Comparative Risk Analysis between Sponsors and Participants for the New Risk-sharing Pension Plan in Japan

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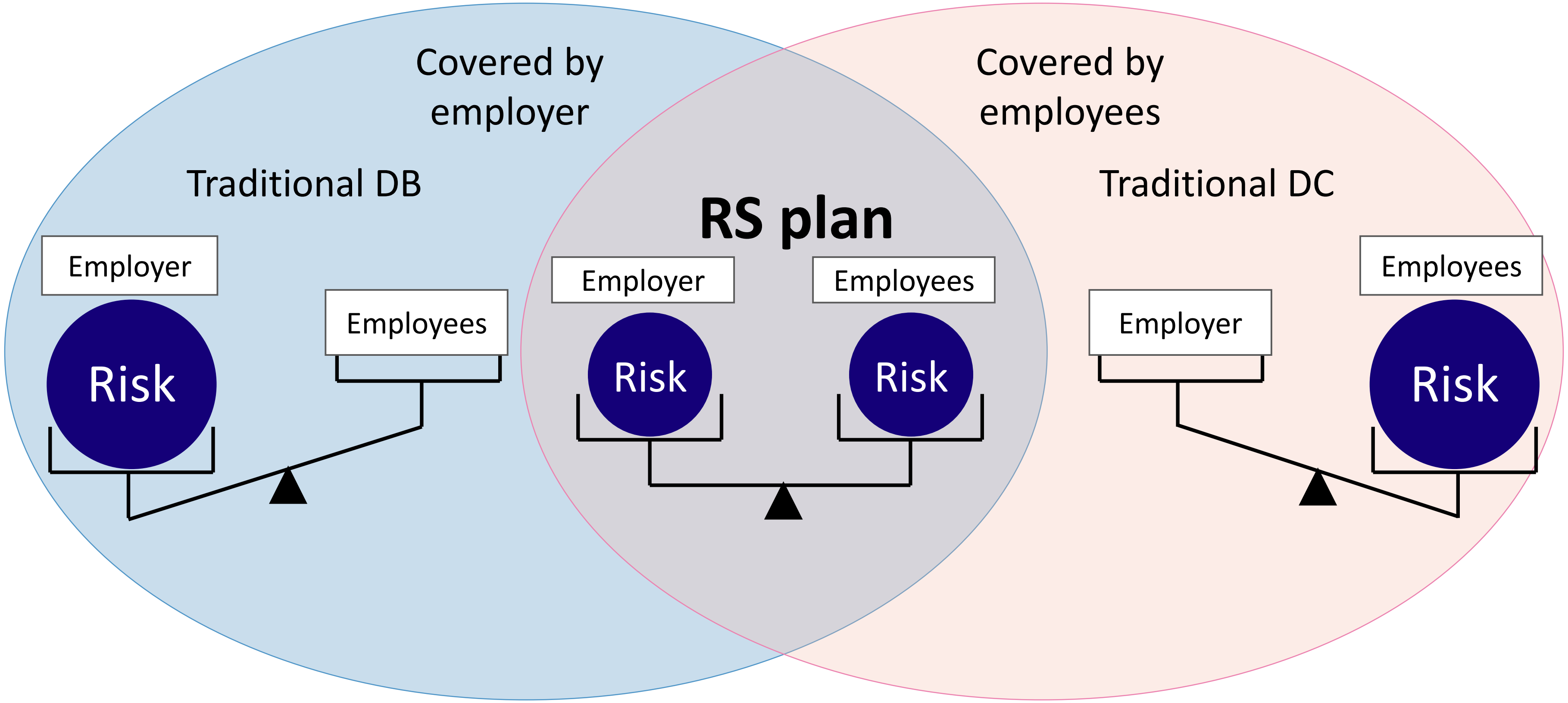
Position of the risk-sharing DB

- Risk-sharing DB (RS) was Introduced as an intermediate between the defined-benefit plan (DB) and the defined-contribution pension plan (DC)
- Employer and employees share risks



Key features of the RS plan

- pre-defined benefits may be exposed to adjustment depending on the plan’s financial status
- employers additionally contribute more than the normal contributions as a risk margin

<table>
<tr><th>Downward adjustment</th><th>No adjustment</th><th>Upward adjustment</th></tr>
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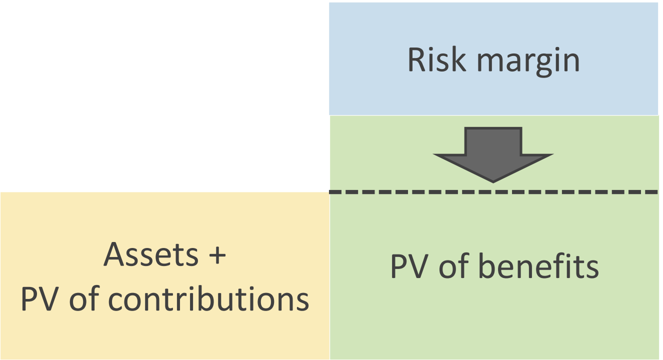
<td>
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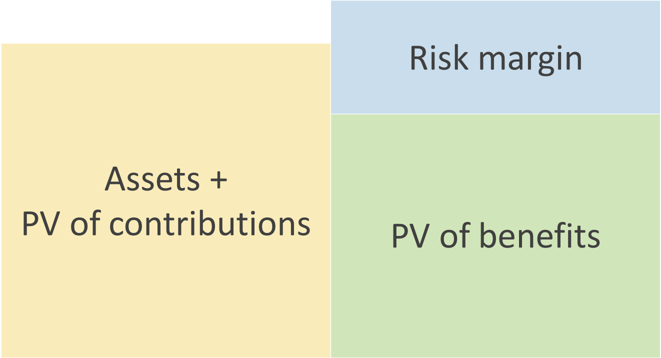
<td>
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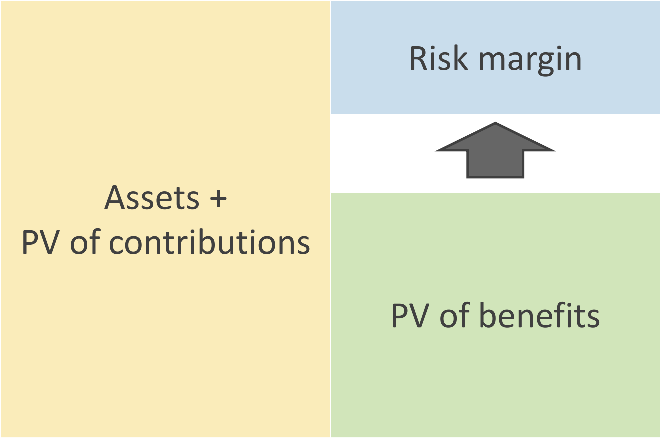
<td>
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<tr>
<td>$$\frac{\text{Assets} + \text{PV of contributions}}{\text{PV of benefits}}$$</td>
<td>$$1$$</td>
<td>$$\frac{\text{Assets} + \text{PV of contributions} - \text{Risk margin}}{\text{PV of benefits}}$$</td>
</tr>
</table>

