

Evaluating Termination Option of Employees' Pension Funds in the Calculation  
of Projected Benefit Obligations

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Abstract:

Employees' Pension Funds are typical Japanese private pensions. A Plan sponsor can terminate the plan under the approval of participants and the Ministry of Health and Welfare. In the case of termination, the cash flow from the fund is smaller than the Projected Benefit Obligations(PBO) owing to the low discount rate under the current Japanese low interest rate. Usual PBO calculations neglect such decrease of obligations of the plan sponsor upon termination. This paper presents a simple formula to calculate PBO considering such termination option of plan sponsors, and also shows some numerical examples.

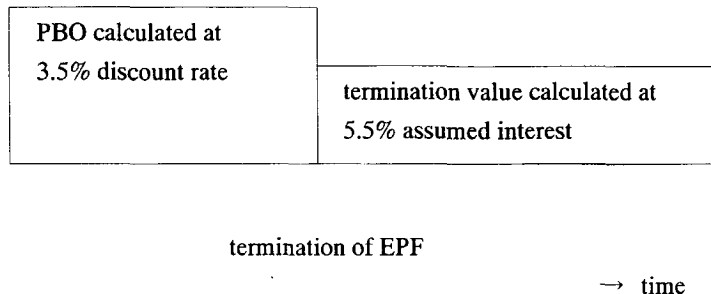
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## 1. Motivation

Some Japanese companies make their financial reports according to U.S. accounting Standards for overseas investors. They report Projected Benefit Obligations (PBOs) in line with FAS87 and FAS132 for the disclosure of retirement benefit obligations. The aim of this paper is to illustrate that the current method of calculation is reasonable from the accounting standpoint but the method overestimates PBOs for the companies sponsoring Employees' Pension Funds (EPFs) and thus underestimates earning per share from the standpoint of investors, because usual computation ignores the possibility of decrease of obligations in the case of the termination of EPFs. An EPF can be terminated under the approval of participants and the Ministry of Health and Welfare. In the case of termination, the cash flow from the fund is smaller than the Projected Benefit Obligations(PBO) owing to the gap between assumed interest rate 5.5% to calculate the termination value(MRR as explained below) and the low discount rate to calculate PBOs. This sudden decrease of obligation is illustrated in the following figure, and the termination of EPFs can be said to include a sort of barrier option .

Figure 1: Abrupt decrease of obligation of a company sponsoring an EPF



In fiscal 1998, The number of termination of EPFs is 18, 1% of all EPFs, which could not be neglected. For the accountant , the consideration of termination possibilities is not practical because the termination is possible but is not probable event. But for investors, considering the effect of this exercise of a sort of barrier option would be useful for forecasting earning per share exactly.

This paper presents a simple formula to calculate PBO considering such termination option of plan sponsors, and also shows some numerical examples.

