

Key theme

Corporate (private) post employment benefits

Title

Consideration of the structures and techniques of risk sharing in cash balance pension plans

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Abstract

When the Defined Benefit Corporate Pension Act was enacted in June 2001, Employees' Pension Funds and newly born Defined Benefit Corporate Pension Plans were permitted to design their benefits by Cash Balance Pension Plans (CBPs). The CBP defines the promised employee benefit by reference to a notional account balance (NAC). An employee's NAC is increased with periodic notional principal credits and notional fixed and/or variable interest credits. Upon resignation, usually with more than 3 years of service, the employee is entitled to the lump-sum amount of his/her NAC.

The interest credits are calculated based on the revaluation rate that has been chosen by the plan sponsor. In many cases, the interest rate of the government bond is used for the revaluation rate.

The reasons of this selection are considered as follows:

The correlation between the interest rate of the government bond and the discount rate used in the calculation of the projected benefit obligation is high. Which results in the mitigation of the volatility of the projected benefit obligation.

When the interest rate falls the benefits by CBPs will become small in comparison with the conventional defined benefit pension plans.

Although the benefits by CBPs change according to the yield curve, plan sponsors bear investment risks, which means they will bear additional burden when a significant drops in funding levels occur. In the current financial crisis, a decline in funding levels of pension plans is spreading, and CBPs are no exception.

In this paper, I review the structure of risk sharing by employers and employees in CBPs in my country, based on the current environment, and I also consider the sharing of the investment risks in order to maintain pension plans in good shape.

1 . Introduction

1.1.Introduction of Cash Balance Pension Plans (CBPs) in Our Country

The history of the defined benefit type corporate pension plan in our country has progressed through several stages: the foundation of Tax-Qualified Pension Plans (TQPPs) in 1962; the foundation of Employees' Pension Funds in 1966; and the enactment of the Defined Benefit Corporate Pension Act (DB Act) in 2001. The design of Defined Contribution Pension plans was made possible owing to the enactment of the Defined Contribution Pension Act (DC Act), which had been enacted alongside the DB Act.

When the DB Act was enacted, Employees' Pension Funds and newly born Defined Benefit Corporate Pension Plans were permitted to design their benefits by CBP.

On the other hand, at the same time, it was decided that TQPPs were to be abolished, effective March 31, 2012, and the design of benefits by CBPs is not permissible within TQPPs. Therefore, in many cases, TQPPs are being transferred to DBs. A lot of plan sponsors are changing from the conventional defined benefit pension plans to CBPs. The reasons of this change is as follows:

- This change results in the mitigation of the volatility of the projected benefit obligation.
- When the economic environment turns bad , (revaluation rate might easily become reduced, and) the benefits by CBPs will become small in comparison with the conventional defined benefit pension plans.

However, plan sponsors of CBPs, as well as plan sponsors of the conventional defined benefit pension plans, bear the investment risk, which means they will bear the additional burden when a significant drop in funding levels occurs, because the yield curve used doesn't completely synchronize with the investment results though the benefits by CBP change according to the yield curve.

1.2. Deterioration in the Investment Environment of Recent Years and Review of Risk Sharing

There are two main events (as below), which characterize the deterioration in the investment environment of recent years. In relation to these events, there is a movement to review the risk sharing between plan sponsor and employee.

- The "Perfect Storm", which occurred from 2000 to 2002; and
- The so-called "once in a century" worldwide recession borne out of the " Subprime

Crisis” and the “Lehman Shock” which occurred from 2007 to 2008.

1.2.1. Review of Risk Sharing after the Perfect Storm

The enactment of the DB Act and the DC Act was largely a reaction to the Perfect Storm. However, the only two reforms to be carried out, to date, in terms of reviewing the risk sharing, are the following:

- the addition of DC as a pension scheme option;
- the addition of CBP as benefit type option in DB.

We have seen some progress in the sense that employees may now bear investment risk, however, under the pension choices now available, we see the emergence of an extreme situation whereby, the burden of risk is either wholly borne by one of the plan sponsor or employees. The risk sharing of investment risk has been achieved between the plan sponsor and employees by simultaneous use of CBP (in DB) and DC. However, the two pension schemes are managed according to the DB and DC Acts respectively, and they are not managed as the same scheme.