Rules for Risk margin measurement

- There are two calculation methods prescribed by law named:
  "standard method", and "special method"

- In the standard method, the following 1 + 2
  ① The risk of asset fluctuations, defined as the risk that may occur once in 20 years
  ② The risk of declining the discount rate, specifically by 1.0%

- In the special method, include other risk occurring from liabilities
  (e.g., employee turnover and mortality)

Advantages of the RS plan

- No need for sudden additional funding

  → **Planned cash flow**

- Accounted for as DC plans under Japanese GAAP and IFRS

  → **Eliminate or reduce PBO**

- Plan assets are pooled and managed collectively

  → **Better investment performance than the DC plan**

Disadvantages of the RS plan

- Raised Contributions for a certain period after introduction
- Participants/retirees receive benefits that may be adjusted
- The mechanism of the benefit adjustment is not simple
  → This complexity makes it unclear how much risks sponsors and participants/retirees bear respectively

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Simulation Assumptions

Introduction — What is the risk-sharing DB? —

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Three approaches to reduce the risk

Simulation Assumptions (1/3)

- An age composition of the participants/retirees is time-homogeneous
- The type of formula
  - Cash balance plan
    - Hypothetical account balances = Pay credit + interest credit
    - Interest rate is fixed at 3.0% per year
    - The pension benefit is an annuity certain for 20 years
    - The lump sum death benefit is paid as the hypothetical account balances
- Risk margin
  - Standard method
    - The risk of asset fluctuations = 2.06σ of plan assets
    - The risk occurring from liability = Increase in liabilities due to 1% decrease in discount rate

Simulation Assumptions (2/3)

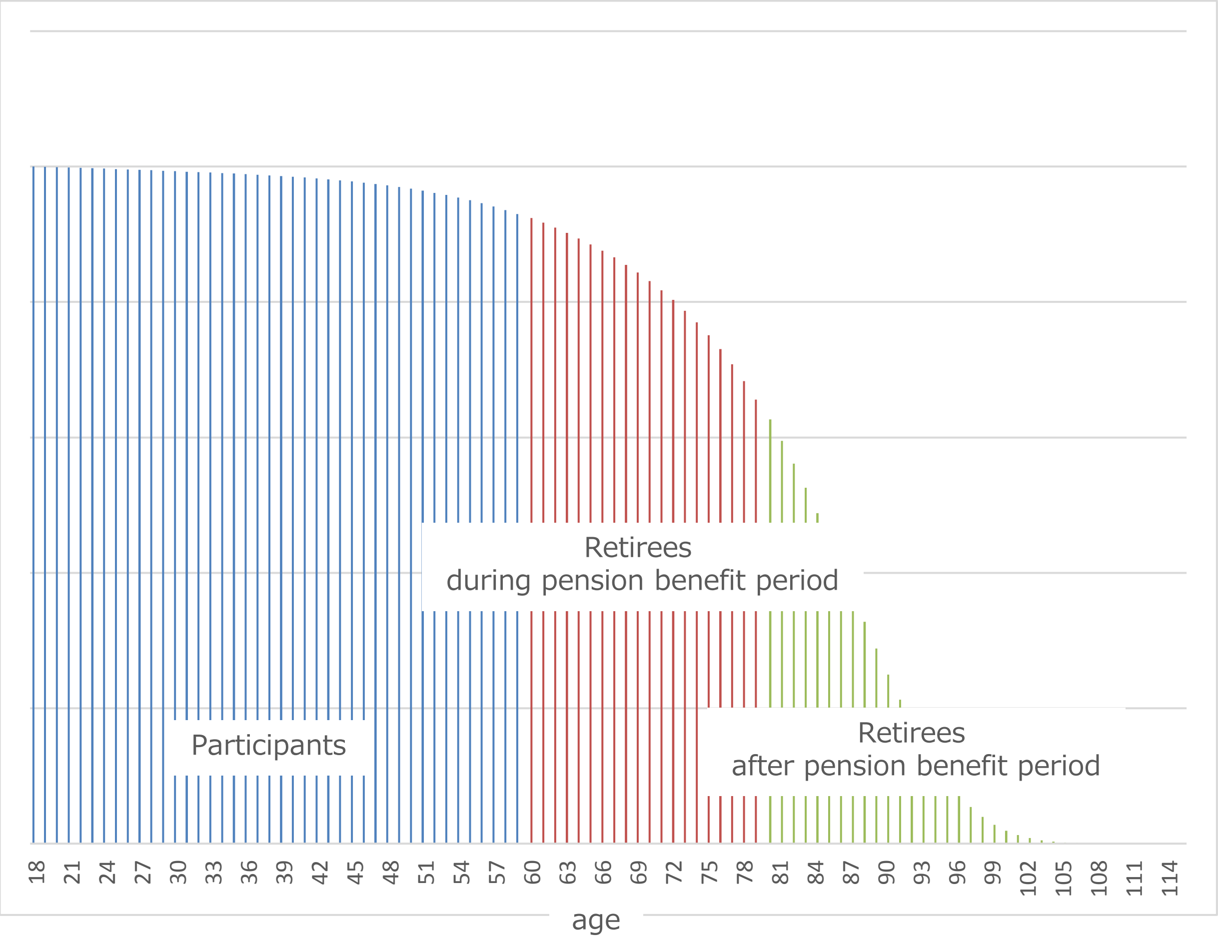
- Asset mix used in the simulation
  - Constant rebalance strategy
  - One-year return has the normal distribution of N(3.0%, 8.26%)

	Expected return	Standard deviation	DB	DS	FB	FS	GA	SA
Portfolio [A]	3.00 %	8.26 %	32.8 %	22.1 %	10.0 %	22.1 %	10.0 %	3.0 %
Portfolio [B]	4.00 %	11.14 %	16.7 %	30.2 %	10.0 %	30.2 %	10.0 %	3.0 %
Portfolio [C]	2.00 %	5.42 %	49.0 %	14.0 %	10.0 %	14.0 %	10.0 %	3.0 %

