IIPC Illmer Investment Performance Consulting AG

Decision-oriented decomposition of the absolute and relative portfolio duration

Date: September 2014

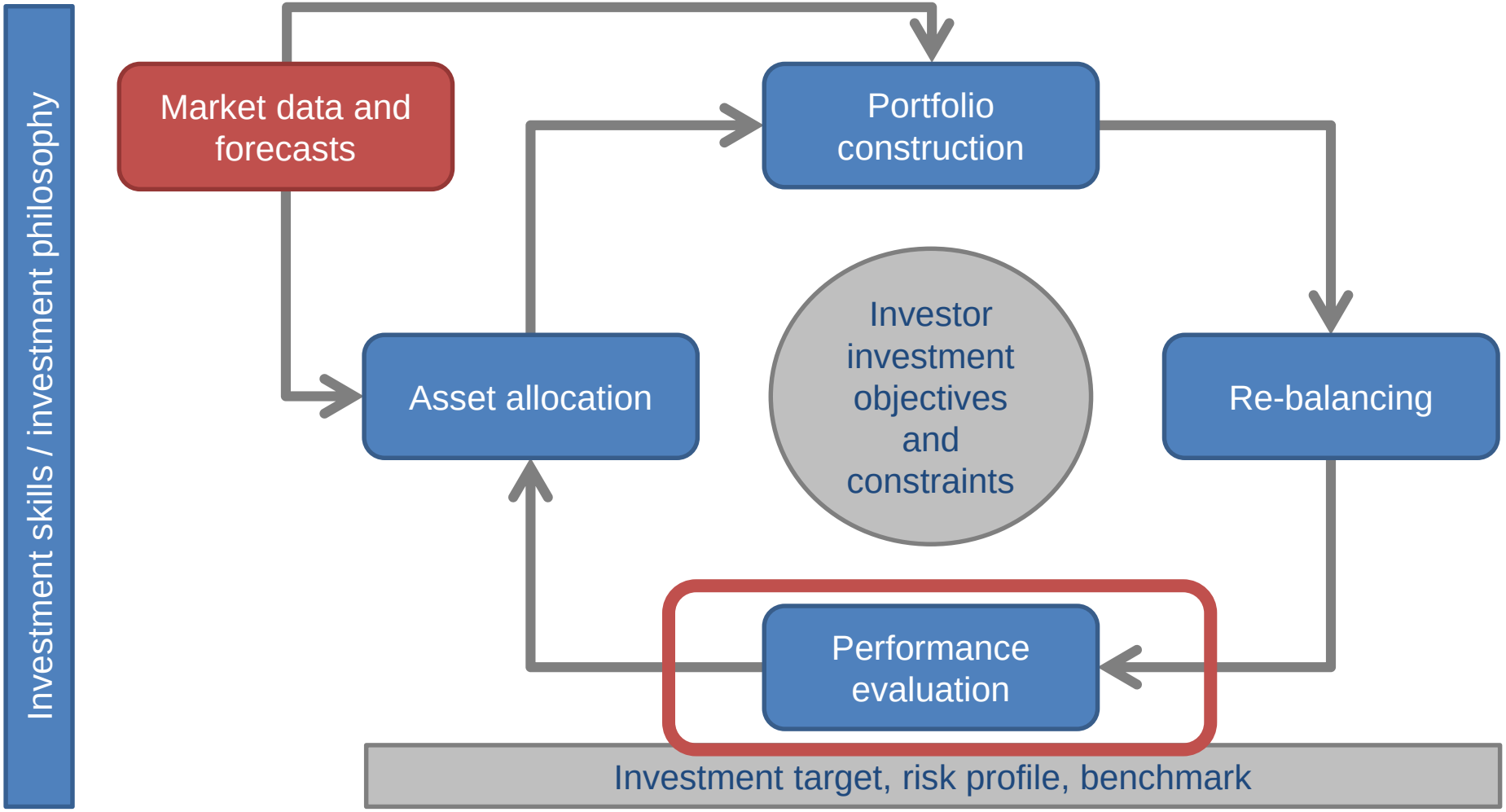
Produced by: Dr. Stefan J. Illmer

Agenda

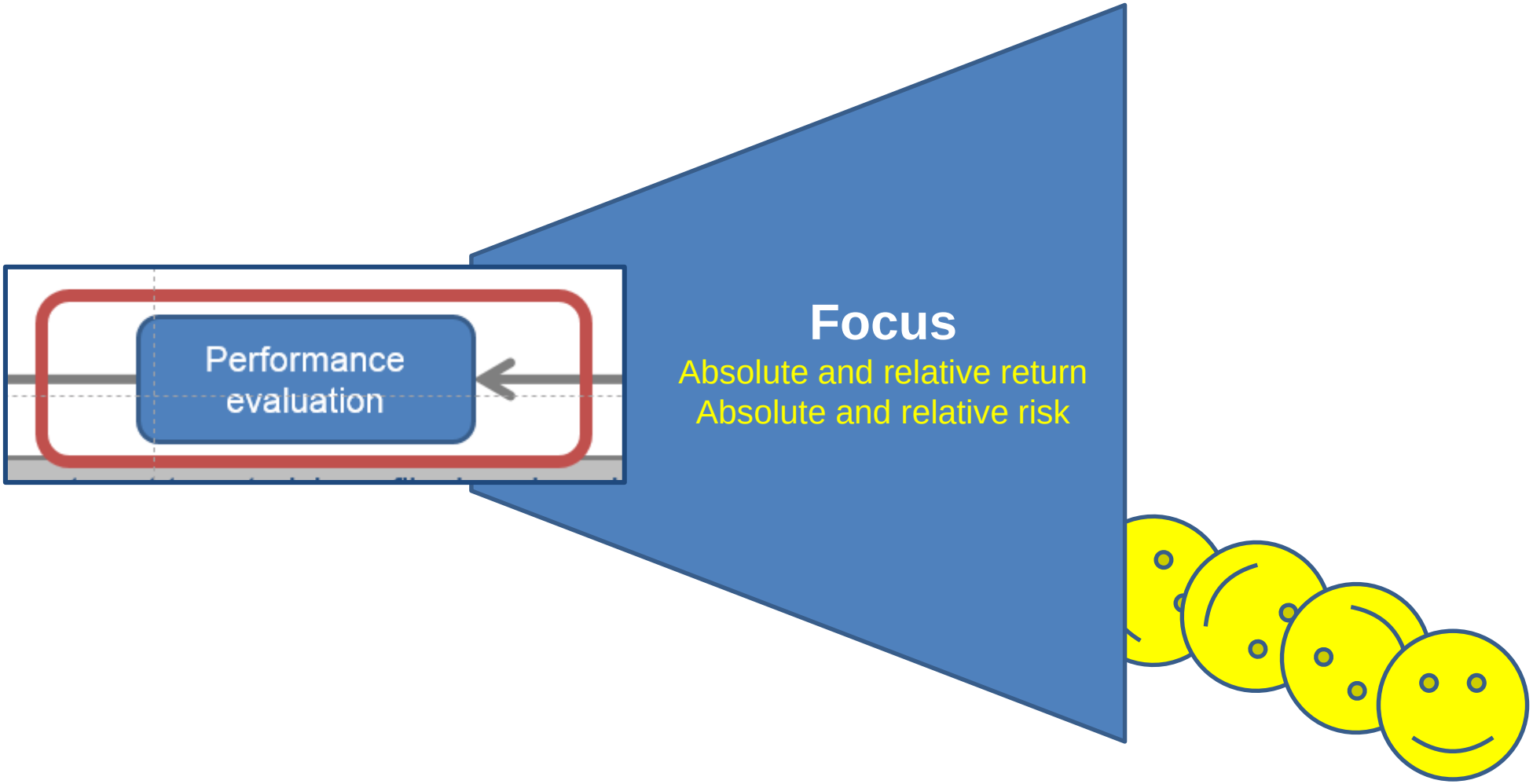
- Is the concept of performance attribution only useful for analyzing performance?
- Concept of decision-oriented investment analysis