1.2.2. Review of Risk Sharing after the Lehman Shock

The investment environment has been deteriorating starting with Subprime Crisis in 2007, and it has developed into the “once in a century” worldwide recession as a result of Lehman Shock in 2008. In our country, there are a lot of corporate pension plans whose actual rates of investment return showed losses of more than 20% for fiscal 2008. In such a situation, to make up for the shortfall, plan sponsors will be required to pay an additional burden and the future of the existing pension plans is “in doubt” as long as this shortfall exists. CBPs are no exception. Therefore, in CBPs, the review of the risk sharing of investment risk between plan sponsor and employees is a pressing need.

A report by the Japanese Society of Certified Pension Actuaries (JSCPA), entitled, “Expansion of the Hybrid-type Pension Plan in our Country,” published in April of 2009, makes current research results public, and suggests some new hybrid-type pension plans with the review of risk sharing as their main objective.

In this paper, I consider “Benchmark Related Pension Plans (BRPs),” which reviewed the risk sharing in CBP.

2. CBP and the Structure of NAC in our Country

2.1. NAC and Benefits (Lump-sum and Annuity)

2.1.1. Benefits (Lump-sum and Annuity) in Conventional Defined Benefit Pension Plans

In our country, it is generally accepted that a part of (or all) retirement benefit (i.e., lump-sum) promised under the work rules (namely, retirement allowance regulations) are transferred to corporate pension plan. And, it is generally accepted that the amount of the retirement benefit (lump-sum) promised under the work rules is different according to the resignation reason. For instance, in many cases, the amount of the lump-sum provided when resigning due to personal preference, is less than that which is provided when resigning due to circumstances beyond the employee's control (e.g., death, mandatory retirement). (Therefore, in CBPs of our country, the amount of the lump-sum does not necessarily correspond to NAC (as below).) This rule gives the appearance of offering preferential treatment to those who serve longer terms. A penalty has been imposed on the person who resigns for his/her own convenience without fulfilling a certain period of service demanded by the plan sponsor. Moreover, the case to surcharge the amount of the lump-sum exists in no small way at the retirement due to the death. For purposes of simplification, we will now present our information on the assumption that the amount of benefits does not depend on the resignation reason.

In conventional defined benefit pension plans, the amount of the annuity is decided based on the amount of the lump-sum at the time of the resignation. The general method for deciding the amount of the annuity is as follows:

the deferred interest on the lump-sum at the time of resignation is added to this lump-sum until the commencement of the annuity payments.

the annuity is the amount obtained by dividing the lump-sum, at the commencement of the annuity payments by the annuity current price rate, based on a guaranteed period and guaranteed interest rate (annuity conversion rate).

And, in the case of whole life annuity with a guaranteed period, in general, the annuity calculated as above is paid the same as before the guaranteed period.)

2.1.2. NAC and Lump-sum

The CBP defines the promised employee benefit by a reference to a notional account balance (NAC). An employee's NAC is increased with periodic (e.g., every month) notional principal credits and notional fixed and/or variable interest credits. It accumulates to the resignation of the notional principal credit, and it accumulates the interest credit until the commencement of the annuity payments. For instance, the notional principal credit is 5% of the salary every month. Upon resignation, usually

with more than 3 years of service, the employee is entitled to the lump-sum amount of his/her NAC.

2.2. Revaluation Rate

The decision method in CBPs is similar to the one in conventional defined benefit pension plans. It is general that the annuity is the amount obtained by dividing the NAC, at the commencement of the annuity payments, current price rate based on a guaranteed period and fixed and/or variable interest rate (annuity conversion rate). The rate used to calculate the NAC and the amount of the annuity is called the “revaluation rate”, and is chosen chiefly by the plan sponsor. The revaluation rate can be different for each of the following three periods:

- for the first day of employment up to the resignation (Part of the DB act was revised in March, 2009, and it became permissible to use a different revaluation rate for every period of service);
- From the resignation to the commencement of the annuity payments;
- after the commencement of the annuity payments.

