Working Paper No. 375

U.S. Workers' Investment Decisions for Participant-Directed Defined Contribution Pension Assets

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March 2003

The author would like to thank participants at the 1997 APPAM research conference, the 1998 ASSA meetings, Eric Engen, Howard Iams, Stan Panis and Steven Venti for helpful comments.

I. INTRODUCTION

Two issues may have a tremendous impact on the adequacy of retirement income for American workers. The first is the growth of 401(k) pension plans, which allow participants to contribute, before taxes, a portion of their salary to a qualified retirement account.[1] By 1998, the most recent year that published information is available, 401(k) plans accounted for about 41 percent of all pension plans, 51 percent of all active participants in pension plans, and 38 percent of all pension assets (DOL 2002). Unlike traditional defined benefit plans, participation in 401(k) plans is voluntary and in most plans participants decide how to invest their pension balance among various investment choices. On average, about 10 investment options are offered by 401(k) pension plans (Holden and VanDerhei 2001). Future retirement income depends on the amount that participants contribute plus how well their investments perform.

The second issue is the possible "privatization" of Social Security. With the long-term financing problem of the Social Security program (OASI), many Social Security reform proposals call for a portion of the Social Security trust fund surplus to be invested in the stock market to take advantage of higher yields.[2] Rather than have the government invest the funds, several of these proposals would create individual accounts to be set up under Social Security and funded by diversion of some portion of the OASI tax. Workers will then decide how to invest their account balances and the expectation is that a large portion of the funds in the individual accounts will be invested in stocks. Consequently, future Social Security benefits may depend, in part, on how well an individual's investments perform.

It is quite possible that, in the future, the level of retirement income for workers will depend, to a large extent, on their investment choices. Some fear that individuals will recklessly invest their account

balances and suffer the loss of their retirement nest-egg. For example, some claim that 401(k) investors try to time the market and as a result do not hold mutual funds (a common investment vehicle for 401(k) savings) long enough to reap the historical average returns.[3] Recent research by Barber and Odean (2001) shows that for individuals with stock investments the monthly turnover rates are 6.4 percent (77 percent annual) for men and 4.4 percent (53 percent annual) for women. Their research indicates that the stock the investors "choose to sell earn reliably greater returns than the stocks they choose to buy" (p. 275).

Many others fear that individuals will invest too conservatively and have lower retirement income than had they invested in prudent but higher yielding assets. For example, many employers and plan administrators report that they are concerned about how their 401(k) participants are allocating their pension assets.[4] Survey results from the early 1990s reported by the Employee Benefit Research Institute (EBRI 1993) show that 69 percent of the respondents would invest their pension money in low-risk, low-return investment, while 25 percent would choose high-risk, high-return investments. The remaining 6 percent would choose a mixture of the two.

The first fear can be corrected somewhat by limiting investment choices. But preventing market timing will be difficult unless severe restrictions are placed on the number of trades that pension participants can make. The second fear is a very real one and short of mandating a portfolio with some stock investments will be impossible to correct.

Since the beginning of the 20th century, stocks have been high-risk but also high-return assets while bonds have been lower-risk and lower-return assets. Between 1910 and 2000, the mean real return on the S&P stock index was 7 percent with a standard deviation of 18.7 percent and the mean real return of riskless bonds was 1.6 percent with a standard deviation of 3.8 percent (Burtless 2000). The mean return and standard deviation of long-term corporate bonds fell between these two. Over long time periods, the stock market generally outperforms bonds, and investment of retirement accounts are usually long-term investments. MaCurdy and Shoven (1992) show that over every 35-year period between 1926 and 1988 stocks outperformed bonds. The ratio of stock to bond accumulation ranged from 1.56 to 6.25 with an average of 3.58. Workers investing their pension assets too conservatively may be in for a rude awakening at retirement.

Understanding the asset allocation decisions of current DC plan participants is important since many proposals for expanding pension coverage involve self-directed pension plans and a Social Security system with individual accounts will mean workers must decide how to invest their account balances. The 1994-96 Social Security Advisory Council, in their simulations of individual account accumulations, used average 401(k) plan asset allocation data to model how workers would allocate a Social Security individual account balance over their lifetimes.[5] The recent President's Commission to Strengthen Social Security (2001) assumed a fixed portfolio for Social Security personal accounts of 50 percent stocks, 30 percent corporate bonds and 20 percent U.S. Treasury long-term bonds in their report. These assumptions miss the actual variation in 401(k) pension asset allocations. Furthermore, the usefulness of how current 401(k) participants allocate their account balance among various assets for predicting how other workers would allocate either 401(k) or Social Security account balances is complicated because current 401(k) participants may be different from other workers along important observed and unobserved dimensions.

This paper examines the investment choices of workers covered by a defined contribution pension plan (typically a 401(k) plan), specifically incorporating selection into DC pension plans. The 1995 and 1998 Surveys of Consumer Finances are used for the analysis to create a time-series of cross-sections. This

paper differs from other studies that examined this issue by using nationally representative data rather than aggregate data or participant data from a limited number of specific 401(k) plans.[6] Furthermore, this analysis corrects for selection bias due the voluntary participation in many DC pension plans. The results suggest that (1) workers from certain demographic groups (e.g., minorities) invest their pension assets conservatively (i.e., in fixed income assets), (2) current participants in DC plans in which the participants direct investments tend to be more aggressive investors (i.e., invest in equities) than the general work force would be, and (3) the selection effects, while statistically significant, are rather small. The next section discusses previous studies on this topic. The data are discussed in section 3. The theoretical underpinnings and empirical strategy are described in section 4, and the results are presented in the subsequent section. Lastly, concluding remarks are offered in section 6.

II. PREVIOUS LITERATURE

Several studies have examined asset allocation decisions in general and pension asset allocation decisions in particular. Some have studied 401(k) plans using data supplied by the plans. Others have used nationally representative data such as the Survey of Consumer Finances. These studies have used either cross-tabular analysis or regression analysis to determine how allocation decisions vary among different demographic groups. None of the studies of pension asset allocation have specifically dealt with possible sample selection problems.

Goodfellow and Schieber (1997) examined 36,000 pension participants drawn from 24 self-directed defined contribution pension plans. Their analysis consists of a series of cross-tabulations examining how asset allocations vary by demographic characteristics. They find that younger participants and higher income participants are more aggressive investors than other participants. They conclude from their analysis that on average self-directed defined contribution plans tend to generate lower rates of return than employer directed pension plans.

EBRI (1996) examined the asset allocation decisions of about 180,000 pension plan participants in three very large self-directed plans. Their cross-tabular results suggest that workers match "their investment patterns with their time horizons in a textbook manner." They find that younger participants are more aggressive investors than other participants. They find, however, a great deal of variation within each age cohort. Their results also suggest that women tend to be more conservative investors than men.

The U.S. General Accounting Office (GAO 1996) examined investment patterns of 401(k) participants using the 1992 Survey of Consumer Finances and the first wave (1992) of the Health and Retirement Survey.[7] GAO's cross-tabular results suggest that women tend to be more conservative investors than men. Furthermore, GAO finds that more educated and higher income 401(k) participants tend to be more aggressive investors than other 401(k) participants.

Women's pension investment decisions were the focus of the Hinz, McCarthy and Turner (1997) study. They use regression analysis to analyze asset allocation decisions of participants in the federal government's Thrift Savings Plan.[8] Their results show that women are more conservative investors than men. They conclude that the gender-gap in retirement income could worsen as self-directed pension plans become more popular. Their results for pension investments confirm Jianakoplos and Bernasek's (1998) and Barsky, Juster, Kimball and Shapiro's (1997) findings that women tend to be more risk averse than men.[9] However, Papke (1998) finds no evidence of gender differences in pension asset investment patterns. Haliassos and Bertaut (1995) find that women are no less likely to hold stocks than men.

