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Comparison of the Actuarial Model for A Normal Lumpsum Pension Plan Using Defined-Benefit and Hybrid Models of Company Employees

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Abstract

In this research, we delve into the realm of pension plan programs, essential for securing a robust livelihood post-retirement through the provision of pension benefits to retired employees. Addressing the intricate balance between financial sustainability and risk mitigation, companies are mandated to allocate funds for pension benefits. The hybrid pension plan, a novel amalgamation of defined-benefit (DB) and defined-contribution (DC) features, emerges as a strategic solution to minimize the inherent risks of both models. This study undertakes the task of calculating the costs associated with pension benefits and the replacement ratio (RR) for both the traditional DB plan and the innovative hybrid pension plan. Drawing on data from 90 employees at Company X, we assume an effective interest rate of 4% for the DB plan and explore various scenarios for the hybrid plan, ranging from 3% to 5%. The findings present a compelling narrative: the costs required to fund the hybrid plan are found to be notably lower than those for the DB plan, ushering in a more economically sustainable approach. Concurrently, the RR derived from the hybrid plan surpasses that of the DB plan, showcasing its potential to provide a more substantial post-retirement income. Additionally, as the effective interest rate escalates, costs rise, and RR declines, emphasizing the sensitivity of these parameters to the interest rate. Considering these results, a conclusion emerges: the hybrid pension plan stands out as the optimal choice for employees at Company X, presenting a novel and advantageous approach to pension program design and implementation.

Keywords: Cost of pension benefits; Defined-benefit; Hybrid; Pension plan; Replacement ratio.

Abstrak

Dalam penelitian ini, kami mendalami program pensiun, yang penting untuk menjamin penghidupan yang kuat setelah pensiun melalui pemberian manfaat pensiun kepada karyawan yang pensiun. Untuk mengatasi keseimbangan rumit antara keberlanjutan finansial dan mitigasi risiko, perusahaan diwajibkan mengalokasikan dana untuk manfaat pensiun. Program pensiun hybrid, yang merupakan penggabungan fitur manfaat pasti (DB) dan iuran pasti (DC), muncul sebagai solusi strategis untuk meminimalkan risiko yang melekat pada kedua model tersebut. Studi ini menghitung biaya yang terkait dengan manfaat pensiun dan replacement ratio (RR) untuk program DB dan program pensiun hybrid. Berdasarkan data dari 90 karyawan di Perusahaan X, kami mengasumsikan tingkat bunga efektif sebesar 4% untuk program DB dan menggunakan rentang 3% hingga 5% untuk program hybrid. Hasil penelitian menemukan bahwa biaya yang diperlukan untuk mendanai program hybrid ternyata jauh lebih rendah dibandingkan dengan program DB, sehingga menghasilkan pendekatan yang lebih berkelanjutan secara ekonomi. Pada saat yang sama, RR yang diperoleh dari program hybrid melampaui program DB, sehingga menunjukkan potensinya dalam memberikan pendapatan pasca-pensiun yang lebih besar. Selain itu, ketika tingkat bunga efektif meningkat, biaya meningkat, dan RR menurun. Hal ini menekankan sensitivitas parameter-parameter ini terhadap tingkat bunga efektif. Kesimpulannya program pensiun hybrid merupakan pilihan optimal bagi karyawan di Perusahaan X, karena menghadirkan pendekatan baru dan menguntungkan dalam perancangan dan implementasi program pensiun.

Kata Kunci: *Biaya manfaat pensiun; Dana pensiun;* Defined-benefit; Hybrid; Replacement ratio.

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1. INTRODUCTION

In this era of globalization, each individual must work to meet the needs of themselves and their families. However, eventually, they will experience old age which is a sign that retirement has arrived in that person's career. One of the effects of retirement is the reduced income earned by individuals. If a person has retired, financial stability is the most important aspect to ensure a prosperous life after retirement [1].

The most effective way to ensure a satisfactory quality of life after retirement is the existence of a pension plan. The Indonesian government has realized the importance of a pension plan. Pension plan programs require regular planning, assumptions, financing, and monitoring [1]. Therefore, the Indonesian government issued the Law of the Republic of Indonesia Number 11 in 1992 regarding Pension plans to ensure the continuity of individual income after retirement.

Normal retirement is defined as employees who retire based on the pre-determined retirement age set by the company. Other forms of retirement include early retirement, deferred retirement, and disabled retirement. This research is based on the normal retirement of employees at Company X. Hence, the assumptions for early retirement, disability, and death are presumed to be irrelevant.

