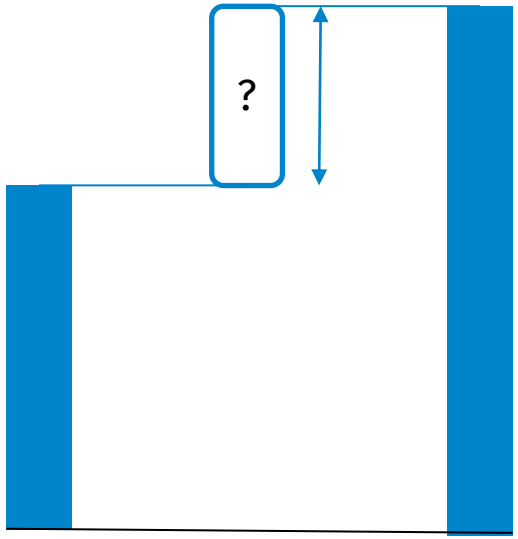
Funding ratio attribution

Maarten Niederer | 2022-06-09

Funding ratio attribution

Overview



Introduction to Funding ratio

Decomposition of ratio changes

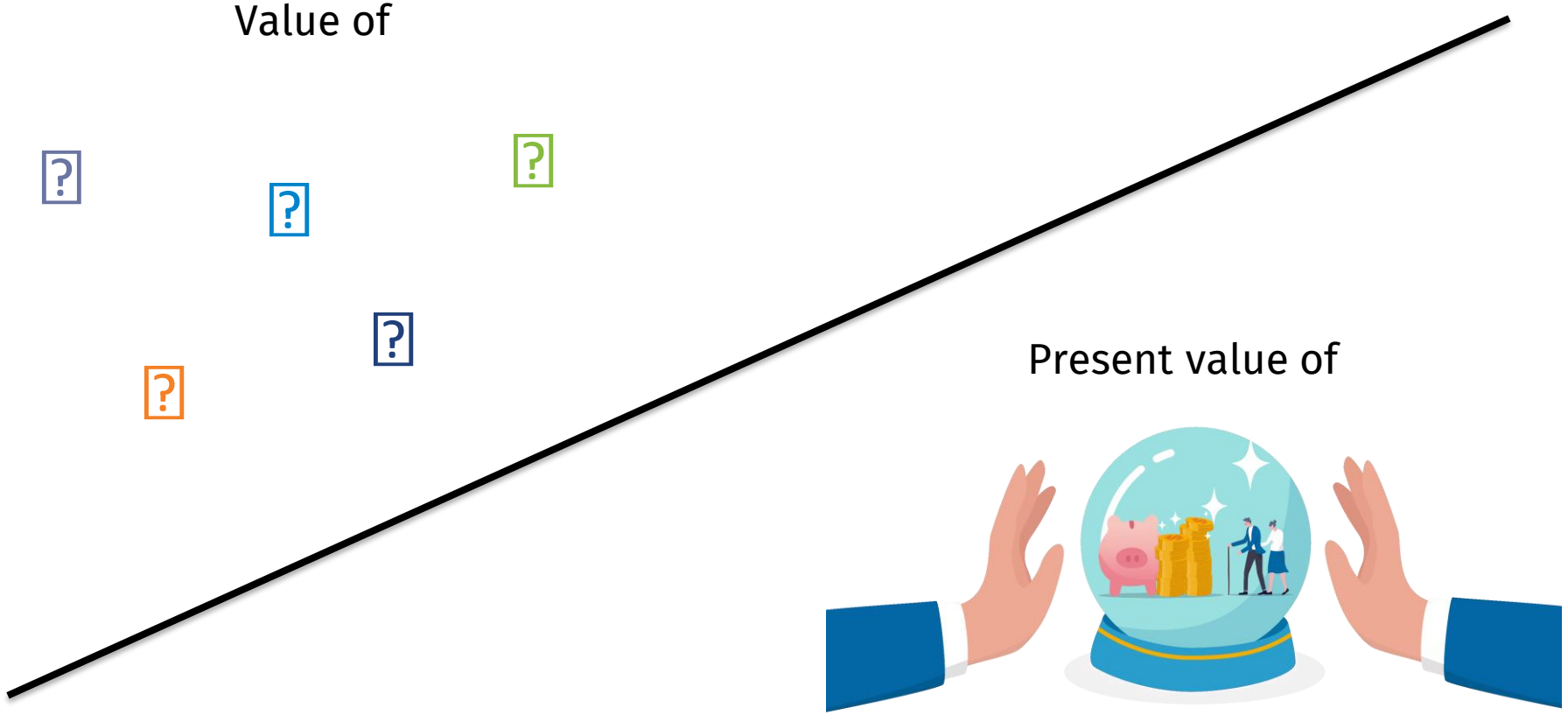
Detail concerns

Summary

Introduction to funding ratio

Assets and Liabilities

Value of



Present value of

Introduction to funding ratio

Solvency ratio and defined contribution schemes

- Main line of presentation is about funding ratio

- Solvency ratio is quite similar
  - Contract and regulatory framework are more strict

- Defined contribution schemes
  - Framework not suitable for surplus income
  - When the goal is to provide base income upon retirement, several aspects apply
  - No ratio, but rather: How did my expected benefits evolve?

Introduction to funding ratio - Liabilities