Both Poterba and Wise (1996) and Bodie and Crane (1997) examine the TIAA-CREF retirement saving system for employees of educational institutions. Poterba and Wise's results are consistent with the findings of others. Women tend to be more conservative with their investments. They also find that more educated participants and those with higher income or more wealth are more aggressive investors than others. Bodie and Crane obtain essentially the same results and further conclude that "individual asset allocations are consistent with the recommendations of expert practitioners and with the prescriptions of economic theory." The authors of both papers caution, however, that TIAA-CREF participants have higher income than non-participants and their results, therefore, may not generalize to the population as a whole.

Liang and Weisbenner (2002) find that pension plan design also affects the allocation of pension assets. First, they find that 401(k) participants tend to follow a $1/n$ diversification rule where n is the number of investment choices which supports the finding of Benartz and Thaler (2001). Second, workers do not offset an employer match in company stock by reducing the investment of their own contribution in employer stock. They conclude that workers tend to view plan restrictions as cues about the desirability of investing in company stock.

The results of these studies are fairly consistent: women tend to be more risk averse, and the proportion of pension assets invested in equities varies directly with education level, income and wealth holdings. Furthermore, plan characteristics, such as the relative number of stock choices and how employer matching contribution are invested, affect asset allocation. Since long-term yields on stocks are higher than yields on bonds, the more aggressive investors should have more income at retirement than conservative investors for a given level of investment.[10] Also, 401(k) participants are not representative of the population as a whole (GAO 1996, Poterba and Wise 1996, and Bodie and Crane 1997). Consequently, the investment decisions of current 401(k) participants may not be representative of how other workers would invest retirement savings given the opportunity.

III. THE DATA

The data used for the model estimation come from the Federal Reserve Board's 1995 and 1998 Survey of Consumer Finances (SCF) to create a time-series of cross-sections. The SCF sampled approximately 4,000 households in each of the two years asking detailed questions on assets and debts. Other information that was collected includes employment history, pension information, and demographic information. The same information was collected for both the primary respondent and his or her spouse.

The unit of observation for this study is the worker. A sample of 5,516 workers was prepared from the SCF that includes all working (the self-employed were excluded) primary respondents and spouses between the ages of 21 and 64 years who were not receiving pension benefits. Workers younger than 21 years are not included in the analysis because ERISA allows pension plans to set a minimum participation age of 21.[11] The data include information about current employment, demographic information, pension coverage, income and assets. Also, the unemployment rate for the worker's industry/occupation/sex cell was merged onto the data. The unemployment rate for each of the 60 industry/occupation/sex cells was calculated from the 36 outgoing rotations of the monthly Current Population Surveys for 1995 to 1998.

The main concern of this paper is with pension coverage and the allocation of DC pension assets. The sample is divided into 4 groups: those covered by a DC pension plan in which the worker contributes and makes investment decisions (referred to investment DC in the paper),[12] those covered by some other type of DC pension plan (referred to as traditional DC in the paper), those covered by a DB plan

only, and those not covered by any pension plan. Those covered by a DC plan may also be covered by another pension plan as well.[13] The first group includes DC plans that usually allow participants to make investment choices for, at least, part of their pension account[14] and in which the worker contributes part of his or her salary. This category accounts for 84 percent of all DC plan participants, with thrift savings and 401(k) plans making up 97 percent of the participants in this category. The goal is to study the allocation of pension assets of workers who make investment decisions regarding their own contributions. In a traditional DC plan the employer makes a contribution to the employee's accounts and determines how the assets are invested (although some do allow workers to make contributions). For example, in most profit-sharing plans and ESOPs only the firm contributes to the worker's account with company stock. The variables used in the analysis are defined in appendix table 1. The means of the variables are also listed in the table.

The SCF asks DC participants how the money in their pension account is invested.[15] Based on the answer to this question, participants are coded as investing their pension account assets in (1) mostly stocks, (2) split between stocks and bonds,[16] or (3) mostly bonds.[17] These responses are the categorical equivalent to the proportion of pension assets invested in bonds (0 percent bonds = 100 percent stocks).

Table 1 summarizes the asset allocation decisions of current DC pension plan participants. Overall, slightly over 40 percent of the sample reported investing their DC plan assets mostly in stocks and another 40 percent report a split allocation. This is hardly surprising since the stock market (e.g., the S&P 500 stock index) had been achieving double digit positive real returns for the previous 4 years. Interestingly, this suggests that in the aggregate there is roughly a 60-40 split between stocks and bonds. There is a great deal of variation in allocation strategies by demographic group. Plan participants in 1998 were a little more aggressive in their investments than the 1995 participants. Men tend to be more aggressive investors than women, and minorities tend to be more conservative investors than whites. The proportion of pension assets invested in stocks is somewhat positively correlated with education levels. There appears to be a somewhat weak negative correlation between the proportion investing mostly in stocks and age. Managers, professionals, technical and clerical workers tend to be slightly more aggressive investors than workers in other occupations. Lastly, income and investment in mostly stocks are positively related.

The four groups of workers (no pension coverage, DB pension coverage, other DC pension coverage and investment DC pension coverage) differ is several ways (see table 2). Women are more likely than men to have no pension coverage. Workers with no pension coverage have less education than pension participants and tend to be slightly younger. Managers and professionals make-up a quarter of those with no pension coverage but account for over 40 percent of those with investment DC pension coverage.

Two complications arise with the data. First, the sample includes both working spouses of married couples so the error terms in the multivariate model will not be independent. Second, the Survey of Consumer Finances employs multiple imputation to deal with missing responses (there are five implicates for each record). Failure to take both of these complications into account will yield biased standard error estimates. Reported standard errors have been adjusted to account for the clustering of observations and imputation variance.[18]

IV. THEORETICAL BACKGROUND AND EMPIRICAL STRATEGY

Most DC pension plans offer participants some educational materials on the conventional wisdom in investment strategies.[19] These materials generally ask participants to think about their time horizons and

attitudes toward investment risks when making investment decisions. For example, a federal Thrift Savings Plan guide points out that the higher yielding stock fund also entails more risk of short-term losses than the lower yielding government bond fund (Federal Retirement Thrift Investment Board 1997). It further encourages participants to figure out their time horizon (time to retirement) and suggests that "if you are relatively young, you are in a position to accept the risk of short-term losses in exchange for the potential of higher long-term returns (p. 7)." The guide further suggests that participants choose the allocation between high risk and low risk assets "with which you are most comfortable (p. 5)."

The standard theoretical framework of dynamic asset allocation is Merton's (1992) continuous-time model of optimal consumption and portfolio choice. Merton shows that more risk averse individuals will invest less in risky assets. Bodie, Merton and Samuelson (1992) extend Merton's model to include flexible labor supply decisions. One result from their model is that individuals' wealth invested in stocks should decline with age. They further show that individuals with riskier human capital will invest less in risky assets.

The conventional wisdom and the theoretical results suggest that pension asset investment strategies will depend on age and attitudes toward risk. Empirically, to model DC pension asset investment behavior involves regressing participant characteristics on an asset allocation variable (such as the percent of the pension account invested in bonds). However, using a sample of DC plan participants may lead to serious sample selection biases since participants *choose* to participate; they are not randomly selected from the population of all workers. Furthermore, not only do pension plan participants differ from non-participants in observed ways, but work by Ippolito (1997) suggests they may differ in unobserved ways.

