Defined Contribution Plans and the Distribution of Pension Wealth

William Even
Department of Economics
Miami University
Oxford, OH 45056
513-529-2865
E-mail: evenwe@muohio.edu

David Macpherson
Department of Economics
Florida State University
Tallahassee, FL 32306
850-644-3586
E-mail: dmacpher@mailer.fsu.edu

Abstract

Over the past 20 years, the defined benefit plan has been replaced by the defined contribution plan as the most popular form of pension plan. This study examines the likely consequences of this transformation for both the level and distribution of future pension wealth using a sample of defined benefit (DB) and defined contribution plans (DC) from the Survey of Consumer Finances. The results reveal that the shift from DB to DC plans is likely to simultaneously increase the level and inequality of pension wealth at retirement. The evidence also suggests that the shift to DC plans may result in less pension wealth at retirement for low income workers, women, and minorities.

We thank Leslie Papke, Pat Purcell, John Turner, participants at the Center for Pension and Retirement Research conference, and the referees for helpful comments.

1. Introduction.

In the 1970s, nearly three-fourths of workers with pension coverage had a defined benefit (DB) plan. At retirement, the DB plan provides workers with a life-annuity that depends upon their earnings and years of employment with the firm sponsoring the plan. By 2001, 77 percent of pension covered workers had defined contribution (DC) plans.[1] DC plans provide workers with an account balance at retirement, the size of which is determined by employer and employee contributions and the returns earned on those contributions.

Simultaneous to the shift from DB to DC plans, there has been a change in the type of DC plan offered. During the early 1980s, the IRS issued clarifying rules for a special type of DC plan -- the 401(k). Because the 401(k) has several advantages relative to the traditional DC plan, it has become the most popular type of DC plan.

Despite the wide range of research examining the causes and effects of the transformation of the pension system, there are only a few studies that provide evidence on how the switch to DC plans will affect pension wealth at retirement. The most recent and arguably most complete study of how the shift to DC plans will affect retirement income is Samwick and Skinner (2004). Their study uses simulation methods applied to pension plans drawn from various years of the Survey of Consumer Finances and concludes that, under most reasonable scenarios, the shift from DB to DC plans will lead to an improvement in the level of pension wealth at retirement.

Using the same data source and similar simulation methods, our study extends their analysis to examine two other important questions. First, will the shift to DC plans have differential effects on various subgroups of the population? Second, among DC plans, how does the shift among DC plans to the 401(k) option affect the level and distribution of pension wealth at retirement?

A preview of the answers is as follows. First, the shift to DC plans will increase the average and median level of pension wealth at retirement under a fairly wide range of rate of return assumptions, retirement ages, and career lengths. However, in some subgroups of the population, average pension wealth is likely to fall. Second, the shift among DC plans to 401(k) plans has given individuals greater control over their pension saving and may enlarge the gap between the pension wealth of high and low income workers.

2. The Shift to DC and 401(k) Plans.

The shift away from DB and toward DC pension plans is well documented. Among pension covered workers, the percentage with only a DB plan fell nearly in half from 44.5 percent in 1989 to 22.8 percent in 2001. The trend in DC plan enrollment provides a sharp contrast as the percentage of pension covered workers with only a DC plan nearly doubled from 31.6 percent 60.9 percent over the same period. While a small percentage of workers have dual coverage by both a DB and DC plan, this has become increasingly rare. Among pension covered workers, the percentage with dual coverage fell from 23.9 to 16.4 percent between 1989 and 2001.[2] Clearly, DC plans are becoming the predominant form of pension in the U.S.

With passage of Section 401(k) of the Revenue Act of 1978, cash or deferred arrangements (CODAs) were established. In a traditional DC plan, which does not take advantage of the 401(k) plan feature, employer contributions are in pre-tax dollars whereas employee contributions are in after-tax dollars. In contrast, with a 401(k) plan, the worker chooses between receiving compensation as cash or as a deferred payment. Deferred payments are tax free until withdrawn from the 401(k). The emergence of the 401(k) plan made it possible for employees to make voluntary contributions that would be in the form of pre-tax instead of post-tax dollars.

The fact that the 401(k) plan simultaneously allows employees to make pre-tax contributions and gives them control over contribution levels has made it a very popular type of pension. In 1989, 23.5 percent of pension covered workers were enrolled in a 401(k) plan. By 2001, this figure had more than doubled to 63.2 percent. . The growing popularity of the 401(k) is also reflected by the fact that 401(k) assets grew from $91.7 billion to $1,772 billion between 1984 and 1999.

Some of the explanations for the shift from DB to DC plans include rising administrative costs in DB plans; employment shifts across industries and from large to small firms; a decline in unionism; and the introduction of the 401(k) plan as a preferred alternative to earlier pensions.[3] Some researchers have argued that the shift to DC plans is partly the result of a desire to make pensions more portable and attempts by employers to encourage later retirement.

The shift from DB to DC plans could lead to important changes in the level and distribution of future retirement income. DB plans promise a retirement benefit as an annuity that is specified according to a formula that usually involves a person's years of service at retirement and final average salary. Since the employer is obligated to assure that pension contributions plus earnings on assets cover the promised benefits, the employer bears the majority of the rate of return risk on pension investments.[4]

In DC plans, the employer and/or employee make contributions to an account and the employee is entitled to contributions plus any earnings on the assets. The rate of return risk in DC plans is absorbed entirely by the employee. DC plans are, however, generally viewed as more portable in the sense that workers who switch jobs frequently will typically accumulate more pension wealth if covered by DC plans when they switch employers. The benefit formula in DB plans penalizes workers who switch employers frequently.[5]

These fundamental distinctions between DB and DC plans reveal several possible ways that the change in plan types could affect future retirement income security. First, the shift to DC plans exposes employees to rate of return risk that they were insulated from in DB plans, but reduces exposure to uncertainty about earnings at the end of their career. Second, the shift to DC plans can either increase or decrease benefit levels depending upon the percentage of pay that is contributed as compared to the replacement rates promised by DB plans.

The growth of the 401(k) as the most popular type of DC plan raises several additional issues. As noted above, a distinguishing feature of 401(k) plans is that employees have greater control over the percentage of pay contributed. Numerous studies examine the determinants of 401(k) participation and contribution levels.[6] The evidence suggests that contribution rates are generally lower for workers that are younger, less educated, or have lower earnings. Hence, the shift to 401(k) plans may change the distribution of pension saving across workers.

A few studies provide insights into how the growth of DC plans might affect the level of pension wealth at retirement. Using data from the 1992 Health and Retirement Study, Blank (1999) estimates the effect of membership in a DB or DC plan on total wealth at retirement which is defined to include the expected discounted value of Social Security, pension and non-pension wealth at retirement age. Her results imply that workers with DB plans have greater total retirement wealth relative to workers with a DC plan invested primarily in stock, but less total retirement wealth than a worker with a DC plan invested in a mix of stocks and bonds. Since Blank's study does not control for the length of pension coverage, the estimate of greater total wealth accumulation under a DB plan may merely reflect the fact that the years of pension coverage are probably greater under DB than DC plans given that many DC plans were started only recently.

Wolff (2002) studies trends in retirement wealth using data from the Survey of Consumer Finances (SCF) between 1983 and 1998. His results reveal dramatic growth in average household holdings of DC wealth and a pronounced decline in DB wealth. The growth of DC wealth more than compensated for the decline in DB wealth and average pension wealth grew by 47% in real terms between 1989 and 1998. Wolff points out, however, that mean pension wealth fell for workers with 12 or less years of education, but rose for workers with college degrees. His study also points out that the unusually strong stock market performance of the 1990s may lead to an overstatement of the long term benefits of the switch to DC plans.

Poterba, Venti, and Wise. (2001) provide comparisons of savings per participant in DB and DC plans. In aggregate data, contributions per participant for 401(k) plans were, on average, twice as large as contributions per participant in DB plans. While on the surface this might suggest that 401(k) plans will lead to twice as much wealth, the authors note that contributions per participant in DB plans may have been below their long run average due to a combination of high stock market returns over that period and limits on overfunding of DB plans. Consequently, a comparison of pension savings rates in the two plans over a short period of time may provide a misleading answer to the eventual effect on pension wealth at retirement.

Samwick and Skinner (2004) combine information on pension plan features and worker characteristics from the SCF to simulate the accumulation of pension wealth under DB and DC plans. Their sample of DB plans is drawn from several years of the SCF . The sample of DC plans and employee contribution behavior is drawn from the 1995 SCF. The study concludes that, in most cases, workers will accumulate more pension wealth with DC than DB plans. The result is shown to be robust to a variety of assumptions regarding the duration of pension coverage, the rate of return on pension saving, and earnings growth.

