Preliminary and Partial Draft
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Demographic Change, Retirement Saving, and Financial Market Returns

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Many analysts have proposed that population aging will adversely affect the assets of baby boomers when they retire. When people are working, they are more likely to be saving for retirement, purchasing (demanding) equities and bidding up their price. When they retire, they are more likely to be selling (supplying) assets, thereby bidding down their price. Thus as the baby boom generation moves from their prime working age toward retirement, they will change from net savers, demanding financial assets and bidding up their price, to net spenders, supplying financial assets and driving down their price. This reasoning would suggest 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 is the first part of an analysis that aims to evaluate the likely empirical importance of demographic trends on market returns in the United States.

We assume that the importance of future demographic trends on market returns would depend primarily on flows into and out of retirement saving plans, which are likely to be most sensitive to demographic trends. Thus a key stepping stone in understanding the effect of demographic trends on market returns is an understanding of the effect of demographic trends on the flow into and out of retirement saving 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 pensions to defined contribution retirement saving plans that are largely controlled by employees. In 1980, 92 percent of private retirement saving contributions went to employer-based plans; 64 percent of these contributions were to defined benefit plans. By 1999, about 88 percent of private contributions were to plans in which individuals decide how much to contribute to the plan, how to invest plan assets, and how and when to withdraw money from the plan. The most important of personal retirement accounts are 401(k) plans. The spread of 401(k) plans in particular is likely to change by an order of magnitude the flow into and out of financial assets, and is likely to change the timing of these flows as well. 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 401(k) plans. In addition, although the relative importance of defined benefit (DB) plans has diminished, the flow of assets into and out of these plans

must also be evaluated. The goal of this paper is to project these flows over the next several decades. (This partial draft presents results for 401(k) plans only.)

There are two core components of the larger analysis. The first component, the subject of this paper, is to predict the future level of retirement assets during the period in which the baby boomers are saving for retirement and then drawing down retirement assets after leaving the labor force. The second component is to estimate the relationship between assets and rates of return. A companion project to this one aims to evaluate the effect of international capital flows on market returns and the results of this project will be considered jointly with that one to develop a more comprehensive understanding of the potential effects of demographic trends on rates of return.

This paper is organized into five sections. The first section summarizes prior research on the relationship between demographic trends and financial market returns. The second section describes the spread of 401(k) saving since the inception of the program in 1982. The third section describes our projection of 401(k) assets through 1940. The fourth section describes initial results based on the projections. The fifth section presents conclusions, comments, and a discussion of future work.

Previous Research on Population Aging and Financial Market Returns

There is a substantial and growing literature on the link between population age structure and returns in financial markets. Several studies have used the basic framework of the overlapping generations model 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, have the potential to 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. Very few studies have used household-level data on asset accumulation profiles to calibrate models of asset demand, and then explored the impact of notional asset demand on financial market returns. The current project, which begins with disaggregate analysis of the assets in defined contribution and defined benefit pension plans, is designed to contribute to this literature.

To place the current research in perspective, it is useful to review the previous theoretical and empirical work on demographic structure and asset returns. Because of space limitations, however, the review is not included in this Conference Proceedings report, but is included in the forthcoming working paper with the same title. Virtually all 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.

The Spread of 401(k) Plans Between 1984 and 2003

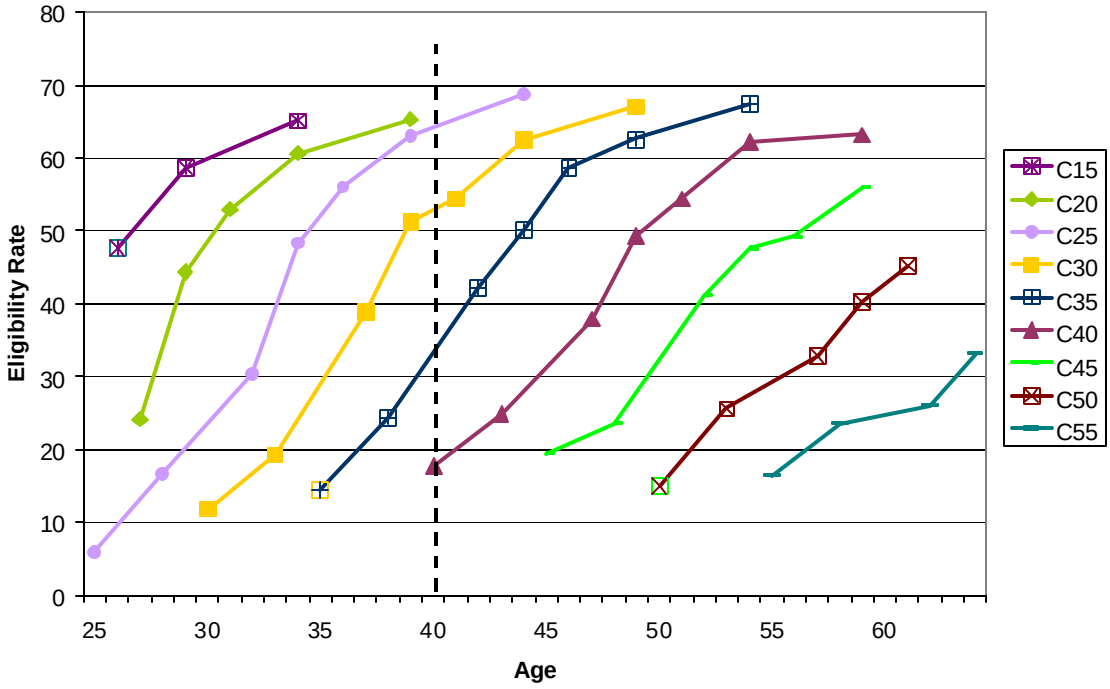
We use data from the Survey of Income and Program Participation (SIPP) to describe the spread of 401(k) plans over the past 25 years. This description also serves as a base for developing projections of future 401(k) assets. From the waves of the SIPP survey, data on eligibility for and participation in 401(k) plans can be obtained for 1984, 1987, 1991, 1993, 1995, 1998, and 2003. Each wave of the SIPP survey is a random cross section sample of the population (with short panel component for each cross-section). The cross-section data can be used to create "synthetic" cohorts. For example, to construct cohort data for the cohort that was age 25 in 1984 we use the 1984 panel to obtain data for persons 25 in that year, the 1987 panel to obtain data for persons who were 28 in that year, the 1991 panel to obtain data for persons who were 32 in that year, and so forth. The cohort that was 25 in 1984 was 44 in 2003. We sometimes label a cohort by the age of the cohort in 1984 and sometimes by the year in which the cohort attains age 65. For example, the cohort that is age 25 in 1984 attains age 65 in 2024 and is referred to as the C25 or the R2024 cohort.

The unit of observation in the SIPP is an individual and some of the calculations are based on the individual data. For other calculations, to describe the spread the 401(k) plans of example, we have grouped the individual responses to form families. Unmarried persons are treated as single-person families and spouses are matched to recreate two-person family units. A family is eligible for (or participates in) a 401(k) plan if at least one member of the family is eligible (or participates) in a plan.

