

PBSS 2016

A Confirmation of Kocken's Proposition about the Intergenerational Risk Transfer within Pension Plans by Monte Carlo Simulations

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Agenda

- Kocken's Proposition
- Motivation
- Discount rate including risk premium(Kocken's proposition 1)
- CDC with smoothing(Kocken's proposition 2)
- Conclusion

Kocken's Proposition

“This article shows how valuation techniques for pension liabilities in risk-sharing pension plans affect the distribution of wealth between generations.

Some techniques in use today underestimate liabilities and benefit current retirees at the expense of other plan stakeholders, undermining the sustainability of risk-sharing pension plans by shifting concealed deficits to future generations.

The liability valuation techniques of state and local pension plans in the United States and those recently proposed in the Netherlands for its Collective Defined Contribution pension system are two examples.

The article shows that these techniques are not “arbitrage free,” meaning that their intergenerational wealth-distribution effects are deeply damaging.”

Source:Kocken,Theo * “ Pension Liability Measurement and Intergenerational Fairness: Two Case Studies” (Rotman International Journal of Pension Management, Vol. 5, No. 1, p. 16, 2012)

*Professor of Risk Management for Institutional Investors in VU University

Kocken's discussion

- Risk premiums should be given in accordance with risks taken.
- The members of U.S. State and local government pensions are given risk premiums by high discount rates, in spite of not taking market risk, because these plans are defined benefit.
- The members of Dutch CDC with 10 year smoothing are given risk premiums more than the portion of risk premiums corresponding to the risk decreased by 10 year smoothing.

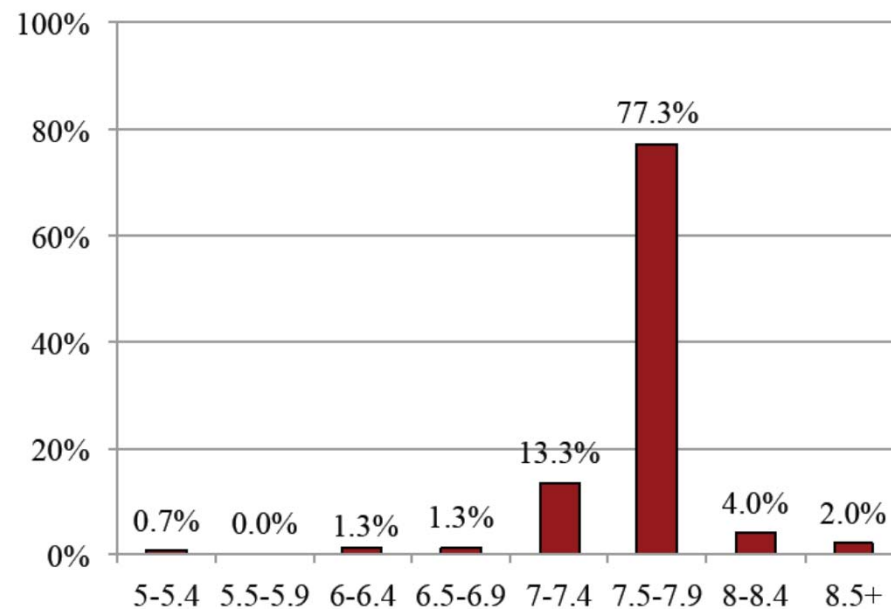
Motivation

- My background
 - 40 years of experience in pension business for Sumitomo Mitsui Trust Bank including pension actuarial consultation , pension investments.
- Japanese multiemployer EPF
 - Assumed rate of return 5.5% & highly risky investments
 - Funding deficits
- Japan will soon introduce CDC(Shared Risk DB).
 - Public consultation until June 26 to change the cabinet order and the ministerial ordinance to introduce CDC.

High Discount Rates of U.S. State and Local Pension Plans

State and Local Pension Plans are public pensions for state and local government employees. These plans cover wide range of occupations including teachers, fire fighters, police, members of judiciary, and many other state and local employees.