In general, pension plans are divided into two models, namely defined benefit (DB) and defined contribution (DC) [2]. The DB plan uses a formula to predetermine the benefits that will be received by the pension plan participants (employees), while the DC plan predetermines the employees' fixed contributions [3]. However, the risks of each hybrid plan are unequally assigned to both employers and employees, with the employer burdening the DB plan's risk and the employees burdening the DC plan's risk [3].

Such injustices can lead to socio-economic disparities and undermine the balance between generations [2]. The solution to overcome the shortcomings of each of these models is to divide the risk equally between employers and employees [4]. Therefore, the hybrid pension plan which combines the characteristics of DB and DC plans can be used as a solution to this problem [4]. The hybrid model is deemed to be flexible based on its characteristics of several types of Hybrid plan applications, namely, floor-offset pension plans, cash balance plans, and pooled variable balance plans [4].

In addition to determining pension benefits, it is necessary to ensure that future pension benefits are adequate to finance a decent life [5]. The parameter that can be used to measure the feasibility of a pension plan in ensuring a prosperous life after retirement is the Replacement Ratio (RR). According to the International Labor Organization (ILO) in 2018, the minimum RR that can guarantee a decent quality of life after retirement is 40% of the total final salary [6].

The existence of a pension plan program for employees is the company's responsibility towards employees who have dedicated themselves during their tenure [7]. The implementation of this pension plan is also carried out at Company X using the DB pension plan that provides lump sum pension benefits to their employees. As an effort to anticipate the risks of the DB plan and to ensure not only the financial stability of the company but also its employees, other pension plans such as a hybrid plan can be considered in planning the pension plan program at Company X.

Based on the advantages of the hybrid pension plan model, this study will not only determine the cost of pension benefits for Company X's employees using the DB plan but also determine the cost of pension benefits using the hybrid plan. In addition, RR will be determined as a parameter to determine the sufficiency of pension plans for Company X's employees after retirement. After that, the results of each plan will be analyzed and compared.

2. METHOD

2.1. Data

The data used in this study is data on the salaries of all employees in Company X, which is as many as 90 employees. The variables used in this study are the variables available in the information on employee salary data at Company X. The variables are as follows:

1. Entry age (x),
2. Retirement age (z),
3. Years of Service (YOS_z), and
4. Monthly salary at retirement age z.

2.2. Assumptions

The assumptions used in this study are as follows:

1) The mortality rate is assumed as in the IV Indonesian Mortality.
2) Conditions for early retirement failure, disability, and death are assumed to be non-existent [8].
3) The classification of pension plan participants are active employees of Company X.
4) FAS_z is calculated using the average salary of three years ($n = 3$) before retirement [9]
5) The constant salary scale is 1% each year (as per information provided by Company X).
6) The proportion (p) of salary prepared for retirement benefits is 2% of the years of service multiplied by the final average salary until retirement age based on the assumption of FAS_z [9].
7) PAB_z and F are calculated and given to the employees of Company X on a lump sum basis (as per Company X policy).
8) The retirement age is different for each employee and is per Company X's salary data, namely at the age of 45, 50, and 55 (as per Company X policy).
9) The effective interest rate (i) for the DB plan on pension obligations and the rate of return on investment is the same, namely 4% [10].
10) The effective interest rates (i) for hybrid plans are 3%, 3.5%, 4%, 4.5%, and 5% [10].
11) The inflation rate is assumed to be constant.
12) The contribution of participants (c) in the hybrid plan is 2% [11].
13) The genders for each employee are not provided by Company X. Therefore, any formulas influenced by the mortality rate must be calculated separately for both male and female employees.

2.3. Model Description

2.3.1. Defined Benefit (DB) Pension Plan

Defined-Benefit (DB) is a pension plan in which the amount of pension benefits paid is determined in advance based on a special formula [1]. The employer's contribution varies with the development of the investment and must consider the exact benefits that must be paid. The contribution of the participants to the pension plan will be determined in advance if needed. It is also formulated that the main characteristics of the DB pension plan model, namely that the DB program pension benefits are guaranteed where the funds specified at the beginning of the agreement are guaranteed to be available and paid in full to the pension plan participants [12].