The Spread of 401(k) Plans

We consider first data on eligibility, organized by cohort. In total, the SIPP provides some data for 56 cohorts. Figure 1a shows these data for 9 cohorts, five years apart, denoted by the age of the cohort in 1984. Consider

Figure 1a. Eligibility data for 9 cohorts



cohort C25 that was 25 years old in 1984, the first year for which data are available from the SIPP. In 1984, about 6 percent of the C25 cohort families were eligible for a 401(k) plan. (Recall that the cohort is defined by the age of the male "head" of the household and if any member of the household is eligible for a 401(k), the family is eligible.) By 1987, the percent eligible had risen to about 17 percent, by 2003 to almost 70 percent. The most important feature of the figure is the increase in eligibility over time for families of a given age. For example, the dashed vertical line highlights the increase in the eligibility of families in cohorts that attained age 40 in successively later years. Cohort C40 was 40 years old in 1984 and about 18 percent of the C40 cohort was eligible for a 401(k) at age 40. Cohort C35 attained age 40 in 1989 and about 34 percent of the C35 cohort was eligible for a 401(k) plan at age 40. The C25 cohort was age 40 in 1999 and about 65 percent of the C25 cohort was eligible for a 401(k) plan at age 40. Similar increases in eligibility are evident at other ages.

Figure 1b. Eligibility data for every other cohort

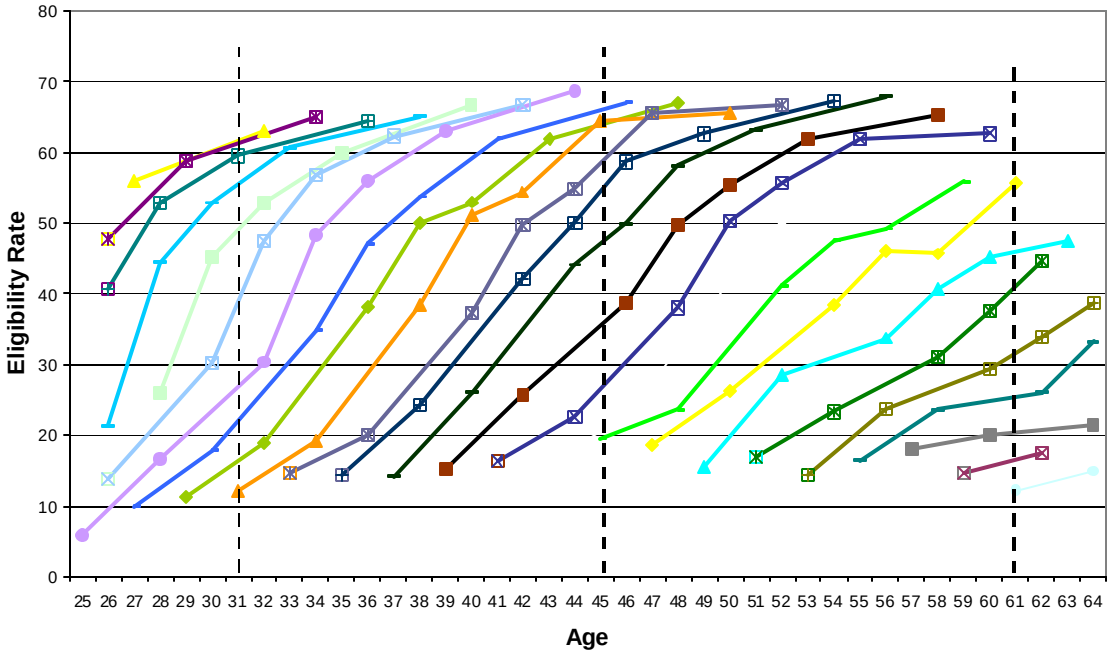


Figure 1c. Eligibility data for all cohorts

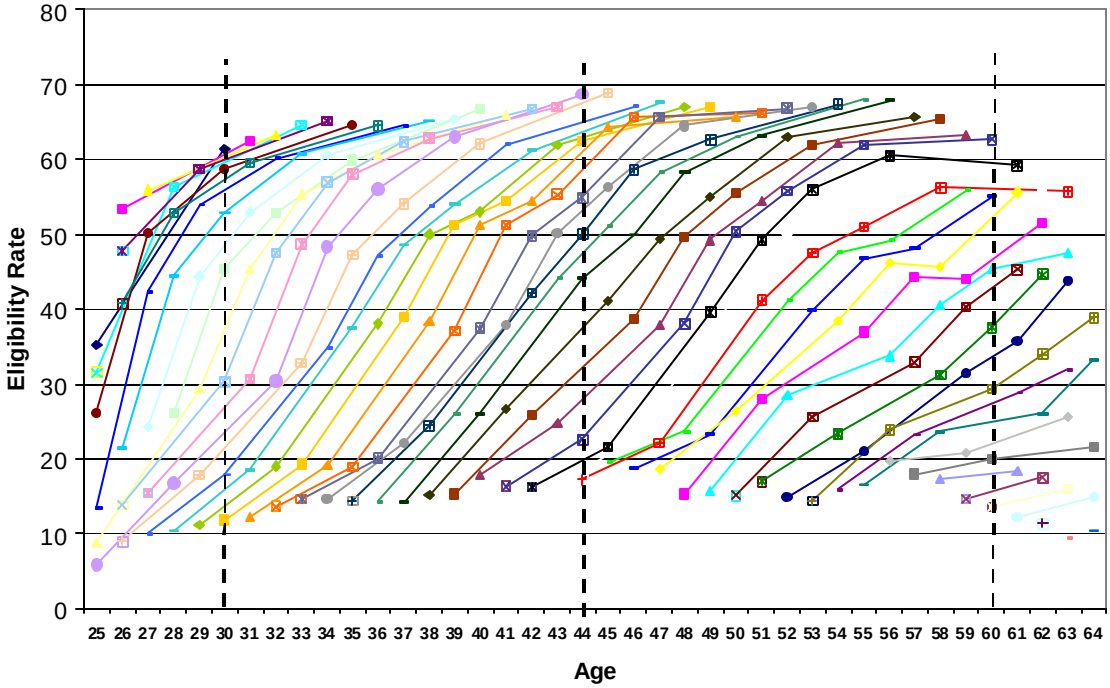


Figure 1b above shows eligibility data for alternate cohorts for which data can be obtained from the SIPP. Figure 1c shows data for each of the cohorts C11 to C64. (For the youngest and the oldest cohorts—upper left and lower right in the figure, eligibility rates are available for only one or two years.) Again, the dashed vertical lines highlight increases in eligibility for cohorts that reached given ages in successively later years. In Figure 1b, it is clear that with few exceptions cohorts that reached a given age in successively later years had successively greater 401(k) eligibility rates.

The increase in eligibility rates reflects the spread of 401(k) plans to more firms especially to smaller employers. As described in Poterba, Venti, and Wise (2004), for example, a large fraction of employers who first adopted 401(k) plans also offered DB plans (and few of these employers discontinued the DB plan when the 401(k) plan was adopted.) Employers who instituted 401(k) plans later were less likely to have existing DB plans and were presumably smaller firms.

