The Differences in the Economic Effects between the DB Plan and the DC Plan

by

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1. Introduction

There are several problems in old-age pension systems in Japan. These problems are observed in both public pension systems and enterprise pension systems. This paper is concerned with the latter. Interested readers can refer to, for example, Tachibanaki (2004) for the former. It is anticipated that the level of the public pension benefit will be reduced for the following two reasons. First, the serious lower birth rate and aging population do not unable retired people to enjoy the current level of the benefit. Second, the slower growth rate economy will decrease the amount of social insurance revenues (i.e., contributions) in the public pension programs in future. Under such unfortunate circumstances it is desirable to develop enterprise pension programs in order to keep the current level of incomes for retired people. In reality, however, it is impossible to understand that enterprise pension systems in Japan have developed sufficiently, although there have been several right reforms. The paper examines and discusses these positive and negative aspects both theoretically and empirically.

2. Recent Reforms in Enterprise Pension systems

Japanese enterprise pension programs have been very complicated, and also have had several serious shortcomings. In 2001 there were two major reforms in the program, and their reforms can be called revolutional. Concretely, two new-laws were enacted in 2001.

There are three principal reforms in these new laws.

The first is that the Zeisei-tekikaku pension programs, one of the two major programs in enterprise pension systems together with the Kosei-nenkin-kikin programs, will be abolished by 2011.

The second is the formal introduction of the defined contribution (DC) plans in enterprise pension programs in Japan where only the defined benefit (DB) plans were common.

The third is that the government admitted the Kosei-nenkin-kikin to abandon the right of managing a part of public pension fund. In other words, the Kosei-nenkin-kikin was able to manage in the past, a part of the public pension funds as an agency for the government, and if the financial rate of return to its fund had been over 5.5 percent, the Kosei-nenkin-kikin were able to receive the part of the return which was over 5.5 percent. Needless to say, if it had been lower than 5.5 percent, enterprises were obliged

to share the financial burden under the DB plan. The recent very low rate of return, even the negative rate in several years, did not enable the Kosei-nenkin-kikin to receive such extra revenues. Instead, many enterprises were obliged to share heavy burdens not only in this agency job but also in enterprise pension programs caused by the very low rate of returns. It is natural for them to hope that the right of managing a part of the public pension fund should be abandoned if they have to contribute extra costs.

The third reform symbolizes the difficulty in pension systems in general when the rate of interest is so low as in the case of the recent Japanese financial market. If both public pension programs and enterprise pension systems were managed under the DB plans, low rates of return to financial assets or low rates of interest give difficulty to both the government and the enterprises which manage various pension programs. One of the methods to escape from such difficulty is to transform the managing principle from the DB plan to the DC plan.

The second reform, which was described above, is the actual implementation of such a transformation. The reform reacted to the demand from enterprises which faced financial difficulty in managing enterprise pension programs with the DB scheme. The recent reform in the enterprise accounting system encourages this transformation because enterprises have to report official financial deficits in their enterprise pension plans more clearly. Another important motive of transforming the managing principle from the DB plan to the DC plan came from the United States where the so-called "401(k) plans" were so successful in inviting a large number of enterprises and employees to join enterprise pension programs, and in managing them.

I find that the main merit of the 401(k) plans is the introduction of the DC plans in managing enterprise pension programs. A large number of concerned people, however, such as financial managers, financial institutions, and non-financial enterprises in Japan thought that the main advantage of the 401(k) plans in the U.S. was the generous tax treatment for both enterprises and employees, and thus they demanded the Japanese government to adopt the similar favorable tax treatment.

I personally did not accept such demands for the following reasons. First, one of the reasons why the U.S. adopted such favorable tax treatments for the 401(k) plans to promote the DC plans is that the U.S. suffered from the low personal saving rate. Since the U.S. type DC plans may be regarded as a kind of personal saving rather than rigorous pension programs, the U.S. government hoped that the U.S. personal saving rate should have been raised. It is not necessary to take such an action to increase the personal saving rate in Japan where the personal saving rate is sufficiently high. This does not necessary exclude such favorable tax treatments in future even in Japan

because the current aging trend is likely to lower the saving rate.

Second, the Japanese government suffers from a huge amount of budget deficits. This is one of the highest budget deficits countries among developed countries. There is no room for favorable tax treatments which would likely to worsen the current serious budget deficit. At the same time, it is unfair to favor only enterprise pension systems in Japan where the degree of favorable tax treatments for other financial goods was reduced considerably, or some favorable tax treatments were abolished entirely.

The first reform has a unique implication particularly for Japan because the Zeisei-tekikaku pension plan was popular among medium-size and small-size enterprises. Abolishing it implies that medium-size and small-size enterprises have to consider other possibilities to support retired people. One of the reasons why the Zeisei-tekikaku plan is going to be terminated is that reliability is somewhat inferior in guaranteeing the pension benefit and managing the plan in various aspects. One possibility is to shift the Zeisei-tekikaku plan from the DB type to the DC type. We notice actually that the majority of enterprises among the former Zeisei-tekikaku plans join newly established DC plans.

It must be kept in mind, nevertheless, that not only small-size enterprises but also large-size enterprises hoped to transform their enterprise pension programs from DB plans to the DC plans. The main reason for their hope is to escape from severe financial burdens which are peculiar to the DB plan. Although the advantage of the DC plan is apparent for larger enterprises, we cannot ignore various demerits of the DC plans for employees. Several examples of such demerits are possible lower pension benefits due to bad financial managements for a part of employees, high management costs, etc. There are, of course, various merits of the DC plans for employees. We discuss below these merits and demerits of the DC plan from both employers' and employees' point of view.

Two notes are added. Firstly, there is a plan, which combines the two plans, i.e., the DB and the DC. It is called the hybrid plan which hopefully attempts to take advantage of the merits of both the DB and the DC plans. This hybrid plan is similar to the cash balance plan called in the U.S. Several firms introduced the hybrid plans in Japan. Although the hybrid plan is promising in the real world, the paper pays no attention to it because the clear distinction is more apparent when we evaluate the DB plan and the DC plan separately.

Secondly, when we are concerned with the real world, i.e., the shares of the DB and DC plans in enterprise pension programs, the DB plans are still the majority, and the DC plans are not so popular yet. For the DB plans, the majority of larger enterprises keep the DB plans without transforming to the DC plans because their financial

conditions are better than those of smaller firms. Several larger enterprises, however, shifted from the DB plans to the DC plans, or to the hybrid plans. For the DC plans, the majority of the DC plans are occupied by smaller enterprises.

3. A Brief Comparison between the DB and the DC Plans

    A brief comparison regarding the merits and demerits between the DB and DC plans is made without describing the reasons and implications of these merits and demerits.

DB plans

    Merits for enterprises

(1) Can keep employee in these enterprises, and enjoy the benefit of longer duration of employment.
(2) Can select capable employees who desire to stay longer.
(3) Can save educational costs for employees' financial managements.

    Demerits for enterprises

(1) Have a possibility of further financial contributions due to deficits in pension benefits.

    Merits for employees

(1) No necessity of the consideration in risk aspects of financial managements.
(2) Can keep the constant amount of pension benefits.

    Demerits for employees

(1) Disadvantages for labor turnover.
(2) No possibility of financial management for each employee.

DC plans

    Merits for enterprises

(1) Suitable for labor mobility in the contemporary age.
(2) No risk and thus no cost in financial managements, and no further financial contributions due to deficits.

    Demerits for enterprises

(1) Necessary to prepare detailed information on financial conditions of each employee.
(2) Have to accept a higher quit rate of capable employees.

<u>Merits for employees</u>

(1) Portability of the pension rights in labor turnover can be assured.

(2) Each employee's financial condition is available.

(3) Can enjoy the merit of financial management if successful, and thus increase the pension benefits.