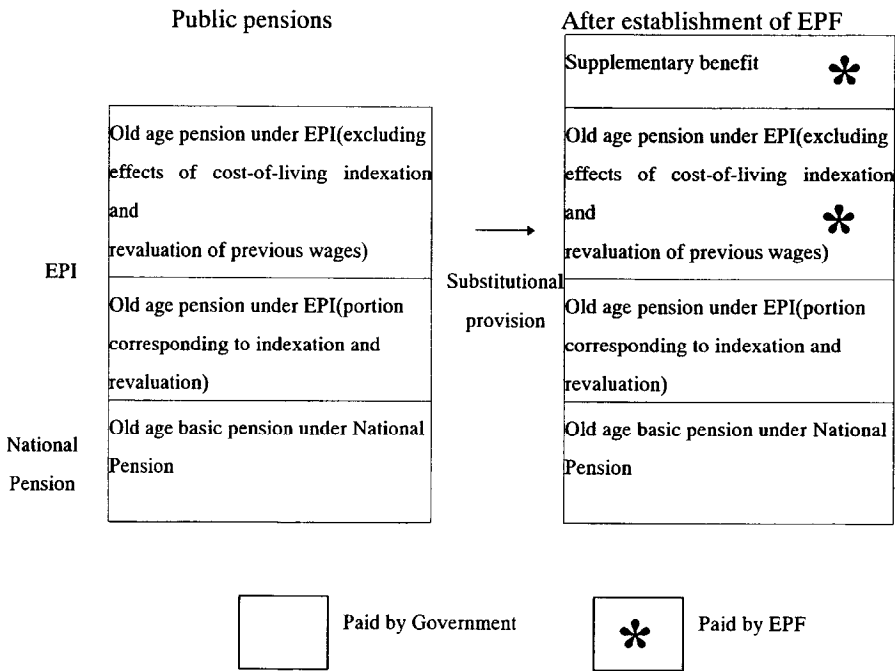
2. EPFs and their termination

(1) Outline of EPF Scheme

The EPF is a type of private pension in Japan created by the 1965 revision of the Employees' Pension Insurance Act(EPIA). The following is the description of EPF scheme in "Corporate Pension Plans in Japan 1995" by the Japanese Society of Certified Pension Actuaries.

Figure 2:

Relationship between EPI and EPFs



An EPF is incorporated with private sector companies or a trade association or regional industrial association as the plan sponsor. The main feature of the scheme is that EPFs substitute for a portion of the old age pensions of the Government-run Employees' Pension Insurance(EPI) excluding amounts corresponding to increases caused by revaluation of previous wages and cost-of-living indexation). In return, EPFs

are exempt from a portion of the EPI contributions payable to the Government to compensate for the costs of providing these substitutional benefits. In addition to the substitutional portion, each EPF is required to make its own supplementary benefit payments at a certain level. Its annuity benefits are paid, in principle, for life. Advance funding is mandatory. Any excess returns realized on assets invested can be used to improve the level of benefits.

Each EPF is a special juridical person as provided under the EPIA, and legally independent from the sponsoring employer or employers. Due to the status as a juridical person, each EPF is granted special powers under public law, but is subject to special supervision and regulations of the Government. More specifically, in carrying out its operations, each fund is authorized to determine and change pensionable wages, make assessments of annuity or lump sum benefits, collect contributions and provide disciplinary measures against arrearage. On the other hand, EPFs are subject to the Government's supervision and regulations on a great number of affairs. Employee pension funds enjoy the same tax treatment as public pensions because they are designed to replace a substantial portion of public pensions. Contributions paid by employers are deductible as welfare expenses.

## (2) Termination of EPF

In the case of termination, the EPF transfers amount called "Minimum Responsibility Reserve"(MRR) to the Pension Fund Association and the EPF became free from the responsibility to provide substitutional benefits. The EPF transfers amount corresponding to supplementary benefits to the Pension Fund Association, or directly to participants and pensioners at its termination.

"Corporate Pension Plans in Japan 1995" explains about the Pension Fund Association as follows:

The Pension Fund Association is a special juridical person established pursuant to the EPIA, and is similar to EPFs. Each fund has an obligation to pay pension benefits to all persons who have been members for at least one month. However, managing pension benefits earned by people with short participation periods causes administrative problems for individual funds. The Pension Fund Association was established to aggregate these small pensions. The Association is engaged in various other activities which are essential for the promotion and sound development of EPFs.

For example, the Association serves as a coordinating body between individual funds, provides consultation and guidance, and exchanges information regarding operation of funds. It also conducts research on corporate pension schemes. Other activities include operating a pension benefit guarantee program which provides guaranteed payment of vested benefits within a certain limit to members of terminated funds, providing pension benefits payments to participants of terminated funds, aggregating vested pension rights of withdrawing fund members, and processing a portion of administrative work on behalf of smaller funds at their request.