Munnell and Sunden (2004) provide a thorough analysis of pension saving in DC plans. While they do not specifically compare the generosity of DB and DC plans, several important concerns with the shift to DC plans (and particularly the 401(k) plan) are discussed. For example, the growth of the 401(k) raises concerns with the ability of workers to decide whether or how much to contribute, how to invest contributions, whether to spend a lump sum distribution at a change of employers, and whether to annuitize at retirement.

3. A Model for Comparing DB and DC Benefits.

One of the difficulties in comparing DB and DC plans is that the key parameters that define the plan are framed in different terms. A DB plan promises a lifetime benefit at retirement, whereas a DC plan promises a series of contributions to provide an account balance at retirement. In DB plans, the most common formula for determining retirement benefits can be described as:

$$\text{Annual Benefit} = S * FAS * \lambda$$

where S is years of service, FAS is some measure of final average salary, and λ is the "generosity rate". The method for determining FAS varies across plans, but typically relies on the last few years of service. The Employee Benefits Research Institute (1997) reports that in 1995, 69 percent of DB pensions used an earnings formula similar to that described above.[7] Of those with a fixed percentage per year of service, the median generosity was between 1.50 and 1.74 percent per year.

In defined contribution plans, the employee is promised rights to an account balance. Over the employee's career, some percentage of compensation is contributed to the pension fund, the assets earn a rate of return, and at retirement the worker may draw down the account or purchase an annuity.

Comparing the two types of pensions requires assumptions on several parameters. To demonstrate the sensitivity of the comparisons to key parameters, consider the following definition of variables relevant to the two plan types:

W_0 = annual salary at start of career.

g = annual rate of growth in salary.

r = nominal interest rate.

T = number of years of service at retirement.

λ = percent of final salary replaced per year of service in DB plan.

c = percent of salary contributed to defined contribution plan annually.

$\alpha(r_a,R)$ = annuity factor representing the size of a life annuity that can be purchased with $1 at retirement assuming interest rate r_a and retirement age R.

Assuming that a person contributes the fraction c of salary into a DC plan for the T years with her employer and earns the rate of return r on pension assets, she will be able to purchase a lifetime annuity at retirement given by:

(1) DC-ANNUITY = $\alpha(r_a, R)\int_0^T cW_0 e^{gt} e^{r(T-t)} dt$

For a person in a DB that replaces the fraction λ of the final salary per year of service, the annual benefit at retirement can be written as:

(2) DB-ANNUITY = $W_0 e^{gT} T\lambda$

To provide a comparison of the DB and DC plan, we solve for the "DC-equivalent contribution rate" necessary to fund a given DB benefit by equating (1) and (2) and solving for the contribution rate. The result is:

$$
\begin{aligned}
c^* &= \lambda / \alpha(r_a, R) \qquad \textit{if } \; g = r \\
&= \frac{T\lambda(g-r)e^{(g-r)T}}{a[e^{(g-r)T} - 1]} \quad \textit{if } \; g \neq r
\end{aligned} \tag{3}
$$

As seen from (3), if the wage growth rate and nominal interest rate are equal, the DC-equivalent contribution rate is simply the ratio of the generosity rate to the annuity rate.

The DC-equivalent contribution rate is quite sensitive to parameter assumptions. To illustrate, consider a DB plan with a 1.5% generosity rate. Table 1 presents the DC-equivalent contribution rate under alternative assumptions. In all three panels of the table, the worker is assumed to begin participation in the plan at age 35.

In the first panel, retirement is assumed at age 65 and the worker receives a life-annuity equal to 45 percent of her final salary from the DB plan. Assuming that the DB benefits are indexed, that the wage growth rate and nominal interest rate are 6 percent, and that the inflation rate is 3 percent, the worker would have to contribute 21.7 percent of salary to a DC plan to generate an equivalent lifetime annuity. Holding other things constant, if the wage growth rate is cut to 3 percent, the equivalent DC contribution rate is reduced to 13.4 percent. If the wage growth rate is cut to 3 percent but the nominal rate of return on pension assets is increased to 10 percent, the DC-equivalent contribution rate is only 4.6 percent. If the DB benefits are not indexed, the contribution rate is reduced to 3.8 percent.[8]

In the second and third panels of table 1, identical calculations are made for retirements at age 55 and 60. Higher interest rates, lower wage growth rates, or non-indexed benefits all reduce the DC-equivalent contribution rate. An earlier retirement increases the DC-equivalent contribution rate for the range of parameter values considered.[9]

While this model of DB and DC plans is highly stylized, it illustrates the sensitivity of the comparisons to modest variations in parameter assumptions. Realistic comparisons are further complicated by the fact that contribution rates may vary over time, annuity rates from DC plans may be less than actuarially fair due to adverse selection problems, and DB benefits may be indexed or tied to some measure other than final earnings. To determine how DB and DC plans compare in reality, attention must be paid to the sensitivity of the results to reasonable variations in the underlying assumptions.

4. Simulations Using Survey of Consumer Finances Data.

To compare the generosity of DB and DC plans, we use data from the SCF. To estimate the pension wealth that would be accumulated in both DB and DC plans, we create a sample containing all employed people in the 1989 SCF covered by a pension plan. We generate estimates of wealth in both DB and DC plans for the same group of pension-covered workers so that wealth differences are due to differences in the plans only -- not differences in who is covered by the plans. The end result is a sample of 6,606 observations on pension covered workers.

There are several steps involved in simulating pension wealth for pension covered workers. First, to create a sample that mimics the U.S. population of pension covered workers, each observation in the pension covered sample is replicated by the population sampling weight times .00015.[10] This expands the sample of pension covered workers from 6,606 to a "simulation sample" of 29,487 people.

The second step in the simulation is to create an age-earnings profile for each pension covered worker in the sample. Using data on the 6,606 pension covered workers in the 1989 SCF, a log-earnings equation is estimated as a function of the person's age, education, gender, race, ethnicity, marital status, union coverage and firm size.[11] The estimated regression is used to generate an age-earnings profile for each observation in the simulation sample. To estimate an age-earnings profile over a worker's career, the age-earnings combination observed in the sample is used as the starting point. The coefficients on the age variables are used to generate earnings before and after the observed age after adding real wage growth of 1 percent beyond what is estimated in the cross-section.[12]

The third step in the analysis is to generate an estimate of DB and DC pension wealth for each pension covered worker based upon his/her characteristics and age-earnings profiles. For DC plans, this is accomplished by estimating a regression equation of contribution behavior for workers from the 1989 SCF. For each worker covered by a DC plan, the percentage of annual earnings contributed to the plan by the employer and employee together is estimated. A censored regression model of the contribution rate is estimated as a function of the person's earnings, age, education, gender, race, ethnicity, marital status, union coverage and firm size. The model adjusts for the fact that the contribution rate cannot be less than zero nor exceed the IRS statutory limit equal to the lesser of $30,000 or 25 percent of salary.[13]

In the case of 401(k) plans, a complication arises because the SCF collects data on 401(k) plans only for workers who say they participate in the plan. Consequently, the SCF does not identify those who are eligible for a 401(k) plan but choose not to participate. To correct for this, we create an artificial sample of workers in the SCF who are predicted to be eligible for a 401(k) plan but choose not to participate. To create the sample of non-participants, the April 1993 Current Population Survey (CPS) is used to create a sample of full-time workers aged 25 to 65 who are not included in a pension plan. For this group of workers, a probit model is used to estimate the probability that a worker is not included in a pension plan but is eligible for a 401(k) plan. The model includes controls for age, race, Hispanic status, marital status, wage income, union coverage, region, education, gender, firm size and industry. Using the probit estimates from the CPS sample, we impute a probability a worker is eligible but not participating in a 401(k) for each person that is not included in a pension plan in the SCF. We then choose a sample of nonparticipants to force the participation rate in the SCF to match that in the CPS (67%) by picking workers without pension coverage who have the highest estimated probabilities of being offered a 401(k) plan.

To simulate contribution behavior in DC plans, the age-earnings profile and vector of characteristics for each pension-covered worker is substituted into the estimated contribution equation. Random noise reflecting the estimated distribution of the error term in the contribution equation is added to the predicted contribution rate and allowed in the contribution error.[14] As with estimation of the contribution equation, the simulations constrain contributions to be non-negative and below the IRS maximum contribution rate. The analysis separates DC plans into 401(k) and traditional [i.e. non-401(k)] DC plans by estimating separate contribution equations for each type of plan.

To estimate pension wealth for DC plans, the contributions to the plan are compounded until an assumed date of retirement. Rate of return assumptions are a critical ingredient to the forecasts. To test for sensitivity of the results to rate of return assumptions, we consider three possibilities: (1) a 3 percent real return; (2) historical returns on a typical portfolio; and (3) a 6.5% real return. The 3 percent real return reflects historical returns on government bonds. The typical pension portfolio is based on estimates of the typical mix between stocks and bonds by VanDerhei et al. (1999) and includes 75 percent stocks split equally between large- and small-cap equities; and 25 percent split equally between long term corporate bonds, long term government bonds, mid term government bonds, and treasury bills. The real returns on assets in the portfolio are drawn from Ibbotson and Associates (1999) for the years 1926 through 1998. Real returns on the typical portfolio are estimated by randomly drawing (with replacement) from the historical return data for each year of contributions. It is assumed that the worker continually rebalances the portfolio so that the mix of assets is constant across time. Separate draws are performed for each observation so that the variance in simulated returns across workers reflects potential time-series variation in returns.