<u>Demerits for employees</u>

(1) Each employee has to share the risk in financial management, and also in management cost.

(2) Cannot receive benefits until entire retirement (say the age 60).

(3) A possibly wider differential in pension benefits among employees. This may be, however, judged as a merit by some people.

Summarizing the above, it would be possible to conclude that the DC plan is beneficial for enterprises, and the DB plan is beneficial for employees, on the average. At the same time, a heavier burden in risks and management costs has to be shared by employees for the DC plan, and by enterprises for the DB plan. The following analysis below attempts to examine some of the above statements both theoretically and empirically.

4. A Model Analysis

As was described above, there is an understanding that a shift from the DB plan to the DC plan is beneficial for enterprises, and harmful for employees. This part examines it by applying the utility function approach theoretically. More concretely, we attempt to examine which plan provides employees with a higher utility from the life-cycle point of view.

There are several studies which compared between the DB plan and DC plan like Merton (1988), Bodie, Marcus and Merton (1988), Campbell and Feldstein (2001), Miyazato (2003), representatively.

This part presents a simple theoretical model which enables us to judge the difference between the DB plan and the DC plan based on individual utilities, and discusses the implication of the difference. The original idea comes from the two-period overlapping generation neo-classical growth model á la Diamond (1965). It should be noted that Bodie, Marcus and Merton (1988) constructed a three-period model in order to analyze the difference between the DB plan and the DC plan. The model considered here is an attempt which combines the above two models, although it is neither a

three-period model nor a complicated one.

An individual lives for two periods (the first; working period and the second; retired period). He (or she) works and receives wages during the first period. At the same time, he contributes some part of wages to the pension plan, and consumes the remaining part of wages. He uses the pension benefit for the second-period consumption, and leaves no bequests. Thus, we consider a life-cycle saving with no bequest motive under the existence of a pension program. This pension program may be either a public pension program or an enterprise pension program. In reality, it is preferable to keep in mind that we consider an enterprises pension program in this model because we deal with either the DB plan or the DC plan. Since the public pension program in Japan is managed, in principle, on the basis of the DB plan, a comparison between the DB plan and the DC plan is much more useful for enterprise pension programs.

The most important difference between the DB plan and the DC plan appears in the treatment of the interest rate, r_t, where t stands for the period, and r_t is treated as a random variable.

The DC plan's interest rate; r_t

The DB plan's interest rate; $E(r_t)$

where E indicates the expected value. Simply, the interest rate at the DB plan and the DC plan is probabilistic. The DC plan's interest rate, however, is post-determined. In other words, a fluctuation in the interest rate is admitted. Since an individual participant of the DC plan bears a burden of fluctuations in the rate interest rate, it is natural to regard the rate of interest as if it were deterministic. The DB plan needs the expected value. This kinds of treatments is equivalent to the Bodie, Marcus and Merton (1988).

The budget constraint for an each individual at the DC plan and the DB plan, respectively, is given by (1),

$$c_t^y + c_{t+1}^o \Big/ (1 + r_{t+1}) = \boldsymbol{q} \, w_t + \frac{1}{1 + r_{t+1}} (1 - \boldsymbol{q}) [(1 + r_{t+1}) \quad or \quad (1 + E(r_{t+1}))] w_t \qquad (1)$$

where c_t^y is consumption during the working period for the t-th generation, c_{t+1}^o is consumption during the retired period for the t-th generation, w_t is wage income for the t-th generation, and $\boldsymbol{q}$ is the rate of non-pension contribution and the $(1 - \boldsymbol{q})$ is the rate of pension contribution.

We consider a time-separable utility function where its form is fairly special, i.e., the log utility function. No individual faces any liquidity constraint. The form is written as follows,

$$U_t = \log(c_t^y) + E_t\big(\boldsymbol{b}\log(c_{t+1}^o)\big) \qquad (2)$$

where $\boldsymbol{b}$ is a discount factor.

We have to consider the behavior of an enterprise. The following Cobb-Douglas type production function is considered under the assumption of perfect competition,

$$Y_t = A_t\, K_{t-1}^{\boldsymbol{a}}\, L_t^{1-\boldsymbol{a}} \qquad (3)$$

where Y_t is production at period t, K_{t-1} is capital stock at period (t-1), L_t is labor, and A_t is a parameter of technology.

We consider the following formulation for A,

$$A_t = A + \boldsymbol{x}_t, \quad E_{t-k}(\boldsymbol{x}_t) = 0 \quad for \ k = 1, 2, \cdots \qquad (4)$$

By dividing equation (3) by L_t in order to express variables in terms of per-labor, we evaluate all related variables per-labor, like $y_t = {Y_t}\big/{L_t}$, $k_{t-1} = {K_{t-1}}\big/{L_t}$.

Capital stock at period t is given by all pension contributions at period (t-1) at the DC plan, and by adjusted pension contributions for any surplus or deficit (indicated by g_t where $s_t = k_t + g_{t+1}$) compared with the desired capital stock at the DB plan. $s_t\ (= w_t - c_t^y)$ is per-labor saving.

Per-labor profit for an enterprise is given by (5) and (6) for the DC plan and the DB plan, respectively.

$$\boldsymbol{p}_t = A_t\, k_{t-1}^{\boldsymbol{a}} - r_t\, k_{t-1} - w_t \qquad (5)$$

$$\boldsymbol{p}_t = A_t\, k_{t-1}^{\boldsymbol{a}} - r_t\big(k_{t-1} + g_t\big) - w_t \qquad (6)$$

Profit maximization behavior determines the rate of interest. It is given by (7), specifically,

$$r_t = A_t\, \boldsymbol{a}\, k_{t-1}^{\boldsymbol{a}-1} = \big(A + \boldsymbol{x}_t\big)\boldsymbol{a}\, k_{t-1}^{\boldsymbol{a}-1} \qquad (7)$$

where no difference appears between the DB and the DC plans regarding the determination of the wage and the rate of interest.

We investigate the DC plan, first. The budget equation is modified as follows,

$$c_t^y + {c_{t+1}^o}\big/{1 + r_{t+1}} = \boldsymbol{q}\, w_t + \frac{1}{1 + r_{t+1}}\big(1 - \boldsymbol{q}\big)\big(1 + r_{t+1}\big)w_t = w_t \qquad (8)$$

Utility maximization is given by (9),

$$\max \quad U_t = \log\left(c_t^y\right) + E_t \, \boldsymbol{b} \log\left(c_{t+1}^o\right)$$

$$s.t. \quad c_t^y + \left.c_{t+1}^o\middle/\left(1+r_{t+1}\right)\right. = w_t \qquad (9)$$

We can solve the above maximization problem, and by applying equations (7) and (8) as follows.

$$w_t = \left(1-\boldsymbol{a}\right)A_t\, k_{t-1}^{\boldsymbol{a}} = \left(1-\boldsymbol{a}\right)\left(A+\boldsymbol{x}_t\right)k_{t-1}^{\boldsymbol{a}} \qquad (10)$$

We obtain the following equations,

$$c_t^y = \frac{w_t}{1+\boldsymbol{b}} = \frac{1-\boldsymbol{a}}{1+\boldsymbol{b}}\left(A+\boldsymbol{x}_t\right)k_{t-1}^{\boldsymbol{a}}$$

$$c_{t+1}^o = \left(1+r_{t+1}\right)\left(w_t - c_t^y\right) = \left[1+\boldsymbol{a}\left(A+\boldsymbol{x}_t\right)k_{t-1}^{\boldsymbol{a}-1}\right]\frac{\boldsymbol{b}(1-\boldsymbol{a})}{1+\boldsymbol{b}}\left(A+\boldsymbol{x}_t\right)k_{t-1}^{\boldsymbol{a}} \qquad (11)$$

$$s_t = \left[\boldsymbol{q}\, w_t + (1-\boldsymbol{q})w_t - c_t^y\right] = \frac{\boldsymbol{b}(1-\boldsymbol{a})}{1+\boldsymbol{b}}\left(A+\boldsymbol{x}_t\right)k_{t-1}^{\boldsymbol{a}} \equiv k_t$$