- Background information for the case study
- Applying the return attribution concept to decompose the absolute and relative portfolio duration
- Decision-oriented decomposition of the absolute and relative portfolio duration
- Discussion
- Contact details and disclaimer

Is the concept of performance attribution only useful for analyzing performance?

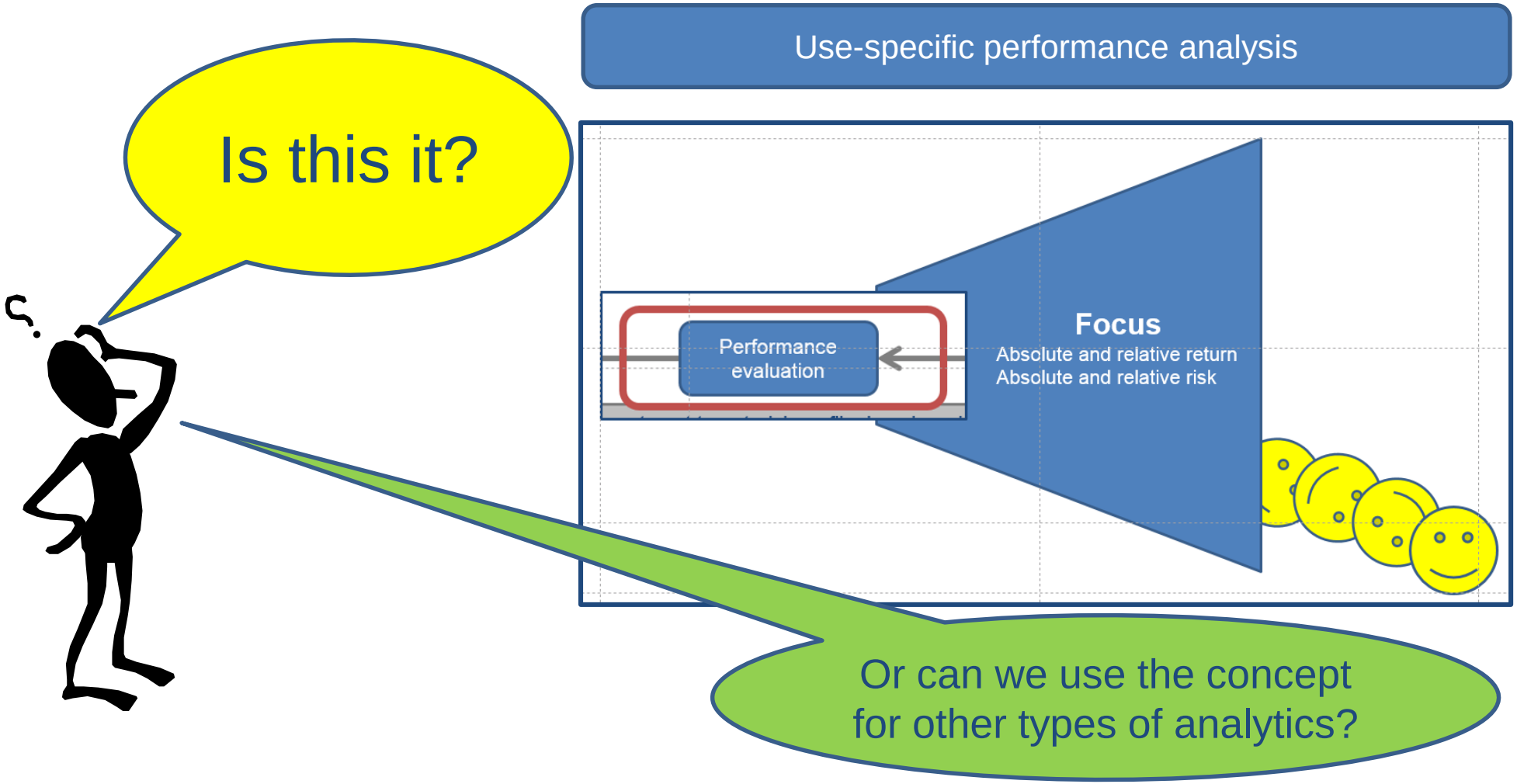
Focus of performance attribution (1/3)



