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How Will 401(k) Pension Plans Affect Retirement Income?

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Abstract

How has the emergence of defined contribution pension plans, such as 401(k) plans, affected the financial security of future retirees? We consider this question using a unique dataset of pension plan formulas for the Surveys of Consumer Finances in 1983 and 1989 and the characteristics of 401(k) plans from the Surveys of Consumer Finances between 1989 and 2001. Our simulations account for uncertainty in earnings and rates of return on stocks and bonds, ownership of company stock, uncertainty in earnings, and heterogeneity in asset choices, plan participation, and job tenure. We find that in the mid-1990s, 401(k) plans were roughly equivalent to defined benefit plans from the 1980s, but by the later 1990s, 401(k) plans dominated defined benefit plans.

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I. Introduction

Two decades ago, most workers with pensions had a defined benefit (DB) plan. The employer made necessary contributions and investments to meet promised pension benefit payments when the employee retired. By 1993, the tide had turned; more than half of covered employees participated primarily in defined contribution (DC) pensions such as 401(k) plans (EBRI, 1997). This dramatic shift was associated as well with growing concerns about the emerging 401(k) plans. Some viewed 401(k) plans as a crisis waiting to happen when current generations, having made minimal (or no) contributions to their DC plan, retired with inadequate pension asset balances (Ferguson and Blackwell, 1995; Willette, 1995). Another concern was that workers switching jobs would use the lump sum distributions for houses, boats, or other purchases rather than reinvesting them in another retirement account (Schultz, 1995; USDOL, 1998b). In a similar vein, newly retired workers may not roll over the assets into an annuity and therefore risk "spending down" their retirement wealth too early (e.g., Brown and Warshawsky, 2001).

The most serious charge against 401(k) plans, however, has been the underlying uncertainty in rates of return, shown most recently by the unhappy experiences of Enron employees with 401(k) plans heavily laden with Enron stock.[1] And even without company stock ownership programs, the more general criticism was that employees made uninformed investment decisions, or that stock market risk, even managed expertly, was inappropriate in any well-functioning pension plan (Ferguson and Blackwell, 1995).[2]

Aside from anecdotal information, however, there is surprisingly little information about

[1] This in turn has generated a barrage of unfavorable news articles (Quinn, 2002) and books with titles such as *The Great 401(k) Hoax* (Wolman and Colamosca, 2002).
[2] Bodie, Marcus, and Merton (1988) argue that, in addition, DB plans can reduce earnings uncertainty.

the adequacy of DC plans relative to the DB plans they have supplanted.[3] Such comparisons have proved difficult to evaluate in the past because of the substantial heterogeneity in the provisions of DB and DC plans across different firms and in the contribution and investment decisions of workers in different DC plans. Comparisons are further complicated by the continued evolution of both DB and DC plans during the past several decades.

We address this question by comparing a representative sample of DB plans with a representative sample of 401(k) plans. We use data from the Surveys of Consumer Finances from 1983 to 2001, and, in particular, the Pension Provider Surveys (PPS) that accompanied the 1983 and 1989 SCFs. Each PPS includes the detailed pension plan formulas for workers who report being covered by a pension in the SCF, thereby making it possible to examine the distribution of DB plans before (and during) the general transition over to DC plans. We compare the distribution of DB pension entitlements from the PPS with the distributions of 401(k) plan benefits in the SCFs from 1989 through 2001.

We characterize the distribution of pension benefits by simulating a broad range of earnings paths, portfolio composition (including company-owned stock), and portfolio returns through the weighted samples of DB and DC plans. Our main finding is that by 1995, the typical 401(k) plan yielded roughly similar median benefits (and higher mean benefits) compared to defined benefits plans in 1983 and 1989, although the 10th percentile benefits were consistently lower. A utility-based comparison of the distributions suggests that in 1995, individuals with risk aversion parameters between 2 and 6 (depending on the simulation) would have been indifferent between a randomly chosen 401(k) and a defined benefit plan from the 1980s. By the end of the decade, however, 401(k) plans provided a distribution of expected retirement income

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[3] Holden and Vanderhei (2002b) are an important exception; they develop a 401(k) model of accumulation under uncertainty, but they do not compare the resulting returns to the universe of defined benefit plans.

that would be preferred by all but the most the risk averse consumers. Our findings are not dependent on the extraordinary gains in equity markets during the 1990s because we *exclude* equity returns after 1990, a year in which the Dow Jones Industrial Average never closed above 3000.

Our basic results also extend to job spells in which workers leave the firm before retirement. The concern that workers will spend rather than save their pre-retirement distributions from 401(k) plans is more than offset by the backloading of DB pension accruals, or the loss to employees in DB benefits that occurs when they leave prior to plan retirement ages. An important difference is that workers between jobs with 401(k) plans get to spend their pension balances on things that they want, rather than having the lost benefits remain with the DB plan sponsor. In short, our results suggest that 401(k) plans are not the ticking time bomb that many fear. We identify two factors that are critical, however, in the comparison of 401(k) with defined benefit plans: the small fraction of workers without any contributions to their 401(k) plans, and burdensome administrative or operating expenses for 401(k) investments.

II. Modeling the Distribution of DB and DC Pension Benefits

Defined contribution plans have experienced rapid growth in the past two decades (VanDerhei and Copeland, 2001). During the early 1980s, DC plans appeared primarily as a way to supplement an existing DB plan. Over time, however, firms began to introduce DC plans as the primary pension plan, forsaking DB plans altogether, or at least in smaller firms, to terminating the DB plan and replacing it with a DC plan (Papke, 1995, 1999; Ippolito and Thompson, 2000). Among workers covered by pension plans, the share with primary defined contribution plans, largely 401(k) plans, grew from 38 percent in 1992 to 57 percent in 1998 (VanDerhei and Copeland, 2001).

