

# How Will Defined Contribution 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 1998. Our simulations account for uncertainty with respect to rates of return on stocks and bonds, uncertainty in earnings, and heterogeneity in asset choices, plan participation, and job tenure. We show that 401(k) plans offered during the 1990s provide a distribution of retirement income that is generally preferred to conventional defined benefit plans. This result is robust to different assumptions regarding the spending of 401(k) plan balances between jobs, equity rates of return, productivity growth, and the date of retirement. Combination defined benefit and defined contribution plans tend to be more generous than either in isolation.

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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). Under DC plans, the employee and employer make regular payments into investment accounts that accumulate tax-free until retirement. The employee typically bears the primary responsibility for investing the contributions and for making supplemental contributions to ensure a satisfactory retirement income. This dramatic shift is most noticeable among small employers, but it is also present in large employers, state and local governments (Dow Jones, 1995), and other countries such as Canada and the United Kingdom (Flavelle, 1997; Martinson, 1998).

This fundamental shift in the nature of pension saving has concerned observers in the popular press and in academia. Some believe that defined contribution pension plans are a crisis waiting to happen when current generations, having made minimal (or no) contributions to their DC plan, retire with inadequate pension asset balances (Ferguson and Blackwell, 1995; Willette, 1995). And even for workers who do contribute, when changing jobs they often use the lump sum distributions for houses, boats, or other purchases rather than reinvesting them in another retirement account (Schultz, 1993, 1995; USDOL, 1998). 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., Dorsey, 1987; Brown and Warshawsky, 2001).

Perhaps the most strident criticisms focus on the risk surrounding DC plan benefits; specifically, the uncertainty in rates of return. Employees may be uninformed about their

investment choices, lack the confidence to manage their own retirement money, or suffer from poor stock market and bond returns (Ferguson and Blackwell, 1995; Flaherty, 1997). Concern about rates of return has intensified with the realization that in 2000, average 401(k) balances declined for the first time (Hakim, 2001). A further source of uncertainty is related to variability in future earnings. Defined contribution plans lack explicit mechanisms to pool earnings risk across workers. In contrast, DB plans often include provisions such as minimum benefit amounts and maximum benefit caps that reduce risk in a cross-section of workers (Bodie, Marcus, and Merton, 1988).

Aside from anecdotal information, however, there is surprisingly little information about the adequacy of DC plans relative to the DB plans they have supplanted. 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. Ideally, the comparisons would involve a representative sample DB pension plans from a period prior to the transition toward DC plans and a representative sample of DC plans from a period after the trend had stabilized.

We approach this ideal by exploiting data from the Surveys of Consumer Finances from 1983 to 1998, 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 from an early part of the transition 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 1998.

Using the methodology developed in Samwick (1993a), we characterize the distribution of pension benefits by simulating a broad range of earnings paths and portfolio returns through the weighted samples of DB and DC plans. Our main finding is that the typical 401(k) plan provides an expected annuitized retirement income that is higher across nearly every point in the probability distribution than the typical defined benefit plan in the early 1980s, when the DB plan was the norm. As well, we find that the typical 401(k) plan in 1995 provided a higher expected retirement income than a typical purely DB plan in 1989, a period after which many of the weaker DB plans had been phased out. (While we do not have direct evidence on more recent DB plans, Gustman et al (1998) found little or no change in the average generosity of DB plans in large firms between 1990 and 1995.) Combination DB and DC plans, on the other hand, tend to be more generous than either plan in isolation.

Our main 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 backloading of DB pension accruals, or the loss to employees in DB benefits that occurs when they leave prior to retirement ages. Our simulations show that, to maintain parity with traditional DB plans, the median employee with a 401(k) plan generally needs only to roll over between half and three-fourths of their 401(k) balance when she changes jobs.

In short, our results suggest that 401(k) plans are not the ticking time bomb that many fear. If some 401(k) plans do not provide adequately for retirement, then neither did many DB plans. These findings do not depend 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. The result is robust to even lower simulated equity rates of

return, as well as changes in productivity growth and earnings uncertainty.

## **II. The Increasing Importance of Defined Contribution Plans**

Defined contribution plans have experienced rapid growth in the past two decades. The percentage of all workers listing DC plans as their *primary* pension has risen from 10 percent in 1982 to 24 percent in 1996. During this same period, the percentage of workers with DB as their primary pension plan plummeted from 36 percent to 23 percent (VanDerhei and Copeland, 2001). 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).

Why have DC plans become so popular? During the 1970s and 1980s, a primary reason was the relative decline in employment at large, unionized manufacturing firms, which tend to favor DB plans relative to small, non-unionized service firms, which tend to favor DC plans (Beller and Lawrence, 1992). During the same period, a succession of legislation since the Employee Retirement Income Security Act of 1974 (ERISA) has increased the relative cost and complexity of DB plans and enhanced the tax advantages of DC plans. Another factor is the growing acceptance of DC plans as saving vehicles by employees themselves. In particular, workers who expect to change jobs frequently over their careers might favor DC plans over DB plans because they provide access to better benefits for short-term workers (although see Francis, 2001). Finally, Poterba, Venti, and Wise (2001) suggest that federal rules preventing firms from contributing to overfunded DB plans led to increased interest in alternative forms of tax-deferred pension contributions, in particular hybrid DB/DC plans.

The process by which DC plans supplanted DB plans was not uniform across the population of covered workers. Using the same PPS data from 1983 and 1989 that we analyze,

Gustman and Steinmeier (1999) found a marked improvement in the capitalized value of DB plans between 1983 and 1989. They suggested that roughly half of the improvement was because of increased generosity of existing plans, with the other half because of termination of weaker DB plans.<sup>1</sup> It is therefore an open question as to which year, 1983 or 1989, provides the truer picture of the “null hypothesis” DB plans that have been replaced by 401(k)s. The sample of DB plans in 1983 reflects DB plans when they were the norm. However, the more generous DB plans in 1989 may also reflect a secular trend towards increased employee fringe benefits. To be conservative, we present our results for both years but focus on the 1989 sample to draw our main conclusions.

During the early 1980s, DC plans appeared primarily as a way to supplement an existing DB plan. Increases in the total level of retirement income could then be made by expanding the DC portion rather than the DB portion. 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 terminate the DB plan and replace it with a DC plan (Papke, 1995, 1999; Ippolito and Thompson, 2000). During the late 1980s and early 1990s, the 401(k) plan became the dominant form of DC plan. In our empirical work, we focus on the 401(k) plan contribution rates and investment allocations from 1995 to draw our main conclusions.

### **III. Modeling the Distribution of Pension Benefits**

In this section, we present our methodology for characterizing the entire distribution of pension benefits from both DB and DC plans taking into account variation (for a given worker) in earnings and asset returns and variation (across workers) in the types of pension plans

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<sup>1</sup> Several pieces of federal legislation were passed during the mid-1980s to attempt to increase pension benefits, particularly among older workers as well as workers with short job tenure and low earnings. See Samwick (1993b) for an analysis of the effect of these provisions on the distribution of pension wealth.

available. We begin by identifying the key characteristics that determine the benefits in both DB and DC plans. We then establish an analytical framework to compare the distributions across plan types.

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).<sup>2</sup> 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.<sup>3</sup> 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.<sup>4</sup> 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

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<sup>2</sup> Allen, Clark, and McDermed (1992) report that firms accounting for 26 percent of workers gave ad hoc increases in pension benefits to account for inflation between 1983-1987. The probability of receiving such ad hoc adjustments is not reflected in our calculations. However, all pension plan formulas have been modified as in Samwick (1993a) so that dollar amounts specified in nominal terms are indexed to nominal wage growth.