A. Basic Pension Asset Allocation Model

The basic investment DC pension asset allocation model is:[20]

$$A^* = \gamma' Z + \mu \qquad (1)$$

where A^* is the propensity to invest pension assets in bonds or the riskless asset, Z is a vector of explanatory variables, and μ is a random error term capturing unobserved factors affecting asset allocation. High values of A^* are associated with investing mostly in bonds and low values are associated with investing mostly in stocks. Given that the SCF only provides qualitative information on pension investments, the asset allocation model is specified as an ordered probit model. Let A be a trichotomous variable equal to 1 if pension assets are invested mostly in stocks, 2 if split between stocks and bonds, and 3 if invested mostly in bonds. The relation between A and A^* is:

$$A = \begin{cases} 1 & \text{if } A^* \le \tau_1 \\ 2 & \text{if } \tau_1 < A^* \le \tau_2 \\ 3 & \text{if } \tau_2 < A^* \end{cases}$$

where τ_1 and τ_2 are thresholds which are estimated.

The explanatory variables are demographic characteristics, characteristics related to attitudes toward risk, and risks faced by the individual. All of the variables have been used by others as explanatory variables for asset allocation (e.g., Bajtelsmit and VanDerhei 1997, Hinz, McCarthy and Turner 1997, Jianakoplos and Bernasek 1998, and Haliassos and Bertaut 1995). Haliassos and Bertaut (1995) argue

that cultural factors related to race, gender and marital status may be related to portfolio choices (all are entered as binary variables). Bodie, Merton and Samuelson (1992) provide a theoretical basis for why asset composition should change with age and investment advisors recommend that the proportion of a portfolio invested in stocks should decline with age. Age is entered as a piecewise linear spline to allow for different affects at different ages.[21]

More educated workers tend to have a longer time or planning horizon and more secure labor income than less educated workers. They may be more willing and able to weather the ups and downs of the stock market. Most other researchers have found a positive affect of education on the proportion invested in risky assets. Education is entered as a series of binary variables with less than 12 years of education (no high degree) as the omitted category. The natural log of job tenure is also included which is a proxy for job specific human capital and layoff risk.

Whether or not the worker has a secure source of retirement income (other than Social Security) may affect his or her willingness to invest in riskier assets. A binary variable indicating whether or not the worker is also covered by a DB plan is included as an explanatory variable as well as if the worker's spouse is covered by a pension plan. Other researchers have shown that income and wealth are related to investment choices. Both are entered as piecewise linear splines to capture nonlinearities in a flexible manner.[22]

The unemployment rate for the industry/occupation/sex cell controls for business cycle risks. Haliassos and Bertaut (1995) suggest a relationship between holding stocks and unemployment risk. In addition, four occupational dummy variables are included (managerial and professional occupations are the omitted category). It has been suggested that managers may be able to acquire investment information at a lower cost than those in other occupations and may be better able to process the information. Lastly, a year dummy variable is included to capture period effects.

A few researchers have included the proportion of wealth invested in stocks as an explanatory variable. But the allocation of non-pension assets is probably determined jointly with the 401(k) asset allocation. Shoven (1999) has shown in a series of simulations based on historical asset returns that stocks should be given preference for inclusion in tax advantaged pension plans (if some assets will be held outside of the pension plan). However, Bodie and Crane (1997) find that pension and non-pension asset allocations are positively correlated--if pension assets are heavily invested in equities so are non-pension assets. Consequently, equation (1) can be thought of as a reduced form model.

The error term captures, among other things, unobserved attitudes toward risk. In an ordered probit the error term is assumed to be normally distributed and the estimated model predicts allocation decisions of all workers. However, if the unobserved attitudes toward risk of DC pension participants differ from that of other workers then the estimated model may not be applicable to how other workers would invest pension accounts if they were to have them. For example, if 401(k) pension coverage were expanded to cover more workers, the newly covered workers may invest differently from those currently covered by 401(k)s after controlling for observables. In equation (1) the distribution of the error terms may be truncated and estimation based on a sample of DC pension participants under of the assumption of a normally distributed error term may lead to biased parameter estimates (variables may be correlated with the error).

B. Selection

There is some literature suggesting that workers covered by a pension plan differ in unobserved ways related to attitudes towards risk from workers with no pension coverage. Curme and Even's (1995) and

Ippolito's (1997) work supports the proposition that pensions allow firms to attract and retain workers with lower discount rates. Ippolito (1997) argues that workers with lower discount rates are more productive than high discounters because they have longer time horizons and consider the long-term consequences of their actions in the work place. Low discounters will not engage in unproductive behaviors that would jeopardize their tenure with the firm and the pension payoff at retirement. Workers with high discount rates will tend to not work at firms that offer pensions. He further notes that defined contribution pension plans also offer an incentive to high discounters to eventually quit the firm and "take the money and run." Furthermore, 401(k) plan allows workers to "pay themselves according to their underlying value of marginal product" (p. 30). This suggests that 401(k) participants will differ in important ways from other workers. Pension plans, especially 401(k) plans, help firms to sort workers by their internal discount rates. Work by Merton (1992) suggests that investors with different time preferences will invest in different ways. His theoretical results suggest that investors with "greater temporal impatience for consumption choose more aggressive investment strategies" (p. 195).

Bodie (1990) has argued for the view that pensions are retirement income insurance for risk averse employees, and DB and DC pension plans essentially offer different kinds of insurance for the various retirement income risks. Not only do workers with pension coverage have different attitudes toward risk than workers with no pension coverage, but workers with different types of pension coverage may have different attitudes toward risk. Consequently, two selection equations are specified.

The first selection equation models whether or not the worker has pension coverage. Let

$$C^* = \beta_1' X_1 + \varepsilon_1 \qquad (2)$$

where C^* is the worker's unobserved propensity to be covered by a pension plan, β_1 is a vector of parameters to be estimated, X_1 is a vector of explanatory variables, and ε_1 is a random error term capturing unobserved factors affecting pension coverage including attitudes toward risk and time preference. The worker will be covered by a pension if C^* is greater than a threshold which is normalized to zero since X_1 includes a constant term. Formally, define a binary variable C where

$$C = \begin{cases} 1 & \text{if } C^* > 0 \\ 0 & \text{otherwise.} \end{cases}$$

For workers with pension coverage, a second equation models the type of pension coverage. Let

$$T^* = \beta_2' X_2 + \varepsilon_2 \qquad (3)$$

where T^* is the worker's unobserved propensity to be covered by a pension plan where the worker assumes the responsibility and risk for managing the plan, β_2 and X_2 are vectors of parameters to be estimated and explanatory variables, respectively, and ε_2 is a random error term. As before, the error term captures unobserved factors affecting T^* including attitudes toward risk. Workers with low values of T^* will be covered by relatively safe DB pension plans where participation is mandatory, the firm assumes the investment risk, and the plan is insured by the Pension Benefits Guaranty Corporation (PBGC). High values of T^* are related to plans where the worker assumes the responsibility and risk for providing for retirement income such as 401(k) plans where the worker decides whether or not to participate, how much to contribute to his or her accounts, and directs the investment of pension assets. Recent events, such as the Enron debacle, have shown that workers are at risk of losing most of their

401(k) retirement nest egg. The type of pension plan the worker has is a categorical variable coded 1 for DB plan coverage, 2 for traditional DC plan coverage, and 3 for investment DC pension coverage (e.g., 401(k) and thrift plans). Formally, let T be the categorical variable such that

$$T = \begin{cases} 1 & \text{if } T^* \leq \delta_1 \\ 2 & \text{if } \delta_1 < T^* \leq \delta_2 \\ 3 & \text{if } \delta_2 < T^*. \end{cases}$$

The overall model to be estimated consists of equations (1)-(3). The three error terms are assumed to be jointly normally distributed:

$$\begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \mu \end{pmatrix} \sim N(0, \Sigma)$$

where

$$\Sigma = \begin{pmatrix} 1 & \rho_{12} & \rho_{13} \\ & 1 & \rho_{23} \\ & & 1 \end{pmatrix}.$$

The three equations produce 6 possible mutually exclusive outcomes which are shown in the tree structure in figure 1. The derivation of the likelihood function is described in the appendix.