Next, we consider the DB plan. The budget constraint is different from the DC plan in the sense that the expected term remains as is given by (12)

$$c_t^y + \left.c_{t+1}^o\middle/\left(1+r_{t+1}\right)\right. = \boldsymbol{q}\, w_t + \frac{1}{1+r_{t+1}}\left(1-\boldsymbol{q}\right)\left[\left(1+E\left(r_{t+1}\right)\right)\right]w_t \equiv z_t \qquad (12)$$

Utility function is given by (13),

$$U_t = \log\left(c_t^y\right) + E_t\, \boldsymbol{b}\log\left[\left(z_t - c_t^y\right)\left(1+r_{t+1}\right)\right] \qquad (13)$$

The first-order condition of the above maximization problem gives the following formulation (14),

$$\frac{\partial U_t}{\partial c_t^y} = \frac{1}{c_t^y} - \boldsymbol{b}\, E_t\left(\frac{1}{z_t - c_t^y}\right) = 0 \qquad (14)$$

Equation (14) is not a simple formulation, and thus it is not easy to obtain the concrete solutions. This is not surprising as illustrated by, for example, the fact that the CRRA class utility function does not provide us with the concrete solutions as shown by Zeldes (1989) and Caballero (1990).

We have to rely on a numerical approach or a simulation approach in order to escape from the analytical difficulty as is encountered here. We evaluate numerical simulations after a technology-shock occurs. The above approach is common in the literature, as shown by, for example, Blanchard and Fisher (1989) and Romer (1996) when analytical solutions are not obtainable and a shock occurs at a certain time.

We consider the following economy. There is no pension program for the

generation zero, and it begins for the generation one. We take each parameter value as follows; $a = 0.35$, $b = 0.95$, $A = 10.0$, $x = 0.01 \ or -0.01$. These values are regarded as the realistic values in Japan. We use the initial capital stock by one given for the stationary economy with no uncertainty. We assume that a positive shock occurs with the probability 0.25, and a negative shock with the same probability 0.25.

We evaluate the simulation for 24 periods, and the result is given by Figure 1. We can consider the following cases.

Case A; a positive shock occurs at period 7, and a negative one at period 13.

Case B; this is a completely different case from Case A. A negative shock at period 7, and a positive one at period 13.

Case C; positive shocks occur at periods 7 and 8, and negative ones at periods 14 and 15.

Case D; positive shocks occur at periods 7 and 15, and negative ones at periods 8 and 14.

Case E; no shock occurs, and this should be regarded as a bench mark result.

Figure 1 suggests the following results; the averages of utilities in all the cases are higher at the DC plan than those at the DB plan, and at the same time, the variances are smaller at the DC plan than those at the DB plan. Although there is normally a trade-off relationship between averages and variances in many cases, the result here presents a somewhat unusual relationship.

The overall result suggests the following conclusions which are quite useful to evaluate the difference between the DB plan and the DC plan.

First, shocks are shared by different generations more strongly at the DC plan than at the DB plan.

Second, utility levels enjoyed by individuals are higher at the DC plan, on average, than those of the DB plan.

It is necessary to argue the reasons why the above conclusions have been obtained, and the implications of the conclusions.

We discuss the first conclusion initially. A clue comes from the effect of a t-th generation shock. The effect appears at the (t-1)th generation through the rate of interest at the DC plan, and at the t-th generation thorough the wage. A shock does not affect, however, the (t-1)th generation at the DB plan. The effect due to any surplus or deficit for capital stock appears at the t-th generation at the DB plan. The difference appeared above between the DC plan and the DB plan is responsible for explaining the difference in the variances of utilities between the two plans.

An intuitive explanation may be suggestive in order to understand the above

conclusion. Suppose we consider a generation who was hired at a bubble period (i.e., higher wages and higher interest rates), and who quits this year. For the DB plan this person receives higher wages and higher rates of returns to pensions because of higher interest rates. A generation who is hired this year, however, cannot receive higher wages because the economy is in a recession due to the post-bubble bad shape. At the same time, lower rates of returns to pensions are anticipated, although the difference in the rates of returns between the two different generations is not so large. It is expected, nevertheless, that the utility levels between the two different generations should be considerably different due largely to a wider difference in wage payments between the two generations.

The DC plan, however, gives a different story from the DB plan as follows. Although wage levels at the bubble generations are higher, the rates of returns to pension reserves are lower during the post-bubble period. The post-bubble generation, however, can enjoy higher returns to pension when the economy is in a boom in future even if their wages are low during the working period. The final outcome of these two different generations gives a smaller difference in the utility levels of the two generations.

The main reason for explaining the second conclusion comes from the difference in capital stocks. As Case E suggests clearly, the two plans, namely DB and DC, produce considerably different convergency results even if initial capital stocks are common between the two plans. This appears due largely to the different saving rates between the two plans.

Why are the saving rates between the two plans different, as indicated by the rate 0.4825 for the DB plan and the rate 0.4872 for the DC plan? The degree of uncertainty in incomes during the retirement period is higher for the DC plans than for the DB plan. A rational individual would have a higher saving rate when uncertainty is high, as many studies like Barsky, Mankiw and Zeldes (1986), Skinner (1988), Zeldes (1989), Caballero (1990), Carrol (1994), etc. indicate. The hypothesis is called "Precautionary Saving Motive."

This high rate of saving for the DC plan produces higher capital stock, and thus raises the growth rate of the economy. The income level (i.e., consumption level) is higher because of the higher growth rate of the economy, and thus the utility level is higher for the DC plan than for the DB plan.

5. An Empirical Analysis

This part examines which is more beneficial between the DB plan or the DC plan empirically when we consider a possibility of labor turnover. Labor turnover here signifies that employees change their employers at certain ages. There has been a common understanding that employees hardly change their employers in Japan. This understanding is an exaggeration even in the past as shown, for example, by Tachibanaki (1984). It was proposed by Tachibanaki that the rate of no changes, i.e., life-time commitments to one employer, was very low, and that the majority had one, two, or more turnovers even in the past period when the life-time employment practice was believed to be common.

It is certainly true that the degree of labor turnover has been increasing recently both voluntarily and involuntarily. There are various reasons why a large number of workers quit their employers, and/or have to leave them as layoffs or discharges. It is not our main concern to discuss these reasons in this paper. Our main interest is to examine the effect of labor turnover on the working of enterprise pension systems. More specifically, we examine who gain or loss pension benefits if they commit to labor turnover. We pay particular attention to the difference in pension benefits among various categories of workers classified by gender, education, size of firm, timing of turnover (i.e., age of turnover), etc. Since wage figures are considerably different among workers who are classified by these categories, pension benefits also should be different. What are the effects of the rates of returns to pension funds? How does the difference between the DB plan and the DC plan appear? We are interested in these subjects.

The following is a brief description of the strategy for our empirical study. We estimate, first, a wage figure of each age for gender, education, size of firm, based on The Wage Structure Survey. This data source shows wage figures only for five years' age intervals. Since this estimation to obtain each age's wage figures is fairly complicated and cumbersome, it will be explained later in the Appendix.

Second, we estimate the amount of pension reserves, by assuming that each employee contributes 4.0 percent of his or her wage, annually to the enterprise pension program. The DB and the DC plans, of course, give different pension benefits because the rates of returns are different between the two plans. The DB plans assumes, normally, 5.5 percent rates of returns, and thus the amount of pension benefits are predetermined. When deficits (i.e., the pension reserve was lower than the pension benefit) occur, employers would have to pay extra-amount to fill the deficits. The amount of pension benefits for the DC plan is determined by the actual rate of returns

which depends on the performance of the financial investment and management for pension reserves.

