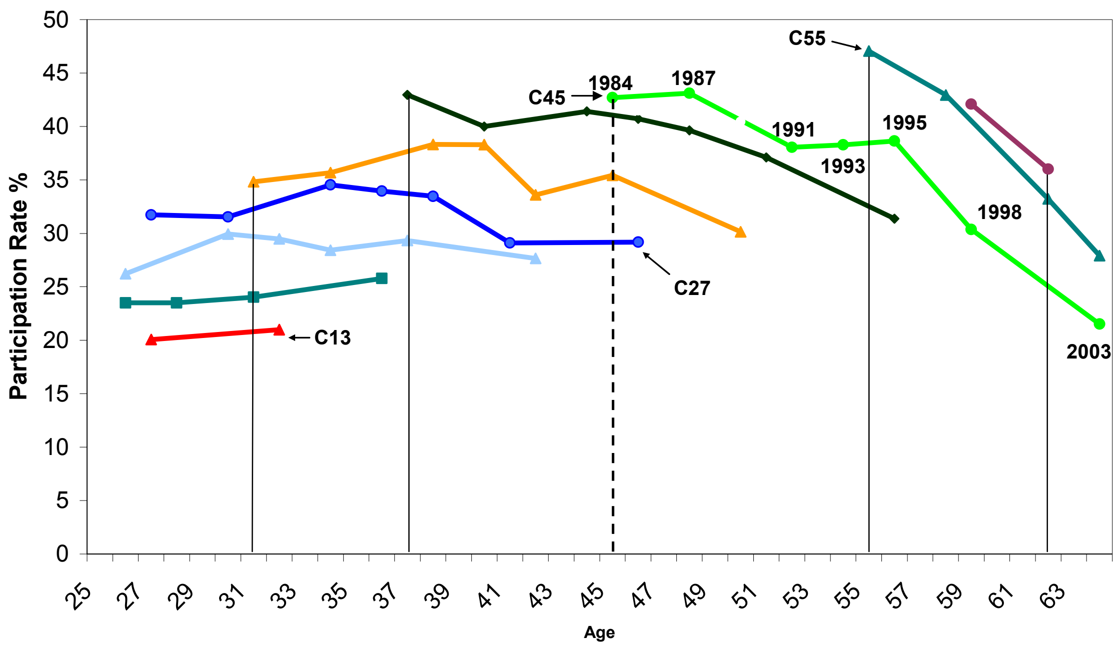


Figure 4-2. DB participation for all persons, estimated cohort effects, by year attained age 65

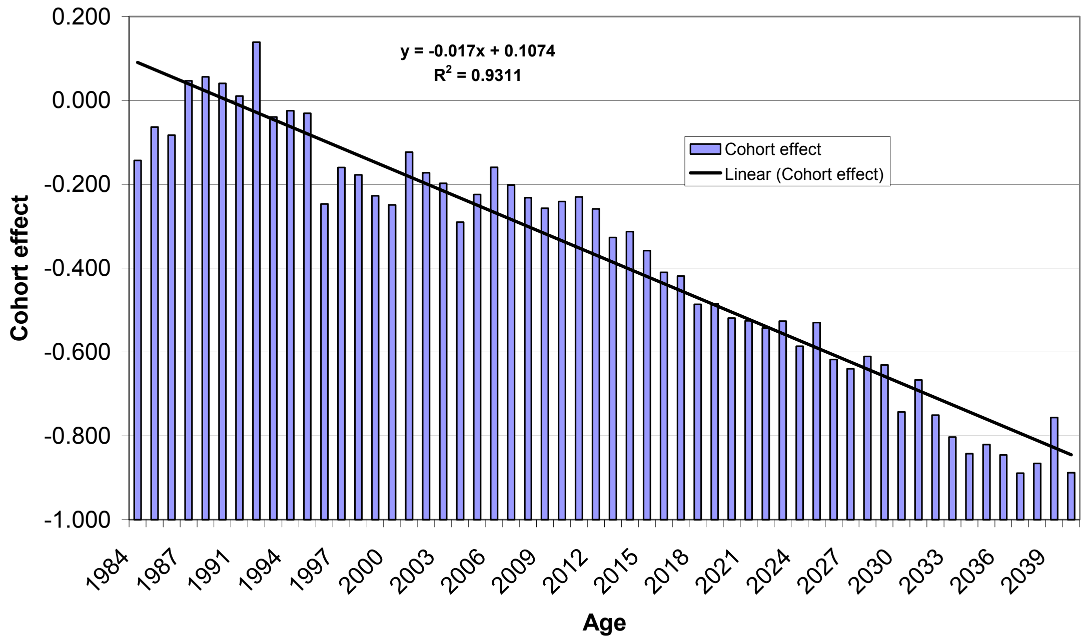


Figure 4-3. Actual versus fitted DB participation profiles for selected cohorts (all persons)

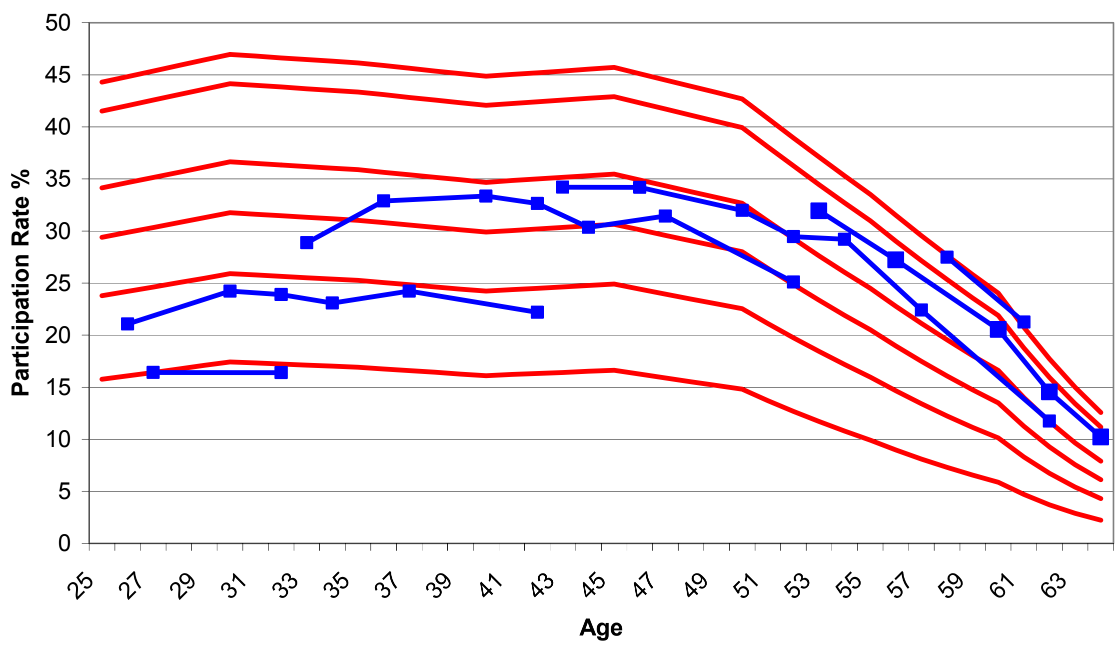
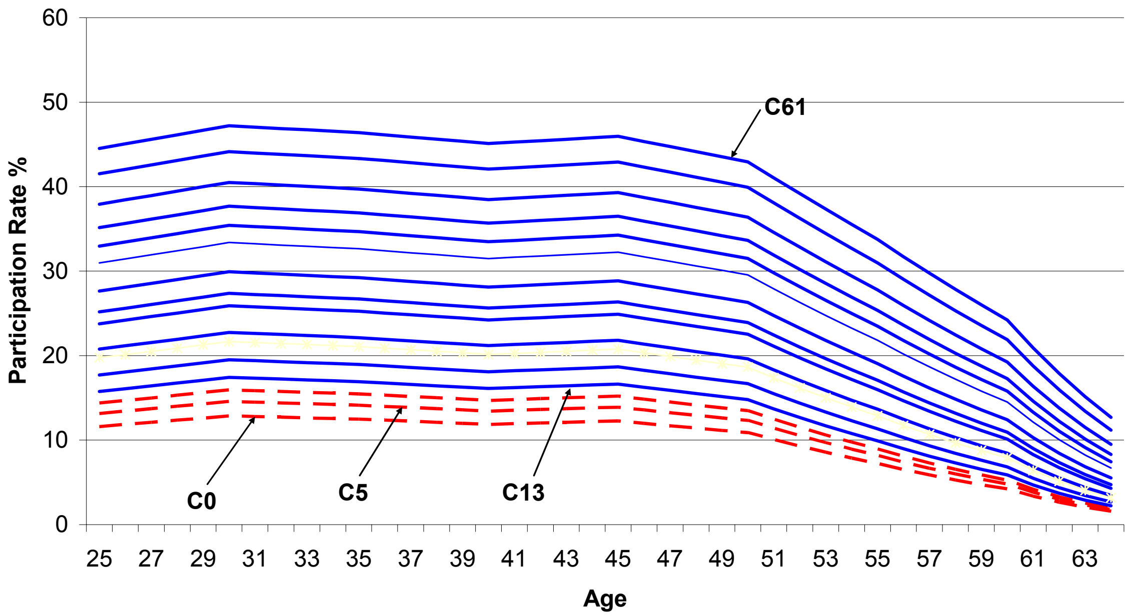


Figure 4-4. DB participation for all persons, projections to younger cohorts (red) (2.1% decline for cohorts that retire 2040-2050)



The youngest cohort in the SIPP data is A2040. For later use we will need cohorts as young as A2050. Figure 4-2 shows that the decline in the estimated cohort effects, with successively younger cohorts, is close to linear—at -0.017 per cohort. Thus, we extrapolate the estimated cohort effects linearly to project the effects for younger cohorts. This extrapolation yields profiles for the younger cohorts shown as dashed lines in Figure 4-4.

All of the projections we make are subject to substantial uncertainty. These projection in particular raise the prospect that the past trend may not be a good predictor of the future trend. For example, several large companies have recently announced that traditional DB pension plans would be phased out. Other companies could follow this lead more rapidly than our projections suggest. This would lead to a faster-than-projected decline in DB assets.