More important than 401(k) eligibility is 401(k) participation. Family participation rate in 401(k) plans are shown by cohort in Figures 2a, 2b, and 2c.

Figure 2a. Participation data for 9 cohorts

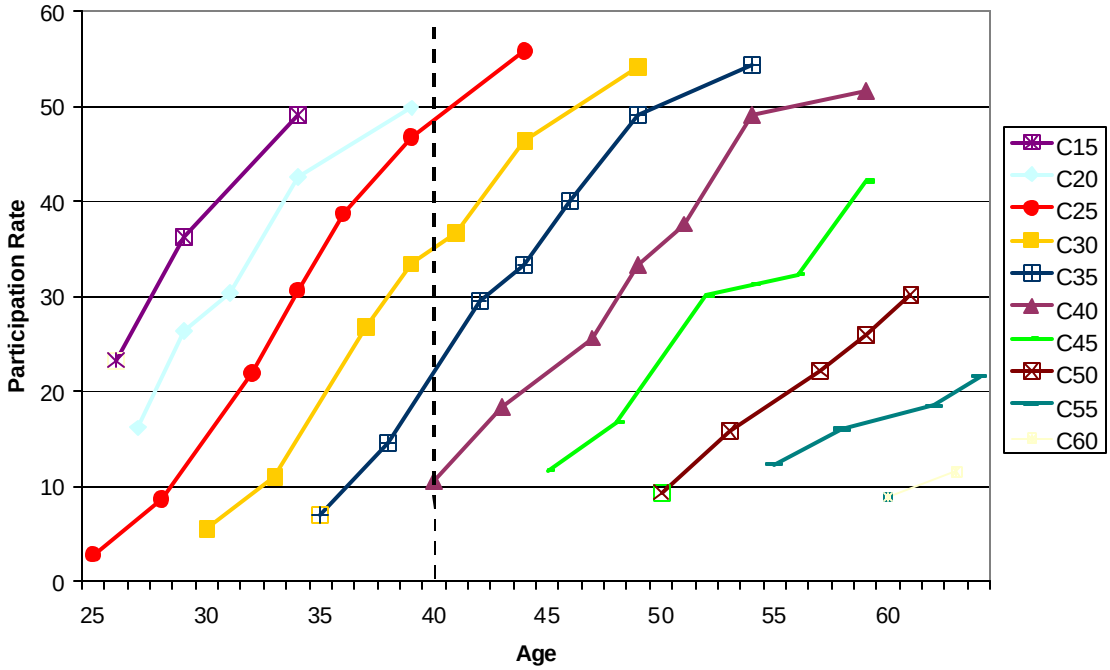


Figure 2b. Participation data for every other cohort

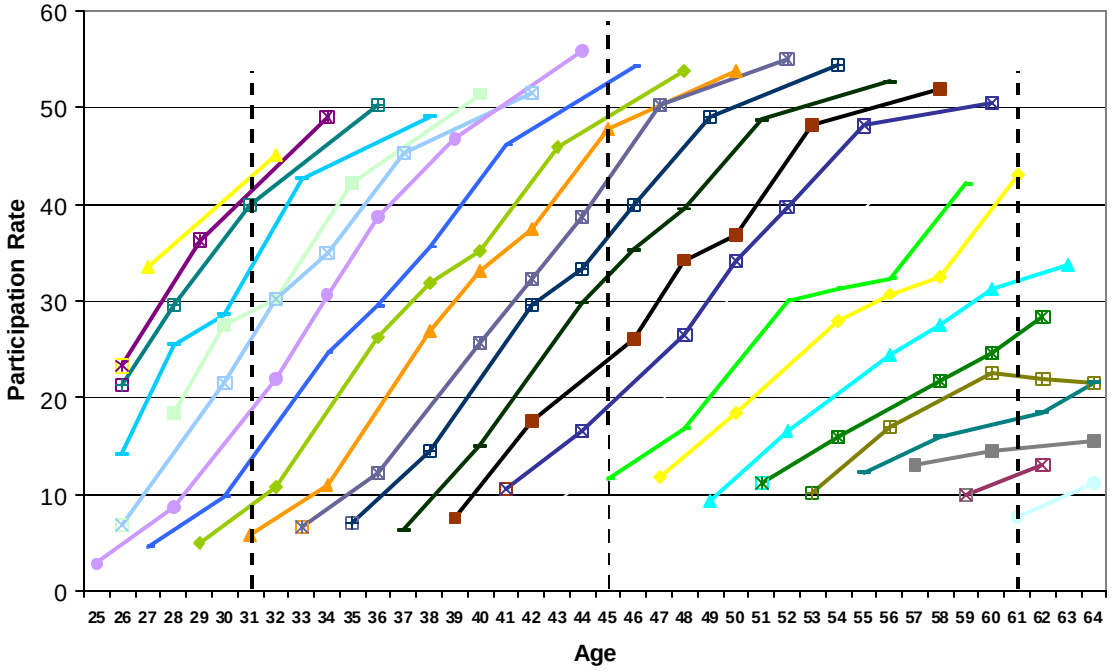
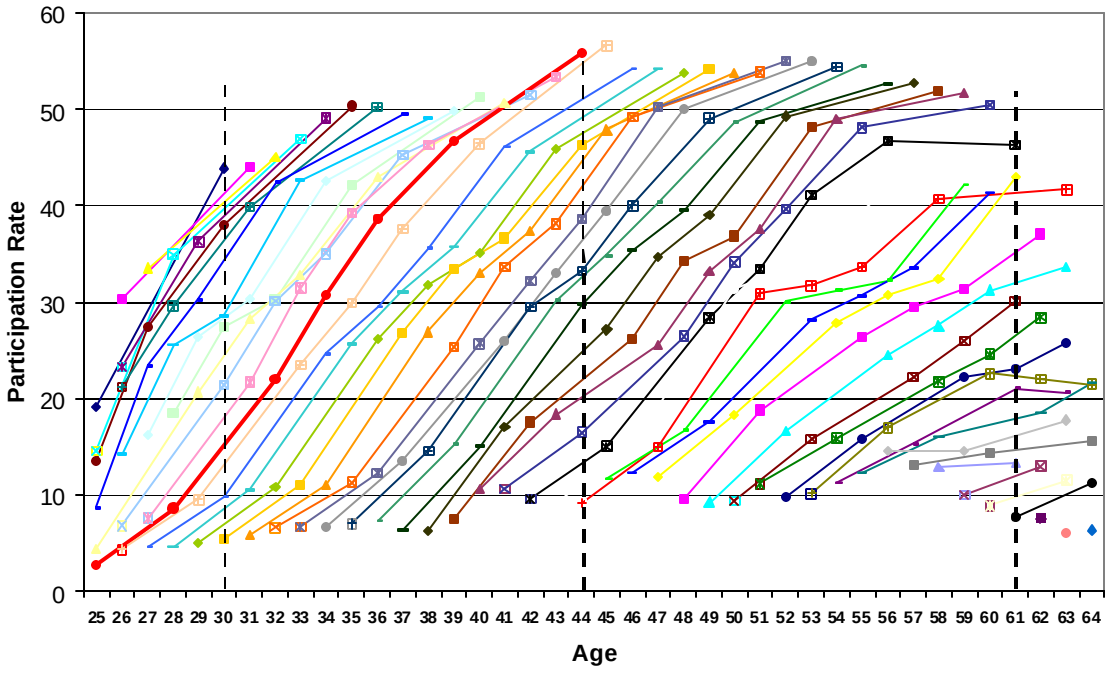


Figure 2c. Participation data for all cohorts



As in the eligibility Figure 1a, 1b, and 1c, the dashed vertical lines highlight the increase in the participation rate of families who attained a given age in successively later years.