<sup>3</sup> 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.

<sup>4</sup> The impact of these incentives on retirement from the firm has been demonstrated in various ways over the past two decades. See, for example, Gustman and Steinmeier (1986), Stock and Wise (1990), and Samwick (1998). Woodbury (1997) discusses how the incentives in DB plans may actually be the consequence of efforts to ensure fairness in replacement rates across different types of workers based on years of service and age rather than explicit policies to manage turnover.

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 the amount of the employee contributions through a “matching” provision. Match rates typically range from \$0.10 to \$1.00 per dollar of employee contribution and may be capped. A common example is a 50 cents on the dollar match on the employee’s first six percent of salary contributed. The second dimension along which DC plans differ is the investment allocation. Some plans provide subsidized access to the company’s stock, particularly for the employer’s contribution. Others are affiliated with a mutual fund family to provide a wide array of diversified stock and bond portfolios. 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 SCFs from 1989 – 1998, we use self-reported data on the employer contributions as well.

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.

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 1989 – 1998, depending on the experiment. In both scenarios, the realizations of earnings and asset returns 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 samples. 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. The key difference between the two approaches is that the benchmark approach separates the characteristics of the worker (principally age and income) from the characteristics of the plan, thereby allowing us to better compare the evolution of plan generosity over time and to evaluate pension benefits for hypothetical job changes.

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  $1 \times T$  vector of earnings for individual  $i$ , and  $\tilde{r}_i$  is a  $1 \times T$  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:

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

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  $B_i^* = G_i^*(\tilde{y}_i, \tilde{r}_i, T)$ . We can also write the distribution function for this pension plan in a way similar to (1) above:

$$F_i^*(B) = \Pr \left\{ G_i^* \left( \tilde{y}_i, \tilde{r}_i, T \right) \leq B \right\} \quad (2)$$

For a given worker, a comparison of these two distribution functions ( $F_i$  and  $F_i^*$ ) determines whether his real annuitized pension benefit is as large under the new 401(k) plan as under the original plan. 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), we integrate over all plans in a given vintage and type to form an overall distribution function:

$$F(B) = \sum_{i=1}^N \pi_i F_i(B) \quad (3)$$

with a similar expression for  $F^*(B)$ , where the sample weight of observation  $i$  in our sample is given by  $\pi_i$ .

We compare the distributions  $F(B)$  and  $F^*(B)$  in two ways. First, we can compute the expected value of pension benefits implied by each distribution:

$$E(B) = \sum_{i=1}^N \pi_i E_i(G_i(\tilde{y}_i, \tilde{r}_i, T)) \quad (4)$$

with a similar expression for  $E^*(B)$ . Second, we also compare the distributions at various percentiles. The following condition,

$$F^{-1}(z) < F^{*-1}(z) \quad (5)$$

holds when the benefit received at the  $z^{\text{th}}$  percentile from the  $F(B)$  distribution is lower than the benefit received at the same percentile from the  $F^*(B)$  distribution.

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

$$\begin{aligned} \ln(y_{it}) &= X_{it} \beta + u_{it} \\ u_{it} &= u_{it-1} + \varepsilon_{it} \\ \varepsilon_{it} &\sim i.i.d. N(0, \sigma^2) \end{aligned} \quad (6)$$

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  $X_{it}$ .<sup>5</sup> For computational simplicity, we ignore transitory shocks to earnings.<sup>6</sup>

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  $t$ ,  $\varepsilon_{it+1}$  yields  $y_{it+1}$ ), and, because we do not have a complete wage history, we also project earnings back where

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<sup>5</sup> 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<sup>2</sup>, age<sup>3</sup>, and age<sup>4</sup> for full-time, white male workers. Murphy and Welch (1990) show that a quartic specification matches the empirical age pattern of earnings more accurately than the more typical quadratic specification using just age and age<sup>2</sup>, which tends to overstate the reduction or reversal of real wage growth near retirement.

<sup>6</sup> Omitting transitory shocks will make DB plans appear less risky than they actually are, as most of them calculate benefits based on a short average of earnings at the end of the working years where transitory shocks might play an important role. In contrast, under DC plans and a minority of DB plans, retirement income is based on a long average of earnings at the firm, so that transitory shocks will have little effect on retirement income.

appropriate using analogous error terms (given earnings in year  $t$ ,  $\varepsilon_{it}$  determines  $y_{it-1}$ , and successively back to  $\varepsilon_{i2}$ , which determines  $y_{i1}$ ).

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  $1 \times M$  vector of weights  $\theta_i$ , 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  $1 \times T$  vector of returns  $\tilde{r}_i$  is written as a weighted average of the asset-specific returns,  $\tilde{r}_i = \theta_i \tilde{\rho}_i$ . The  $M \times T$  matrix of asset-specific returns  $\tilde{\rho}_i$  is written (dropping the subscript  $i$  for legibility):

$$\tilde{\rho} = \begin{bmatrix} \tilde{\rho}_{1,1} & \cdots & \tilde{\rho}_{1,T} \\ \vdots & \ddots & \vdots \\ \tilde{\rho}_{M,1} & \cdots & \tilde{\rho}_{M,T} \end{bmatrix} \quad (7)$$

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 through simulated “draws” of  $T-1$  independent values of  $\varepsilon_{it}$  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.)

A somewhat different approach is used for simulating asset returns. Here we sample with replacement from historical rates of return rather than drawing from a parametric distribution. The distribution of pension benefits for each worker,  $F_i(B)$  and  $F_i^*(B)$ , can be estimated for a

sufficiently large number of draws, and the overall distribution functions,  $F(B)$  and  $F^*(B)$ , can be estimated by aggregation over all pension plans and individual wage and investment return scenarios. To ensure that the distribution functions are weighted appropriately, we set the number of simulation draws to be proportional to the sample weight for each worker,  $\pi_i$ .

#### **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.<sup>7</sup> 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).<sup>8</sup>

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.<sup>9</sup>

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<sup>7</sup> Descriptions of the SCF 1983 are provided in Avery et al. (1984a, b).

<sup>8</sup> 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. As discussed in Appendix C, we have revised the original formulas based on Samwick (1993a, b) to allow for individual-specific investment allocations, stochastic wage profiles, and stochastic investment returns.

<sup>9</sup> Comparisons of 1983 DB pension benefits in the sample excluding workers who report that they are not covered

Table 1 describes the characteristics of the sample of workers covered by pensions in the SCFs from 1983 and 1989. 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 the imputation procedure described in Appendix B.

The sample of covered workers in 1983 had an average age of 42, an average age of hire of 31, and an average wage of \$23,262 in current dollars (\$40,218 in constant 1995 dollars). The sample of covered workers in 1989 had an average age of 43, an average age of hire of 31, and an average wage of \$33,801 in current dollars (\$46,938 in constant 1995 dollars). Annual hours of work and average conditional contributions to DC plans were also somewhat higher than in 1983. 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 an initial earnings level 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. 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. Using the same benchmark worker allows us to evaluate directly whether

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by Social Security versus 1983 DB pension benefits in the sample excluding public sector employees shows little difference. We are grateful to Arthur Kennickell for suggesting this approach.

pension plans became more or less generous between 1983 and 1989.