The revaluation rate that can be used in our country can be chosen from one of four legally-recognized options, provided that the resulting rate doesn't fall below zero.

Fixed rate

The interest rate of the government bond, or another objective index that it is possible to forecast reasonably

Combination of and

or , provided that this choice dose not go beyond the upper or lower bounds (which have been set by the plan sponsor)

In many cases, the yield of the government bond is used, though the national consumer price index and the wage rate index are stipulated in the law “examples of objective indexes that it is possible to forecast reasonably”.The reasons for this selection are as follows:

There is a high correlation between the interest rate of the government bond and the discount rate used in the calculation of the PBO. This results in the mitigation of the volatility of PBO.

When the interest rate falls, the benefits by CBPs will become small in comparison with the conventional defined benefit pension plans.

2.3. Structure of NAC

NAC is composed of the accumulated amount of the notional principal credit and the accumulated amount of the interest credit as stated above. The accumulated amount of the notional principal credit increases in direct proportion to the period of service, because it is thought that the notional principal credit is generated as a by-product of work. Therefore, the idea of decreasing is impossible.

On the other hand, the accumulated amount of the interest credit may decrease by deterioration of the investment environment, because it is thought that the interest credit is a reflection of the health of the economic environment. But, in our country, as for the current state, the accumulated amount of the interest credit doesn't decrease, because the interest credit every single fiscal year becomes 0 or more due to the restriction of the revaluation rate.

In addition, in CBP, which the revaluation rate equals the sum of the fixed rate and the variable rate, we may think that the fixed rate portion of the interest credit is generated as a by-product of work.

3. Structure of Risk Sharing

3.1. Risks in Pension Plan

There are a variety of risks in pension plans. In the following, I explain separately the risks thought to be important in this paper and other risks that are not as relevant.

3.1.1. Important Risks (in this paper)

Risks thought to be important in this paper are investment risk and longevity risk.

3.1.1.1. Investment Risk

In DB, this risk is that the plan sponsor might be required to pay an additional burden when rates of investment return (RORs) fall below the expected ROR assumed in contribution calculations. In DC, this risk is that the employee's future benefit might become smaller than expected when the actual RORs fall below the expected RORs.

3.1.1.2. Longevity Risk

This risk is also called the "Annuity Conversion Risk". From the point of view of the plan sponsor, this risk is that the actual amount of annuities every year exceeds the amount of the expectation when the results mortality rate to fall below the expected one because the annuitants live long. (This risk mainly occurs in the case of whole life

annuity.) From the point of view of employees and pension recipients (including persons who are waiting for the commencement of the annuity payments) , this risk is that the original capital for old age is insufficient when they live longer than one expects and that financial capital to maintain their livelihoods in old age might need to be increased. (This risk mainly occurs in the case of temporary annuity.)

3.1.2. Other Risks

The following risks exist in addition to above-mentioned risks.

3.1.2.1. Mortality Rate Improvement Risk

This risk is that the plan sponsor might be required to pay an additional burden when mortality rates might improve beyond expectation and future benefits might be higher than expected. (The liability of the one increases, and the funding levels decrease.) In our country, mortality rates assumed in contribution calculations improve every 5 years.

3.1.2.2. Earnings Increase Risk

This risk is that the plan sponsor might be required to pay an additional burden when earnings increase faster than expected and future benefits are higher than expected. This risk becomes larger in final earnings pension plans. From the point of view of pension recipients, this risk is that the income substitution rate for the real wages might fall when the wage of active employees rises. From the point of view of employees, this risk is that the income substitution rate for the real wages might fall when the wage growth rate is less than the inflation rate.

3.1.2.3. Inflation Risk

This risk is that the real value of benefits might be reduced due to inflation, and this risk becomes large in such cases where the amounts of benefits are proportionate to one's career average earnings and past earnings are not revalued.

3.1.2.4. Default Risk

This risk is that the rights of participants (employees and pension recipients) to receive benefits might be partially or completely lost when the plan sponsor (i.e., the corporation) becomes insolvent and the pension plan is forced to be terminated or to be dissolved.