For example, Figure 2a shows that only about 10 percent of the C40 cohort (that attained age 40 in 1984) participated in a 401(k) plan. But about 48 percent of the C25 cohort, that attained age 40 in 1999, participated in a 401(k) plan. More detail is shown in Figures 2b and 2c. Figure 2b shows participation data for alternate cohorts and Figure 2c shows participation data for each of the cohorts for which data are available in the SIPP.

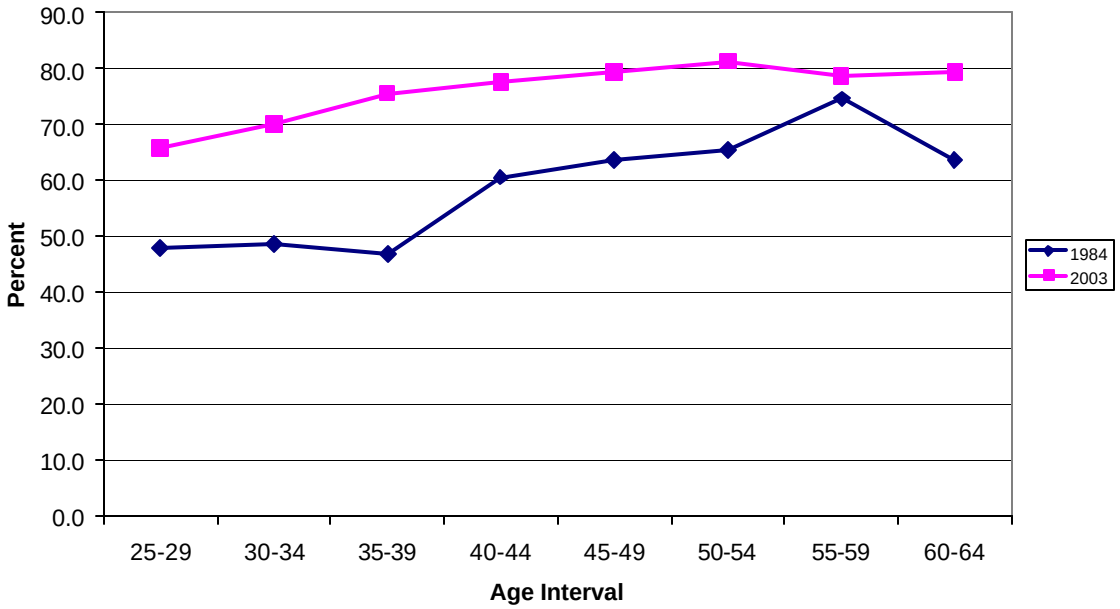
The cohort figures show a very large increase in 401(k) eligibility and participation rates. The increase in eligibility and participation rates at selected ages between 1984 and 2003 is summarized in Table 1. The table shows the eligibility rate and the participation rate for cohorts that reached age 30, 45 and 60 in 1984 and in 2003. For example, while only 11.8 percent of the cohort that attained age 30 in 1984 was eligible for a 401(k) plan, 61.6 percent of the cohort that attained age 30 in 2003 was eligible. Only 5.5 percent of the cohort that attained age 30 in 1984 participated in a 401(k) plan, but 43.9 percent of the cohort that attained age 30 in 2003 participated in a 401(k) plan. The table also shows the percent of those eligible who participated in 1984 and 2003. For each age, the participation rate given eligibility increased very substantially over this period. For example, in 1984, 45.6 percent of age-30 families who were eligible participated; this percent had increased to 71.3 percent by 2003. At age 45, participation given eligibility increased from 60.0 percent to 81.0 percent between 1984 and 2003.

Table 1. Family eligibility and participation rates by year attained selected ages

Eligibiliy / Participation	Age 30	45	60
Eligibiliy			
1984	11.8	19.5	13.6
2003	61.6	69.9	62.6
Paticipation			
1984	5.5	11.7	8.9
2003	43.9	56.6	50.5
Participation Rate / Eligibility Rate			
1984	46.6%	60.0%	65.4%
2003	71.3%	81.0%	80.7%

More detail on participation given eligibility is shown in Figure 3. The figure shows that given eligibility the participation rate increased for each age interval, especially for the younger age intervals. The figure shows that in 2003 the participation rate given eligibility was about the same (80 percent) for each of the age intervals from 40-44 to 60-64.

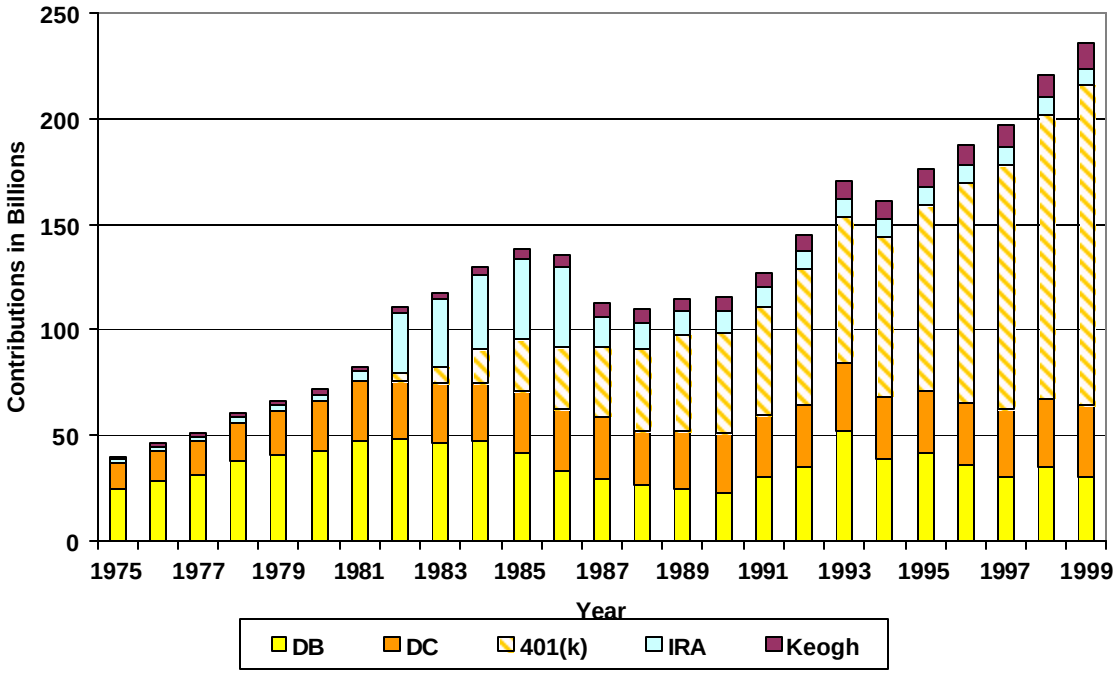
Figure 3. Participaton percent given eligibility by age, 1984 and 2003.



