The Dynamics of Employers' Pension Choices

Jennifer Li-Ling Wang
National Chengchi University

Ching-Fan Chung[1]
Institute of Economics, Academia Sinica

Larry Yu-Ren Tzeng
National Taiwan University

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Abstract

By using rich twelve-year panel data of long-standing firms, identifying the 401(k) plan as a distinct pension choice, and separating employers' pension decisions at both the primary plan and the secondary plan levels, we obtain detailed information about how long-standing firms chose 401(k) or other pension plans at both levels. The unique formulation of the proposed multinomial logit model with random-effects enables us to analyze the dynamic effects of industrial classification, plan age, firm size, and union status on employers' pension choices. The estimation of the random-effects allows us to establish the general patterns in employers' pension plan decisions that are independent of the time and plan characteristics. One striking empirical finding is that firms in the manufacturing industry are more inclined to switch their primary plans from defined benefit to defined contribution plans, including 401(k) plans.

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[1]Corresponding author: Ching-Fan Chung, Institute of Economics, Academia Sinica, Nankang, Taipei, Taiwan. Tel: (886-2) 2782-2791 ext. 118, Fax: (886-2) 2653-3593, E-Mail: cfchung@ieas.econ.sinica.edu.tw.

1 Introduction

Pension research has focused on two major types of pension plans — defined benefit (DB) and defined contribution (DC) plans. DB plans specify the final retirement benefits, whereas DC plans make certain contributions each year and the final retirement benefits depend on the investment performance of plan assets. Over the past two decades the trend in the private pension system has been moving away from DB plans and toward DC plans because of changes in business environments and in the labor market. Wang and VanDerhei (2000) examine pension trends with respect to the changing shares of primary plans, active participants, and employers' costs across plan types and firm types from 1985 to 1993. Their findings suggest that DB plans have decreased about 20 percent for all three measurements from 1985 to 1993 and that DC plans are no longer considered as secondary plans.

Since its establishment in 1978, the 401(k) plan has grown substantially and become the most prevalent DC plan over the past fifteen years. The key elements of the 401(k) plan, which distinguish it from other DC plans, are that employees can make voluntary pre-tax contributions and that employers offer matching contributions. The relatively low cost of sponsoring a 401(k) plan makes it very attractive as a supplement to existing DB plans. Some authors argue that the 401(k) plan is a substitute for both DB and other DC plans and speculate that the rapid growth of 401(k) plans is perhaps the most important reason for the current trend toward DC plans.

Although previous pension studies have provided many useful insights, most of them share some of the following limitations. First, most of the studies treat the sponsorship of the DB and DC plans as a dichotomous decision (Petersen, 1994; Ippolito, 1995; Papke, 1999). Yet employers often offer more than one type of plan — one primary and the other supplemental. It would be more appropriate to examine multiple plan choices accordingly. Moreover, when investigating the substitution of a 401(k) plan for DB or other DC plans, Papke (1994, 1999) and Papke, Petersen, and Poterba (1996) include the choice of the 401(k) plan as an exogenous explanatory variable in their regression models. In reality, the 401(k) plan is obviously an endogenous option for employers to choose; and treating it as an exogenous variable may cause endogeneity bias.

Another drawback in many studies (e.g., Clark and McDermed, 1990, 1993; Gustman and

Steinmeier, 1992; Ippolito, 1995; and Kruse, 1995) is that the analysis is frequently based on the comparsion of pension choices between only two years. However, as suggested by Gustman and Steinmeier (1998), there have been important changes in pension system over the years. A great deal of information about such a dynamic process would be lost if we compared changes in pension choices only between two specific years. Tracing year-by-year changes over a reasonably long period of time, preferably using panel data, seems necessary for a more thorough analysis. Moreover, old companies constantly drop out while new companies enter into the market. Pension choices of new firms, surviving firms, and quitting firms can be quite different due to their fundamental differences with regard to labor-market considerations, cost comparisons, and financial conditions. Failing to control such evolution in the population of firms, as in the studies of Clark and McDermed (1990), Clark, McDermed, and Trawick (1993), Gustman and Steinmeier (1992), Ippolito (1995), and Kruse (1995) may lead to serious misrepresentation.

In this paper we try to address the aforementioned problems and provide additional empirical evidence for employers' pension decisions. We first put together panel data on the firms that existed every year between 1985 and 1996 based on *Form 5500* from the Internal Revenue Service (IRS). We then propose a dynamic multinomial logit model with random-effects to examine how employers switched their pension offerings among alternative plan types across the years. Our empirical analysis begins with three settings that differ from previous studies. First, in order to avoid heterogeneity caused by add-in and drop-out firms, we concentrate only on long-standing firms, i.e., the firms that have survived during the twelve years between 1985 and 1996. We note that the cause for the trend of moving away from DB plans toward DC plans can be either that the existing firms replaced their original DB plans by DC plans or that new firms were more likely to adopt DC plans. Our study provides new empirical results specifically regarding the effects of long-standing firms' decision changes. Second, we separate the 401(k) plan from other DC plans and regard it as a distinct choice so that there are three basic plan types in our study: DB, 401(k) and other DC plans (the term "DC plan" in the rest of the paper is therefore referred to as the class of DC plans that excludes 401(k) plans). We single out the 401(k) plan due to its unique matching mechanism feature and its growing importance, which have already been recognized by

many authors even though, as mentioned earlier, the exogenous treatment of the 401(k) plan in the literature is, we believe, not the best way to analyze it. Third, since we believe that employers' decisions about the primary pension plans and about the supplementary plans are made at two different stages, we divide our empirical study accordingly into two parts. In the first part we examine how employers changed their choices of primary pension plans across the years; and in the second part we go one step further to find out how employers supplemented their primary pension plans with various secondary plans, given that their primary choice was the traditional DB plan. It turns out that employers, indeed, made decisions on primary plans and secondary plans based on quite different considerations. The need for such separate analyses has generally been overlooked in the literature.