Focus of performance attribution (2/3)



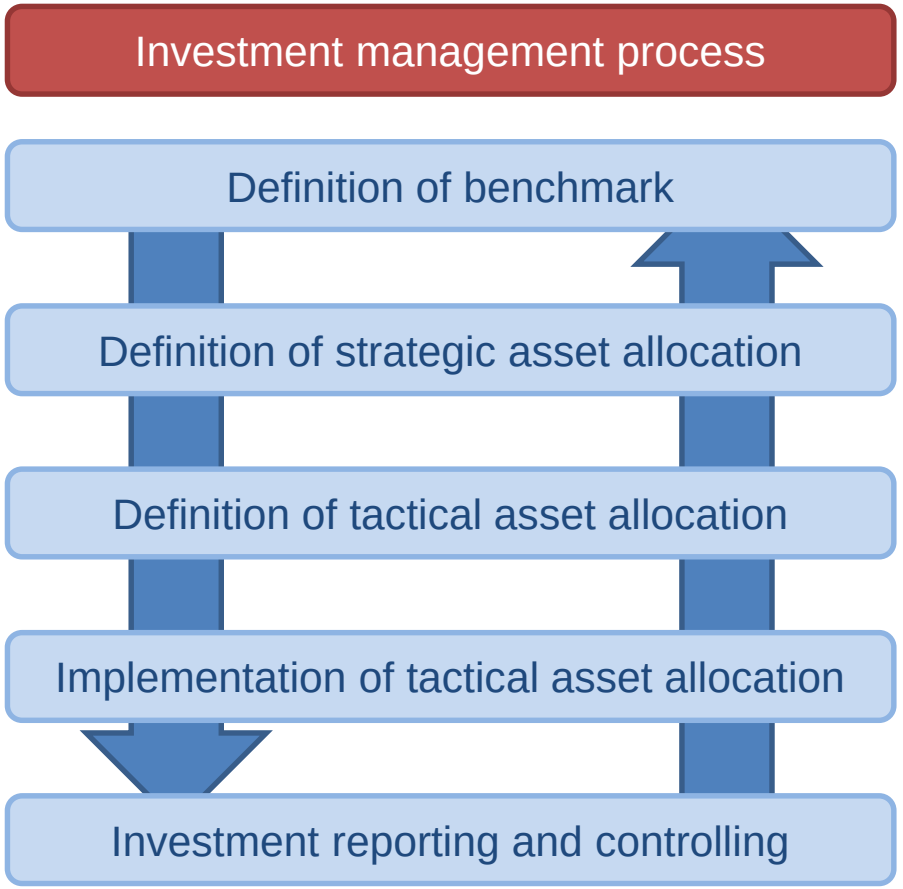
Focus of performance attribution (3/3)



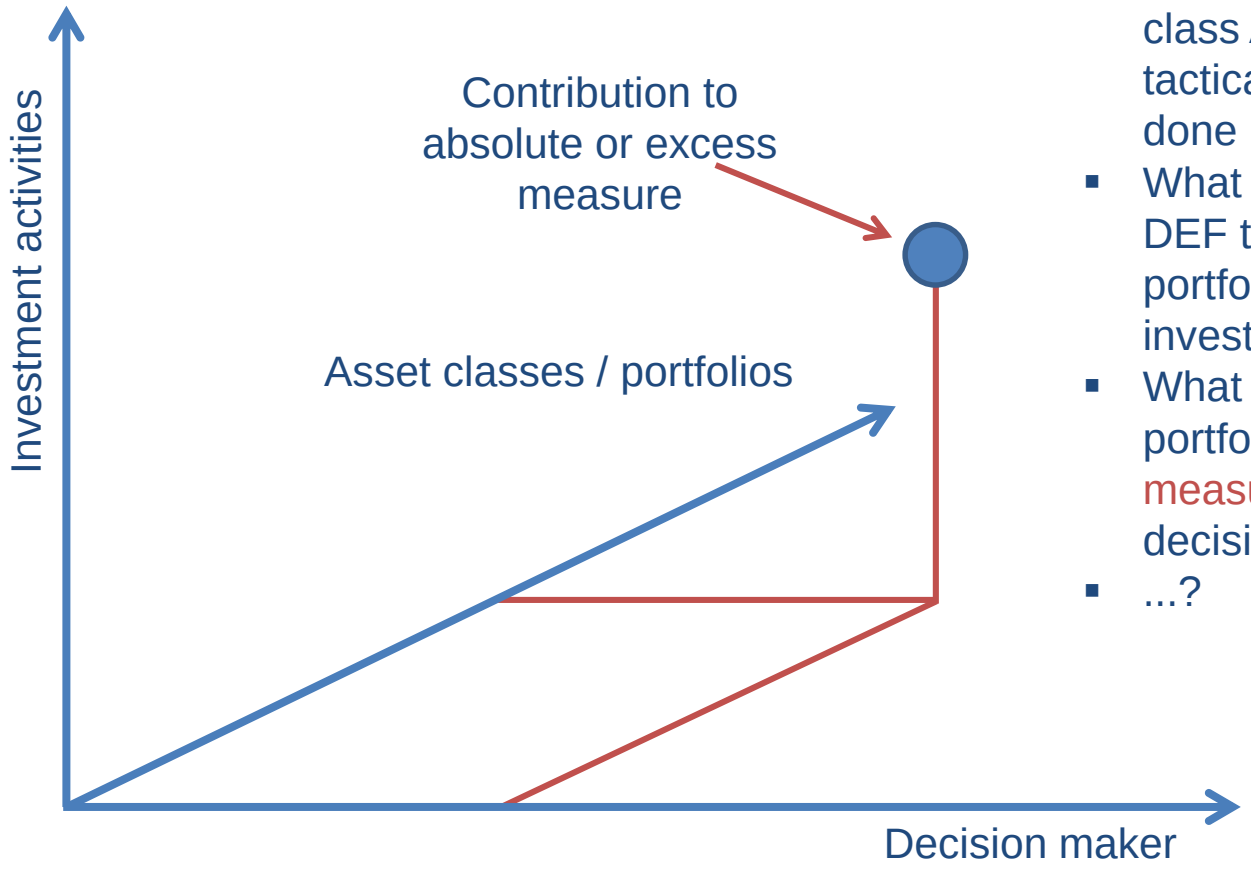
Concept of decision-oriented investment analysis