The defining characteristic of a DB plan is that the firm promises to pay the worker a nominal annuity based on a set of formulas related to the worker's age, years of service, and final average pay (Gustman and Steinmeier, 1989).[4] Final average pay may be the average of the last few years of earnings but is more often the average of the highest few years or the highest consecutive years during the last few years. (The distinction matters when wages are stochastic or decline later in the work life.) Many plans specify a replacement rate per year of service, but the replacement rate varies substantially across firms.[5] Other plans pay a flat rate of benefits in dollar terms per year of service worked (Kotlikoff and Smith, 1983).

Some DB plans are also integrated with Social Security to varying degrees, and most have more than one formula that can be operative for a given worker. Finally, there are differences in how DB plans treat early retirement, both in terms of what is considered a "normal" retirement date and the extent to which benefits are reduced because of early retirement.[6] Given the heterogeneity in the specific features of each DB plan, there is no way to accurately characterize the distribution of benefits without the full summary plan descriptions provided in a dataset such as the Pension Provider Survey.

In contrast to DB plans, DC plans differ across firms along just two key dimensions. The first is the total contribution rate. Contributions may come from the employee, the employer, or both. Some DC plans are non-contributory, so that the employer funds the entire pension. Others, such as many 401(k) plans, explicitly link the amount of the employer contributions to

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[4] Allen, Clark, and McDermed (1992) report that some firms gave ad hoc increases in pension benefits to account for inflation between 1983-1987. The likelihood of receiving such ad hoc adjustments is not reflected in our calculations. However, all pension plan formulas have been modified so that dollar amounts specified in nominal terms are indexed to nominal wage growth.

[5] For example, if the replacement rate is 1.5 percent per year of service and the number of years of service is 20, the replacement rate would be 30 percent of final average pay.

[6] For a discussion of how these incentives affect retirement, see Gustman and Steinmeier (1986), Stock and Wise (1990), Samwick (1998), and Woodbury (2001).

the amount of the employee contributions through a "matching" provision, commonly ranging from $0.10 to $1.00 per dollar of employee contribution. The second dimension along which DC plans differ is the investment allocation. Some plans subsidize (and actively encourage) the purchase of company stock, while others limit investments to an array of diversified stock and bond portfolios.

We employ two different approaches to comparing pension distributions. The first approach is a *counterfactual* experiment. In the counterfactual, we estimate benefits for the sample of workers covered by their actual pension plans in the PPS 1983 or 1989. We then assign each worker a randomly chosen 401(k) plan from an SCF in the years 1989 through 2001. In both the DB and 401(k) scenarios, the realizations of earnings are identical for each worker, and workers are assumed to have worked at the firm from their date of hire until age 62.

Our second approach to comparing pension plans is to use a hypothetical *benchmark* worker. We endow the benchmark worker with the average characteristics (age, date of hire, earnings) of the PPS sample. We calculate the benefits for the benchmark worker in each pension plan from the PPS assuming the worker is covered by the plan from age 31 to age 62. As in the counterfactual approach, we compare the distribution of benefits under the PPS plans and randomly assigned 401(k) plans. There are three key differences between the approaches. The first is that the benchmark approach allows us to better compare the evolution of plan generosity over time—separately from changes in the characteristics of workers covered by these plans. The second is that it allows the evaluations of pension benefits for hypothetical job changes. And finally, it allows the ranking of the 401(k) and DB benefits in a utility framework with specified risk aversion parameters.

In both approaches, we specify pension benefits for worker i as $B_i = G_i(\tilde{y}_i, \tilde{r}_i, T)$. In this

expression, T is the number of years of eligible service, $\tilde{y}_i$ is a 1xT vector of earnings for individual i, and $\tilde{r}_i$ is a 1xT vector of returns that depends on the individual's portfolio allocation as well as the rates of return on the underlying assets. The function G_i represents how the individual's pension plan maps earnings, rates of return, and years of service into the pension benefit. For ease of exposition, G_i represents all of the plans for which a worker is eligible on his current job.

Clearly, both earnings and rates of return are stochastic, so each worker may face considerable uncertainty about his benefits at retirement. The probability that worker i receives retirement benefits from his pension plan that are less than a given level B is written:

$$F_i(B) = \Pr\left\{G_i\left(\tilde{y}_i, \tilde{r}_i, T\right) \leq B\right\} \tag{1}$$

where $F_i(B)$ is the probability of observing vectors $\tilde{y}_i$ and $\tilde{r}_i$ such that the resulting pension benefit is less than a given level B.

Suppose that the new 401(k) plan can be characterized by a new function G_i^*, with benefits equal to $B_i^* = G_i^*(\tilde{y}_i, \tilde{r}_i, T)$ and corresponding distribution function $F_i^*(B)$ as in (1). Since our objective is to compare the entire panoply of pension plans by vintage and type (actual plans in the PPS or 401(k) plans in later SCFs), our theoretical objective is to integrate over all plans in a given vintage and type to form an overall distribution function $F(B) = \sum_{i=1}^{N} \pi_i F_i(B)$ with a similar expression for $F^*(B)$, where the sample weight of observation i in our sample is given by π_i. Numerically, this takes the form

$$F(B) = \frac{\sum_{i=1}^{N} \sum_{s=1}^{S(\pi_i)} \mathrm{I}\left[G_{is}(\tilde{y}_{is}, \tilde{r}_{is}, T) \le B\right]}{\sum_{i=1}^{N} S(\pi_i)} \qquad \textbf{(2)}$$

where **I** is an indicator value that takes the value of one when the statement is true and zero otherwise, and $S(\pi_i)$ is the integer number of earnings and asset return simulations performed for each of the i workers, with $S(\pi_i)$ proportional to the sampling weight π_i. In the empirical section, we present results for both the expected value of each distribution, and percentile values $F^{-1}(z)$ and $F^{*-1}(z)$ for the 10th, 50th, and 90th percentiles.