The rapid spread of 401(k) eligibility and participation has resulted in very rapid increase in aggregate contributions to 401(k) plans. Figure 4 shows contributions to 401(k) plans and, for comparison, to all other private pension plans from 1975 to 1999.[1] Contributions to 401(k) plans are shown by the lined bars. Contributions to 401(k) plans were first made in 1982. By 1999 total contributions to 401(k) plans had reached $152 billion and accounted for 65.5 percent of contributions to all private pension plans. The increase in total pension plan contributions between 1982 and 1999 was accounted for almost entirely by the increase in contributions to 401(k) plans.

[1] More recent Form 5500 data are not available.

Figure 4. Private Pension Contributions



Projecting Future 401(k) Contributions

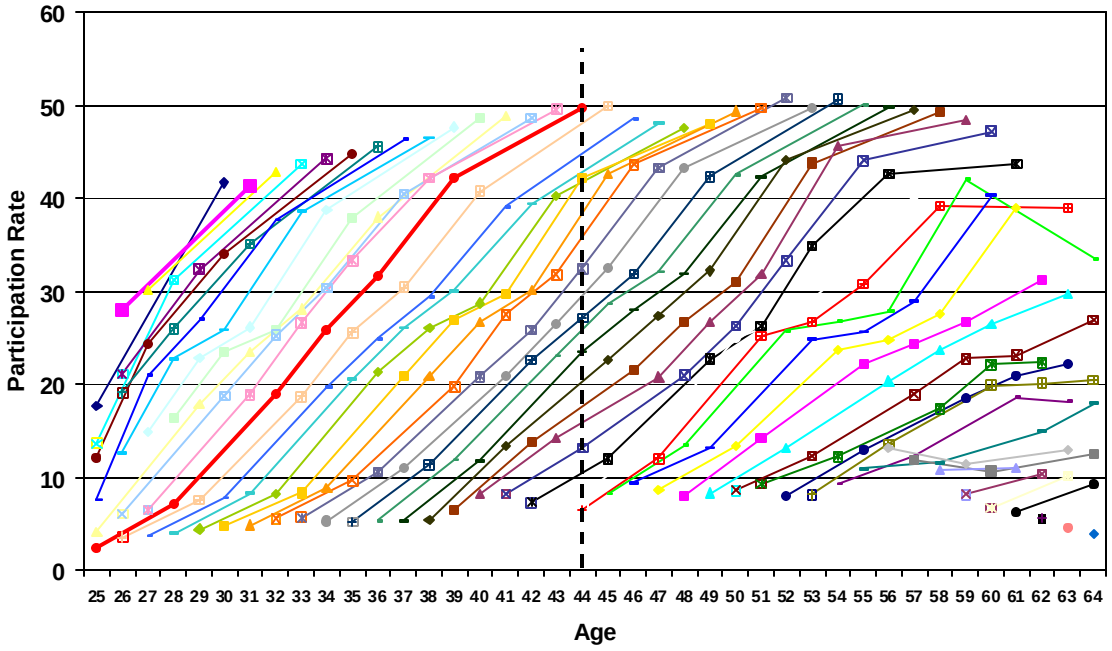
Participation rates: We begin with historical participation rates by cohort, like those shown in section 2 above. Here, however, we use individual data, instead of family data. The SIPP provides data for cohorts attaining age 65 in 1985 through 2040. The most recent data is for 2003 and the earliest data for 1984. Only a few of the cohorts (the bottom right of Figures 1 and 2 above) had attained age 65 by 2003. Thus for all but a few of the cohorts we must project participation rates from the cohort age in 2003 to age 65.

Neither for eligibility nor for participation given eligibility have we found a compelling way to formally project future rates. Thus we have simply made "plausible" assumptions about future participation rates and used these assumptions to project future cohort participation rates for the cohorts covered in the SIPP data described above.

It is clear that simple extrapolations of the data for each cohort are likely to yield implausibly large participation rates. The cohort participation data for persons are shown in Figure 5. Consider, for example, the participation rates at age 44 highlighted by the vertical dashed line. The C44 cohort attained age 44 in 1984 and had a participation rate

of 6.55 percent. The C25 cohort attained age 44 in 2003, 19 years later, and had a participation rate of 49.71 percent. On average, the participation rate at age 44 increased 2.27 percentage points with each successively younger cohort. Were this rate to continue, the participation rate of the C12 cohort at age 44 (attained in 2016) would be 79.24 percent (13 x 2.27). To us, this rate seems unlikely.

Figure 5. Person Participation Rate by Cohort



Estimation of cohort effects shows some compression in the cohort effects with successively younger cohorts. In addition, Figure 5 suggests that within cohorts, the increase in participation rates declined beginning with the 1998 to 2003 period (the last two data points for each cohort). Thus we want to recognize the apparent compression in the cohort effects and the apparent decline in the within cohort increase in participation. To do this, we make future projections for each cohort starting with the 2003 observed participation rate for the cohort. We assume that the increase in the participation rate between 1998 and 2003 declines in future years. Assuming that the future decline is 0.12 percent per year, the projected future participation rates for the C25 and the C12 cohort would be as shown in Figure 6, which also shows the actual participation rates for these cohorts in 2003 and earlier years. Based on these projections, the participation rate of the C12 cohort when it attains age 44 in 2016 would be 66.28 percent, compared to 49.71

percent for the C25 cohort, that attained age 44 in 2003. At age 64, the participation rate would be 62.6 percent for the C25 cohort and 74.4 percent for the C12 cohort.