The explanatory variables for equations (2) and (3) include both the employer and employee characteristics. The variables have been used by other researchers (e.g., Curme and Even 1995, and Even and MacPherson 1994, 2000) and include sex (female), age (entered as a piecewise linear spline), marital status (married), three educational dummy variables (less than high school is the omitted category), race/ethnicity, spouse pension coverage, job tenure, union membership, two firm size dummies, five industry dummies, four occupational dummies, and a year dummy.

C. Identification

Technically, the model is identified based on function form. However, the functional form assumption has no theoretical basis. Reasonable exclusion restrictions, however, can be made. First, two variables, part-time and part-year work status, are included in the pension coverage model (the X_1 vector of equation (2)) but not in the pension type and asset allocation equations (the X_2 and Z vectors, respectively). ERISA allows firms to exclude workers who have not completed one year of service with the firm.[23] One year of service is defined as the first 12 month period after starting the job in which the employee works over 1,000 hours. Many part-time and part-year workers work fewer than 1,000 hours per year and can, therefore, be excluded from the pension plan. There is no theoretical or legal basis for including these two variables in the other two equations.

Second, many of the employer characteristics are excluded from the asset allocation equation (the Z vector in equation (1)). These characteristics are the industry dummies, union coverage, and firm size. There is no theoretical justification for including these variables in the asset allocation model and other researchers have not used these variables in studies of asset allocation. In addition, these variables were included in one specification of the asset allocation equation and the coefficient estimates were not

significant and the other coefficient estimates were largely unaffected. Pension plan variables known to affect asset allocation are included in the Z vector.

D. Misclassification

Hausman, Abrevaya and Scott-Morton (1998) report that misclassification of the dependent variable in discrete-response models may cause inconsistent coefficient estimates when traditional estimation techniques are used. There is a small literature on workers' knowledge of their pension plans using the SCF or HRS linked with employer pension information (e.g., Mitchell 1988, Gustman and Steinmeier 1999, and Starr-McCluer and Sundén 1999). Some of these studies find that workers are misinformed about the details of their pension plans. The three dependent pension variables are categorical or discrete-response variables and may pose a problem.

No research has been done on how accurate worker's responses are concerning whether or not they are covered by a pension plan. However, given the media attention to pensions since the mid-1990s and the availability of fringe benefit information from the employer and/or the union, workers presumably know whether or not they are covered by a pension plan and accurately report this on surveys. In addition, it is assumed that workers with investment DC plans (mainly 401(k) and thrift plans) accurately report how their pension assets are invested--that is, they have a general idea from their periodic pension account statements how their account is allocated among various options.

Gustman and Steinmeier (1999), using the HRS linked to employer pension information, found that about 50 percent of the older workers in their sample correctly identified the type of pension coverage (DB or DC) they have. Mitchell (1988), however, found that about 90 percent of the workers in her sample correctly report their pension type, but that there are also disparities between those covered by DB plans and those covered by DC plans. She used the 1983 SCF linked to employer pension information. Starr-McCluer and Sundén (1999), using the 1989 SCF linked to employer pension information, found a high degree of accuracy about pension type and no differences between those with DB plans and those with DC plans. The dependent variables do not relate to the details of the pension plans but rather more general features of the plan and are probably fairly accurately reported.

V. THE RESULTS

The results are reported in two parts. First, the estimation results are presented for the single equation pension asset allocation model and the multiple equation pension asset allocation with selection model. Second, the coefficient estimates are then used to calculate predicted probabilities for all workers in the sample.

A. Coefficient Estimates: Single Equation Model

The single equation ordered probit results are presented in column (1) of table 3. The coefficient estimates indicate how the distribution shifts when the value of each explanatory variable changes. A positive coefficient estimate indicates a rightward shift which places more mass above τ_2, thus increasing the likelihood of investing mostly in bonds and decreasing the probability of investing mostly in stocks. The opposite is true for a negative coefficient estimate. The effect on the likelihood of a split investment is ambiguous and can only be determined by calculating the marginal effects.[24] A rightward shift (positive coefficient estimate) is a shift toward more conservative investments in bonds and the leftward shift (negative coefficient estimate) is a shift toward more aggressive investments in stocks.

Many of the coefficient estimates have the expected signs based on previous research. Women tend to be more conservative investors--the coefficient estimate is positive, relatively large and statistically

significant at the 1 percent level. More educated workers tend to be more aggressive investors; the coefficient estimates are negative (the omitted category is less than a high school education) and statistically significant. Furthermore, the impact is largest for the highest educational group of college graduates.

Workers who are also covered by a DB plan pension are generally more aggressive investors than workers with no such additional pension coverage though the coefficient estimate is significant only at the 10 percent level. A primary DB pension plan may allow workers to feel they are in a better position to take on more risk in their DC pension investments. Blacks and Hispanics tend to be more conservative investors than whites and other racial/ethnic groups. However, while the coefficient estimate is statistically significant for African-Americans, it is not for Hispanics.

Age, marital status, spouse's pension coverage, employer contributions to the worker's account, and job tenure appear to have little affect on asset allocation--all the coefficient estimates are relatively small and not statistically significant. The unemployment rate for the worker's occupation/industry/sex cell is negative and statistically significant suggesting that workers more at risk of unemployment may be less risk averse than others and are more aggressive investors. Net worth has little affect on asset allocation as none of the coefficient estimates of the piece-wise linear spline are statistically significant. This finding is somewhat at odds with previous studies.

Income below the median has little affect on asset allocation; both the first and second income quartile coefficient estimates for the spline function are not statistically significant. The third income quartile coefficient estimate is statistically significant and negative suggesting that these upper income workers tend to be more aggressive investors. Increases in income past the 75^{th} percentile has no apparent affect on asset allocation. Workers in service occupations are more conservative investors than workers in other occupations; coefficient estimates for the occupational dummies are not statistically significant (manager and professional occupations are the omitted category). Lastly, workers appeared to be more aggressive investors in 1998 than in 1995. This could be due to the continued high stock market returns between 1995 and 1998. The high returns could have lured more workers to invest in stocks or workers just failed to rebalance their pension account portfolios and through this inaction became seemingly more aggressive investors.

B. Coefficient Estimates: Multiple Equation Model

The asset allocation results for the multiple equation selection model are presented in column (2) of table 3 (the coefficient estimates for the two selection equations are displayed in appendix table 2). Marginal effects of variable changes on conditional probabilities were calculated and are reported in columns (3)-(5) of table 3. Many of the variables also appear in the selection equations, consequently, the marginal effects for these variables can be thought of as having two components. The first is the direct effect based on the coefficient estimates reported in table 3. The second is the indirect effect of changes in the probability of pension coverage and type of pension due to variable changes which operates through the correlation coefficients.