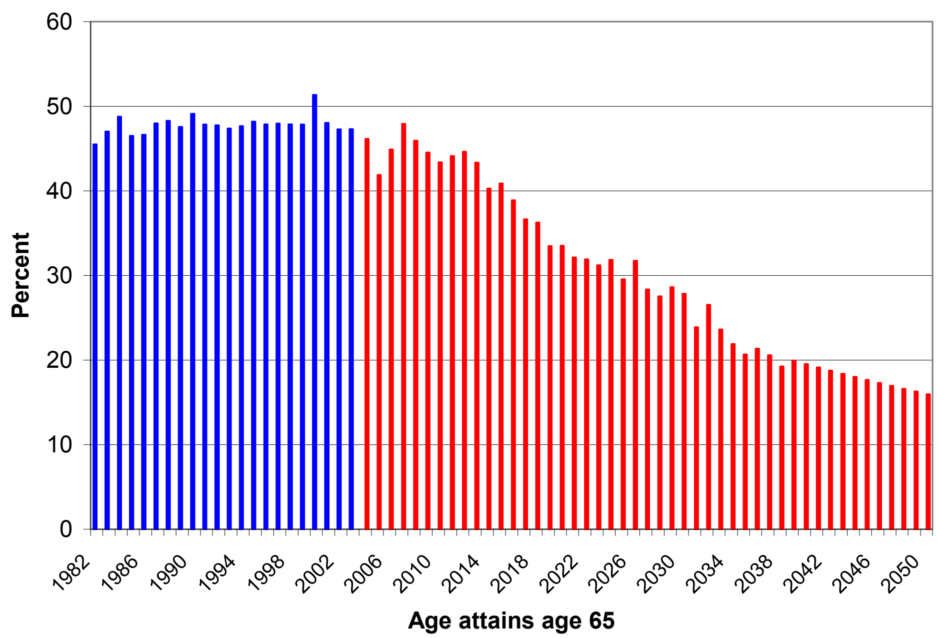
5. Projected Benefits Paid

To develop projections of the total value of benefits paid by DB plans, we combine estimates of the level of benefits in section two with estimates of the probability of benefit receipt in section three. To help to forecast benefit receipt for younger cohorts (retiring after 2003), we use estimates of DB participation of these younger cohorts during their working ages. In particular, we use the population-based estimates of DB participation by cohort discussed in section four to predict pension receipt after retirement. The necessary data is set out in Table 5-1. We first use the estimates of probability of benefit receipt for cohorts A1982 to A2003 to predict the percent of each of these cohorts that receives benefits at age 70 (recall from Figure 3-1 that age 70 is the age at which the maximum percent of persons receive benefits) . As discussed in section three, for these cohorts there are a sufficient number of SIPP observations to obtain reasonably reliable estimates of benefit receipt. These probabilities are shown in column (3) of Table 5-1. The probabilities are also graphed in Figure 5-1 for the years 1982 through 2003.

We next need to project benefits at age 70 for younger cohorts (A2004 to A2040). To make these projections, we use the population-based DB participation rates, discussed in section four. From these data, we have calculated the maximum participation rates, over ages 25 to 64, for each cohort. These estimates are shown in column (5) of Table 5-1. We use the maximum participation rate during working years to predict the probability of benefit receipt at age 70 for cohorts A2004 and younger. We assume that the year-to-year percent change in the probability of receipt of benefits at age 70 is the same as the year-to-year percent change in the maximum DB participation rate. Thus, for example, the last cohort for which the receipt probability is observed is A2003 (47.3%). We project the 2004 receipt probability by assuming it declines by the same percentage amount as the maximum participation probability (from 38.6% for A2003 to 37.7% in 2004). The prediction for 2004, 46.2% (shown in column 4) is 47.3% x (37.7%/38.6%). The same calculations are continued to project the probability of receiving benefits at age 70 for cohorts A2004 through A2040. For cohorts younger than A2040 (not shown in the table) a two percent decline is assumed. This is an extrapolation of the decline for the cohorts A2031 to A2040.

Figure 5-1. Percent receiving benefits at age 70, by cohort

(blue is fitted SIPP estimate and red is projected)



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From the percent that receives benefits at age 70, we predict the percent that receives benefits at each age, as described in section three above. These estimates are shown for selected cohorts in Figure 5-2 below.

Figure 5-2. Projected percent receiving benefits for selected cohorts attaining age 65 in years 1982 through 2040
(blue is fitted SIPP estimate and red is projected)

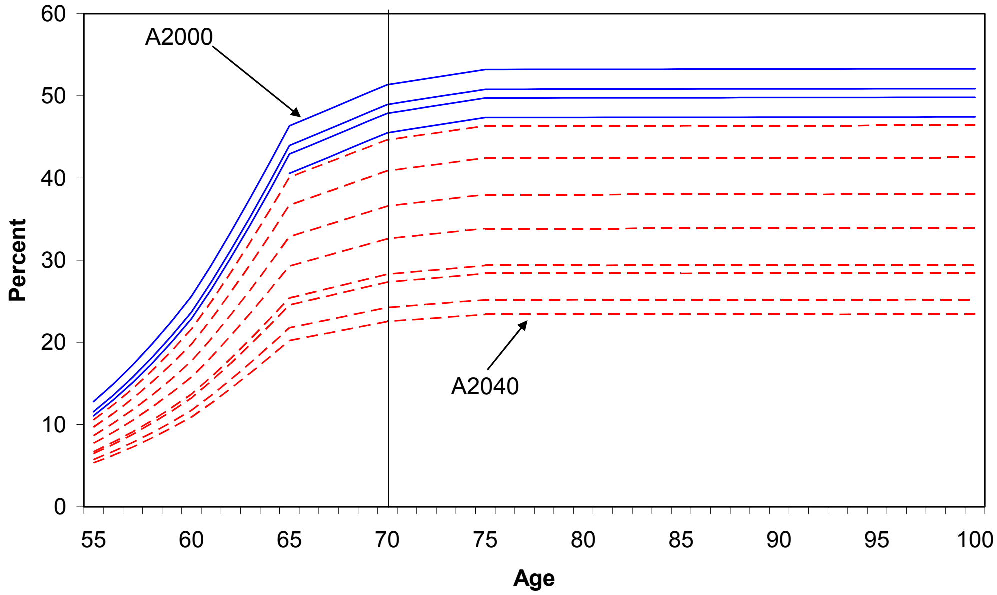

Table 5-1 Projections of the probability of benefit receipt at age 70, by cohort

(1) Year cohort attains age 65	(2) Age of cohort in 1984	(3) Probability receive benefits at age 70 (from benefit receipt data)	(4) Projected probability receive benefits at age 70	(5) DB participation maximum (from DB participation data)
1982	67	45.5		
1983	66	47.0		
1984	65	48.8		
1985	64	46.5		39.7
1986	63	46.6		42.9
1987	62	48.0		42.1
1988	61	48.3		47.2
1989	60	47.6		45.4
1990	59	49.1		47.6
1991	58	47.9		47.0
1992	57	47.7		45.8
1993	56	47.4		50.9
1994	55	47.7		43.8
1995	54	48.2		44.4
1996	53	47.9		44.2
1997	52	48.0		35.8
1998	51	47.9		39.1
1999	50	47.9		38.4
2000	49	51.4		36.6
2001	48	48.0		35.7
2002	47	47.3		40.5
2003	46	47.3		38.6
2004	45		46.1	37.7
2005	44		41.9	34.2
2006	43		44.9	36.6
2007	42		47.9	39.1
2008	41		45.9	37.5
2009	40		44.5	36.4
2010	39		43.4	35.4
2011	38		44.1	36.0
2012	37		44.6	36.4
2013	36		43.3	35.4
2014	35		40.3	32.9
2015	34		40.9	33.4
2016	33		38.9	31.8
2017	32		36.7	29.9
2018	31		36.3	29.6
2019	30		33.5	27.3
2020	29		33.5	27.4
2021	28		32.1	26.2
2022	27		31.9	26.0
2023	26		31.2	25.5
2024	25		31.9	26.0
2025	24		29.5	24.1
2026	23		31.7	25.9
2027	22		28.4	23.1
2028	21		27.5	22.5
2029	20		28.6	23.4
2030	19		27.9	22.7
2031	18		23.9	19.5
2032	17		26.5	21.7
2033	16		23.6	19.3
2034	15		21.9	17.9
2035	14		20.7	16.9
2036	13		21.4	17.4
2037	12		20.6	16.8
2038	11		19.3	15.7
2039	10		20.0	16.3
2040	9		19.5	15.9

6. Present Value of DB benefits at 65

We have projected the average level of the DB benefits of recipients, by age and cohort, B_{ac}, for cohorts attaining age 65 in the years 1982 through 2050. We have also projected the probability of benefit receipt for each age and cohort. First, we obtain for each cohort the average present value of benefits at age 65 for persons who <u>receive</u> DB benefits, given by:

(1)
$$PV(recipients)_{c,65} = \sum_{a=65}^{100} \left[\prod_{t=65}^{a} S_{t,c} \right] \left[B_{a,c} / (1+r)^{(a-65)} \right]$$

where $S_{t,c}$ is the cohort-specific probability of survival to age t conditional on being alive at t-1, and r is the discount rate. Second, we calculate the present value of DB benefits at age 65 for <u>all</u> cohort members, both those with and those without a DB plan. The expected average benefit received by all persons of age a in cohort c is $\bar{B}_{ac} = \Pr[benefit\ receipt] \cdot \left[benefits_{ac} \mid benefit\ receipt\right] = B_{ac} \cdot P_{ac}$. Thus the present value of benefits averaged over <u>all</u> persons is given by:

(2)
$$PV(all\ \ persons)_{c,65} = \sum_{a=65}^{100} \left[\prod_{t=65}^{a} S_{t,c} \right] \left[B_{a,c} \cdot P_{ac} / (1+r)^{(a-65)} \right]$$

Figure 6-1 graphs both of these present value calculations. The present value amounts have been converted to constant year 2000 dollars. A real discount rate of 3 percent and average SSA age-specific survival probabilities are assumed. For these calculations pension benefits received prior to age 65 have been ignored. The top profile shows that the average present value of DB benefits for persons that receive DB benefits will be greater for cohorts retiring in the future than for cohorts retiring today. This is because we assume that nominal benefits increase by 3.9 percent annually and the inflation rate is 2.8 percent. However, the lower profile shows that the PV of DB wealth, averaged across all persons, will decline in the future as fewer persons participate. Indeed, these projections show DB wealth peaking in 2003 at about $73,000 and falling to about $50,000 by 2020.[3]