Present value of liabilities

- Present value of liabilities =

Introduction to funding ratio - Liabilities

Present value of liabilities – Promised pension benefits

Promised pension benefits may change with:

- Benefit payments and new capital inflows
- Contractual adjustments (e.g. change in retirement age)
- Realized survival rate
- Realized inflation (if promise/aspiration to compensate)

Introduction to funding ratio - Liabilities

Present value of liabilities – Discount rate

Discount rate may change with:

- Changes in expected future returns on assets
  - Regulatory framework
  - Expected returns for asset classes
    - Yield curve
- Expected inflation (if promise/aspiration to compensate)

Introduction to funding ratio - Assets

Asset value

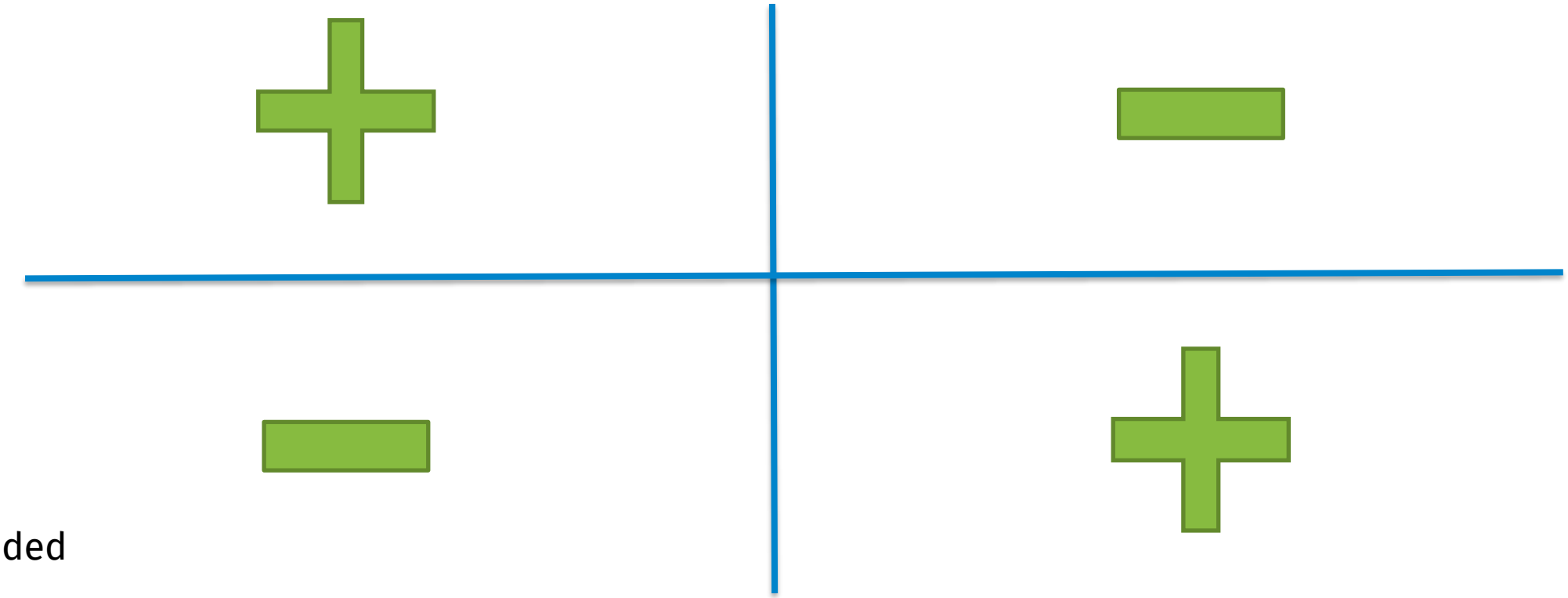
Asset value may change with:

- Benefit payments and new capital inflows
- Asset appreciation/depreciation
  - Neutral position
  - All investment decisions

Introduction to funding ratio – Net cashflows

Impact of subscriptions and redemptions

Overfunded



Underfunded

Net outflow

Net inflow

Introduction to funding ratio – Changes

Relation to growth of assets and liabilities

Arithmetic relation

$$\Delta FundingRatio(t, t-1) = \frac{Assets(t)}{Liabilities(t)} - \frac{Assets(t-1)}{Liabilities(t-1)}$$

$$= \frac{Assets(t-1)}{Liabilities(t)} \cdot \left(\frac{Assets(t)}{Assets(t-1)} - \frac{Liabilities(t)}{Liabilities(t-1)} \right) = Scaling\ factor\ \cdot XS\ Growth$$

Scaling factor depends on

- Initial funding ratio
- Growth of liabilities

Introduction to funding ratio – Changes

Relation to growth of assets and liabilities

Geometric relation

$$\Delta FundingRatio(t, t-1) = \frac{\frac{Assets(t)}{Liabilities(t)}}{\frac{Assets(t-1)}{Liabilities(t-1)}}$$

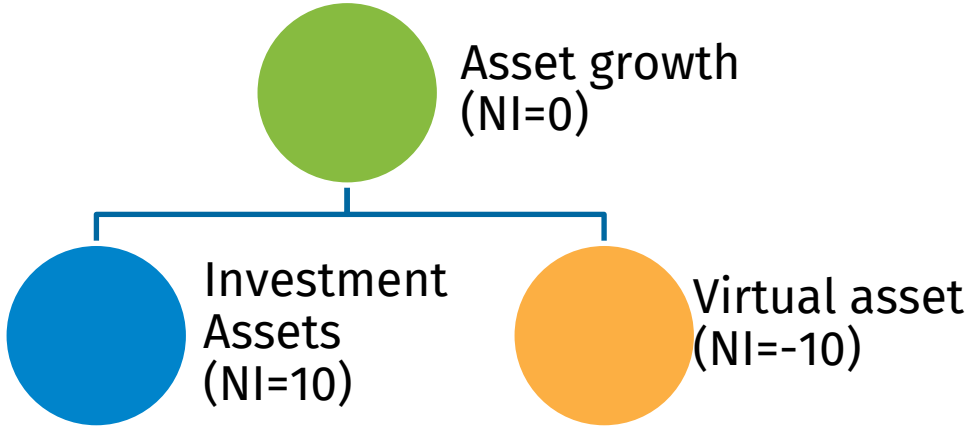
$$= \frac{\frac{Assets(t)}{Assets(t-1)}}{\frac{Liabilities(t)}{Liabilities(t-1)}} = Geometric\ XS\ growth$$

Introduction to funding ratio – Attribution

Growth is technically the same as an investment return

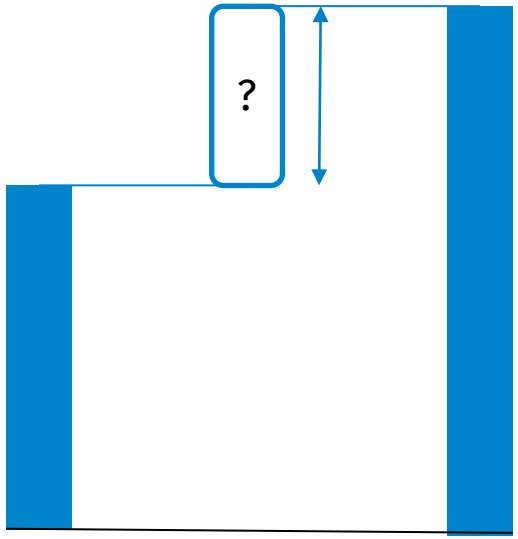
- On top of the house analysis:
  - Treat cash flows as autonomous components of growth/return
- On a lower level correct for the cashflows to have actual investment returns and an investible benchmark
- Feed into performance attribution formula sets/software