Benefits of participants are reduced due to shortfalls and other reasons, though pension plans are externally funded

3.2.Risk Sharing in CBP

In relation to the above-mentioned risks in CBP, it is thought that two points (the investment risk and the earnings increase risk) are improved in comparison to the final earnings pension plan. When the economic environment turns bad, the benefits by CBPs will become small in comparison with the conventional defined benefit pension plans. Therefore, from the point of view of the plan sponsor, the investment risk is reduced. If the revaluation rate (of CB plans) consecutively does not fall below the consumer price index, the earnings increase risk is reduced.

4. Examination of New Pension Plan due to the Review of Risk Sharing

The JSCPA reviewed risk sharing of CBP in the report published in April of 2009 and suggested BRPs.

4.1.Structure of BRP

The main differences between the BRP and the CBP are as follows:

- a different index can be used as the revaluation rate;
- the presence of a lower bound for NAC; and
- a different of method for deciding the amount of the annuity.

4.1.1. Revaluation Rate in BRP

In CBPs, as we have said above, the revaluation rate has conditions such as, “don't fall below zero,” etc. But, in BRPs, we abolish the lower bound of the revaluation rate (i.e., zero) and can use a combined benchmark index rate of return (CBROR). When the CBROR is provided in the BRP, the following content is decided between the plan sponsor and employees:

- asset allocation;
- the selection of index in each asset class.

A representative example of an index in each asset class is as follows:

- Domestic bonds: Nomura-BPI
- Domestic stocks: TOPIX (dividend reinvested)
- International bonds: Composite index of Citigroup World Government Bond Index (excluding Japan, yen denominated, no hedge)
- International stocks: Morgan Stanley Capital International (MSCI)-KOKUSAI (yen denominated, gross dividend reinvested)
- Short-term assets: One-month repo rate of Treasury bill

It is thought that the plan sponsor should bring the real asset allocation as close to the decided asset allocation as possible to suppress the investment risk.

4.1.2.NAC in BRP

The BRP defines the promised employee benefit by reference to NAC. And NAC of BRP is composed of the accumulated amount of the notional principal credit and the accumulated amount of the interest credit. Both of these are the same under the CBP.

4.1.2.1 Lower Bound of NAC

The revaluation rate might be able to be less than zero because it uses CBROR as one. Therefore, there is a possibility of greatly decreasing NAC even if it is a single fiscal year. However, we don't permit the NAC of BRPs to be less than the accumulated amount of the notional principal credit at the time of the resignation (i.e., the accumulated amount of the interest credit at the time of the resignation can't be less than zero), because it is thought that the notional principal credit is generated as a by-product of work in BRP, much like the CBP. Therefore, this means that the accumulated amount of the interest credit is rounded up to zero when it falls below zero at the time of the resignation. Furthermore, it is always rounded up to zero when it falls below zero at the commencement of annuity payments.

In this paper, it is assumed that the accumulated amount of the interest credit will be rounded up once at the time of the resignation, because it is important to maintain the balance between the benefit of the person who DOES select the future annuity payments and the benefit of the person who dose NOT (i.e., the person who selects the lump-sum payment at the time of the resignation). Opinions might be divided on the necessity of rounding up to zero at the time of the resignation.

4.1.2.2.How to Calculate NAC in BRP

How to calculate NAC in BRP is as follows.

- From the first day of employment up to the commencement of the annuity payments

NAC (at the end of fiscal year)

$$= \text{NAC (at the end of previous fiscal year)} \times (1+r)$$

+ the accumulated amount of the notional principal credit (for fiscal year)

r = revaluation rate

NAC (notional principal credit, at the end of fiscal year)

= the accumulated amount of the notional principal credit(From the first day of

employment up to the end of fiscal year)
NAC (interest credit, at the end of fiscal year)

= NAC (at the end of fiscal year)

- NAC (notional principal credit, at the end of fiscal year)

In addition, from the resignation to the commencement of the annuity payments, the notional principal credit is zero. And when the accumulated amount of the interest credit at the time of the resignation or at the commencement of the annuity payments falls below zero, it is rounded up to zero.