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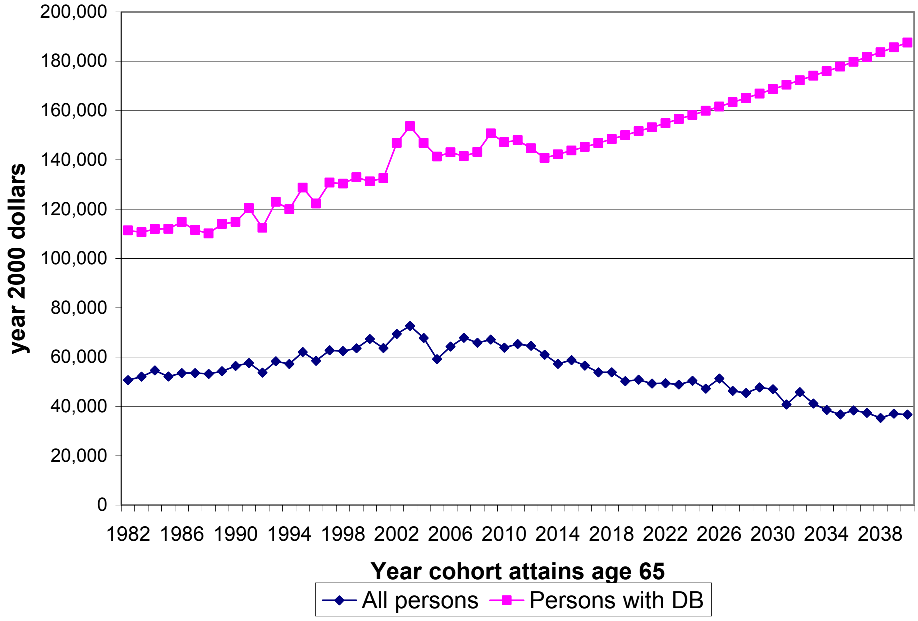
[3]These estimates indicate that in 2000 the average of DB benefits over all persons was $67,386. Based on HRS data, Johnson, Burman and Kobes (2004), estimate that the mean present value of employer sponsored pension income for persons 65 to 69 in 2000 was $50,203. Our estimate should be larger than theirs because we include persons of all ages. In particular, average benefits increase with age because death rates selectively leave in the sample

Figure 6-1. Present value DB benefits at age 65: all persons and persons with a DB



For comparison, we show the average present value of 401(k) assets at age 65, reported in Poterba, Venti and Wise (2006).[4] The comparison between the average present value of DB benefits at age 65 and average 401(k) assets at age 65 is graphed in Figures 6-2a and 6-2b for all persons. The comparisons in Figures 6-3a and 6-3b pertain to persons with plans. Figures 6-2a and 6-3a show 401(k) assets at retirement assuming that the return on equities in the future will be equal to the historical average. Figures 6-2b and 6-3b show 401(k) assets assuming that the return on equities in the future will be 300 basis points less than historical average return.

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persons with higher benefits, and because of ad hoc cost of living increases and indexed benefits in many government plans.

[4] These projections use actual annual pre-tax returns through 2005. Beginning in 2006 we assume that the average annual nominal return on equities is 12 percent and that the average nominal return on corporate bonds is 6 percent. Ibbotson Associates (2006) reports that the historical arithmetic mean of pretax returns on long-term corporate bonds has been 6.2 percent per year, while large-capitalization stocks have returned an average of 12.3 percent over the period 1926-2005. These returns are the pretax total return available on a portfolio with no management fees. We have not as yet accounted for asset management fees.

Assuming historical rates of return, Figure 6-2a shows that average 401(k) assets of all persons reach the average PV of DB benefits of all persons in 2010 when both are about $67,000. Thereafter assets in 401(k) accounts continue to grow, reaching about $137,000 in 2020, $226,000 in 2030, and $452,000 in 2040. Assuming historical rates of return less 300 basis points, average 401(k) assets reach the average PV of DB benefits of all persons in 2011 when both are about $66,000. Thereafter assets in 401(k) accounts continue to grow, reaching about $104,000 in 2020, $149,000 in 2030, and $269,000 in 2040. The lower rate of return on equities substantially reduces the accumulation of assets in 401(k) plans. Even with the lower rate of return on equities, however, by 2040 the accumulation of assets in 401(k) plans would be 3.7 times as large as the historical maximum level of assets ("fully funded") in DB plans, which was realized in 2003.

Figure 6-3a shows the present value of DB benefits for persons who have a DB plan and the 401(k) assets for persons who have a 401(k) plan, assuming the average historical equity return. For these persons, balances in 401(k) accounts reach the PV of DB benefits in 2011, when both are about $148,000. Thereafter the 401(k) assets continue to grow, reaching about $243, 000 in 2020, $363,000 in 2030, and $580,000 in 2040. For persons with DB plans the average present value of benefits also continues to grow, reaching $187,000 by 2040. By 2040, the accumulation of 401(k) assets is about 3 times the PV of DB assets. Figure 6-3b shows 401(k) assets assuming that the rate of return on equities is 300 basis points lower than the historical average. Here the assets of persons with 401(k) accounts reach the level of the PV of DB benefits for persons who receive benefits in 2014, when both are about $145,000. Thereafter the 401(k) assets continue to grow, reaching about $185, 000 in 2020, $241,000 in 2030, and $345,000 in 2040. For persons with DB plans the average present value of benefits also continues to grow, reaching $187,000 by 2040. Thus for persons with plans, by 2040 the accumulation in 401(k) plans is about 1.8 times the PV of DB assets at 65.

Figure 6-2a. Present value DB benefits at age 65 and 401(k) assets at age 65, all persons--historical rates of return.

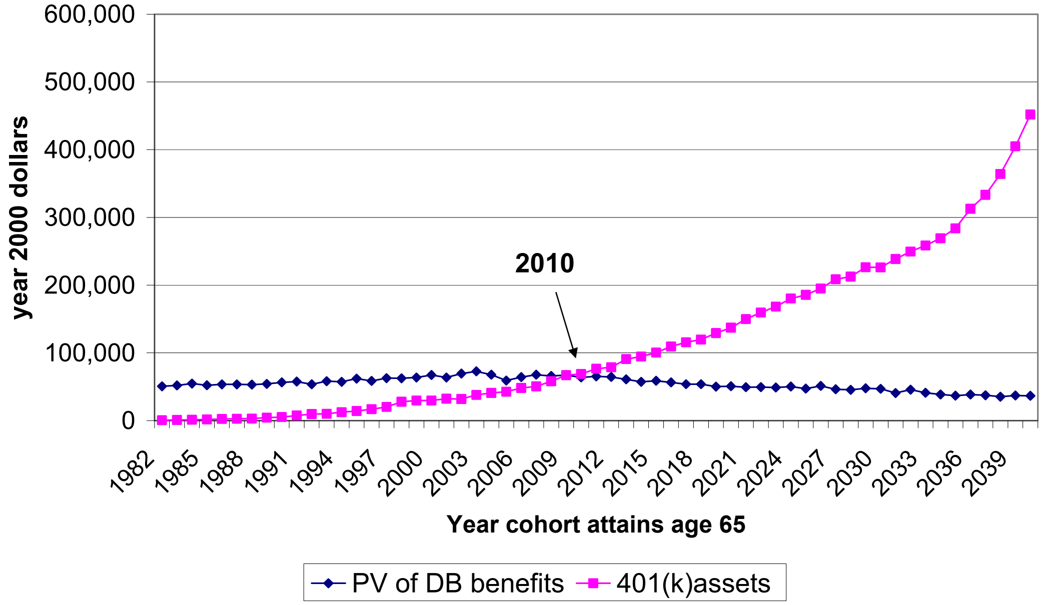


Figure 6-2b. Present value DB benefits at age 65 and 401(k) assets at age 65, all persons--historical rates of return minus 300 basis points.

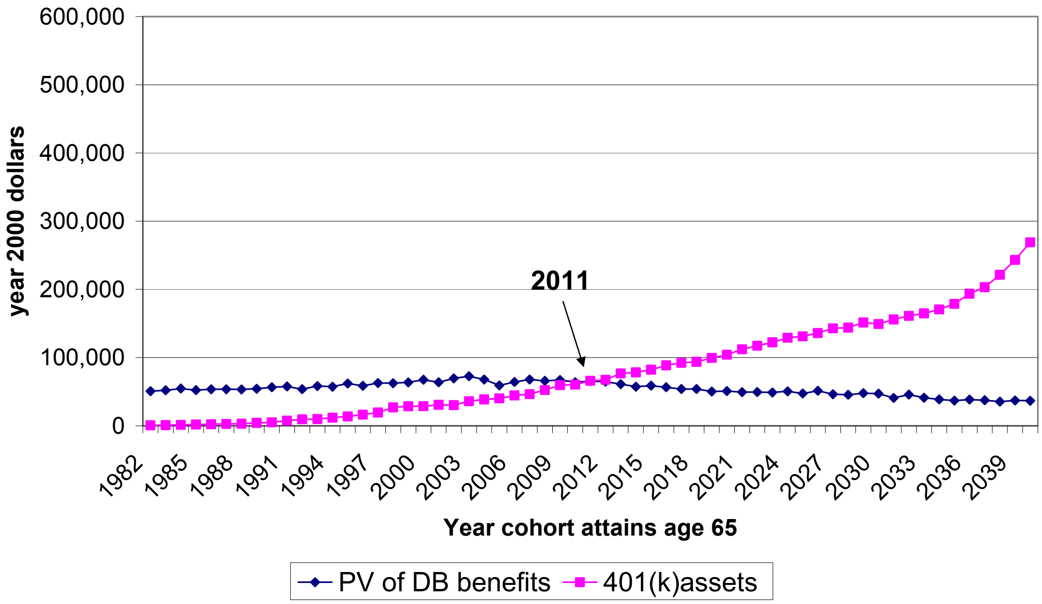


Figure 6-3a. Present value of DB benefits at age 65 for persons with a DB and 401(k) assets at age 65 for persons with a 401(k)