The focus of our analysis is the dynamic effects of firms' characteristics, such as the history of pension plans, the industrial classification, the firm size, unionization, etc., on employers' pension decisions across the years. More specifically, in addition to the random-effects, we include in our multinomial logit model the lagged dependent variables and their interactions with firms' characteristics as the explanatory variables. Consequently, we can estimate and analyze the effects of firms' characteristics on the probabilities of *maintaining the same pension choice* and of *switching to the different one across the years*. The novel methodology for such a dynamic analysis is the main contribution of this paper. It is fundamentally different from those studies based on the static multinomial logit model which are concerned with the probabilities of *choosing particular plan types at a particular point of time*. Our analysis provides much more details in the dynamics of plan types switching than the previous studies which are at most sketchy about the general trend. Furthermore, panel data allow us to conduct an in-depth investigation of employers' dynamic pension decisions that are independent of the time and plan characteristics. As a result our study yields a more complete and definite analysis than those studies that are based on comparisons across only two years in which we can never be certain whether empirical findings are specific to the two picked years or indeed a general pattern. We should nevertheless point out that most of our empirical results confirm, rather than refute, many of the conclusions that have been reached in earlier studies. The most interesting exception is perhaps that firms in the manufacturing industry

are more inclined than those in other industries to switch their primary plans from DB to DC plans, including 401(k) plans. This and all other empirical results will be presented in the next section. A summary is then included in section 3.

2 The Empirical Analysis

Based on *Form 5500* from the Internal Revenue Service (IRS), we first identify firms that sponsored at least one pension plan with at least 100 participants in 1985 and then trace them every year until 1996, the latest year for which data are available. We then construct panel data for the 7,668 firms that existed for all twelve years. A number of tax and regulatory changes during the early 1980s increased employer's costs for offering DB plans and thus encouraged employers to establish DC/401(k) plans or to terminate their existing DB plans. We, therefore, specifically keep the pre-regulatory 1985 data.

2.1 The Econometric Model

To fully exploit the special feature of panel data, we adopt the random-effects multinomial logit model as the econometric framework for analyzing the pension plan choices.[2] The specification of the model is as follows: Suppose firm i at time t has J plans to choose from. Let y^*_{jit} be the unobservable "utility" of choosing the jth plan, which is specified as a linear regression model:

$$y^*_{jit} = \boldsymbol{\beta}'_j \mathbf{x}_{it} + \gamma_j v_i + u_{jit}, \qquad j = 1, \ldots, J, \tag{1}$$

where $\mathbf{x}_{it}$ is a vector of explanatory variables, v_i is an unobservable *time-invariant, plan-invariant* random-effect, and u_{jit} is the usual random disturbance. Also, $\boldsymbol{\beta}_j$ and γ_j are plan-specific pa-

[2]There are two reasons why we do not consider the fixed-effects version proposed by, for example, Chamberlain (1980). First, many explanatory variables that we find interesting are time-invariant and in a fixed-effects model the influences of these variables cannot be separately estimated. The second reason is that, as will be explained shortly, we are going to include lagged dependent variables as explanatory variables which render the fixed-effects model overly complicated.

rameters to be estimated. Firm i chooses the jth plan if $y^*_{jit} > y^*_{kit}$, for all $k \neq j$. We make two distributional assumptions: (1) the random disturbances u_{jit} are independently and identically distributed across all j, i, and t with the common (type-I) extreme-value distribution; and (2) the "random-effects" v_i are independent of u_{jit} and are independently and identically distributed across all i with a common density $g(v)$ that has a zero mean and unit variance. It is straightforward to show that the probability for firm i at time t to choose the jth plan is

$$\mathrm{P}_{it}(j) = \frac{\exp\left(\boldsymbol{\beta}'_j \mathbf{x}_{it} + \gamma_j v_i\right)}{\sum_{k=1}^{J} \exp\left(\boldsymbol{\beta}'_k \mathbf{x}_{it} + \gamma_k v_i\right)}. \tag{2}$$

Such an econometric model is a random-effects multinomial logit model that can be estimated using the maximum likelihood estimation. In Appendix A we provide the full specification of the log-likelihood function for the model.

As is well known, the estimation of the multinomial logit model requires a normalization rule that one of the J sets of parameters $\boldsymbol{\beta}_j$ and γ_j needs to be zero. If we set $\boldsymbol{\beta}_1 = 0$ and $\gamma_1 = 0$, which means that the first plan is set to be the base, then the corresponding estimate of $\boldsymbol{\beta}_j$ reflects the effects of the explanatory variables $\mathbf{x}_{it}$ on the probability $\mathrm{P}_{it}(j)$ of choosing the jth plan as opposed to $\mathrm{P}_{it}(1)$ for the first plan. More precisely, the estimate of β_{kj} (the kth element of the vector $\boldsymbol{\beta}_j$) reflects the effect of the kth explanatory variable $x_{k,it}$ on the "odds ratio" $\mathrm{P}_{it}(j)/\mathrm{P}_{it}(1)$. If $\beta_{kj} > 0$ (< 0), then $x_{k,it}$ causes an increase (decrease) in the odds ratio of choosing the jth plan against the first plan. As for the coefficient γ_j, it indicates the time-invariant, plan-invariant random individual effects on the odds ratio of choosing the jth plan against the first plan. The incorporation of such random-effects helps exploit the panel data to reduce the influence of the omitted time-invariant and plan-invariant heterogeneity across the sampled firms. When the coefficient γ_j of the random-effects v_j are all equal to zero, then the specification reduces to the standard multinomial logit model without random-effects.

The proposed random-effects multinomial logit model is used to investigate two issues regarding employers' pension plan decisions. The first issue is about substitution among the primary pension plan choices; and the second is how employers supplement their primary pension plans

with alternative secondary plans, given that their primary choice is the DB plan.

2.2 The Dynamics of the Primary Pension Decision

The objective of the first part of our empirical analysis is to examine how employers switch their choices of pension plans at the primary level over the years. Here we identify three alternative primary pension plans: the DB plan, the DC plan, and the 401(k) plan.[3] As mentioned earlier, the DC plan here is actually the subset of DC plans that excludes the 401(k) plan. The reason for making the 401(k) plan a separate category is due to its unique matching mechanism characteristic as well as its growing importance, clearly illustrated in Table 1, which shows how the 7,668 long-standing firms were distributed among the three categories between 1985 and 1996. We note that while the number for the DC plan fluctuates without an apparent trend, particularly in the 1990s, the decline of the DB plan and especially the growth of the 401(k) plan are quite obvious.