The 6.5 percent real rate of return is based on the average real rate of return on defined contribution plans between 1985 and 1994 for plans with over 100 participants in the Form 5500 data.[15] It also approximates the 6.5 percent average real rate of return on the typical pension portfolio. A comparison of the distribution of pension wealth with historical returns on the typical pension portfolio and a 6.5 percent fixed rate of return provides an indication of the impact of the time series variation in returns on the distribution of pension wealth.

To estimate pension wealth from DB plans, information is drawn from the 1989 Survey of Pension Providers (SPP) that was conducted in conjunction with the 1989 SCF. Each DB pension plan in the SPP is matched to the workers covered by that plan in the 1989 SCF. As in Samwick and Skinner (2004), plans that generate zero benefits because they have been phased out are dropped from the sample. If a DB plan is matched to a worker with both a DB and DC plan, that match is dropped to avoid inclusion of supplemental plans in the sample. This reduces the sample of DB plans from 267 to 215.[16] Since less than one-fifth of pension covered workers have dual coverage and dual coverage has diminished over time, we do not see this as an important exclusion. Nevertheless, we check the robustness of our results to this exclusion in some of our simulations.

For the simulations, each pension covered worker (independent of his or her actual type of pension coverage) is assigned a DB plan. To accomplish this, each DB plan that matches with one or more workers in the SCF is assigned a cell based upon the characteristics of the workers.[17] The cells are defined by the workers' industry (7 categories), race (4 categories), firm size (4 categories), gender, and union status. Each pension covered worker in the 1989 SCF is then randomly assigned a DB plan from a cell matching his or her characteristics. The probability that a particular plan is drawn from a given cell is proportional to the weights of the workers covered by that plan.[18] If there are no plans matching the characteristics of a particular individual, we sequentially collapse cells by industry, race, and firm size until a match is created.[19]

After matching all pension-covered workers (regardless of actual coverage type) from the 1989 SCF to a DB plan, we use the same earnings history employed in the simulation sample to generate a DB benefit using a pension benefit calculator developed by Richard Curtin for the Survey Research Center.[20] Inflation reduces pension wealth in DB plans that do not index benefits after retirement.[21] Our DB simulations assume 3% inflation. The pension calculator incorporates sex-specific annuity tables to convert DB benefits into an actuarially equivalent lump sum assuming a 3% real interest rate.[22] All workers are assumed to elect a single-life annuity as the payout option. This assumption eliminates any preferential treatment given to married workers through the subsidization of joint annuities. Because women have a longer life-expectancy than men, their annuity rates are lower -- .0658 versus .0754 for a real single-life annuity commencing at age 65.[23] This implies that a $1 real single-life annuity commencing at age 65 converts into $15.30 of pension wealth for women, but only $13.26 for men.[24]

Since DB plans are required by law to use a sex-neutral benefit formula, holding earnings histories constant, men and women would receive the same annuity from a given DB plan, but the estimate of women's pension wealth at age 65 would be approximately 15% higher. A shift to DC plans will eliminate this advantage since most DC participants are not given the option of directly converting their balance into a life-annuity. To receive an annuity, most DC participants must withdraw their account balance and purchase an annuity in the private market, where men and women are charged different rates.[25]

Before turning to the simulation results, it is important to discuss some of the shortcomings of our simulations. First, as in Samwick and Skinner (2004), our simulations assume that a shift from DB to DC plans has no effect on employee salaries. If, however, a shift from DB to DC plan results in (for the sake of example) a reduction in the employer contributions to the plan, one might expect that the employer would have to offset this by increasing the employee's salary in order to attract and retain the same workers. However, as noted by Samwick and Skinner, employees may place a higher (or lower) value on a dollar contributed to a DC than a DB plan.[26] As a result, it is possible that employer contributions to the pension could decline with a shift from a DB to DC plan and yet the firm could still attract and retain workers without increasing employee salaries. Nevertheless, if the shift from DB to DC plans results in, for example, a reduction in employer contributions to pensions and this is accompanied by an increase in employee salaries, our simulations would understate DC benefits by whatever percentage earnings are understated. One might try to estimate the potential size of such an effect by adjusting salaries in the DC simulations to reflect any difference in the employer contribution rate to the DB and DC plans. The difficulty with such an approach, however, is that there is no explicit long term employer contribution rate to DB plans. The employer controls the contribution rate from year to year, and over the long term the contribution rate will vary depending upon a host of factors including rate of return experience, employee turnover, and the longevity of retirees.[27]

It is also important to emphasize that the simulations are designed only to evaluate the effect of the shift to DC plans on pension wealth at retirement. The simulations do not support inferences about the effect of the shift to DC plans on pre-retirement consumption or lifetime well-being. In fact, it is possible that a shift to DC plans could improve (for example) pension wealth at retirement, but make workers worse off if workers are borrowing constrained and forced to reduce pre-retirement consumption which may have a higher relative value. Also, while the simulations provide insight into how the shift to DC plans will affect pension wealth at retirement, workers could offset any such effects on total retirement wealth by adjustments in non-pension saving. The issue of pension offsets in saving behavior has received a good deal of attention and there is mixed empirical evidence on the extent of the offset.[28] The relevance of observed differences in offsetting behavior across income levels will be reviewed below.

5. Simulation Results.

Table 2 presents a summary of the worker and pension characteristics from our simulation sample. The average worker has average annual real wage growth of 1.8% per year between ages 36 and 65. The average annual earnings (in 1995 dollars) grow from $41,096 at age 36 to $70,538 at age 65. Median earnings grow from $33,692 to $57,830 over the same age span.

In traditional DC plans, the median contribution rate (representing the sum of employer and employee contributions) rises gradually from 9.3% at age 36 to 12.8% at age 65. In 401(k) plans, the median contribution rate rises from 3.4% at age 36 to 15.3% at age 65. The differences in contribution rates between traditional DC and 401(k) plans underscores the potential importance of the shift among DC plans to 401(k) plans.

The median percentage of final pay replaced by DB plans at age 65 is 27.1%, implying a generosity rate of .90% per year of service. This is lower than the median generosity rate of 1.5% reported by the U.S. Department of Labor (DOL) (1999) for medium and large establishments. The lower generosity rate observed here could be explained by several factors.

First, the DOL estimate is for DB plans at medium and large establishments. Our sample also includes plans at small establishments. Previous research indicates that the generosity rises with employer size.[29] Second, the DOL estimate includes only those plans with benefits based upon a fixed percentage of terminal earnings per year of service. This sample includes DB plans with a variety of different types of benefit formula (e.g., a fixed dollar amount per year of service, or a varying percentage depending on years of service).

Table 3 provides a summary of predicted pension wealth accumulation under DB and DC plans. The DC results are presented for all DC plans along with a separate analysis of 401(k) and traditional DC plans.[30] For each plan type, the distribution of pension wealth is described with several statistics. In addition to the mean, several percentiles of the distribution are provided. Also, as gauges of wealth inequality, the coefficient of variation, Gini coefficient, and the ratio of the 90th to 10th percentile of the pension wealth distribution are presented. For

DC plans, results are presented for the three different rate of return assumptions described earlier.

Not surprisingly, rate of return assumptions have a dramatic effect on the comparison of wealth accumulation under DB and DC plans. Using the most conservative assumption of a 3.0% real rate of return on DC plan assets, the distribution of pension wealth under DB and DC plans is remarkably similar. The mean wealth estimated for DB plans is $276,000 and that for DC plans is $272,000. The differences in pension wealth at the various points of the wealth distribution are modest. The three measures of inequality are very similar for the DC and DB plans. Consequently, with a very conservative assumption of a 3.0 percent real rate of return on DC pension assets, DC and DB plans generate a very similar distribution of pension wealth.

Increasing the real rate of return assumption to 6.5 percent, average pension wealth for DC plans rises to 1.6 times that of DB plans. All three measures of pension inequality rise slightly as well. Adjusting the rate of return assumption to reflect historical returns on a balanced portfolio of stocks and bonds (as described earlier) generates average pension wealth very similar to that found with a fixed 6.5 percent real rate of return. Introducing time-series risk on rates of return, however, substantially increases the inequality in the distribution of pension wealth. All three measures of pension inequality rise substantially and while DC wealth is predicted to be 1.7 times higher than DB wealth on average, the ratio varies substantially across the pension wealth distribution. For example, DC wealth is predicted to be 1.9 times DB wealth at the 90th percentile, 1.2 at the median, and only 1.0 times DB wealth at the 10th percentile. This suggests that investment of DC assets in a typical mix of stocks and bonds could lead to a substantially higher level of average pension wealth, but much higher inequality in the distribution of pension wealth across successive cohorts of retirees.