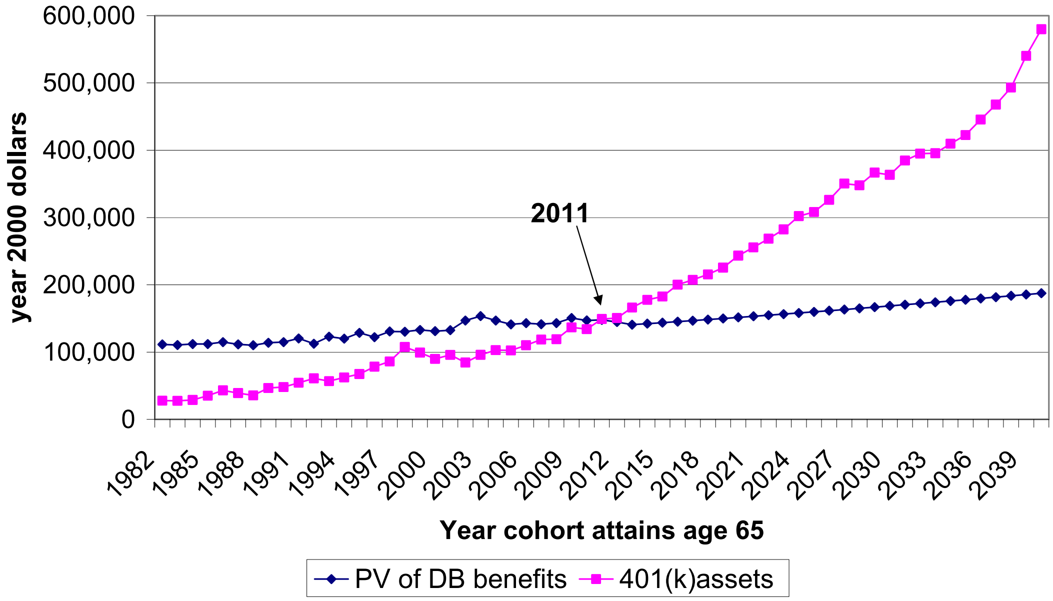
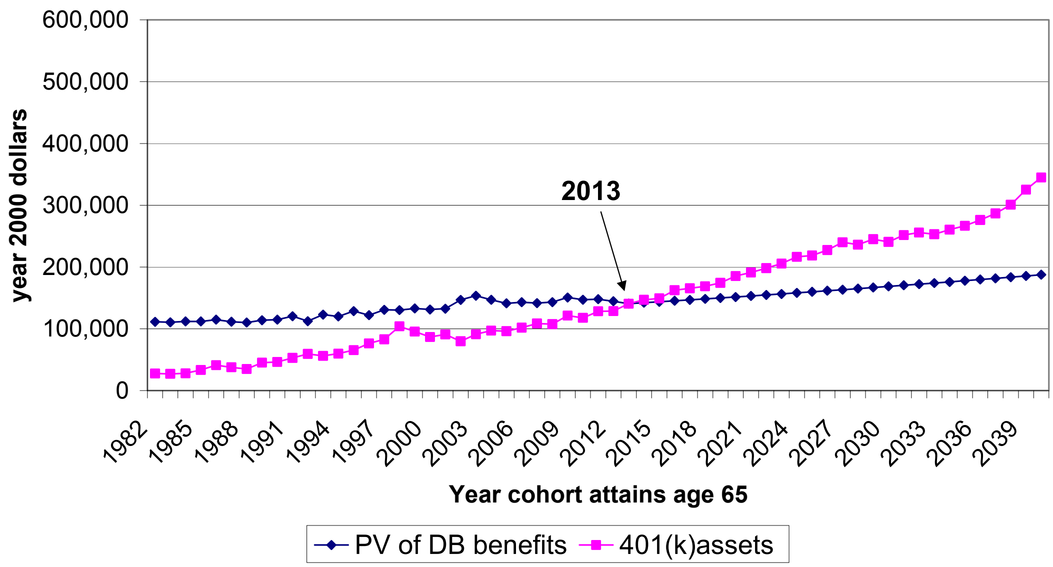


Figure 6-3b. Present value of DB benefits at age 65 for persons with a DB and 401(k) assets at age 65 for persons with a 401(k)--historical rates of return minus 300 basis points



Our 401(k) asset projections do not account for legislated increases in the contribution limits between 2003 and 2007. The limit increases are large for all income groups, with the largest increases for persons with incomes between $15,000 and $20,000. Only a small proportion of persons are currently contributing at the maximum. However, as incomes increase a larger and larger fraction of employees are likely to be contributing at the new limits. For this reason, it is likely that future contributions to 401(k) plans will be greater than our assumptions (projections) suggest. In addition, we have not accounted for the effects of the Pension Protection Act of 2006, which gives employers latitude to set more "saving friendly" defaults in 401(k) plans. Beshears, Choi, Laibson, and Madrian (2006) survey some of the recent evidence on how changing defaults for enrollment, contribution rates, and asset allocations can significantly increase retirement saving.

7. Assets in DB Trust Funds and Total DB Benefits Paid

Finally, we want to estimate the level of total assets in DB trust funds. These estimates are likely to be particularly important for assessing future changes in the demand for financial assets. We made similar calculations with respect to 401(k) and other personal retirement account assets in Poterba, Venti, and Wise (2006). We believe the DB component, together with the “401(k)” component, represent a substantial fraction of the demography-induced change in asset demand.

There are at least two general ways to predict future assets in DB plans. One way is to predict total benefits paid in future years and then to suppose that assets in a year are sufficient to pay the present value of these future obligations. We take this approach here. We believe, however, that this approach should yield “fully-funded” current assets that are greater than actual assets. A second way is to predict future assets based on an extrapolation of current assets compared to “fully-funded” liabilities. A possible extrapolation procedure, for example, is to assume that assets will continue to be a given percent below the “fully-funded” level. We have not pursued this approach here.

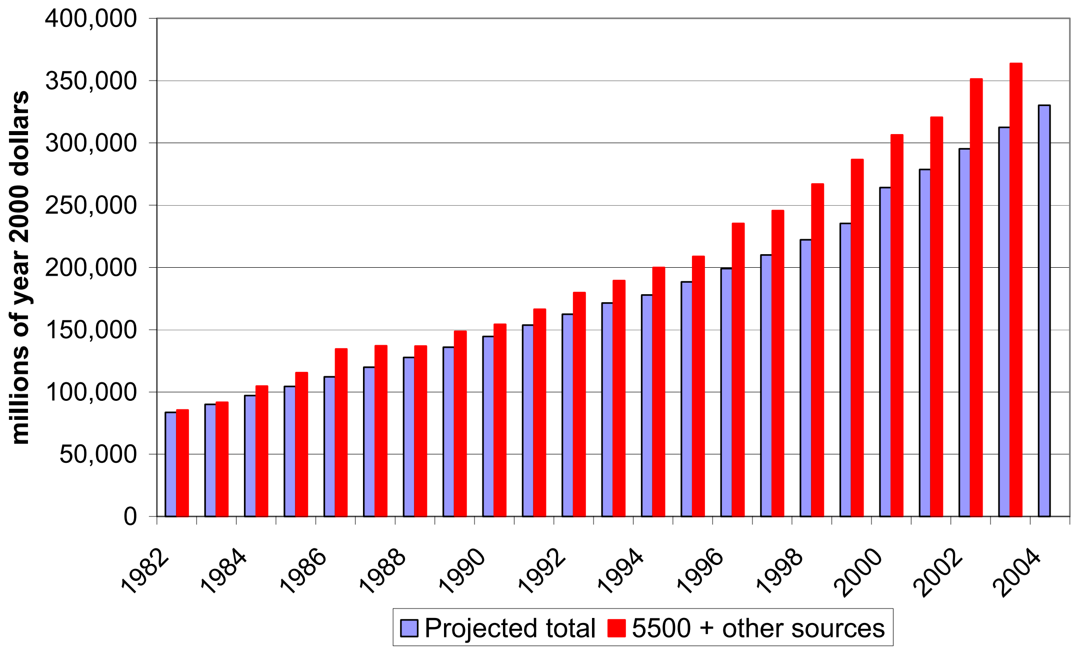
To obtain the present value of future obligations we must first calculate total DB benefits paid each year. As described above, we have projected the average level of DB benefits of recipients by age and cohort (or, alternatively, by age and calendar year). We have also projected the conditional probability of receiving benefits for each age and year. We now combine these projections with demographic projections obtained from the Social Security Administration to obtain total DB benefits paid in each year. More precisely, we calculate the total dollar value of DB benefits paid to all persons in year t as:

(3) $$DB_t = \sum_{a=55}^{100} N_{a,t} P_{a,t} B_{a,t}$$

Where $N_{a,t}$ is the number of persons age a in year t, $P_{a,t}$ is the probability that benefits are received by a person age a in year t, and $B_{a,t}$ is the average benefit received (conditional on benefit receipt) by a person of age a in year t.

Figure 7-1, shows these totals for the years 1982 to 2004, together with a constructed series that sums together private sector DB benefits, benefits paid to federal employees, and benefits paid to state and local employees. The private sector data are from the form 5500 data and exclude benefits paid directly by insurance carriers. Federal DB benefits include payments made by the Civil Service Retirement System, the Federal Employees Retirement System, and the Military Service Retirement System. DB and DC benefits are not reported separately for state and local plan. The data used here include DC as well as DB benefits. Thus our projected DB benefits should be somewhat greater than sum of these reported government and private sector benefits.

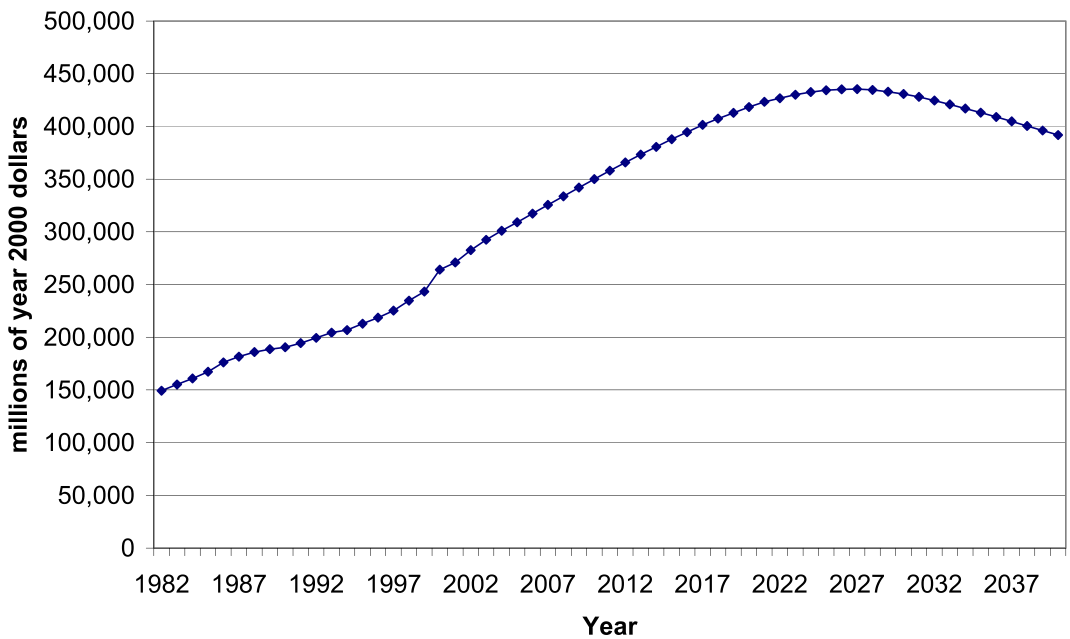
Figure 7-1. DB benefits paid: projected vs 5500 plus other sources, 1982 to 2004



The projected totals are close to the constructed totals in the early years but are smaller than the constructed totals in the later years. The discrepancy is due in part at least to the growing importance of 401(k)-like accounts in the state and local government plans. Thus we believe that the comparison lends credence to our estimates, based on SIPP data, for these years. Our forward projections depend on the assumptions we have made to project benefit levels and benefit receipt for future cohorts not represented in the SIPP data.