Definition

Decision-oriented investment analysis is the decomposition of a specific absolute (excess) measure for an investment portfolio according to specific investment decisions done by specific decision makers.
The decomposition approach is difficult to standardize and therefore usually tailor-made as the relevant investment management processes differ – sometimes substantially.



Aspects addressed and clarified



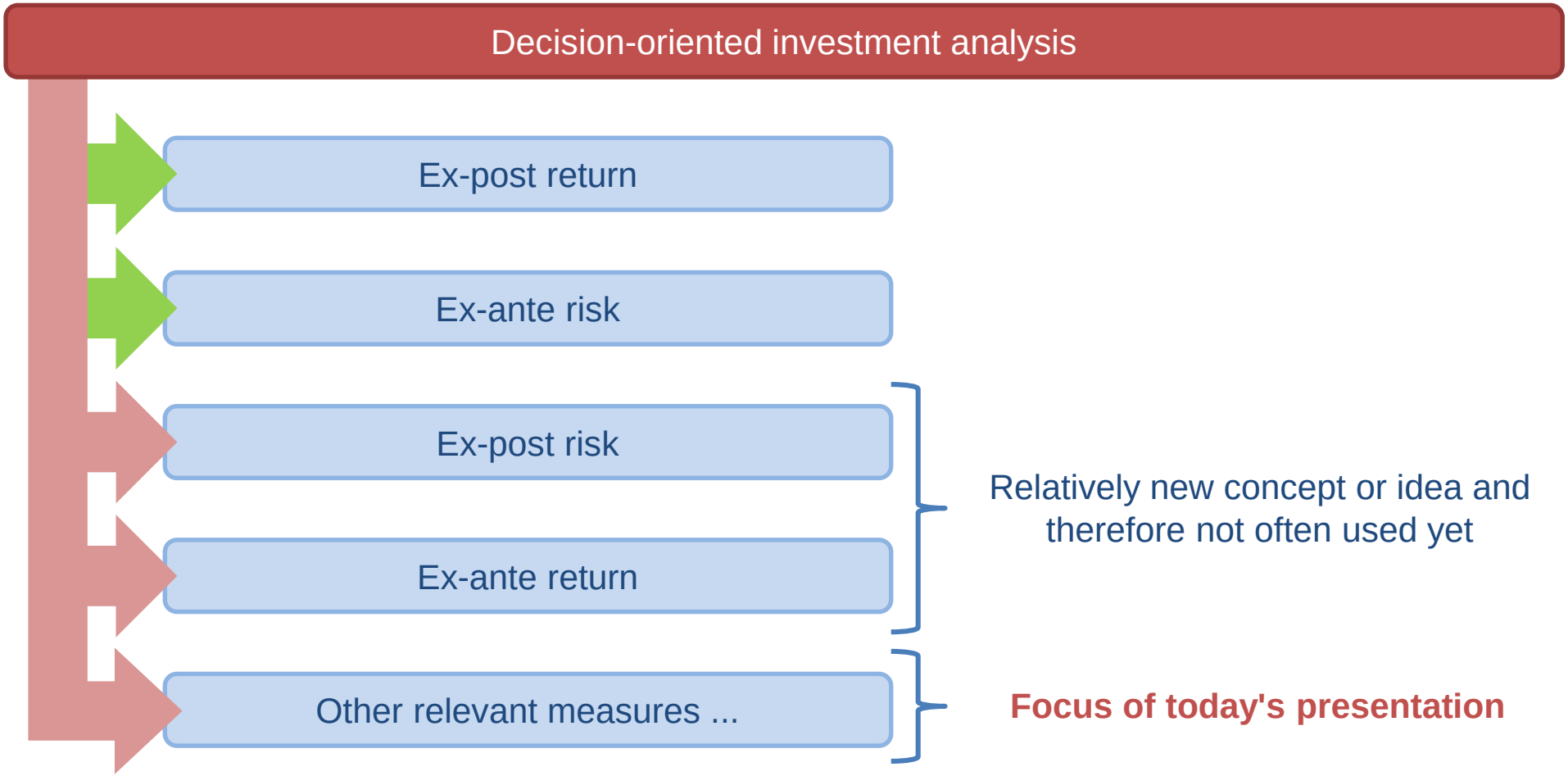
- What is the contribution of the asset class ABC to excess measure due to tactical asset allocation decisions done by the investment committee?
- What is the contribution of portfolio DEF to absolute measure due to portfolio positioning done by the investment committee?
- What is the contribution of the portfolio manager GHI to excess measure due to security selection decisions?
- ...?

