IIPC Illmer Investment Performance Consulting AG

Selected topics of performance measurement – Insights to the average invested capital

Date: 19.01.2017

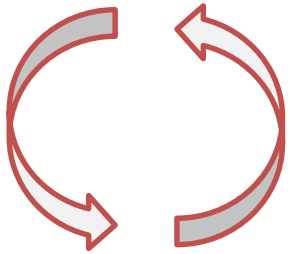
Produced by: Dr. Stefan J. Illmer

Starting point (1/3)

Capital budgeting

Capital budgeting, or **investment appraisal**, is the planning process used to determine whether an organization's long term investments such as new machinery, replacement of machinery, new plants, new products, and research development projects are worth the funding of cash through the firm's capitalization structure (debt, equity or retained earnings). It is the process of allocating resources for major capital, or investment, expenditures. One of the primary goals of capital budgeting investments is to increase the value of the firm to the shareholders.
=> put from WIKIPEDIA

Capital budgeting uses expected returns and is therefore forward looking.



Performance measurement

Performance measurement is the process of collecting, analyzing and/or reporting information regarding the performance of an individual, group, organization, system or component. It can involve studying processes/strategies within organizations, or studying engineering processes/parameters/phenomena, to see whether output are in line with what was intended or should have been achieved.
=> put from WIKIPEDIA

Performance measurement calculates historical returns and is therefore backward looking.

Starting point (2/3)

... but I also have other questions to answer

Now, I understand the measure for the return of a portfolio manager.

Performance analyst

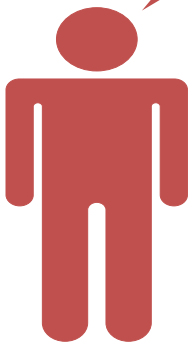
Did I meet my expectations?

Client / User

Starting point (3/3)

... but on a related topic.

Don't worry. This is not another talk on money-weighted rate return ...



Stefan Illmer

What is the average invested capital?

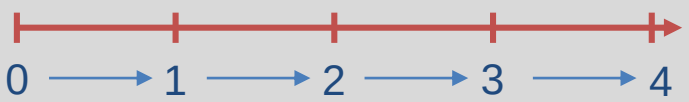
Client / User

What do we know about the average invested capital (1/13)

- The average invested capital (AIC) is the basis for the return calculation.

$$Return = \frac{Gain\ and\ loss}{Average\ invested\ capital}$$

- The AIC is the average of the money invested over the total measurement period.



AIC = Average of the money invested over the whole period (0 to 4).

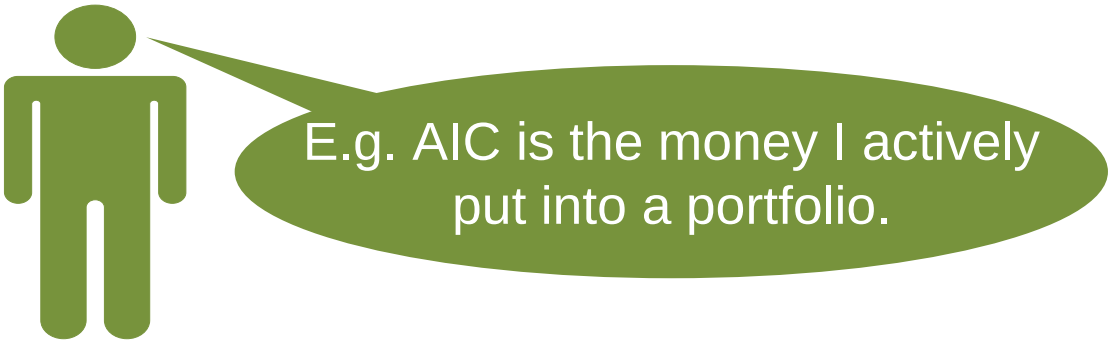
AIC <> Average of the AICs of the 4 sub-periods.

What do we know about the average invested capital (2a/13)

- Example – with no interim cash flows:

T	0	1	2	3
Portfolio value	100.00	101.30	102.21	102.82
AIC whole period	100.00			
AIC of sub-period		100.00	101.30	102.21
AIC using AIC of sub-periods	101.17			

=> What is the correct AIC? => It depends ... on the relevant question.



=> AIC = 100

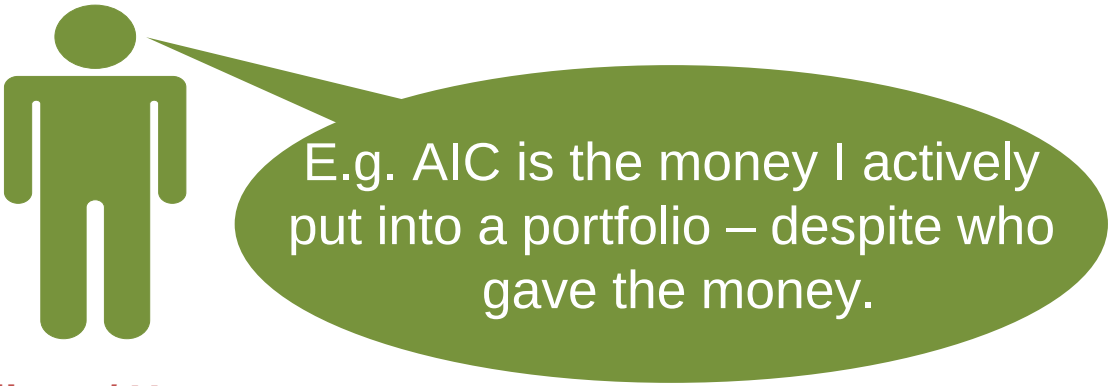
Client / User

What do we know about the average invested capital (2b/13)

- Example – with no interim cash flows:

T	0	1	2	3
Portfolio value	100.00	101.30	102.21	102.82
AIC whole period	100.00			
AIC of sub-period		100.00	101.30	102.21
AIC using AIC of sub-periods	101.17			

=> What is if we use leverage and the 100 are borrowed?