Our projected estimates of total DB benefits in future years are shown in Figure 7-2 below, in year 2000 dollars. Total benefits paid from DB plans continue to increase until 2027. The profile turns down eventually because the probability that benefits are received (at age 70) reaches a maximum with the cohort that attains age 65 in 2007, although this cohort continues to receive benefits after 2007. From a peak of $435,000 in 2027, the real value of total benefits paid declines modestly to $392,000 by 2040. As noted in Figures 6-2 and 6-3, the real level of benefits increases through the end of the projection period, so the decline in total benefits in Figure 7-2 is driven by the decline in the probability of benefit receipt.

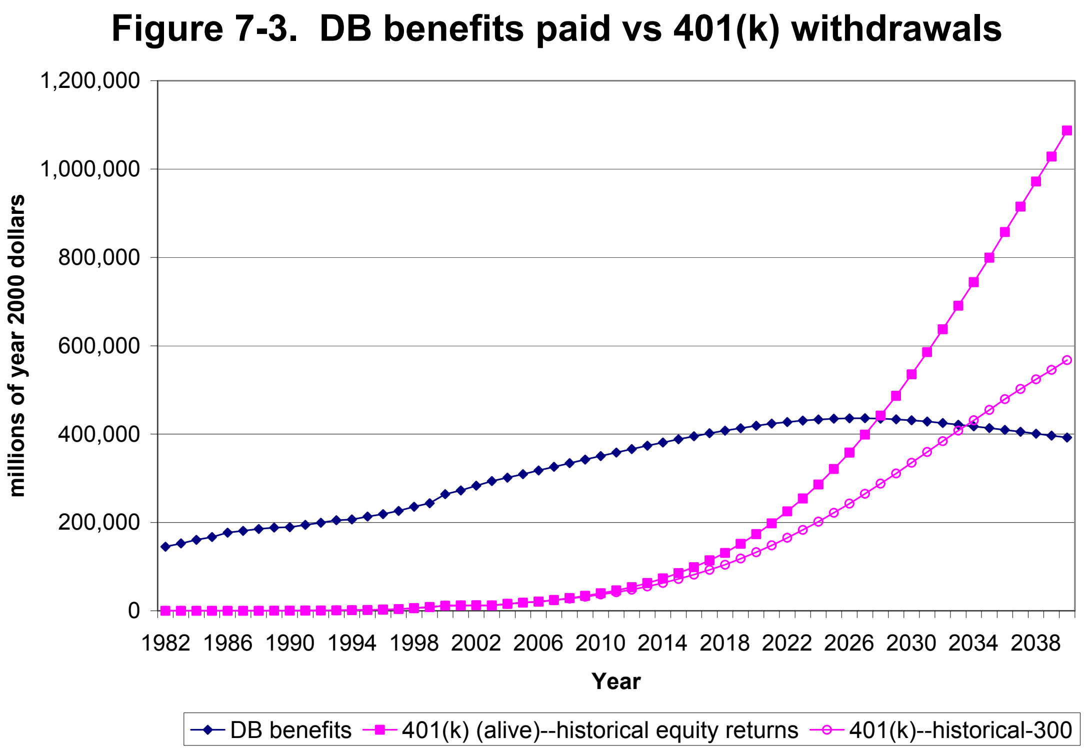
Figure 7-2. Projected DB benefits paid: by year



For comparison, projected benefits paid from DB plans are graphed against amounts withdrawn from 401(k) plans in Figure 7-3.[5] Benefits from DB plans exceed withdrawals of 401(k) assets until 2028, assuming historical rates of equity returns. After 2028 the value of DB benefits falls each year and 401(k)

[5] The 401(k) withdrawals shown in this figure are projected amounts disbursed when account owners are alive and do not include balances that remain in accounts when account owners die.

withdrawals increase rapidly thereafter. If the future average rate of return on equities is assumed to be the average historical rate less 300 basis points, the benefits from DB plans exceed withdrawals of 401(k) assets until 2034.



We use our projections of benefits to be paid from DB plans to help to project future assets in DB trust funds. Suppose that in each year assets held by DB plan sponsors were equal to the present value of future obligations. If future liabilities are discounted at 3 percent and firms have a twenty year planning horizon, the present value of liabilities each year is shown in Figure 7-4. The figure also shows two series representing reported total assets in DB plans. The first is from the Flow of Funds accounts that include private sector DB plans and the value of assets in DB and DC plans for government sponsors. The second series is composed of private sector DB assets from Form 5500 reports, federal DB assets from various federal agency annual reports, and the sum of DB and DC assets for state and local governments from the Census Bureau's series on State and local Government Retirement Systems. Actual assets, for the years they are available, are substantially below our calculation of the present value of liabilities in all years, with the possible exception of 1999. But the gap between actual assets and “fully-funded” assets declined between 1985 and 1999. During this period, contributions to DB plans sometimes exceeded and sometimes fell short of the change in the present value of liabilities, as shown in Figure 7-5.

Figure 7-4. Present value of DB liabilities vs DB assets

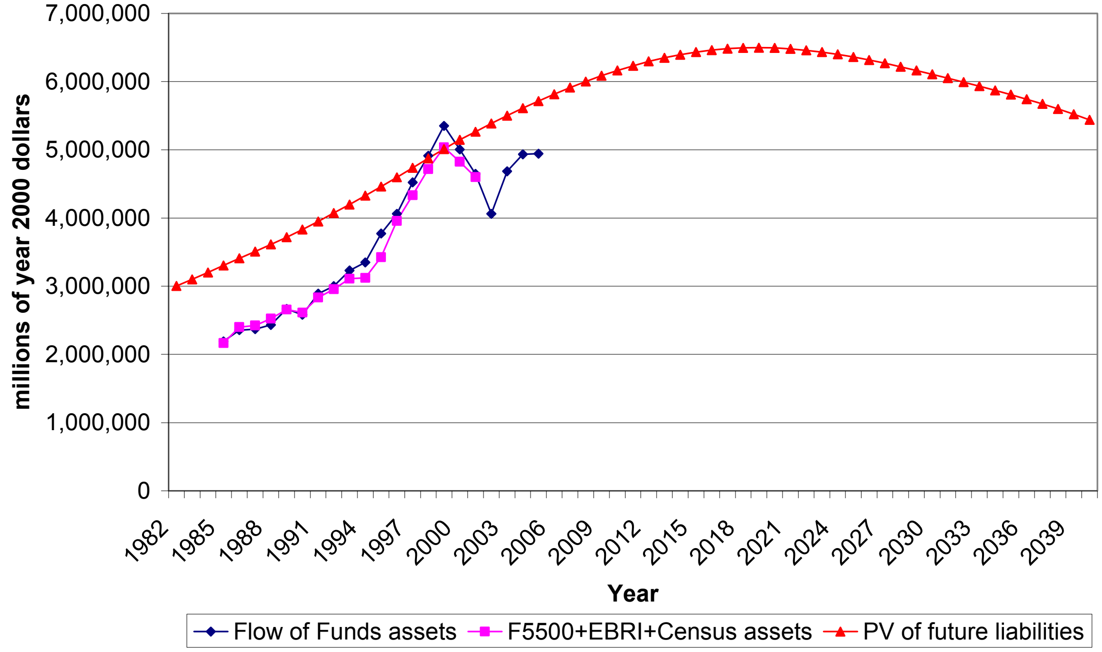
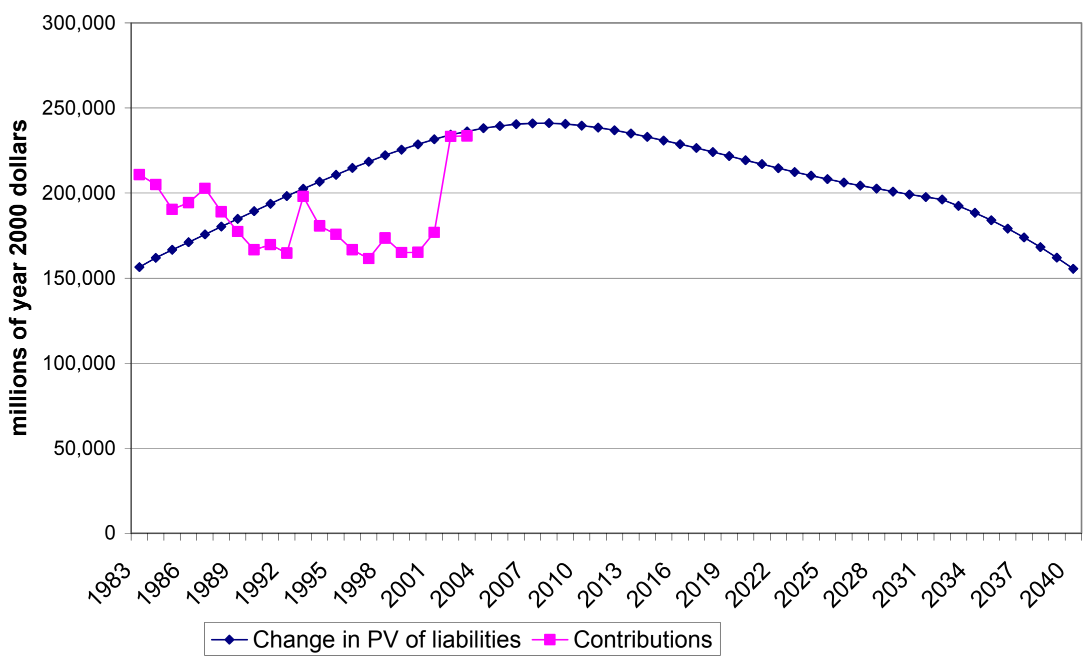


Figure 7-5. Change in present value of future DB liabilities vs contributions



It is perhaps not surprising that actual assets are less than our estimates of the assets employers would have to hold to fully fund projected liabilities.