Table 2 shows the cross-plan interchanges among the three categories in 1985 and 1996, which are the first and last of the sampled years. The interpretations are as follows: the three middle columns show how the three groups of the employers that chose the DB plan, the DC plan, and the 401(k) plan, respectively, in 1985 switched their choices in 1996. For example, among the 4,388 employers that chose the DB plan in 1985, 2,887 held the same decision while 1,101 switched to the DC plan and 400 switched to the 401(k) plan in 1996. In contrast, the three middle rows show how each of the three groups in 1996 is originated from the three groups in 1985. For

[3]To identify firms' pension plan choices, we classify firms into seven categories as follows: 1. firms with DB plans only; 2. firms with DC plans only; 3. firms with 401(k) plans only; 4. firms with both DB and DC plans; 5. firms with both DB and 401(k) plans; 6. firms with both DC and 401(k) plans; and 7. firms with DB, DC, and 401(k) plans. Employers may offer multiple plans such as one DB plan and two DC plans in which case the firm is classified as a category-4 firm. We use the primary code in IRS 5500 tapes to define each firm's primary plan. The primary code is attached to the 5500 tapes by the U.S. Department of Labor based on an algorithm designed to sort through multiple coverage in the same firm. If only one plan exists within an EIN (Employer Identification Number), it is labeled as the primary plan. Otherwise, a DB plan is considered primary if the number of participants covered by such a DB plan is greater than the numbers covered by other plans. On the other hand, a DC/401(k) plan is considered primary if the number of participants covered by a DC/401(k) plan is greater than the number covered by other plans.

Table 1: The Distribution of the Firms' Choices

Year	DB	DC	401(k)
1985	4,388	2,567	713
1986	4,435	2,432	801
1987	4,340	2,411	917
1988	4,360	2,218	1,090
1989	4,324	2,117	1,227
1990	4,159	2,015	1,494
1991	4,097	2,038	1,533
1992	4,050	1,932	1,686
1993	3,823	2,151	1,694
1994	3,999	1,714	1,955
1995	2,692	3,411	1,565
1996	3,049	2,728	1,891

example, among the 3,049 employers that chose the DB plan in 1996, 2,887 chose the same plan, 99 chose the DC plan and 63 chose the 401(k) plan in 1985. Table 2 presents the dynamics of the employers' decisions. The most salient impression we get from this table is about those 4,388 employers that chose the DB plan in 1985: While the majority held the same decision in 1996, many of them also switched to other choices so that the popularity of the DB plan appears to be declining substantially. We also note that a large number (1,021) of those employers that chose the DC plan in 1985 switched to the 401(k) plan to make the latter a much more important choice and thus became its largest group of constituents (54% out of 1,891) in 1996. It is also interesting to note the reason the number of the DC plan adopters more or less remained the same (from 2,567 to 2,728) over the years is because this group, while losing many members to the 401(k) plan, obtained many converts (1,101) from those who chose the DB plan in 1985.

To rigorously investigate the effects of firms' characteristics on their primary pension plan choices, we fit the data to the random-effects multinomial logit model in which the DB plan is set as the base. Seven groups of explanatory variables are included:

1. Plan age is a continuous variable indicating the number of years that the chosen plan has been sustained. More specifically, the plan age is the average age of a firm's pension plans

Table 2: The Interchanges of the Firms' Choices

1985/1996	DB	DC	401(k)	1996
DB	2,887	99	63	3,049
DC	1,101	1,447	180	2,728
401(K)	400	1,021	470	1,891
1985	4,388	2,567	713	

weighted by the plan participants under each plan. Due to the benefit-backloading nature of the DB plan, the marginal benefits from this plan are higher than those from the DC plan in the later years of service. As a result, the opportunity cost for a firm to switch from the DB plan to the DC or the 410(k) plan increases as the firm/plan ages. As indicated by Lazear (1985) and Ippolito (1985), the older a firm (and its pension plan) is, the more likely it is to stay with the DB plan.

2. Two industry dummies are included to identify the industry to which the firm belongs. This pair of dummies distinguishes three types of industries: the manufacturing industry (which is the base), the service-related industry (which consists of the trading industry; the finance, investment, and insurance industry; and the service industry), and the others (which consists of the agriculture and mining industry; the construction industry; and the transportation industry). Gustman and Steinmeier (1992) and Ippolito (1995) suggested that the manufacturing and service industries may favor different pension plans due to the nature of their business.

3. Firm size in the form of one dummy is used to indicate whether the number of employees in the firm is greater than 1,000. The base is of the smaller size. We note that financially a large firm may be capable of offering either more benefits or a larger variety of plans to its employees. See Kotlikoff and Smith (1983).

4. Union in the form of one dummy is adopted to indicate whether the firm is unionized. The base is without a union. Kotlikoff and Smith (1983) and Ippolito (1995) pointed out that employees can often bargain for better pension benefits through unions.

5. Ten yearly dummies are used to carry the year-effects, one for each year between 1987 and 1996; 1986 is set as the base year. These yearly dummies, in addition to random-effects, help control for the effects of yearly macroeconomic changes to further reduce heterogeneity in the data. It should be pointed out that it is the panel data that allow us to include the yearly dummies in our estimation.

6. The lagged dependent variables in the form of two dummies are included to designate the employer's choice of the primary plan in the previous year. Choosing the DB plan in the previous year is the base. It is these lagged dependent variables that render our model a dynamic one and allow us to examine the degree of persistence in maintaining the same choice of pension plans as well as the tendency to switch to any particular alternative. We again note that estimating the dynamic model is possible only with panel data.

7. Eight interaction terms in the form of cross-product terms of the two lagged dependent variables and four dummies for the industry, the firm size, and unionization are also considered. The analysis of the effects of the lagged dependent variables and their interactions with other explanatory variables is the main focus of our study.