Table 2 describes samples of 401(k) plans from the SCFs in 1989 – 1998 that are randomly assigned to the workers as part of the counterfactual and benchmark scenarios.<sup>10</sup> The number of workers with only a 401(k) plan rose substantially over this period, from 8.17 million in 1989 to 23.47 million in 1998, with the largest change occurring between 1992 and 1995.<sup>11</sup> Employee and total contribution rates increased over this period as well, while employer contributions showed a decline between 1995 and 1998.

Asset allocation also evolved over the period, with greater investment in equities in the later years. The SCFs between 1989 and 1998 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.”<sup>12</sup> The proportion of the accounts invested mostly in stocks increased from 23.69 percent in 1989 to 45.43 in 1998, with the largest increase occurring between 1992 and 1995. These increases came at the expense of investments mostly in bonds.

Because the investment allocation questions pertain to the balance in the accounts rather than the contributions, there is some possibility that the portfolio shares in equity in 1995 and

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<sup>10</sup> The matched plans could actually be any type of tax-deferred savings plan, including thrift or saving plans, 403(b) plans, supplemental retirement accounts, profit sharing, stock purchase, deferred compensation, IRA-SEP (not a conventional IRA), TIAA-CREF, money purchase plan, or tax-deferred annuities. As most of the plans are in fact 401(k) plans, we refer to all such tax-deferred saving plans as 401(k) plans in the text.

<sup>11</sup> 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 Appendix A.)

<sup>12</sup> 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

especially 1998 are inflated due to the high stock returns of the mid- and late 1990s and a delay in portfolio rebalancing by 401(k) plan participants. Two considerations mitigate this problem. First, rebalancing will not have an impact on workers' accounts that are invested "mostly in stock." Second, VanDerhei, Galer, Quick, and Rea (1999) examine portfolio allocations in an EBRI/ICI 1996 database of a wide range of 401(k) plans stratified by the participant's tenure. They found that for workers with tenure levels of between 0-2 years, workers for whom asset balances will be closest to the allocation of contributions, nearly one-third reported 100 percent equity investment and another 40 percent held between 20 and 80 percent equity. These percentages are similar to those in Table 2 for 1995 and 1998, suggesting that high equity allocations are a phenomenon of contributions, not just existing balances.

As a further precaution, we focus on the 1995 sample of 401(k) plans rather than the 1998 sample to avoid overstating the degree of equity investment going forward. In the same vein, we also assume that workers who report any diversified allocation rebalance their portfolios to maintain that allocation each year. In our parameterization of investment allocations, we assume that all "interest earning" assets are evenly divided between short-term and long-term bonds.

As noted above, we simulate  $\tilde{\rho}_i$  by using random draws of the *actual* returns received in years from 1901-1990. Note that we have taken a very conservative approach to stock market returns by excluding the robust returns from the 1990s and by including the early part of the 20<sup>th</sup> century, when equity returns were somewhat lower than in the latter part of the century. We follow Siegel (1992, updated to 1990 by personal communication) and distinguish between three types of assets: short-term bonds, long-term bonds, and stocks ( $M = 3$ ). A given worker will

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other three in our simulations. All miscellaneous investment allocations were classified as "interest bearing."

maintain the same asset weights throughout his life, and for all simulated draws from the sample of asset returns. While asset returns are correlated, we assume that earnings shocks are not correlated with asset returns.<sup>13</sup>

Summary statistics for the real returns on stocks, long-term bonds, and short-term bonds are presented in Table 3. The first row of the table shows that stocks had an average annual real return of 7.95 percent per year, compared to 1.58 percent for long-term bonds and 0.75 percent for short-term bonds. The remainder of the table presents other summary statistics on the distribution of returns, including the correlation matrix.<sup>14</sup>

In our basic simulations of earnings for both the counterfactual and the benchmark, 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 (6), meaning that the standard deviation of the (permanent) innovation in log earnings is 13 percent per year.<sup>15</sup> Economy-wide real earnings growth is assumed to be 1.5 percent annually, the real interest rate used for computing present values is assumed to be 3 percent, and the inflation rate is assumed to be 3 percent. Finally, we simulate one earnings and asset draw for every 1,000 workers in the sample

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<sup>13</sup> See Davis and Willen (2000) for evidence on this lack of correlation. We also do not allow for serial correlation in the asset returns, so that the years of historical returns are assumed to be i.i.d. We have tested for the robustness of our results to this assumption by also sampling asset returns in five-year “blocks” with replacement, so it would be possible for a single individual to sample the years (say) 1929-33 and then 1930-34. The results were similar to those reported below.

<sup>14</sup> Our allocation method probably overstates the variance in pension benefits by forcing contributors to maintain the same asset allocations and contribution rates for every working year. One would expect that workers who contribute little early in their careers will compensate by contributing more later on. On the other hand, we probably understate variance because we do not account for the fact that 19 percent of 401(k) funds take the form of employer stock (Holden and VanDerhei, 2001), rather than a broad market index.

<sup>15</sup> Using a large sample of individual labor market histories taken from the Social Security earnings records of young men, Topel and Ward (1992) find that the evolution of wages within jobs closely approximates a random walk. They estimate the standard deviation of the permanent innovation in log earnings to be about 13 percent. Using similar methods but earnings histories of workers of all ages from the *Panel Study of Income Dynamics*, Samwick (1993a) also obtains an estimate of approximately 13 percent.

population weights, for a total of 39,784 simulations for the 1983 data and 40,203 for the 1989 data.

## V. Empirical Results

In this section, we present the comparison of distributions of pension income under the actual plans in the PPS 1983 and 1989 and randomly assigned 401(k) plans from 1989 to 1998. We begin with our counterfactual comparisons, which answer the direct question of whether the distribution of benefits for actual workers would be higher under the 401(k) plans. We then use our benchmark comparison to consider whether a hypothetical worker with average characteristics would fare better under the actual plans or the 401(k) plans. We continue using the benchmark worker to examine the sensitivity of our main results to different economic parameters and to compare distributions when workers change jobs before retirement.

### *Counterfactual Comparisons*

The results of our counterfactual simulations using 1983 workers and DB plans are presented in Table 4A, with all values in 1995 dollars. The first two columns present the mean, median, 10<sup>th</sup> percentile, 90<sup>th</sup> 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 \$13,917 and median benefits of \$9,227, with a benefit at the 10<sup>th</sup> percentile of \$1,638. Assigning randomly chosen 401(k) plans from 1995 for the same earnings and asset draws yields mean benefits of \$30,880, median benefits of \$12,694, and 10<sup>th</sup> percentile benefits of \$1,890. Although the identity of the workers at these various percentiles may differ across the two distributions, for nearly every probability  $z$ ,  $F^{*-1}(z) > F^{-1}(z)$ , where  $*$  denotes the distribution of 401(k) benefits.<sup>16</sup>

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<sup>16</sup> We have also conducted Kolmogorov-Smirnov tests for the equality of each pair of distributions that we compare. In all cases, the null hypothesis that the distributions are equal is rejected with a p-value of 0.002 or below. The

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 more than two plans with at least one of each type. We adopt a conservative approach to the counterfactual by replacing both the DB and the DC plan with a single 401(k) plan, rather than just replacing the DB plan. Median benefits from the 401(k) plan alone are less than the benefits from the combined DB and DC plan (\$17,086 versus \$22,970). However, the next two columns show that, within the universe of workers with *any* DB plan in 1983, 401(k) plans in 1995 provided higher median benefits (\$14,061 versus \$11,874), and roughly equivalent 10<sup>th</sup> percentile benefits (\$2,160 versus \$2,103).