Workers generally have greater control over their contribution levels in 401(k) than traditional DC plans which could lead to a different distribution of pension wealth than would emerge when the employer establishes contribution rates for all employees. To test this possibility, separate simulations were performed by splitting workers covered by only DC plans into those covered by only a 401(k) or only a traditional DC and estimating distinct age-contribution profiles for each plan type. The results of these simulations are presented near the bottom of table 3. For each of the three rate of return assumptions, average pension wealth for 401(k) plans is below that for traditional DC plans. Also, all three measures of inequality are higher for 401(k) than traditional DC plans.

To assure that the simulation results are robust, we investigated two variations of our simulation approach. First, we examined the consequences of expanding the choice of DB plans to include those held by workers with both DB and DC coverage. This expanded our sample of DB plans from 215 to 267. With this larger set of DB plans, results change only slightly. Average pension wealth rises by 1.1 percentage points, the median rises by 0.5 percentage points, and the distribution of pension wealth changes only slightly.[31]

A second variation we considered simulating the effect of a shift to DC plans for workers with only DB coverage, thus avoiding assignment of DB plans to workers on the basis of their industry, firm size, etc. These simulations reveal that workers with DB coverage have lower average incomes and lower projected pension wealth than the overall population of pension covered workers. Nevertheless, the effect of a shift from DB to DC plans on pension wealth is very similar in percentage terms.[32]

Given that DB and DC plans lead to different pension accrual patterns over the life-cycle, it is possible that the conclusions drawn above could differ depending upon when a worker chooses to retire. To determine whether the results are robust to retirement age assumptions, the simulations using historical returns on a balanced portfolio are repeated for retirements at age 55, 60 and 65 and compared to the predicted pension wealth from DB plans. Regardless of retirement age, the pension wealth is evaluated with compounding to age 65.

Table 4 presents the pension wealth estimates by retirement age. Two earlier conclusions are robust to retirement age assumptions. First, mean pension wealth is highest for traditional DC plans and lowest for DB plans. Second, the inequality in pension wealth is lowest with DB plans and highest with 401(k) plans.

For all three pension types, the accrual of pension wealth rises sharply as a worker approaches age 65. For each plan type, over one-half of the wealth accumulated between age 36 and 65 occurs in the last 10 years of the career. The fact that the rate of growth in pension wealth is similar in DB and DC plans may be surprising given that DB plans are thought to backload the accrual of pension wealth more than DC plans. This comparison, however, typically assumes that DC contribution rates are age-invariant, whereas our evidence suggests that contribution rates rise with age.[33]

From the worker's perspective, the greater portability of a DC plan is a major advantage relative to the DB plan. Holding DC plan features and contribution rates constant across employers, a worker would accumulate the same wealth whether he worked for one employer for 30 years or two employers for fifteen years each. This is not true with DB plans. With a final salary plan that is constant across employers, a worker will accumulate more pension wealth with one job for 30 years than two jobs of fifteen years each. For example, consider a plan that offers 1 percent of final salary per year of service and normal retirement at age 65. If a worker works for a single employer until age 65 and has accumulated 30 years of service, his annual benefit at retirement would be 30 percent of his final salary with that employer. If the worker is employed by two separate employers for 15 years each and becomes eligible for pension benefits at age 65 in both plans, he collects two pension benefits. Each will equal 15 percent of his final salary at the two separate employers. If there is wage growth over time, the sum of these two benefits will be less than the benefit received from 30 years of employment with a single firm. Consequently, even if the DB plans are identical across employers, job-switching reduces pension wealth. Also, job switching leads to greater DB losses when wage growth is higher.

DC plans are more flexible than DB plans. After a worker is vested, assets may be transferred to a plan with a new employer if there is a job switch. Alternatively, the assets can be left in the previous plan and continue to accumulate earnings. Switching between employers with identical DC plans does not affect pension wealth at retirement unless the worker leaves prior to vesting or spends a lump sum distribution prior to retirement.

To examine the sensitivity of our DB/DC comparisons to job-switching, table 5 presents simulations of pension wealth for workers who have one of three pension coverage profiles: (1) early pension coverage where the worker is covered between the ages of 36 and 50; (2) late pension coverage where the worker is covered between the ages of 51 and 65; and (3) pension coverage with a switch of employment where the worker is covered by the same type of pension plan between the ages of 36 and 65, but a switch of employers occurs at age 51.

For the early coverage profile and coverage with a switch of employment, the simulations account for the chance that workers receive and spend a lump sum distribution (LSD) from their DC plans. To incorporate this into the simulation, a sample of workers is drawn from the Health and Retirement Study who had assets in a DC plan when they made a switch of employers. For the sample of 533 workers who fit this criteria, a probit model is estimated to determine how the probability of spending a LSD varies with the worker's age, education, race, sex, marital status, and the size of the LSD. The probit estimates are then used to generate a probability that each worker in the simulation spends their pension assets upon leaving their employer at age 50. If this estimated probability exceeds a random draw from a uniform (0,1) distribution, the worker is assumed to spend the pension account.[34]

Pension wealth estimates for the three pension coverage profiles are presented in table 5. The ranking of mean pension wealth across plan types is unaffected by the timing of the pension coverage and the expenditure of lump sum distributions. Regardless of whether pension coverage occurs early or late in the career or a combination of the two, DB plans result in the lowest mean pension wealth. The differences in the level of wealth accumulation across plan types is, however, much lower for workers with coverage in the latter part of their careers.[35]

Regardless of whether pension coverage is early or late in the career, DB plans generally result in less inequality in the distribution of pension wealth than either 401(k) or traditional DC plans. However, the results also reveal that the bulk of the increase in inequality from a shift to DC or 401(k) plans reflect wealth accumulation in the early years.

For DC plans, early career coverage increases inequality partly by extending the period of time over which unequal returns are earned on pension contributions. For DB plans, early career coverage increases the level of inequality by accentuating the effect of plan differences in eligibility requirements for normal retirement. For example, at age 65 with 30 years of service, in most plans workers would be eligible to begin collecting benefits. If a worker quits at age 50 with 15 years of service, there is likely to be greater variation in the number of years that a worker would have to wait before being eligible for benefits. This leads to a greater variation in pension wealth across plans.

One concern with 401(k) plans is that many low income workers choose not to participate in the plan. With traditional DC and DB plans, workers are given little control over their level of pension saving. If a firm sets a common pension saving rate for all workers, pension saving rates could be higher than what low income workers would voluntarily choose and lower than what high income workers would voluntarily choose. Consequently, the greater control over pension saving offered by a 401(k) plan may lead to greater divergence in the savings rates of high and low income workers.

Table 6 illustrates the distribution of pension wealth assuming historical asset returns and a career from age 36 to 65 for workers divided into low, medium, and high income groups. The income cutoffs for each group are chosen to divide the sample into thirds based upon projected income at age 65.[36]

Within each income group, the ranking of mean pension wealth across plan types matches the earlier findings -- DB plans generate the least and traditional DC plans generate the most wealth. The additional wealth that DC plans generate relative to DB plans rise with income level. Relative to DB plans, 401(k) plans increase mean pension wealth 3 percent for low income workers; 17 percent for middle income workers; and 55 percent for high income workers. Traditional DC plans increase mean pension wealth 47, 49, and 75 percent in the low, middle, and high income groups. This suggests that the shift from DB to DC plans will be least beneficial to the low income workers.

The effect of a shift from DB to DC plans on the distribution of pension wealth differs across income groups as well. Table 6 shows the level of pension wealth at various percentile points of the simulated wealth distribution. Comparing the entire empirical distribution of pension wealth across plan types reveals that, among the group of low income workers, DB plans generate more wealth than 401(k) plans in the bottom 80 percent of the pension wealth distribution. In the middle income group, DB plans dominate in the bottom 73 percent of the wealth distribution. In the high income group, DB plans are dominated by 401(k) plans in the all but the bottom 2 percent of the distribution. Consequently, despite the fact that the simulations suggest that 401(k) plans generate a higher level of mean pension wealth than DB plans, the majority of low and middle income workers are predicted to accumulate less pension wealth with 401(k) plans. The increase in average pension wealth from 401(k) plans is the result of large increases in pension wealth at the upper end of the distribution.

To provide further evidence on how the shift from DB to DC plans affects pension wealth, a regression approach is employed. For each person in the simulation sample, pension wealth at age 65 for a 30 year career is estimated for coverage by each of the three plan types (DB, 401(k), traditional DC). For the DC plans, historical returns on a typical pension portfolio are assumed. The dependent variable in the regressions is the log-difference between estimated pension wealth with a DC and DB plan. The regressions control for sex, marital status, race, income level (low, medium and high), and union coverage. The regressions are used to provide a summary of the patterns in the simulations. The statistical significance of coefficients is an indication of whether the simulated data (which contains a variety of different sources of random noise) generates a statistically significant relationship. However, because there are replications of the underlying observations from the SCF to generate the simulation sample, the standard errors are likely to be understated.