Client / User

=> AIC = 100

What do we know about the average invested capital (3a/13)

- The AIC is measured in absolute and not in %-terms.

Period 1

Asset class	Portfolio		
	Weight	Return	Contribution
Cash EUR	10.00%	0.00%	0.00%
Bonds EUR	80.00%	1.00%	0.80%
Equities EUR	10.00%	5.00%	0.50%
Total	100.00%	1.30%	1.30%

Period 2

Asset class	Portfolio		
	Weight	Return	Contribution
Cash EUR	50.00%	0.00%	0.00%
Bonds EUR	40.00%	1.00%	0.40%
Equities EUR	10.00%	5.00%	0.50%
Total	100.00%	0.90%	0.90%

Period 3

Asset class	Portfolio		
	Weight	Return	Contribution
Cash EUR	80.00%	0.00%	0.00%
Bonds EUR	10.00%	1.00%	0.10%
Equities EUR	10.00%	5.00%	0.50%
Total	100.00%	0.60%	0.60%

Period 1 to 3

Asset class	Portfolio		
	Weight	Return	Contribution
Cash EUR	46.67%	0.00%	0.00%
Bonds EUR	43.33%	3.03%	1.31%
Equities EUR	10.00%	15.76%	1.51%
Total	100.00%	2.82%	2.82%

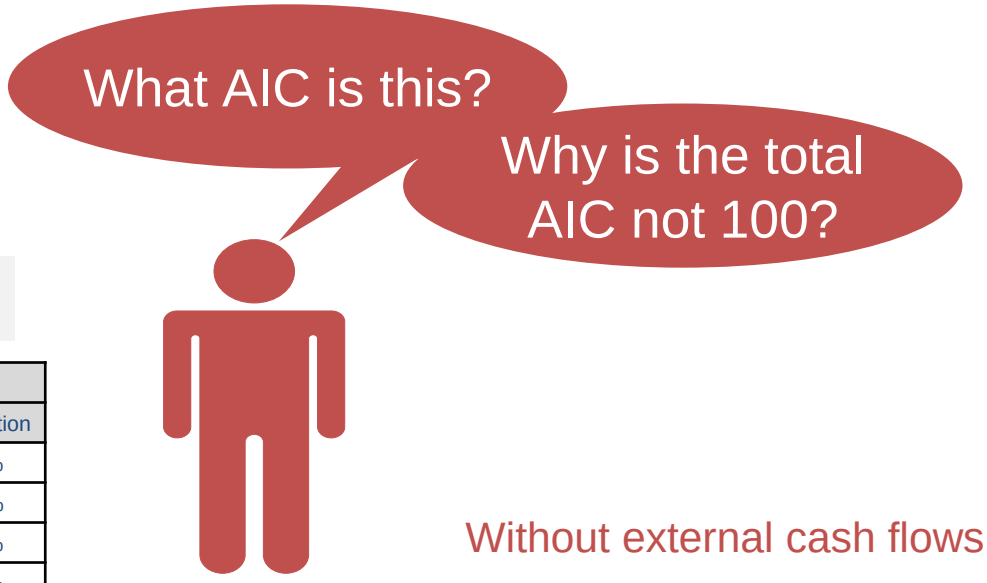
Excel - Spreadsheet

46.92%
43.08%
10.00%
100.00%

≠

Underlying calculation implies a specific definition of AIC

Asset class	Portfolio		
	Weight	Return	Contribution
Cash EUR	47.47	0.00%	0.00%
Bonds EUR	43.58	3.03%	2.33%
Equities EUR	10.12	15.76%	1.52%
Total	101.17	3.85%	3.85%



Without external cash flows

What do we know about the average invested capital (3b/13)

- The AIC is measured in absolute and not in %-terms.

Period 1

Asset class	Portfolio		
	Weight	Return	Contribution
Cash EUR	10.00%	0.00%	0.00%
Bonds EUR	80.00%	1.00%	0.80%
Equities EUR	10.00%	5.00%	0.50%
Total	100.00%	1.30%	1.30%

Period 2

Asset class	Portfolio		
	Weight	Return	Contribution
Cash EUR	50.00%	0.00%	0.00%
Bonds EUR	40.00%	1.00%	0.40%
Equities EUR	10.00%	5.00%	0.50%
Total	100.00%	0.90%	0.90%

Period 3

Asset class	Portfolio		
	Weight	Return	Contribution
Cash EUR	80.00%	0.00%	0.00%
Bonds EUR	10.00%	1.00%	0.10%
Equities EUR	10.00%	5.00%	0.50%
Total	100.00%	0.60%	0.60%

Period 1 to 3

Asset class	Portfolio		
	Weight	Return	Contribution
Cash EUR	46.67%	0.00%	0.00%
Bonds EUR	43.33%	3.03%	1.31%
Equities EUR	10.00%	15.76%	1.51%
Total	100.00%	2.82%	2.82%