The estimation results are given in Table B.1 in Appendix B. We have also estimated the standard multinomial logit model without random-effects, which is a special case of our main model. We then employ the likelihood-ratio test and conclude that the hypothesis of no random-effects (i.e., $\gamma_j = 0$, for all j, in equations (1) and (2)) is rejected at the 99 precent level. This testing result simply confirms the statistical significance of the estimates for the two parameter γ_j in Table B.1 (under the label of "Random-Effects").

Based on the estimation results in Table B.1 we can examine the effects of various explanatory variables on the odds ratios, such as the one for choosing the DC plan over the DB plan: P(DC)/P(DB). We first note that the negative and statistically significant estimate -0.024 of the coefficient for plan age (in the second column of Table B.1) implies that each additional year of plan age lowers the odds ratio P(DC)/P(DB) to $0.976 = \exp(-0.024)$. The interpretation is that the longer a firm has a pension plan, the less likely the firm will choose the DC plan over the DB

plan as its primary choice. Based on a similar calculation for the 401(k) plan, we confirm the well-known result that the older a firm (and its pension plan) is, the less likely the firm is to favor the DC/401(k) plan over the more traditional DB plan. See Ippolito (1985) and Papke (1999).

To analyze the effects of industrial types, the size of firms, and unionization, we have to consider how employers switch their choices of pension plans *across years*, since, in our empirical model, these explanatory variables are set to be interacted with the lagged dependent variables. To be more specific, let us define the conditional odds ratios such as $\mathrm{P}(\mathrm{DC}_t|\mathrm{DB}_{t-1})/\mathrm{P}(\mathrm{DB}_t|\mathrm{DB}_{t-1})$ for choosing the DC plan over the DB plan for employers who choose the DB plan in the previous year. Here $\mathrm{P}(\mathrm{DC}_t|\mathrm{DB}_{t-1})$ and $\mathrm{P}(\mathrm{DB}_t|\mathrm{DB}_{t-1})$ are the probabilities of choosing the DC plan and the DB plan, respectively, in year t given that the DB plan is chosen in year $t-1$. Such *conditional odds ratios* are affected by industrial types, the size of firms, and unionization. For example, our estimation results indicate that

$$\frac{\mathrm{P}(\mathrm{DC}_t|\mathrm{DB}_{t-1};\,\mathrm{S})/\mathrm{P}(\mathrm{DB}_t|\mathrm{DB}_{t-1};\,\mathrm{S})}{\mathrm{P}(\mathrm{DC}_t|\mathrm{DB}_{t-1};\,\mathrm{M})/\mathrm{P}(\mathrm{DB}_t|\mathrm{DB}_{t-1};\,\mathrm{M})} = \exp(-0.389) = 0.678,$$

where S and M indicate two types of industries: service-related and manufacturing, respectively. The interpretation is that the conditional odds ratio for firms belonging to the service-related industry is only 67.8 percent of that for firms belonging to the manufacturing industry. In other words, firms in the service-related industry are less likely to switch from the DB plan to the DC plan than those in the manufacturing industry.

As the second example, let us consider the effect of unionization on the odds ratio of choosing the 401(k) plan over the DC plan for employers that chose the DC plan in the previous year:

$$\frac{\mathrm{P}[401(\mathrm{k})_t|\mathrm{DC}_{t-1};\,\mathrm{U}_t]/\mathrm{P}[\mathrm{DC}_t|\mathrm{DC}_{t-1};\,\mathrm{U}_t]}{\mathrm{P}[401(\mathrm{k})_t|\mathrm{DC}_{t-1};\,\mathrm{NU}_t]/\mathrm{P}[\mathrm{DC}_t|\mathrm{DC}_{t-1};\,\mathrm{NU}_t]} = \exp(-1.725 - 0.646 + 1.195 + 0.802) = 0.688,$$

where U_t and NU_t indicate whether the firm is unionized or not unionized, respectively, in year t. Hence, unionized firms are less likely to switch from a DC plan to a 401(k) plan. All in all, what we report here are the effects of firms' characteristics on the conditional odds of *switching* the primary pension plan. The complete estimation results are given in Table 3. It should be emphasized that these results differ from those from a standard multinomial logit model without including lagged dependent variables, which estimates the effects of explanatory variables on the odds of *choosing*

Table 3: The Odds of Switching Primary Pension Plan

	Service†	Other†	Large Size	Union
$DB_{t-1} \rightarrow DC_t$	0.678**	0.645**	1.026	0.303**
$DB_{t-1} \rightarrow 401(k)_t$	0.869	0.903	0.530**	0.178**
$DC_{t-1} \rightarrow DB_t$	1.048	0.693**	3.343**	7.367**
$DC_{t-1} \rightarrow 401(k)_t$	0.837*	0.825*	1.390**	0.688**
$401(k)_{t-1} \rightarrow DB_t$	1.130	1.106	6.160**	8.224**
$401(k)_{t-1} \rightarrow DC_t$	0.877*	0.931	1.733**	0.872*

† The base is the manufacturing industry.
* Significantly different from 1 at the 95 percent level.
** Significantly different from 1 at the 99 percent level.

one plan over another (cf. the effects of plan ages given earlier). It should also be pointed out that conducting conditional analyses is possible only with the use of panel data and the inclusion of lagged dependent variables.

In addition to the results that both the service-related industry and the other industries are less likely than the manufacturing industry to change between the DC plan and the 401(k) plan, the most surprising result is that both the service-related industry and the other industries are also less inclined to change from the DB type to the DC type (the other industries are also unlikely to change back from the DC plan to the DB plan). This latter finding is not consistent with the popular belief that employers in the manufacturing industry are more likely to adopt DB plans from the labor market perspective because the nature of the DB plans helps increase employees' productivity and reduce quit rates of younger employees (Ippolito,1985). Our suggestive explanations for such a contradiction are as follows: After simple calculation we note that the pension cost per person under the DB plan in the manufacturing industry was $6,790, almost twice as much as $3,400 in the service industry. We also find that the pension cost per person under the DC plan, including 401(k) plans, in the manufacturing industry was $1,167, which is less than half the cost ($2,719) in the service industry. It seems that employers' choices regarding pension plans may be based on the cost-reduction argument rather than on labor-market considerations.