Figure 6. Projected participation rates for cohorts C25 (R2024) and C12 (R2037)

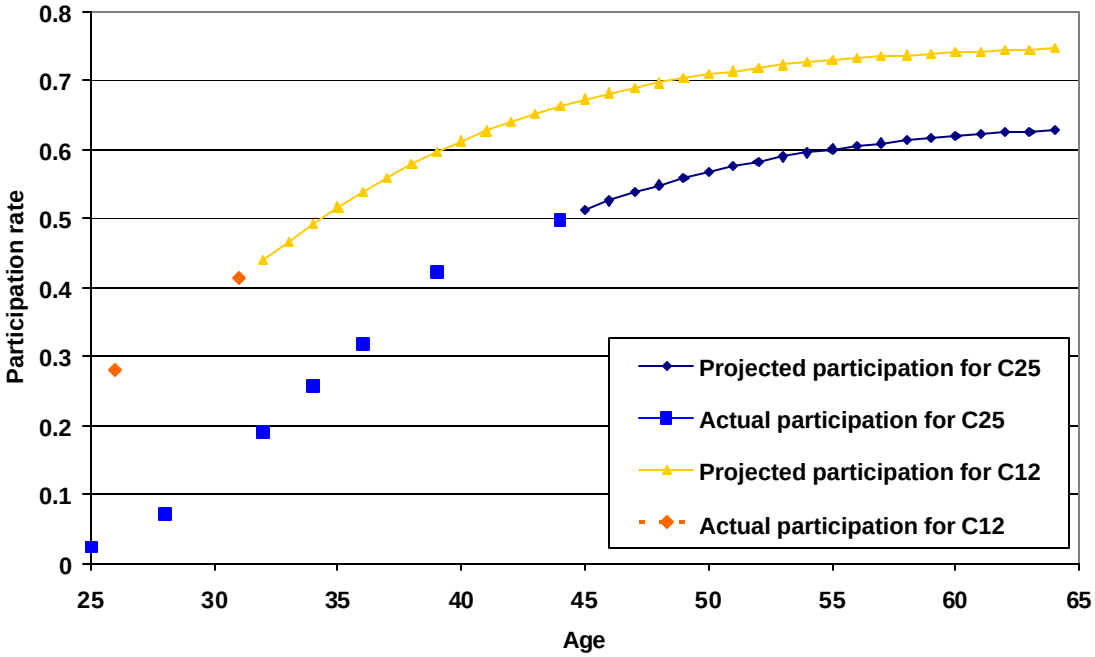


Figure 7. Interpolated (1982-2003) and projected (2004-2040) participation rates for selected cohorts

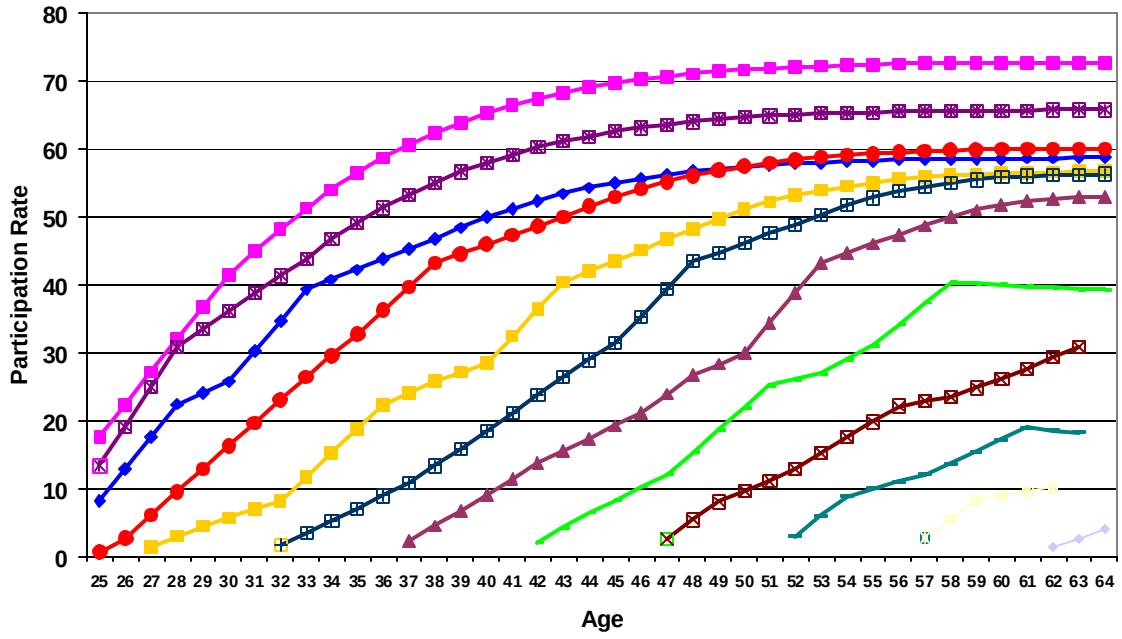


Figure 7 shows the projected participation rates of selected cohorts from C11 (R2038) to C64 (R1985). The figure also shows the estimated rates for each cohort between the years for which data are available. These estimates are obtained by interpolation between the actual observed rates.

Rate of Return: We assume (for the current results) that 60 percent of contributions are allocated to large-capitalization equities and 40 percent to corporate bonds. The projections reported below use the actual annual pre-tax returns through 2003. Beginning in 2004 we assume stocks return of 12 percent and bonds return of 6 percent per year.[2] These returns are the pretax returns available on a portfolio with no management fees, which we have not as yet accounted for. The average dollar weighted management fee on stock funds is currently about 70 basis points.

Job Separation and Cashouts: At age 25 each person is assigned to a 401(k) job based on the participation probability for that person's age and cohort. In subsequent years each person either remains in the 401(k) job or leaves the 401(k) job. The quit probabilities vary by age, but not by time in the job. The job separation rates are 6.0 percent per year for ages < 35, 4.5 percent for ages 35-45, 4.0 percent for ages 45-55, and 5.0 percent for 55+. After leaving a 401(k) job persons enter a pool of "non-participants." In each year members of this pool are selected for a new 401(k) job at a rate that makes the overall participation rate for persons of a particular age and cohort equal to the projected probability for that age and cohort.

We also allow for participants to cash out 401(k) balances at the time of a job change. The likelihood of a cashout is related to the 401(k) balance at the time of separation. For example, a small balance (less than $2,460 in 2000 dollars) is cashed out 60 percent of the time. A large balance (over $123,000 in 2000 dollars) is cashed out only about 3 percent of the time. Details of the job change and the cashout algorithms are described in Poterba, Venti, and Wise [2001].

Earnings: To estimate the 401(k) contributions of a cohort, we need to assign earnings to the members of the cohort and the assume contribution rate for cohort members. To estimate earnings we begin with the Social Security earnings histories of

[2] Ibbotson Associates (2004) 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 12.4 percent over the period 1926-2003.

the HRS respondents, available for the years 1961 through 1991. (These are earnings up to the Social Security earning limit.) Earnings for 1992 through 2000 are obtained directly from the HRS respondents. We begin with the earnings of the cohorts that attained age 65 in 1998, 1999, and 2000. We obtain earnings histories for all single persons that attained age 65 in these years and for all persons in two-person families in which the male head attained age 65 in these years. The earnings of the 1998 cohort are "aged" two years and the earnings of the 1999 cohort are age one year, based on the Social Security average wage index. We then treat these earnings histories as a "random" sample of the earnings of the cohort that attained age 65 in 2000 (the "R2000" cohort). The "R2000" cohort contains some female spouses that did not attain age 65 in 2000.

To project a "random" sample of the earnings of younger cohorts, we inflate the "R2000" sample using the "intermediate" earnings assumptions reported in the 2005 Annual report of the Board of Trustees of the Social Security Administration. Similarly, to project a sample of earnings for older cohorts we deflate the earning of the "R2000" cohort, based on the Social Security average wage index. (This method does not account for any change in the relative earnings of high and low-wage persons.)