• After the commencement of the annuity payments

NAC (at the end of the current fiscal year)

= NAC (at the end of previous fiscal year) \times (1+r)

- the accumulated amount of the annuity (for the current fiscal year)

NAC (notional principal credit part, at the end of fiscal year)

= NAC (notional principal credit part, at the end of previous fiscal year)

- Annuity (notional principal credit part, for the current fiscal year)

NAC (interest credit, at the end of fiscal year)

= NAC (at the end of fiscal year)

- NAC (notional principal credit, at the end of fiscal year)

In addition, when the accumulated amount of the interest credit at the end of the current fiscal year falls below zero, after the end of the current fiscal year the accumulated amount of the interest credit equals zero.

4.2.Method for Deciding the Amount of the Annuity

The annuity conversion rate in both the CBP and the BRP is the revaluation rate. But, in the BRP, the annuity conversion rate isn't permitted to use the CBROR, because the high volatility of the CBROR would cause the annuity to fluctuate too much. In this case, annuitants might not find a sure means of making a living. It is thought that most annuitants naturally want to keep the amount of their annuity constant.

In the BRP, much like the CBP, the annuity is the amount obtained by dividing the NAC (at the commencement of the annuity payments) by an annuity current price rate, based on a guaranteed period and the revaluation rate (annuity conversion rate). And, periodically, annuity is recalculated. The annuity conversion rate functions like a valve to adjust the amount of the annuity paid from the NAC. In addition, the amount of the guaranteed minimum annuity is calculated, based on the NAC at the commencement of

the annuity payments, as follows and doesn't change. If the accumulated amount of the interest credit at the end of the current fiscal year falls below zero, the annuity changes the guaranteed minimum annuity.

Lowest guarantee annuity

= the accumulated amount of the notional principal credit (at the commencement of the annuity payments)

/ the guaranteed period

Dividing by the guaranteed period means that annuity conversion rate will be zero percent.

(There are examples of amount of annuity changing in the Appendix.)

5. Examination Problems in the Future in the BRP

As reviewing of risk sharing of Investment risk in CBP, I considered BRP in the above-mentioned. But, In the BRP, there will be examination problems in the future.

5.1. Correspondence of the fluctuation of benefit by economic environment before the time of resignation

The amount of benefit decreases greatly if the economic environment before the time of resignation turns bad. The size of the change in amount of benefit increases in direct proportion to the period of service, because the amount of benefit increases in direct proportion to the period of service.

As a countermeasure, it is thought that the asset allocation used to calculate CBROR be changed according to age (e.g., over a certain age). (The proportion of high-risk assets decreases in direct proportion to the age of the employee.) However, it is necessary to pay attention that the NAC not become too complex. And if we don't pay attention to the investment method, investment risk may increase.

5.2. Lower Bound of NAC (at The Time of Resignation) and Annuity

When changing from the current pension plan to the BRP, the employee's benefit might be reduced. In this case, benefit reduction from the current pension plan can be avoided, because the lower bound of NAC (at the time of resignation) and the annuity (i.e., guaranteed minimum benefit) are paid if the current pension plan is continued. However, the effectiveness of the change may be reduced if the benefit level of the BRP is too low because, as above, many employees under the BRP receive the guaranteed minimum benefit.

5.3. Method for Calculating Liability in Pension Financing and Retirement Benefit Accounting

It is necessary to devise a method for calculating the liability in pension financing and the retirement benefit accounting. The method for setting the revaluation rate in the calculation and a method for reflecting the liability of the guaranteed minimum benefit, are examination problems for the future though it is thought that the calculation method in CBP will be the basis.

5.4. Further review of risk sharing

As stated above, in our country, it is generally accepted that a part of (or all) retirement benefit (i.e., lump-sum) promised under the work rules (namely, retirement allowance regulations) is transferred to a corporate pension plan. Therefore, in many cases, the annuity of the corporate pension plan is a temporary annuity. In the case of a whole life annuity with a guaranteed period, generally the annuity paid during the guaranteed period is calculated base on the lump-sum and the amount of annuity paid thereafter is the same as before the guaranteed period.