### (3) Amount of MRR

The formula to calculate of MRR is stipulated in regulations. The amount is expressed as follows:

The amount of MRR

= Average standard compensation as of September 30,1999 x 7.5/1000 x life annuity value of 1 (interest rate 5.5%)

+ Accumulation of premiums for substitutional part from October 1,1999

- Accumulation of substitutional benefits form October 1,1999

+ Investment return computed at the return of EPI

As of year 2000, the almost all of MRR is calculated using 5.5% assumed interest rate , which is much higher than the discount rate used to estimate PBOs under the current Japanese low interest rate economic situations. Therefore termination of EPF

usually brings decrease of PBOs for sponsoring companies.

### 3. The PBO of substitutional part of an EPF ignoring termination probability

Usual PBO calculation for participants is performed using the following formula:

Supposing discount rate  $i$ ,

$$PBO = \sum_x \sum_r \sum_f S(x,r,f,w) \times r/(r+i) \times 1/(1+i)^f$$

where

$x$  is the current age of each participant

$r$  is current years of service or each participant

$f$  is the future service period

$S(x,r,f,j)$  is the expected benefit for the participant at age  $x$ , years of service being  $r$ , ceased to be a participant for the reason  $j$  after  $f$  years of future service.

(The expected benefit means present value of pension as for pension benefit.) Because EPF do not provide death benefit which is paid from EPI, we do not bother to calculate obligations for death benefit. So we must think only about  $j=w$ , withdrawal including retirement.

We must note that government expense for EPF is ignored for simplicity.

Now we derive the formula for  $S(x,r,f,j)$ .

$$S(x,r,f,j) = (r+f) \times 7.5/1000 \times B_{x+f,r+f} \times {}_f q_x^{(j)} \times {}_{60|} a_{x+f}^{[i]}$$

where

$B_{x+f,r+f}$  is average standard compensation for persons at current age  $x$ , years of service  $r$ , future period  $f$  to decrement time.

${}_f q_x^{(j)}$  is the decrement probability for reason  $j$  after  $f$  years of future service for persons at current age  $x$ .

${}_{60|} a_x^{[i]}$  is the present value of annuity of 1 for the person at age  $x$ . The starting age of the annuity is 60.

${}_f q_x^{(j)}$  is calculated as  $d_{x+f|}^{(j)} / l_x$  for  $j=w$  (withdrawal) or  $d$  (death).

$$d_{x+f|}^{(j)} = l_x \times q_x^{(j)}$$

where  $q_x^{(w)}$  is the withdrawal rate for a person at age  $x$  and

$q_x^{(d)}$  is the mortality rate for a person at age  $x$ .

#### 4. The PBO of substitutional part of an EPF considering termination probability

If termination probability is reflected, we must use two new variables, one is the termination probability  $q^{(T)}$  which is the probability for a EPF to terminate within one year, another is the obligation decrease rate  $k$  which is computed as MRR divided by PBO for substitutional part of EPF. We first suppose for simplicity that the above two variables are both constant for years.

Let  $l_x$  be the number of persons at current age  $x$  in a EPF, the number of persons which have possibilities to receive future benefit from EPF after 1 year, denoted by  $l_{x+1}$  is expressed as follows if termination probability is ignored:

$$l_{x+1} = l_x \times (1 - q^{(w)}_x - q^{(d)}_x)$$

where  $q^{(w)}_x$  is withdrawal rate,

and  $q^{(d)}_x$  is mortality rate.

But  $l_{x+1}$  will be as follows if termination probability is contemplated:

$$l_{x+1} = l_x \times (1 - q^{(w)}_x - q^{(d)}_x - q^{(T)})$$

We define the following variables:

$$d^{(w)}_x = l_x \times q^{(w)}_x$$

$$d^{(d)}_x = l_x \times q^{(d)}_x$$

$$d^{(T)}_x = l_x \times q^{(T)}$$

Decrement reason  $j$  is now not only  $w$ (withdrawals),  $d$ (death), but also  $T$ (termination).