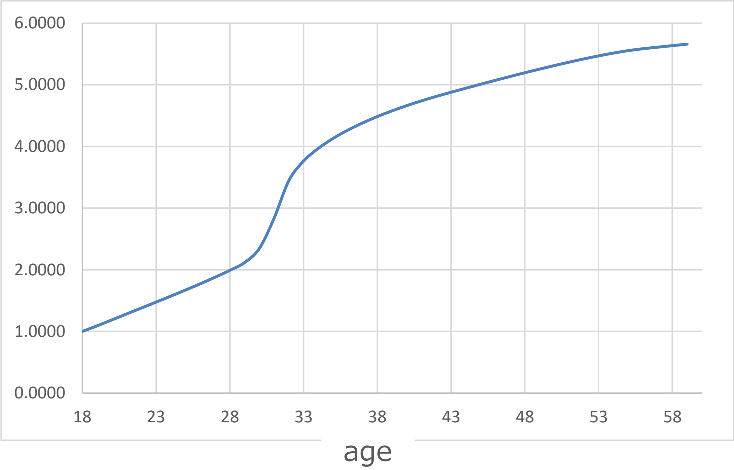
	DB	DS	FB	FS	GA	SA
Expected return	0.00 %	5.80 %	1.40 %	6.60 %	1.25 %	- 0.10 %
Standard deviation	1.80 %	18.50 %	10.00 %	18.00 %	0.00 %	0.30 %
Correlation	DB	DS	FB	FS	GA	SA
Domestic bond (DB)	1.0	-	-	-	-	-
Domestic stock (DS)	-0.3	1.0	-	-	-	-
Foreign bond (FB)	-0.3	0.7	1.0	-	-	-
Foreign stock (FS)	-0.4	0.8	0.8	1.0	-	-
General account (GA)	0.0	0.0	0.0	0.0	1.0	-
Short-term asset (SA)	-0.2	0.2	0.3	0.3	0.0	1.0

Simulation Assumptions (3/3)

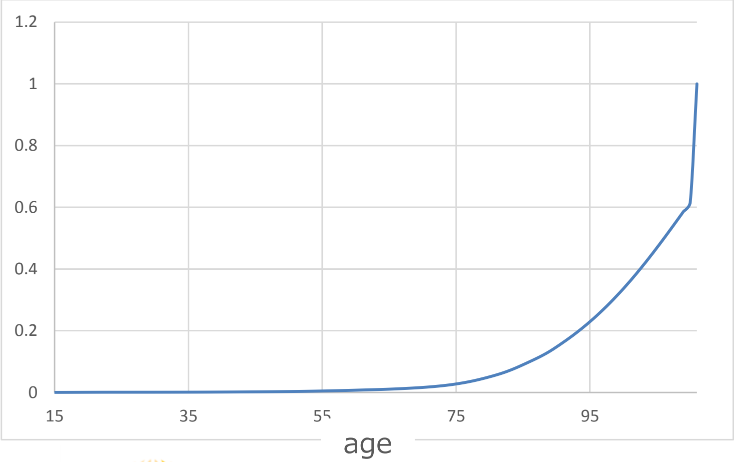
- The age composition



- Rates of salary increase



- Mortality rates



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Initial status of BS/PL

- Payments in a year are scaled to be just 100 for convenience
- It also means that the total amount of benefits which a certain generation should be paid is 100

Balance sheet

Risk margin
Estimated risk occurring from liabilities 434
Estimated risk occurring from assets 305

Present value of contributions 794

Assets 1,794

Present value of benefits 2,588

Profit and loss statement

Payments 100

Contributions 45

Investment income 55

(note 1) The contribution is paid at the beginning of each year, while the benefit is received at the end of each year

(note 2) Time-homogeneous age composition are assumed

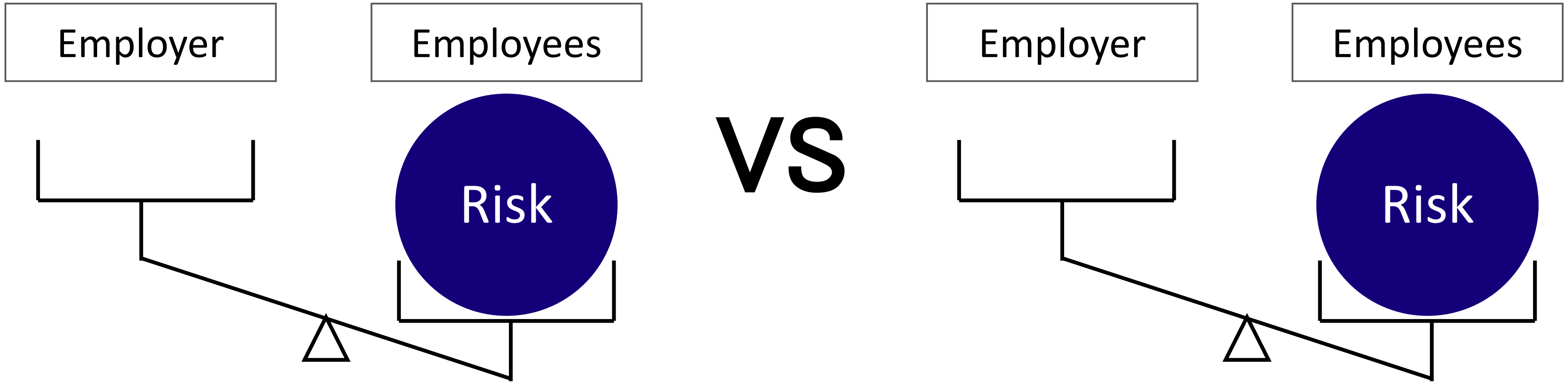
Difference in benefits among DB, DC and RS plan

Setting

- Risk-buffer contributions (contributions on top of the normal contributions in order to build up a risk buffer) are zero for the RS plan
- In this way, it can be considered that all the risks are put on participants/retirees because the additional burden of the employer is zero for the RS plan.
- In RS and DC plan, only the employees are exposed to all risks under this premise.