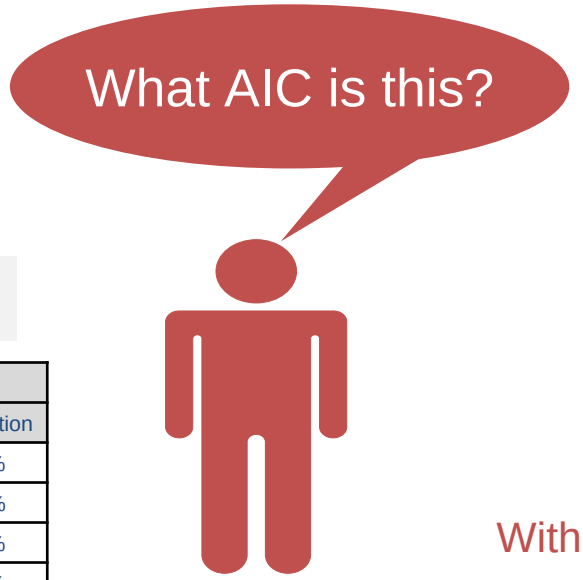
Excel - Spreadsheet

54.15%
35.85%
10.00%
100.00%

≠

Underlying calculation implies a specific definition of AIC

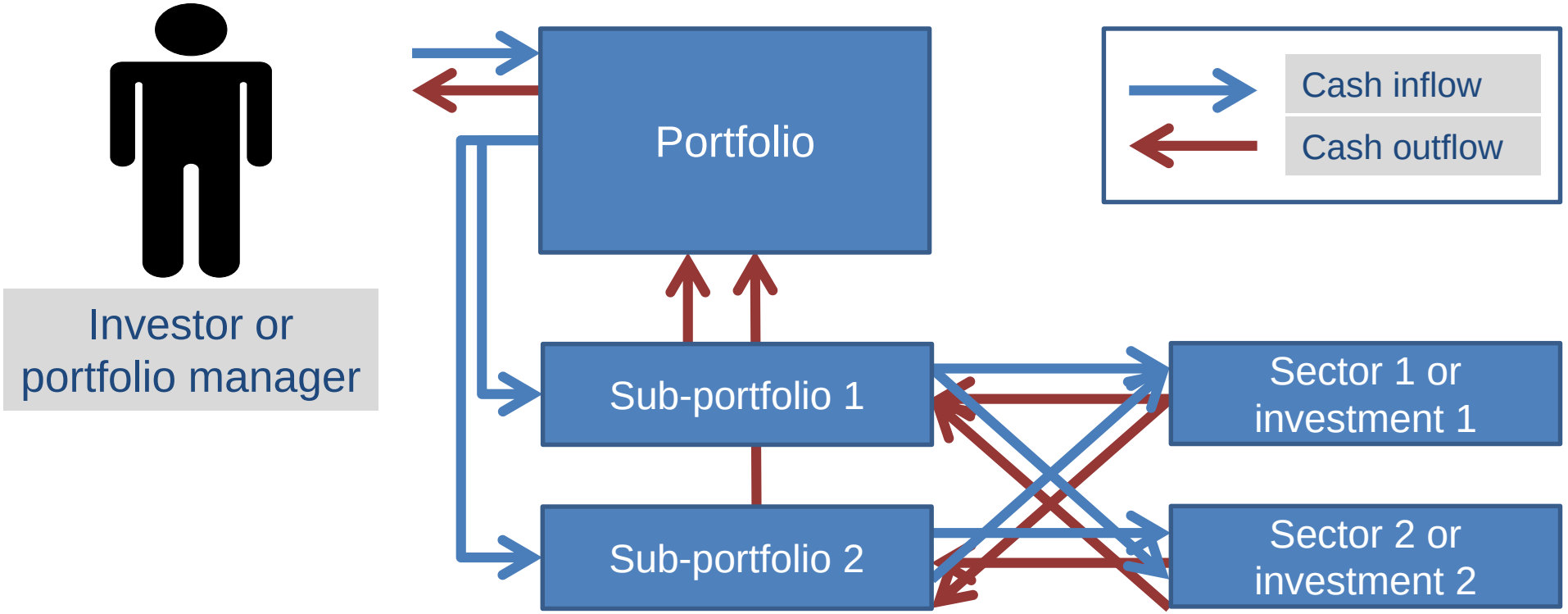
Asset class	Portfolio		
	Weight	Return	Contribution
Cash EUR	91.05	0.00%	0.00%
Bonds EUR	60.28	3.03%	2.33%
Equities EUR	16.81	15.76%	1.52%
Total	168.14	3.85%	3.85%



With external cash flows

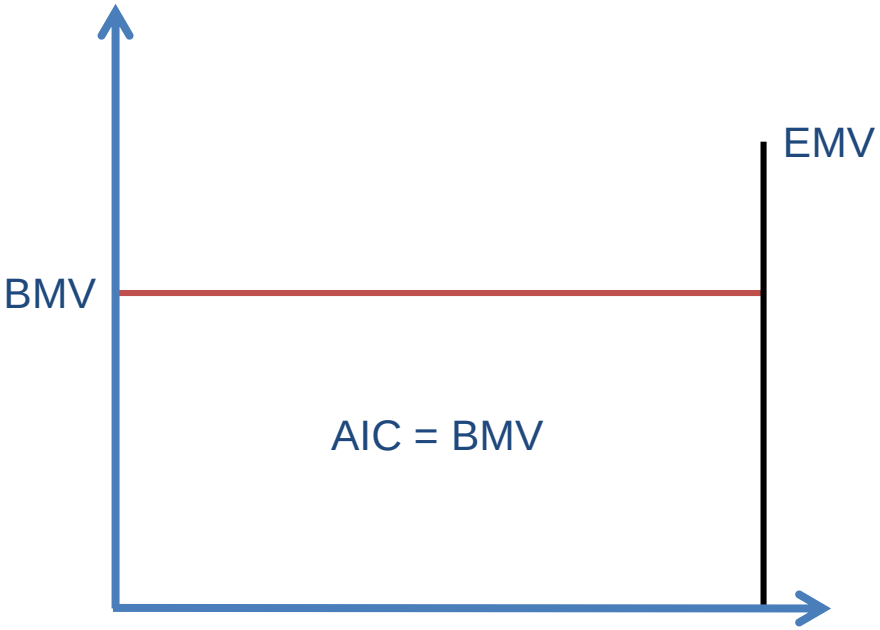
What do we know about the average invested capital (4/13)