FIGURE 6. DISTRIBUTION OF DISCOUNT RATES FOR PUBLIC PLANS UNDER GASB 25, FY 2014

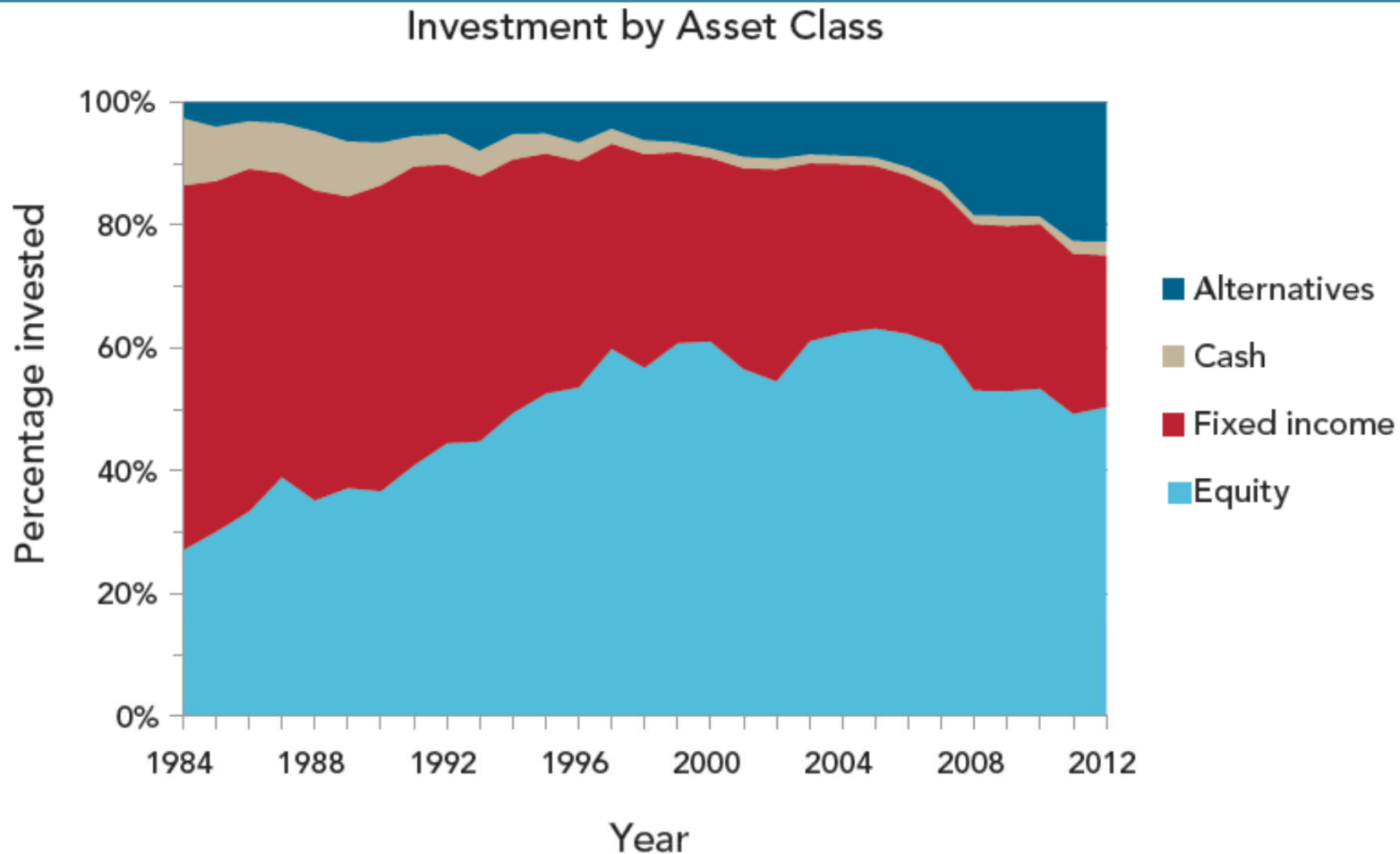


Sources: 2014 actuarial valuations; and PPD (2001-2014).

cf. 30-year treasury yield
1 April 2014 : 3.6%
1 June 2016 : 2.63%
(Source: Board of Governors of the Federal Reserve System)

Source: Munnell, Alicia H., Jean-Pierre Aubry 2015. "The Funding of State and Local Pensions: 2014–2018." State and Local Pension Plans Issue Brief 45. Chestnut Hill, Mass.: Center for Retirement Research at Boston College.

Asset Allocation of U.S. State and Local Pension Plans



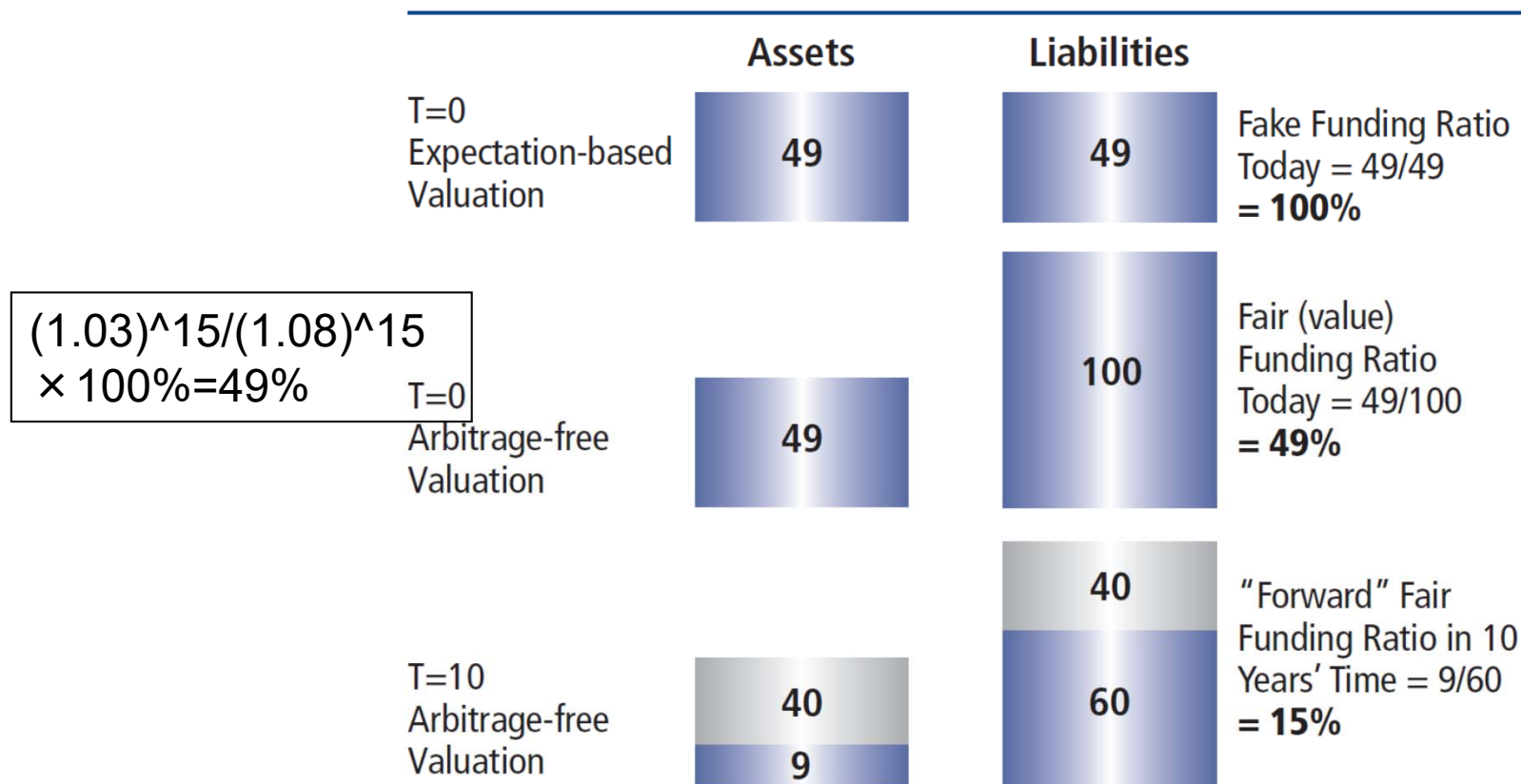
Source: Pension & Investments; Alternatives include real estate