Third, it is necessary to estimate pension reserves and pension benefits when employees change their employers. We consider the following four cases; (1) no turnover (i.e., commitment to life-time employment), (2) turnover at age 30, (3) turnover at age 35, (4) turnover at age 40. We assume that labor turnovers occur within the same class of firm sizes. In other words, workers do not change the size of firms when they change employers. This assumption is not so unrealistic in Japan, as shown by Taki and Tachibanaki (1995), for example.

Fourth, one important difference appears between the DC plan and the DB plan regarding the treatment of pension reserves in the following way; while employees ought to abandon pension reserves for the latter, they can carry them to a new plan for the former. In other words, portability is not available for the latter, while it is assumed for the former. This difference regarding the treatment of portability of pension reserves is responsible for producing the considerably different amounts of pension reserves and pension benefits between the two plans.

Fifth, it is necessary to estimate the lump-sum retirement allowance when an employee leaves his employer, and to take into account the contribution of this payment in evaluating pension reserves and pension benefits. The calculation of the lump-sum retirement allowances is so complicated that it is not explained here. It is desirable to keep in mind that the lump-sum retirement allowance is very low if an employees leaves within several years, and large if an employee stays longer. The rate of increase is very steep and is like a exponential function.

Sixth, it would be desirable to take into consideration the management cost of the pension fund in order to calculate the amount of pension benefits exactly. We did not it for the following reasons. First, there are no reliable data of the management cost, although it is suggested that it would be about 1.4 percent on average. This rate is regarded as low at this stage. Second, management costs differ from pension fund to pension fund. It is not easy to estimate each management cost because the DC plans were introduced quite recently. Also, data disclosures are underdeveloped in this field. Third, our main interest is to compare pension benefits among different workers relatively, and it is not our concern to estimate the exact amount of pension benefits.

This does not necessarily imply, however, that the management cost does not matter. It is important to evaluate the amount of administration costs, if the aim is to estimate pension benefits under different rules, as given, for example, by Mitchell (1998). We hope that relevant data are available for Japan in future.

Table 1 – Table 12 present the estimated value of pension benefits at age 60, and their relative values compared with the case of no turnover (equal to unity) for various categories of workers classified by gender, education, and size of firm, and for various interest rates.

Empirical observations derived from those 12 tables are presented. They are common findings for all 12 tables. In other words, we do not pay any serious attention to the differences among different categories of workers. We present the result which can be derived within each common category of workers.

First, there is a decreasing trend in pension benefits when they experience labor turnovers sometime during the working periods. The rate of decreases in pension benefits is not great for the DC plans, even if employees prolong their age of turnovers. For example, the difference between no turnover and turnover at age 30 is about 10 percent for male university graduates at large firms, while the difference between no turnover and turnover at age 40 is 12 percent. The difference is only 2 percent. This result arises due to the fact that workers, who do not change employers until age 39, can receive considerably high amount of wages, and at the same time due to the fact that they are able to carry pension reserves for the DC plans. This similar story to the case of male university graduates at large firms is observed for other categories of workers.

Second, we observe higher degrees of losses in pension benefits as workers prolong their ages of turnovers. For example, male university graduates at large firms lose about 20 percent if they leave employers at age 30, about 32 percent at age 35, and about 46 percent at age 40. There is a considerable increase in the loss of pension benefits when they experience turnovers at late ages. The reason for their increasing loss is due to the fact that workers lose a large amount of pension reserves for the DB plans. The amount of the loss is larger for junior high school graduates than for university graduates.

Third, we interpret the result regarding the difference in the rates of returns. One important result appears in the completely different outcomes between the DC plans and the DB plans. For the DC plans the difference in pension benefits is the same as the first observation described above. The difference, however, shrinks when the effect of the interest rate is taken into consideration. For example, the case of male university graduates at large firms suggests that the degree of the loss in pension benefits is about 7 percent for labor turnover at age 30, and only about 8 percent for turnover at age 40, when the rate of return, which can be regarded as high, is equal to 5 percent.

The reasons for this shrink may be as follows. If workers change employers at younger ages, say age 30, they can enjoy reasonably high wages at next firms because

they can stay longer in these new firms. Thus, it is highly probable that pension reserves are higher for them than for workers who change employers at older ages, say age 40.

The actual story does not support the above proposition because the following story is more realistic; workers who changed employers at younger ages, say age 30, have lost the higher amount of wages (and thus pension contribution) because they could receive higher wages if they stayed until age 40. Also, it is likely that a loss of financial returns to pension reserves would amplify because the amount of pension reserves was lower. The above story suggests that workers who change employers at later age, say age 40 do not lose pension benefits so much. This is, in particular, true when the interest rate is high. Consequently, it is possible that the degree of handicap due to later-age turnovers decreases when the rate of interest becomes higher. This conclusion is supported also for the other categories of workers in the case of the DC plans.

The case of the DB plan, however, is different from the DC plan. The degree of the loss in pension benefits increases as the age of labor turnover is prolonged, when the rate of interest is higher. The decrease in pension benefits in the case of 5 percent interest rate is 31 percent when an employee changes his employer at age 30 and 63 percent when he changes at age 40 for male university graduates at large firms. These losses are substantial, and the similar result is observed for the other groups of workers.

Fourth, we evaluate the effect of a change in the interest rate, numerically, by taking an example of male university graduates at large firms who had no turnovers. The difference between one percent interest rate and two percent interest rate gives the difference in pension benefits by about 2 million yens, and the difference between two percent interest rate and three percent interest rate gives about 2.5 million yens. These differences are substantial, and thus it is possible to conclude that the interest rate is crucial in the determination of pension benefits.

One difficulty for the DB plan arises when the actual rate of returns is lower than the predetermined rate of return. For example, if the actual rate of return were one percent in spite of the fact that the predetermined rate of return was two percent, somebody would have to pay about 2 million yens per worker in order to fill the gap. The situation in Japan is much more serious than the above example because the actual rate of return is approximately one percent now in spite of the fact that the predetermined rate of return was fixed at about 5 percent. A rough calculation suggests that somebody has to bear about ten million yens per worker.

"Somebody" here has been enterprises in Japan, traditionally. They contributed a significantly higher amount of funds to fill the deficit in order to keep the traditionally good and sound industrial relations system with their employees. The serious recession, which has continued for about 15 years, led these enterprises to alter their policies. One policy alternative is to ask workers to accept in lowering their pension benefits without changing the DB plan principle, and the other alternative is to modify the principle from the DB plan to the DC plan or to introduce a hybrid type of the two plans.

Several enterprises adopted the first alternative, and some other enterprises adopted the second alternative. If enterprises and their employees agreed to adopt the second alternative, workers would have to give up some amount of pension benefits. A simple calculation suggests about a loss of one million yen, if there happens about one percent difference in the rates of returns for the DC plan.

An illustrative calculation gives the following result; the expected pension benefit under the DC plan which shows one percent or three percent rate of return with the 25 percent probability respectively and the DC plan which shows two percent rate of return with the 50 percent probability is about 1,293 million yen. The pension benefit under the DB plan which shows two percent rate of return is about 1,280 million yen. The difference between the two plans is only 13 thousand yens.

The above example implies that the difference between the DB plan and the DC plan is not great when the difference between the rates of returns for the DB plan and for the DC plan is not large. If the variance in the rate of returns were so large, the different outcome would appear at the pension benefits. Consequently, the effect of the rate of return is very important when we compare between the DB and DC plans.