Because we use a sample of actual earnings histories, including years with zero earnings, we account for years of non-employment. The assumption is that the employment rate and the distribution of employment by age do not change for future cohorts.

Contribution Rate: We assume a contribution rate of 9 percent of earnings, including both the employee and the employer contributions. There are several sources of information on contribution rates. Data from the 1998 SIPP are shown in Table 2. The median of the total of the employee and the employer rates is 9 percent. The mean, may be substantially affected by reporting errors, is higher.

In Poterba, Venti, and Wise (1998), we estimated contribution rates based on the 1993 Current Population Survey (CPS). The average contribution rate of an individual employee was 7.1 percent and the average employer rate was 3.1 percent. The earnings-weighted family rates--averaged over rates for both members of a two-person family, for example—were 6 percent for employees and 2.7 percent for employers. The average

earnings-weighted total family contribution--counting both employee and employer contributions—was 8.7 percent.

Holden and VanDerHei (2001), based on an Employee Benefit Research Institute (EBRI)-Investment Company Institute (ICI) survey, report that in 1999 the average total contribution rate was 9.7 percent. The 1998 Form 5500 shows that about 32 percent of dollars are contributed by employers, which is rather consistent with the 1998 SIPP median percent and with the 1993 CPS values.

Table 2. Employee and employer 401(k) contribution rates as a percent of salary, for individuals, based on 1998 SIPP

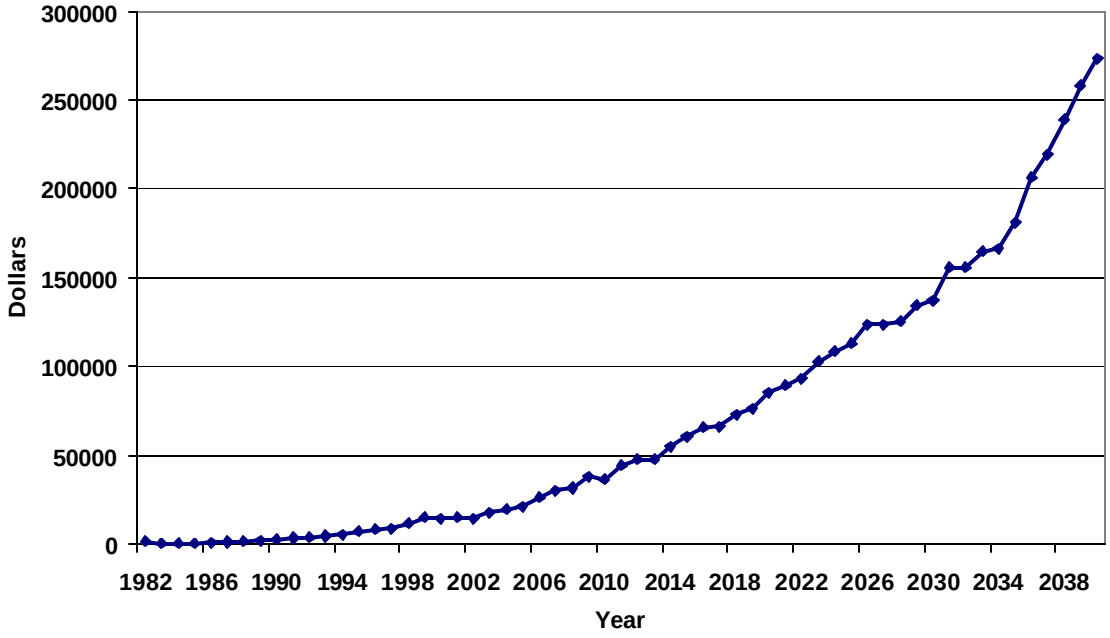
Age	Employee		Employer		Total	
	Mean	Median	Mean	Median	Mean	Median
25 - 29	17.8	5	14.5	3	32.3	8.8
30 - 34	7.2	5	4.3	2.8	11.5	8.6
35 - 39	7.2	5	4.6	3	11.8	8.9
40 - 44	6.8	5	5.3	3	12.1	8.3
45 - 49	8.2	5.5	4.6	3	12.8	9.3
50 - 54	8.9	6	4.5	2.2	13.4	9.1
55 - 59	9.3	6	5	3	14.4	10
60 - 64	9.2	6	4.7	3	13.9	10
All	8.9	5.1	5.8	3	14.7	9

Assets in 401(k) Plans by Cohort and Total Assets by Year

From demographic projections provided by the Office of the Actuary of the Social Security Administration we obtain the number of persons at each age, by family status, in each year. The demographic data, combined with the projected participations rates, earnings and contribution rates, and rates of return, can be used to project 401(k) assets at each age for each cohort. These data can be used to estimate the aggregate 401(k) assets at each year in the future, through 2040. These estimates are a key component of the aggregate level of retirement assets that may affect the rate of return on financial assets in the future. The data can also be used to describe other aspects of 401(k) saving, such as the average 401(k) assets at 65 for each cohort. We consider the 401(k) retirement assets of future cohorts first and then turn to the aggregate level of 401(k) assets by year.

401(k) Assets at Retirement: The average over persons of 401(k) assets at age 65 (in 2000 dollars) is shown in Figure 8, for cohorts R1982 to R2040. Contributions began in 1982 and the average was $14,445 in 2000. The projected average is $85,581 in 2020 and $273,418 in 2040. The increase is due to the increase in the participation rates among younger cohorts and to the increase in the number of years that 401(k) plans were available to successively younger cohorts. The 401(k) program effectively began in 1982 so cohorts retiring before 2020 could only make contributions over part of their working lives. Persons who attained age 65 in 2000, could contribute to a 401(k) plan for at most 18 years. For the cohort that will attain age 65 in 2040, 401(k) plans will have been available over the entire working lives of many employees.

Figure 8. Mean 401(k) assets at retirement, by cohort, for persons (in 2000 dollars)



Total 401(k) Assets by Year: The projections in the section above are based on the accumulation (and decumulation) of the 401(k) assets of persons in cohorts R1982 through R2040. To project aggregate assets by year through 2040, however, requires that the accumulation of assets of younger cohorts also be accounted for. For example, the aggregate level of 401(k) assets in the year 2040 is the sum of the assets of cohorts R1982 through R2040 plus the assets of cohorts R2041 through R2080. The R2080 cohort will be age 25 and just starting to contribute to 401(k) plans in the year 2040.

Thus we must assume a 401(k) participation rate for the younger cohorts. For the results below we assume that the participation rate of the R2041 to R2080 cohorts is the same as the R2040 cohort.