Source: An Independent Panel Commissioned by the Society of Actuaries "Report of the Blue Ribbon Panel on Public Pension Plan Funding" February 2014

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Kocken:

Figure 1: Actual Fair-Value Funding Ratio and 10-Year Forward Fair-Value Funding Ratio
(Market Value of Assets vs. Liabilities in Year 10)
of an Apparently 100%-Funded Pension Fund
(Expectation-Based Accounting)

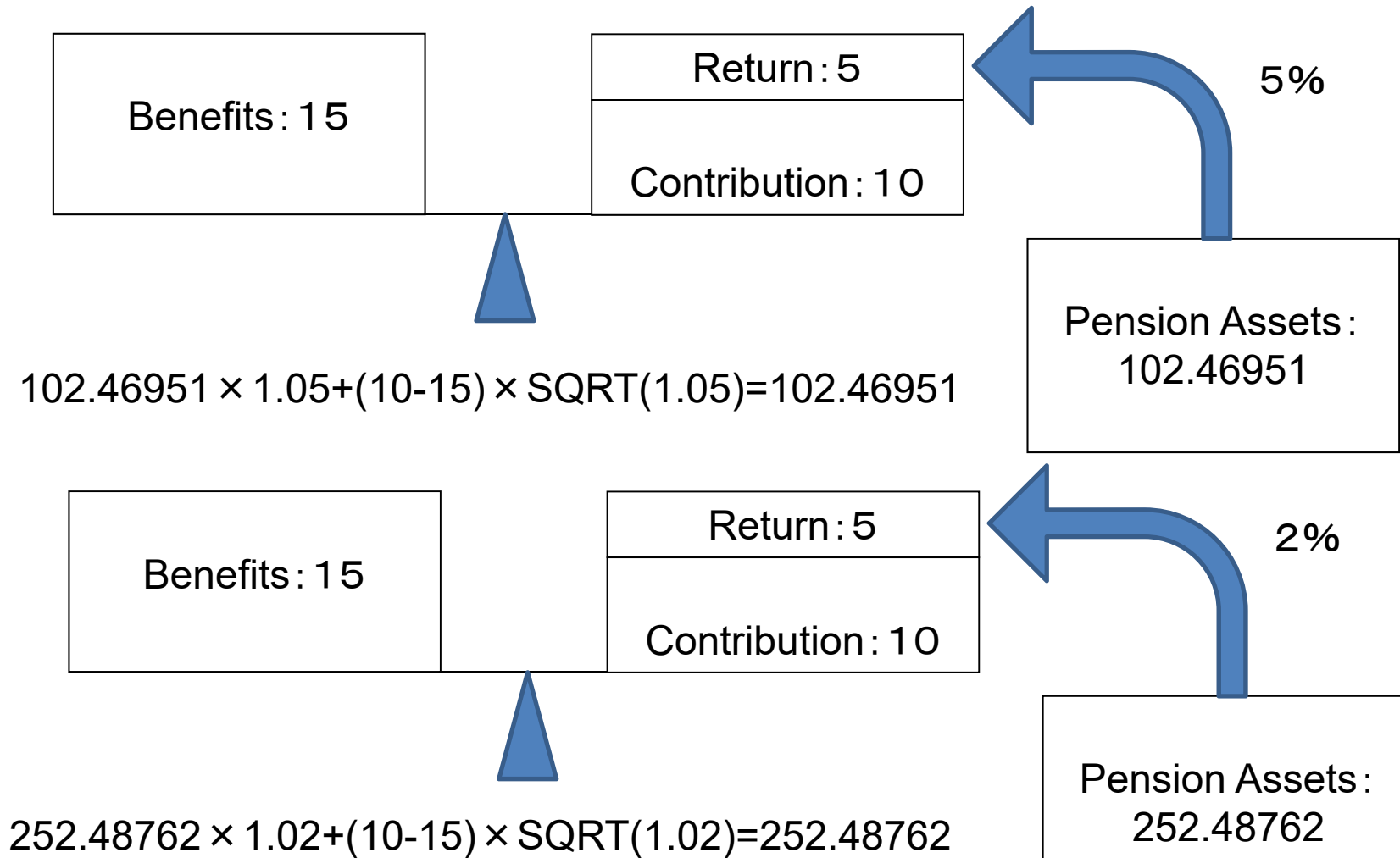


Source: Kocken "Pension Liability Measurement and Intergenerational Fairness: Two Case Studies" (Rotman International Journal of Pension Management, Vol. 5, No. 1, p. 16, 2012)

Kocken's proposition 1

- The liability valuation techniques of state and local pension plans in the United States underestimate liabilities and benefit current retirees at the expense of other plan stakeholders, undermining the sustainability of risk-sharing pension plans by shifting concealed deficits to future generations.
- We construct simple models by extracting the essence of U.S. state and local pensions ,and show that the model pensions will deplete even if they are fully funded with discount rates including risk premiums.