One additional important variable, which was not investigated seriously in this paper, is the management cost. It is, in particular, crucial for the DC plan. It is possible that various conclusions obtained in this paper might be different, if the factor of management cost were taken into account more explicitly.

Fifth, a different story appears when we evaluate a change in the rates of returns. That is an inverse relationship between pension reserves and pension benefits. The following example shows such an inverse relationship; Although the order of pension reserves from the largest amount to the smallest amount is (no labor turnover)>(turnover at age 30)>(turnover at age 35)>(turnover at age 40), the order of pension benefits is not equal to the order of pension reserves, depending on the timing of turnovers. This inverse relationship is more common, if the rate of return is higher.

The following calculations provide us with possibilities of different orders of pension benefits.

Male university graduates at large firms: the pension benefit is equal between turnover at age 35 and turnover at age 40, when the rate of return is 4.1 percent. In other words, the pension benefit is greater at turnover at age 40 than that turnover at age 35, when the rate of interest is greater than 4.1 percent. This is an example of the inverse relationship between the order of pension reserves and pension benefits for male university graduates at large firms.

Several examples of the inverse relationship regarding pension benefits are presented by showing the cases of the equality among different timings of turnovers.

Female university graduates at large firms: turnover at age 30 and turnover at age 40 appears at the interest rate 4.15 percent.

Male senior high school graduates at large firms; two inverse relationships appear; (1) turnover at age 35 and turnover at age 40 at the interest rate, 0.5 percent, and (2) turnover at age 30 and turnover at age 40, at the interest rate, 3.66 percent.

These two examples show several interesting results as follows; first, an inverse relationship appears even in the case of lower rates of returns. Second, the property of compound interest rates is responsible for yielding an inverse relationship even when an employee commits to labor turnover at young ages like age 30.

Sixth, it is an interesting subject to inquire the difference among various categories of workers classified by gender, education, size of firm, timing of turnover, etc. If we pay attention to the DB plans, the reduction in pension benefits are larger for senior high school graduates than for university graduates, and it is more significant for females than for males. For example, male university graduates at large firms have the 45 percent of the decrease rate when they change employers at age 40 in comparison with no change, while male senior high school graduates at large firms have the reduction rate by 58 percent. One reason for this difference between university graduates and senior high school graduates is due to the difference in starting ages of the working activity between these two groups.

The similar story is observed for female workers. While female university graduates at large firms show the 48 percent reduction rate when they change employers at age 40, female senior high school graduates at large firms have the 63 percent decreasing rate. Female workers have to accept about 6 percent points higher reduction than male workers when they have the common characteristics of education and size of firm. The difference between men and women in the reduction rate of pension benefits arises mainly because women have to accept much lower rates of wage decrease than men, after these two genders experience labor turnover. In sum, women have to pay extra costs regarding enterprise pension programs when they consider a

possibility of labor turnover. Female workers face many handicaps in the labor market in Japan. The handicap in the area of enterprise pension program is a new one, which has not been presented and argued previously.

Seventh, a small note on the effect of firm size is described. Although we anticipated that the effect might be important and interesting regarding enterprise pension programs, we found no mentionable results on the effect of firm size, fortunately or unfortunately.

Finally, tables indicate the decrease in pension benefits for the DB plan is much higher than for the DC plan. The impact of rates of returns cannot be ignored, when we are concerned with the exact amount of the difference in the decreases in pension benefits between the two plans, as was explained previously. It is a general rule, nevertheless, that labor turnover leads higher reductions in pension benefits for the DB plans than the DC plans.

6. Concluding Remarks

The paper investigated the difference in the economic effects between the defined benefit plans (DB) and the defined contribution plans (DC) at enterprise pension programs. After reviewing several aspects of merits and demerits in those two plans, we presented two studies regarding this subject. The first was to investigate a possible difference in individual utilities, by employing an overlapping generation life-cycle model, for the DB plans and the DC plans, respectively. The second was to estimate what happens to pension benefits, when workers commit to labor turnover during their working activities, by applying Japanese data. An attention was paid to not only the difference between the DB plans and the DC plans but also the difference among various categories of workers in Japan which are classified by gender, education, size of firm, timing of labor turnover, etc.

We have obtained several useful results. We avoid repetitions of these detailed results. One important message from this study may be summarized as follows; it was believed that the DB plan was beneficial for employees, and the DC plan was beneficial for employees, on the average. This study presented that the likelihood of the superiority in the DC plan over the DB plan is high when we compare the two plans both theoretically and empirically.

<u>Figure</u>

Figure 1-1: Numerical simulation-Case A
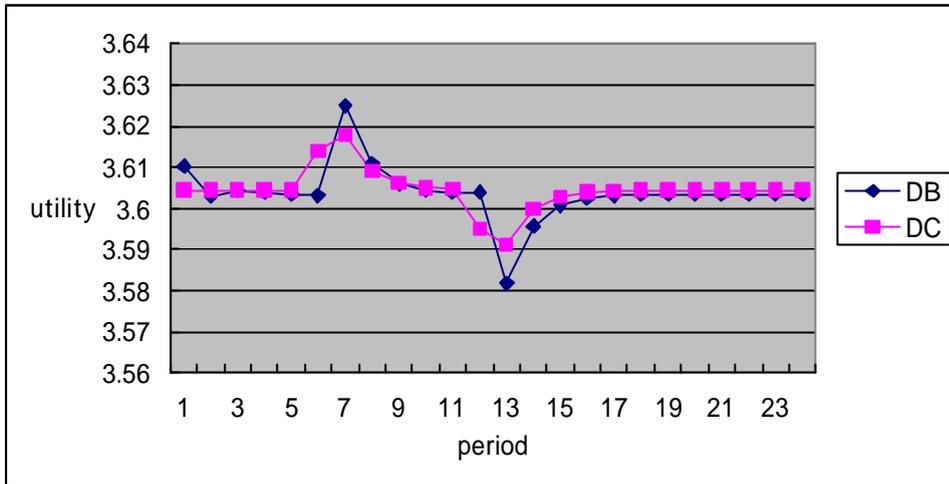
Average values of utilities
DC Plan: 3.60440
DB Plan: 3.60379

Figure 1-2: Numerical simulation-Case B
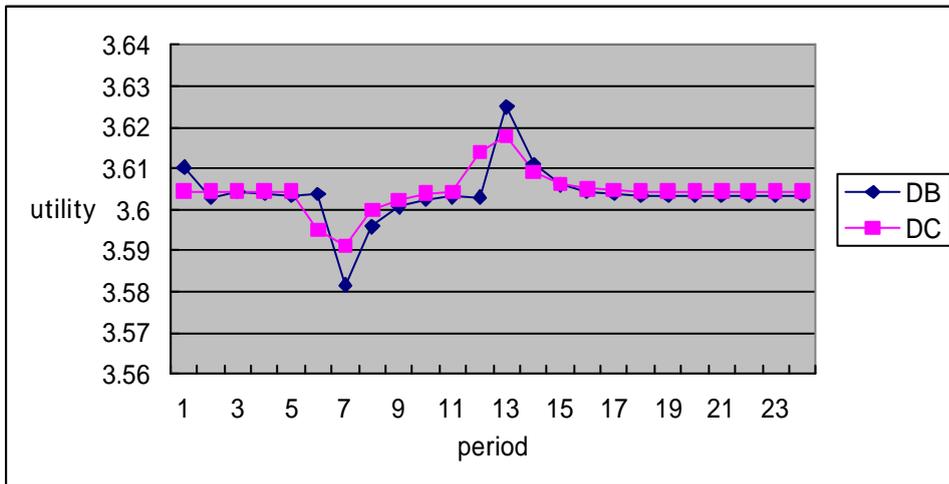
Average values of utilities
DC Plan: 3.60440
DB Plan: 3.60378