The last three rows show the estimated correlation coefficients; two of the three are moderately large and statistically significant. The correlation between ε_1 and ε_2 (ρ_{12}) in the pension coverage and pension type equations is -0.5260 and is statistically significant at the 1 percent level. This suggests that workers with unobservables that increase the likelihood of pension coverage tend to increase the likelihood of DB pension coverage. The correlation between ε_2 and $\mu(\rho_{23})$ in the pension type and asset allocation equations is 0.4605 and is significant at the 1 percent level suggesting that unobservables increasing the likelihood of investment DC pension coverage tend to increase the

likelihood of investing mostly in bonds--these unobservables are associated with more conservative investments. The third correlation coefficient (ρ_{13}) is negative, relatively small and not statistically significant at conventional confidence levels. However, taken together these estimated correlation coefficients suggest the presence of selectivity.

Overall, most of the coefficient estimates from the multiple equation selection model are smaller than those from the single equation model. As in the single equation model, the coefficient estimates for a number of variables are not statistically significant. These include the four age variables, marital status, the Hispanic indicator variable, the employer contribution variable, spouse pension coverage, and job tenure. The coefficient estimates for female is smaller by about a third but still statistically significant (at the 10 percent level)--men are, in general, 6.5 percentage points more likely to invest mostly in stocks than women. The coefficient estimates for Black, the unemployment rate, service occupations, and year 1998 are no longer statistically significant suggesting these effects are captured through the correlation of the errors.

The coefficient estimate for the 3rd income quartile spline variable is larger than before but is only significant at the 10 percent level now. The 3rd net worth quartile spline variable coefficient estimate is now statistically significant at the 10 percent level. Workers with higher income or higher wealth (i.e., above the median) tend to be more aggressive investors than workers with lower wealth or income The coefficient estimates for the three education variables and the DB pension coverage variable are all slightly larger than before and are still significant. High school graduates and college graduates are 10 percentage points and 14 percentage points more likely to be aggressive investors than high school dropouts, respectively. Workers also covered by a DB pension are 6 percentage points more likely to invest mostly in stocks than others.

C. Simulation Results

The results presented in the previous section suggest the presence of selection. Two questions remain, however. First, how would other workers invest DC pension assets if they had the opportunity? The second question deals with differences between predictions based on the single equation model and the multiple equation model--is selection economically important?

Predicted conditional probabilities of asset allocation are generated for each worker in the sample. The probabilities are the probability of a particular investment (e.g., mostly in stocks) conditional on being covered by an investment DC pension. The results are displayed in figure 2 with workers separated by the type of pension coverage (and no coverage) they have. Workers with no pension coverage are predicted to be the most conservative investors and those with investment DC plan (e.g., 401(k) plans) are the most aggressive investors. For example, there is a 5.2 percentage point difference between these two groups in the likelihood of investing mostly in stocks. This difference would translate into a 2.7 percent difference, on average, in a 40-year account balance.[25] Workers covered by a DB plan and traditional DC plans fall between these two groups and there is little difference between these two. For the most part, this pattern is observed for demographic subgroups (defined by sex, race/ethnicity, education, or age group).

A similar set of predictions are used to determine the difference between the single equation and multiple equation selection models. Predicted probabilities were calculated for all workers using the two sets of coefficient estimates and a 40-year period for account accumulation. The accounts were calculated assuming constant annual contributions, continual rebalancing to maintain the predicted asset allocation, and constant (throughout the 40-year period) asset returns. The average predicted probabilities for asset allocation are reported in appendix table 3. The percent differences between

simulated account balances are reported in table 4 for workers with no pension coverage, those with a DB plan, and those with a traditional DC plan. A positive entry indicates that the multiple equation model generates a higher account balance than the single equation model. The opposite is true for a negative entry.

The first row of table 4 shows the average percent differences for all workers in each of the three groups. The average difference in simulated account balances between the two models is fairly small--less than one percent. Subsequent rows display the average percent differences for various demographic and economic subgroups within each of the three groups. Two features should be highlighted. First, the differences in simulated account balances is fairly small, typically less than one percent. Second, the multiple equation model tends to yield higher account balances (more aggressive investments) than the single equation model for workers with no pension coverage. The opposite is true for workers covered by a DB plan. There is no clear pattern for workers with traditional DC pension coverage. It appears that selection bias in asset allocation, while statistically important, is not economically important under the assumptions used to create the account balances.

VI. CONCLUDING REMARKS

This paper has examined the investment decisions of DC pension participants paying particular attention to self-selection. The results suggest that DC pension participants are different from other workers in both observable and unobservable ways. There are two important results of the paper. First, evidence was found for the presence of selection. While selection is important statistically, it appears that selection may be of marginal economic importance. This finding relating to economic importance, however, is based on a set of assumptions--constant contributions, constant returns, and continual rebalancing--that do not hold in real life. Workers do not have constant earnings over their lifetimes and, consequently, they do not make constant contributions to pension accounts year in and year out. Furthermore, asset returns, especially for stocks, vary over time. Nevertheless, projections of retirement income under different scenarios may not be too far off the mark if selection is ignored.

Second, workers who have no pension coverage are predicted to be more conservative investors than workers with DC pensions, such as 401(k) plan participants. But again, visual inspection of the results suggests that these differences in asset allocation may be relatively small. It appears that workers with no pension coverage have both observed (e.g., less education) and unobserved characteristics associated with slightly more conservative investment decisions. In addition, these are the workers most likely to have lower earnings and more spells of unemployment. Under a self-directed contributory retirement income plan,[26] these workers would be at greatest risk of low account balances at retirement due to low contributions and fewer years of compounding if the unemployment spells occur early in the work career; uninformed investment decisions could exacerbate this problem.[27]

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Table 1: Proportion with Each Investment Mix

	Mostly Bonds	Split	Mostly Stocks
Total Sample	18.3	40.1	41.6
1995	18.7	42.7	38.6
1998	18.0	38.2	43.8
Male	15.6	41.6	42.8
Female	21.8	38.3	39.9
White/other	16.8	40.4	42.8
Black	29.6	36.3	34.1
Hispanic	24.9	43.8	31.4
<H.S. Education	32.5	36.9	30.5
H.S. Diploma	20.1	41.4	38.5
Some College	16.6	45.5	37.9
College Grad	15.9	35.7	48.4
Age 21-34	17.2	35.9	46.9
Age 35-44	19.4	42.0	38.6
Age 45-54	18.1	40.5	41.4
Age 55-64	18.0	44.6	37.5

Man/Prof	15.4	38.7	46.0
Tech/Clerical	18.7	40.8	40.6
Service	29.5	37.2	33.3
Skilled Labor	17.7	44.9	37.4
Unskilled Labor	22.8	40.5	36.6
Income Quartile 1	26.2	39.4	34.4
Income Quartile 2	20.3	42.8	36.9
Income Quartile 3	19.4	38.2	42.4
Income Quartile 4	13.1	40.2	46.7
Note: Rows may not sum to 100 percent due to rounding; Sample weights used.			

Table 2: Characteristics of Each Group

	No Pension	DB Plan	Traditional DC	Investment DC
Female	0.548	0.480	0.450	0.441
Age 21-34	0.379	0.212	0.291	0.288
Age 35-44	0.301	0.314	0.396	0.346
Age 45-54	0.197	0.343	0.228	0.250
Age 55-64	0.123	0.130	0.085	0.116
Married	0.653	0.739	0.696	0.704
Black	0.108	0.112	0.121	0.095
Hispanic	0.111	0.061	0.060	0.036
<H.S. Education	0.148	0.066	0.056	0.062
H.S. Diploma	0.353	0.290	0.286	0.279
Some College	0.278	0.250	0.298	0.286
College Grad	0.220	0.394	0.360	0.374
Man/Prof	0.262	0.409	0.349	0.410
Tech/Clerical	0.277	0.220	0.324	0.297
Service	0.166	0.136	0.047	0.048
Skilled Labor	0.123	0.088	0.118	0.110
Unskilled Labor	0.172	0.148	0.161	0.135
Note: Sample weights used.				