This means that the plan sponsor bears an additional liability for the benefits after this period. Therefore, in corporate pension plans, a whole life annuity is not necessarily generally widespread.

On the other hand, it is thought that a whole life annuity is important to ensure that the average life span may keep rising in our country, and to support the employee's life at old age. One solution is to provide an annuity such that the whole life annuity is equal in value to the lump-sum principal. As a result, the longevity risk is transferred from the employees (annuitant in the future) to the plan sponsor though the employees should accept a decrease in the amount of the annuity.

To achieve this, it is necessary to establish the computational method of NAC after the commencement of the annuity payments and the scheme to decide and to revise the amount of the annuity. Moreover, a mortality rate improvement risk is generated from to a whole life annuity. It is necessary to note that the plan sponsor may bear this risk, if the amount of the annuity is not revised to reflect an improvement in the mortality rate.

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Appendix Example of Amount of Annuity Changing in BRP

Example1

**Method for Deciding the Amount of the Annuity : This Paper's Method
(Temporary Annuity(guaranteed period : 15 years))**

Year	Rest of year (at end of previous year)	ROR	NAC (at end of previous year)			Annuity (per year)			
			Notional principal credit part	Interest credit part	Total	Notional principal credit part	Interest credit part	Total	
1	15	3.0%	1,500,000	1,500,000	3,000,000	100,000	128,898	228,898	
2	14	3.0%	1,400,000	1,461,102	2,861,102	100,000	131,699	231,699	
3	13	3.0%	1,300,000	1,415,236	2,715,236	100,000	134,571	234,571	
4	12	3.0%	1,200,000	1,362,122	2,562,122	100,000	137,523	237,523	
5	11	3.0%	1,100,000	1,301,463	2,401,463	100,000	140,565	240,565	
6	10	3.0%	1,000,000	1,232,942	2,232,942	100,000	143,711	243,711	
7	9	3.0%	900,000	1,156,219	2,056,219	100,000	146,979	246,979	
8	8	3.0%	800,000	1,070,927	1,870,927	100,000	150,392	250,392	
9	7	3.0%	700,000	976,663	1,676,663	100,000	153,985	253,985	
10	6	3.0%	600,000	872,978	1,472,978	100,000	157,808	257,808	
11	5	3.0%	500,000	759,359	1,259,359	100,000	161,945	261,945	
12	4	3.0%	400,000	635,195	1,035,195	100,000	166,536	266,536	
13	3	3.0%	300,000	499,715	799,715	100,000	171,868	271,868	
14	2	3.0%	200,000	351,838	551,838	100,000	178,651	278,651	
15	1	3.0%	100,000	189,742	289,742	100,000	189,742	289,742	
							minmum:	128,898	
							maximum:	189,742	
							average:	152,992	

Note:

NAC(Total, at end of year)
 = NAC(Total, at end of previous year) × (1 + ROR) - Annuity(Total)
 NAC(Notional principal credit part, at end of year)
 = NAC(Notional principal credit part, at end of previous year)
 - Annuity(Notional principal credit part)
 NAC(Interest credit part, at end of year)
 = NAC(Total, at end of year)
 - NAC(Notional principal credit part, at end of year)
 Annuity(Total)
 = NAC(Total, at end of previous year) / Current price rate(*),
 *Guaranteed period : Rest of year at end of previous year
 Annuity conversion rate : 2.0%
 If NAC(Interest credit part, at end of previous year) falls below zero,
 Annuity(Total) = Annuity(Notional principal credit part)
 Annuity(Notional principal credit part) [Lowest guarantee annuity]
 = NAC(Notional principal credit part, at at commencement of the annuity payments)
 / Guaranteed period (15 year)
 Annuity(Interest credit part)
 = Annuity(Total) - Annuity(Notional principal credit part)

Example2

**Method for Deciding the Amount of the Annuity : JSCPA Report's Method
(Temporary Annuity(guaranteed period : 15 years))**