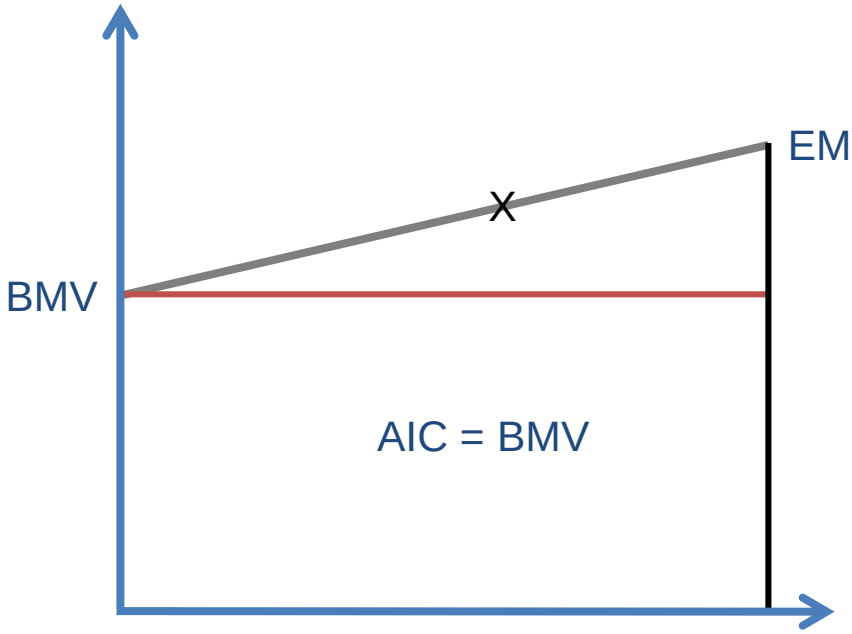
- The AIC depends on the external cash flows put into or withdraw from the (sub-)portfolio. Cash inflows increases and cash outflows decreases the AIC.



What do we know about the average invested capital (5/13)

- From a return measurement perspective, if there are no external cash flows then AIC equals the beginning market value.

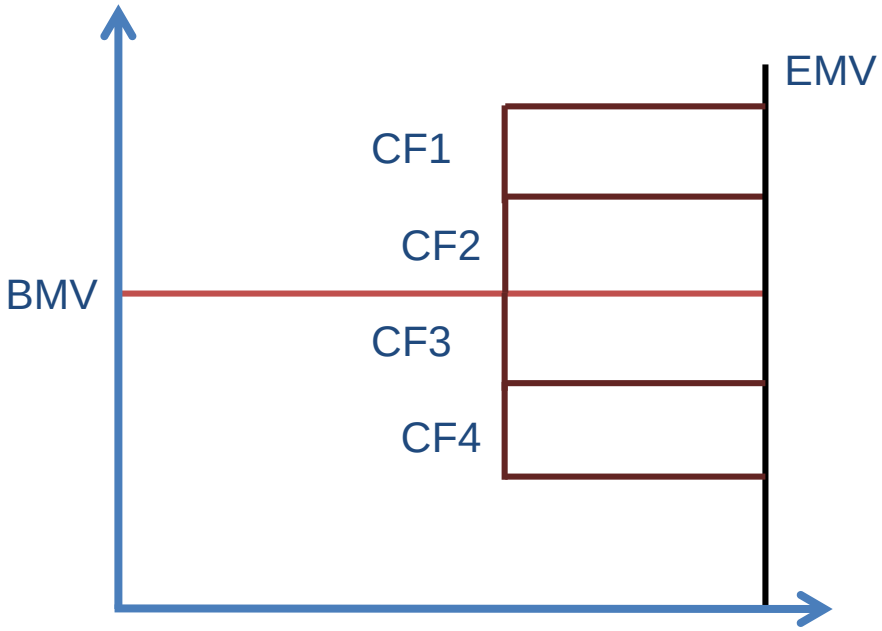




- This means that the return measurement uses a specific / implied assumption for the average invested capital.