Figure 1. Mechanism of DB plan

Pension benefits in DB pension plans are determined by considering a proportion of the average income per year or final average salary (FAS_z) [3]. The following formula is used if the final average salary is calculated from the last n years before retirement [13].

$$FAS_z = \frac{1}{n}\left(\frac{s_{z-n} + s_{z-n+1} + \cdots + s_{z-1}}{s_x}\right) \cdot CAS_x \tag{1}$$

Retirement benefits are also a function of the employee's years of service. Therefore, projected annual benefits at retirement age (PAB_z) will begin at the retirement age (z) for employees who are hired at age (x) and can be formulated as follows [13].

$$PAB_z = p \cdot YOS_z \cdot FAS_z. \tag{2}$$

A lump sum is a one-time payment equal to the actuarial present value of pension benefits [14]. If the pension benefit is provided as a lump sum, it is the pension benefit (PAB_z) multiplied by the annuity after retirement until the age of 65 years. The formula is as follows

$$APV_{DBlumpsum} = PAB_z \cdot \sum_{t=1}^{111-z} v^t \ {}_tp_z \ . \tag{3}$$

Based on Equation (3), $APV_{DBlumpsum}$ is the total cost of the DB plan pension benefit borne by the employer, while the DB plan replacement ratio can be calculated using the following formula:

$$RR = \frac{PAB_z}{CAS_z}. \tag{4}$$

where CAS_z is the current annual salary at entry age x, s_x is a salary scale factor, PAB_z is the projected annual benefit, p is the proportion of salary prepared for retirement benefits, s_{z-n} salary scale factor for the period $z-n$, $v^t = (1+i)^{-t}$ is the present value of effective interest rate i, ${}_tp_z$ is mortality factor for individuals at retirement age z experience to survive till age $z+t$.

2.3.2. Hybrid Pension Plan

The hybrid plan is a solution to overcome the risks faced by the DB and DC plans, where the parameters of pension benefits and contributions have been explicitly determined [3]. The hybrid plan which combines the characteristics of both the DB and DC plans can better meet the needs of employers and employees [15]. This study will use a floor-offset pension-type hybrid model. This floor-offset pension is a DC plan that is protected by a guaranteed minimum retirement benefit (as per the DB plan) [4]. If the pension plan accumulated in the participant's DC pension plan does not

meet the minimum limit, the company must fund the shortfall. The hybrid plan can guarantee the profitability of a more effective model in which the employer/another third party will manage the monthly contributions in the participant's DC pension plan to reach the minimum promised pension benefit limit [12].

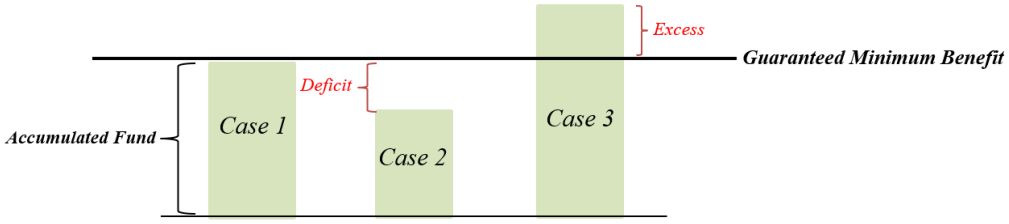

Figure 2. Mechanism of Hybrid Plan

The general formula for the hybrid plan pension benefit with the floor-offset Pension type is as follows [9]:

$$\max(F, PB) = F + \max(0, PB - F). \tag{5}$$

Based on Equation (5), the cost of pension benefits that must be borne by employers if using a hybrid plan (C_H) is as follows:

$$C_H = \begin{cases} PB - F, & F < PB, \\ 0, & F \geq PB. \end{cases} \tag{6}$$

The accumulated fund (F) depends on two random variables, namely the effective interest rate and the constant salary scale [9]. Therefore, the right investment strategy must be applied to the accumulated pension plans. F can be calculated by the following formula [9]:

$$F = c \cdot CAS_x \cdot \ddot{s}^*_{x:\overline{z-x}|}, \tag{7}$$

in which $\ddot{s}^*_{x:\overline{z-x}|}$ is

$$\ddot{s}^*_{x:\overline{z-x}|} = \sum_{t=0}^{z-x-1} (1+i)^{z-x-t-1} \cdot {}_tp_x \cdot \frac{S_{x+t}}{S_x}. \tag{8}$$

PB is calculated by multiplying the years of service, with the final average salary (FAS_z), and the annuity factor. Therefore, it is assumed to be equal to PAB_z in Equation (11).

$$PB = PAB_z. \tag{9}$$

Hybrid plan replacement ratio can be calculated using the following formula:

$$RR = \begin{cases} \dfrac{PB}{CAS_z}, & F < PB, \\ \dfrac{F}{CAS_z}, & F \geq PB. \end{cases} \tag{10}$$

where F is accumulated fund at retirement, PB is promised benefits, $\ddot{s}^*_{x:\overline{z-x}|}$ is the accumulated value of an annuity, c is the normal contribution rate, and S_x is a salary in the year of entry age (x).