Table 4B performs the same counterfactual experiment as in Table 4A, 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 \$29,723 than are benefits from their original DB plans at \$18,813. Median benefits are also higher (\$13,171 versus \$12,061), as are 10<sup>th</sup> percentile benefits levels (\$2,167 versus \$1,994). As we regard this as our main result, 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 story is different when we consider the universe of workers with *any* DB plan. While mean benefits for the 1995 401(k) are somewhat higher compared to the DB plans, median benefits are now lower, \$15,217 versus \$17,910. That these results differ from those in 1983 reflects in part the trend of firms to supplement the weaker DB plans with supplemental DC plans.

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strong statistical significance of these differences is influenced by the large sample sizes we use—about 40,000 for each year, with at least 6,000 in any subsample that we consider.

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 our 1989 sample. In their sample of 50 large firms, Gustman et al (1998) found a mean change in accrued benefits between 1990 and 1995 of about 0.5 percent, and a median change of 0. 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, 2000). Thus, we view the 1989 PPS sample of DB plans as reflecting the upper bound on the generosity of current DB plans.

The universe of DC plans in the population includes a wider variety of plans than just the 401(k) or thrift plans that are the focus of this study. Because the Pension Provider Surveys also collect data on DC plans, we can compare the samples of DC plans from 1983 and 1989 with randomly assigned 401(k) plans from later years of the SCF. These comparisons are shown in the last two columns of Tables 4A and 4B. For both years, the benefits provided by 401(k) plans from 1995 are higher at the median, mean, 10<sup>th</sup> percentile, and 90<sup>th</sup> percentile. The results suggest that the 401(k) plans as of 1995 were also superior to the DC plans that existed in the earlier period.

### *Benchmark Comparisons*

The disparities between the DB and DC distributions in Table 4 are the result of two effects; differences in the generosity of plans and differences in the characteristics of workers who are covered by those plans. Similarly, changes in counterfactual pension benefits over time combine secular trends in worker income and age with trends in the generosity of the pension plan. The benchmark comparisons, by holding constant characteristics of the worker, allows us

to compare characteristics of plans either within a given time period or across time.

Table 5A presents the distribution of pension benefits by plan type and year. In 1983, the typical DC plan yielded median benefits of \$15,397, which was well in excess of the median benefits for DB plans that existed by themselves (\$10,517) or with supplemental DC plans (\$13,524). Comparing plans across the two years, we find, like Gustman and Steinmeier (1998), that DB plans in 1989 were more generous than DB plans in 1983, with an increase in the mean and median benefits from \$14,304 to \$17,024 and from \$10,517 to \$12,440, respectively, although benefits at the 10<sup>th</sup> percentile fell slightly, from \$3,023 to \$2,833.

Table 5B presents the benchmark distribution of pension benefits from the samples of 401(k) plans from 1989 – 1998. All four samples provide higher mean, median, and 10<sup>th</sup> and 90<sup>th</sup> percentile returns compared to the 1983 “DB Only” pension plans. The 1989 “DB Only” and 401(k) plans are similar with respect to medians and 10<sup>th</sup> percentiles, although the 401(k) plans provided higher mean and 90<sup>th</sup> percentile benefits. Since 1989, expected 401(k) benefits have improved, particularly at the low end—the 10<sup>th</sup> percentile increases from \$2,856 in 1989 to \$4,456 in 1995 and \$5,115 in the 1998. Higher contribution rates make extremely low outcomes less likely in the more recent years of data. By 1992, median 401(k) benefits were almost at the level of 1989 DC plans, and by 1995, median 401(k) benefits were higher than median benefits from 1983 DC plans. Figure 2 summarizes these patterns in median benefits for the benchmark worker across different plan types.

We can also provide a utility-based interpretation of the benchmark comparisons across distributions. To do so, we calculate the fraction by which the “DB Only” distribution would have to be increased in order to make the benchmark worker indifferent between the “DB Only” plans and each of the distributions of 401(k) plan benefits. 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. We assume a constant relative risk aversion utility function and a coefficient of relative risk aversion of 3. To make the benchmark worker indifferent between the 1989 (only) DB and the alternative 401(k) distributions, each point in the DB benefit distribution would have to be higher by 16, 33, 64, and 66 percent of benefits for the 1989, 1992, 1995, and 1998 401(k) plans, respectively. For more risk-averse workers, comparisons were even less favorable to the DB plans.<sup>17</sup>

For the “Any DB” samples, the 1995 sample of 401(k) plans surpasses the 1983 PPS plans for all measured percentiles. However, not even the 1998 sample of 401(k) plans is able to match the median benefits from the sample of “Any DB” plans from 1989. Like the counterfactual simulation above, these results show that by the end of the 1980s, workers with combination DB and DC plans could expect larger retirement benefits than either DB or 401(k) plans alone.

### *Sensitivity Analysis*

Having established our main results regarding the comparison of “DB Only” and 401(k) plans, we investigate the sensitivity of our results in Table 6. For simplicity, we focus just on a benchmark comparison of 1989 “DB Only” plans and 1995 401(k) plans, and we consider four changes that would improve benefits in DB plans relative to 401(k) plans. The first two columns reduce the rate of return on equity by 3 percentage points. This has a small impact on the

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<sup>17</sup> We were also concerned that for a few simulated earnings profiles, some of the DB pension plans implied zero benefits. In many cases, these zero benefits were found in plans integrated with Social Security through the offset method in which pension benefits are offset by a fraction of expected Social Security benefits. For low-income workers, the pension formula can yield a complete offset. Subsequent legislation has made it illegal to offset a worker’s pension entirely. To test the sensitivity of our results to *any* zero DB pensions, we excluded them entirely from the sample when computing the summary statistics. In the counterfactual in Table 4B, for example, 10<sup>th</sup> percentile DB benefits rose from \$1,994 to \$2,384, while the equivalent 10<sup>th</sup> percentile 401(k) benefits also rose from \$2,167 to \$2,288. (The 401(k) plan benefits rise because the zero benefit DB plans tend to be for lower income workers who are now excluded from the sample.) The 10<sup>th</sup> percentile for DB plans are slightly higher, but

distribution of DB returns, since they are rarely tied to stock market returns. On the other hand, the returns on the 401(k) plans are reduced substantially, with median benefits declining from \$17,089 to \$12,817. This implies rough equality on the basis of median retirement income, although both the mean and the 10<sup>th</sup> percentile of the 401(k) plans remain higher than in the DB plans.

The next two columns of Table 6 consider the simulations when the rate of productivity growth is raised to 2.5 percent per year. This tends to favor the DB plans, which usually have benefits tied to the last few years of employment, over 401(k) plans, which are based on earnings-related contributions from each working year. While the higher productivity growth does cause median DB plan benefits to rise to \$16,153, median 401(k) benefits also rise to \$19,654.

In the next two columns, we reduce the standard deviation of the permanent shocks to earnings from 13 to 5 percent per year. Because the shocks are permanent and DB plans rely more heavily on the last few years of earnings, reducing the standard deviation will tend to make DB plans appear less risky relative to 401(k) plans. At the 10<sup>th</sup> percentile, DB benefits rise by 53 percent (\$2,833 to \$4,348) and 401(k) benefits rise by only 25 percent (\$4,456 to \$5,571), but the 401(k) benefits are still higher at that percentile. Benefits also remain higher for 401(k) plans at the median and 90<sup>th</sup> percentiles.