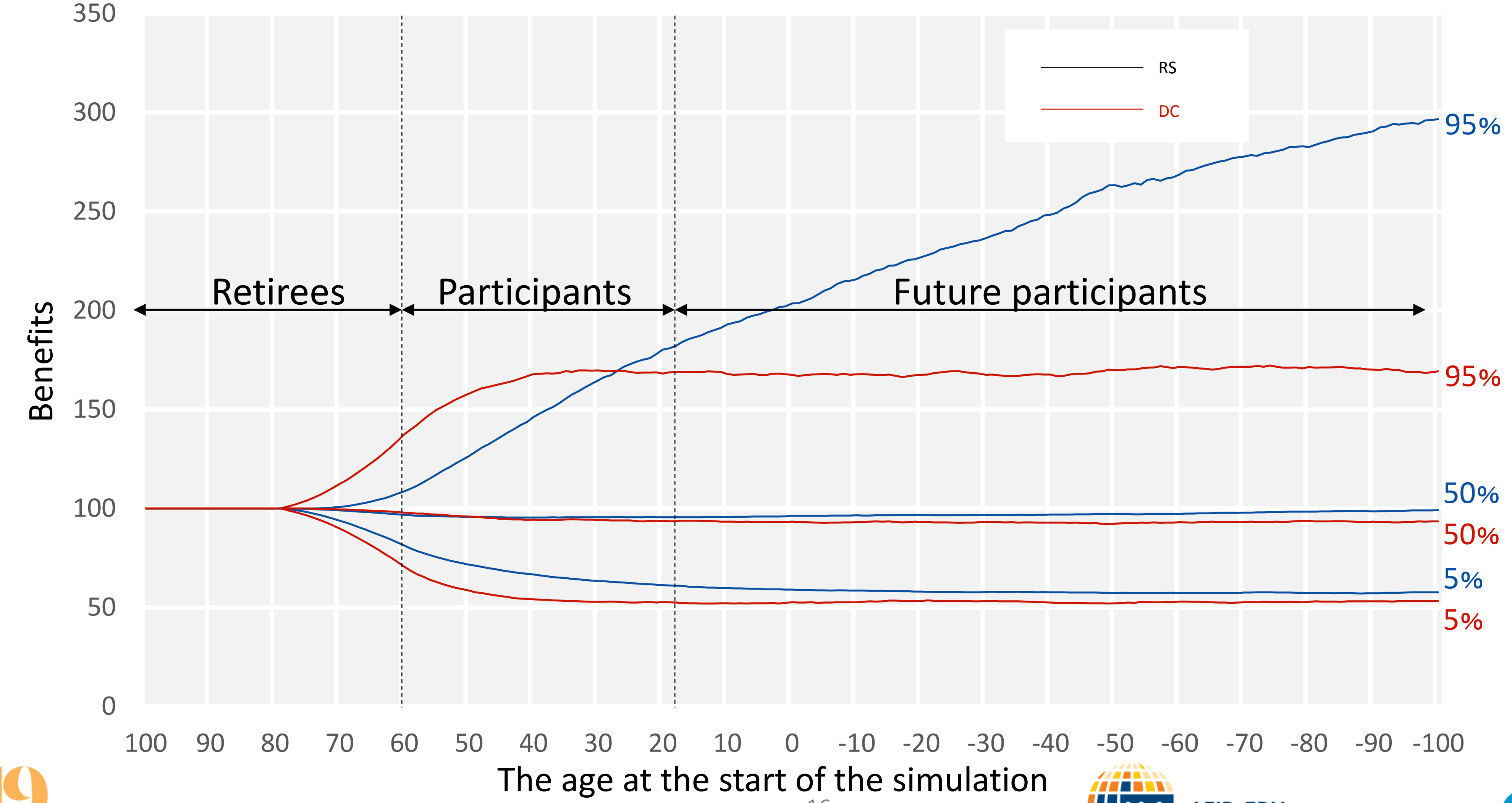
RS plan
（Risk-buffer contributions = 0）

DC

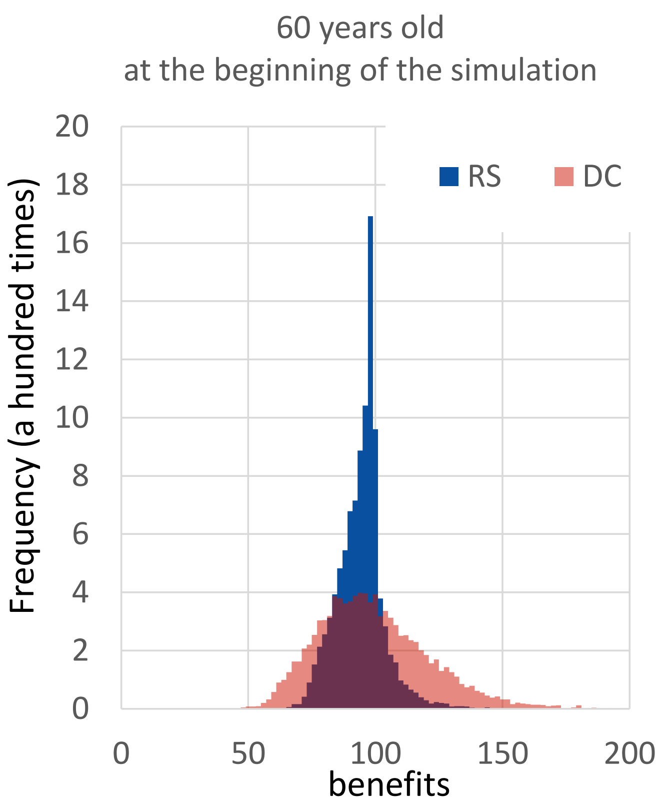


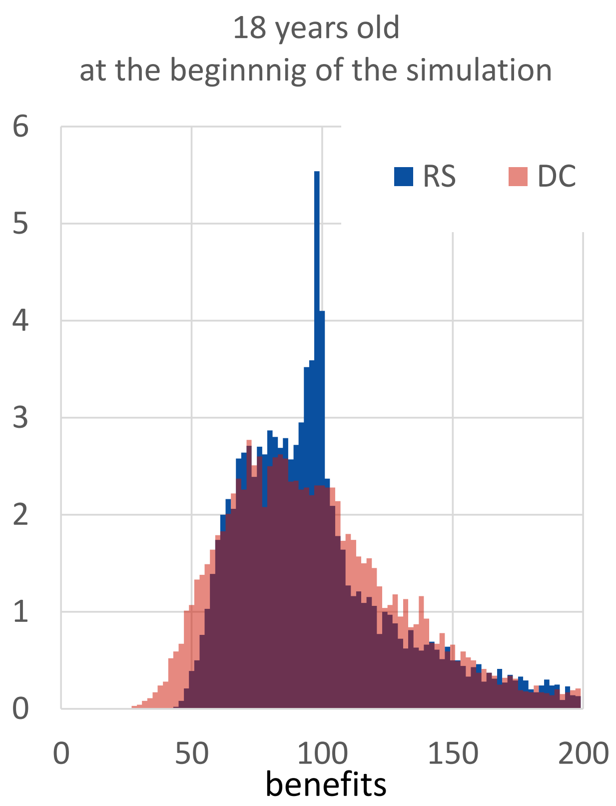
Distribution of the total amounts of benefits (1/2)

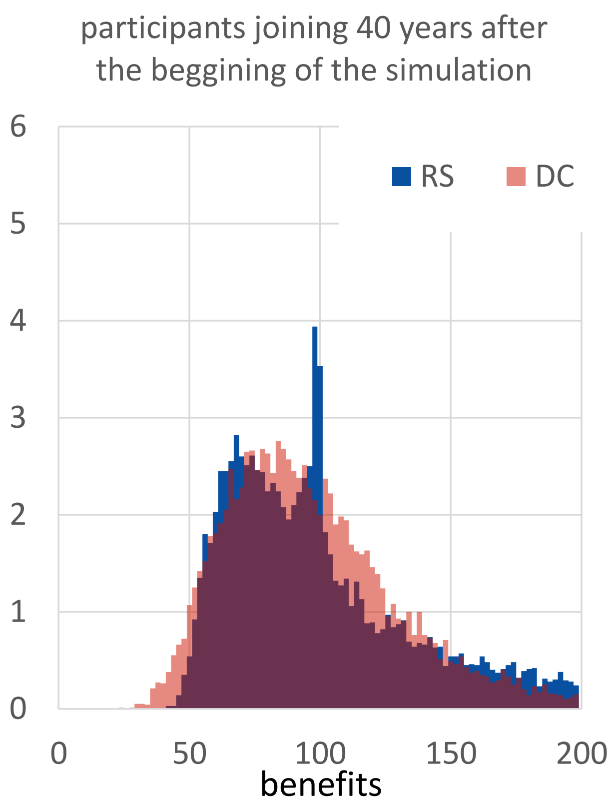
- The fluctuation range in the RS plan spreads more slowly than the DC plan