Private sector plan sponsors have substantial latitude in the assumption of interest rates, investment returns, when benefits will be paid, and other features that determine funding levels.[6] The former Director of the PBGC, Bradley Belt (2005), estimated that private DB plans were under-funded by $450 billion in 2004. There are even fewer restrictions on the funding of federal, state, and local plans and many are thought to be substantially under-funded.

Our "fully-funded" method yields assets that are well above actual assets in DB plans, at least in recent years. We know of no way to confidently predict future funding levels, however. Thus we have projected future assets levels according to the "fully-funded" method described above.

8. DB and "401(k)" Assets Combined

What will be the change in asset levels for all pension plans--DB and 401(k) plans combined--in future years? The evolution of total assets depends on three components: contributions, withdrawals, and the internal build-up. In our prior work we projected assets held in 401(k) plans. These 401(k) assets, DB plan liabilities ("fully-funded" DB assets) and the sum of both series are shown in Figure 8-1a and 8-1b, assuming historical equity returns and historical returns minus 300 basis points respectively. If equities in 401(k) plans earn the historical return, then 401(k) asset balances overtake DB balances in 2009. If equities earn 300 basis points less than the historical average then 401(k) assets first exceed DB assets in 2010.

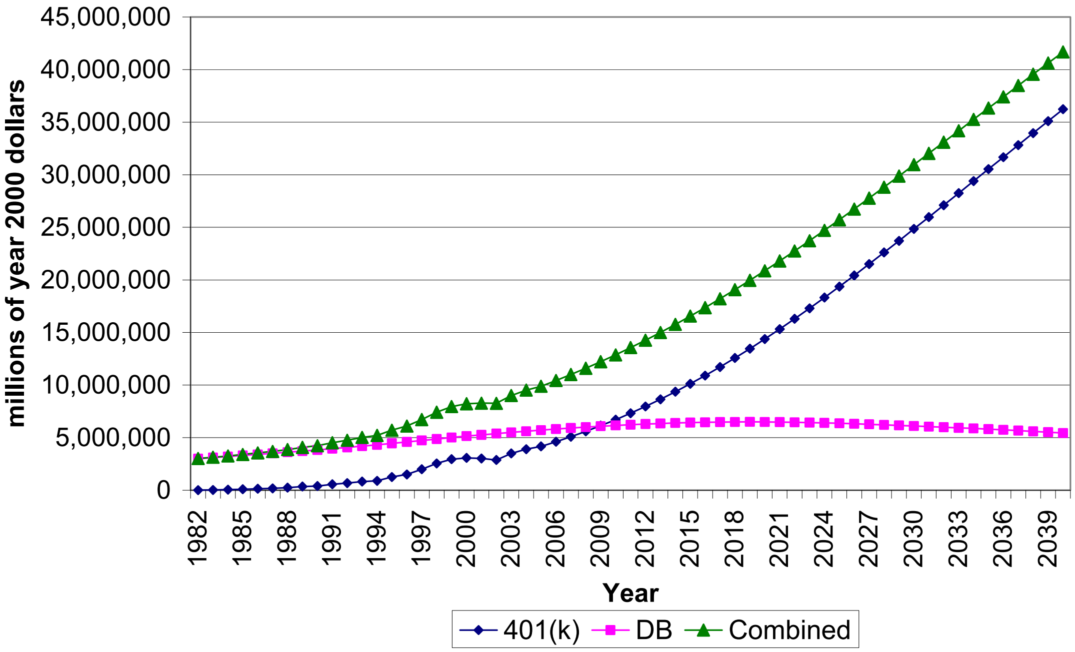
We also consider total "contributions" to DB and 401(k) plans and total withdrawals from DB and 401(k) plans. Figure 8-2 shows contributions to 401(k) plans, the annual change in DB liabilities (a rough measure of contributions to a fully funded DB plan) and the sum of these "contributions." The sum is relatively flat between 2000 and 2040. In contrast, the sum of benefits paid grows rapidly through 2040, especially if historical equity rates of return are assumed. Withdrawals from 401(k) plans, DB benefits paid, and the sum of the two are shown in Figure 8-3a using historical equity returns and Figure 8-3b using the historical return less 300 basis points.

Figure 8-4 shows the total projected contributions to and withdrawals from DB and 401(k) plans combined. Withdrawals assuming historical equity rates of return and withdrawals assuming the historical return minus 300 basis points are shown in the figure. Withdrawals exceed contributions after 2020 and 2021 for these two withdrawal series respectively. Figure 8-5 shows the combined withdrawals minus contributions. Again, withdrawals exceed contributions after 2020 if historical equity rates of return are assumed and after 2022 if historical rates minus 300 basis points are assumed. The excess of withdrawals over

[6]Bergstresser, Desai, and Rauh (2006) discuss these issues in the context of earnings manipulation.

contributions reaches about $872 billion by 2040 (in year 2000 dollars) when historical rates of return are assumed but only about $353 billion if historical rates minus 300 basis points are assumed. Because of internal buildup however, under either equity return scenario total assets in pension plans continue to grow through 2040. This is shown in Figures 8-1a and 8-1b.[7]

Figure 8-1a. Projected assets: 401(k), DB, and combined--historical equity rates of return



[7]Schieber and Shoven (1997) consider the implications of population aging for private pension fund saving and project saving as a percent of payrolls. Their projection method is very different from ours and it does not focus on the rising importance of self-directed defined contribution plans in the way that ours does. Nevertheless, their results are qualitatively similar to ours. They project that total private pension withdrawals will exceed contributions beginning in 2024, reversing the pattern of earlier years.

Figure 8-1b. Projected assets: 401(k), DB, and combined--historical equit rates if return minus 300 basis points

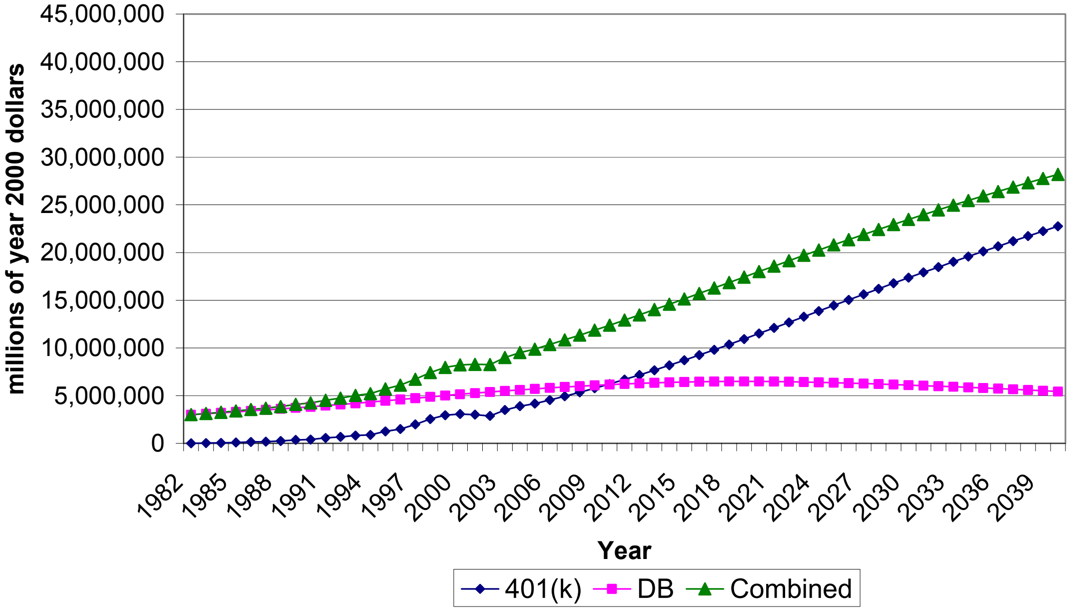


Figure 8-2. Projected contributions: 401(k), DB (change in liabilities), and combined--historical equity returns

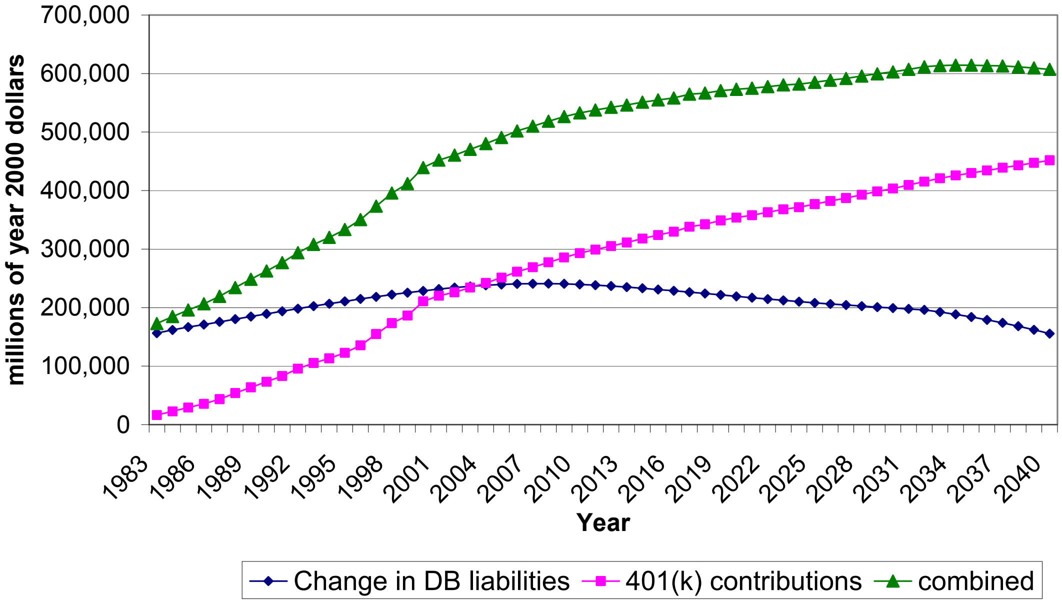


Figure 8-3a. Projected withdrawals: 401(k), DB (benefits paid), and combined--historical equity returns