The regression results, presented in table 7, reveal that the reference worker (a never married, white, non-Hispanic, nonunion male with projected pay at age 65 in the bottom third of the earnings distribution) is predicted to have approximately 43 percent higher pension wealth with a 401(k) plan than a DB.[37] The advantage of 401(k) plans relative to a DB differs markedly across subgroups of the population, however. For example, a divorced black unionized female in the lowest third of the income distribution is predicted to accumulate 75 percent less wealth with a 401(k) plan than a DB plan. At the other extreme, a single white nonunion male in the top third of the income distribution is predicted to accumulate 82 percent more wealth with a 401(k) than a DB.

Comparing the traditional DC to the DB, the reference worker is predicted to accumulate 30 percent more wealth with the traditional DC. On the other hand, a divorced black unionized female in the lowest third of the income distribution is predicted to accumulate 18 percent less wealth with a traditional DC than a DB. At the other extreme, a single white non-union male in the top third of the income distribution is predicted to accumulate 52 percent more wealth with a traditional DC than a DB.

These results highlight the fact that although a transition from DB to DC plans is likely to increase average pension wealth in the population, some subgroups of the population will experience a decline in average pension wealth. For example, a transition to either 401(k) or traditional DC plans places low income workers and women at the greatest of risk of experiencing a decline in pension wealth.

Compared to traditional DC plans, a movement toward 401(k) plans creates a greater risk that low income workers will experience a decline in pension wealth. This result is consistent with expectations since 401(k) plans give workers greater control over their contribution rates compared to traditional DC plans, leading to reduced contributions among low income workers.

The evidence also suggests that the shift from DB plans to 401(k) plans will be less advantageous for women than men. Part of the explanation for this is that DB plans are required to be sex-neutral in the annuity payouts. As noted earlier, this implies that any given annuity commencing at age 65 translates into approximately 15 percent higher pension wealth for women than men. The switch to a DC plan eliminates this advantage. The regression estimates reveal, however, that the elimination of the sex-neutral annuity in DB plans alone cannot account for sex differences in the effect of the shift to 401(k) plans. For example, the shift from DB to 401(k) plans is projected to increase women's pension wealth by 48 percent less for women than men. This difference far exceeds the 15 percentage point difference that could be explained by sex differences in annuity rates. The elimination of the sex-neutral annuity is, however, more than sufficient to explain the lower benefits realized in traditional DC plans. Part of the explanation for this could be that 401(k) plans give workers more control over contribution rates than traditional DC plans. This may serve to amplify male-female differences in contribution behavior.

While sex-differences in life-expectancy are accounted for in the comparison of DB and DC pension wealth, there are other well-known correlates with life-expectancy including race, ethnicity, wealth and marital status that are not accounted for in the conversion of the DB annuity into a measure of pension wealth. Consequently, the net gain from a shift to DC plans will systematically be understated for any group with a shorter than average life-expectancy. For example, since black retirees have lower life-expectancy than whites, the average black worker would gain more (lose less) from a shift to DC plans than implied by our simulations.[38]

Until now, the analysis has focused on the impact of pension type on the level of pension saving. An alternative approach is to examine the effect of pension type on the worker’s ability to replace their income at retirement. To calculate a replacement rate under the various pension scenarios, pension wealth is converted into a real life annuity. The sex-specific annuitization rates are calculated using a real interest rate of 3 percent and the mortality tables for group annuitants provided by the Society of Actuaries.[39] At age 65, $1 purchases a real life annuity of $.075 for men and $.066 for women.[40] The replacement rate is calculated as the real life annuity divided by projected earnings at age 65.

Because our annuity rates rely upon mortality tables for group annuitants rather than the population as a whole, the estimated annuity rate reflects the consequences of adverse selection into the annuity market. The annuity rate used here does not, however, include the charge that the average insurance company includes for marketing and administrative expenses. Mitchell et al. (1999) estimate that adverse selection in group annuity markets reduces the annuity rate by approximately 10 percent, and overhead charges for marketing, administration, and other insurance company expenses reduce the annuity rate by approximately 15 percent. Since our annuity rate adjusts for adverse selection but not the insurance companies' overhead charges, it should be viewed as an intermediate estimate. If a random worker chooses to self-annuitize, the appropriate annuity rate does not include either adverse selection or the overhead charges. If a worker chooses to enter the group annuity market, the appropriate annuity rate should be reduced by both adverse selection and overhead charges.

Table 8 summarizes the distribution of replacement rates at age 65 under the three plan types for low, middle, and high income workers. The average replacement rates generated by DB plans are very similar across income groups, ranging from .28 to .30. On the other hand, 401(k) plans generate fairly substantial differences in average replacement rates across income groups, ranging from .30 in the low income group to .43 in the high income group. Traditional DC plans lie between the two extremes. Within any given income group, DB plans generate the lowest range of replacement rates. The range of replacement rates is highest for low income workers in 401(k) plans. Consistent with the earlier findings on the distribution of pension wealth, the shift to DC plans (and particularly the 401(k)) increases the variation in replacement rates both within and across income groups.

Table 9 provides OLS regression estimates of the determinants of replacement rates for the three pension types. Comparing regression coefficients across the regressions suggests that a shift to 401(k) and DC plans will lead to greater inter-group variation in replacement rates. For example, compared to workers in the bottom one-third of the age-65 earnings distribution, workers in the top-third are projected to have a replacement rate that is 1% higher with a DB plan; 7% higher with a traditional DC plan, and 8% higher with a 401(k) plan.

DC and 401(k) plans also amplify differences in replacement rates within groups. The standard deviation of the regression residual provided at the bottom of table 8 implies that within group variation in replacement rates is 2.6 to 3.2 times higher with 401(k) and traditional DC plans than with DB plans.[41]

The evidence on replacement rates thus suggests that the shift from DB to DC plans will improve the average fraction of income replaced at retirement for low, middle, and high income workers. However, the effects are not uniform across income groups. The shift to DC plans improves the average replacement rate of high income workers the most. Moreover, a significant share of low and middle income workers are projected to have lower replacement rates with DC plans than DB plans.

6. Summary and Conclusions.

The transition from DB to DC pension plans has been dramatic over the past 20 years. Like Samwick and Skinner (2004), this study concludes that the shift to DC plans will generally have a positive effect on average pension wealth and replacement rates. This result is robust to a variety of assumptions regarding rates of return, retirement ages, and career lengths.

While the transition to DC plans is likely to contribute to higher average pension wealth, the evidence presented here reveals that the increased rate of return risk and variability in contribution behavior in DC plans will contribute to greater inequality in pension wealth. Also, greater control over contribution rates made possible by 401(k) plans may amplify both within and between group differences in pension saving rates relative to the traditional DC plan.

The shift to DC plans will also likely lead to a decline in pension wealth for some subgroups of the population. Those most likely to experience a decrease in pension wealth at retirement are workers in low income groups.

Since our conclusions refer to the accumulation of pension wealth alone, the consequences of the shift to DC plans for total wealth at retirement are less clear. Any change in the accumulation of pension wealth brought about by the shift in plan type may be offset by changes in other forms of saving. While the evidence on whether workers offset pension saving by adjusting other forms of pension saving is mixed, both theory and empirical evidence suggest that offsetting behavior is least likely among less educated and low income workers.[42] As a result, if the shift from DB to DC plans reduces the pension wealth of workers at the bottom of the income distribution, these workers may be the least inclined to adjust by increasing other forms of saving. Moreover, it is conceivable that, even if pension wealth is unaffected by the shift to DC plans, the degree of pension offsetting may be altered by the shift to DC plans.[43]

Another important concern with the shift to DC plans is that many workers will choose not to annuitize their balances at retirement. Consequently, the shift to DC plans increases the chance that workers outlive their resources. Another important question that remains is how this shift from annuitized benefits to lump sums affects the distribution of pension wealth. As noted by Brown (2003), a shift away from uniformly priced annuities will financially benefit workers with shorter than average life expectancies (less educated black males, for example). Nevertheless, the increased risk of outliving their resources may leave a risk averse worker worse off even though expected retirement income would be higher without annuities.

References.

Allen, Steven G., Robert L. Clark, and Daniel A Sumner. 1986. "Post-retirement Adjustments of Pension Benefits." *Journal of Human Resources* 21 (Winter): 118-37

Basset, William F., Michael J. Fleming, and Anthony P. Rodrigues. 1998. "How Workers Use 401(k) Plans: The Participation, Contribution, and Withdrawal Decisions." *National Tax Journal* 51 (June): 263-289.