What do we know about the average invested capital (6/13)

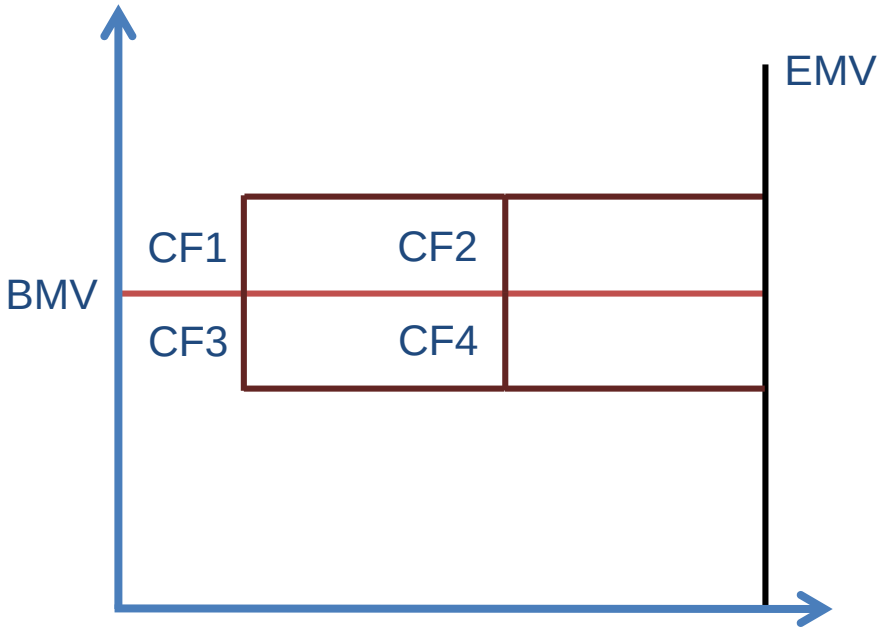
- The AIC depends on the amount of the external cash flows. Cash inflows increases and cash outflows decreases the AIC.



=> AIC1 > AIC2 > AIC 3 > AIC4

What do we know about the average invested capital (7/13)

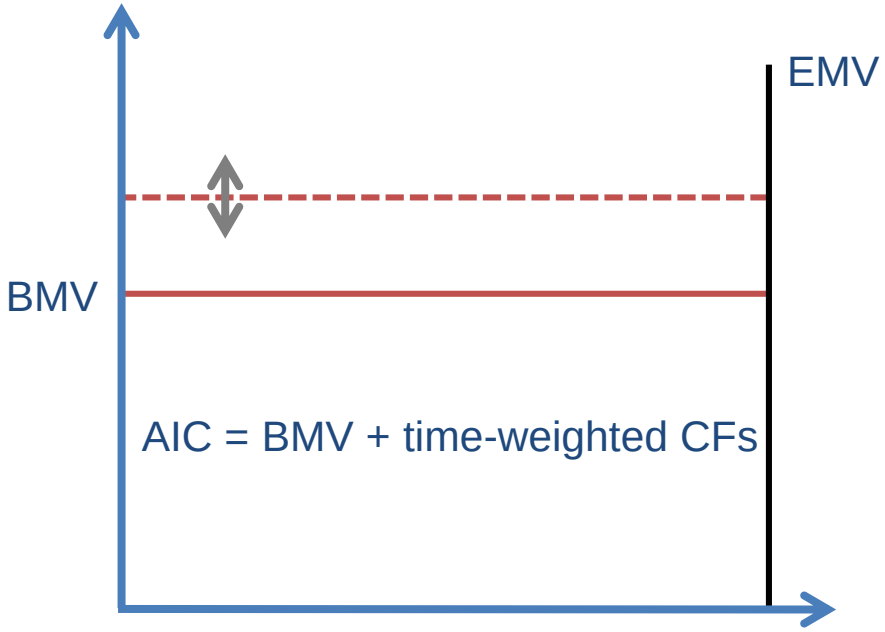
- The AIC depends on the timing of the external cash flows.

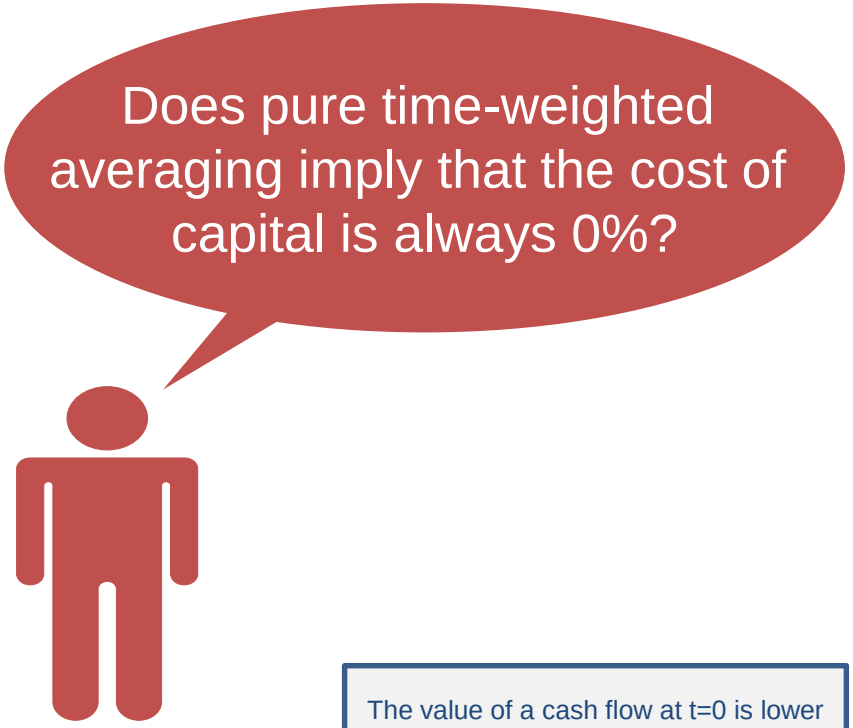


=> AIC1 > AIC2 > AIC4 > AIC3

What do we know about the average invested capital (8/13)

- In general the AIC is defined by the sum of the beginning market value of the measurement period and the time-weighted external cash flows.