Distribution of the total amounts of benefits (2/2)







	RS	DC
mean	95.7	100.2
95% tile	108.6	137.3
50% tile	96.7	97.8
5% tile	81.3	70.5

	RS	DC
mean	103.4	99.9
95% tile	182.2	169.0
50% tile	95.5	93.5
5% tile	60.9	52.4

	RS	DC
mean	112.7	99.2
95% tile	229.1	168.3
50% tile	96.5	93.0
5% tile	57.7	53.3

Valuation of the risk covered by sponsors and participants

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Evaluation measures of risks covered by sponsor and participants

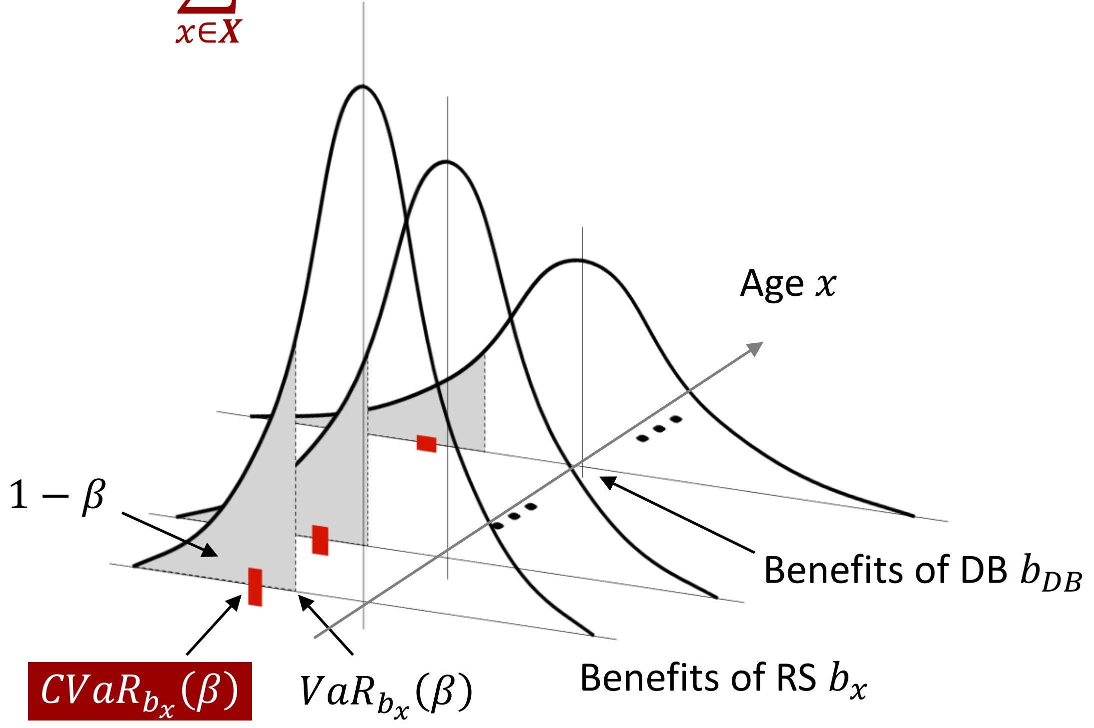
Risks covered by Sponsor

$$RS = F + PG - S$$

PV of Risk-buffer contributions	Risk margin
Assets and PV of contributions F + PG	PV of benefits S

Risks covered by participants of generation *x*

$$RP_x = \sum_{x \in \boldsymbol{X}} Max\left(b_{DB} - CVaR_{b_x}(\beta), 0\right)$$

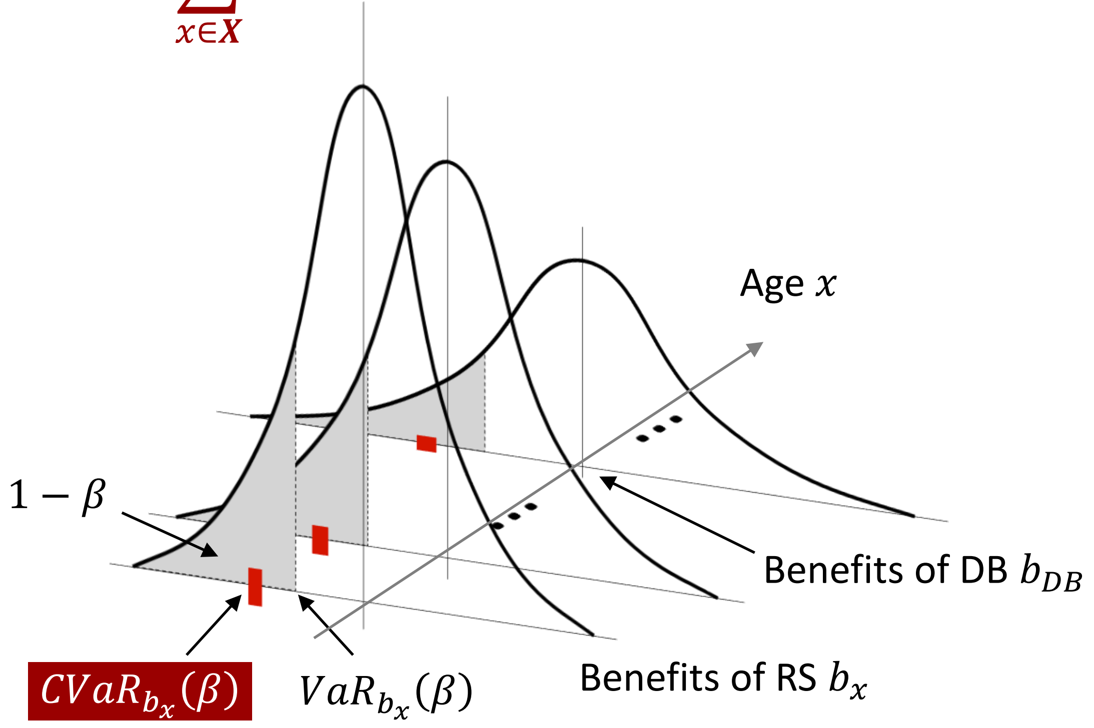


Parameters Setting

- Total amount of benefits paid to a certain generation from a DB plan is $b_{DB} = 100$
- Confidence level of CVaR is $\beta = 0.95$
- The risk covered by retirees is $RP_{\boldsymbol{R}} = \sum_{x \in \boldsymbol{R}} RP_x$, where $\boldsymbol{R} = \{x | x \geq 60\}$
- The risk covered by active participants is $RP_{\boldsymbol{P^a}} = \sum_{x \in \boldsymbol{P^a}} RP_x$, where $\boldsymbol{P^a} = \{x | 18 \leq x \leq 59\}$
- The risk covered future participants for 40 years is $RP_{\boldsymbol{P^f}} = \sum_{x \in \boldsymbol{P^f}} RP_x$, where $\boldsymbol{P^f} = \{x | -22 \leq x \leq 17\}$
- The risk-buffer contributions are lump-sum contributions at the start of the simulation.