3. RESULTS AND DISCUSSIONS

3.1 DB Plan

Based on the research stages described in the previous chapter, pension benefits for employees at Company X can be calculated using pre-determined assumptions.

- Final Average Salary

Detailed calculation shall be shown for Employee No.1's case only with an entry age of 38 years old and retirement age of 55 years old. Employee No.1's annual salary is $\text{Rp } 282{,}060{,}000.00$. Therefore, the final average salary is as $FAS_z = \frac{1}{3}\left(\frac{1.4026+1.4166+1.4308}{1.2202}\right) \times \text{Rp } 282{,}060{,}000 = \text{Rp } 327{,}473{,}711.$

- Projected Annual Benefit

  Employee No.1's projected annual benefit could be calculated as $PAB_z = 0.02 \times 17 \times \text{Rp } 327{,}473{,}711 = \text{Rp } 111{,}341{,}061.$

- $APV_{DBlumpsum}$

Since genders are not provided in Company X's data, the calculations for $APV_{DBlumpsum}$ must calculate both male and female employees separately. This is also the result of the cost of pension benefits using the DB plan.

1. If Employee No.1 is male, then

$$APV_{DBlumpsum} = \text{Rp } 111{,}341{,}061 \times \sum_{t=1}^{111-55} v^t \, {}_tp_{55} = \text{Rp } 111{,}341{,}061 \times 16.3258 = \text{Rp } 1{,}817{,}727{,}783.$$

2. If Employee No.1 is female, then

$$APV_{DBlumpsum} = \text{Rp } 111{,}341{,}061 \times \sum_{t=1}^{111-55} v^t \, {}_tp_{55} = \text{Rp } 111{,}341{,}061 \times 16.4480. = \text{Rp } 1{,}831{,}339{,}005.$$

- Replacement Ratio

  Employee No.1's replacement ratio could be calculated as $RR = \frac{\text{Rp } 111{,}341{,}061}{\text{Rp } 282{,}060{,}000} = 39\%.$

Table 1 portrays an excerpt of the results of the DB plan for other employees.

3.2 Hybrid Plan

When calculating the hybrid plan for Employee No.1, we must first calculate the accumulated fund. Calculations for the accumulated fund are done as follows:

- Accumulated Fund

Before calculating the accumulated fund, the accumulated value of the annuity must be calculated. If Employee No.1 is male with an effective interest rate of 3%, the accumulated value of the annuity is calculated in Table 2.

If we were to input the effective interest rates of 3%, 3.5%, 4%, 4.5%, and 5%, then we would obtain the accumulated value of an annuity for Employee No.1 as portrayed in Table 3. The reason for such effective interest rates to be used is that they are discrete midpoints with a range of 3% to 5% as per Bank Indonesia's prevailing interest rates.

Table 1. Result of Cost of DB Pension Plan and Its Replacement Ratio

No.	Entry Age (x)	Retirement Age (z)	Current Annual Salary (CAS_z) in Rp	Final Average Salary (FAS_z) in Rp	Projected Annual Benefit (PAB_z) in Rp	Cost of Pension Plan for Male Employees (C_H) in Rp	Cost of Pension Plan for Female Employees (C_H) in Rp	RR
1	38	55	282,060,000	327,473,711	111,341,062	1,817,727,783	1,831,339,005	39%
2	28	55	228,720,000	293,327,526	158,396,864	2,585,949,662	2,605,313,361	69%
3	27	55	171,840,000	222,584,191	124,647,147	2,034,959,776	2,050,197,641	73%
4	20	50	236,352,000	312,300,069	187,380,042	3,128,453,235	3,312,376,964	79%
5	22	50	212,064,000	274,686,300	153,824,328	2,568,214,915	2,719,201,881	73%
.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.
90	32	50	54,156,000	63,504,265	22,861,535	381,690,834	404,130,677	42%