Because we do not observe the entire history of earnings and asset returns, we specify the distribution of these variables. We assume that the structure of the earnings process is given by:

$$\begin{aligned} \ln(y_{it}) &= X_{it}\beta + u_{it} \\ u_{it} &= u_{it-1} + \varepsilon_{it} \\ \varepsilon_{it} &\sim i.i.d.\ N(0, \sigma^2) \end{aligned} \qquad (3)$$

where $\ln(y_{it})$ is the natural logarithm of earnings y_{it}, which is assumed to follow a random walk with a quartic drift in age, represented by X_{it}.[7] For computational simplicity, we ignore transitory shocks to earnings.[8] The randomness in earnings is characterized by the T-1 vector of error terms $\{\varepsilon_{it}\}$. We project earnings forward using these error terms (i.e., given earnings in year t, ε_{it+1} yields y_{it+1}), and project earnings back where appropriate using analogous error terms.

Computing expected pension benefits requires, at a minimum, the evaluation of a T-1 dimensional integral over all of the shocks to earnings. Since it is not possible to evaluate the distribution function G analytically, we instead simulate the probability distribution of earnings

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[7] The age-related components of earnings growth were estimated from the March 1983 Current Population Survey by regressing the logarithm of annual earnings on age, age^2, age^3, and age^4 for full-time, white male workers (see Murphy and Welch, 1990).

[8] Omitting transitory shocks will make DB plans appear to be less risky, as most of them calculate benefits based on a short average of earnings at the end of the working years where transitory shocks may play an important role.

through simulated "draws" of T-1 independent values of ε_{it} from $N(0,\sigma^2)$. Together with the actual reported earnings in the survey year, we can construct the worker's entire earnings history for each simulated draw in the counterfactual case. (In the benchmark case, we begin each simulated earnings draw at the median earnings of the 31-year-old.)

Estimating the benefits provided by 401(k) plans also requires us to specify a process governing asset returns. The vector of returns $\tilde{r}_i$ over the T years depends on the portfolio of assets held and the rates of return on each asset. Suppose there are M different types of assets, with a 1xM vector of weights θ_i, which are assumed to be constant over time for a given worker; in other words, they are assumed to rebalance their portfolio to maintain the same asset share. The 1xT vector of returns $\tilde{r}_i$ is written as a weighted average of the asset-specific returns, $\tilde{r}_i = \theta_i \tilde{\rho}_i$. Asset returns are sampled with replacement from historical rates of return.

IV. Data and Parameterization

Our estimates of pension benefits are based on the household data in the *Surveys of Consumer Finances* (SCF) and the companion *Pension Provider Surveys* (PPS). Conducted triennially since 1983 by the Federal Reserve Board, the SCFs are designed to provide a comprehensive survey of household wealth in the United States. Each survey collects detailed information on income and wealth for both a representative cross-section of households and a special sample of high-income households identified from tax returns (Avery, et. al., 1984a,b). For every respondent or spouse in the 1983 and 1989 SCF samples who reported being covered by a pension, the PPS attempted to obtain the summary plan description for the plan from the pension provider, usually the employer.[9]

[9] The original documentation for the PPS in Curtin (1987) contains template programs that convert the PPS data into formulas to compute benefit entitlements under each plan. We have revised the original formulas to allow for individual-specific investment allocations, stochastic wage profiles, and stochastic investment returns.

One complication with our use of the 1989 Pension Provider Survey is that in 1989 (unlike 1983), the SCF does not identify whether the worker is covered by Social Security in addition to pensions. This creates the largest problem for state or local government employees whose pension plans may substitute for Social Security benefits. To avoid potential bias, we remove public sector employees from our simulations both 1983 and 1989.[10]

There are 2,180 workers in the SCF 1983 and 1,587 workers in the SCF 1989 who report being covered by a pension (including those covered only by a 401(k)-type plan) at their current employers, representing 43.39 and 44.15 million workers, respectively. Because many individuals may participate in the same plan, the total number of different plans used is 929 in 1983 and 541 in 1989. Approximately 74 and 71 percent of the workers reporting coverage had valid data on their plans in the PPS 1983 and 1989, respectively. Workers for whom a pension plan is not found in the PPS are assigned a pension plan according to an imputation procedure described in Samwick and Skinner (1998).

In DB plans, the annual benefit payment is typically specified in nominal terms and may change over time, such as providing an extra benefit in years before Social Security benefits are available. We therefore calculate the actuarial present value of the benefits and convert this actuarial present value into a constant, real annuity beginning at the age of retirement. For DC plans, we compute the constant, real annuity that could be supported by the balance in the account as of the retirement date. For DC plans obtained from the PPS in 1983 or 1989, we use the plan formula to determine employer contributions and self-reported data to determine employee contributions and investment allocations. For 401(k) plans in the various years of the SCF (spanning 1989 to 2001), we use self-reported data on the employer contributions as well.

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[10] Comparisons of 1983 DB pension benefits in the sample excluding workers who report that they are not covered by Social Security versus 1983 DB pension benefits in the sample excluding public sector employees show little

Table 1 describes samples of 401(k) plans from the SCFs in 1989 – 2001 to be randomly assigned to the workers as part of the counterfactual and benchmark scenarios.[11] The number of workers with only a 401(k) plan rose substantially over this period, from 8.17 million in 1989 to 27.75 million in 2001, with the largest change occurring between 1992 and 1995.[12] Employee and total contribution rates increased over this period as well; by 2001 combined rates of contribution were 11.53 percent of earnings.

Pension plans in the PPS that predict zero retirement benefits are excluded from our central simulations; these include DB plans that had been phased out or those with Social Security offset provisions that incorrectly assign zero benefits in some scenarios. In the SCF household surveys, there are a small percentage of workers who claim to be covered only by a 401(k) plan who nonetheless have no reported 401(k) contribution (by both the employer or employee); this percentage ranged from 2.7 to 4.7 percent depending on the year of the survey (see Table 1). Given our assumption that the annual contribution is maintained throughout the worker's employment, these workers would be predicted to end up without any pension. It is highly unlikely, however, that these workers would remain zero contributors their entire lives – since roughly three-quarters of these zero-contributors have 401(k) asset balances from prior contributions – but we will also present "lower bound" estimates under the assumption that workers will end up at retirement without any pension.[14]

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difference. We are grateful to Arthur Kennickell for suggesting this approach.