Asset value (t-1)	110
Asset value (t)	130
Growth	18.2%
Net cash flow	10
Return	9.1%



Funding ratio attribution

Overview



Introduction to Funding ratio

Decomposition of ratio changes

Detail concerns

Summary

Decomposition – Example case

Example case introduction

	Start value	Subscriptions & Redemptions	End value
Assets	110	10	130
Liabilities	80	9	100
Funding ratio	1.375		1.30

- Nominal benefits (no inflation compensation)
- Discount rate is the SAA ex-ante expected return
  - Some fixed income exposure → Some interest rate sensitivity
- Investible benchmark is the SAA ex-post realized return

Decomposition

Main decomposition components – and related questions

Funding ratio change is driven by risk drivers, that either

- Can't be hedged (at reasonable costs)
  - Separate out actuarial impact
  - Do the costs of hedging indeed outweigh the added risks?
  - Is the SAA an effective proxy for discount rate changes?

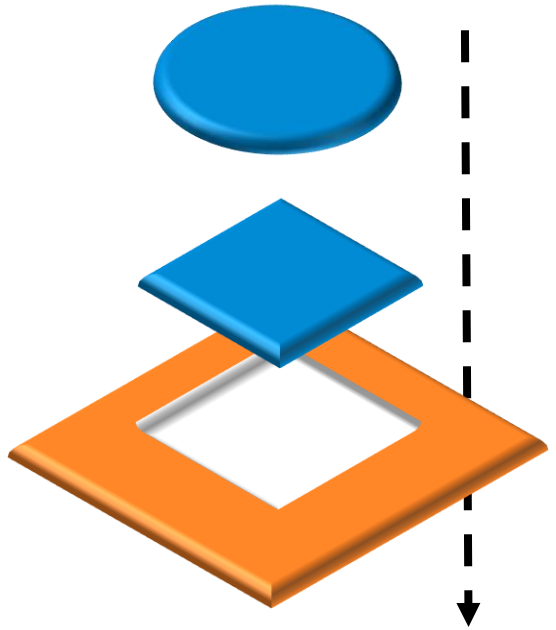
- Are (supposed to be) hedged
  - Did we hedge according to policy?

- Are active investment decisions
  - How did our active decisions contribute?

Decomposition

Macro/Decision Attribution analysis

- Use macro / decision attribution formula sets to derive these results
  - Not all risk drivers are decisions, but for the formula sets they are equal



- Also measure ex-post risk associated with the risk drivers
  - Tracking error decomposition

Decomposition – Example case

Liabilities repricing

- Transform liabilities growth to investible benchmark
- Liabilities are repriced for several steps of immunized risk drivers
- Valuate liabilities under several conditions
  - Normal
  - Corrected for net cash flows (similar to the asset side correction)

Promised retirement benefits

Δ Cash flows

Decomposition – Example case

Returns/growth rates to decomposition

	Start	NI	End
Assets	110	10	130
Liabilities	80	9	100
Funding ratio	1.375		1.30

Arithmetic:
(9.1%-13.8%) - (18.2%-25.0%)
= -2.2%

Valuation	Assets	Liabilities	Δ Arithmetic	Δ Geometric
Top for Funding ratio	18.2% = 20/110	25.0% = 20/80		
Corrected for cash flows	9.1% = 10/110	13.8% = 11/80		

Geometric:
(1.091/1.138) / (1.182/1.250) -1
= -1.4%

Decomposition – Example case

Liabilities repricing

- Valuate liabilities under several conditions
  - Normal
  - Corrected for net cash flows
  - Constant nominal benefits