Blank, Emily C. 1999. "Pension Type and Retirement Wealth." *Industrial Relations* 38 (January): 1-10

Brown, Jeffrey. 2003. "Redistribution and Insurance: Mandatory Annuitization with Mortality Heterogeneity." *The Journal of Risk and Insurance* 70 (March): 17-41..

Burman, Leonard E., Norma B. Coe, and William G. Gale. 1999. "Lump Sum Distributions From Pension Plans: Recent Evidence and Issues for Policy and Research." *National Tax Journal* 52 (3): 553-62.

Clark, Robert L., Ann A.McDermed, and Michelle White Trawick. 1993. "Firm Choice of Type of Pension Plan: Trends and Determinants." In *The Future of Pensions in the United States*, edited by Ray Schmitt, pp. 115-25. Philadelphia: Pension Research Council and University of Pennsylvania Press.

Clark, Robert L. and Sylvester J. Schieber. 1993. "Factors Affecting Participation and Contribution Levels in 401(k) Plans." Working paper. Raleigh, NC: North Carolina State University.

Clark, Robert L., and M. Melinda Pitts. 1999. "Faculty Choice of a Pension plan: Defined Benefit versus Defined Contribution." *Industrial Relations* 38 (January): 18-45.

Employee Benefit Research Institute. 1997. *EBRI Databook on Employee Benefits,* 4th edition. Washington, D.C: Employee Benefit Research Institute.

Engen, Eric and William Gale. 2000. “The Effects of 401(k) Plans on Household Wealth: Differences Across Earnings Groups.” Working Paper. Washington, DC: Federal Reserve Board of Governors.

Engen, Eric; William Gale; and John Karl Scholz. 1996. “The Illusory Effects of Saving Incentives on Saving,” *Journal of Economic Perspectives* 10 (Fall): 113-38.

Even, William E., and David A. Macpherson. 1996. "Employer Size and Labor Turnover: The Role of Pensions." *Industrial and Labor Relations Review* 49 (July): 707-728.

________. 2005. "The Effects of Employer Matching in 401(k) Plans." *Industrial Relations* 44 (July): 525-49.

Gale, William. 1998 "The Effects of Pensions on Household Wealth: A Re-examination of Theory and Evidence." *Journal of Political Economy* 106 (August): 706-23

Gale, William, and Joseph Milano. 1998. "Effects of Pensions on Retirement Wealth Accumulation: Implications of the Shift Toward Defined Contribution Plans,” In *Living with Defined Contribution Plans*, edited by Olivia S. Mitchell and Sylvester J. Schieber, pp. 115-35. Philadelphia: Pension Research Council and University of Pennsylvania Press.

Gustman, Alan L., and Thomas L. Steinmeier. 1992. “The Stampede toward DC Pension Plans: Fact or Fiction?” *Industrial Relations* 31 (Spring): 361-69.

________. 1995. *Pension Incentives and Job Mobility*. Kalamazoo: W. E. Upjohn Institute for Employment Research.

Hubbard, Glenn R. and Jonathan S. Skinner, 1996. “Assessing the Effectiveness of Saving Incentives.” *Journal of Economic Perspectives* 10 (Fall): 73-90.

Ibbotson and Associates. 1999. *Stocks, Bonds, Bills, and Inflation: 1999 Yearbook*. Chicago, IL.: Ibbotson and Associates.

Ippolito, Richard A. 1995. "Towards Explaining the Growth of DC Plans." *Industrial Relations* 34 (January): 1-20.

Kusko, Andrea; James Poterba; and David Wilcox. 1997. "Employee Decisions with Respect to 401(k) Plans: Evidence from Individual Level Data." In *Living with Defined Contribution Pensions: Remaking Responsibility for Retirement*, edited by Olivia Mitchell. Philadelphia PA: University of Pennsylvania Press.

Kruse, Douglas. 1995. "Pension Substitution in the 1980s: Why the Shift Toward DC?" *Industrial Relations* 34 (April): 218-241.

Munnell, Alicia and Annika Sunden. 2004. *Coming Up Short: The Challenge of 401(k) Plans*. Washington, DC: Brookings Institution Press.

Mitchell, Olivia S., James M. Poterba, Mark J. Warshawsky, and Jeffrey R. Brown. 1999. “New Evidence on the Money’s Worth of Individual Annuities.” *American Economic Review* 89 (December): 1299-1318.

Papke, Leslie E. 1995. "Participation in and Contributions to 401(k) Pension Plans." *Journal of Human Resources* 30 (Spring): 311-325.

________. 2004. "Pension Plan Choice in the Public Sector: The Case of Michigan State Employees." *National Tax Journal* 57 (2): 329-39.

Poterba, James M.; Steven F.Venti; and David A. Wise. 1996. “How Retirement Saving Programs Increase Saving,” *Journal of Economic Perspectives* 10 (Fall): 91-112

________. 2001. “The Transition to Personal Accounts and Increasing Retirement Wealth: Macro and Micro Evidence.” National Bureau of Economic Research Working Paper 8610. Cambridge, MA: National Bureau of Economic Research.

Rajnes, David. 2002. “An Evolving Pension System: Trends in Defined Benefit and Defined Contribution Plans.” Employee Benefit Research Institute Issue Brief No. 249. Washington, DC: Employee Benefit Research Institute.

Samwick, Andrew, and Jonathan S. Skinner. 2004. "How Will 401(k) Pension Plans Affect Retirement Income?" *American Economic Review* 94 (March): 329-43.

Society of Actuaries Group Annuity Valuation Task Force. 1996. “1994 Group Annuity Mortality Tables and 1994 Group Reserving Table,” *Transactions of the Society of Actuaries* 107 (1996): 865-913.

Steinmeier, Thomas. 1998. “The Pension Calculator Program for the Health and Retirement Study: User’s Guide.” Mimeo.

Turner, John A. 1993. *Pension Policy for a Mobile Labor Force*. Kalamazoo, Mich.: W. E. Upjohn Institute for Employment Research.

Uccello, Cori; Melissa Favreault; Karen Smith; and Lawrence Thompson. 2003. “Simulating the Distributional Consequences of Personal Accounts: Sensitivity to Annuitization Options.” Working Paper. Washington, DC: The Urban Institute.

U.S. Department of Labor, Pension and Welfare Benefits Administration. 1999-2000. "Abstract of 1996 Form 5500 Annual Reports," *Private Pension Plan Bulletin* 9, Winter.

U.S. Department of Labor, Bureau of Labor Statistics. 1999. *Employee Benefits in Medium and Large Private Establishments 1997*. Bureau of Labor Statistics Bulletin 2517, September.

VanDerhei, Jack, Russell Galer, Carol Quick, and John Rea. 1999. "401(k) Plan Asset Allocation, Account Balances, and Loan Activity." Employee Benefit Research Institute Issue Brief No. 205. Washington, DC: Employee Benefit Research Institute.

Wolff, Edward. 2002. *Retirement Insecurity: The Income Shortfalls Awaiting the Soon-to-Retire*. Washington, DC: Economic Policy Institute.

Table 1: DC Contribution Rates Required to Generate an Equivalent DB Benefit.

Assumptions: DB plan replaces 1.5% of final salary per year of service. Worker begins participation in pension plan at age 35. Inflation rate is 3%.

DC contribution rate	Nominal growth rate in wages	Nominal rate of return on investment	Real interest rate	Annuity factor	Interest rate for annuity factor	COLA in DB Plan?
			Retirement age =65			
21.7%	6.0%	6.0%	3.0%	6.9%	3.0%	Yes
13.4%	3.0%	6.0%	3.0%	6.9%	3.0%	Yes
4.6%	3.0%	10.0%	7.0%	9.6%	7.0%	Yes
3.8%	3.0%	10.0%	7.0%	11.7%	10.0%	No
19.5%	7.0%	6.0%	3.0%	8.9%	6.0%	No
			Retirement age=60			
25.0%	6.0%	6.0%	3.0%	6.0%	3.0%	Yes
17.0%	3.0%	6.0%	3.0%	6.0%	3.0%	Yes
6.0%	3.0%	10.0%	7.0%	8.7%	7.0%	Yes
5.0%	3.0%	10.0%	7.0%	10.9%	10.0%	No
21.0%	7.0%	6.0%	3.0%	8.0%	6.0%	No
			Retirement age=55			
28.0%	6.4%	6.0%	3.0%	5.4%	3.0%	Yes
20.4%	3.0%	6.0%	3.0%	5.4%	3.0%	Yes

8.5%	3.0%	10.0%	7.0%	8.1%	7.0%	Yes
6.7%	3.0%	10.0%	7.0%	10.3%	10.0%	No
22.3%	7.0%	6.0%	3.0%	7.4%	6.0%	No

Table 2: Summary Statistics for Pension Simulations.