Table 3: Coefficient Estimates for Asset Allocation, Single and Multiple Equations Models

	Single Equation model (1)	Multiple Equation Model (2)	Marginal Effects		
			Mostly Bonds (3)	Split (4)	Mostly Stocks (5)
Female	0.1872*** (0.0635)	0.1236* (0.0641)	0.0402	0.0245	-0.0647
AgeSpline1	0.0149 (0.0126)	0.0145 (0.0120)	0.0037	0.0018	-0.0056
AgeSpline2	0.0086 (0.0104)	0.0066 (0.0104)	0.0025	0.0015	-0.0040
AgeSpline3	-0.0050 (0.0112)	-0.0071 (0.0110)	-0.0018	-0.0009	0.0027
AgeSpline4	0.0045 (0.0231)	0.0116 (0.0226)	0.0019	0.0009	-0.0028
Married	0.0183 (0.0668)	-0.0017 (0.0644)	0.0036	0.0032	-0.0068
H.S. Diploma	-0.2280* (0.1318)	-0.2475** (0.1218)	-0.0572	-0.0358	0.0931
Some College	-0.2295* (0.1379)	-0.2474* (0.1297)	-0.0582	-0.0389	0.0971
College Grad	-0.3294** (0.1448)	-0.3925*** (0.1376)	-0.0873	-0.0533	0.1406
Black	0.1946** (0.0972)	0.1428 (0.0923)	0.0532	0.0211	-0.0743
Hispanic	0.2016 (0.1572)	0.1336 (0.1492)	0.0440	0.0214	-0.0653
EmpCon	0.0028 (0.0649)	0.0469 (0.0607)	0.0119	0.0067	-0.0186
DBplan	-0.1258* (0.0662)	-0.1395** (0.0636)	-0.0371	-0.0227	0.0599
Spouseplan	-0.0070 (0.0645)	-0.0202 (0.0636)	-0.0028	-0.0025	0.0053
LnTenure	0.0445 (0.0313)	-0.0093 (0.0388)	0.0088	0.0057	-0.0144
UR	-0.0486* (0.0248)	-0.0258 (0.0253)	-0.0068	-0.0037	0.0104
Income Spline1	0.0037 (0.1587)	-0.0002 (0.1431)	-0.0007	-0.0004	0.0010

Income Spline2	-0.1414 (0.1341)	-0.1094 (0.1326)	-0.0298	-0.0161	0.0459
Income Spline3	-0.0792** (0.0387)	-0.1226* (0.0670)	-0.0336	-0.0182	0.0518
Income Spline4	-0.0002 (0.0009)	0.0000 (0.0010)	0.0000	0.0000	0.0000
Networth Spline1	-0.0064 (0.0104)	-0.0059 (0.0394)	-0.0016	-0.0009	0.0025
Networth Spline2	0.0208 (0.0222)	0.0188 (0.0225)	0.0049	0.0026	-0.0075
Networth Spline3	-0.0144 (0.0089)	-0.0142* (0.0085)	-0.0040	-0.0022	0.0061
Networth Spline4	0.0000 (0.0000)	0.0000 (0.0000)	0.0000	0.0000	0.0000
Tech/Clerical	0.0594 (0.0773)	0.0244 (0.0767)	0.0114	0.0074	-0.0188
Service	0.3385** (0.1523)	0.0896 (0.1640)	0.0457	0.0262	-0.0719
Skilled Labor	0.1514 (0.1149)	0.0624 (0.1178)	0.0214	0.0129	-0.0343
Unskilled Labor	0.2379 (0.1498)	0.0677 (0.1527)	0.0349	0.0210	-0.0559
T98	-0.1467*** (0.0547)	-0.0758 (0.0566)	-0.0371	-0.0237	0.0608
t_1	-0.0895 (0.4905)	-0.0134 (0.5037)			
t_2	1.0592** (0.4893)	1.0758** (0.5006)			
r_{12}		-0.5260*** (0.1332)			
r_{13}		-0.1125 (0.0945)			
r_{23}		0.4605*** (0.1147)			

*** Significant at 1 percent level; ** Significant at 5 percent level; * Significant at 10 percent level.

Table 4: Percent difference in predicted account balance between single and multiple equation estimation results

	No Pension	DB Pension	Traditional DC Pension
All	0.14	-0.55	0.09
Men	0.05	-0.79	-0.23
Women	0.20	-0.43	0.53
White/other	0.11	-0.61	0.06
Black	0.26	-0.26	0.34
Hispanic	0.46	-0.45	-0.50
Less than High School	-0.01	-1.42	0.37
High School Diploma	0.20	-0.57	-0.09
Some College	-0.05	-0.83	0.38
College Graduate	0.46	-0.35	0.12
Income quartile 1	0.10	-0.56	-0.09
Income quartile 2	-0.19	-1.38	-0.41
Income quartile 3	0.33	-0.49	-0.01
Income quartile 4	0.96	0.11	0.92
1995	-0.09	-0.69	-0.15
1998	0.46	-0.33	0.32

Note: Based on 40 year account accumulation with constant annual contribution.