Promised retirement benefits

Δ Cash flows

Survival rate

Δ Other actuarial

Decomposition – Example case

Returns/growth rates to decomposition

	Start	NI	End
Assets	110	10	130
Liabilities	80	9	100
Funding ratio	1.375		1.30

Valuation	Value
Liabilities at start	80
With cash flows	89
Actuarial impact	94

Arithmetic:
(9.1%-7.5%) - (9.1%-13.8%)
= -6.3%

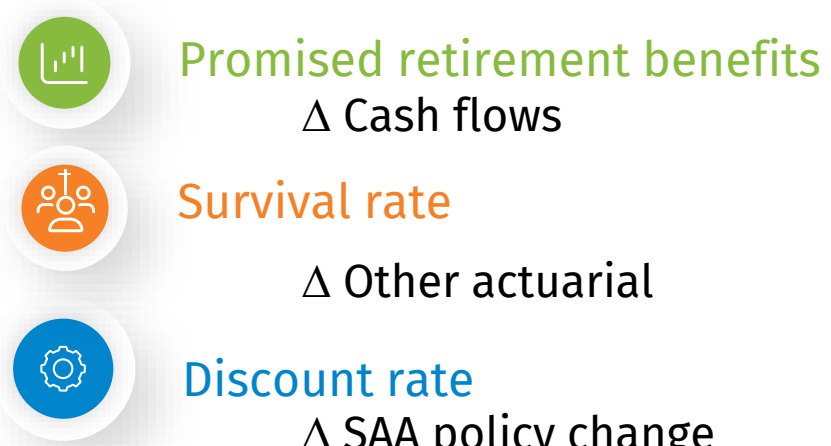
Valuation	Assets		Δ Arithmetic	Δ Geometric
Top for Funding ratio	18.2% = 20/110	25.0% = 20/80		
Corrected for cash flows	9.1% = 10/110	13.8% = 11/80	-2.2%	-1.4%
Corrected for Actuarial impact	9.1%	7.5% = 6/80		

Geometric:
(1.091/1.075) / (1.091/1.138) -1
= -5.5%

Decomposition – Example case

Liabilities repricing

- Valuate liabilities under several conditions
  - Normal
  - Corrected for net cash flows
  - Constant nominal benefits
  - …, discounted with start of period SAA asset mix
  - …, discounted with start of period ex-ante SAA return



Decomposition – Example case

Returns/growth rates to decomposition

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Assets	110	10	130
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Valuation	Value
Liabilities at start	80
With cash flows	89
Actuarial impact	94
& SAA weights	92
& SAA returns	95

Valuation	Assets	Liabilities	Δ Arithmetic	Δ Geometric
Top for Funding ratio	18.2% = 20/110	25.0% = 20/80		
Corrected for cash flows	9.1% = 10/110	13.8% = 11/80	-2.2%	-1.4%
Corrected for Actuarial impact	9.1%	7.5% = 6/80	-6.3%	-5.5%
& SAA weights	9.1%	10.0% = (8/80)	2.5%	2.3%
& SAA returns	9.1%	6.3% = (5/80)	-3.8%	-3.4%

Decomposition – Example case

Returns/growth rates to decomposition

	Start	NI	End
Assets	110	10	130
Liabilities	80	9	100
Funding ratio	1.375		1.30

Valuation	Value
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Valuation	Assets	Liabilities	A Arithmetic	A Geometric
	18.2% = 20/110	25.0% = 20/80		
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Corrected for Actuarial impact	9.1%	7.5% = 6/80	-6.3%	-5.5%
& SAA weights	9.1%	10.0% = (8/80)	2.5%	2.3%
& SAA returns	9.1%	6.3% = (5/80)	-3.8%	-3.4%
Top for investments	9.1%	12.5%		

Remaining XS:
The impact of actual investment decisions

Impact of SAA ex-ante vs ex-post:
The realized investment climate

Decomposition – Example case

Final decomposition results

	Arithmetic	Geometric
Total funding ratio change	-7.5	-5.5
Subscriptions redemptions	-2.4	-1.4
Actuarial impact	-6.9	-5.5
Discount rate impact	-1.4	-1.2
Change in SAA policy weights	2.8	2.3
Change in expected returns	-4.1	-3.4
Investment year realization	6.9	5.9
Investment decisions	-3.8	-3.0