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 53 percent decline (\$12,440 to \$5,902) for DB plans versus a 45 percent decline (\$16,231 to \$8,932) for the 401(k) plans. Similar changes are observed for other points

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median benefits are still lower; \$12,559 for the DB plan compared to \$13,428 for 401(k) plans.

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, the key problem is that when switching jobs, the worker is entitled only to vested deferred benefits. The final average pay used to calculate retirement benefits when the worker is eventually eligible (years later at the early or normal retirement age) 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 worked immediately prior to the (early or normal) retirement age. So a worker who is continuously covered by a DB pension, but not the *same* DB pension, will have lower benefits than one who is continuously covered by the same pension. 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 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 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), Early (31 to 42), Middle (42 to 53), and Late (53 to 65).<sup>18</sup> For comparison, we also consider careers that start late (42 to 65) and end early (31 to 53). Table 7 presents median pension wealth (not benefits) at the termination of the

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<sup>18</sup> 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. Shorter job durations would lessen DB pensions even more.

job, for the samples of DB plans from 1983 and 1989 and the 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 55 and 65 percent of the 401(k) plans in 1983 and 1989, respectively. Thus, workers who enjoy a long career under the same pension could spend 35 percent of their balances immediately and still have enough to obtain the median annuity from the 1989 sample of DB plans.<sup>19</sup> The comparison becomes more favorable for DB plans when the career starts later. Focusing on the 1989 DB balances (which are larger than the 1983 balances), the “Late Start” worker (age 42 to 65) can only spend 15 percent of the balance, while for the “Late Career” (53 to 65) worker, the median 401(k) balance is in fact 13 percent *below* median DB wealth.

More importantly, the comparisons become less favorable for DB plans when the career ends before 65. For the Early Career job, the median DB wealth is just 26 percent of the median 401(k) balance, suggesting that the workers could spend about three fourths of the distribution and not lose pace with the DB plans. For the Middle Career job, the worker could spend 45 percent of the distribution, and for the Early Departure, the worker could spend 53 percent of the distribution.

Poterba, Venti, and Wise (1998) report that the probability of reinvesting lump-sum distributions based on the 1993 CPS rises steadily with age and is 48 percent for those age 35 to 44, 57 percent for those age 45 to 54, and 73 percent for those age 55 to 64.<sup>20</sup> While this is a somewhat different calculation than the fraction of each distribution that is reinvested, these are

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<sup>19</sup> Retirees may face adverse selection in attempting to purchase annuities outside of a group (such as the pool of DB plan beneficiaries). Recent evidence in Brown, Mitchell, and Poterba (2000) suggests that private annuity purchasers are receiving nearly fair market rates.

generally larger amounts than what we calculate are necessary to match DB plans, aside from “late start” workers. And this comparison does not account for benefits to workers from actually *spending* that money or using it to pay off mortgages, rather than having it revert to employers as 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, tax issues aside, 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 magnitude and risk characteristics of 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 increase the gross wage by the amount they had previously contributed to the DB pension fund. To the extent that wages are increased to compensate for the employee contributions, our comparisons are biased against DC plans, since increasing gross earnings along with randomly assigning a 401(k) plan would also increase simulated 401(k) benefits.

Suppose, however, 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

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<sup>20</sup> Also see Chang (1996), Engelhardt (2001), and Berman, Coe, and Gale (2001).

lower retirement benefits than the DC plans counting only employer contributions.<sup>21</sup>

Simulations (not reported) suggest the opposite; the reason why DC plans generally dominate DB plans is because of the additional employee contribution. Thus, we argue that at least for these general equilibrium effects, the net effect is to bias downward our estimated net pension benefits for DC 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, recent evidence suggests a net positive impact on lower or middle income contributors.<sup>22</sup>

## **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 1998. Our results suggest that generally, 401(k) plans do at least as well, or in most cases do a better job of providing for retirement pension benefits. These results hold under a wide range of assumptions regarding equity returns, turnover rates, and other parameters. 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

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<sup>21</sup> The employer can cut wages in the DC world only if the employer contribution to the DC plan yields higher benefits than the status quo DB plan. Otherwise the worker would be worse off.

<sup>22</sup> 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).

rates of return. By comparison, defined benefit plans that are tied to the final few years of earnings expose the worker to considerable earnings risk.

The growing popularity of combination DB and DC plans (VanDerhei and Copeland, 2001) complicates our comparisons, since we cannot split the covered workforce into those who have *either* DB plans or DC plans. The implications of these simulations are that the DB workers with supplemental DC plans actually can expect more generous pension benefits than workers with just DB or DC plans.

The major reason why DC plans can fail to provide an equivalent retirement income stream to a DB plan is because of inadequate contribution rates. Samwick and Skinner (1997) estimated that 2 – 4 percent of all workers are offered 401(k) plans, fail to contribute, yet have no other pension plan.<sup>23</sup> Thus, in principle, legislation that sets minimum contribution rates could improve retirement benefits substantially for the bottom decile of pension benefits (USDOL, 1998), assuming pensions are not eliminated in response. However, based on our simulations, it is clear that among workers who now rely solely on a 401(k) for employment-related retirement income, contribution rates and allocations to equity are sufficiently high that benefits even at the low end of the distribution surpass those of the DB plans that used to be the norm. Our results suggest that the trend toward defined contribution plans has not weakened, and may have substantially strengthened, the retirement security of current workers.

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<sup>23</sup> A larger number of workers are offered 401(k) plans and fail to contribute, but most of these are covered by other pension plans (Samwick and Skinner, 1997).

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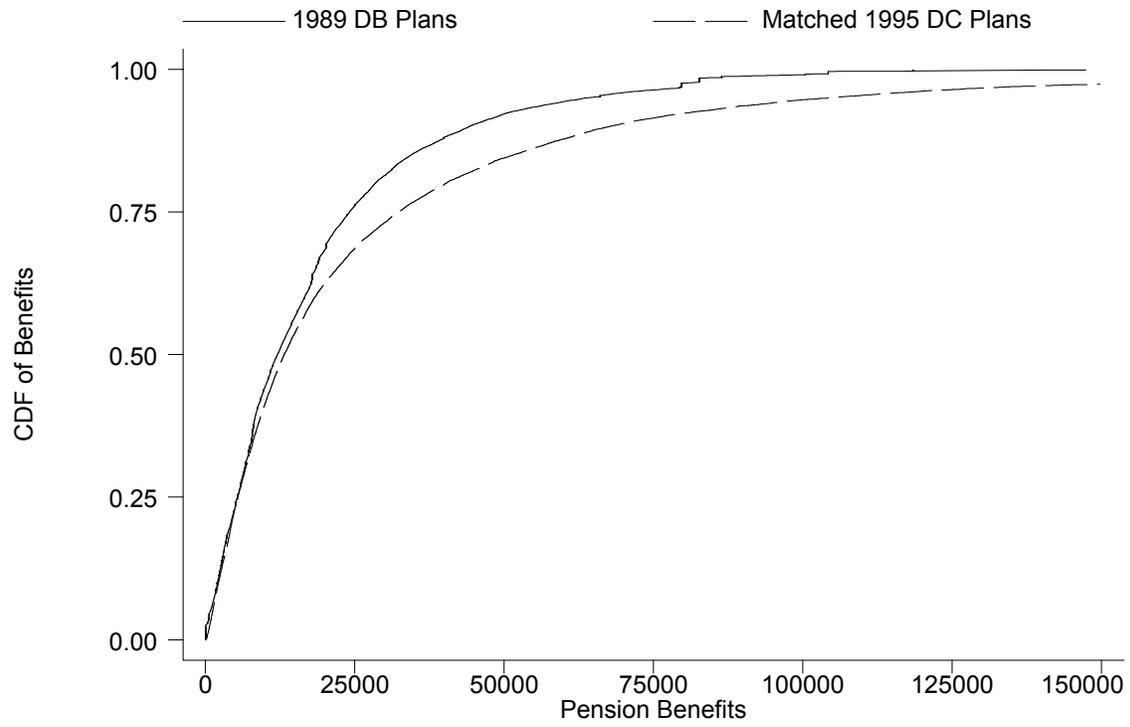
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**Figure 1: Cumulative Distribution of Defined Benefit and Matched Defined Contribution Plans**