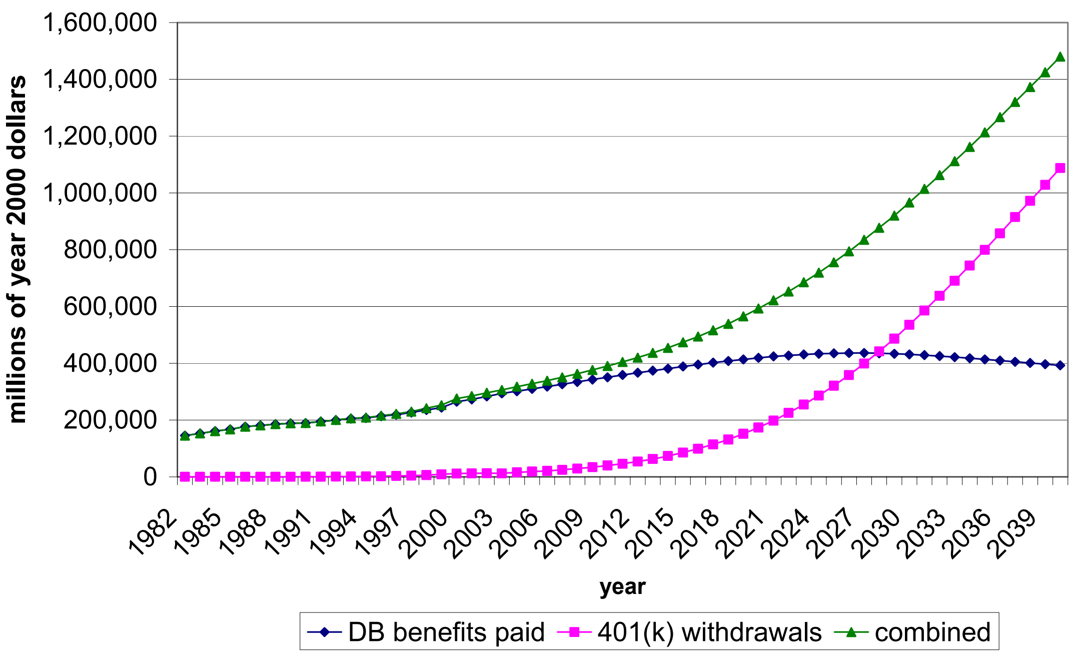


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Figure 8-3b. Projected withdrawals: 401(k), DB (benefits paid), and combined--historical equity returns minus 300 basis points.

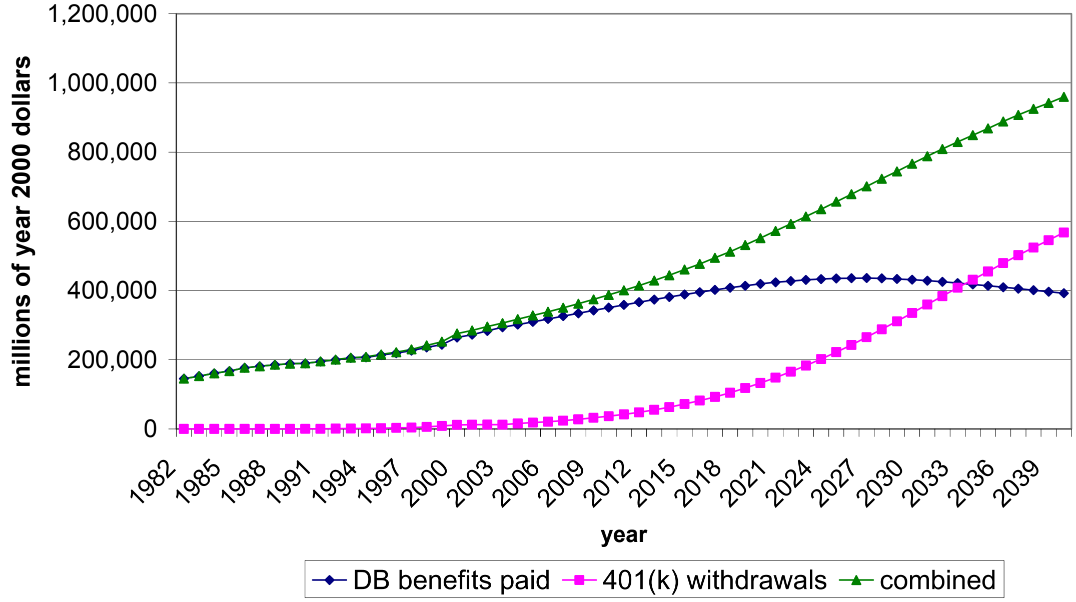

Figure 8-4. Projected contributions and withdrawals: DB and 401(k) plans combined

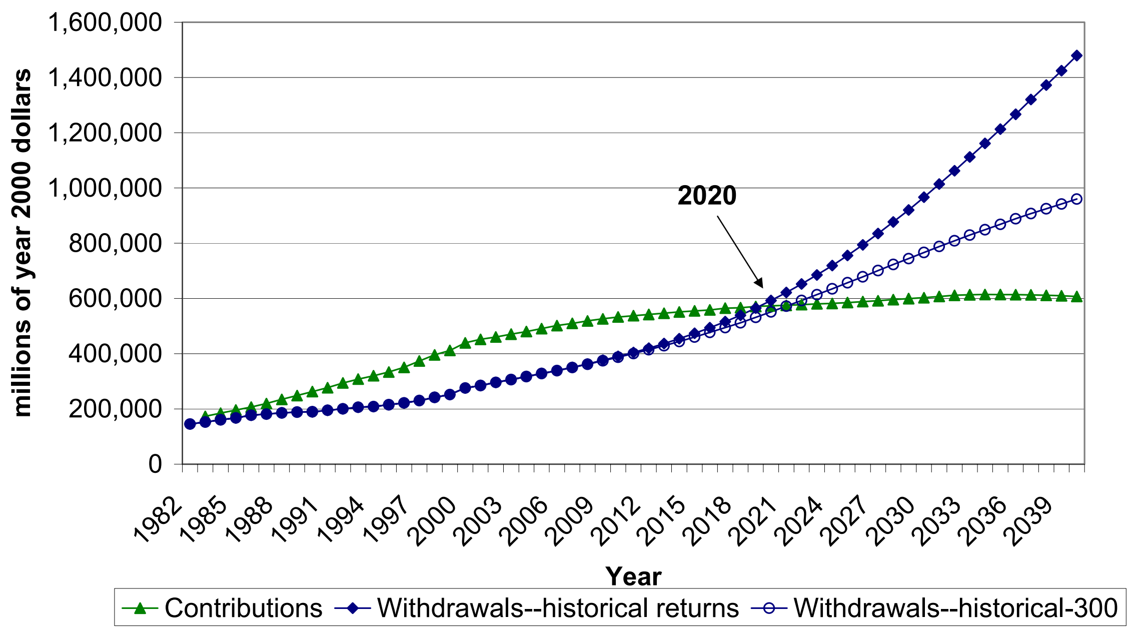

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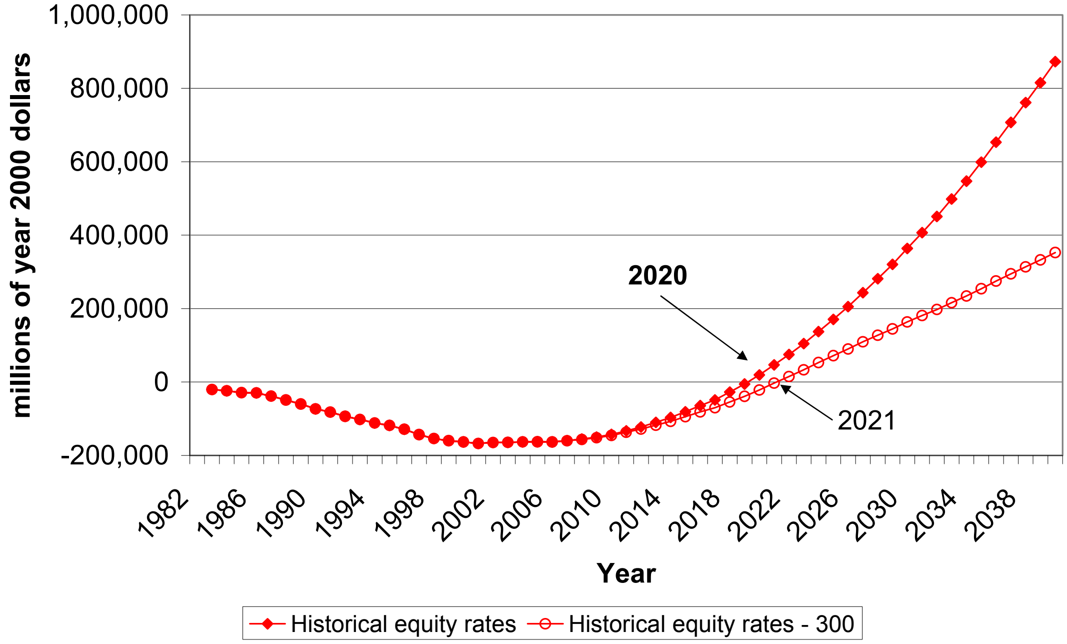
Figure 8-5. Projected withdrawals minus contributions: DB and 401(k) plans combined



9. Demographically-Sensitive Assets and Rates of Return

Whether demographically-induced changes in DB and DC assets will have an appreciable effect on the rates of return on equities and other financial assets depends on the magnitude of these changes relative to the other components of asset demand. Other changes in asset demand may reinforce or counterbalance them. Since asset markets are global, domestic demand for financial assets is not the only force determining the returns on stocks and bonds in the United States. Several recent studies have explored how demographic change in the currently developed world will affect global asset demand. Our estimates of the future demand for pension assets in the United States, if replicated in other countries, could be an important input to such studies. Whether international capital flows will reinforce or moderate the demographic pressures on asset returns that may arise from changes in the population age structure in the United States depends critically on the future rate of development of currently-young economies and on the age structure of other developed nations.

When evaluating how demographic change affects the demand for financial assets in general, and specifically corporate equities, one must remember that a large fraction of financial assets are owned by a small fraction of the population. This group of high net worth investors is likely to be less sensitive to age-related changes in asset demand than other investors who have lifecycle motives for saving. Kennickel (2006) reports that in the 2004 Survey of Consumer Finances, the wealthiest 5 percent of households owned 65.6 percent of equities, including mutual funds, and 79.1 percent of equities excluding mutual funds. Pension assets represent a smaller share of the assets of this group than of other less-affluent sectors of the population.

Retirement plan assets are one of the most, if not the most, demographically-sensitive components of the household financial balance sheet. There are clear demographic effects on assets in DB plans, which are typically paid out as benefit annuities at the time of retirement. The link between demographic structure and 401(k) plan assets is less mechanical, since older households have discretion over the rate at which they draw down assets in retirement. There is uncertainty both about the date at which withdrawals will begin and the rate of such withdrawals once they start. At present many 401(k) participants do not begin to make withdrawals until they are required to do so at age 70½. In the future, the average age of first withdrawal is likely to increase even for those who do not wait until 70½ to begin withdrawals, since the average age of retirement is likely to rise. This is likely to result both from the increase in the normal Social Security retirement age from 65 to 67 by 2027, and from the conversion from DB plans, with strong incentives to leave the labor force early, to personal retirement accounts without these incentives. Longer working lives will probably delay withdrawals from personal retirement accounts and increase the accumulation of retirement assets.