Funding ratio attribution

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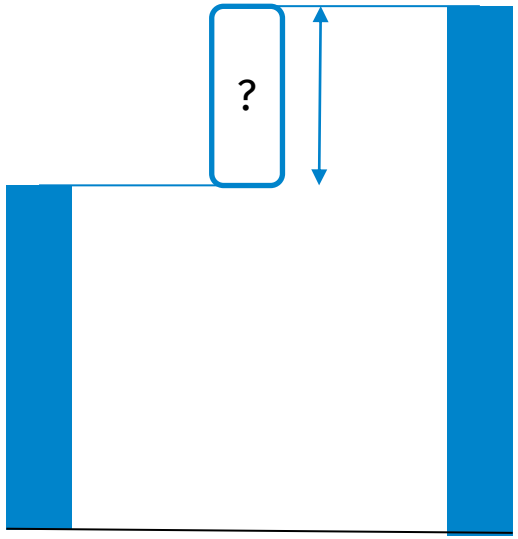


Introduction to Funding ratio

Decomposition of ratio changes

Detail concerns – Liabilities repricing frequency

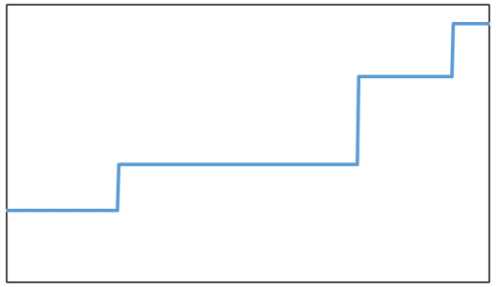
Summary

Details – Liability repricing frequency

Shocks and continual changes

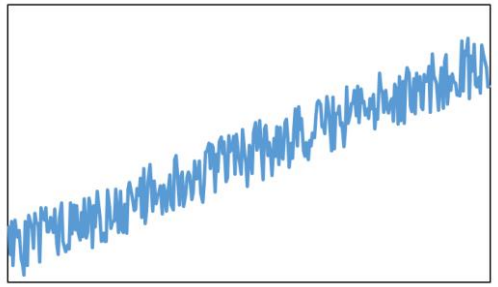
Growth of liabilities, may come …

in shocks



- Change in expected equity returns (> 1Y)
- Change in SAA asset-mix (> 1Y)
- Realized inflation (1Q-1Y)
- Update in life expectancy (> 1Y)
- Subscription/Redemptions (1M-1Y)
- New/Terminated business (1M-1Y)

'continuous'



- Accrual
- Change in expected bond returns
- Change in expected inflation

Details – Liability repricing frequency

Needs for frequent repricing

Many sources can typically be modelled as a once-a-year shock impact

Stale pricing should not be used for

- Change in expected bond returns
  - Change in expected inflation
- Accrual
- For ‘open’ schemes
  - Moved (new/terminated) business

Funding ratio attribution

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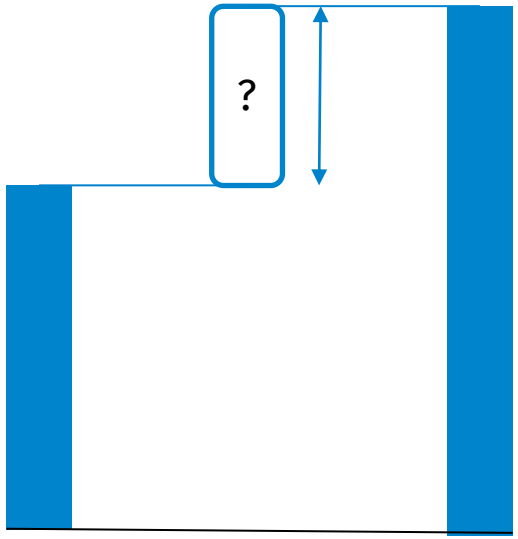

Introduction to Funding ratio

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Detail concerns – Integrating investment decision