Figure 1: Diagram of Selection Model

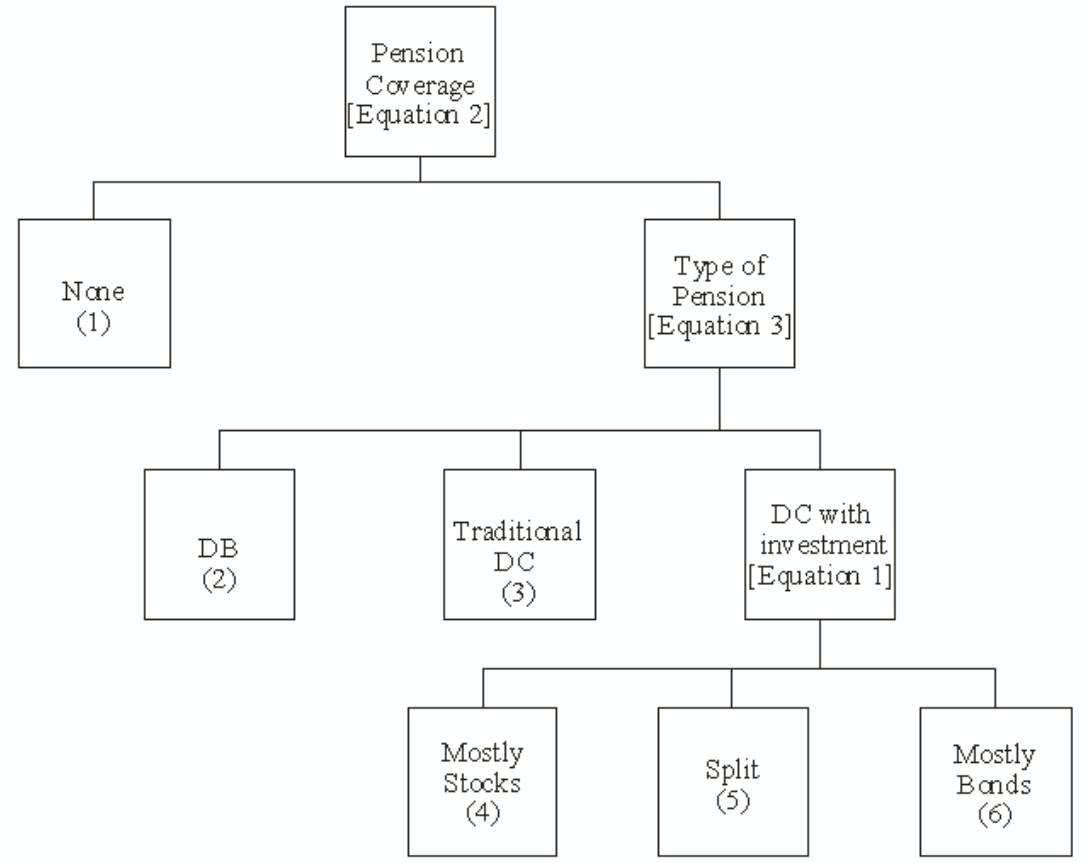
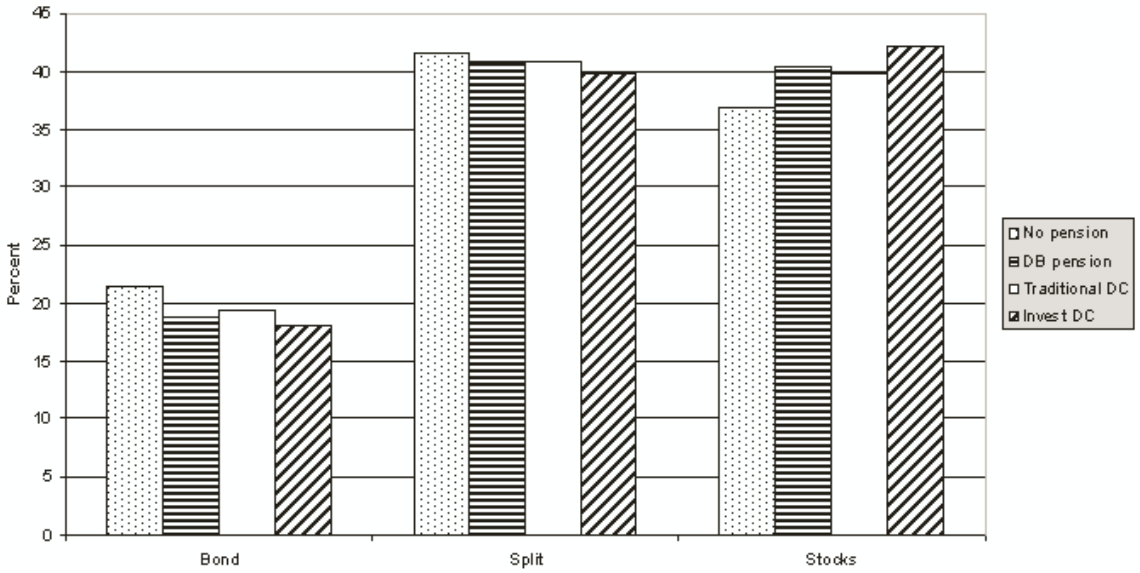


Figure 2: Predicted Asset Allocation of Account Balances



Appendix: Derivation of the likelihood function

Individuals fall into one of six mutually exclusive groups (see figure 1). The contribution to the likelihood function of each group is shown in appendix figure 1 (the individual subscripts in the figure have been omitted for clarity) where ϕ_1, ϕ_2, and ϕ_3 are the univariate, bivariate and trivariate standard normal probability distribution functions, respectively. The log likelihood function can then be written as:

$$\ln L = \sum_{i \in G_1} \ln \Pr^i + \sum_{i \in G_2} \ln \Pr^i + \sum_{i \in G_3} \ln \Pr^i + \sum_{i \in G_4} \ln \Pr^i + \sum_{i \in G_5} \ln \Pr^i + \sum_{i \in G_6} \ln \Pr^i$$

Full information maximum likelihood estimation is employed to estimate the parameters. The standard errors were calculated using the method of Berndt, Hall, Hall, and Hausman (1974).

Appendix figure 1: Contributions to the likelihood function

(1) no pension:

$$\Pr^1(C = 0) = \int_{-\infty}^{-\beta_1 X_1} \phi_1(\varepsilon_1) d\varepsilon_1$$

(2) DB pension:

$$\Pr^2(C = 1 \ \& \ T = 1) = \int_{-\beta_1 X_1}^{+\infty} \int_{-\infty}^{\varepsilon_1 - \beta_2 X_2} \phi_2(\varepsilon_1, \varepsilon_2; \rho_{12}) d\varepsilon_2 d\varepsilon_1$$

(3) Other DC pension:

$$\Pr^3(C = 1 \ \& \ T = 2) = \int_{-\beta_1 X_1}^{+\infty} \int_{\varepsilon_1 - \beta_2 X_2}^{\varepsilon_1 - \beta_2 X_2} \phi_2(\varepsilon_1, \varepsilon_2; \rho_{12}) d\varepsilon_2 d\varepsilon_1$$

(4) DC pension and investment in mostly bonds:

$$\Pr^4(C = 1 \ \& \ T = 3 \ \& \ A = 1) = \int_{-\beta_1 X_1}^{+\infty} \int_{\varepsilon_1 - \beta_2 X_2}^{+\infty} \int_{-\infty}^{\tau_1 - \gamma Z} \phi_3(\varepsilon_1, \varepsilon_2, \mu; \rho_{12}, \rho_{13}, \rho_3) d\mu d\varepsilon_2 d\varepsilon_1$$

(5) DC pension and investment split between bonds and stocks:

$$\Pr^5(C=1\ \&\ T=3\ \&\ A=2)=\int_{-\beta_1 X_1}^{+\infty}\int_{\varepsilon_2-\beta_2 X_2}^{+\infty}\int_{\tau_1-\gamma Z}^{\tau_2-\gamma Z}\phi_3(\varepsilon_1,\varepsilon_2,\mu,\rho_{12},\rho_{13},\rho_3)d\mu d\varepsilon_2 d\varepsilon_1$$

(6) DC pension and investment in mostly stocks:

$$\Pr^6(C=1\ \&\ T=3\ \&\ A=3)=\int_{-\beta_1 X_1}^{+\infty}\int_{\varepsilon_2-\beta_2 X_2}^{+\infty}\int_{\tau_2-\gamma Z}^{+\infty}\phi_3(\varepsilon_1,\varepsilon_2,\mu,\rho_{12},\rho_{13},\rho_3)d\mu d\varepsilon_2 d\varepsilon_1$$

Appendix Table 1: Variable definitions and means

Variable	Definition	Total Sample	Investment DC
Female	=1 if female	0.496	0.431
Age	Age in years	41.360	42.061
Married	=1 if married	0.715	0.735
H.S. Diploma	=1 if high school graduate	0.281	0.243
Some College	=1 if some college	0.261	0.263
College Grad	=1 if college graduate	0.376	0.446
Black	=1 if African-American	0.092	0.079
Hispanic	=1 if Hispanic	0.061	0.031
EmpCon	=1 if employer makes contribution to pension account	a	0.788
DBplan	=1 if covered by DB plan	a	0.226
Spouseplan	=1 if spouse covered by pension plan	0.305	0.349
LnTenure	natural log of job tenure	1.726	1.970
UR	Unemployment rate for industry/occupation/sex cell	3.848	3.322
Income	Equivalence adjusted real family income (1995 $)	118,245	113,378
Net Worth	Real family net worth (1995 $)	1,455,159	1,608,486
Tech/Clerical	=1 if technical or clerical occupation	0.267	0.269
Service	=1 if service occupation	0.100	0.042
Skilled Labor	=1 if skilled labor occupation	0.100	0.095
Unskilled Labor	=1 if unskilled labor occupation	0.130	0.109
T98	=1 if from 1998 SCF	0.499	0.536
Ind2	=1 if manuf, transport, or utilities industries	0.183	0.240

Ind3	=1 wholesale or retail trade industries	0.137	0.102
Ind4	=1 F.I.R.E. or business services industries	0.133	0.164
Ind5	=1 if other services industries	0.410	0.386
Ind6	=1 if public administration	0.072	0.065
Union	=1 if union member	0.208	0.206
Mfirm	=1 if medium sized firm	0.179	0.194
Lfirm	=1 if large sized firm	0.500	0.645
Othertrain	=1 if received other training	0.158	0.143
Ptime	=1 if part-time worker	0.116	0.039
Pyear	=1 if part-year worker	0.111	0.058
N		5,516	2,046
a Not defined for individuals not covered by pension plan.			