[11] The matched plans could actually be any type of tax-deferred savings plan; for simplicity, we refer to all such tax-deferred saving plans as 401(k) plans in the text.

[12] Although the sampling frames are slightly different, the implied pension coverage and contribution rates are consistent with those from the CPS for the 1988 and 1993. (See Samwick and Skinner, 1998, Appendix A.)

[14] Recall that all simulations exclude zero pension outcomes for defined benefit plans. Excluding noncontributors could impart an upward bias by assuming that temporarily high contributors contribute that amount for the rest of their lives.

The SCFs between 1989 and 2001 report contribution and asset allocation information for up to four pension plans per worker. For each of their three largest accounts, we assigned shares of equity in each 401(k) plan to 100, 0, and 50 percent, depending on whether respondents indicated that the account was invested “mostly or all in stock,” “mostly or all in interest earning assets,” or “split between these.”[15] The proportion of the accounts invested mostly in stocks increased from 23.69 percent in 1989 to 54.54 in 2001.

Individuals may hold a large part of their portfolio in company stock.[16] Holden and VanDerhei (2002a) estimated that 42 percent of enrollees in 1996 were given the option to purchase company stock; of these, 65.5 percent held some company stock in their portfolio, with 15.3 percent holding more than 90 percent. We randomly assigned company stock ownership to match the overall distribution of company stock ownership in Holden and VanDerhei (2002a).[17]

With regard to rates of return, we use data from Siegel (1992, updated to 1990 by personal communication) for 1901-1990 for three broad categories of assets: short-term bonds, long-term bonds, and stocks. For company stock, the fourth category of assets, rates of return are drawn from the Center for Research in Security Prices (CRSP) database on individual stocks during 1926-1990, weighted in each year by relative asset value. (In practice, we draw randomly from the distribution of real stock return, discretized into 0.5 percent segments.) To capture the probability of an Enron-style collapse, we convert the bottom 0.5 percent of company stock returns to bankruptcy (i.e., -100 percent returns).

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[15] Because this question was not asked in 1983, we randomly assigned the 1989 allocations to the 1983 DC plans where necessary. The proceeds of the fourth account were assumed to be invested in the same proportions as the other three in our simulations. All miscellaneous investment allocations were classified as “interest bearing.” In our parameterization of investment allocations, we assume that all “interest earning” assets are evenly divided between short-term and long-term bonds.

[16] See Holden and VanDerhei (2002a), Mitchell and Utkus (2002), and Liang and Weisbenner (2002). We assume that earnings shocks are not correlated with asset returns (Davis and Willen, 2000). Unfortunately, company stock returns could not be matched to individual workers.

Average returns (10th and 90th percentiles) are 7.95 percent per year for equity (–6.12 percent, 21.12 percent), 1.58 percent for long-term bonds (-4.51, 6.60), and 0.75 percent for short-term bonds (-1.23, 2.99).[18] We imputed administrative load factors of 92, 71, and 42 basis points for equity, long-term bond, and short-term bond assets, respectively based on a report by the Investment Company Institute.[19] This means that the average rate of return on short-term bonds, for example, is just 0.33 percent (0.75-0.42). In our basic simulations of earnings the worker is assumed fully employed until age 62, although in subsequent simulations, we allow the worker to switch jobs or retire early. We set $\sigma = 0.13$ in equation (3), meaning that the standard deviation of the (permanent) innovation in log earnings is 13 percent per year.[20] Economy-wide real earnings growth is assumed to be 1.5 percent annually, and both the real interest rate and the inflation rate are 3 percent. Finally, we simulate one earnings and asset draw for every 1,000 workers in the sample population weights, for a total of 39,784 simulations for the 1983 data and 40,203 for the 1989 data.

V. Empirical Results

Counterfactual Comparisons

We first consider the counterfactual, where individuals in DB plans are assigned randomly chosen 401(k) plans along with the corresponding asset allocation and contribution

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[17] For example, 6.5 percent (0.42 x 15.3 percent) of 401(k) enrollees hold 90-100 percent of their entire portfolio in company stock. Midpoints of deciles (in this case 95 percent) were used in the numerical calculations.

[18] The mean return on individual (company) stock is higher because rates of return when these data were available (1926-90) were higher than the entire period 1900-1990.

[19] We base these load factors on average operating expenses in 1998, reported in ICI (2002). The ICI report further adjusts administrative costs by "distribution costs," to adjust for front-end costs of mutual funds. However, their distribution costs are simply the total costs in that year divided by outstanding assets, and thus would be biased upward if mutual funds were expanding (as they were in 1998). Thus we take the average front-end sales costs (1.8 percent for the 44 percent of plans charging such costs), plus 12b-1 costs, and amortize over an assumed 10-year holding period, and add this 9 basis point charge to both stocks and long-term bonds. We assume no administrative costs for company-owned stock.

[20] Topel and Ward (1992) and Samwick (1993) estimate the standard deviation of the permanent innovation in log earnings to be about 13 percent.

rates; these are presented using 1983 workers and DB plans in Table 2A, with all values in 1995 dollars. The first two columns present the mean, median, 10th percentile, 90th percentile, and standard deviation of pension benefits for actual workers with just a DB pension in the PPS assuming they continue working on their current jobs until age 62. In 1983, these workers could expect mean benefits of $14,237 and median benefits of $9,440, with a benefit at the 10th percentile of $2,022. Assigning randomly chosen 401(k) plans from 1995 for the same earnings and asset draws yields mean benefits of $25,983, median benefits of $11,004, and 10th percentile benefits of $1,521. (Kolmogorov-Smirnov tests for the equality of each pair of distributions reject the null.) When the 4.36 percent of 401(k) enrollees with zero contributions (and hence zero benefits) are included, the median falls to $9,950, still higher than median DB benefits in 1983. Although the identity of the workers at these various percentiles may differ across the two distributions, expected benefits under the 401(k) plans are higher for nearly every probability level. The exception is at the 10th percentile; DB plans yield an annual payment of $2,022 while 401(k) plans provide $1,521 (including the zero contributors reduced the 10th percentile benefit to $727). A utility framework is considered in the benchmark analysis below to allow ranking of the 401(k) and DB distributions.