Figure 1-3: Numerical simulation-Case C
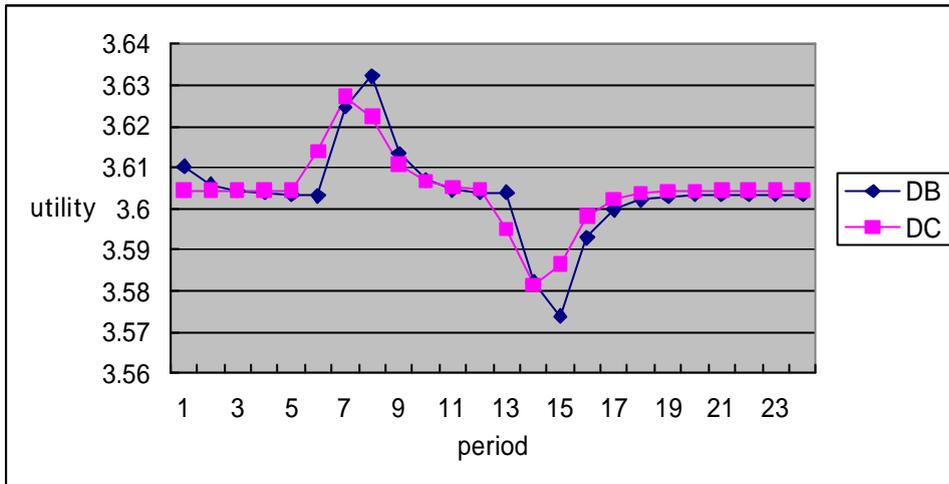
Average values of utilities

DC Plan: 3.60439

DB Plan: 3.60375

Figure 1-4: Numerical simulation-Case D
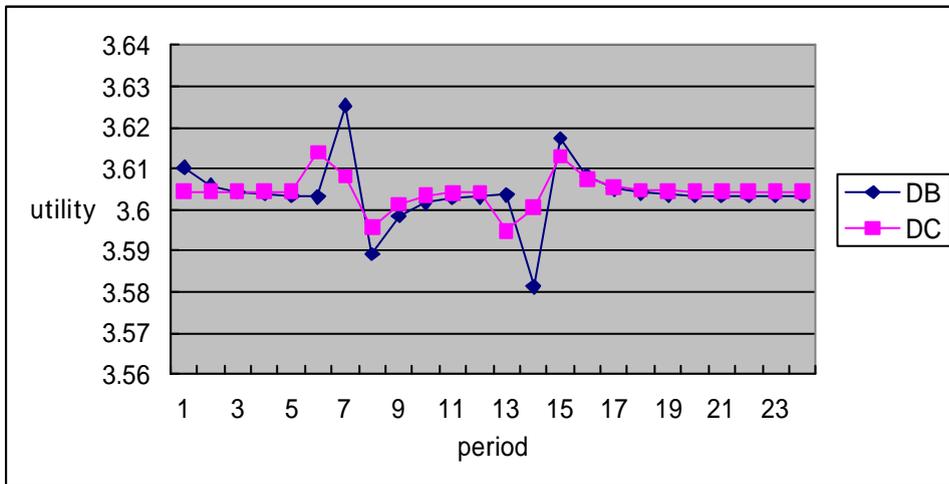
Average values of utilities

DC Plan: 3.60481

DB Plan: 3.60378

Figure 1-5: Numerical simulation-Case E
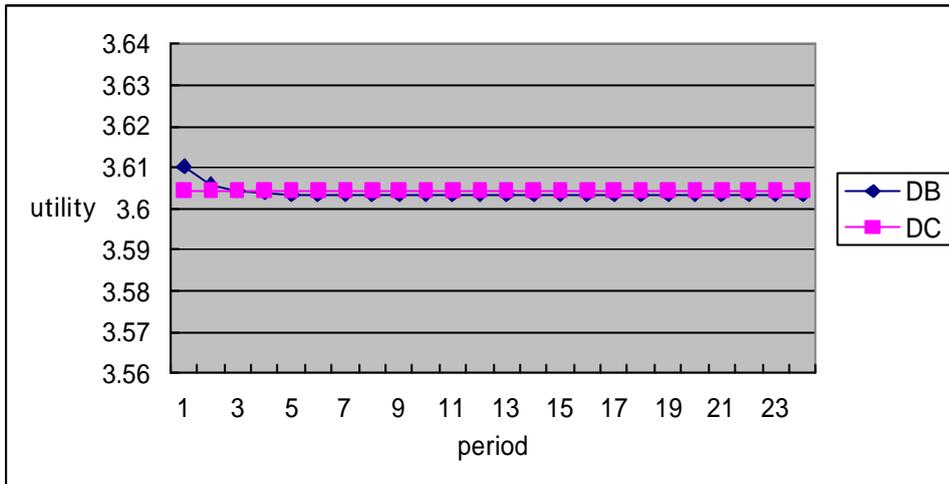
Average values of utilities
DC Plan: 3.60441
DB Plan: 3.60379

Table

Table 1-1: Pension Benefits for Male University graduates at Large Firms at Age 60
(Absolute Values, ten thousand yen)

Rate of returns %	No Turnover	Turnover at age 30		Turnover at age 35		Turnover at age 40	
		DC	DB	DC	DB	DC	DB
0	916.26	839.9	740.64	812.59	624.8	800.91	502.48
0.73	1064.27	946.13	818.83	917.59	681.84	907.02	540.55
1	1078.6	989.95	850.43	960.97	704.6	950.9	555.52
2	1280.86	1177.42	981.9	1146.96	797.56	1139.22	615.55
3	1534.34	1413.09	1139.84	1381.45	906.08	1376.97	683.56
5	2258.3	2089.47	1560.13	2057.23	1181.7	2063.07	848.22

Table 1-2: Pension Benefits for Male University graduates at Large Firms at Age 60
(Relative Values Compared with No Turnover)

Rate of returns %	No Turnover	Turnover at age 30		Turnover at age 35		Turnover at age 40	
		DC	DB	DC	DB	DC	DB
0	1	0.917	0.808	0.887	0.682	0.874	0.548
0.73	1	0.889	0.769	0.862	0.641	0.852	0.508
1	1	0.918	0.788	0.891	0.653	0.882	0.515
2	1	0.919	0.767	0.895	0.623	0.889	0.481
3	1	0.921	0.743	0.900	0.591	0.897	0.446
5	1	0.925	0.691	0.911	0.523	0.914	0.376

Table 2-1: Pension Benefits for Male University graduates at Middle-size Firms at Age 60 (Absolute Values, ten thousand yen)

Rate of returns %	No Turnover	Turnover at age 30		Turnover at age 35		Turnover at age 40	
		DC	DB	DC	DB	DC	DB
0	752.38	720.24	628.87	711.63	545.53	707.93	452.43
0.73	848.5	814.63	697.39	805.65	596.85	801.87	487.43
1	888.19	853.66	725.14	844.53	617.34	840.72	501.2
2	1058.26	1021.13	840.86	1011.42	701.21	1007.51	556.44
3	1272.52	1232.58	980.43	1222.22	799.35	1218.19	619.07
5	1889.49	1843.23	1353.97	1831.29	1049.51	1826.99	770.84

Table 2-2: Pension Benefits for Male University graduates at Middle-size Firms at Age 60 (Relative Values Compared with No Turnover)

Rate of returns %	No Turnover	Turnover at age 30		Turnover at age 35		Turnover at age 40	
		DC	DB	DC	DB	DC	DB
0	1	0.957	0.836	0.946	0.725	0.941	0.601
0.73	1	0.960	0.822	0.949	0.703	0.945	0.574
1	1	0.961	0.816	0.951	0.695	0.947	0.564
2	1	0.965	0.795	0.956	0.663	0.952	0.526
3	1	0.969	0.770	0.960	0.628	0.957	0.486
5	1	0.976	0.716	0.969	0.555	0.967	0.408