Deterministic Simulations



Cf. Pension assets : 502.49378 in case of 1% return

Assumptions for Simulations

Asset class	Expected return	Expected risk	Expected correlation				
Cash	0.20%	0.12%	1.000	0.265	-0.161	-0.014	-0.039
Domestic Bonds	0.90%	2.71%	0.265	1.000	-0.229	0.073	-0.094
Domestic Stocks	6.80%	17.97%	-0.161	-0.229	1.000	0.260	0.600
Foreign Bonds	3.30%	10.96%	-0.014	0.073	0.260	1.000	0.579
Foreign Stocks	8.30%	19.12%	-0.039	-0.094	0.600	0.579	1.000

Asset Class	Target Return: 2%	Target Return: 5%
Cash	9%	0%
Domestic Bonds	73%	40%
Domestic Stocks	9%	22%
International Bonds	1%	0%
International Stocks	8%	38%

Returns & Risks

- Risk 10% for return 5%
- Risk 3.2% for return 2%

These combinations are achievable in the U.S. market.

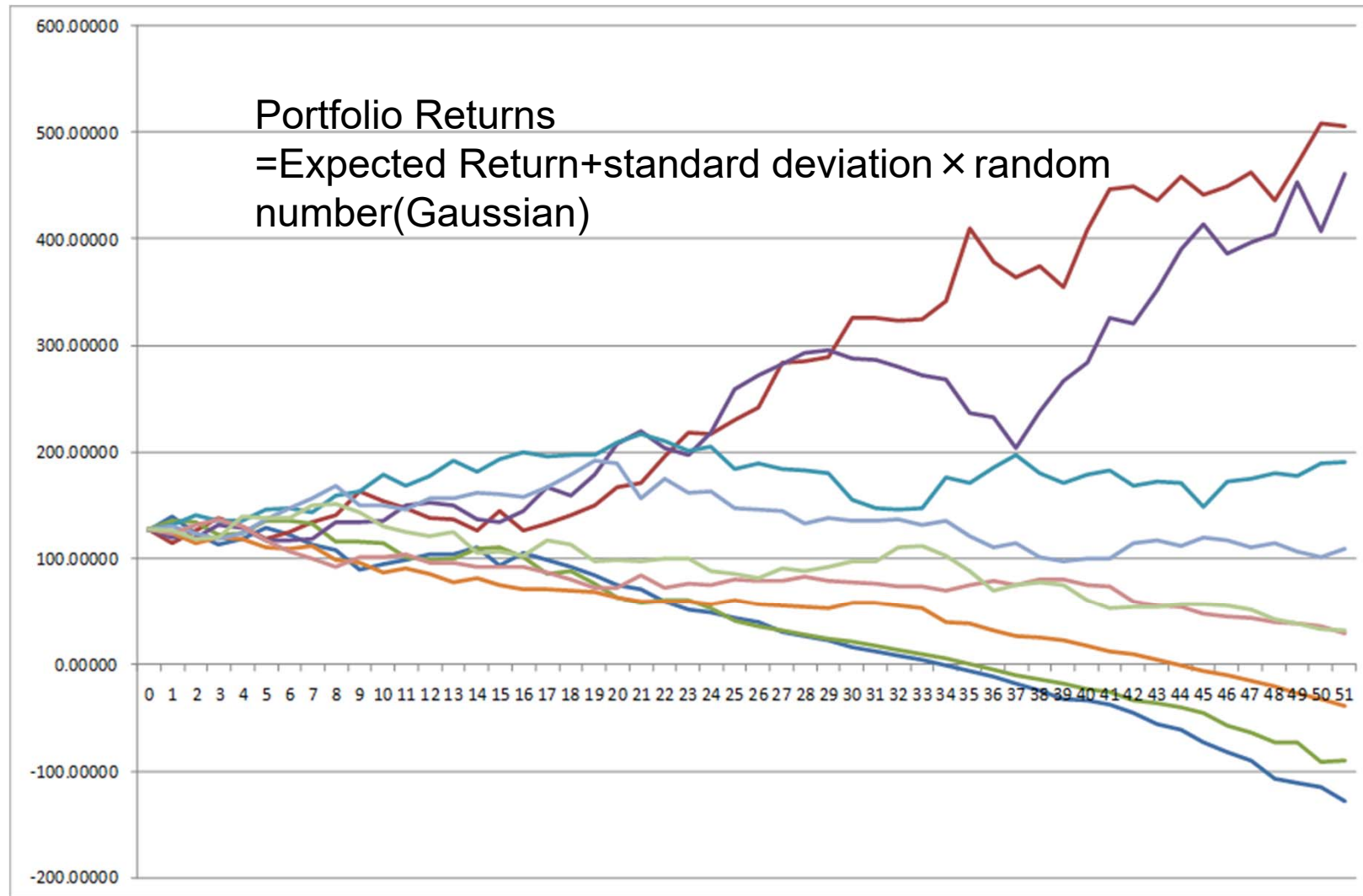
Assumed asset returns, risks, and correlation matrix in the U.S. market as of April 4, 2016

Asset Class	Return	Standard Deviation	Correlation Matrix			
			U.S.Stocks	U.S.Bonds	U.S.Real Estate	U.S. Treasury Bills
U.S.Stocks	8.2%	21.0%	1.00			
U.S.Bonds	4.2	10.5	0.14	1.00		
U.S.Real Estate	8.2	9.0	-0.04	-0.03	1.00	
U.S. Treasury Bills	0.2	0.0	-0.05	-0.03	0.25	1.00

Return 5% for Risk 9.5%(4.6%)

Return 2% for Risk 3.6%(1.7%)

Sample Paths of A Simulation



Basic Case(Target Return: 5%)