The next two columns make the analogous comparison for the 26 percent of the sample in 1983 with combined DB and DC plans. These workers may have a plan that has important attributes of each type of plan, or they may simply have two or more plans with at least one of each type. We take a conservative approach by replacing both the DB and the DC plan with just

a single 401(k) plan. Median benefits from the 401(k) plan alone are less than the benefits from the combined DB and DC plan ($15,108 versus $23,152). The final two columns of Table 2A compare the larger group of DC plans (of which 401(k) plans are a subset) from the 1983 PPS against 401(k) plans from 1995. The higher median benefits for the 401(k) plans in 1995 suggest that typical defined contribution plans have become more generous since 1983.

Table 2B performs the same counterfactual experiment as in Table 2A, now using the sample of plans from the PPS 1989. Once again, for workers with only DB plans, mean benefits from 401(k) plans are substantially larger at $25,531 than are benefits from their original DB plans at $19,102. However, median benefits are 10 percent lower for 401(k) plans ($11,274) compared to DB plans ($12,524). (Including noncontributors in the sample reduces median benefits to $10,176, although the mean is still higher.) As well, the 10th percentile pension is lower for the 1995 401(k) plan, $1,716 compared to $2,421.

Unfortunately, the lack of a pension provider survey in the SCFs later than 1989 precludes a direct comparison of 1995 401(k) plans with 1995 DB plans. However, other evidence suggests that the characteristics of DB plans in 1995 were not substantially different from those in the 1989 sample (Gustman et al., 1998). If anything, the introduction of cash balance plans later in the 1990s has eroded the generosity of existing DB plans, at least for workers who remain in their job until age 62 (Clark and Schieber, 2002). Thus, we view the 1989 PPS sample of DB plans as reflecting the upper bound on the generosity of current DB plans. Indeed, the 1983 sample of DB plans are probably more representative of pensions available at the dawn of the 401(k) era.

Benchmark Comparisons

Table 3 presents the distribution of pension benefits for the benchmark individual.[22] Because real income is held constant over time, we can evaluate secular changes in the generosity of pension plans. As noted by Gustman and Steinmeier (1998), DB plans in 1989 were more generous than DB plans in 1983 along all points of the distribution, perhaps reflecting the retirement of the least generous DB plans during this period (e.g., Papke, 1999; Ippolito and Thompson, 2000).

In the counterfactual exercise, the 1989 DB plan provides a higher mean and median payment than the corresponding 1989 401(k) plan. However, by 1995 expected benefits from the 401(k) plans provided higher retirement benefits at both the mean and median, although the 10th percentile is still below that for the 1989 DB plans. Figure 1 shows the entire distribution of benefits in the two samples. The distributions are very close until the medians, above which the 401(k) plans show increasingly larger benefits. The expected benefits from 401(k) plans have continued to grow through the latter 1990s, so that by 2001 even the 10th percentile from the 401(k) plan is roughly equivalent to the corresponding percentile from the 1989 DB plans. The secular growth in benefits reflects higher contribution rates and a shift away from the very low-yield short-term bonds. These results are robust to including the 4.36 percent of 401(k) enrollees with zero benefits. Table 4 presents benchmark estimates for this larger group. While in 1995, median and mean benefits are larger for 401(k) plans than for the 1989 DB plans, the gap between 10th percentile 401(k) and DB benefits have widened.

To consider these differences in a unified framework, we use a utility-based comparison

[22] To construct the benchmark worker, we begin with the average real income ($40,218) and age (42) of the 1983 sample, and used the age-earnings profile to project average earnings back to age 31, resulting in initial earnings of $27,092 in constant 1995 dollars for each simulated earnings history. We specify fulltime work of 2080 hours per year and voluntary contributions to DC plans of 5.68 percent, the sample mean. We simulate earnings forward from age 31. For the 1989 simulations, we maintain the same real earnings at age 31 (and earnings dynamics), but adjust nominal earnings to the 1989 price level ($19,500) and change the worker's birth date to 1958 from 1952.

where we estimate the degree of relative risk aversion under which 401(k) plans would be preferred to the "DB Only" option. To approximate the actual income the worker is likely to have, we add the pension benefits to the Social Security benefits the worker would receive under the same earnings profiles. Using the 1995 401(k) plans that exclude zero contributors, we find that all workers with an Arrow-Pratt measure of relative risk aversion $\gamma \leq 6$ would prefer the 401(k) to the corresponding DB plans; the value is even higher in comparison to the 1983 DB plans. The "lower bound" estimates that include 1995 401(k) noncontributors (with zero pension income), the indifference point is $\gamma \leq 2$ (relative to the 1989 DB plans) and $\gamma \leq 4$ (relative to the 1983 DB plans). Even when noncontributors are included in the sample, individuals with $\gamma \leq 7$ prefer the distribution of returns from the 2001 401(k) plans in comparison to 1989 DB plans. Most estimates of relative risk aversion are substantially below this value (see Halek and Eisenhauer, 2001). In sum, these results suggest that 401(k) plans, particularly those observed in more recent years, are preferred to defined benefit plans for all but the most risk averse individuals.