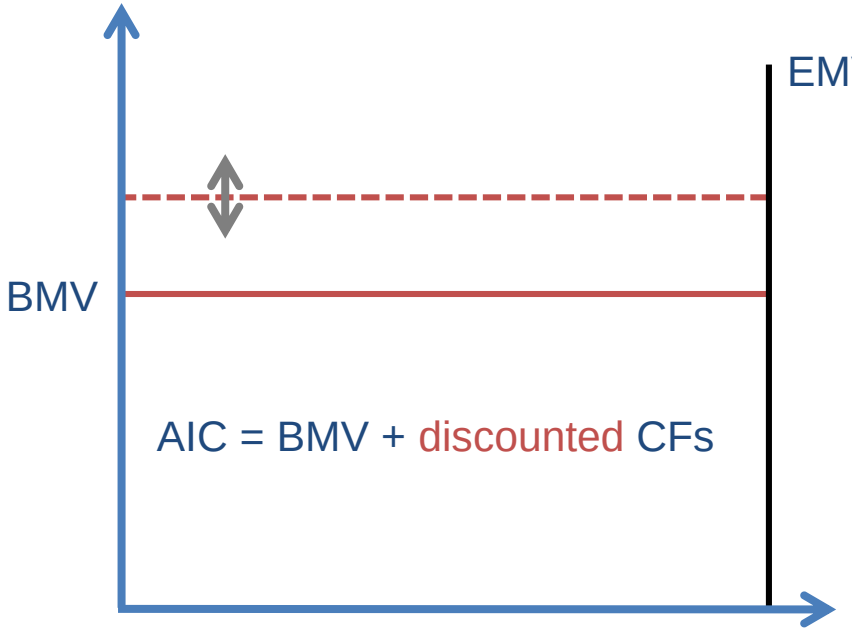


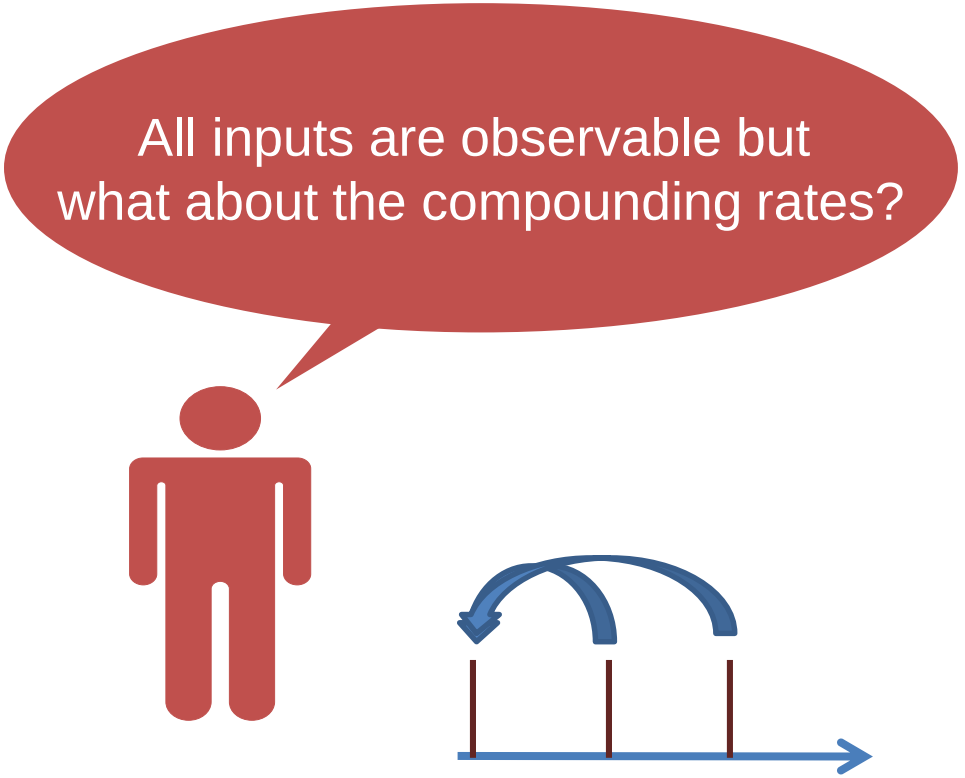


The value of a cash flow at t=0 is lower than at t+x
(assuming positive interest rates).

What do we know about the average invested capital (9/13)

- Therefore, more precise by considering compounding, the AIC is defined by the sum of the beginning market value of the measurement period and the discounted external cash flows.





What do we know about the average invested capital (10a/13)

- The implied or economic AIC is that AIC that makes the return to result in the absolute gain and loss.

Impact of the cash flow on the AIC:

=> AIC = BMV + delta AIC
= BMV + (delta P&L due to cash flow) / return
= BMV + (P&L – implied P&L on BMV) / return.

Example:

- Equity portfolio:
- 31.12.2013: BMV = 100.00 EUR.
- 31.12.2014: EMV = 130.00 EUR.
- 31.12.2014: Cash outflow = - 30.00 EUR (end of day).
- 31.12.2015: EMV = 96.00 EUR.

What is the impact on the initial capital at risk ?
=>
How much initial capital at risk is needed to generate the actual P&L assuming a return equal to the calculated one and no cash flows?

What do we know about the average invested capital (10b/13)

=> IRR (cum.) = 30.24% and IRR (annu.) = 14.12%.

=> MDR (cum.) Modified Dietz Method = 30.59% and MDR (annu.) = 14.28%.

=> TWR (cum.) = 24.80% and TWR (annu.) = 11.71%.