Table 3-1: Pension Benefits for Male University graduates at Small Firms at Age 60
(Absolute Values, ten thousand yen)

Rate of returns %	No Turnover	Turnover at age 30		Turnover at age 35		Turnover at age 40	
		DC	DB	DC	DB	DC	DB
0	734.41	665.64	576.37	644.66	482.41	636.09	386.56
0.73	828.29	753.35	638.8	731.48	527.52	723.47	416.38
1	867.05	789.65	664.08	767.46	545.53	759.71	428.11
2	1033.16	945.61	769.48	922.28	619.25	915.74	475.19
3	1242.44	1142.92	896.57	1118.59	705.51	1113.75	528.59
5	1845.08	1714.61	1236.58	1689.08	925.37	1689.65	658.08

Table 3-2: Pension Benefits for Male University graduates at Small Firms at Age 60
(Relative Values Compared with No Turnover)

Rate of returns %	No Turnover	Turnover at age 30		Turnover at age 35		Turnover at age 40	
		DC	DB	DC	DB	DC	DB
0	1	0.906	0.785	0.878	0.657	0.866	0.526
0.73	1	0.910	0.771	0.883	0.637	0.873	0.503
1	1	0.911	0.766	0.885	0.629	0.876	0.494
2	1	0.915	0.745	0.893	0.599	0.886	0.460
3	1	0.920	0.722	0.900	0.568	0.896	0.425
5	1	0.929	0.670	0.915	0.502	0.916	0.357

Table 4-1: Pension Benefits for Female University graduates at Large Firms at Age 60 (Absolute Values, ten thousand yen)

Rate of returns %	No Turnover	Turnover at age 30		Turnover at age 35		Turnover at age 40	
		DC	DB	DC	DB	DC	DB
0	773.25	680.57	589.81	652.33	485.96	641.33	383.49
0.73	871.12	769.68	653.23	740.27	531.19	730.21	413.04
1	911.5	806.54	678.9	776.72	549.24	767.07	424.66
2	1084.34	964.88	785.88	933.61	623.13	925.91	471.33
3	1301.74	1165.09	914.77	1132.62	709.57	1127.63	524.26
5	1926.3	1744.82	1259.24	1711.31	929.81	1714.83	652.65

Table 4-2: Pension Benefits for Female University graduates at Large Firms at Age 60 (Relative Values Compared with No Turnover)

Rate of returns %	No Turnover	Turnover at age 30		Turnover at age 35		Turnover at age 40	
		DC	DB	DC	DB	DC	DB
0	1	0.880	0.763	0.844	0.628	0.829	0.496
0.73	1	0.884	0.750	0.850	0.610	0.838	0.474
1	1	0.885	0.745	0.852	0.603	0.842	0.466
2	1	0.890	0.725	0.861	0.575	0.854	0.435
3	1	0.895	0.703	0.870	0.545	0.866	0.403
5	1	0.906	0.654	0.888	0.483	0.890	0.339

Table 5-1: Pension Benefits for Female University graduates at Middle-size Firms at Age 60 (Absolute Values, ten thousand yen)

Rate of returns %	No Turnover	Turnover at age 30		Turnover at age 35		Turnover at age 40	
		DC	DB	DC	DB	DC	DB
0	736.35	669.82	582.64	651.98	495.24	644.42	404.64
0.73	827.86	757.31	645.41	738.69	541.57	731.12	435.88
1	865.62	793.5	670.82	774.58	560.07	767.02	448.18
2	1027.29	948.93	776.81	928.88	635.79	921.39	497.49
3	1230.76	1145.44	904.63	1124.16	724.43	1116.84	553.41
5	1816.05	1714.27	1246.73	1690.26	950.38	1683.64	688.96

Table 5-2: Pension Benefits for Female University graduates at Middle-size Firms at Age 60 (Relative Values Compared with No Turnover)

Rate of returns %	No Turnover	Turnover at age 30		Turnover at age 35		Turnover at age 40	
		DC	DB	DC	DB	DC	DB
0	1	0.910	0.791	0.885	0.673	0.875	0.550
0.73	1	0.915	0.780	0.892	0.654	0.883	0.527
1	1	0.917	0.775	0.895	0.647	0.886	0.518
2	1	0.924	0.756	0.904	0.619	0.897	0.484
3	1	0.931	0.735	0.913	0.589	0.907	0.450
5	1	0.944	0.687	0.931	0.523	0.927	0.379

Table 6-1: Pension Benefits for Female University graduates at Small Firms at Age 60 (Absolute Values, ten thousand yen)

Rate of returns %	No Turnover	Turnover at age 30		Turnover at age 35		Turnover at age 40	
		DC	DB	DC	DB	DC	DB
0	629.61	560.31	476.02	538.79	368.83	531.54	300.5
0.73	713.93	636.63	528.46	614.36	423.28	608.34	323.8
1	748.82	668.29	549.71	645.77	437.84	640.28	332.97
2	898.8	804.76	638.42	781.49	497.46	778.46	369.81
3	1088.57	978.22	745.53	954.61	567.3	954.9	411.62
5	1638.34	1484.33	1032.74	1462.11	745.53	1472.59	513.18

Table 6-2: Pension Benefits for Female University graduates at Small Firms at Age 60 (Relative Values Compared with No Turnover)

Rate of returns %	No Turnover	Turnover at age 30		Turnover at age 35		Turnover at age 40	
		DC	DB	DC	DB	DC	DB
0	1	0.890	0.756	0.856	0.586	0.844	0.477
0.73	1	0.892	0.740	0.861	0.593	0.852	0.454
1	1	0.892	0.734	0.862	0.585	0.855	0.445
2	1	0.895	0.710	0.869	0.553	0.866	0.411
3	1	0.899	0.685	0.877	0.521	0.877	0.378
5	1	0.906	0.630	0.892	0.455	0.899	0.313

Table 7-1: Pension Benefits for Male Junior high school graduates at Large Firms at Age 60 (Absolute Values, ten thousand yen)

Rate of returns %	No Turnover	Turnover at age 30		Turnover at age 35		Turnover at age 40	
		DC	DB	DC	DB	DC	DB
0	723.46	606.38	482.06	588.25	391.74	586.17	304.93
0.73	826.11	697.08	535.52	679.09	429.08	679.04	328.91
1	868.98	735.14	557.2	717.27	444.01	718.08	338.35
2	1055.6	901.81	647.73	884.81	505.18	889.41	376.28
3	1296.72	1119.09	757.16	1103.81	576.92	1113.36	419.39
5	2020.89	1780.44	1051.02	1772.4	760.31	1796.45	524.24

Table 7-2: Pension Benefits for Male Junior high school graduates at Large Firms at Age 60 (Relative Values Compared with No Turnover)

Rate of returns %	No Turnover	Turnover at age 30		Turnover at age 35		Turnover at age 40	
		DC	DB	DC	DB	DC	DB
0	1	0.838	0.666	0.813	0.541	0.810	0.421
0.73	1	0.844	0.648	0.822	0.519	0.822	0.398
1	1	0.846	0.641	0.825	0.511	0.826	0.389
2	1	0.854	0.614	0.838	0.479	0.843	0.356
3	1	0.863	0.584	0.851	0.445	0.859	0.323
5	1	0.881	0.520	0.877	0.376	0.889	0.259

Table 8-1: Pension Benefits for Male Junior high school graduates at Middle-size Firms at Age 60 (Absolute Values, ten thousand yen)