Generic decomposition approach

Decision-oriented decomposition of a specific absolute (excess) measure allows to quantify the contribution of the individual decisions and decision makers, and is based on the following steps:

- Step 1: Identify the circumstances, the investment management setup, and derive relevant assumptions for the calculation.
- Step 2: Mirror the specific investment decisions into (absolute) asset allocations.
- Step 3: Calculate the corresponding measures.
- Step 4: Assign the measures or its contributions as well as the differences of the measures to the investment decisions and to the relevant decision makers.

Current applications of the generic concept

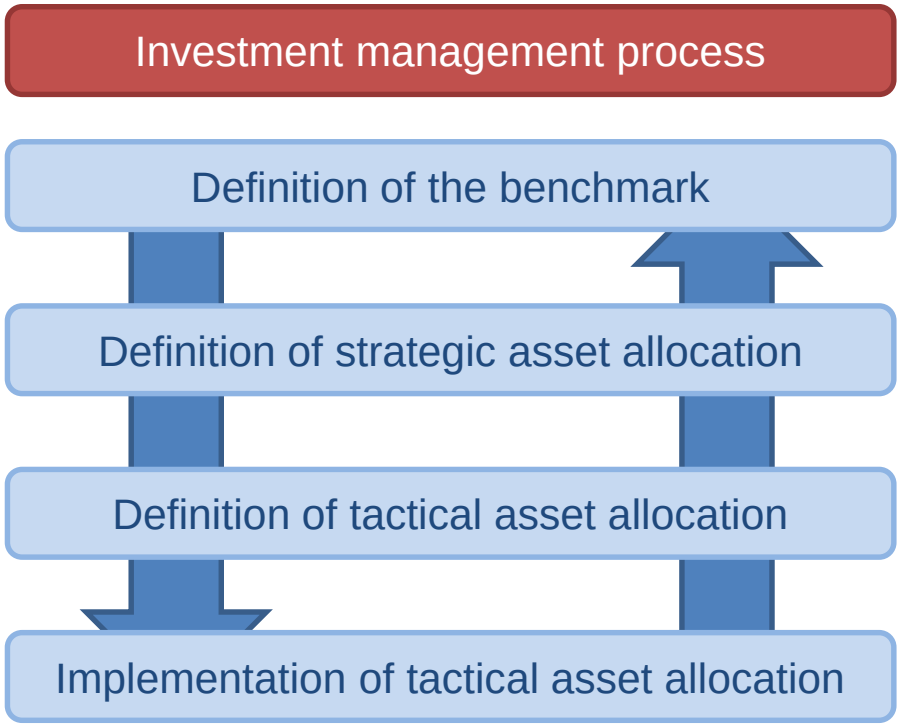


Background information for the case study

Background information (1/2)

Relevant information for the case study:

1) Medium size pension plan.
2) Only Euro and European investments.
3) Three asset classes: short and long term fixed income as well as equity.
3) No use of derivatives.
4) Three decision makers: Board of directors, investment committee and internal portfolio managers.
5) Simple investment process.
6) Duration of liabilities: 20 years.
7) Investment target: Excess return of 2% over the interest paid on the liabilities.



Background information (data all in Euro and as of 30th of June) (2/2)

1

Benchmark	Weight	Modified Duration in Years
Euro fixed income - long term	100.00%	20.00
Euro fixed income - short term	0.00%	0.00
European equity	0.00%	0.00
Total assets	100.00%	20.00

2

Strategic asset allocation	Weight	Modified Duration in Years
Euro fixed income - long term	60.00%	11.00
Euro fixed income - short term	0.00%	0.00
European equity	40.00%	0.00
Total assets	100.00%	6.60

3

Tactical asset allocation	Weight	Modified duration in years
Euro fixed income - long term	50.00%	11.00
Euro fixed income - short term	10.00%	1.00
European equity	40.00%	0.00
Total assets	100.00%	5.60

4

Portfolio asset allocation	Weight	Modified duration in years
Euro fixed income - long term	30.00%	12.00
Euro fixed income - short term	30.00%	2.00
European equity	40.00%	0.00
Total assets	100.00%	4.20

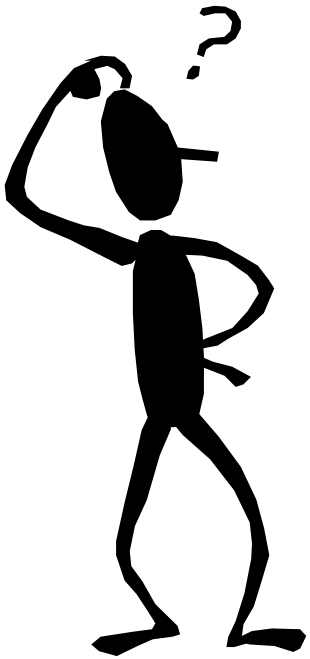
How was the short duration generated?
What decision and who added what to the portfolio duration?

... especially if considering that the duration of the total assets is depending on weight (allocation) and duration (selection) decisions.

Applying the return attribution concept to decompose the absolute and relative portfolio duration

Initial thoughts

What should be the focus of the investment analysis?



Like with the portfolio return or risk, the portfolio duration is the result of different decisions:
– Asset allocation decision
– Security selection decision
...
of course, we could also consider other decisions on credit, currency, selection, maturity, etc.,
...
important considerations but normally if analyzing a single or a group of fixed income portfolio(s),
...
and not, as in our example, when analyzing the big picture and therefore:
– Asset allocation and
– **Duration** selection.

Decomposing portfolio duration – necessary inputs

- Weights of the different asset classes or asset segments for the portfolio at the relevant reporting date.
- Weights of the different asset classes or asset segments for the benchmark at the relevant reporting date.
- Duration of the different asset classes or asset segments for the portfolio at the relevant reporting date.
- Duration of the different asset classes or asset segments for the benchmark at the relevant reporting date.