	Mean	Median
Real Earnings Growth Rate	1.8%	1.8%
Salary		
Age 36	$41,096	$33,692
Age 45	$46,459	$38,089
Age 55	$52,024	$42,652
Age 65	$70,538	$57,830
DC Contribution Rates:		
Age 36	9.8%	9.3%
Age 45	10.8%	10.4%
Age 55	11.8%	11.6%
Age 65	12.9%	12.8%
401(k) Contribution Rates:		
Age 36	5.2%	3.4%
Age 45	7.8%	6.8%
Age 55	11.0%	10.7%
Age 65	14.9%	15.3%
Replacement Rate DB Plans	29.3%	27.1%
Generosity rate of DB plans	0.98%	0.90%
Years of Schooling:		
<12	10.1%	--
12	32.1%	--
13-15	22.7%	--
16	35.1%	--

Sample size	29,487

Table 3. Distribution of Pension Wealth at Age 65 with Alternative Pension Types.[a]

	Rate of return assumption	Mean Pension Wealth	Percentile of Pension Wealth					90-10 ratio	Coefficient of variation	Gini
			10	25	50	75	90			
DB	--	$276	$60	$123	$221	$362	$532	8.9	0.82	0.41
All DC plans	3.0%	$272	$63	$117	$208	$345	$535	8.5	0.89	0.42
	6.5%	$454	$100	$190	$343	$577	$901	9.0	0.92	0.43
	Historical	$456	$63	$128	$266	$537	$1,006	16.0	1.47	0.54
401(k)	3.0%	$229	$40	$85	$166	$295	$476	11.9	0.98	0.46
	6.5%	$370	$58	$130	$262	$475	$777	13.4	1.03	0.48
	Historical	$372	$41	$94	$208	$431	$837	20.4	1.56	0.57
Traditional DC	3.0%	$260	$64	$116	$203	$330	$509	8.0	0.87	0.42
	6.5%	$447	$107	$196	$346	$566	$878	8.2	0.89	0.42
	Historical	$449	$62	$127	$263	$531	$990	16.0	1.45	0.54

[a] Pension wealth estimates are for a sample of pension covered workers assuming a career from age 36 to 65, measured in thousands of dollars. Historical portfolio returns are for a typical pension portfolio consisting of a mixture of equities and bonds. See text for details.

Table 4. Distribution of Pension Wealth at Age 65 with Alternative Pension Types, by Retirement Age.[a]

	Mean Pension Wealth	Percentile of Pension Wealth					90-10 ratio	Coefficient of variation	Gini
		10	25	50	75	90			
Age 55 Retirement									
DB	$121	$23	$46	$92	$156	$246	10.7	0.90	0.45
401(k)	$143	$14	$35	$81	$170	$321	22.9	1.46	0.57
Traditional DC	$189	$30	$61	$120	$229	$403	13.4	1.28	0.51
Age 60 Retirement									
DB	$194	$38	$78	$152	$260	$386	10.2	0.87	0.43
401(k)	$234	$24	$58	$131	$274	$528	22.0	1.49	0.57
Traditional DC	$296	$45	$89	$180	$356	$648	14.4	1.34	0.53
Age 65 Retirement									
DB	$276	$60	$123	$221	$362	$532	8.9	0.82	0.41
401(k)	$372	$41	$94	$208	$431	$837	20.4	1.56	0.57
Traditional DC	$449	$62	$127	$263	$531	$990	16.0	1.45	0.54

[a] Pension wealth estimates are for a sample of pension covered workers assuming a career from age 36 to 65, measured in thousands of dollars. Historical portfolio returns are for a typical pension portfolio. The 401(k) and traditional DC simulations assume historical returns a typical pension portfolio. See text for details.

Table 5 Distribution of Pension Wealth at Age 65 with Alternative Pension Types for Early and Late Career Coverage, Accounting for Lump Sum Distributions[a]

	Mean Pension Wealth	Percentile of Pension Wealth: 10	25	50	75	90	90-10 ratio	Coefficient of variation	Gini
Early Career (Age 31-50)									
DB	$88	$12	$35	$64	$109	$192	16.0	1.02	0.48
401(k)	$200	$0	$18	$75	$214	$493	--	2.22	0.69
Traditional DC	$282	$7	$46	$132	$322	$671	95.9	1.86	0.64
Late Career (Age 51-65)									
DB	$143	$26	$61	$113	$185	$274	10.5	0.94	0.43
401(k)	$162	$28	$57	$112	$205	$346	12.4	1.06	0.48
Traditional DC	$158	$32	$60	$112	$198	$328	10.3	1.02	0.46
Split Career (Sum of early and late career)									
	$231	$40	$100	$181	$302	$451	11.3	0.94	0.44
401(k)	$363	$37	$85	$195	$419	$830	22.4	1.60	0.58
Traditional DC	$440	$53	$116	$253	$522	$987	18.6	1.48	0.56

[a] Pension wealth estimates are for a sample of pension covered workers assuming either an early (age 36-50) or late (age 51-65) career with pension coverage, measured in thousands of dollars. The figures for the combination of early and late career reflect what a worker would accumulate with pension coverage

Table 6. Distribution of Pension Wealth at Age 65 with Alternative Pension Types, by Income.[a]

	Mean Pension Wealth[a]	Percentile of Pension Wealth 10	25	50	75	90	90-10 ratio	Coefficient of variation	Gini coefficient
				Low Income					
DB	$146	$31	$79	$132	$206	$277	8.9	0.6	0.3
401(k)	$150	$20	$45	$97	$189	$332	16.6	1.2	0.5
Traditional DC	$215	$36	$73	$146	$269	$470	13.0	1.1	0.5
				Middle Income					
DB	$245	$76	$158	$225	$348	$414	5.4	0.5	0.3
401(k)	$287	$56	$107	$199	$361	$609	10.9	1.0	0.5
Traditional DC	$364	$74	$138	$253	$454	$785	10.6	1.0	0.5
				High Income					
DB	$438	$84	$246	$379	$572	$790	9.4	0.7	0.4
401(k)	$681	$134	$237	$433	$821	$1,432	10.7	1.3	0.5
Traditional DC	$768	$149	$271	$501	$922	$1,604	10.8	1.3	0.5

[a] Pension wealth estimates are for a sample of pension covered workers assuming a career from age 36 to 65, measured in thousands of dollars. The 401(k) and traditional DC simulations assume historical returns for a typical pension portfolio. See text for details.

Table 7. Factors Affecting Differences in Wealth Accumulation Across Pension Types.

Note: The dependent variables is the log-difference in pension wealth between a particular type of DC plan and the DB plan accumulated between ages 36 and 65 assuming historical returns on a typical pension portfolio. The reference person is a white, non-Hispanic, never-married, nonunion, male with projected earnings at age 65 in the bottom one-third of the earnings distribution.

	401(k) vs. DB	Traditional DC vs. DB	DC vs. DB
Intercept	.36	.26	.25
	(14.37)	(10.76)	(10.27)
Female	-.65	-.12	-.38
	(43.98)	(8.25)	(27.20)
Black	-.78	.16	.04
	(33.27)	(6.97)	(1.93)
Hispanic	-.15	-.12	.01
	(5.13)	(4.20)	(.49)
Married	-.096	.04	.11
	(4.29)	(1.75)	(5.02)
Widowed, divorced, separated	-.14	-.45	-.02
	(5.01)	(16.72)	(.62)

Union coverage	-.19	-.05	-.033
	(13.31)	(3.33)	(2.46)
Middle income	.06	.009	.04
	(3.37)	(.53)	(2.22)
High income	.24	.16	.21
	(13.67)	(9.36)	(12.68)
Sample mean of log-difference	-0.04	0.23	0.24

Table 8. Distribution of Replacement Rates at Age 65 with Alternative Pension Types, by Income.[a]

	Mean Replacement Rate[a]	Percentile of Replacement Rate Distribution					90-10 ratio
		10	25	50	75	90	
Low Income							
DB	0.30	0.08	0.19	0.27	0.45	0.47	5.9
401(k)	0.30	0.05	0.10	0.20	0.38	0.65	13.0
Traditional DC	0.44	0.09	0.16	0.30	0.55	0.93	10.3
Middle Income							
DB	0.30	0.09	0.20	0.27	0.45	0.48	5.3
401(k)	0.35	0.07	0.13	0.25	0.45	0.76	10.9
Traditional DC	0.45	0.09	0.17	0.31	0.56	0.96	10.7
High Income							
DB	0.28	0.05	0.17	0.27	0.38	0.47	9.4
401(k)	0.43	0.10	0.18	0.31	0.53	0.88	8.8
Traditional DC	0.49	0.11	0.20	0.35	0.61	0.99	9.0

[a] The replacement rate is calculated as the fraction of earnings at age 65 that would be replaced by purchasing a single-life real annuity with pension wealth. Pension wealth is calculated assuming continuous enrollment between ages 36 and 65 and assuming historical returns on a typical pension portfolio. See text for additional details.

Table 9. Factors Affecting Replacement Rates by Pension Type.