Table 2. Accumulated Value of Annuity

t	$z-x$ $-t-1$	$(1+i)^{z-x-t-1}$	${}_tp_x$	S_{x+t} in Rp	$\frac{S_{x+t}}{S_x}$	$(1+i)^{z-x-t-1}\ {}_tp_x\frac{S_{x+t}}{S_x}$
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0	16	1.6047	1.0000	282,060,000	1.0000	1.6047
1	15	1.5580	0.9602	284,880,600	1.0100	1.5109
2	14	1.5126	0.9218	287,729,406	1.0201	1.4224
3	13	1.4685	0.8849	290,606,700	1.0303	1.3388
4	12	1.4258	0.8492	293,512,767	1.0406	1.2599
5	11	1.3842	0.8148	296,447,895	1.0510	1.1853
6	10	1.3439	0.7815	299,412,374	1.0615	1.1149
7	9	1.3048	0.7494	302,406,497	1.0721	1.0484
8	8	1.2668	0.7184	305,430,562	1.0829	0.9855
9	7	1.2299	0.6885	308,484,868	1.0937	0.9261
10	6	1.1941	0.6595	311,569,717	1.1046	0.8699
11	5	1.1593	0.6315	314,685,414	1.1157	0.8167
12	4	1.1255	0.6044	317,832,268	1.1268	0.7665
13	3	1.0927	0.5782	321,010,591	1.1381	0.7191
14	2	1.0609	0.5529	324,220,697	1.1495	0.6742
15	1	1.0300	0.5284	327,462,904	1.1610	0.6318
16	0	1.0000	0.5047	330,737,533	1.1726	0.5917
			$\ddot{s}^*_{x:\overline{z-x}\rceil}$			17.4669

Table 3. Accumulated Value of Annuity for Employee No.1

$\ddot{s}^{*}_{x:\overline{z-x}\rceil}$ for Employee No.1		
i	Male	Female
3.0%	17.466870	17.569522
3.5%	18.290681	18.395735
4.0%	19.159103	19.266639
4.5%	20.074585	20.184685
5.0%	21.039705	21.152456

- Accumulated Fund

The accumulated fund for Employee No.1 could be calculated as follows:

1. If Employee No.1 is male, with an $i = 3\%$, then $F = 0.02 \times \text{Rp } 282{,}060{,}000 \times 17.466870 = \text{Rp } 98{,}534{,}105.$

   Which is then converted into lumpsum as follows:

   $$F = \text{Rp } 98{,}534{,}105 \times \sum_{t=1}^{111-55} v^t \; {}_tp_{55} = \text{Rp } 98{,}534{,}105 \times 16.3258 = \text{Rp } 1{,}608{,}644{,}451.$$

2. If Employee No.1 is female, with an $i = 3\%$

   $$F = 0.02 \times \text{Rp } 282{,}060{,}000 \times 17.569522 = \text{Rp } 99{,}113{,}188.$$

   Which is then converted into lumpsum as follows:

   $$F = \text{Rp } 99{,}113{,}188 \times \sum_{t=1}^{111-55} v^t \; {}_tp_{55} = \text{Rp } 99{,}113{,}188 \times 16.4480 = \text{Rp } 1{,}630{,}214{,}811.$$

- Promised Benefit

The promised benefit is no longer calculated as it is the same result as the projected annual benefit in the DB plan.

- Cost of Pension Benefit

1. If Employee No.1 is a male with an $i = 3\%$,
   Because $F < PB$, then $C_H = \text{Rp } 854{,}149{,}531 - \text{Rp } 755{,}901{,}360 = \text{Rp } 98{,}248{,}171.$
2. If Employee No.1 is female with an $i = 3\%$,
   Because $F < PB$, then $C_H = \text{Rp } 891{,}145{,}128 - \text{Rp } 793{,}276{,}385 = \text{Rp } 97{,}868{,}743.$

- Replacement Ratio

1. If Employee No.1 is a male with an $i = 3\%$,
   Because $F < PB$, then $RR = \frac{\text{Rp } 111{,}341{,}062}{\text{Rp } 282{,}060{,}000} = 39\%.$
2. If Employee No.1 is female with an $i = 3\%$,
   Because $F < PB$, then $RR = \frac{\text{Rp } 111{,}341{,}062}{\text{Rp } 282{,}060{,}000} = 39\%.$

The results of the cost of the hybrid plan and its replacement ratio are portrayed in Table 4 – 6.