Contribution to duration (1/2)

$$D_p = \sum_{i=1}^{n} CD_p^i$$

$$where \;\; CD_p^i = w_p^i \times d_p^i$$

D_p = *Portfolio duration.*
CD_p^i = *Contribution of asset class i to portfolio duration.*
w_p^i = *Weight of asset class i in portfolio.*
d_p^i = *Duration of asset class i in portfolio.*

Contribution to duration (2/2)

$$D_b = \sum_{i=1}^{n} CD_b^i$$

$$where \;\; CD_b^i = w_b^i \times d_b^i$$

D_b = *Benchmark duration.*
CD_b^i = *Contribution of asset class i to benchmark duration.*
w_b^i = *Weight of asset class i in benchmark.*
d_b^i = *Duration of asset class i in benchmark.*

$$ED = D_p - D_b = \sum_{i=1}^{n} \left(CD_p^i - CD_b^i \right)$$

ED = *Excess duration.*

Contribution to duration – Example

	Portfolio			Strategic asset allocation						Total
	Duration	Weight	Contri-bution	Duration	Weight	Contri-bution				
Euro fixed income - long term	12.00	30.00%	3.60	11.00	60.00%	6.60				-3.00
Euro fixed income - short term	2.00	30.00%	0.60	0.00	0.00%	0.00				0.60
European equity	0.00	40.00%	0.00	0.00	40.00%	0.00				0.00
Total assets	4.20	100.00%	4.20	6.60	100.00%	6.60				-2.40

Remark: Here we analyze the excess duration of the actual portfolio against the strategic asset allocation and not versus the – very long term – benchmark.

Assuming a simple decision making process

Here we assume the following three step decision making process and decompose the excess duration accordingly:

Step 1: Strategic asset allocation (weights and duration of asset classes).

Step 2: Actual asset allocation (over- and underweighting of asset classes).

Step 3: Duration selection (extending and reducing of duration of asset classes).

Management effects

- (Actual) asset allocation effect

  Contribution to excess duration due to the over- and underweighting of asset classes.

- Duration selection effect

  Contribution to excess duration due to extending and reducing the duration of asset classes.

- Interaction effect

  Contribution to excess duration due to the over- and underweighting of asset classes with extended or reduced duration.

Contribution to excess duration (1/2)

$$ED = D_p - D_b$$
$$\Rightarrow ED = AAE_{Total} + DSE_{Total} + IAE_{Total}$$
$$\Rightarrow ED = \sum_{i=1}^{n} CAAE_i + \sum_{i=1}^{n} CDSE_i + \sum_{i=1}^{n} CIAE_i$$

Remark: There are different ways for calculating the management effects. The used methodology is based on the return attribution methodology of Brinson, Hood and Beebower.

$$CED_i = CAAE_i + CDSE_i + CIAE_i$$
$$AAE_{Total} = \sum_{i=1}^{n} CAAE_i = \sum_{i=1}^{n} \left(w_p^i - w_b^i\right) \times d_b^i$$
$$DSE_{Total} = \sum_{i=1}^{n} CDSE_i = \sum_{i=1}^{n} \left(d_p^i - d_b^i\right) \times w_b^i$$
$$IAE_{Total} = \sum_{i=1}^{n} CIAE_i = \sum_{i=1}^{n} \left[\left(w_p^i - w_b^i\right) \times \left(d_p^i - d_b^i\right)\right]$$

Contribution to excess duration (2/2)

AAE_{Total} = *Total (actual) asset allocation effect.*
DSE_{Total} = *Total duration selection effect.*
IAE_{Total} = *Total interaction effect.*
$CAAE_i$ = *Contribution of asset class i to total asset allocation effect.*
$CDSE_i$ = *Contribution of asset class i to total duration selection effect.*
$CIAE_i$ = *Contribution of asset class i to total interaction effect.*
CED_i = *Contribution of asset class i to excess duration.*

No management effects – Example

	Portfolio			Strategic asset allocation			Management effects			
	Duration	Weight	Contri-bution	Duration	Weight	Contri-bution	Asset allocation	Duration selection	Interaction	Total
Euro fixed income - long term	11.00	60.00%	6.60	11.00	60.00%	6.60	0.00	0.00	0.00	0.00
Euro fixed income - short term	0.00	0.00%	0.00	0.00	0.00%	0.00	0.00	0.00	0.00	0.00
European equity	0.00	40.00%	0.00	0.00	40.00%	0.00	0.00	0.00	0.00	0.00
Total assets	6.60	100.00%	6.60	6.60	100.00%	6.60	0.00	0.00	0.00	0.00

Remark: Here no bets, everything is indexed.

Asset allocation effect – Example

	Portfolio			Strategic asset allocation			Management effects			
	Duration	Weight	Contri-bution	Duration	Weight	Contri-bution	Asset allocation	Duration selection	Interaction	Total
Euro fixed income - long term	11.00	30.00%	3.30	11.00	60.00%	6.60	-3.30	0.00	0.00	-3.30
Euro fixed income - short term	0.00	30.00%	0.00	0.00	0.00%	0.00	0.00	0.00	0.00	0.00
European equity	0.00	40.00%	0.00	0.00	40.00%	0.00	0.00	0.00	0.00	0.00
Total assets	3.30	100.00%	3.30	6.60	100.00%	6.60	-3.30	0.00	0.00	-3.30

Remark: Here asset class duration equals the benchmark duration.

Duration selection effect – Example

	Portfolio			Strategic asset allocation			Management effects			Total
	Duration	Weight	Contri-bution	Duration	Weight	Contri-bution	Asset allocation	Duration selection	Interaction	
Euro fixed income - long term	12.00	60.00%	7.20	11.00	60.00%	6.60	0.00	0.60	0.00	0.60
Euro fixed income - short term	2.00	0.00%	0.00	0.00	0.00%	0.00	0.00	0.00	0.00	0.00
European equity	0.00	40.00%	0.00	0.00	40.00%	0.00	0.00	0.00	0.00	0.00
Total assets	7.20	100.00%	7.20	6.60	100.00%	6.60	0.00	0.60	0.00	0.60

Remark: Here asset class weights equals benchmark weights.