**Figure 2: Median Pension Benefits, by Type of Plan and Year**

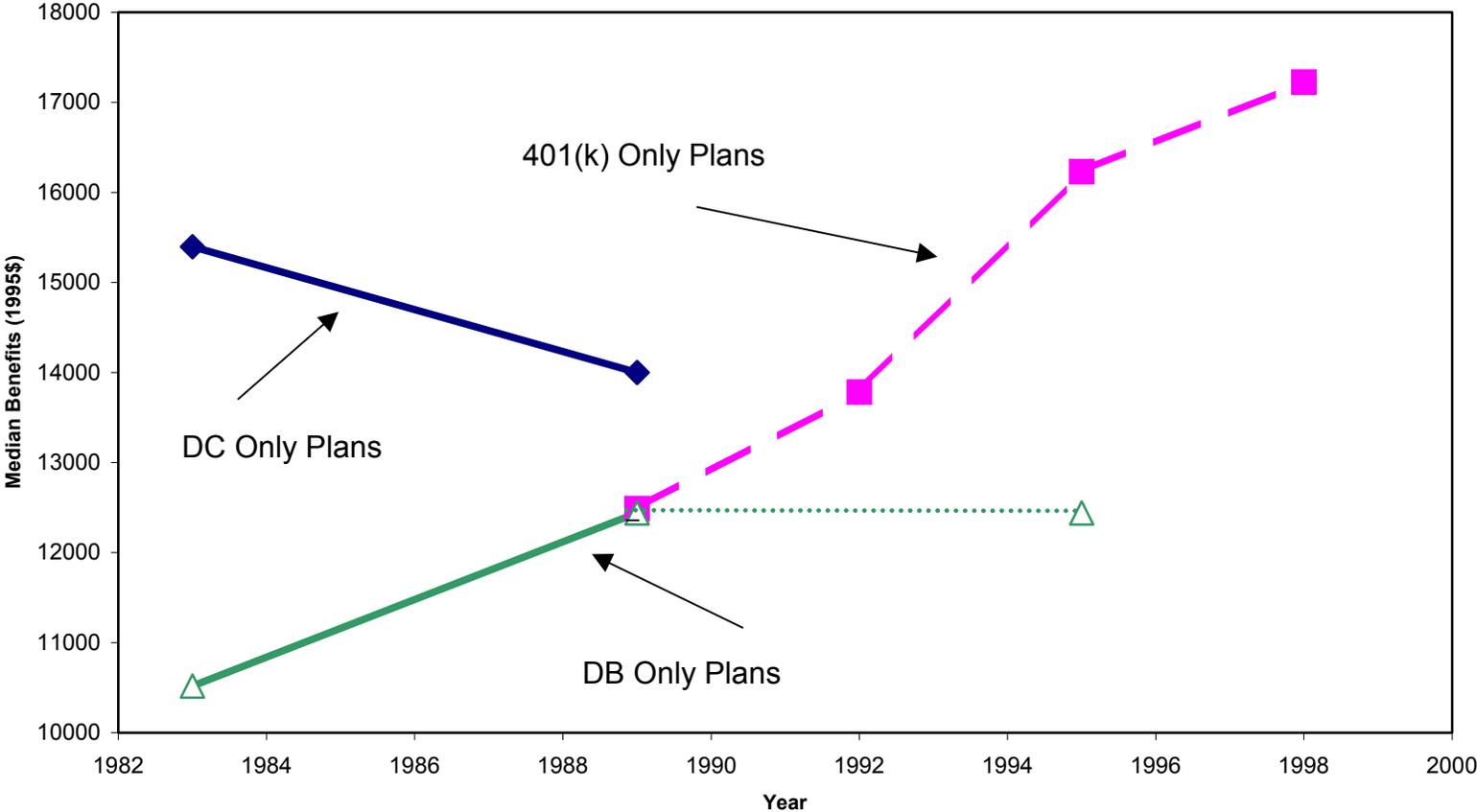


Table 1: Characteristics of the Counterfactual and Benchmark Workers, 1983 and 1989

Characteristic	1983		1989	
	Actual	Benchmark	Actual	Benchmark
Average Date of Birth	1941	1952	1946	1958
Average Date of Hire	1972	1983	1978	1989
Annual Earnings				
Current dollars	23,262	15,670	33,800	19,500
Constant 1995 dollars	40,218	27,092	46,938	27,080
Annual Hours of Work	2055	2080	2158	2080
Average Voluntary Contributions to DC Plans (if nonzero)	5.68	5.00	6.97	5.00
Millions of Workers Covered by Pensions	43.39		44.15	
SCF Observations for Covered Workers	2180		1587	
Total Number of Distinct Pension Plans	929		541	
Percent of Covered Workers with Imputed Pension Plans	25.48		28.71	

Notes:

- 1) Source: Authors' calculations from the Surveys of Consumer Finances and Pension Provider Surveys, 1983 and 1989.
- 2) All summary statistics reflect the weighted sample of households covered by a pension plan and include households for which pension plans were imputed.

Table 2: Characteristics of Matched 401(k) Plan Samples, 1989 – 1998

Characteristic	1989	1992	1995	1998
<i>Workers with 401(k) Plans Only</i>				
Number of Observations	330	516	849	1,009
Millions of Workers	8.17	11.90	19.09	23.47
<i>Contributions to 401(k) Plans</i>				
Mean (median) employee contribution	5.28 (4.00)	5.55 (5.00)	5.99 (5.00)	6.46 (5.65)
Mean (median) employer contribution	5.03 (3.00)	5.16 (4.00)	5.08 (4.00)	4.58 (3.36)
Mean (median) total contribution	10.31 (9.00)	10.71 (9.00)	11.08 (10.00)	11.04 (10.00)
<i>Asset Allocation</i>				
Mostly in Stocks	23.69	24.74	38.22	45.43
Split Between Stocks and Bonds	36.79	39.92	41.23	37.94
Mostly in Bonds	39.52	35.34	20.55	16.63

Notes:

- 1) Source: Authors' tabulations of the Surveys of Consumer Finances, 1989 – 1998.
- 2) 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 3: Descriptive Statistics on Real Asset Returns, 1901-1990

	Short-Term Bonds	Long-Term Bonds	Stocks
Mean	0.75	1.58	7.95
Standard Deviation	4.88	9.35	20.62
Maximum	17.38	35.12	75.59
90th Percentile	2.99	6.60	21.12
Median	1.25	1.01	8.99
10th Percentile	-1.23	-4.51	-6.12
Minimum	-15.07	-16.74	-42.64

*Correlation Coefficients of Asset Returns*

Short-Term Bonds	1.00		
Long-Term Bonds	0.66	1.00	
Stocks	0.17	0.32	1.00

Notes:

1) Source: Authors' tabulations based on Siegel (1992).