From the first and third rows in Table 3 we find that unionized firms are quite unlikely to switch from a DB plan to a DC plan while large unionized firms tend to move from a DC plan to a DB

plan. From the second and fifth rows in Table 3 we also note that large unionized firms are strongly inclined to change from a 401(k) plan to a DB plan but not vice-versa. These results confirm what has been reported in the literature — unionized firms favor DB plans which offer more protection to the employees (see Freeman, 1985; Gustman and Steinmeier, 1992; and Ippolito, 1995). From the fourth and sixth rows in Table 3 we also find that large non-unionized firms tend to switch back and forth between a DC plan and a 401(k) plan (Papke, 1994; and Papke, Petersen, and Poterba, 1996). It is possible to gain further insights into employers' decisions in large unionized firms by comparing the corresponding estimates between the first two rows, between the middle two rows, and between the last two rows in Table 3. From such comparisons we find that for large unionized firms that decide to change their original choice of a DC plan or a 401(k) plan, the DB plan is always their favored choice. But when these firms decide to change their original DB plan, they are more likely to choose a DC plan instead of a 401(k) plan.

The explanations for the rest of the parameter estimates in Table B.1 are as follows: The coefficient estimates of the yearly dummies indicate that while we observe a continuous rise in the odds ratio of choosing a 401(k) plan over a DB plan over the years, the increases in the odds ratio of choosing a DC plan over a DB plan is somewhat irregular. Moreover, if we subtract the coefficient estimates for 401(k) plans by those for DC plans, we find that increases in the odds ratio of choosing a 401(k) plan over a DC plan are also quite substantial. The time trends reflected by these estimation results confirm what we have noticed in Table 2 — between 1985 and 1996 the groups of firms that chose DB plans lost many members to both groups of DC plans and 401(k) plans while many DC plans adopters also changed to 401(k) plans.

Finally, the coefficient estimates for the random-effects imply that there are time-invariant plan-invariant random factors that increase the odds of choosing a 401(k) plan over either a DB plan or a DC plan, while these factors also cause firms to favor a DB plan over a DC plan. These findings can be viewed as the general pattern in employers' decisions about the primary pension plans, independent of time and pension plan characteristics.

2.3 The Selection of Supplementary Pension Plans

The second part of our empirical investigation focuses on the effects of firms' characteristics on their decisions about supplementing a primary DB pension plan with alternative secondary plans. The sample used here is a *subset* of the 7,668 firms considered in the previous subsection that includes only 4,388 firms that in 1985 chose a DB plan as the primary pension plan (not all firms that chose DB plan considered it as the primary plan). The reasons for considering this subset are that the DB plan has traditionally been regarded the most typical choice and firms that adopted a DB plan as the primary plan made up the largest group in 1985 (see Table 1). Concentrating on this smaller set of firms, while simplifying the analysis greatly, still offers enough insights into employers' decisions on secondary plans.

Given that a DB plan is the primary plan, we consider four possible combinations of secondary plans. They are, respectively, the case of no secondary plan, the case with a DC plan only, the case with a 401(k) plan only, and the case with both a DC and a 401(k) plan. (A fifth possibility specifies the situation in which the sampled firms switched their primary plan choice away from a DB plan.) Table 4 shows how these 4,388 firms are divided into these five categories between 1985 and 1996. We note that while supplementing a primary DB plan with a 401(k) plan has become increasingly popular, the continuous decrease in the numbers of cases with no secondary plan and cases with a DC plan as the single supplement is also quite apparent. As for the choice of combining a primary DB plan with both a DC plan and a 401(k) plan, we observe a slight downward trend. Given what was stated in the previous subsection, it is not surprising to see the increase in the size of the "other" category, which consists of firms that altered their primary pension choice away from the DB plan.

We give the cross-plan interchanges among the five categories between the two years of 1985 and 1996 in Table 5, whose interpretation is the same as that of Table 2. The most notable impression we get from this table is that no matter which group a firm belonged to in 1985, there is a good chance that it chose a 401(k) plan as the single supplement in 1996.

As in the previous subsection, we apply the proposed dynamic multinomial logit model with random-effects to the present subsample. The explanatory variables are the same as those specified

Table 4: The Distribution of the Firms' Choices

Year	DB	DB+DC	DB+401(k)	DB+DC+401(k)	Other
1985	2,347	864	718	459	0
1986	2,162	776	862	521	67
1987	2,053	639	983	514	199
1988	1,934	532	1,201	515	206
1989	1,867	473	1,321	462	265
1990	1,730	418	1,389	421	430
1991	1,633	424	1,421	423	487
1992	1,353	547	1,457	493	538
1993	1,223	637	1,343	429	756
1994	1,269	531	1,567	420	601
1995	768	489	966	333	1,832
1996	868	445	1,205	369	1,501

earlier (except that the number of the lagged dependent variables becomes four instead of two). The base is the case with no supplementary plan; and the estimation results are given in Table B.2 in Appendix B.