=> AIC(MDR) = 100.00 + (26.00 - 100.00 * MDR (cum.)) / MDR (cum.)
= 26.00 / MDR (cum.) = 85.00.

=> AIC(IRR) = 100.00 + (26.00 - 100.00 * IRR (cum.)) / IRR (cum.)
= 26.00 / IRR (cum.) = 85.99.

=> AIC (TWR) = 100.00 + (26.00 - 100.00 * TWR (cum.)) / TWR (cum.)
= 26.00 / TWR (cum.) = 104.84.

AIC for MDR (1/2)

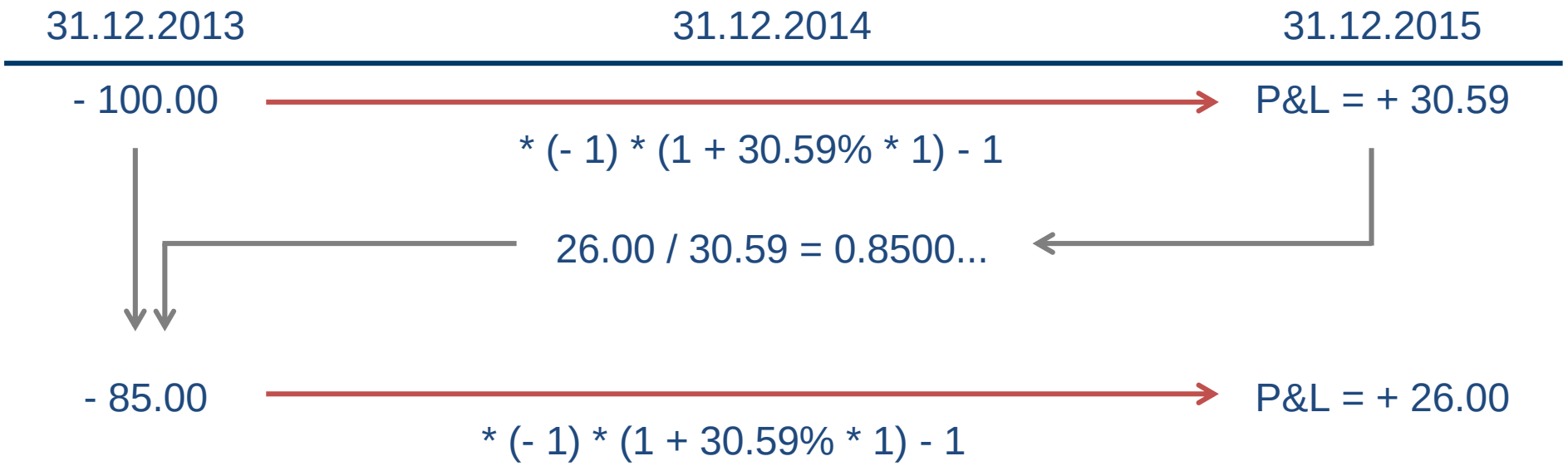
31.12.2013	31.12.2014	31.12.2015
- 100.00	+ 30.00	+ 96.00
	P&L = + 26.00 and MDR (cum.) = 30.59%	

31.12.2013	31.12.2014	31.12.2015
- 100.00	+ 30.00	+ 96.00
	Compounded with cost of capital - here equals MDR	* (1 + 30.59% * (1/2)) + 34.59
- 100.00		+ 130.59

* (- 1) / (1 + 30.59% * 1)

! Linear compounding

AIC for MDR (2/2)



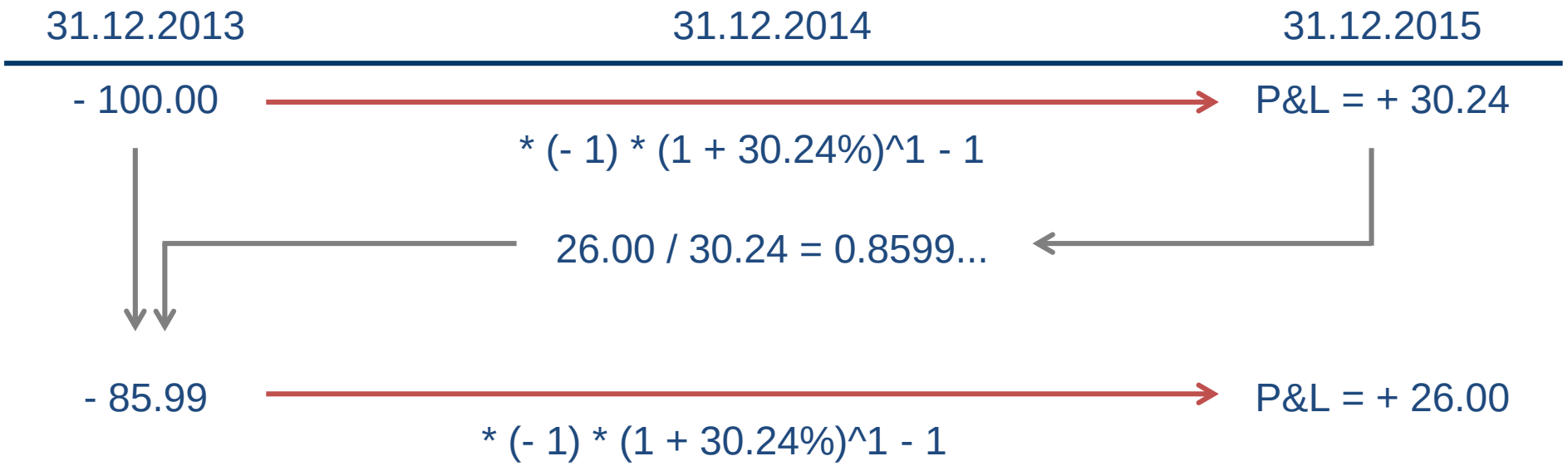
AIC for IRR (1/2)