Appendix Table 2: Estimation Results for selection equations (standard errors in parenthesis)

	Pension Coverage	Type of Pension Coverage
Female	-0.1847*** (0.0441)	-0.0980* (0.0541)
Age Spline 1	0.0152** (0.0077)	0.0043 (0.0106)
Age Spline 2	-0.0064 (0.0075)	-0.0086 (0.0087)
Age Spline 3	-0.0032 (0.0086)	-0.0023 (0.0096)
Age Spline 4	-0.0157 (0.0169)	0.0156 (0.0202)
Married	-0.0206 (0.0475)	-0.0719 (0.0555)
H.S. Diploma	0.2483*** (0.0842)	-0.1133 (0.1154)
Some College	0.4401*** (0.0910)	-0.0672 (0.1247)
College Grad	0.6072*** (0.0967)	-0.0095* (0.1316)
Black	-0.1461** (0.0670)	-0.0437 (0.0773)

Hispanic	-0.2634*** (0.0856)	-0.0921 (0.1122)
Spouseplan	0.3148*** (0.0467)	-0.0532 (0.0522)
LnTenure	0.3487*** (0.0216)	-0.1755*** (0.0330)
Union	0.4115*** (0.0523)	-0.5898*** (0.0504)
Mfirm	0.5435*** (0.0567)	0.0080 (0.0867)
Lfirm	0.8131*** (0.0465)	-0.0137 (0.0856)
Othertrain	0.2031*** (0.0665)	-0.0126 (0.0829)
Ind2	0.2532*** (0.0895)	0.2661** (0.1143)
Ind3	-0.1204 (0.0980)	0.2011 (0.1245)
Ind4	0.0968 (0.0985)	0.4146*** (0.1283)
Ind5	0.0910 (0.0888)	-0.0361 (0.1087)
Ind6	0.3081*** (0.1136)	-0.5128*** (0.1223)
Tech/Clerical	-0.0075 (0.0545)	-0.0777 (0.0655)
Service	-0.4925*** (0.0836)	-0.2329** (0.1050)
Skilled Labor	-0.2371*** (0.0828)	-0.0624 (0.0936)
Unskilled Labor	-0.2493*** (0.0771)	-0.2102** (0.0934)
T98	0.0178 (0.0393)	0.2039*** (0.0455)
Ptime	-0.7942*** (0.0685)	
Pyear	-0.3156*** (0.0734)	

Constant	-1.7135 (0.2620)	
δ_1		-1.5634 (0.4118)
δ_2		-1.2554 (0.4160)
*** Significant at 1 percent level; ** Significant at 5 percent level; * Significant at 10 percent level.		

Appendix Table 3: Predicted asset allocation for workers from single-equation and multiple-equation models

		Mostly Bonds	Split	Mostly Stocks
No Pension Coverage	Single equation	21.9	41.3	36.8
	Multiple equation	21.5	41.6	36.9
DB Pension Coverage	Single equation	18.3	40.1	41.5
	Multiple equation	18.8	40.8	40.3
Traditional DC Pension Coverage	Single equation	19.6	40.7	39.7
	Multiple equation	19.4	40.8	39.8

NOTES

1. The two basic types of pension plans are defined benefit (DB) and defined contribution (DC) plans. Pension benefits in a defined benefit plan are generally based on a formula that includes years with the firm, age at retirement and salary. In defined contribution plans, employers promise only to make periodic contributions to workers' accounts. 401(k) plans are probably the most well known of defined contribution plans.
2. The Social Security trust fund surplus is currently "invested" in special issue government bonds.
3. See Bill Barnhart, "Individuals do lousy job guiding their 401(k) plans," *Chicago Tribune,* February 13. 2002, and K. C. Swanson, "Nebraska Sees Red Over Its 401(k) Plans," *TheStreet.com,* May 7, 2002 (http://www.thestreet.com).
4. See Ellen E. Schultz, *Wall Street Journal,* March 27, 1997 and Elizabeth Wine, *Financial Times,* March 13, 2002.
5. The Advisory Council used the average distribution of 401(k) assets between stocks and U.S. securities by age group. See Advisory Council on Social Security (1997), p. 171.
6. Participant data from specific 401(k) plans generally provide only limited demographic and economic information about the plan participants and no information about non-participants.
7. The Survey of Consumer Finances (SCF) is nationally representative of all U.S. households and the Health and Retirement Survey (HRS) is nationally representative of households in which a household member was born between 1931 and 1941.
8. The Thrift Savings Plan is the 401(k)-like pension plan for federal government employees.
9. Jianakoplos and Bernasek use the 1989 SCF to examine the proportion of wealth in risky assets.

Barsky and others use the HRS to calculate risk aversion parameters.

10. GAO(1996) also finds that contribution rates to 401(k) accounts tend to vary directly with educational and income levels.
11. 26 USC 410(a)(1)(A)(I).
12. These plans include thrift and savings plans, salary reduction plans such as 401(k) plans, 403(b) plans, the federal Thrift Savings plan and TIAA-CREF, and IRA-SEPs.
13. For example, many 401(k) pension plans are supplemental plans to a defined benefit plan.
14. Many firms match workers' contributions but only in company stock.
15. The specific question is "How is the money in this account invested? Is it mostly in stocks, mostly in interest earning assets, is it split between these, or what?"
16. Interest earning assets (e.g., guaranteed investment contracts (GICs) and money market accounts) will be referred to as bonds in this paper.
17. About 1 percent of the participants listed "other" as how their account balances were invested. These individuals were dropped from the sample. These individuals tend to be slightly younger and less likely to be married than the other participants.
18. See Montalto and Sung (1996) for an accessible description of the method for dealing with multiple imputation.
19. In 1996, the Department of Labor issued an interpretive bulletin to clarify the difference between investment advice and investment education (see 61 FR 29588, June 11, 1996).
20. The subscripts indicating the individual have been omitted from equations in the text to avoid cluttering the equations.
21. Since cross-sectional data is used it is impossible to distinguish between age effects and cohort effects.
22. Both income and net worth are divided by 10,000 for the analysis. The nodes or kink points are at the respective quartile breaks.
23. 26 USC 410(a)(1)(A)(I).
24. Marginal effects are not calculated for the single equation model since only the qualitative impacts are discussed.
25. The account accumulation is based on contributing a constant amount over a 40-year period and continually rebalancing the account to maintain the predicted allocation. The assumed asset returns are taken from the Commission to Strengthen Social Security (2001) with stocks yielding a 6.5 percent real return and bonds (50 percent corporate and 50 percent government) yielding a 3.25 percent real return.
26. For example if Social Security were partially privatized or if the government sponsored individual retirement accounts for workers with no pension coverage such as the USA account proposal by former President Clinton.
27. Many argue that investment education for participants in self-directed retirement plans will lead to informed investment decisions. However, Bodie (2002) notes that much of the advice by financial services firms on the web is "logically flawed and dangerously misleading."