Year	Rest of year (at end of previous year)	ROR	NAC (at end of previous year)			Annuity (per year)		
			Notional principal credit part	Interest credit part	Total	Notional principal credit part	Interest credit part	Total
1	15	3.0%	1,500,000	1,500,000	3,000,000	100,000	100,000	200,000
2	14	3.0%	1,400,000	1,490,000	2,890,000	100,000	106,429	206,429
3	13	3.0%	1,300,000	1,470,271	2,770,271	100,000	113,098	213,098
4	12	3.0%	1,200,000	1,440,281	2,640,281	100,000	120,023	220,023
5	11	3.0%	1,100,000	1,399,466	2,499,466	100,000	127,224	227,224
6	10	3.0%	1,000,000	1,347,226	2,347,226	100,000	134,723	234,723
7	9	3.0%	900,000	1,282,920	2,182,920	100,000	142,547	242,547
8	8	3.0%	800,000	1,205,861	2,005,861	100,000	150,733	250,733
9	7	3.0%	700,000	1,115,304	1,815,304	100,000	159,329	259,329
10	6	3.0%	600,000	1,010,434	1,610,434	100,000	168,406	268,406
11	5	3.0%	500,000	890,341	1,390,341	100,000	178,068	278,068
12	4	3.0%	400,000	753,983	1,153,983	100,000	188,496	288,496
13	3	3.0%	300,000	600,106	900,106	100,000	200,035	300,035
14	2	3.0%	200,000	427,074	627,074	100,000	213,537	313,537
15	1	3.0%	100,000	232,349	332,349	100,000	232,349	332,349
							minmum:	100,000
							maximum:	232,349
							average:	155,666

Note:

$$\begin{aligned} & \text{NAC(Total, at end of year)} \\ &= \text{NAC(Total, at end of previous year)} \times (1 + \text{ROR}) - \text{Annuity(Total)} \\ & \text{NAC(Notional principal credit part, at end of year)} \\ &= \text{NAC(Notional principal credit part, at end of previous year)} \\ & \quad - \text{Annuity(Notional principal credit part)} \\ & \text{NAC(Interest credit part, at end of year)} \\ &= \text{NAC(Total, at end of year)} \\ & \quad - \text{NAC(Notional principal credit part, at end of year)} \\ & \text{Annuity(Total)} \\ &= \text{Annuity(Notional principal credit part)} + \text{Annuity(Interest credit part)} \\ & \text{Annuity(Notional principal credit part)} \\ &= \text{NAC(Notional principal credit part, at end of previous year)} \\ & \quad / \text{Rest of year(at end of previous year)} \\ & \text{Annuity(Interest credit part)} \\ &= \max \{ 0, (\text{NAC(Interest credit part, at end of previous year)} \\ & \quad / \text{Rest of year(at end of previous year)}) \} \end{aligned}$$

Example3

**Method for Deciding the Amount of the Annuity : This Paper's Method
(Temporary Annuity(guaranteed period : 15 years))**

Year	Rest of year (at end of previous year)	ROR	NAC (at end of previous year)			Annuity (per year)		
			Notional principal credit part	Interest credit part	Total	Notional principal credit part	Interest credit part	Total
1	15	-10.0%	1,500,000	1,500,000	3,000,000	100,000	128,898	228,898
2	14	-10.0%	1,400,000	1,071,102	2,471,102	100,000	100,116	200,116
3	13	-10.0%	1,300,000	723,876	2,023,876	100,000	74,844	174,844
4	12	-10.0%	1,200,000	446,644	1,646,644	100,000	52,653	152,653
5	11	-10.0%	1,100,000	229,327	1,329,327	100,000	33,165	133,165
6	10	-10.0%	1,000,000	63,229	1,063,229	100,000	16,045	116,045
7	9	-10.0%	900,000	0	900,000	100,000	0	100,000
8	8	-10.0%	800,000	0	800,000	100,000	0	100,000
9	7	-10.0%	700,000	0	700,000	100,000	0	100,000
10	6	-10.0%	600,000	0	600,000	100,000	0	100,000
11	5	-10.0%	500,000	0	500,000	100,000	0	100,000
12	4	-10.0%	400,000	0	400,000	100,000	0	100,000
13	3	-10.0%	300,000	0	300,000	100,000	0	100,000
14	2	-10.0%	200,000	0	200,000	100,000	0	100,000
15	1	-10.0%	100,000	0	100,000	100,000	0	100,000
							minnum:	0
							maximum:	128,898
							average:	27,048