Rate of returns %	No Turnover	Turnover at age 30		Turnover at age 35		Turnover at age 40	
		DC	DB	DC	DB	DC	DB
0	695.81	581.72	460.51	564.53	374.47	562.6	292.18
0.73	794.51	669.32	511.77	652.21	410.29	652.09	315.21
1	835.75	706.1	532.56	689.08	424.61	689.73	324.28
2	1015.38	867.31	619.41	850.98	483.31	855.03	360.73
3	1247.72	1077.74	724.45	1062.82	552.17	1071.28	402.16
5	1946.72	1719.36	1006.79	1710.55	728.3	1731.92	502.95

Table 8-2: Pension Benefits for Male Junior high school graduates at Middle-size Firms at Age 60 (Relative Values Compared with No Turnover)

Rate of returns %	No Turnover	Turnover at age 30		Turnover at age 35		Turnover at age 40	
		DC	DB	DC	DB	DC	DB
0	1	0.836	0.662	0.811	0.538	0.809	0.420
0.73	1	0.842	0.644	0.821	0.516	0.821	0.397
1	1	0.845	0.637	0.825	0.508	0.825	0.388
2	1	0.854	0.610	0.838	0.476	0.842	0.355
3	1	0.864	0.581	0.852	0.443	0.859	0.322
5	1	0.883	0.517	0.879	0.374	0.890	0.258

Table 9-1: Pension Benefits for Male Junior high school graduates at Small Firms at Age 60 (Absolute Values, ten thousand yen)

Rate of returns %	No Turnover	Turnover at age 30		Turnover at age 35		Turnover at age 40	
		DC	DB	DC	DB	DC	DB
0	664.67	587.69	462.41	575.28	379.22	573.91	296.75
0.73	763.28	677.58	514.73	665.4	415.82	665.62	320.2
1	804.57	715.33	535.96	703.3	430.46	704.2	329.44
2	984.91	880.92	624.72	869.79	490.47	873.69	366.56
3	1219.01	1097.24	732.16	1087.74	560.89	1095.56	408.74
5	1926.98	1757.5	1021.32	1754.55	741.09	1773.9	511.34

Table 9-2: Pension Benefits for Male Junior high school graduates at Small Firms at Age 60 (Relative Values Compared with No Turnover)

Rate of returns %	No Turnover	Turnover at age 30		Turnover at age 35		Turnover at age 40	
		DC	DB	DC	DB	DC	DB
0	1	0.884	0.696	0.866	0.571	0.863	0.446
0.73	1	0.888	0.674	0.872	0.545	0.872	0.420
1	1	0.889	0.666	0.874	0.535	0.875	0.409
2	1	0.894	0.634	0.883	0.498	0.887	0.372
3	1	0.900	0.601	0.892	0.460	0.899	0.335
5	1	0.912	0.530	0.911	0.385	0.921	0.265

Table 10-1: Pension Benefits for Female Junior high school graduates at Large Firms at Age 60 (Absolute Values, ten thousand yen)

Rate of returns %	No Turnover	Turnover at age 30		Turnover at age 35		Turnover at age 40	
		DC	DB	DC	DB	DC	DB
0	595.73	473.05	361.13	455	281.96	454.16	211.31
0.73	682.85	545.67	400.12	528.41	307.96	530.37	227.44
1	719.33	576.27	415.92	559.42	318.35	562.58	233.79
2	878.7	711.03	481.84	696.39	360.88	704.81	259.28
3	1085.69	888.24	561.43	877.21	410.68	892.45	288.23
5	1712.3	1434.83	774.89	1437.25	537.83	1475.45	358.61

Table 10-2: Pension Benefits for Female Junior high school graduates at Large Firms at Age 60 (Relative Values Compared with No Turnover)

Rate of returns %	No Turnover	Turnover at age 30		Turnover at age 35		Turnover at age 40	
		DC	DB	DC	DB	DC	DB
0	1	0.794	0.606	0.764	0.473	0.762	0.355
0.73	1	0.799	0.586	0.774	0.451	0.777	0.333
1	1	0.801	0.578	0.778	0.443	0.782	0.325
2	1	0.809	0.548	0.793	0.411	0.802	0.295
3	1	0.818	0.517	0.808	0.378	0.822	0.265
5	1	0.838	0.453	0.839	0.314	0.862	0.209

Table 11-1: Pension Benefits for Female Junior high school graduates at Middle-size Firms at Age 60 (Absolute Values, ten thousand yen)

Rate of returns %	No Turnover	Turnover at age 30		Turnover at age 35		Turnover at age 40	
		DC	DB	DC	DB	DC	DB
0	516.75	426.86	320.05	414.81	254.77	414.39	195.51
0.73	594.28	495.66	356.59	483.84	279.54	462.18	211.06
1	626.84	524.72	371.43	513.03	289.45	505.67	217.2
2	769.68	653.05	433.61	642.19	330.13	514.74	241.85
3	956.38	822.48	509.08	813.08	377.95	821.14	269.9
5	1527.03	1347.85	713.01	1344.2	500.64	1362.65	338.26

Table 11-2: Pension Benefits for Female Junior high school graduates at Middle-size Firms at Age 60 (Relative Values Compared with No Turnover)

Rate of returns %	No Turnover	Turnover at age 30		Turnover at age 35		Turnover at age 40	
		DC	DB	DC	DB	DC	DB
0	1	0.826	0.619	0.803	0.493	0.802	0.378
0.73	1	0.834	0.600	0.814	0.470	0.778	0.355
1	1	0.837	0.593	0.818	0.462	0.807	0.346
2	1	0.848	0.563	0.834	0.429	0.669	0.314
3	1	0.860	0.532	0.850	0.395	0.859	0.282
5	1	0.883	0.467	0.880	0.328	0.892	0.222

Table 12-1: Pension Benefits for Female Junior high school graduates at Small Firms at Age 60 (Absolute Values, ten thousand yen)

Rate of returns %	No Turnover	Turnover at age 30		Turnover at age 35		Turnover at age 40	
		DC	DB	DC	DB	DC	DB
0	488.81	413.75	309.86	403.22	247.45	402.77	189.97
0.73	563.47	480.34	345.1	470.16	271.31	471.17	204.94
1	594.85	508.47	359.41	498.46	280.86	500.11	210.84
2	732.64	632.69	419.33	623.71	320.04	628.1	234.55
3	912.94	796.7	492.02	789.42	366.06	797.39	261.51
5	1464.87	1305.31	688.29	1304.54	484.01	1322.92	327.14

Table 12-2: Pension Benefits for Female Junior high school graduates at Small Firms at Age 60 (Relative Values Compared with No Turnover)

Rate of returns %	No Turnover	Turnover at age 30		Turnover at age 35		Turnover at age 40	
		DC	DB	DC	DB	DC	DB
0	1	0.846	0.634	0.825	0.506	0.824	0.389
0.73	1	0.852	0.612	0.834	0.481	0.836	0.364
1	1	0.855	0.604	0.838	0.472	0.841	0.354
2	1	0.864	0.572	0.851	0.437	0.857	0.320
3	1	0.873	0.539	0.865	0.401	0.873	0.286
5	1	0.891	0.470	0.891	0.330	0.903	0.223

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The main data source is <u>Wage Structure Survey in 2000</u> published by the Ministry of Welfare and Labor. The data source reports wage figures based on gender, age, job seniority, education, occupation, size of firm, etc. Age and job tenure are given for each five years' intervals. Thus, it is necessary to estimate wage figures for each year intervals based on those for five years' intervals.

We estimated the following wage equations classified by gender (male and female), education (junior high school and university graduates) and size of firm (large firms; over 1,000 employees, middle-size firms; 100-1,000 employees, small firms; less than 100 employees). There are totally 12 equations.

$$Wage = f\left(const, \quad age, \quad (age)^2, \quad job \ tenure, \quad (job \ tenure)^2\right)$$

Based on the estimated coefficients of the above wage equations, we attempted interpolation jobs in order to obtain wage figures for each year intervals of ages and job tenures.