Table 4. Result of Cost of Hybrid Pension Plan and Its Replacement Ratio with $i = 3\%$ dan $i = 3.5\%$

No	Entry Age (x)	Retirement Age (z)	$i = 3\%$				$i = 3.5\%$			
			Cost of Pension Plan for Male Employees (C_H) in Rp	Cost of Pension Plan for Female Employees (C_H) in Rp	RR (Male)	RR (Female)	Cost of Pension Plan for Male Employees (C_H) in Rp	Cost of Pension Plan for Female Employees (C_H) in Rp	RR (Male)	RR (Female)
1	38	55	209,083,332	201,124,194	39%	39%	133,212,855	124,462,764	39%	40%
2	28	55	371,728,956	365,462,245	69%	69%	185,684,471	177,679,572	69%	76%
3	27	55	296,876,769	292,271,716	73%	73%	143,959,686	137,938,792	73%	80%
4	20	50	452,055,967	471,582,499	79%	79%	195,289,925	199,355,378	79%	79%
5	22	50	363,589,533	379,297,270	73%	73%	170,021,086	174,094,564	73%	73%
.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.
90	32	50	43,296,611	44,781,796	42%	42%	26,228,070	26,683,679	42%	43%

Table 5. Result of Cost of Hybrid Pension Plan and Its Replacement Ratio with $i = 4\%$ dan $i = 4.5\%$

No	Entry Age (x)	Retirement Age (z)	$i = 4\%$				$i = 4.5\%$			
			Cost of Pension Plan for Male Employees (C_H) in Rp	Cost of Pension Plan for Female Employees (C_H) in Rp	RR (Male)	RR (Female)	Cost of Pension Plan for Male Employees (C_H) in Rp	Cost of Pension Plan for Female Employees (C_H) in Rp	RR (Male)	RR (Female)
1	38	55	53,233,870	43,654,636	40%	42%	0	0	42%	39%
2	28	55	0	0	76%	82%	0	0	83%	69%
3	27	55	0	0	80%	87%	0	0	88%	73%
4	20	50	0	0	82%	82%	0	0	90%	90%
5	22	50	0	0	74%	74%	0	0	80%	81%
.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.
90	32	50	8,169,020	7,535,872	44%	46%	0	0	46%	42%

3.3 Comparison of Cost of Pension Benefits

After calculating the cost of pension benefits using the DB plan and the Hybrid plan, a comparison of each cost will be made. This is done so that the best model can be determined based on the cost of the required pension benefits. The comparison will be based on the total cost and the average cost required for each hybrid plan. Tables 7 and 8 respectively show the details of the total and average costs required to finance all employees of Company X using the DB plan and the Hybrid plan with a certain effective interest rate. The data listed in the two tables are then depicted in the form of a bar graph as shown in Figure 3.

Table 6. Result of Cost of Hybrid Pension Plan and Its Replacement Ratio with $i = 5\%$

No.	Entry Age (x)	Retirement Age (z)	Cost of Pension Plan for Male Employees (C_H) in Rp	Cost of Pension Plan for Female Employees (C_H) in Rp	RR (Male)	RR (Female)
1	38	55	0	0	39%	42%
2	28	55	0	0	70%	83%
3	27	55	0	0	73%	88%
4	20	50	0	0	98%	99%
5	22	50	0	0	88%	88%
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
90	32	50	0	0	42%	46%

Table 7. Total cost of employee pension benefits of company X (in Rp)

Model	i	Company X Employees	
		Male	Female
DB	4%	85,467,273,144	87,214,229,316
H	3%	13,350,039,931	13,360,582,406
H	3.5%	7,246,777,830	7,136,829,272
H	4%	1,830,520,202	1,780,881,579
H	4.5%	999,095,593	992,332,064
H	5%	526,908,599	525,081,248

Table 8. Average cost of employee pension benefits of company X (in Rp)

Model	i	Company X Employees	
		Male	Female
DB	4%	908,375,126	927,900,912
H	3%	143,360,355	143,697,980
H	3.5%	77,976,101	76,974,117
H	4%	20,428,579	19,968,126
H	4.5%	11,483,857	11,406,116
H	5%	6,056,421	6,035,417