Additional Sensitivity Analysis

Having established our main results regarding the comparison of "DB Only" and 401(k) plans, we further investigate the sensitivity of our results in the remaining columns of Table 4. The first is to lower equity returns by 2 percentage points (Column 3). The returns on the 401(k) plans are reduced such that the average return is roughly equal to the corresponding DB plans, but the median benefit \$12,081, or 8 percent below the DB plan benefit. (The 10^{th} percentile is largely unchanged.) The second sensitivity test is with regard to administrative fees. There is considerable variation across plans with regard to fees, with the largest and most efficient plans charging roughly 30 basis points. Lower mutual fund fees have a substantial positive impact on

benefits, raising the median by 10 percent and the 10^{th} percentile by 17 percent. Finally, lowering the retirement age to 55 will take advantage of some of the early retirement provisions in DB plans, while reducing the length of time for investments to grow in 401(k) plans. Surprisingly, the reduction in median benefits is greater for the DB plans than for the 401(k) plans, a 51 percent decline ($13,151 to $6,431) for DB plans versus a 44 percent decline ($13,942 to $7,861) for the 401(k) plans. Similar changes are observed for other points in the distribution as well.

Job Changes

In our main comparisons, we assumed that workers were covered by the same pension from age 31 to 62. The final retirement benefits of both DB plans and 401(k) plans can suffer if the worker changes jobs before retirement. For DB plans, final average pay used to calculate retirement benefits when the worker is eventually eligible is the *nominal* wage when he left the firm. This lack of indexation causes DB benefits to be backloaded—a disproportionate share of the retirement benefits for long career workers are accumulated in the years prior to the (early or normal) retirement age. For 401(k) plans, the danger is not the backloading of benefits but the potential for spending pre-retirement lump sum distributions rather than rolling them over into other retirement or savings accounts.

To assess the consequences of job turnover on eventual retirement income distributions, we consider the following question in the context of the benchmark simulations: what fraction of a worker's 401(k) plan could be withdrawn upon job change and still leave the same median benefits as the typical DB plan? To do this, we simulate the distribution of pension wealth for the benchmark worker in a variety of careers: Long (ages 31 to 65), Late Start (42 to 65), Early

(31 to 42), Middle (42 to 53), and Late (53 to 65).[23] Table 5 presents median pension *wealth* (not benefits) at the termination of the job for the samples of DB plans from 1983 and 1989 and the matched 401(k) plans from 1995. For the DB plans, benefits are discounted back to the age at which the job ends using a 3 percent real interest rate. For jobs that last from age 31 to 65, the median DB benefits are 67 and 82 percent of the 401(k) plans in 1983 and 1989, respectively. Thus, workers who enjoy a long career under the same pension could spend 18 percent of their balances immediately and still have enough to obtain the median annuity from the 1989 sample of DB plans.[24] The comparison becomes more favorable for DB plans when the career starts later. Compared to the 401(k) plans, median wealth is 4 percent higher in the 1989 DB sample for "Late Start" workers (age 42 to 65) and 13 percent lower in the 1983 DB sample.

The comparisons become much less favorable for DB plans when the career ends before 65. For the Early Career job (age 31 to 42), the median DB wealth is just 31.3 percent of the median 401(k) balance, suggesting that the workers could spend about two-thirds of the distribution and not lose pace with the DB plans. Similarly, for the Middle Career job (ages 42 to 53), the median DB wealth is just 65.6 percent of the median 401(k) balance, allowing more than one-third of the lump sum distribution to be spent rather than saved.[25] Factoring in the 31.3 percent higher DB benefits for the Late Career job, and allowing the portion of lump sum distributions that are saved to compound at a real interest rate of 3 percent, a policy of saving 37 percent of both pre-retirement distributions at the median would be sufficient to maintain parity

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[23] We allow the worker to remain employed for at least 10 years in each job to ensure that they do not run afoul of DB vesting restrictions in the 1983 survey. Jobs that end before 5 years, the current vesting period, would lessen DB pensions even more.

[24] Retirees may face adverse selection in attempting to purchase annuities outside of a group, although Brown, Mitchell, and Poterba (2000) suggest that private annuity purchasers are receiving nearly fair market rates.

[25] Poterba, Venti, and Wise (1998) report that the probability of reinvesting lump-sum distributions based on the 1993 CPS rises steadily with age, from 48 percent for those age 35 to 44 to 73 percent for those age 55 to 64. Also see Chang (1996), Engelhardt (2001), and Berman, Coe, and Gale (2001).

with the sequence of median benefits from the DB plans. Note that comparing remaining pension benefits does not capture a critical difference between the hypothetical loss in 401(k) benefits and the loss of DB benefits: at least 401(k) enrollees buy something they want, rather than having it revert to employers as it does under DB plans.

VI. Are Workers Really Better Off Under DC Plans?

One important limitation of our analysis is that we focus just on retirement benefits and not on the general equilibrium wage and saving effects that could occur as DC plans cover a larger fraction of workers. A standard life cycle model would suggest that, aside from tax issues, the form of the pension plan is irrelevant to the worker's retirement security. What matters is the total compensation package of the worker, which includes both wages and fringe benefits. Any changes in the pension plan can be neutralized by the appropriate adjustment to net wages and the *non-pension* wealth of the worker. For example, a shift from a DB plan funded by the employer to a DC plan funded entirely by employee contributions has a first-order impact on the overall wage of the worker. To keep compensation constant, employers would increase the gross wage by the amount they had previously contributed to the DB pension fund. Thus our comparisons tend to be biased against DC plans, since increasing gross earnings along with randomly assigning a 401(k) plan would also increase simulated 401(k) benefits.

However, suppose that employers understood that DC plans provided generally superior benefits to employees at retirement. In this case, employers could respond by *reducing* wages while keeping the overall level of compensation (wages plus pensions) the same. But for this effect to dominate the opposite bias noted above, it would have to be the case that DB plans yield lower retirement benefits than the 401(k) plans counting only employer contributions, something that we do not find in our (unreported) simulations. Thus, we argue that general equilibrium

effects would tend to be biased against 401(k) plans relative to DB plans.