Thus

$${}_tq^{(j)}_x = d^{(j)}_{x+t} / l_x \quad (j = w, d \text{ or } T).$$

We must define not only

$$S(x, r, f, w) = (r+f) \times 7.5/1000 \times B_{x+f, r+f} \times {}_tq^{(w)}_x \times {}_{60|}a^{[i]}_{x+f}$$

but also

$$S(x, r, f, T) = k \times (r+f) \times 7.5/1000 \times B_{x+f, r+f} \times {}_tq^{(T)}_x \times {}_{60|}a^{[i]}_{x+f}$$

which is the expected cashflow for the participant at age  $x$ , years of service being  $r$ , in the case of EPF termination occurred after  $f$  years.

We can now derive the formula of PBO:

$$PBO = \sum_x \sum_r \sum_f \sum_j S(x, r, f, j) \times r / (r+f) \times 1 / (1+i)^f$$

## 5. Numerical Examples

Let us examine the effect of the termination probability consideration in the simple numerical examples. We compute PBO for a participant in an EPF at age 40 with 10 years of service having average standard compensation as 200,000 yen. We suppose termination probability  $q^{(T)}$  is 1%, obligation decrease rate  $k$  is 60%. We do not suppose salary increase for simplicity. The discount rate for PBO is 3.5%. The pension is paid 6 times annually and age  $x$  has no fragment. Retirement will occur just after reaching the retirement age 60. Withdrawals and death will occur in the middle of

each year.

We examine PBOs for 3 level of withdrawal rates, 10%, 1%, and 0.1%.

The decrement table for 1% withdrawal rate will be as follows:

age	mortality rate	withdrawal rate	$l_x(\text{ignoring termination})$	$l_x(\text{considering termination 1\% per year})$
40	0.00075	0.01	1000000	1000000
41	0.00084	0.01	989250	979250
42	0.00092	0.01	978527	958842
43	0.00099	0.01	967841	938783
44	0.00106	0.01	957204	919078
45	0.00114	0.01	946617	899722
46	0.00125	0.01	936072	880702
47	0.00138	0.01	925541	861987
48	0.00153	0.01	915008	843558
49	0.00168	0.01	904458	825396
50	0.00184	0.01	893894	807501
51	0.00198	0.01	883310	789865
52	0.00210	0.01	872728	772504
53	0.00224	0.01	862168	755432
54	0.00242	0.01	851615	738631
55	0.00262	0.01	841038	722071
56	0.00287	0.01	830424	705738
57	0.00313	0.01	819736	689598
58	0.00342	0.01	808973	673648
59	0.00374	0.01	798117	657871
60	0.00408		787151	642253

The formula for PBO ignoring termination probability will be as follows:

$$\begin{aligned}
 PBO_t &= \sum_{r=10} \sum_f S(40, r, f, w) \times r/(r+f) \times 1/(1+3.5\%)^f \\
 &= \sum_{r=10} \sum_f r(r+f) \times 7.5/1000 \times B_{40+f, r+f} \times {}_f q^{(w)}_{40} \times {}_{60} a^{[3.5\%]}_{40+f} \times r/(r+f) \times \\
 &\quad 1/(1+3.5\%)^f \\
 &= \sum_f 7.5/1000 \times 200,000 \times {}_f q^{(w)}_{40} \times {}_{60} a^{[3.5\%]}_{40+f} \times 10 \times 1/(1+3.5\%)^f
 \end{aligned}$$

The formula for PBO considering termination probability will be as follows:

$$\begin{aligned}
 PBO_t &= \sum_f (7.5/1000 \times 200,000 \times {}_f q^{(w)}_{40} \times {}_{60} a^{[3.5\%]}_{40+f} \times 10 \times 1/(1+3.5\%)^f \\
 &\quad + 0.6 \times 7.5/1000 \times 200,000 \times {}_f q^{(T)}_{40} \times {}_{60} a^{[3.5\%]}_{40+f} \times 10 \times 1/(1+3.5\%)^f)
 \end{aligned}$$

The result of calculation is shown in the following table:

withdrawal rate	(i)PBO ignoring termination (yen)	(ii)PBO considering termination 1% per year (yen)	(ii)/(i)
10%	119,393	115,473	0.96717
1%	119,435	111,475	0.93335
0.10%	119,449	110,805	0.92763

PBOs of EPFs decrease clearly if termination probability is considered even if the probability is the level of 1%.