Risks covered by participants of generation *x*

$$RP_x = \sum_{x \in \boldsymbol{X}} Max\left(b_{DB} - CVaR_{b_x}(\beta), 0\right)$$



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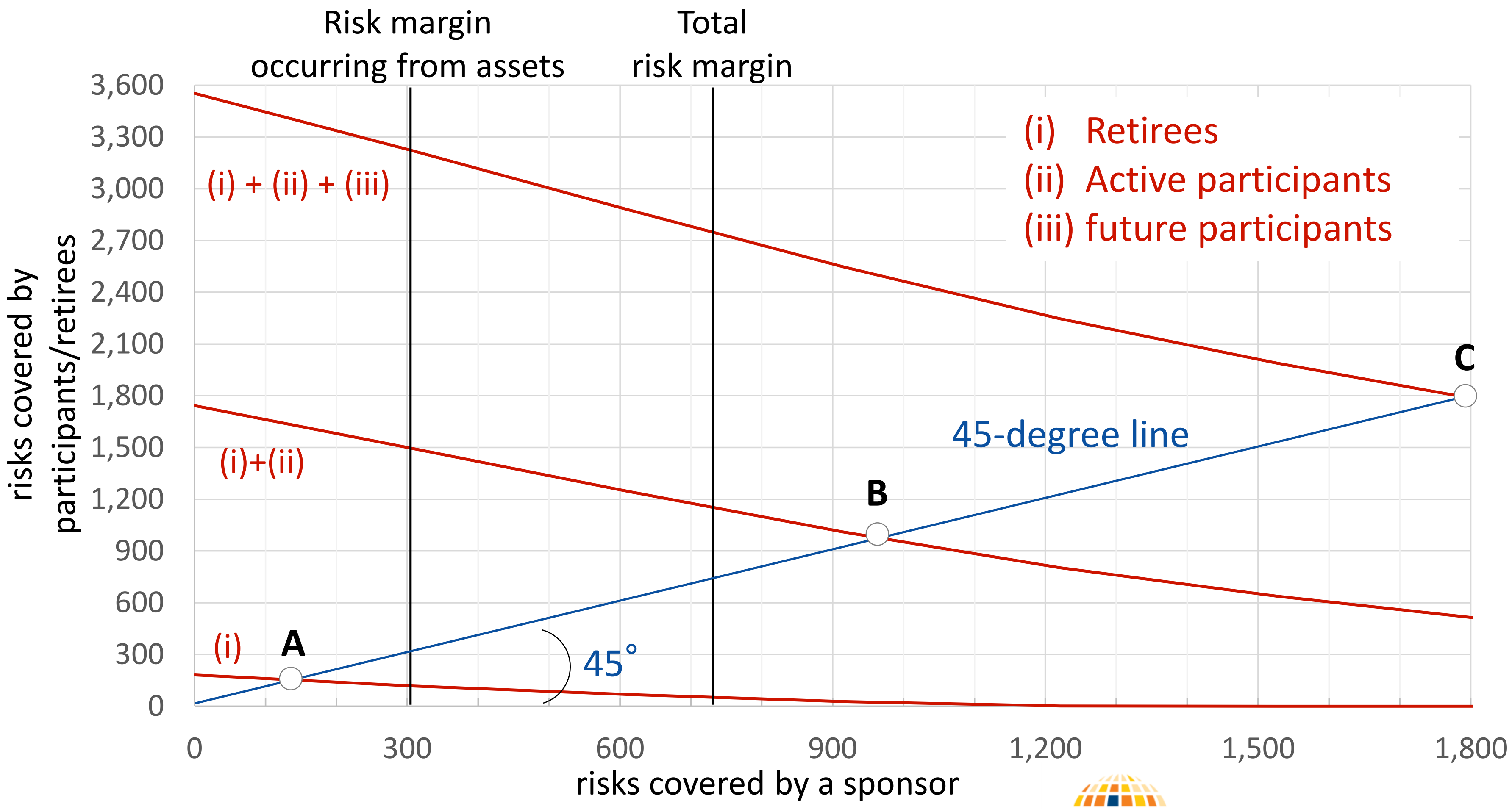
Risks covered by sponsors and participants/retirees in RS plan

- Increasing the risk covered by the plan sponsor, the participants/retirees' risk decrease
- Point A, B and C represents the risk-balanced point between them



Three approaches to reduce the risk

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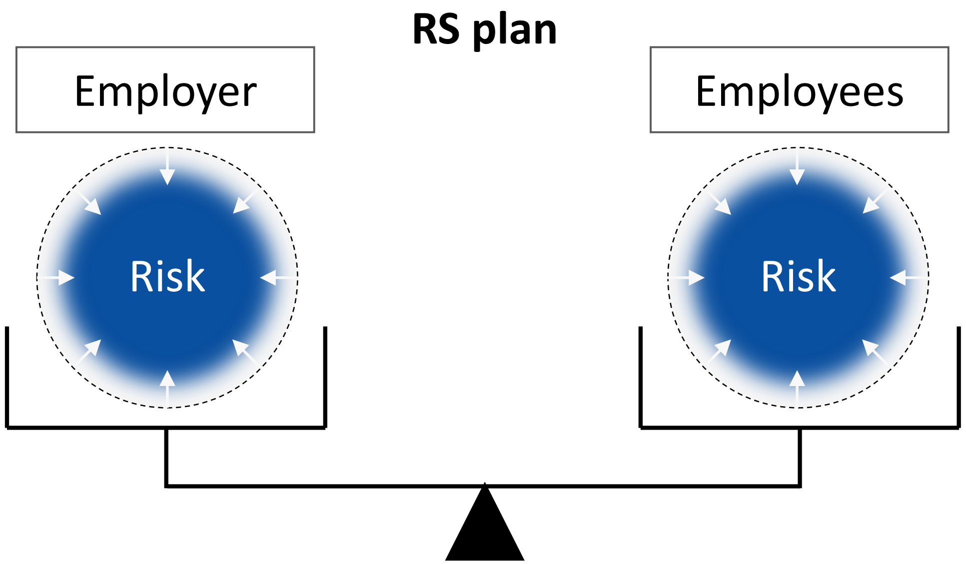
Three approaches to reduce the risk