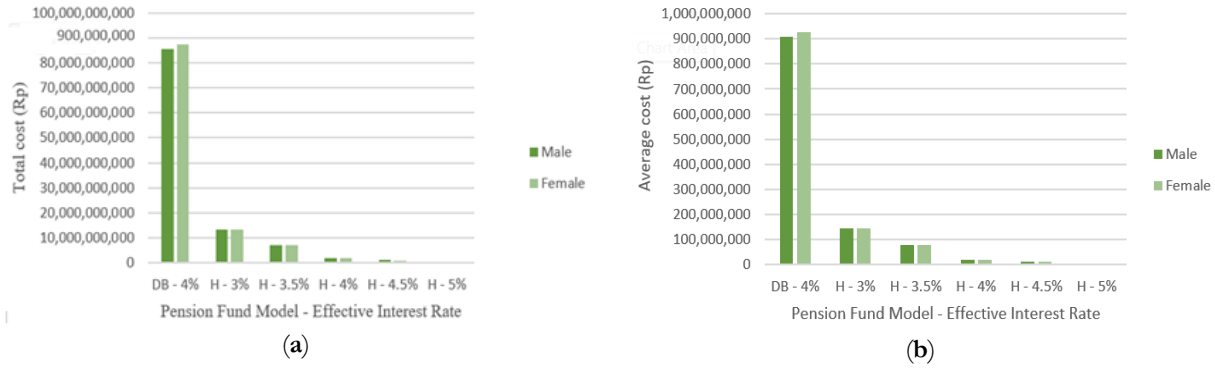

Figure 3. Cost of employee pension benefits of company X (**a**) total cost; (**b**) average cost.

Based on Table 7 and Figure 3, overall, the total cost of pension benefits required by the hybrid plan is marginally smaller when compared to the cost of the DB plan pension benefits. It can be seen that the cost of the most expensive pension benefit is the DB plan. The DB plan requires funds of Rp. 85,467,273,144 for male employees and Rp. 87,214,229,316 for female employees.

Based on Figure 3, the higher the effective interest rate in a hybrid plan, the smaller the total cost required. However, the total cost required for a hybrid plan with an effective interest rate of 3% is still in the billions of rupiah. In detail, the total costs are respectively Rp. 13,350,039,931 for male employees and Rp. 13,360,582,406 for female employees.

It can be said that these costs will decrease drastically when the effective interest rate is 4.5% where the cost of pension benefits is in the range of hundreds of millions of rupiah. When the effective interest rate is 4.5%, male employees need funds as much as IDR 999,095,593, and female employees require funds as much as IDR 992,332,064. Therefore, the smallest total cost required by the hybrid plan is at an effective interest rate of 5% with costs of Rp. 526,908,599 and Rp. 525,081,248, respectively, for male and female employees of Company X.

In addition, it is seen that female employees cost more pension funding than male employees. However, the difference is not very significant. The difference is in the range of hundreds of rupiah. This is true for both hybrid plans, as well as the average cost of their retirement benefits.

Overall, according to the information shown in Figure 3, the higher the effective interest rate in a hybrid plan, the lower the cost of the required pension benefits. The smallest average cost of pension benefits is a hybrid plan with an effective interest rate of 5%, where male employees require an average cost of Rp 6,056,421 and female employees require an average cost of Rp 6,035,417. The average cost in a hybrid plan with effective interest rates of 3% is in the hundreds of millions of rupiah, then drastically decreases to tens of millions of rupiahs when the effective interest rates increase to 3.5%, 4%, and 4.5%.

It can be concluded that the Hybrid plan requires a smaller pension benefit cost than the DB plan. This is because the majority of participants have accumulated funds (F) that have exceeded the promised funds (PB) in a hybrid plan so that the company does not need to provide additional funds. In addition, participants who accumulate funds (F) over the promised funds (PB) will also receive pension benefits that are larger in nominal terms, while the DB plan is fully borne by the company and indirectly requires much larger funds.

3.4 Comparison of Replacement Ratio

Next, a comparison of the RR for the Hybrid plan and the DB plan will be further elaborated, along with its respective interest rates. Table 9 and Figure 4 are the results of the average RR in the Hybrid plan and the DB plan for all employees of Company X with a certain effective interest rate.