Explanation: The dependent variables are the replacement rates described in table 8 for each type of pension plan. The reference person is a white, non-Hispanic, never-married, nonunion, male with projected earnings at age 65 in the bottom one-third of the earnings distribution. T-statistics are listed in parentheses beneath the coefficients.

	401(k)	Traditional. DC	DB
Intercept	0.42	0.39	.24
	(50.57)	(38.51)	(75.75)
Female	-0.09	0.07	.08
	(19.04)	(12.10)	(43.87)
Black	-0.16	0.08	.01
	(20.58)	(8.73)	(4.71)
Hispanic	-0.05	-0.05	-.02
	(4.97)	(4.23)	(6.31)
Married	-0.03	0.02	-.002
	(4.10)	(1.76)	(.73)
Widowed/divorced/sep.	-0.03	-0.13	.02
	(3.69)	(11.99)	(5.15)
Union coverage	-0.02	0.02	.38
	(3.79)	(3.56)	(20.81)

Middle income	0.02	0.02	.01
	(4.16)	(3.49)	(5.15)
High income	0.08	0.07	.01
	(13.42)	(9.22)	(4.20)
Std. deviation of regression error	0.373	0.464	0.143

FOOTNOTES

---

[1]Calculations from the 2001 Survey of Consumer of Finances.. It is important to note that part of the rise in the defined contribution share is due to an increase in the proportion of defined benefit plan participants with a supplemental defined contribution plan.

[2]These statistics are based on pension covered wage and salary workers in the 1989 and 2001 Survey of Consumer Finances.

[3]See Gustman and Steinmeier (1992), Clark, McDermed, and Trawick (1993), Kruse (1995), Ippolito (1995), and Rajnes (2002).

[4]In the event that a firm goes bankrupt and defaults on its pension obligations, worker benefits are guaranteed by the Pension Benefit Guarantee Corporation (PBGC). However, the PBGC places a cap on insured benefits so that high income workers face some risk of lost benefits. For plans terminated in 2006, the cap on insured benefits was approximately $48,000 annually.

[5]Turner. (1993) provides a good review of how pension design affects the cost of job mobility.

[6]For example, Basset, Fleming and Rodrigues (1998), Papke (1995), Clark and Schieber (1993), Kusko, Poterba and Wilcox (1997), and Even and Macpherson (2005).

[7]The second most common formula (23 percent of plans) uses a fixed dollar amount per year of service.

[8]If DB benefits are indexed, the annuity factor used for computing the equivalent DC contribution rate is based on a real instead of a nominal interest rate.

[9]An earlier retirement age increases the implicit contribution rate unless the growth rate in the nominal wage exceeds the nominal interest rate.

[10]If the number of replicates for each observation equaled the population sampling weight, the number of observations would be an estimate of the number of pension covered people in the United States.

[11]The OLS regression uses sample weights and the sample is restricted to persons age 25 to 65 who are full-time wage and salary workers. The earnings equation includes a cubic in age to allow for a flexible age-earnings profile. The coefficients on the age variables are jointly significant at the .01 level.

[12]For example, if a 40 year old in the sample has earnings of $40,000 in the SCF, 1 percent real wage growth plus the coefficients on the age variables are used to generate predicted earnings before and after age 40. At age 40, the earnings are set equal to $40,000.

[13]The $30,000 cap on contributions was fixed in nominal terms over the years that we examine.

[14]The estimated standard error of the error in the contribution equation is .070 for 401(k) plans and .061 for traditional DC plans. The generated contribution error term is constructed to contain a permanent and transitory component such that the correlation across errors for a given person is .45. The estimated correlation in the residuals is based upon estimates of contribution behavior using panel data in the National Longitudinal Survey.

[15]U.S. Department of Labor (1999-2000).

[16]Samwick and Skinner (2004) use 541 pension plans from the 1989 SCF, but this includes both DB and DC plans included in the pension provider survey.

[17]Because some pension plans in the SPP are matched to more than one worker in the SCF, a given DB plan could be assigned to more than one cell.

[18]For example, if there are 10 DB plans assigned to a particular cell, the probability that a given plan is drawn will depend upon the weights of the DB workers that are actually covered by that plan relative to the weights of the DB workers covered by all the other plans in that cell.

[19]Because non-discrimination rules require that pension coverage at a given firm be similar among high and low income workers at a given firm, we do not use worker income to assign pension coverage.

[20]See Steinmeier (1998) for a description of the pension benefit calculator.

[21]The DB simulations account for cost-of-living adjustment (COLA) that are explicit plan features. Also, consistent with evidence in Allen et al. (1986) that many DB plans give ad hoc cost of living adjustments when there is no explicit formula in the plan documents, plans without an explicit COLA were assumed to provide a COLA equal to 50% of the inflation rate.

[22](.0754 versus .0658). The pension calculator also allows for mortality rates to vary with birthyear to reflect rising life-expectancy. However, our simulations impose a birth year of 1954 for all workers.

[23]These annuity rates reflect the 1994 Society of Actuaries Group Annuitant Mortality Table included in Society of Actuaries Group Annuity Valuation Task Force (1996).

[24]Pension wealth is calculated as the annuity divided by the annuity rate.

[25]See Uccello et al. (2003) for a discussion of the annuitization options in DC plans.

[26]Clark and Pitts (1999) and Papke (2004) both illustrate how the relative value workers place on the two types of plans varies in a predictable way with a variety of worker characteristics, including worker age and expected turnover.

[27]This same point is made by Poterba et al. (2001) in their comparison of contribution rates to DB and 401(k) plans.

[28]Engen, Gale, and Scholz (1996); Poterba, Venti, and Wise (1996); and Hubbard and Skinner (1996) contain good summaries of the range of estimates on the tendency to offset pension saving.

[29]See Even and Macpherson (1996).

[30]The sample size for estimating the contribution equation is 964 for people with only 401(k) plans; 1157 for people with only DC plans; and 2339 for people with a 401(k) and/or a traditional DC plan but no DB coverage. Since some people have a traditional DC and a 401(k) plan, the sample size for the third group exceeds the sum of the first two groups.

[31]For example, the coefficient of variation rises from .82 to .83 and the Gini is unchanged at .41.

[32]For the entire sample, a shift from DB to DC plans increases average pension wealth from $276,000 to $456,000 (65% increase). For DB workers, the shift increases average pension wealth from $248,000 to $395,000 (60% increase).

[33]For example, the comparison of wealth accrual in DB and DC plans in chapter 2 of Gustman and Steinmeier (1995) shows that the pension accrual rate (defined as the change in pension wealth divided by annual wages) rises with age in DB plans but falls with age in DC plans. This illustration, however, assumes that the DC contribution rate is fixed over time.

[34]Several studies have focused on how much pension wealth at retirement is "lost" because workers do not always roll over their LSDs into IRAs or pensions and the effects of tax policy on such decisions. Burman et al. (1999) provide a good summary of the research.

[35]Additional analysis was conducted using DC contribution behavior in the 1992, 1995, and 1998 SCF data to examine whether there has been a changes in the generosity of DC plans over time. These years of the SCF do not allow for reexamination of DB benefit formulae. There been a modest downward trend in the relative generosity of both traditional DC and 401(k) plans, but the rankings of pension wealth under the different plan types is unchanged and our main conclusions are unaltered.

[36]The income group in the bottom third has simulated earnings at age 65 of approximately $48,000 or less; the top third has income of approximately $70,000 or more.

[37]The percentage difference in benefits is calculated as e^a-1 where a is the estimated difference in the log of benefits from the regression equation.

[38]Brown (2003) provides a summary of mortality heterogeneity and discusses the distributional implications of mandating annuitization of private accounts at retirement. His study also points out that there are large utility gains from annuitization that grow with the degree of worker risk aversion. Our simulations do not account for utility losses caused by switching from annuities (DB plans) to lump sum payments (DC plans).

[39]The source of the mortality rates is Society of Actuaries Group Annuity Valuation Task Force (1996), Table 13.

[40]Brown et al. (1999) report an average single premium immediate annuity rate at age 65 of $.095 for men and $.086 for women across a sample of life insurance companies in 1995. Unlike the annuity rates in this study, their estimates are for non-indexed annuities. Assuming a nominal interest rate of 6.0%, we estimate a non-indexed annuitization rate of $.099 for men and $.089 for women. A higher interest rate would yield a higher annuitization rate.

[41]Because of the skewed nature of the replacement rate distribution, we also estimated a median regression to reduce the potential influence of outliers. The signs of all coefficients were unchanged relative to the OLS results, though most coefficients were slightly smaller in absolute value.

[42] Gale (1998) provides evidence that pension offsetting is less pronounced among less educated workers. Engen and Gale (2000) find that saving through 401(k) plans is much less likely to be offset by low income workers.

[43]Gale and Milano (1998) address this issue, but are unable to draw strong conclusions with their empirical work.