Note:

NAC(Total, at end of year)
 = NAC(Total, at end of previous year) × (1 + ROR) - Annuity(Total)
 NAC(Notional principal credit part, at end of year)
 = NAC(Notional principal credit part, at end of previous year)
 - Annuity(Notional principal credit part)
 NAC(Interest credit part, at end of year)
 = NAC(Total, at end of year)
 - NAC(Notional principal credit part, at end of year)
 Annuity(Total)
 = NAC(Total, at end of previous year) / Current price rate(*),
 *Guaranteed period : Rest of year at end of previous year
 Annuity conversion rate : 2.0%
 If NAC(Interest credit part, at end of previous year) falls below zero,
 Annuity(Total) = Annuity(Notional principal credit part)
 Annuity(Notional principal credit part) [Lowest guarantee annuity]
 = NAC(Notional principal credit part, at at commencement of the annuity payments)
 / Guaranteed period (15 year)
 Annuity(Interest credit part)
 = Annuity(Total) - Annuity(Notional principal credit part)

Example4

**Method for Deciding the Amount of the Annuity : JSCPA Report's Method
(Temporary Annuity(guaranteed period : 15 years))**

Year	Rest of year (at end of previous year)	ROR	NAC (at end of previous year)			Annuity (per year)		
			Notional principal credit part	Interest credit part	Total	Notional principal credit part	Interest credit part	Total
1	15	-10.0%	1,500,000	1,500,000	3,000,000	100,000	100,000	200,000
2	14	-10.0%	1,400,000	1,100,000	2,500,000	100,000	78,571	178,571
3	13	-10.0%	1,300,000	771,429	2,071,429	100,000	59,341	159,341
4	12	-10.0%	1,200,000	504,945	1,704,945	100,000	42,079	142,079
5	11	-10.0%	1,100,000	292,372	1,392,372	100,000	26,579	126,579
6	10	-10.0%	1,000,000	126,556	1,126,556	100,000	12,656	112,656
7	9	-10.0%	900,000	1,244	901,244	100,000	138	100,138
8	8	-10.0%	800,000	0	800,000	100,000	0	100,000
9	7	-10.0%	700,000	0	700,000	100,000	0	100,000
10	6	-10.0%	600,000	0	600,000	100,000	0	100,000
11	5	-10.0%	500,000	0	500,000	100,000	0	100,000
12	4	-10.0%	400,000	0	400,000	100,000	0	100,000
13	3	-10.0%	300,000	0	300,000	100,000	0	100,000
14	2	-10.0%	200,000	0	200,000	100,000	0	100,000
15	1	-10.0%	100,000	0	100,000	100,000	0	100,000

minmum:	0
maximum:	100,000
average:	21,291

Note:

$$\begin{aligned}
 & \text{NAC(Total, at end of year)} \\
 &= \text{NAC(Total, at end of previous year)} \times (1 + \text{ROR}) - \text{Annuity(Total)} \\
 & \text{NAC(Notional principal credit part, at end of year)} \\
 &= \text{NAC(Notional principal credit part, at end of previous year)} \\
 & \quad - \text{Annuity(Notional principal credit part)} \\
 & \text{NAC(Interest credit part, at end of year)} \\
 &= \text{NAC(Total, at end of year)} \\
 & \quad - \text{NAC(Notional principal credit part, at end of year)} \\
 & \text{Annuity(Total)} \\
 &= \text{Annuity(Notional principal credit part)} + \text{Annuity(Interest credit part)} \\
 & \text{Annuity(Notional principal credit part)} \\
 &= \text{NAC(Notional principal credit part, at end of previous year)} \\
 & \quad / \text{Rest of year(at end of previous year)} \\
 & \text{Annuity(Interest credit part)} \\
 &= \max \{ 0, (\text{NAC(Interest credit part, at end of previous year)} \\
 & \quad / \text{Rest of year(at end of previous year)}) \}
 \end{aligned}$$