Table 9. Average RR of company X employees

Model	i	Company X Employees	
		Male	Female
DB	4%	70%	
H	3%	70%	70%
H	3.5%	70%	70%
H	4%	71%	71%
H	4.5%	77%	77%
H	5%	83%	83%

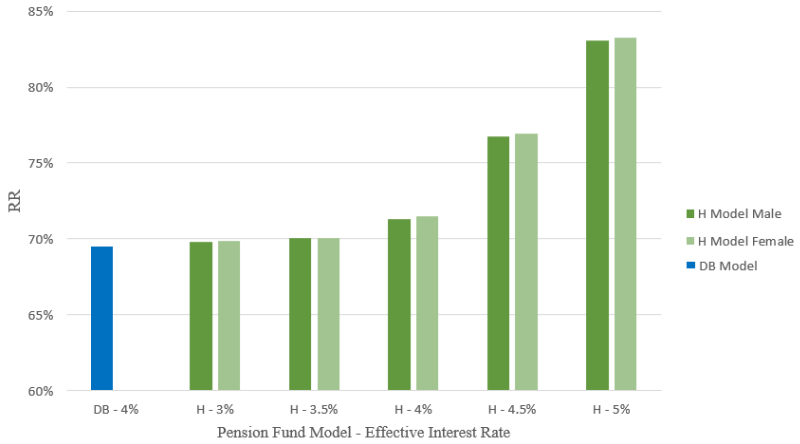

Figure 4. Average RR model of company employee pension plan X

Based on Table 9 and Figure 4, it can be concluded that the average RR in a hybrid plan is higher than the average RR in the DB plan, where the average RR in a hybrid plan is equal to or more than 70%. However, the average RR in the DB plan is slightly below 70%. In addition, Figure 5 shows that as the effective interest rate increases, the average RR in a hybrid plan will also increase. This means that the higher effective interest rate will indirectly increase the accumulated funds in hybrid pension plans (F). This increase will also increase the guarantee of a better quality of life after retirement. Broadly speaking, both hybrid plans have met the minimum RR requirement to ensure a decent life after retirement as determined by the ILO (2018), which is 40%.

In addition, when the interest rates are 4.5% and 5%, the majority of the RR of Company X's employee pension plans are in the sixth and seventh intervals, which is above 80%. RR hybrid plan when $i \in \{4.5\%, 5\%\}$ are in the eighth interval with a range greater than 100%. This means that there is an RR whose value is more than 100% if the effective interest rate reaches 4.5% and 5% and the RR value will also increase significantly when the effective interest rate reaches this figure.

When compared to the RR of female employees with male employees, the RR of female employees is slightly higher than that of male employees, especially in a hybrid plan. However, the difference is not too drastic and tends to be equal. This can be interpreted that although the pension benefits of female employees are more feasible in ensuring the quality of life after retirement compared to male employees, the difference is not too significant.

Therefore, it can be concluded that the higher the effective interest rate in a hybrid plan, the more employees with an RR above 40%. Overall, Figure 5 shows that both plans can guarantee a decent quality of life because the majority of the RR of employee pension plans in Company X is already above 40%.

4. CONCLUSIONS

Based on the results and discussions that have been described, the results obtained used the assumption of a defined-benefit (DB) pension plan model assuming an effective interest rate of 4% and a hybrid plan assuming an effective interest rate of 3%, 3.5%, 4%, 4.5%, and 5%. Overall, the cost of pension benefits calculated using the hybrid plan is smaller than the DB plan. In addition, female employees cost more than male employees, but the difference is not too significant. Based on

the results of a hybrid plan, the higher the effective interest rate, the lower the cost of the required pension benefits. Therefore, the floor-offset pension type Hybrid plan with the highest effective interest rate is the best model to be used as a pension plan model for all employees of Company X. This is because the costs that must be prepared by the company are smaller and employees will also receive higher pension benefits.

The replacement ratio (RR) is a parameter to measure the feasibility of pension plans in ensuring proper livelihood after retirement. In this case, it means that the higher the RR, the higher the guarantee of proper livelihood after retirement. The RR of female and male employees did not experience significant differences and tended to be similar except for the hybrid plan with an $i = 4.5\%$. Based on the results obtained, the hybrid plan and the DB plan can guarantee a decent life because the RR value of the majority of Company X's employees is above 40%. However, it can also be concluded that the RR in the hybrid plan is higher than the RR in the DB plan. In addition, it is also found that the higher the effective interest rate in a hybrid plan, the higher the RR in a hybrid plan. In conclusion, a hybrid plan with the floor-offset pension type is the pension plan with the best guarantee of proper livelihood after retirement.

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