2) All returns reflect the real holding period returns on the market portfolio of each type of security: short-term corporate bonds, long-term corporate bonds, and corporate equities.

Table 4A: Counterfactual Pension Income Distributions, 1983 Pension Provider Survey

	DB Only		DB and DC		Any DB		DC Only	
	1983 PPS	1995 401(k)	1983 PPS	1995 401(k)	1983 PPS	1995 401(k)	1983 PPS	1995 401(k)
Mean	13,917	30,880	38,135	36,905	21,412	32,745	24,039	39,240
Median	9,227	12,694	22,970	17,086	11,874	14,061	8,458	13,308
10 <sup>th</sup> Percentile	1,638	1,890	4,929	3,102	2,103	2,160	926	1,796
90 <sup>th</sup> Percentile	30,301	69,864	80,152	77,267	46,862	72,488	50,220	86,083
Standard Deviation	15,951	65,068	87,993	77,767	51,933	69,303	163,499	118,049
Obs.	22,999		10,308		33,307		6,477	

Table 4B: Counterfactual Pension Income Distributions, 1989 Pension Provider Survey

	DB Only		DB and DC		Any DB		DC Only	
	1989 PPS	1995 401(k)	1989 PPS	1995 401(k)	1989 PPS	1995 401(k)	1989 PPS	1995 401(k)
Mean	18,813	29,723	45,220	38,231	31,202	33,714	32,124	33,277
Median	12,061	13,171	27,350	17,941	17,910	15,217	11,953	13,685
10 <sup>th</sup> Percentile	1,994	2,167	6,440	2,798	2,969	2,435	1,595	2,059
90 <sup>th</sup> Percentile	44,198	67,757	99,432	86,124	71,676	76,969	64,377	77,506
Standard Deviation	20,742	67,510	59,154	73,926	45,206	70,719	88,752	67,288
Obs.	13,727		12,131		25,858		14,345	

Notes:

- 1) Source: Authors' tabulations of the Surveys of Consumer Finances, 1983, 1989, and 1995, 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 5A: Benchmark Pension Income Distributions, 1983 and 1989 PPS Samples

	1983 PPS			1989 PPS		
	DB Only	DC Only	Any DB	DB Only	DC Only	Any DB
Mean	14,304	23,728	19,141	17,024	21,291	24,543
Median	10,517	15,397	13,524	12,440	14,000	18,952
10 <sup>th</sup> Percentile	3,023	5,536	3,798	2,833	5,421	4,716
90 <sup>th</sup> Percentile	29,516	48,227	39,823	37,323	43,685	50,295
Std Deviation	14,106	28,333	20,361	16,144	24,940	22,821

Table 5B: Benchmark Pension Income Distributions, Matched 401(k) Plans, 1989 – 1998

	1989 401(k)	1992 401(k)	1995 401(k)	1998 401(k)
Mean	20,243	21,789	25,712	27,495
Median	12,487	13,782	16,231	17,225
10 <sup>th</sup> Percentile	2,856	3,071	4,456	5,115
90 <sup>th</sup> Percentile	43,482	47,572	55,137	59,369
Std Deviation	27,636	27,643	32,436	33,753

## Notes:

- 1) Source: Authors' tabulations of the Surveys of Consumer Finances, 1983, 1989, and 1995, 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 6: Benchmark Pension Income Distributions, Sensitivity Analysis

	Equity Returns Reduced by 3%		Productivity Growth Increased to 2.5%		Std Deviation of Wage Shocks Reduced to 5%		Retirement Age Lowered to 55	
	1989	1995	1989	1995	1989	1995	1989	1995
	DB Only	401(k)	DB Only	401(k)	DB Only	401(k)	DB Only	401(k)
Mean	16,953	19,117	21,930	30,927	16,558	27,309	8,587	13,133
Median	12,381	12,817	16,153	19,654	14,990	18,379	5,902	8,932
10 <sup>th</sup> Percentile	2,825	3,744	3,583	5,378	4,348	5,571	1,187	2,691
90 <sup>th</sup> Percentile	37,122	41,071	49,291	66,530	31,061	56,179	19,881	27,722
Std Deviation	16,091	21,518	19,859	38,829	10,938	31,827	8,303	14,380

Notes:

- 1) Source: Authors' tabulations of the Surveys of Consumer Finances, 1989 and 1995, and the Pension Provider Survey, 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. The sensitivity analyses change one assumption at a time, as indicated in the column heading.
- 4) Public sector workers are excluded from the sample.

Table 7: 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)	381,256	446,455	688,734	0.55	0.65
Late Start (42 – 65)	279,690	315,637	371,078	0.75	0.85
Early Departure (31 – 53)	76,485	107,454	229,136	0.33	0.47
Early Career (31 – 42)	11,168	15,427	60,328	0.19	0.26
Middle Career (42 – 53)	38,365	51,927	93,566	0.41	0.55
Late Career (53 – 65)	153,136	168,525	149,415	1.02	1.13

Notes:

- 1) Source: Authors' tabulations of the Surveys of Consumer Finances, 1983, 1989, and 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, a 1.5 percent rate of annual productivity growth, and a retirement age of 62.
- 4) Public sector workers are excluded from the sample.

## Appendix A: Correspondence Between the SCF and the Current Population Survey

Summary statistics for workers covered by DC plans in the 1989, 1992, and 1995 SCFs are presented in Table A.1. Also presented are tabulations for 1988 and 1993 from the Current Population Survey Employee Benefits Supplements from EBRI (1994).<sup>24</sup>

The first three rows show that approximately 27.8 percent of the workers in the SCF 1995 were covered by a DC plan, up from 21.0 percent in the SCF 1992 and 18.0 percent in the SCF 1989. The next rows describe the rates and levels of employee contributions. In 1995, 78.8 percent of the covered workers made a contribution to their plans, down from 81.4 percent in 1989. The CPS numbers show the same trend but at a lower level. Average employee contributions (including those who did not contribute) were 5.3 percent of earnings or \$2,502 in 1995 and totaled \$71.8 billion in aggregate. The CPS 1993 shows a slightly lower contribution rate of 4.9 percent and \$1,971 on average and a much lower aggregate total of \$49.6 billion.<sup>25</sup> Other years match up more closely between the SCF and CPS samples.

According to the SCF in 1995, 72.3 percent of employers made contributions. The average percent contributed was 5.0 percent, with an average dollar value of \$2,160 and aggregate contributions of \$62.0 billion. The EBRI (1994) tabulations do not present employer contributions explicitly, but they do provide a range for the percent of employers who provide any contributions; the SCF estimates are inside the relevant ranges. Overall, the two data sources suggest a fairly high level of participation and contribution to tax-deferred savings

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<sup>24</sup> In order to compare the contribution rates with the CPS, we include all DC plans in the table, whether or not the worker also has another pension plan. In our simulations, we sample only from the set of individuals for whom the DC plan is a 401(k) plan and the 401(k) plan is the only employer-sponsored retirement plan.