Total picture – Example

	Portfolio			Strategic asset allocation			Management effects			
	Duration	Weight	Contri-bution	Duration	Weight	Contri-bution	Asset allocation	Duration selection	Interaction	Total
Euro fixed income - long term	12.00	30.00%	3.60	11.00	60.00%	6.60	-3.30	0.60	-0.30	-3.00
Euro fixed income - shortterm	2.00	30.00%	0.60	0.00	0.00%	0.00	0.00	0.00	0.60	0.60
European equity	0.00	40.00%	0.00	0.00	40.00%	0.00	0.00	0.00	0.00	0.00
Total assets	4.20	100.00%	4.20	6.60	100.00%	6.60	-3.30	0.60	0.30	-2.40

Remark: Management effects should reflect the investment process !

Decision-oriented decomposition of the absolute and relative portfolio duration

Step 1 (Investment process) (1/2)

Analyze the circumstances or characteristics relevant for the investment portfolio:

- Decision makers:
  - Board of directors.
  - Investment committee.
  - Internal portfolio managers.
- Monthly revolving investment management process.
- Investment portfolio invests in three asset classes:
  - Euro fixed income – long term.
  - Euro fixed income – short term.
  - European equities.

Example – Step 1 (Investment process) (2/2)

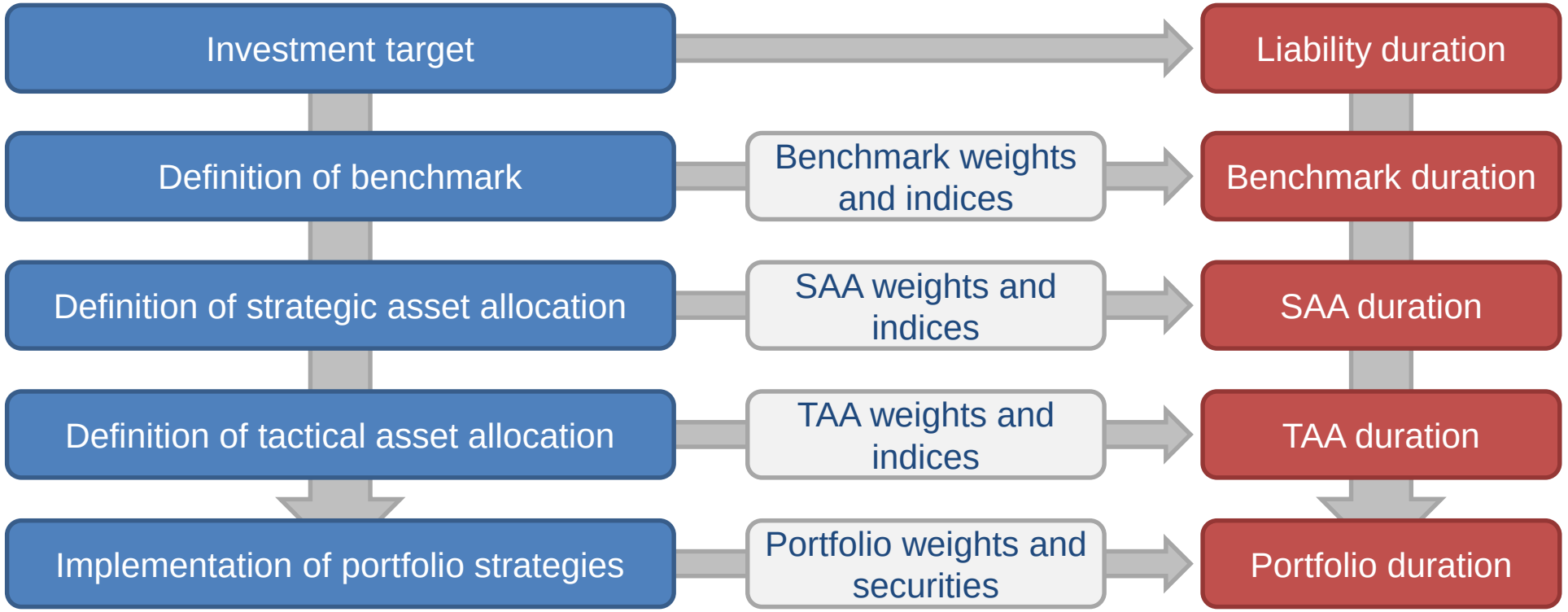
- Investments are managed through three sub-portfolios – one for each asset class.
- No specific investment restrictions to be considered.
- 4 step investment management process:
  - Definition of benchmark.
  - Definition of strategic asset allocation.
  - Definition of tactical asset allocation.
  - Implementation of portfolio strategies.

Example – Step 2 (Mirror investment decisions)