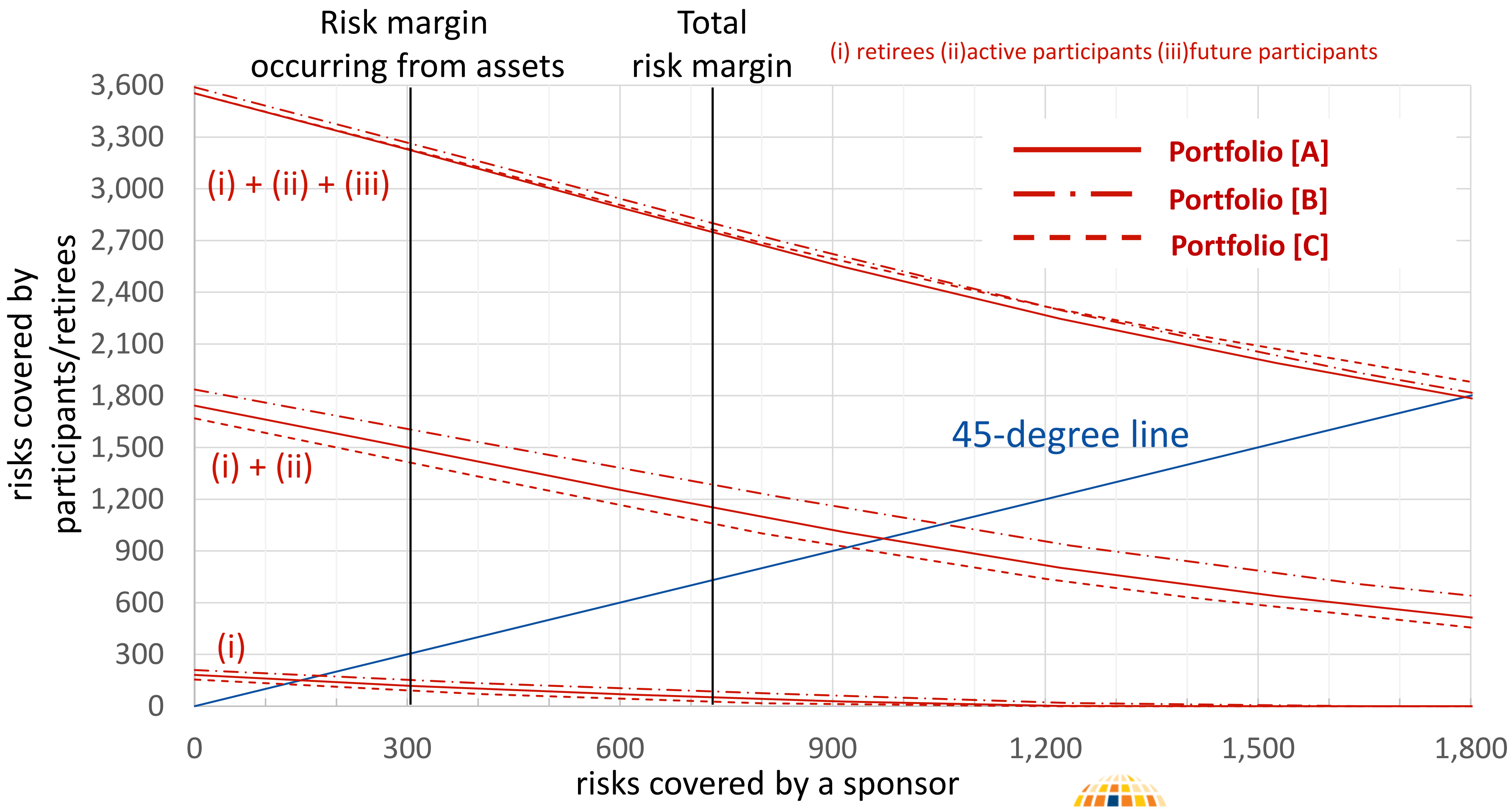
Setting

- Three approaches to reduce the risk are as follows
  - Change the portfolio
    - Measure the effects of adopting the portfolio [B] and [C] in the slide 11 in addition to the portfolio [A]
  - Abolish upward adjustment of benefits
  - Prolong risk-buffer contributions periods



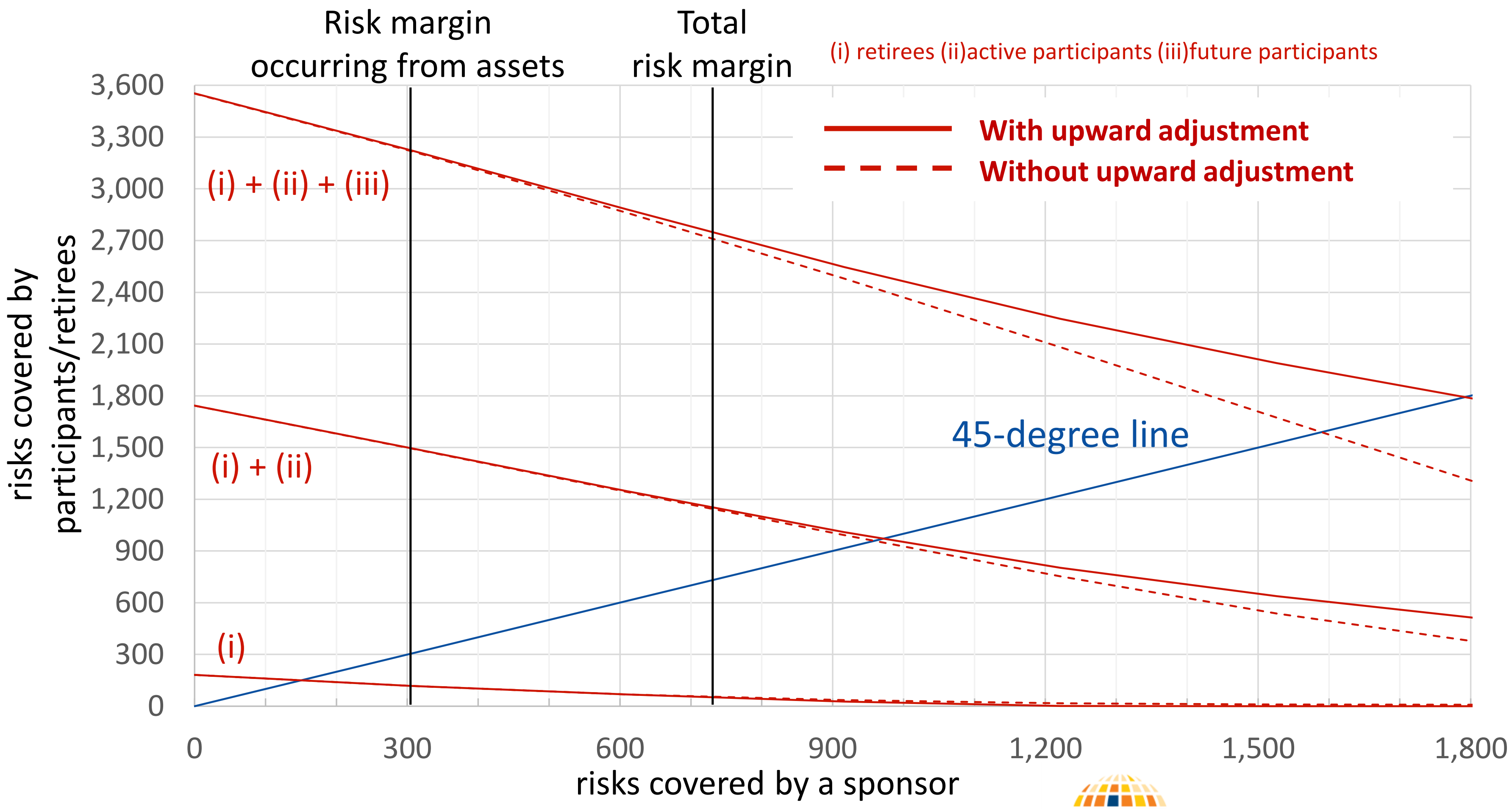
Effects of changing the portfolio

- Increasing the expected return will reduce the risk of future generations, but will increase the overall risk
- Who will take the risk for whom?