Based on the coefficient estimates for plan age, we note that the longer a firm has a pension plan, the less likely the firm is to supplement a primary DB plan with any new secondary plan. Similarly, firms that have already supplemented a primary DB plan with a 401(k) plan are less likely to replace a secondary 401(k) plan with a DC plan or to add a DC plan as an additional supplement. But for firms that have already supplemented a primary DB plan with a DC plan, an

Table 5: The Interchanges of the Firms' Choices

1985/1996	DB	DB+DC	DB+401(k)	DB+DC+401(k)	1996
DB	786	49	27	6	868
DB+DC	204	127	64	50	445
DB+401(K)	449	233	356	167	1,205
DB+DC+401(K)	62	127	56	124	369
Other	846	328	215	112	1,501
1985	2,347	864	718	459	

Table 6: The Odds of Adding or Switching the Supplementary Plan

	Service†	Other†	Large Size	Union
$DB_{t-1} \rightarrow [DB+DC]_t$	1.227*	0.827	2.248**	0.769*
$DB_{t-1} \rightarrow [DB+401(k)]_t$	0.589**	0.986	2.964**	1.015
$DB_{t-1} \rightarrow [DB+DC+401(k)]_t$	0.707	1.005	8.159**	3.572**
$[DB+DC]_{t-1} \rightarrow [DB+401(k)]_t$	0.784	1.087	1.208**	1.254**
$[DB+DC]_{t-1} \rightarrow [DB+DC+401(k)]_t$	0.765	1.294*	3.508**	2.056**
$[DB+401(k)]_{t-1} \rightarrow [DB+DC]_t$	0.854	0.919	1.048	0.942
$[DB+401(k)]_{t-1} \rightarrow [DB+DC+401(k)]_t$	0.681*	0.951	3.838**	2.688**

† The base is the manufacturing industry.
* Significantly different from 1 at 95 percent level.
** Significantly different from 1 at 99 percent level.

opposite conclusion can be reached. That is, the longer these firms have pension plans, the more likely they are to either replace a secondary DC plan with a 401(k) plan or to add a 401(k) plan as another supplement.

In Table 6 we present the estimation results that help analyze the dynamic effects of industrial types, the size of firms, and unionization on employers' decisions about restructuring their secondary pension plans over the years. The most apparent pattern found in this table is that larger firms are more likely to supplement a primary DB plan with as many secondary plans as possible. This result is consistent with the hypothesis that larger firms have more resources to offer a broader variety of pension plans. Unionized firms also have the tendency to supplement a primary DB plan with as many secondary plans as possible. Moreover, we notice that unionized firms are less likely to supplement a primary DB plan with a DC plan and tend to replace an existing secondary DC plan with a 401(k) plan. The reason unionized firms prefer a 401(k) plan as a supplement can be interpreted from the perspective of the 401(k) plan's matching mechanism. According to our calculations, the average matching rate of a 401(k) plan in a unionized firm is 2.72 whereas the corresponding figure in a non-unionized firm is only 1.06. In other words, unions are able to bargain for better matching rates and therefore prefer a 401(k) plan to a DC plan as a supplement.

We also note that there does not seem to be any significant cross-industry difference in firms'

choices of supplementary plans except that, compared to the service-related industry, firms in the manufacturing industry tend to supplement with a 401(k) plan instead of a DC plan. One possible explanation for this difference is that providing a 401(k) plan in the manufacturing industry is cheaper than in the service-related industry since, as our calculation shows, the average matching rate in the manufacturing industry is 0.86, which is much lower than the 1.35 in the service industry.

Finally, from the coefficient estimates for the random-effects in Table B.2, we note that there are time-invariant plan-invariant random factors that increase the odds of choosing a 401(k) plan over a DC plan as the supplementary plan, which represents the general pattern in employers' decisions about secondary pension plans that is independent of time and pension-plan characteristics.

3 Conclusion and Policy Implications

By using rich twelve-year panel data of long-standing firms, classifying employer's pension decisions as multiple plan choices, and constructing a dynamic model with random-effects, our study provides new evidence for employers' pension decisions. The unique formulation of the econometric model enables us to analyze the dynamic effects of industrial classification, plan age, firm size, and union status on pension choices. More specifically, by adding the lagged dependent variables in our model, we are able to estimate the conditional odds ratios to analyze employers' decisions in *switching from one plan type to another* (rather than statically choosing one plan type) across years. In addition, by identifying a 401(k) plan as a distinct pension choice and separating pension choices at both the primary and secondary levels, we are able to obtain detailed information about the substitution and supplement effects between 401(k) and other pension plans at both plan levels. The estimation of the random-effects in our models allows us to establish the general patterns in employers' pension plan decisions that are independent of the time and plan characteristics.

Regarding the primary plans, we observe that the number of firms that adopted DB plans has steadily decreased while those that adopted DC plans — 401(k) plans in particular — have substantially increased over the years so that DC plans and 401(k) plans have rapidly taken the place of DB plans as the primary sources of pension income. As is well known (e.g., Bodie, 1990), DC

plan participants must face greater uncertainty regarding retirement benefits; and 401(k) plans offer less forced-saving incentives than other DC plans. Therefore, policy-makers may need to focus more on improving pension income security when considering any Social Security reform.

Our estimation results also confirm that the older a firm is, the more likely the firm is to favor a traditional DB plan over a DC or 401(k) plan and that unionized firms are quite unlikely to switch from a DB plan to either a DC or 401(k) plan (particularly so among large unionized firms). Both of these results are not unexpected. But our empirical results also yield a surprising finding that firms in the manufacturing industry are more inclined than those in other industries to switch their primary plans from DB to DC plans, including 401(k) plans. This unexpected finding, together with some related analyses, suggests that, for long-standing firms at least, cost reductions rather than labor economics considerations are more important factors in employers' primary pension decisions. A substantive policy implication is that legislation should be oriented toward reducing DB pension costs through taxation or regulation if encouraging employers to offer more DB plans as primary plans is the objective.

For the secondary plans, larger and unionized firms are more likely to supplement their primary DB plan with as many secondary plans as possible in order to have better protection against different kinds of retirement risks (see Mitchell, Gordon, and Twinney, 1997). In addition, unionized firms are less likely to adopt a DC plan as a supplement and tend to replace an existing secondary DC plan with a 401(k) plan. Unionized firms' preference for a 401(k) plan as a supplement can be attributed to the unions' ability to demand higher matching rates from employers. As for the finding that firms in the manufacturing industry tend to supplement with a 401(k) plan instead of a DC plan, the interpretation can also be ascribed to matching rate considerations: 401(k) plans are simply cheaper for employers to provide due to lower average match rates in the manufacturing industry. Here, we should point out that our empirical findings do not refute Ippolito and Thompson (2000) in that the majority of DB plans may survive but no longer be considered the primary plans.