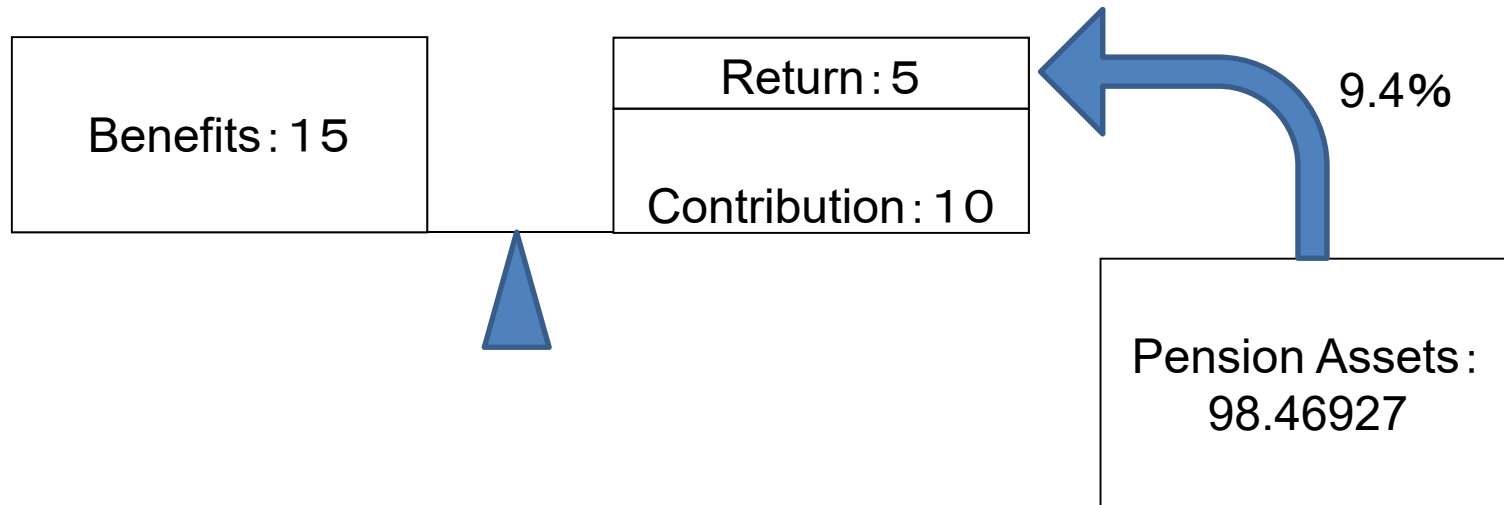
Statistics	beginning of 1 st year	end of 50 th year	end of 100 th year
Mean	102	104	120
Percentage of depletion	0.0%	49.9%	64.0%
Standard deviation	0	428	6,181
Standard error	0.000	0.428	6.181
Skewness	-	3	6
Kurtosis	-	21	154
Minimum amount of asset	102	-1,903	-91,623
Maximum amount of asset	102	12,415	473,367
Median	102	1	-763

Even though the average return is the same as the discount rate, why the shortage occurs ?

- Lack of option premium
- Since old workers retire after acquiring constant risk premiums, risks associated with these premiums are left to young workers.
- Constant benefit regardless of the investment returns
→ Difficulty of catching up after bad returns

$$102.46951 \times 1.05 + (10 - 15) \times \text{SQRT}(1.05) = 102.46951$$

$$102.46951 \times 1.01 + (10 - 15) \times \text{SQRT}(1.01) = 98.46927 < 102.46951$$



Basic Case(Target Return: 2%)

Statistics	Beginning of 1 st year	End of 50 th year	End of 100 th year
Mean	252	253	253
Percentage of depletion	0.0%	0.0%	18.7%
Standard deviation	0	101	297
Standard error	0.000	0.101	0.297
Skewness	-	1	1
Kurtosis	-	1	2
Minimum amount of asset	252	-39	-647
Maximum amount of asset	252	1,155	3,814
Median	252	241	206

Case with the amortization of deficits (target return 5%)

Statistics	Beginning of 1 st year	End of 50 th year	End of 100 th year
Mean	102	275	2,220
Percentage of depletion	0.0%	0.0%	0.0%
Standard deviation	0	356	5,388
Standard error	0.000	0.356	5.388
Skewness	-	5	10
Kurtosis	-	40	254
Minimum amount of asset	102	28	29
Maximum amount of asset	102	13,542	452,465
Median	102	141	455

The average additional contribution for 100 years is 72.→ 10.72/year

Case with the amortization of deficits (target return 2%)

Statistics	Beginning of 1 st year	End of 50 th year	End of 100 th year
Mean	252	300	413
Percentage of depletion	0.0%	0.0%	0.0%
Standard deviation	0	72	211
Standard error	0.000	0.072	0.211
Skewness	-	2	2
Kurtosis	-	4	8
Minimum amount of asset	252	175	177
Maximum amount of asset	252	1,266	4,099
Median	252	279	340

The average additional contribution for 100 years is 46. → 10.46/year

Case with the amortization of deficits and contribution suspension (target return 5%)

Contribution suspended if the assets exceed 502.

Statistics	Beginning of 1 st year	End of 50 th year	End of 100 th year	cf. No suspension End of 100th year
Mean	102	253	1,457	2,220
Percentage of depletion	0.0%	0.0%	0.0%	0.0%
Standard deviation	0	283	3,631	5,388
Standard error	0.000	0.283	3.631	5.388
Skewness	-	4	11	10
Kurtosis	-	35	344	254
Minimum amount of asset	102	29	30	29
Maximum amount of asset	102	10,643	334,590	452,465
Median	102	142	433	455

The average additional contribution is 72, suspended contribution is 164
for 100 years.

Case with the amortization of deficits and contribution suspension (target return 2%)

Contribution suspended if the assets exceed 502.

cf. No
suspension

Statistics	Beginning of 1 st year	End of 50 th year	End of 100 th year	End of 100 th year
Mean	252	299	363	413
Percentage of depletion	0.0%	0.0%	0.0%	0.0%
Standard deviation	0	68	105	211
Standard error	0.000	0.068	0.105	0.211
Skewness	-	1	0	2
Kurtosis	-	1	-1	8
Minimum amount of asset	252	175	177	177
Maximum amount of asset	252	779	1,414	4,099
Median	252	279	340	340