It could also be the case that workers are simply saving less in conventional saving accounts in response to the increase in 401(k) employee contributions. In this case, there is a complete offset between taxable saving and tax-deferred saving, with little improvement in financial security at retirement. While there is still some controversy regarding the impact of 401(k) plans on higher income households, even the critics of 401(k) plans find a net positive impact on lower or middle-income contributors.[26]

VII. Conclusion

The surprisingly rapid increase in the number of defined contribution pension plans raises an obvious question: will such plans provide adequate retirement income security compared to the previously dominant defined benefit plans? We have addressed this question using a large sample of workers and detailed information on their pension plans from the *Surveys of Consumer Finances* from 1983 through 2001 along with simulated earnings and asset returns, including returns from company-owned stock. Our results suggest that generally, 401(k) plans, particularly those provided in later years, are as good or better providing than DB plans in providing for retirement. While benefits at the 10th percentile are generally lower among 401(k) plans, utility-based comparisons generally favor 401(k)s across a wide range of risk aversion parameters, particularly 401(k) plans from more recent years. The intuition behind this result is that stock market returns are largely uncorrelated, so that over the worker's employment career, low rates of return tend to be balanced by higher rates of return. By contrast, defined benefit plans tied to the final years of earnings expose the worker to considerable earnings risk.

These results would be strengthened in a more complex model where DB plans could

[26] See Poterba, Venti, and Wise (1996), Engen, Gale, and Scholz (1996), Hubbard and Skinner (1996), Engen and Gale (2000), and Khitatrakun, Kitamura, and Scholz (2000).

reduce benefits *ex post*, for example with cash balance plans (Clark and Schieber, 2000) or because of default and government subsidies to pay existing DB claims. The Pension Benefit Guaranty Corporation, which insured DB pension plans, recently reported a $5.4 billion deficit, and the automobile industry pensions are reported underfunded by $60 billion (Kandarian, 2003).

There are two important reasons why 401(k) plans may fall short of defined benefit plans. The first is inadequate (or zero) contribution rates. While fewer than 5 percent of workers without defined benefit plans who are offered 401(k)s fail to contribute in any form, legislation that sets minimum contribution rates could improve retirement benefits substantially for the bottom decile of pension benefits (Samwick and Skinner, 1997). Second, our sensitivity analysis has shown the importance of investment fees for administering 401(k) balances. Any advantages of 401(k) plans over DB plans can be largely eroded with the often very high load factors found in smaller 401(k) plans (USDOL, 1998a). Still, despite the recent media outcry to the contrary, our results suggest that the trend toward 401(k) plans has strengthened the retirement security of current workers.

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Figure 1: Cumulative Distribution of Defined Benefit and Matched 401(k) Plans

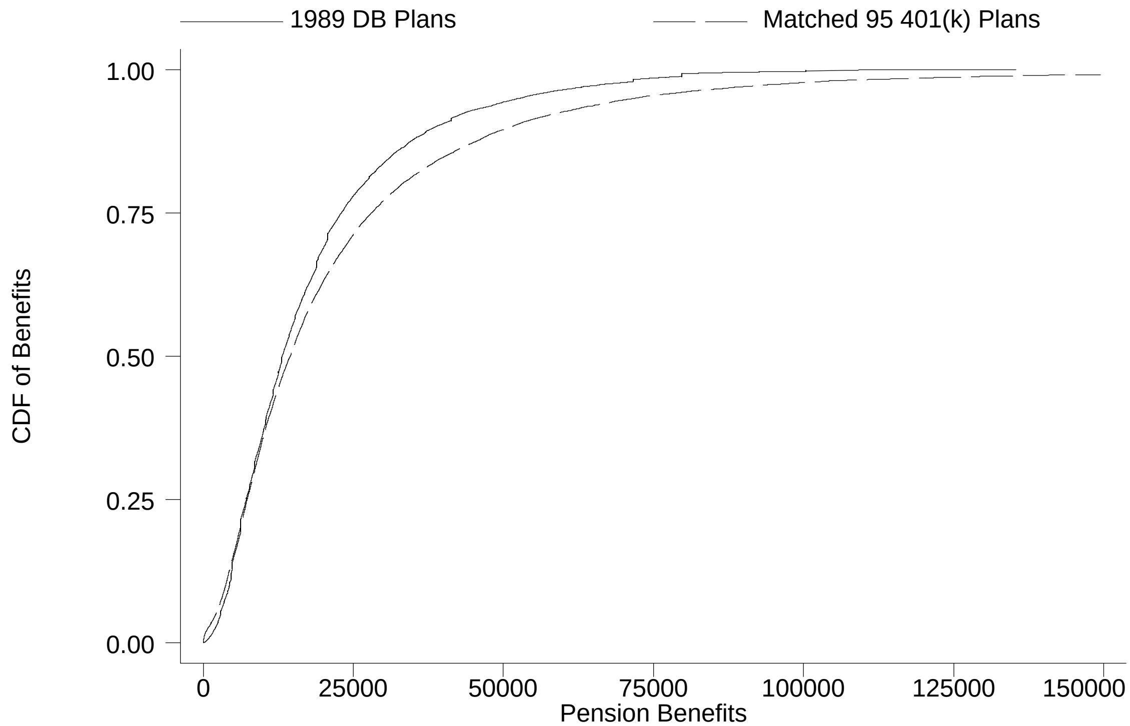

Table 1: Characteristics of Matched 401(k) Plan Samples, 1989 – 2001

Characteristic	1989	1992	1995	1998	2001
Workers with 401(k) Plans Only					
Number of Observations	330	516	849	1,009	1,204
Millions of Workers	8.17	11.90	19.09	23.47	27.75
Contributions to 401(k) Plans					
Mean (median) employee contribution	5.28 (4.00)	5.55 (5.00)	5.99 (5.00)	6.46 (5.65)	6.65 (6.00)
Mean (median) employer contribution	5.03 (3.00)	5.16 (4.00)	5.08 (4.00)	4.58 (3.36)	4.89 (4.00)
Mean (median) total contribution	10.31 (9.00)	10.71 (9.00)	11.08 (10.00)	11.04 (10.00)	11.53 (10.00)
Percent of workers with no contributions	*	4.67	4.36	4.04	2.72
*Asset Allocation***					
Mostly in Stocks	23.69	24.74	38.22	45.43	54.54
Split Between Stocks and Bonds	36.79	39.92	41.23	37.94	34.13
Mostly in Bonds	39.52	35.34	20.55	16.63	10.31

Notes:
Source: Authors' tabulations of the Surveys of Consumer Finances, 1989 – 2001. Contribution amounts to the 401(k) plans are reported for the sample of workers who report positive total contributions.