In passing ERISA in 1974, the U.S. Congress made clear its intention that private pension plans are to be managed mainly to supplement Social Security and to ensure better retirement income

security. But as the Social Security solvency problem deteriorates, future Social Security benefits are more likely to be cut; and some have even suggested privatizing the entire Social Security system. Consequently, the portion of future retirement income received from the government has become less certain. The trend in the private pension system does not ameliorate the situation. As our empirical results indicate, DB plans have steadily decreased while DC plans and 401(k) plans have substantially increased at both the primary and secondary plan levels. Given the fact of life that considerably greater risks and responsibility have been transferred from employers to employees over the years, it is important to pursue the issue about how this trend may influence the saving behavior of the public, as has been suggested by many authors; see Diamond and Hausman (1984), Makin and Couch (1989), Kuehlwein (1983), and Venti and Wise (1986, 1991, 1992).

Appendix A: The Log-Likelihood Function

To facilitate the presentation of the log-likelihood function, let us define the following J dummy variables

$$y_{jit} = \begin{cases} 1, & \text{if firm } i \text{ chooses the } j\text{th plan at time } t, \\ 0, & \text{otherwise,} \end{cases} \qquad j = 1, \ldots, J.$$

That is, firm i at time t chooses the jth plan if $y_{jit} = 1$ and $y_{kit} = 0$, for all $k \neq j$. Then the likelihood for firm i to observe y_{jit}'s for $t = 1, 2, \ldots, T$ is

$$L_i(\boldsymbol{\beta}_2, \ldots, \boldsymbol{\beta}_J, \gamma_2, \ldots, \gamma_J) = \int_{-\infty}^{\infty} \prod_{t=1}^{T} \left\{ \prod_{j=1}^{J} \left[\mathrm{P}_{it}(j) \right]^{y_{jit}} \right\} \cdot g(v_i) \; dv_i. \tag{3}$$

where $\mathrm{P}_{it}(j)$ is defined in (2). The log-likelihood for the entire sample is

$$\ln L(\boldsymbol{\beta}_2, \ldots, \boldsymbol{\beta}_J, \gamma_2, \ldots, \gamma_J) = \sum_{i=1}^{n} \ln L_i(\boldsymbol{\beta}_2, \ldots, \boldsymbol{\beta}_J, \gamma_2, \ldots, \gamma_J). \tag{4}$$

In our estimation the density function of g of the random-effects v_i is assumed to be standard normal.

The log-likelihood function (4) involves integrals, one for each i, and is quite complicated. The estimation of such a random-effects multinomial model is very time-consuming. However, computation time can be greatly reduced if the analytic gradients of the log-likelihood function can be included in the numeric maximization algorithm. We do provide such analytic gradients in our computer program. Finally, we point out that the computation of the standard errors of the parameter estimates is based on the so-called BHHH method, that is, the variance-covariance matrix of the maximum likelihood estimator $\hat{\boldsymbol{\theta}}$ of $\boldsymbol{\theta} = [\, \boldsymbol{\beta}_2 \;\; \ldots \;\; \boldsymbol{\beta}_J \;\; \gamma_2 \;\; \ldots \;\; \gamma_J \,]'$ is approximated by

$$\left\{ \sum_{i=1}^{n} \left[\frac{\partial \ln L_i(\hat{\boldsymbol{\theta}})}{\partial \boldsymbol{\theta}} \right] \left[\frac{\partial \ln L_i(\hat{\boldsymbol{\theta}})}{\partial \boldsymbol{\theta}} \right]' \right\}^{-1}.$$

Appendix B: Parameter Estimates

Table B.1: Parameter Estimates for the Three-Group Classification

	DC (Plan 2)		401(k) (Plan 3)	
	Est.	T-Ratio	Est.	T-Ratio
Cnst.	−3.155	−32.037	−4.080	−34.161
Age	−0.024	−14.655	−0.061	−25.084
Service	−0.389	−7.104	−0.140	−1.412
Others	−0.439	−4.783	−0.102	−0.594
Large Size	0.026	0.512	−0.634	−6.355
Union	−1.195	−16.957	−1.725	−9.625
(Plan 2)$_{t-1}$	6.825	109.565	5.491	47.895
(Plan 3)$_{t-1}$	5.578	36.341	8.230	64.118
(Plan 2)$_{t-1}$ × Service	0.342	4.956	−0.085	−0.611
(Plan 2)$_{t-1}$ × Others	0.806	6.920	0.277	1.202
(Plan 2)$_{t-1}$ × Bigger	−1.233	−19.057	−0.244	−1.843
(Plan 2)$_{t-1}$ × Union	−0.802	−9.058	−0.646	−2.715
(Plan 3)$_{t-1}$ × Service	0.136	0.825	0.018	0.133
(Plan 3)$_{t-1}$ × Others	0.267	0.994	0.001	0.005
(Plan 3)$_{t-1}$ × Bigger	−1.294	−8.194	−1.184	−8.670
(Plan 3)$_{t-1}$ × Union	−1.049	−3.932	−0.382	−1.736
1987	0.509	4.564	0.625	5.016
1988	0.056	0.500	0.592	4.918
1989	0.251	2.111	0.858	6.925
1990	0.635	5.390	1.664	13.499
1991	0.489	4.029	1.130	9.081
1992	0.378	3.158	1.445	11.578
1993	1.215	9.905	1.818	13.773
1994	−0.499	−4.140	1.209	9.420
1995	3.382	32.267	2.880	24.079
1996	−0.219	−2.186	1.188	10.218
Random-Effects	−0.309	−5.069	0.763	11.201

The sample consists of eleven years (1986-1996) of data for 7,668 firms. The base is the DB plan. The variables corresponding to the labels in the leftmost column are as follows: Age: the number of years that the pension plan has been sustained; Service: a dummy for the service-related industry, which consists of the trading industry, the finance, investment, and insurance industry, and the service industry; Others: a dummy for the group of industries that consists of the agriculture and mining industry, the construction industry, and the transportation industry; Large Size: a dummy indicating whether the number of employees of the firm is greater than 1,000; Union: a dummy indicating whether the firm is unionized; Plans 2 and 3 are referred to as the DC and 401(k) plans, respectively; 1987–1996: yearly dummies to carry the year-effects; Random-Effects: the estimate of the coefficient γ_j.