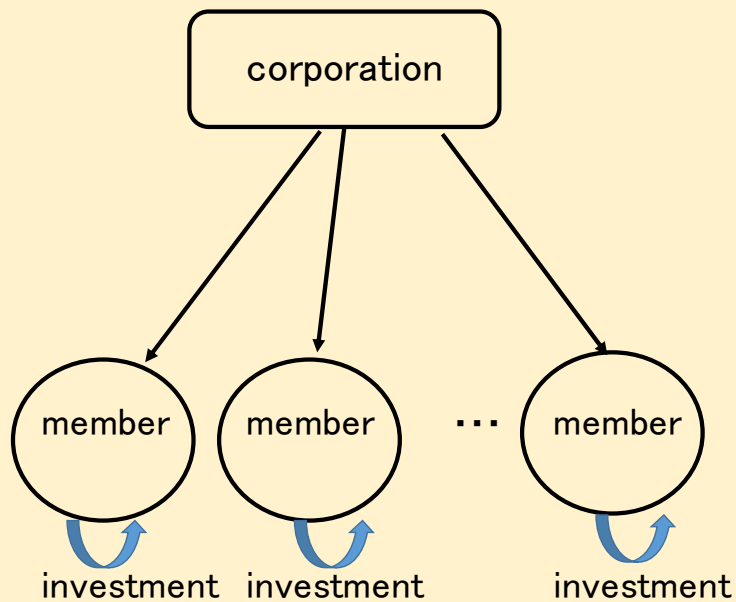
The average of additional contribution is 46, suspended contribution is 33 for 100 years.

Conclusion about Proposition 1

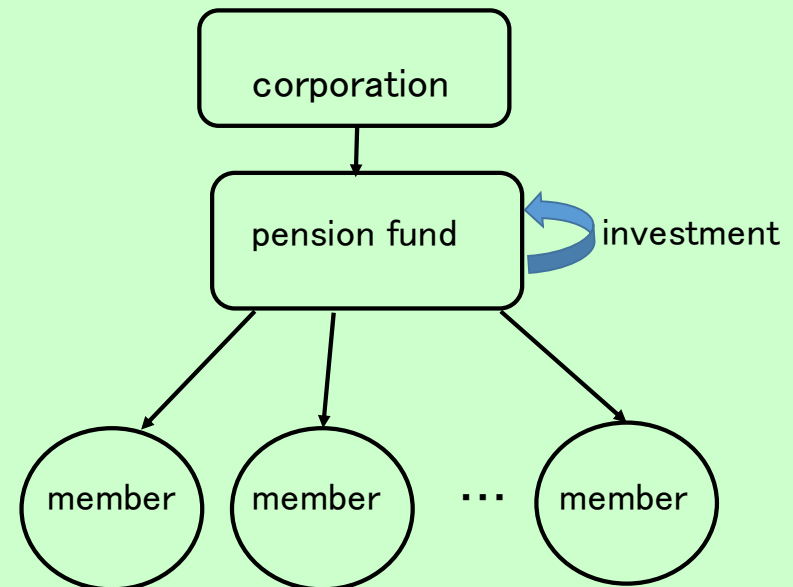
- High discount rates may cause depletion of pension assets especially when it is difficult for the plan sponsor to raise the premium, even if the initial liability is fully funded. To avoid depletion, additional contributions, benefit reductions are necessary.
→ Risk transfer from old pensioner to young workers

What is Collective DC (CDC)

DC



CDC



Investment losses → Underfunding → Increase of employee contribution
Elimination of cost-of-living adjustments
Benefit Reductions

Kocken: Valuation of Pension Payments

FTK → FTK2 → nFTK

$$2\% + (-2\%)/10 = 2\% - 0.2\% = 1.8\%$$

Table 1: Pension Payments to Retirees in Year 1 under Market-Consistent Liability Valuation vs. Expected Return Liability Valuation in a Collective DC Fund

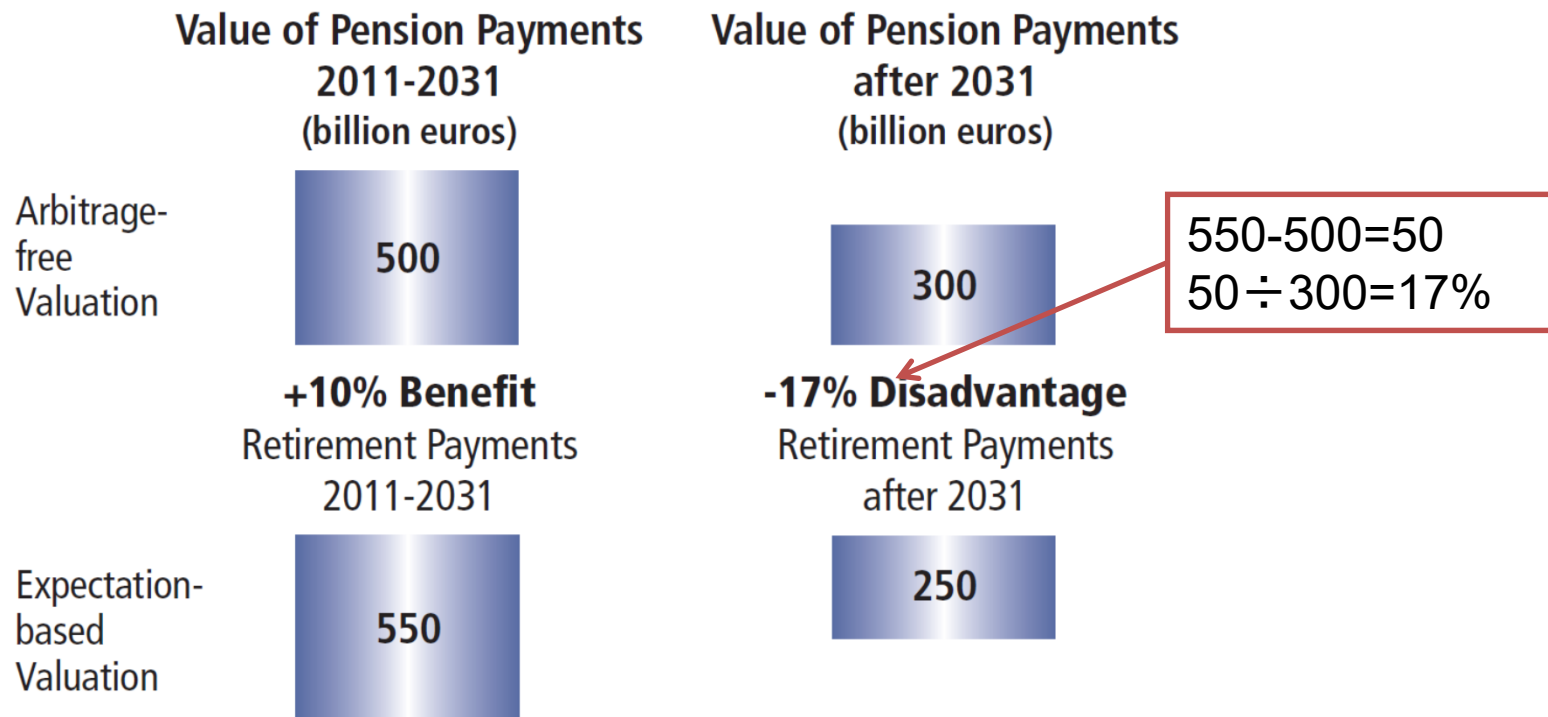
Pension Payments in Year 1 (€)			
Realized Annual Return (%)	Market-Consistent (Arbitrage-Free) Valuation	Pension Accord (Full Expected Return) Valuation	Excess Payment in Year 1 Due to Market-Inconsistent Valuation (€)
Risk-free rate + 4%	100.40	102.20	1.80
Risk-free rate + 2% (expected return)	100.20	102.00	1.80
Risk-free rate	100.00	101.80	1.80
Risk-free rate – 2%	99.80	101.60	1.80
Risk-free rate – 4%	99.60	100.40	1.80