Figure 9. Total 401(k) stock assets in each year (in millions of year 2000 dollars)

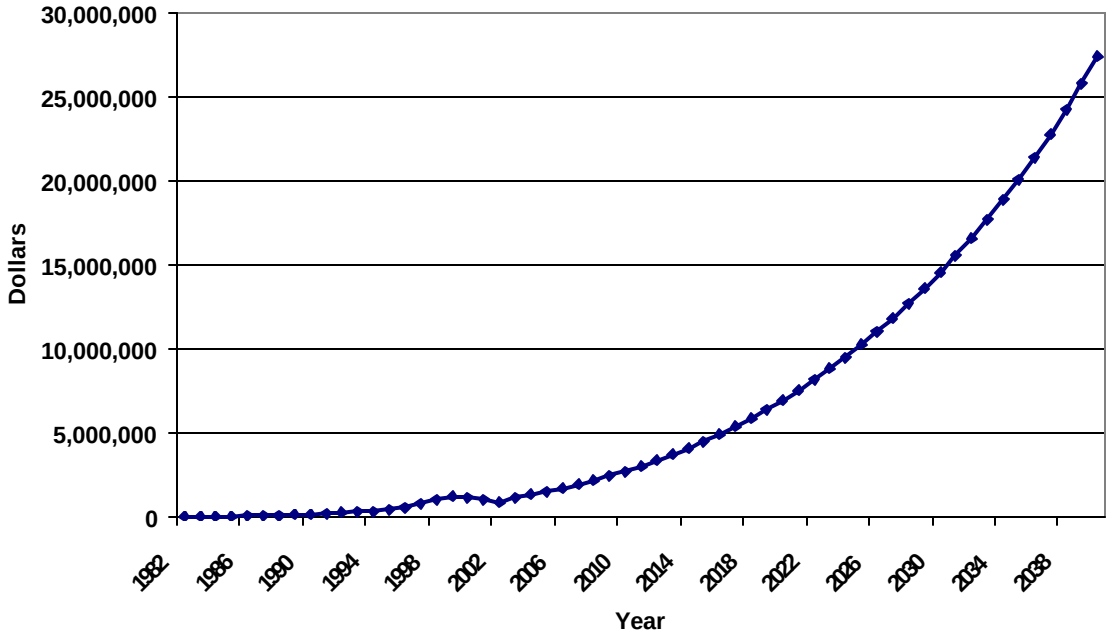


Figure 10. Stock contributions and withdrawals (in millions of 2000 dollars)

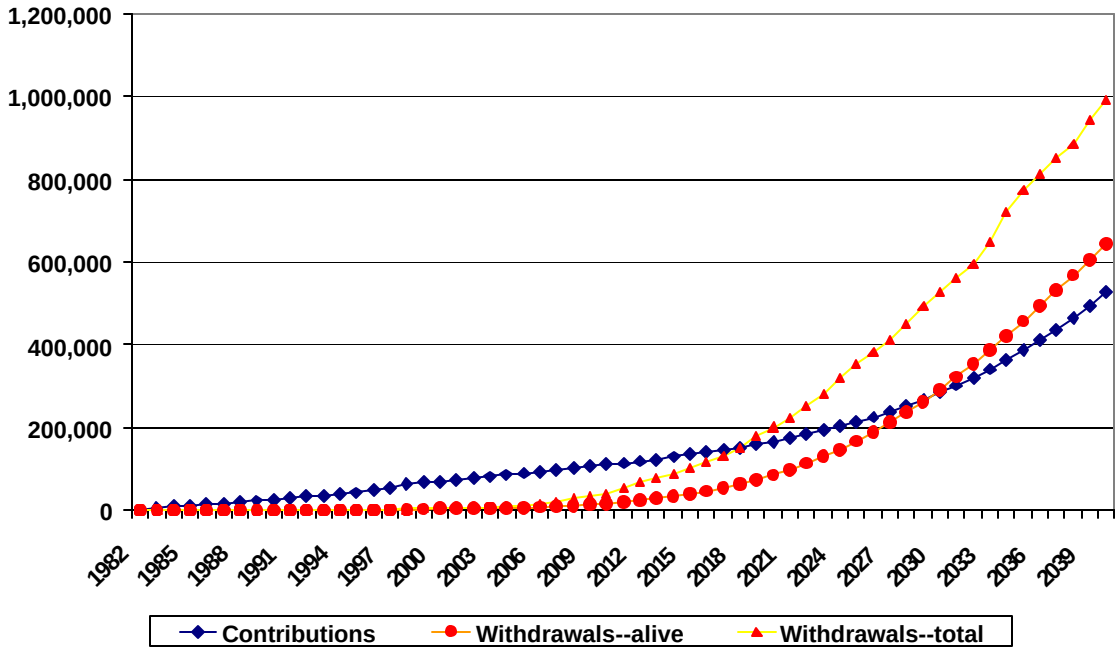


Figure 9 shows preliminary projected total 401(k) assets in stocks for the years 1982 to 2004. Figure 10 shows preliminary contributions and withdrawals of stocks in 401(k) accounts over the same time period. Total equity assets grew from about $1.1 trillion in 2000 to about $27 trillion in 2040. Contributions exceed withdrawals of living participants until about 2029. (If balances at death art treated as "withdrawals," contributions exceed withdrawals until about 2018.)

Whether effect of changes in the net contributions to 401(k) plans on 401(k) assets is likely to have an appreciable effect on equity prices depend on the importance of such changes relative to the size of the total equity market. For example, the value of all corporate equities was about $18 trillion in 2000, when the value of 401(k) projected equities was about $1.1 trillion.

Conclusions, Comments, and Future Work

This report presents the initial results from the first stage of a project on the potential effect of demographic trends on market rates of return. We described the rapid rise of 401(k) plans between 1982 and 2003. We then projected the 401(k) assets of cohorts who will reach age 65 in future years, through 2040, and the assets of cohorts

who will reach age 65 in 2041 through 2080. From these cohort projections we projected the aggregate level of 401(k) assets for each year through 2040. To complete this paper we will project the level of DB plan assets over the same time period, and then the level of assets in other retirement plans such as IRA, Keogh, 401(b), etc. Then we will be in a position to evaluate the potential effects of demographic trends on rates of return in financial markets.

We also used the data to project the assets at age 65 of cohorts who reach age 65 in each year from 1982 to 2040. These estimates are of considerable interest independently of the effect of the changing level of retirement assets on financial market rates of return. We find that by 2040 the mean level of 401(k) assets of persons retiring in that year will be $273.418 (in 2000 dollars), compared to $14,445 in 2000.

We have not taken account of the recent (and currently-enacted prospective) changes in the contribution limits that will also affect flows into 401(k) accounts. In addition, unlike many traditional DB pension plans, personal retirement plans do not encourage early retirement. Thus employees are likely to work longer under these plans and to continue to make contributions to the plans for more years than would be the case with employer contributions to DB plans. This shift to longer working careers and a corresponding change in the length of the retirement period will likely affect the total amount of retirement asset accumulation.

Unlike the retirement annuities provided under DB plans, retirees with accumulations in personal accounts have substantial flexibility in how they choose to de-cumulate their assets. Very few retirees buy annuities with assets accumulated in personal accounts. Thus there is no scheduled withdrawal of funds from personal accounts. Current law requires retirees to begin making minimum distributions from traditional 401(k) plans at age 70½. Despite the multitude of decumulation options, there has been little empirical analysis of when retirees will actually begin withdrawals and the amount of withdrawals. We will give more attention to this issue.

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