For households that are constrained by the mandatory withdrawal requirements from personal retirement accounts, withdrawals of DC plan assets are likely to overstate the decline in asset demand at older ages. There is no requirement that households consume their minimum distributions, and households that would prefer not to make any withdrawals from their 401(k) plans or IRAs may simply reinvest the mandatory payouts in other investment options. It is possible that such households will bequeath a substantial portion of their tax-deferred assets to their heirs, who may continue to accumulate assets in a tax-deferred setting for many years. Recent legislation has facilitated such transfers of personal retirement account assets. While this consideration suggests that 401(k) assets may remain substantial even for households at very advanced ages, it is also possible that the financial burden of health care in retirement will be greater for future retirees than for past cohorts, and that this will necessitate greater expenditures during retirement. If the cost of health care continues to increase, future retirees are likely to spend more on health care than current retirees. This could affect not only the accumulation of retirement assets, but could accelerate withdrawals from retirement accounts as well.

The many uncertainties that arise in trying to link one source of asset demand to equilibrium rates of return make us reluctant to attempt to quantify the impact of demographically-induced changes in retirement asset accumulation on prospective stock or bond returns. There is also a fundamental circularity in this question. Our projections of future DC assets are based on assumptions about the rate of return that plan assets will earn in the next few decades. This

Figure 9-1. Total pension assets as share of GDP--historical and historical minus 300 equity return

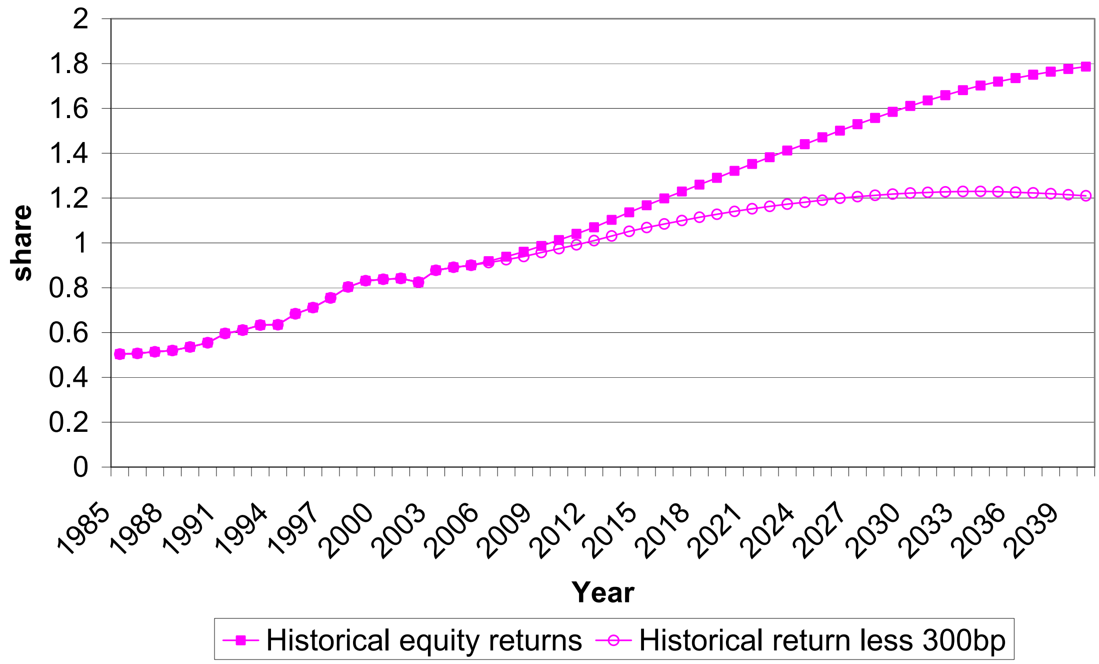
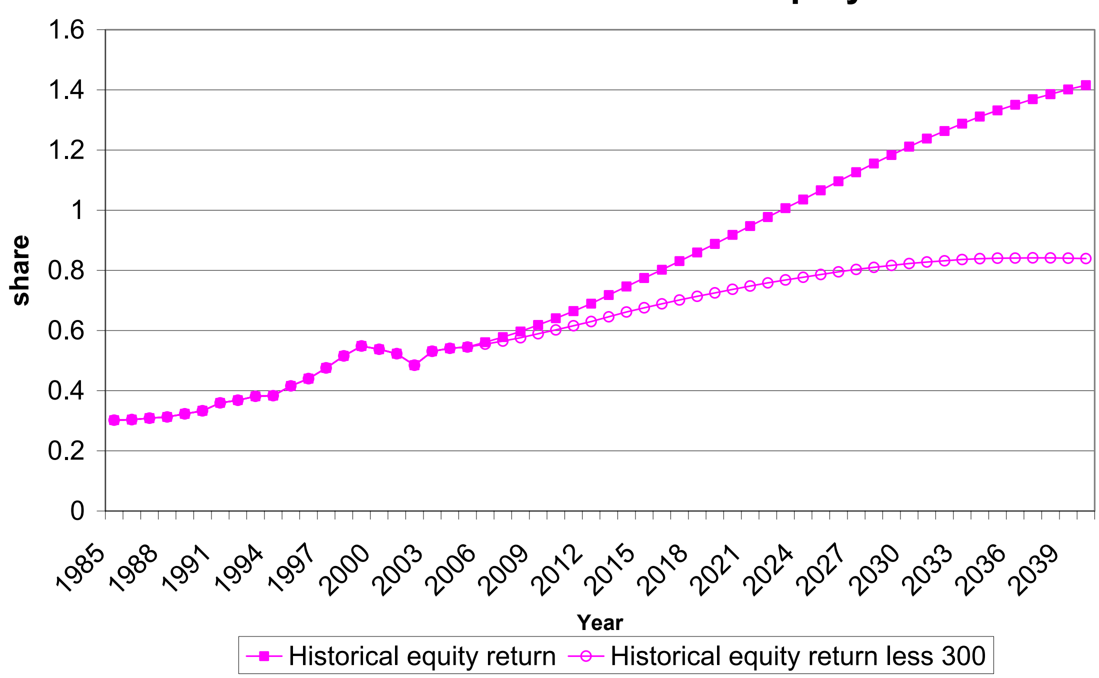


Figure 9-2. Pension equity as share of GDP--historical and historical minus 300 equity return



underscores the importance of considering the sensitivity of future retirement asset projections to rate of return assumptions. This concern notwithstanding, we have developed one metric to provide some indication of the quantitative importance of the demographically-induced changes in retirement asset demand.

Figure 9-1 shows our projected demand for all pension plan assets, including both bonds and equities, as a percentage of the Social Security Administration intermediate GDP projection. The figure shows that pension assets grow from 50 percent of GDP in 1985 to 100 percent in 2010 to 179 percent in 2040. If the return on equity is 300 basis points lower than the historical return then total pension assets grow to about 120 percent of GDP by 2040. Both of these projections suggest a very substantial increase retirement saving over the coming decades.

Figure 9-2 shows the projected demand for corporate equity in both DB and DC plans as a percentage of the Social Security Administration intermediate GDP projection: one based on the historical equity rate of return and the other based on the historical return less 300 basis points.[8] Historically, pension equities grew from about 30 percent of GDP in 1985 to about 55 percent in 2005. Our projections suggest continued growth between now and 2040, to 142 percent of GDP when the projection is based on the historical equity return and 84 percent of GDP when the assumed rate of return is the historical value minus 300 basis points. The shape of the projected growth path is also affected by the different rate of return assumptions. For example, the one year growth rate of pension assets between 2039 and 2040 is 1.0 percent in the former case and -0.2 percent when we assume the lower equity return. The figure shows that even when we make the lower rate of return assumption, the stock of pension assets continues to increase for the next three decades, even relative to the aggregate economy. The projections do not suggest a sharp decline in pension assets, either in absolute dollars or relative to GDP, when the baby boom cohort reaches retirement age. If low returns depress the growth of 401(k) assets, however, there may be some years in which total retirement assets as a share of GDP are stable or decline slightly.

10. Summary

A key component to any effort to analyze how demographic trends may affect future returns on financial assets is a careful analysis of how these trends will affect assets in defined benefit and defined contribution pension plans. This paper on DB pension plan assets and our earlier companion paper on 401(k) assets explore this issue. The dramatic decline in DB participation in the past three decades stands in contrast to the rapid expansion of 401(k)-like plans. We develop projections of the DB benefits of cohorts retiring between now and 2040 and use them to project the total assets held in DB plans through 2040. The

[8] The equity share is based on projected accumulated equity assets, which depends on the assumed rate of return on equities. We assume no rebalancing in 401(k) plans.

projections are based on extrapolation of cohort data from many waves of the SIPP along with demographic projections from the Social Security Administration.

We project the present value of DB benefits at age 65 for cohorts who reach age 65 in each year from 1982 to 2040, and we compare these projections to projections of 401(k) assets. Our projections suggest that the average (over all persons) of the present value of real DB benefits at age 65 attained an historical maximum in 2003, when the value was $72,637. Our projections also suggest that the average value of 401(k) assets at age 65 surpasses the average present value of DB benefits at age 65 in about 2010. Thereafter the value of 401(k) assets grows rapidly, attaining levels much greater than the maximum present value of DB benefits. If equity returns between 2006 and 2040 are comparable to those observed historically, by 2040 average projected 401(k) assets will be over six times larger than the historical maximum level of DB benefits at age 65, attained in 2003. Even if equity returns average 300 basis points below their historical value, we project that average 401(k) assets in 2040 would be 3.7 times as large as the value of DB benefits in 2003.

The projected growth of real 401(k) assets more then offsets the projected decline in real DB plan assets during the next three decades. Focusing on DB assets alone suggests that an aging population, in conjunction with a shift away from DB plans, will lead to a decline in the real value of pension assets averaged across all retirees in future cohorts. When we combine projected 401(k) assets with projected DB assets, however, we find that real pension assets not only increase, but increase substantially, in future decades.

Our findings underscore the need for further analysis of the factors that determine the diffusion of 401(k) plans across corporations, especially small companies with low-wage workers, as well as the contribution behavior and withdrawal behavior of 401(k) participants. The growing role of 401(k)-type plans in the retirement landscape suggests that understanding asset accumulation and draw-down in these plans is a critical component of any analysis of the effect of demographic change on financial markets.

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