Source: Kocken "Pension Liability Measurement and Intergenerational Fairness: Two Case Studies" (Rotman International Journal of Pension Management, Vol. 5, No. 1, p. 16, 2012)

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Intergenerational Wealth Transfer

**Figure 2: Intergenerational Wealth Transfer
Due to Expected Return Discounting in a
10-Year Smoothed Collective DC System**



Source: Kocken "Pension Liability Measurement and Intergenerational Fairness: Two Case Studies" (Rotman International Journal of Pension Management, Vol. 5, No. 1, p. 16, 2012)

Kocken's proposition 2

- The liability valuation techniques proposed in the Netherlands for its Collective Defined Contribution pension system in 2012 underestimate liabilities and benefit current retirees at the expense of other plan stakeholders, undermining the sustainability of risk-sharing pension plans by shifting concealed deficits to future generations.

Assumptions

- A participant is supposed to enter the pension plan at age 20 working until just before age 60, and they do not die or withdraw.
- Pensions are supposed to be paid from age 60 to age 79, namely they are annuity 20 years certain. In short, money is accumulated for 40 years with interest, and it is paid for 20 years from age 60.
- Pensioners are not supposed to die during those 20 years. The amount of pension for each year varies according to the return of the pension fund for previous years.
- The contribution for each active member is 1 every year, thus total amount of all contributions are 40. Contributions and payments are supposed to be given at the middle of each year.

Smoothing

【Dutch FTK2】

The smoothed rate of return s

$$s_{\tau} = \mu + \frac{1}{10} \sum_{i=0}^9 (r_{\tau-i} - \mu) = \frac{1}{10} \sum_{i=0}^9 r_{\tau-i}$$

where μ is expected return, and r is actual return.

【Kocken's market consistent valuation】

The market consistent smoothed return m_{τ} is

$$m_{\tau} = r_{\tau}/10$$

Return-Risk combination (5%, 10%) and (2%, 3.2%) are achievable in the Netherlands as of April ,2016


Returns and Risk of Frank Russell in Alphen et al.(1997)

Asset Class	Expected return (%)	Expected Standard Deviation (%)
Inflation(Wages)	4.5	5.0
Inflation(Prices)	2.4	4.0
Dutch Bonds	6.5	7.0
Dutch Stocks	9.5	21.0
International Bonds	6.5	10.0
International Stocks	9.0	7.0