<sup>25</sup> The greater disparity in the totals than the average is presumably related to the over-sampling of high-income workers in the SCFs. Even with appropriate sample weights in each survey, the SCF is likely to do a better job of characterizing values like pension contributions that increase with income.

accounts over the last ten years.<sup>26</sup>

Table A.1

401(k)-Type Plans in SCF 1989, 1992, and 1995, With Comparisons to CPS 1988 and 1993

	Surveys of Consumer Finances Self-Reported Household Data			Current Population Survey Employee Benefits Supplement		
	1995	1992	1989	1993	1988	Table
Workers (million)	103.2	96.1	93.6	105.8	101.7	21
Participants (million)	28.7	20.2	16.9	25.1	15.6	22
Coverage Rate (percent)	27.8	21.0	18.0	23.7	15.3	22
Employee Contributions						
Percent Contributing	78.8	71.1	81.4	69.7	77.4	24
Avg. Percent of Earnings	5.3	5.1	5.8	4.9	5.0	23
Average Dollar Amount	2502	2438	2635	1971	1994	25
Aggregate Amount (bln)	71.8	49.2	44.5	49.6	38.0	24
Employer Contributions						
Percent Contributing (lo)	72.3	64.8	79.7	61.8	70.9	27
Percent Contributing (hi)				80.0	75.9	27
Avg. Percent of Earnings	5.0	3.9	4.6			
Average Dollar Amount	2160	1832	2030			
Aggregate Amount (bln)	62.0	36.9	34.3			

Notes:

- 1) The SCF samples include all respondents and spouses that are currently employed. The sample in the CPS includes all civilian, nonagricultural workers over age 16.
- 2) The column marked "Table" refers to the table number in EBRI (1994) that is the basis for the statistic in each row.
- 3) All monetary amounts are expressed in constant 1995 dollars.
- 4) Contribution rates in the SCF are prorated so that the total of employer and employee contributions is no more than the minimum of \$30,000 and 25 percent of earnings.

<sup>26</sup> When necessary, we impose both dollar and percentage limits on the contributions to all DC plans and 401(k) plans in all years (including 1983 in the simulations in the text) that are consistent with the current law for DC plans, as documented in McGill et al (1997). Contribution rates are prorated so that the total of employer and employee contributions is no more than the lesser of 25 percent of earnings and \$30,000, with the dollar amount indexed to inflation in future years.

## **Appendix B: Imputations of Pension Plans Not Found in Pension Provider Survey**

Only 74 percent of the respondents to the SCF 1983 and 71 percent of respondents to the SCF 1989 who reported pension coverage could be linked to a pension plan in the Pension Provider Survey. This censoring is not random—workers at smaller firms are less likely to have their plans in the PPS, while public sector workers are more likely to have their plans in the PPS. We used a hot decking procedure to overcome the sample selection bias that results if the censoring probability is not uncorrelated with the generosity of the pension plan. For each person whose pension plan is not found, the plan of a person with similar characteristics whose plan is found is substituted. That plan is chosen according to the following procedure. If any step in the procedure would eliminate all remaining plans, then that step is not taken, but the procedure continues. The procedure is laid out for the SCF 1983. Differences for the SCF 1989 are discussed below.

### *1) Employer Type*

The set of respondents with plans in the PPS is first sorted according to the type of employer: federal government, state/local government, public school/college, private school, military, private employers with greater than 100 employees, and private employers with fewer than 100 employees. Military plans are imputed as their own group without further disaggregation.

### *2) State of Residence*

The set of respondents in the SCF 1983 who work for state/local governments and public schools/colleges are sorted according to state of residence. For these purposes, the high-income sample is treated as if it were its own state of residence.

### *3) Social Security Coverage*

All categories (except for federal government employees) are sorted according to whether the respondent reports being covered by Social Security in addition to the employer-provided pension. As of 1983, some workers (generally public sector employees) were not covered by Social Security. The pension plans for these workers are designed to provide benefits comparable to the pension and Social Security benefits of comparable private sector workers. Note that all public sector workers are excluded from the comparisons in the text.

### *4) Union, Industry, Occupation*

All categories are then further disaggregated first by union coverage, then by 1-digit industry code, and lastly by 1-digit occupation code.

At the end of these four steps, each respondent whose plan is not found in the PPS has a set of possible matches among the plans of those respondents with matching characteristics whose plans are found in the PPS. One of these plans is randomly allocated to the censored respondent. This procedure will remove any sample selection bias that is the result of the full interaction of employer type (including state and Social Security coverage where applicable), union coverage, industry, and occupation. This procedure will not remove the bias that may result from censoring within these categories.

The procedure for the PPS 1989 differs in the presence and sequence of some of the steps. The SCF 1989 does not have corresponding information on employer type, state of residence, or self-reported Social Security coverage. The first three steps are therefore omitted. The SCF 1989 has information on the number of employees working at the respondent's employer. This step is inserted between Industry and Occupation, resulting in a sequence of Union-Industry-Employer Size-Occupation for the PPS 1989.

## **Appendix C: Modifications to Original Pension Provider Survey Code**

The PPS 1983 documentation in Curtin (1987) also provides programs that calculate pension entitlements based on the data in the SCF and the PPS. They are sufficiently general so that entitlements can be computed under a variety of economic assumptions for any individual in the SCF or hypothetical worker. Nearly identical programs for the PPS 1989 were obtained from the Survey Research Center at the University of Michigan. The original programs are written in a version of PASCAL tailored to the University of Michigan MTS mainframe computer. This language also compiles with some editing on an IBM RS/6000, which was used to generate the simulations in this paper. Updated versions of the original programs, adapted for use on the PC, are now available from the Survey Research Center as part of the Health and Retirement Study.

The original programs were designed in two stages. The first set read the information on the pension plans from the PPS dataset and created a specific procedure for each plan. The key step is to parse the literal formula codes and generate programming statements from them. These first stage programs could not be reliably modified. Instead, each of the 1011 (1983) or 798 (1989) separate pension plan procedures was edited individually in order to consider fundamental changes in the calculation of pension benefits.

Two important modifications were made in this way to the pension plan procedures. First, the original programs used an approximation for final average pay that was inappropriate when wages are stochastic. Most DB pensions that are based on final average pay calculate FAP as the average of the highest or highest consecutive years of earnings during some specified period. For example, the highest five years of earnings during the last ten is quite common. If nominal earnings are always increasing with age, this formula reduced to the last five years of earnings. The original programs calculated FAP in this simplified way. However, when a more general specification of

the wage equation is used, it is possible for nominal earnings at older ages to decline. The simplified FAP calculation would understate FAP (and therefore pension benefits) in such cases. The modified programs compute FAP in the precise way specified in the summary plan description so that this does not occur.

Second, since pension formulas are adjusted periodically in line with the firm's overall financial position (and *must* be included in all collective bargaining arrangements), it is unreasonable to believe that a formula that promises, say, \$20 per month in benefits for every year worked will remain at \$20 in nominal terms into the indefinite future. A more likely scenario is that the overall generosity of the benefits will increase in line with price or wage growth. In the current version of the programs, every such nominal amount is augmented by a user-specified growth rate. For our calculations, we use the growth rate in nominal wages, to ensure that DB plans are not unduly penalized.

The second set of the original programs read in the information on the plan participants from the SCF and used the (now edited) code generated by the first set of programs to compute entitlements. Portions of these few programs were rewritten to allow for stochastic wage profiles, individual-specific investment allocations, and stochastic asset returns. Other portions were rewritten to incorporate the changes in the Social Security benefit formulas (necessary to calculate benefits for integrated pension plans) made in the 1983 legislation and to phase-in the limits on maximum covered wages, benefits payable, and contributions possible for pension plans set by tax reforms in 1982, 1984, 1986, and 1987.