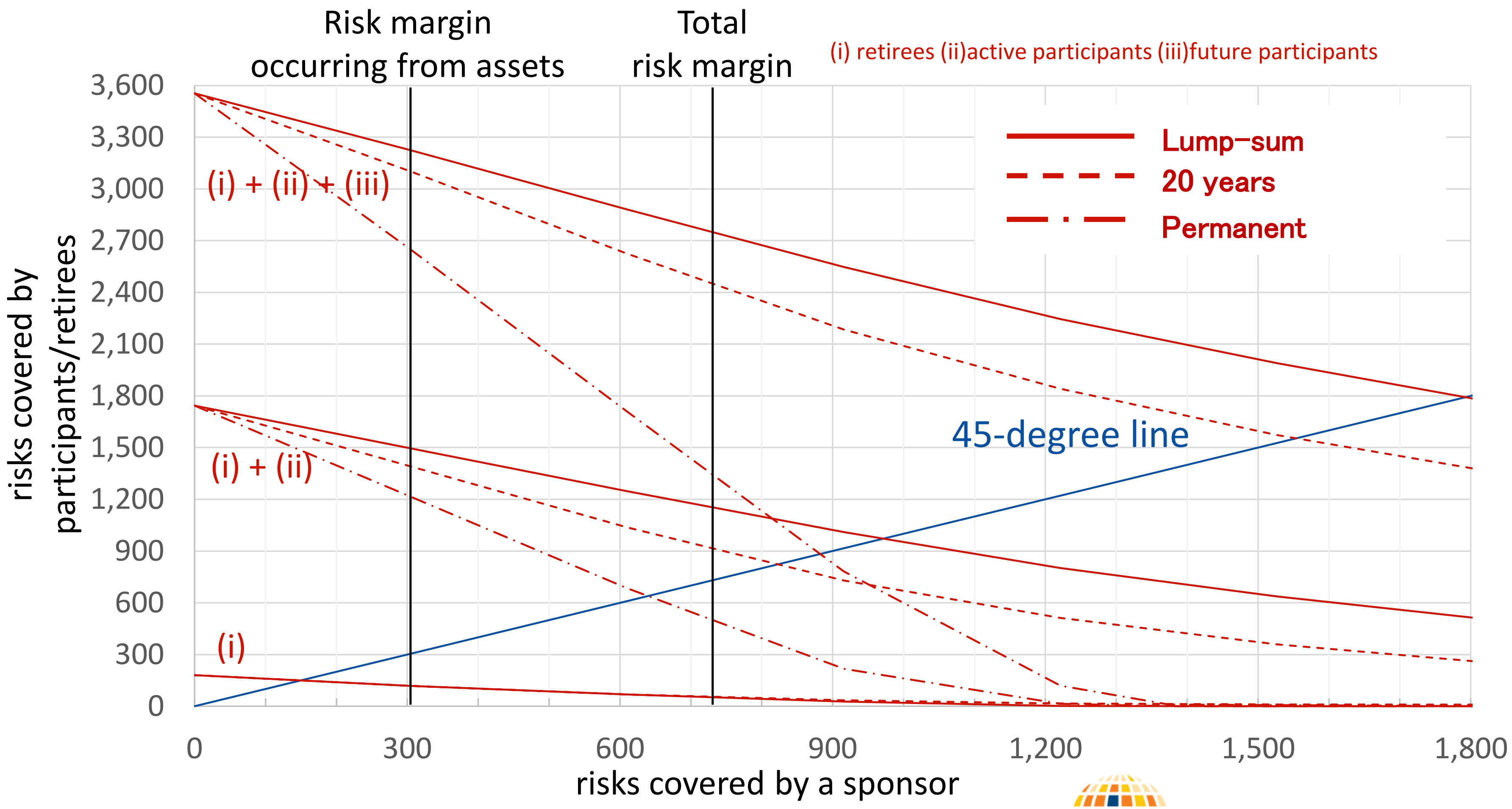
Effects of abolishing upward adjustment of benefits

- The risk of the participants/retirees is lowered
- However, there is almost no impact where the employer's risk burden is small



Effects of prolonging risk-buffer contributions

- It is very effective to prolong risk-buffer contributions periods to reduce risk
- The risk of active and future generations has been significantly reduced



Conclusion

- Quantitative approach with Monte Carlo simulation cleared the difference in the characteristics of the benefits in the DB, DC and RS plan.
- I employed the CVaR as the evaluation measures and evaluated the risk transferred to the employees from employers.
- Prolongation of risk-buffer contributions is very effective to reduce the risk in the RS plan.

References

[1] Pension Fund Association, statistical material for defined contribution pension, (February 12, 2019). (in Japanese)
https://www.pfa.or.jp/activity/tokei/files/dc_toukei_20190212_1.pdf

[2] Turner, J., Hybrid Pensions: Risk Sharing Arrangements for Pension Plan Sponsors and Participants, (February 2014).
https://www.soa.org/Files/Research/Projects/research-2014-hybrid-risk-sharing.pdf

[3] Hardy, M., Reviewing Target Benefit Pension Plans, IAA Colloquium (Oslo, Norway), 2015.
http://www.actuaries.org/oslo2015/presentations/SC-Hardy-P.pdf

[4] Kamiyama, T. and K. Tanaka, Discussion of Collective Defined Contribution in the UK, Nomura Capital Market Quarterly, 17-3(2014). (in Japanese)
http://www.nicmr.com/nicmr/report/repo/2014/2014win07web.pdf

[5] Research institute for Policies on Pension & Aging, Survey and research for target benefit plan in Canada, (2015). (in Japanese)
http://www.nensoken.or.jp/pastresearch/pdf/h27/H27_01f.pdf

[6] Norio Hibiki and Masaaki Ono, Simulation Analysis for Evaluating Risk-sharing Pension Plans, December 14, 2016.
http://www.ae.keio.ac.jp/lab/soc/hibiki/profile_2/HO_2016.pdf

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