Summary

Details – Integrating investment decisions

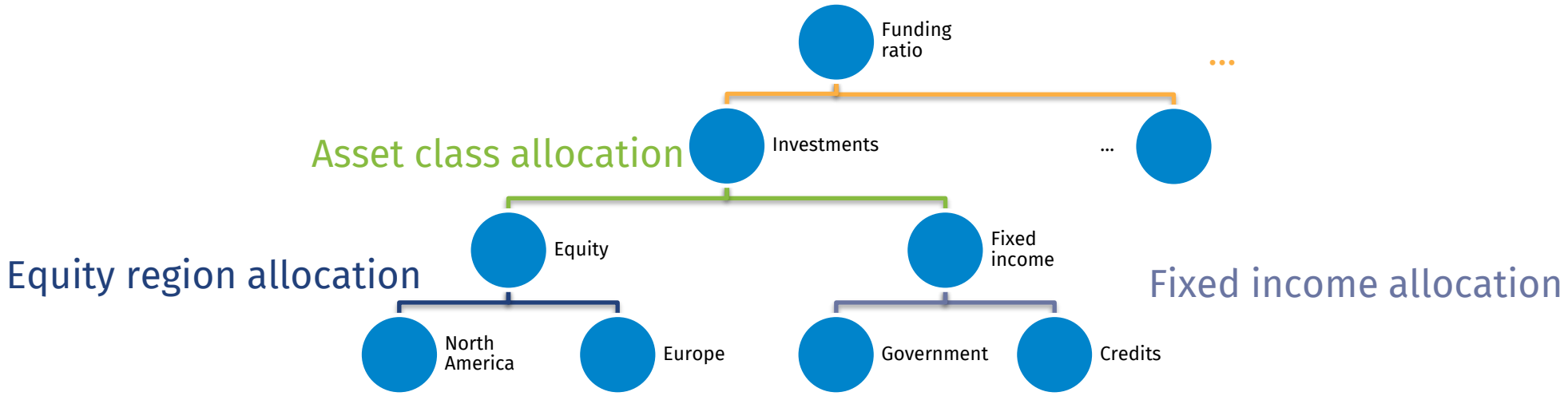
Investment decisions

Typical investment decisions

- Currency management
  - Strategical
  - Tactical
- Interest rate management
  - Strategical
  - Tactical
- Tactical asset mix
- Implementation decisions

Details – Integrating investment decisions

Model structure



Details – Integrating investment decisions

Micro attribution framework

	Actuarial	Asset class	EQ Region	FI Alloc
Top	-3.7	-3.4	0.7	-1.1
…	-3.7			
Investments		-3.4	0.7	-1.1
Equity		-1.9	0.7	
North America			0.5	
Europe			0.2	
Fixed income		-1.5		-1.1
Government				-0.3
Credits				-0.8

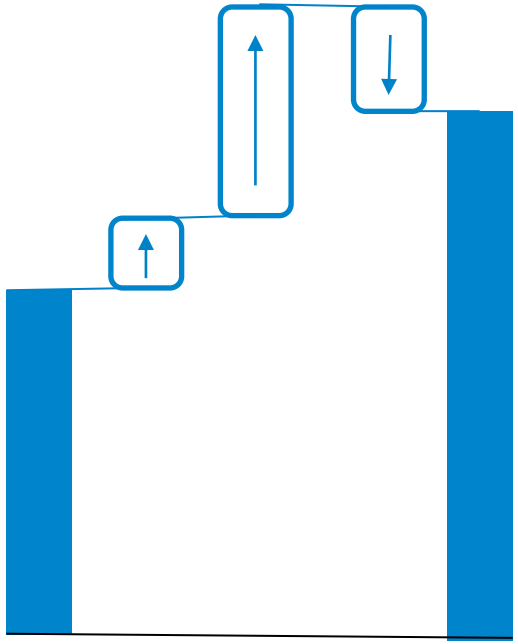
Details – Integrating investment decisions

Transposed

Total funding ratio change	-7.5
Actuarial Impact	-3.7
Investment decisions	-3.8
Asset class	-3.4
EQ Region	0.7
FI Allocation	-1.1

Funding ratio attribution

Overview



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Summary

Summary and time for questions

- Funding ratio attribution by molding data into existing formula sets
  - Treat growth as investment returns
  - Treat risk factors as investment decisions

- Specific circumstances require proper modelling choices
  - Solvency ratio and DC scheme differences
  - Regulatory framework
  - Model to transform discount rate into investible benchmark
  - Liability valuation frequency

Contact me

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Background

Maarten Niederer, CFA, CIPM holds a Master degree in Computer Science from Utrecht University. Since joining Ortec Finance in 2008, Maarten has held several roles within the Investment Performance department. These roles ranged from business consultant, subject matter expert to software developer. Maarten is currently employed as a software developer for the PEARL solution.

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