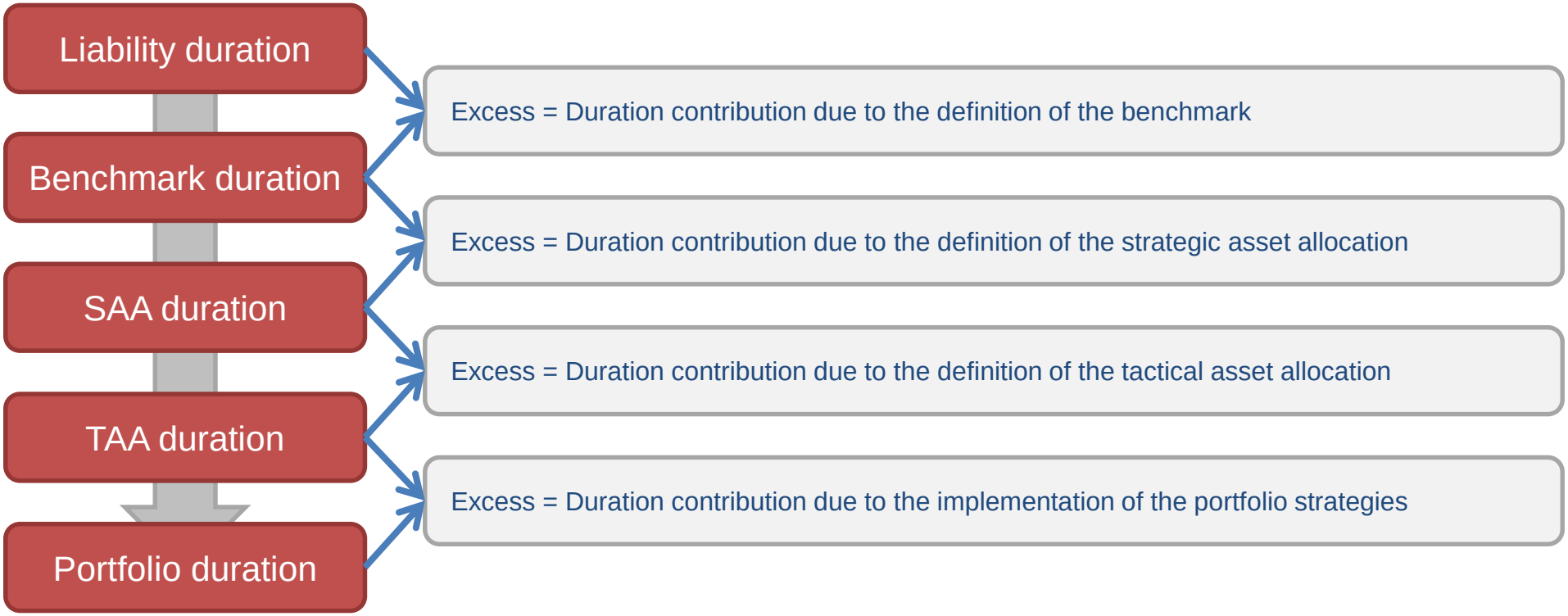
Weights	Benchmark	Strategic asset allocation	Tactical asset allocation	Portfolio asset allocation
Euro fixed income - long term	100.00%	60.00%	50.00%	30.00%
Euro fixed income - short term	0.00%	0.00%	10.00%	30.00%
European equity	0.00%	40.00%	40.00%	40.00%
Total assets	100.00%	100.00%	100.00%	100.00%

Durations	Benchmark	Strategic asset allocation	Tactical asset allocation	Portfolio asset allocation
Euro fixed income - long term	20.00	11.00	11.00	12.00
Euro fixed income - short term	0.00	0.00	1.00	2.00
European equity	0.00	0.00	0.00	0.00
Total assets	20.00	6.60	5.60	4.20

Example – Step 3 (Calculation of durations) (1/3)



Example – Step 3 (Calculation of durations) (2/3)



Example – Step 3 (Calculation of durations) (3/3)

Portfolio duration
4.20 years

-

Liability duration
20.00 years

Excess duration for the investment portfolio => **- 15.80 years**

= Duration contribution due to benchmark definition => **0 years**

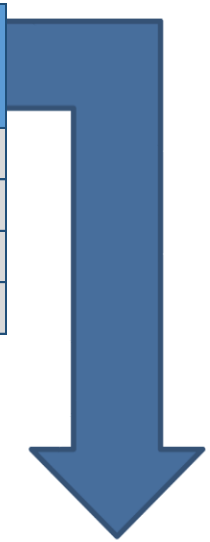
+ Duration contribution due to strategic asset allocation => **- 13.40 years**

+ Duration contribution due to tactical asset allocation => **- 1.00 years**

+ Duration contribution due to implementation => **-1.40 years**

Example – Step 4 (Assigning of (excess) durations) (1/2)

	Management effects			Total
	Asset allocation	Duration selection	Interaction	
Euro fixed income - long term	-3.30	0.60	-0.30	-3.00
Euro fixed income - shortterm	0.00	0.00	0.60	0.60
European equity	0.00	0.00	0.00	0.00
Total assets	-3.30	0.60	0.30	-2.40



Duration contributions	Investment committee	Portfolio manager	Total
Euro fixed income - long term	-1.10	-1.90	-3.00
Euro fixed income - short term	0.10	0.50	0.60
European equity	0.00	0.00	0.00
Total assets	-1.00	-1.40	-2.40

Remark: Here we analyze the excess duration of the actual portfolio against the strategic asset allocation and not versus the – very long term – benchmark.

Discussion

Discussion – What other measures could be analyzed?

Decision Investment analysis
Attribution
Contribution Investment
process Decision makers Return
Risk Ex-post Ex-ante
Performance Absolute Excess
Relative ...


thank you!

Contact details and disclaimer

Contact details

Illmer Investment Performance Consulting AG
Weinbergstrasse 28
CH - 8200 Schaffhausen
Switzerland
www.iipc-ag.com

Dr. Stefan Joachim Illmer
Tel. +41 / 79 / 962 20 37
Email: stefan.illmer@iipc-ag.com

Disclaimer

This document was produced by Illmer Investment Performance Consulting AG (hereafter "IIPC-AG") with the greatest of care and to the best of its knowledge and belief. However, IIPC-AG provides no guarantee with regard to its content and completeness and does not accept any liability for losses which might arise from making use of this information. This document is provided for information purposes only and is for the exclusive use of the recipient. It does not constitute an offer or a recommendation to buy or sell financial instruments or banking services.

It is expressly not intended for persons who, due to their nationality or place of residence, are not permitted access to such information under local law.