* Reported value of 0.02 percent which is almost surely the result of confusion regarding the question. When 401(k) plans were relatively scarce, workers may not have been aware of their 401(k) plans unless they or their employers were actively contributing.

** Possible answers to the asset allocation questions are: (a) Mostly or all stock; stock in company, (b) Mostly or all interest earning; guaranteed; cash; bank account, (c) Split between stock and interest earning assets, (d) Real estate, (e) Insurance / Retirement plan, (f) Other. Responses (a) and (c) are imputed at 100 and 50 percent in equity, respectively. All other responses are imputed at 0 percent in equity.

Table 2A: Counterfactual Pension Income Distributions
1983 Pension Provider Survey

	DB Only		DB and DC		DC Only	
	1983 PPS	1995 401(k)	1983 PPS	1995 401(k)	1983 PPS	1995 401(k)
Mean	14,237	25,983	37,232	33,690	18,597	30,965
Median	9,440	11,004	23,152	15,108	7,220	11,648
10th Percentile	2,022	1,521	5,110	2,611	924	1,541
90th Percentile	31,055	58,891	75,739	73,032	40,385	72,560
Standard Deviation	15,789	60,208	79,321	70,973	49,276	71,785
Obs.	22,365		10,052		6,426	

Table 2B: Counterfactual Pension Income Distributions
1989 Pension Provider Survey

	DB Only		DB and DC		DC Only	
	1989 PPS	1995 401(k)	1989 PPS	1995 401(k)	1989 PPS	1995 401(k)
Mean	19,102	25,531	42,638	36,883	28,970	29,258
Median	12,524	11,274	26,356	16,284	10,581	12,004
10th Percentile	2,421	1,716	6,154	2,191	1,543	1,191
90th Percentile	44,014	57,952	90,072	81,411	57,252	68,233
Standard Deviation	20,700	61,565	61,427	83,435	86,319	65,463
Obs.	13,409		12,131		14,260	

Notes:
1) Source: Authors' tabulations of the Surveys of Consumer Finances, 1983 and 1989 – 2001, and the Pension Provider Surveys, 1983 and 1989.

2) All amounts are in 1995 dollars and represent the level of constant, real annuities payable at retirement based on the actuarial present value of DB pension benefits or the balance in the DC pension or 401(k) account.

3) The baseline assumptions assume a 13 percent standard deviation of the permanent shock to earnings each year, a 1.5 percent rate of annual productivity growth, and a retirement age of 62.

4) Public sector workers are excluded from the sample in both 1983 and 1989.

Table 3: Benchmark Pension Income Distributions, Matched 401(k) Plans, 1989 – 2001

	DB Only Plans from Pension Provider Surveys		Matched 401(k) Plans from Surveys of Consumer Finances				
	1983	1989	1989	1992	1995	1998	2001
Mean	14,552	18,228	17,503	19,535	23,112	24,797	26,461
Median	10,681	13,151	10,633	12,136	13,942	15,113	16,338
10th Percentile	3,272	4,415	1,969	3,243	3,385	4,384	4,200
90th Percentile	29,831	38,628	37,395	41,181	49,793	52,519	56,510
Std Deviation	14,003	16,388	26,619	26,407	34,761	35,771	35,536

1983 PPS sample, N = 22,512; 1989 PPS sample, N = 12,922. See Notes to Table 2.

Table 4: Benchmark Pension Income Distributions, Sensitivity Analysis

	Base-Case (From Table 3)		401(k) Plans Changed to have:			Retirement Age Lowered to 55	
	1989 DB Only	1995 401(k)	4.36% Zero Balances	2% Lower Equity return	Admin. Fees Equal 0.30%	1989 DB Only	1995 401(k)
Mean	18,228	23,112	22,294	18,436	25,081	9,187	11,599
Median	13,151	13,942	13,624	12,081	15,373	6,431	7,861
10th Percentile	4,415	3,385	2,518	3,227	3,950	1,899	2,268
90th Percentile	38,628	49,793	49,918	39,910	55,339	20,570	24,664
Std Deviation	16,388	34,761	30,471	22,076	33,159	8,307	12,817

See Notes to Table 2.

Table 5: Median Pension Wealth for Benchmark Worker with Interrupted Pension Coverage

Job Duration	Median Wealth 1983 DB (1)	Median Wealth 1989 DB (2)	Median Wealth 1995 401(k) (3)	Wealth Ratio 1983/1995 (1)/(3)	Wealth Ratio 1989/1995 (2)/(3)
Long Career (31 – 65)	386,162	473,492	574,844	0.672	0.824
Late Start (42 – 65)	286,926	343,448	330,828	0.867	1.038
Early Career (31 – 42)	12,157	17,609	56,252	0.216	0.313
Middle Career (42 – 53)	39,613	57,673	87,936	0.450	0.656
Late Career (53 – 65)	155,263	184,815	140,808	1.103	1.313

Notes:

1) Source: Authors' tabulations of the Surveys of Consumer Finances, 1995, and the Pension Provider Surveys, 1983 and 1989.

2) All amounts are in 1995 dollars and represent the present value of pension benefits in the year the worker leaves the firm, discounted at a real interest rate of 3 percent.

3) The baseline assumptions assume a 13 percent standard deviation of the permanent shock to earnings each year and a 1.5 percent rate of annual productivity growth.

4) Public sector workers are excluded from the sample.