## 6. Generalization

The hypothesis that termination probability  $q^{(T)}$  and obligation decrease rate  $k$  are both constant would be deemed oversimplified. We now research the model that these variables vary with years. The termination probability and obligation decrease rate are now both the function of  $f$  and denoted by  $q^{(T)}_f$  and  $k_f$ .

$l_x$  is now the function of  $f$  as well as  $x$ , and now denoted by  $l_{x,f}$ . In general  $l_{x+2,1} \neq l_{x+2,2}$ .

We can derive withdrawal rate, mortality rate and termination rate for each year as follows:

$$\begin{aligned} {}_f q^{(w)}_x &= l_{x+f,f} / l_x \times q^{(w)}_x \\ {}_f q^{(d)}_x &= l_{x+f,f} / l_x \times q^{(d)}_x \\ {}_f q^{(T)}_x &= l_{x+f,f} / l_x \times q^{(T)}_f \end{aligned}$$

The formula for expected withdrawal benefit  $S(x,r,f,w)$  is the same as the simple model stated in section 4:

$$S(x,r,f,w) = (r+f) \times 7.5/1000 \times B_{x+f,r+f} \times {}_f q^{(w)}_x \times {}_{60|} a^{[i]}_{x+f}$$

But expected benefit for termination  $S(x,r,f,T)$  reflects the variation of  $k_f$  with year  $f$ .

$$S(x,r,f,T) = k_f \times (r+f) \times 7.5/1000 \times B_{x+f,r+f} \times {}_f q^{(T)}_x \times {}_{60|} a^{[i]}_{x+f}$$

The formula for PBO is unchanged:

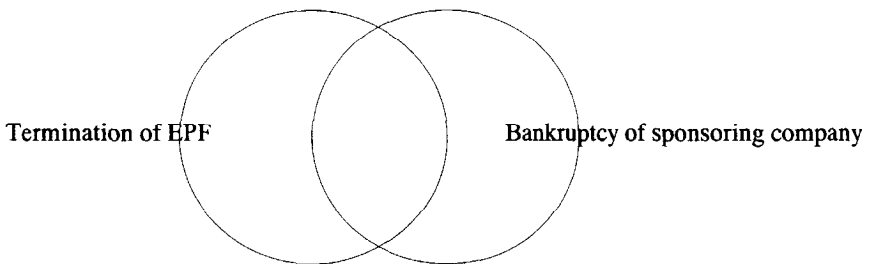
$$PBO = \sum_x \sum_r \sum_f \sum_j S(x,r,f,j) \times r/(r+f) \times 1/(1+i)^j$$

## 7. Conclusion and practical considerations

As stated above, PBOs of EPFs decrease clearly if termination probability is considered even if the probability is such small number as 1%. The current formula ignoring this probability might be seen as meaningful for accountants, because of the unstable probability of termination depending on business trends, funding level of each company, the level of profit of each company, the level of premiums compared with exempted contribution to the Government, and so on. But consideration of termination probability would bring more rigorous estimation of earning per share of sponsoring companies, which would be important to investors.

For practical applications, several points must be remembered. First, the termination occurs sometimes as the result of the bankruptcy of the sponsoring company. If the investors have already considered such probability, they must subtract such probability from the termination probability.

Figure 3: Termination of EPF and Bankruptcy of sponsoring company



Second, the termination probability is different among sponsoring companies. The companies issuing disclosure reports for overseas investors are usually seemed more robust than ordinary Japanese companies. Therefore for such companies, termination probabilities must be set lower than the simple average.

I hope the above research will contribute to investors through the consideration of latent options of companies, not confining the field of retirement benefit.

## 8. Reference

The Japanese Society of Certified Pension Actuaries "Corporate Pension Plans in Japan 1995"