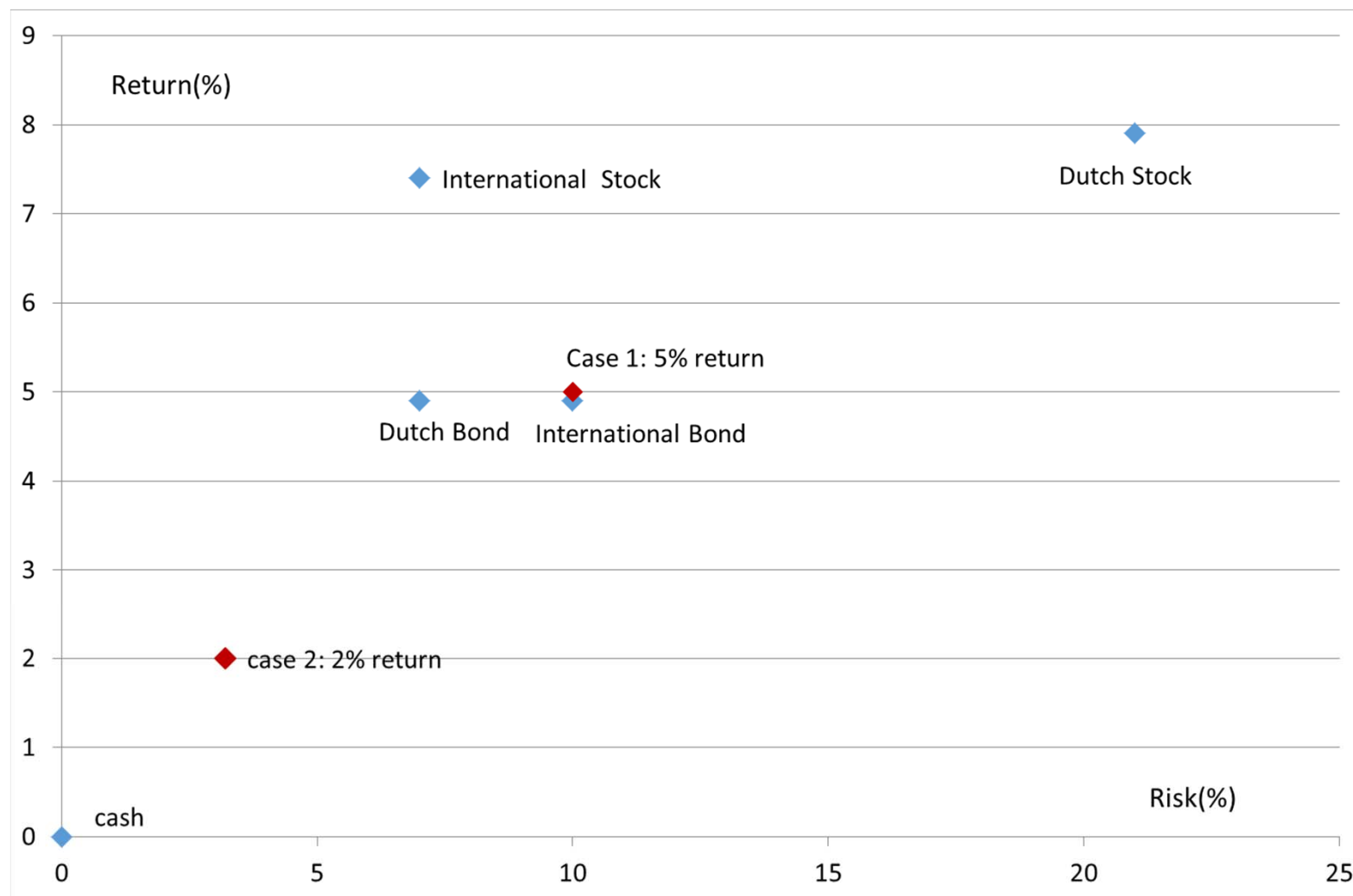
Expected Returns and Risk of Dutch market as of April , 2016

Asset Class	Expected return (%)	Expected Standard Deviation (%)
Dutch Bonds	4.9	7.0
Dutch Stocks	7.9	21.0
International Bonds	4.9	10.0
International Stocks	7.4	7.0

return
-
1.64%



Returns and Risks of Dutch asset classes



FTK2 Smoothing (Target Rate 5%)

Statistics	Beginning of 1 st year	End of 50 th year	End of 100 th year
Mean	3,153	1,640	-18,846
Percentage of depletion	0.00%	39.78%	67.73%
Standard deviation	0	21,597	303,228
Standard error	0.00	21.60	303.23
Skewness	-	1.80	0.94
Kurtosis	-	16.89	72.65
Minimum amount of asset	3,153	-89,969	-3,446,024
Maximum amount of asset	3,153	166,820	5,084,282
Median	3,153	919	-12,922

Kocken's Market Consistent Smoothing (Target Rate 5%)

Statistics	Beginning of 1 st year	End of 50 th year	End of 100 th year
Mean	1,306	13,130	148,118
Percentage of depletion	0.00%	0.00%	0.00%
Standard deviation	0	27,364	517,557
Standard error	0.00	27.36	517.56
Skewness	-	2.44	4.94
Kurtosis	-	11.91	63.48
Minimum amount of asset	1,306	1,041	2,382
Maximum amount of asset	1,306	174,153	8,805,533
Median	1,306	10,908	99,552

FTK2 Smoothing (Target Rate 2%)

Statistics	Beginning of 1 st year	End of 50 th year	End of 100 th year
Mean	1,711	1,677	1,552
Percentage of depletion	0.00%	0.00%	0.90%
Standard deviation	0	1,066	2,209
Standard error	0.00	1.07	2.21
Skewness	-	0.61	0.54
Kurtosis	-	0.78	1.52
Minimum amount of asset	1,711	478	-3,281
Maximum amount of asset	1,711	4,536	8,411
Median	1,711	1,645	1,499

Kocken's Market Consistent Smoothing (Target Rate 2%)

Statistics	Beginning of 1 st year	End of 50 th year	End of 100 th year
Mean	1,241	3,107	8,113
Percentage of depletion	0.00%	0.00%	0.00%
Standard deviation	0	1,614	6,201
Skewness	0.00	1.61	6.20
Standard error	-	0.59	0.87
Kurtosis	-	0.65	1.39
Minimum amount of asset	1,241	1,521	2,782
Maximum amount of asset	1,241	6,899	26,804
Median	1,241	3,059	7,855

Conclusion about Proposition 2

- Smoothed cases for CDC show 68% probability of depletion for target rate 5%, and 0.9% for target rate 2%.
- Negative value of pension assets means loans, additional contributions, the reduction of benefits, or winding up of the plan. If the benefits decrease, risk transfer from old pensioner to young workers could be present, which support Kocken's proposition.
- However the probability of depletion for target rate 2% is less than 1%, and can be evaded by the small raise of the premiums.
- Kocken's market consistent policy excludes the worry about the asset depletion, but the amount of surplus should be distributed fairly, which is another problem to be solved.

Conclusion

We confirmed Kocken's assertion by Monte Carlo simulation with additional findings.

- High discount rates may cause depletion of pension assets especially when it is difficult for the plan sponsor to raise the premium, even if the initial liability is fully funded.
- Market consistent policy for CDC proposed by Kocken prevent pension funds from depletion successfully with a large amount of surplus.

	Traditional Pension Mathematics	Pension Mathematics Considering Volatility of Asset Returns
Low discount rate	High premium	High premium
High discount rate	Low premium	Low premium and <u>forecast of average additional premium</u>