Table B.2: Parameter Estimates for the Five-Group Classification

	DB+DC (Plan 2)		DB+401(k) (Plan 3)		DB+DC+401(k) (Plan 4)		Others (Plan 5)	
	Est.	T-Ratio	Est.	T-Ratio	Est.	T-Ratio	Est.	T-Ratio
Cnst.	−3.506	−28.277	−2.971	−29.605	−6.779	−16.226	−3.960	−22.151
Age	−0.011	−4.977	−0.006	−2.954	−0.009	−4.165	−0.071	−23.536
Service (S.)	0.205	2.035	−0.529	−7.226	−0.347	−0.772	−0.924	−8.282
Others (O.)	−0.190	−0.928	−0.014	−0.119	0.005	0.009	−0.434	−2.163
Large Size (L.)	0.810	8.383	1.087	16.541	2.099	5.647	0.108	0.890
Union (U.)	−0.263	−2.080	0.015	0.178	1.273	2.929	−3.985	−15.832
$(\text{Plan 2})_{t-1}$	6.169	53.181	3.275	21.639	6.239	14.056	3.036	18.473
$(\text{Plan 3})_{t-1}$	3.189	18.131	5.528	54.818	5.254	11.475	2.812	20.041
$(\text{Plan 4})_{t-1}$	4.048	10.793	3.663	10.754	9.756	21.102	3.372	9.736
$(\text{Plan 5})_{t-1}$	3.061	14.683	2.763	15.085	4.969	9.730	4.138	27.043
$(\text{Plan 2})_{t-1} \times$ S.	0.030	0.208	0.521	2.847	0.314	0.643	0.591	2.942
$(\text{Plan 2})_{t-1} \times$ O.	0.272	0.968	0.180	0.648	0.335	0.516	0.271	0.733
$(\text{Plan 2})_{t-1} \times$ L.	−0.056	−0.404	−0.144	−0.843	−0.090	−0.217	0.207	1.038
$(\text{Plan 2})_{t-1} \times$ U.	0.170	0.930	0.118	0.553	−0.645	−1.342	1.989	5.471
$(\text{Plan 3})_{t-1} \times$ S.	0.122	0.593	1.014	7.283	0.448	0.918	0.897	4.739
$(\text{Plan 3})_{t-1} \times$ O.	0.594	1.749	0.502	2.205	0.433	0.673	0.327	1.041
$(\text{Plan 3})_{t-1} \times$ L.	0.667	3.414	0.343	2.575	0.676	1.572	0.936	4.813
$(\text{Plan 3})_{t-1} \times$ U.	0.407	1.747	0.188	1.193	−0.081	−0.171	2.416	7.850
$(\text{Plan 4})_{t-1} \times$ S.	0.321	0.829	0.449	1.226	0.677	1.245	0.863	2.236
$(\text{Plan 4})_{t-1} \times$ O.	0.140	0.271	−0.123	−0.276	−0.094	−0.130	−0.757	−1.332
$(\text{Plan 4})_{t-1} \times$ L.	0.570	1.462	0.746	2.001	−0.174	−0.363	0.740	1.946
$(\text{Plan 4})_{t-1} \times$ U.	1.510	3.184	1.571	3.528	0.153	0.249	4.359	8.209
$(\text{Plan 5})_{t-1} \times$ S.	−0.134	−0.559	0.526	2.576	0.325	0.623	0.468	2.677
$(\text{Plan 5})_{t-1} \times$ O.	0.461	1.022	0.209	0.563	−0.130	−0.180	0.533	1.518
$(\text{Plan 5})_{t-1} \times$ L.	1.095	4.494	1.026	4.901	1.306	2.726	0.759	3.851
$(\text{Plan 5})_{t-1} \times$ U.	−0.388	−1.426	−0.346	−1.507	−0.637	−1.244	1.465	4.748
Random-Effects	−0.138	−2.508	0.223	4.809	−0.011	−0.179	−1.677	−27.692

The sample consists of eleven years (1986-1996) of data for 4,388 firms. The base is the DB plan. The variables corresponding to the labels in the leftmost column are as follows: Age: the number of years that the pension plan has been sustained; Service (S.) : a dummy for the service-related industry, which consists of the trading industry, the finance, investment, and insurance industry, and the service industry; Others (O.): a dummy for the group of industries that consists of the agriculture and mining industry, the construction industry, and the transportation industry; Large Size (L.): a dummy indicating whether the number of employees of the firm is greater than 1,000; Union (U.): a dummy indicating whether the firm is unionized; Plans 2 – 5 are referred to as the plan combinations DB+DC, DB+401(k), DB+DC+401(k), others, respectively; 1987–1996: yearly dummies to carry the year-effects; Random-Effects: the estimate of the coefficient γ_j.

Table B.2: Parameter Estimates for the Five-Group Classification (Cont.)

	DB+DC		DB+401(k)		DB+DC+401(k)		Others	
	Est.	T-Ratio	Est.	T-Ratio	Est.	T-Ratio	Est.	T-Ratio
1987	−0.484	−3.738	−0.234	−2.249	−0.625	−4.007	1.025	5.250
1988	−0.471	−3.615	0.098	0.900	−0.461	−3.044	0.810	4.152
1989	−0.605	−4.529	−0.183	−1.665	−0.911	−5.880	1.158	6.133
1990	−0.390	−2.813	0.042	0.379	−0.592	−3.612	2.234	12.293
1991	−0.206	−1.459	−0.003	−0.022	−0.427	−2.513	2.198	11.621
1992	0.901	7.367	0.685	5.825	0.715	4.446	2.935	15.307
1993	0.510	3.667	−0.022	−0.168	−0.374	−2.214	3.394	17.877
1994	−0.527	−3.796	0.109	0.889	−0.735	−4.401	1.963	9.744
1995	1.016	7.166	−0.008	−0.056	0.326	1.895	6.230	32.657
1996	−0.376	−2.511	−0.006	−0.046	−0.667	−3.773	3.839	19.236

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