31.12.2013	31.12.2014	31.12.2015
- 100.00	+ 30.00	+ 96.00
	P&L = + 26.00 and IRR (cum.) = 30.24%	

31.12.2013	31.12.2014	31.12.2015
- 100.00	+ 30.00	+ 96.00
	Compounded with cost of capital - here equals IRR	* (1 + 30.24%)^(1/2) → + 34.24
- 100.00	← * (- 1) / (1 + 30.24%)^1	+ 130.24

! Continuous compounding

AIC for IRR (2/2)



What do we know about the average invested capital (11/13)

- The AIC of two cash flow streams with identical returns are not identical but the AICs as well as the absolute profits and losses are multiples of each other driven by the ratio between the different P&L figures.

$$AIC^1 = \frac{30.24}{(1+30.24\%)^1 - 1} = \frac{30.24}{30.24\%} = 100.00 \Leftrightarrow$$

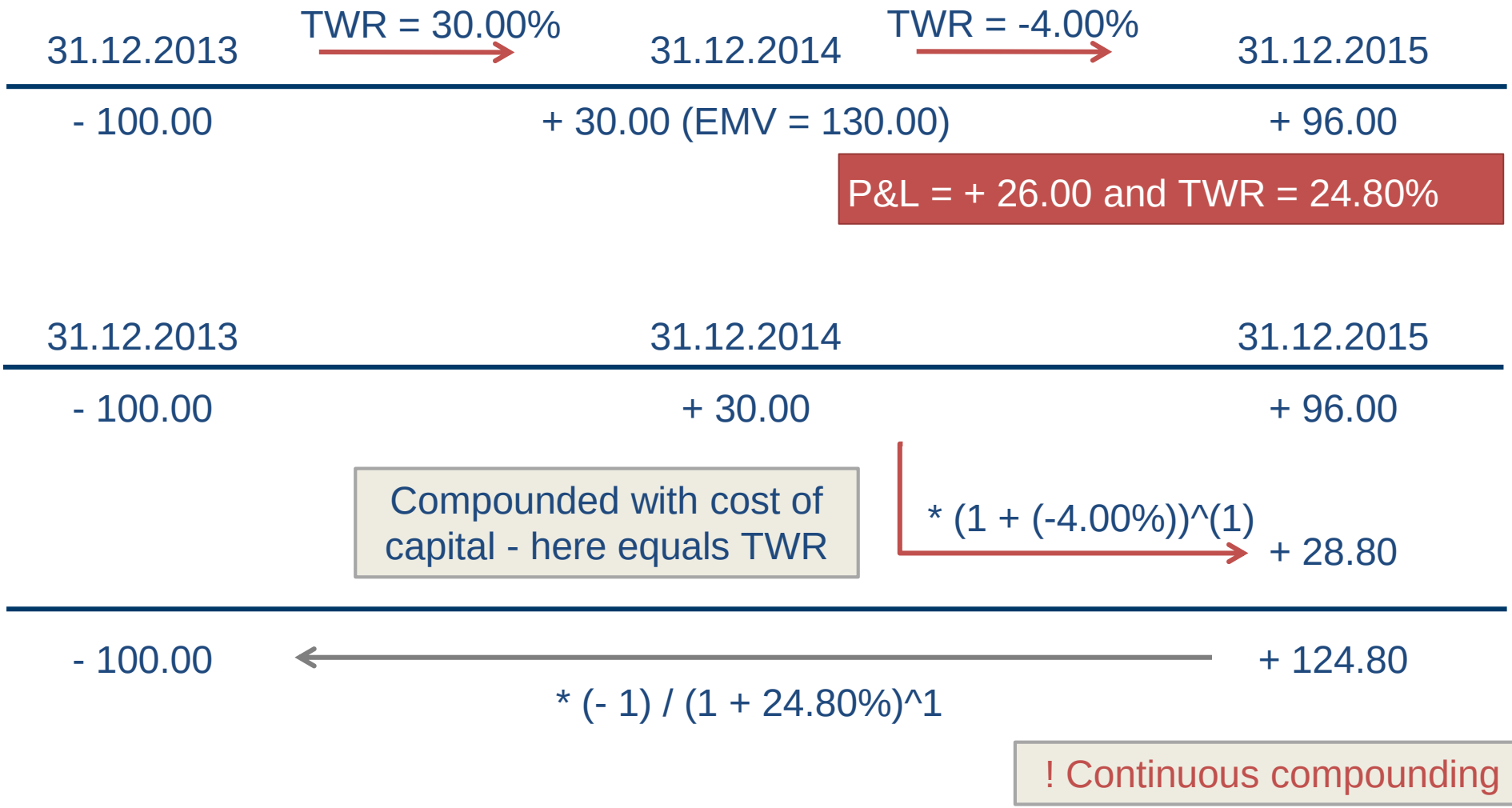
$$AIC^2 = \frac{26.00}{(1+30.24\%)^1 - 1} = \frac{26.00}{30.24\%} = 85.99$$

$$IRR^1 = IRR^2 \Leftrightarrow \frac{PL^1}{AIC^1} = \frac{PL^2}{AIC^2} \Leftrightarrow AIC^1 = AIC^2 \times \frac{PL^1}{PL^2}$$

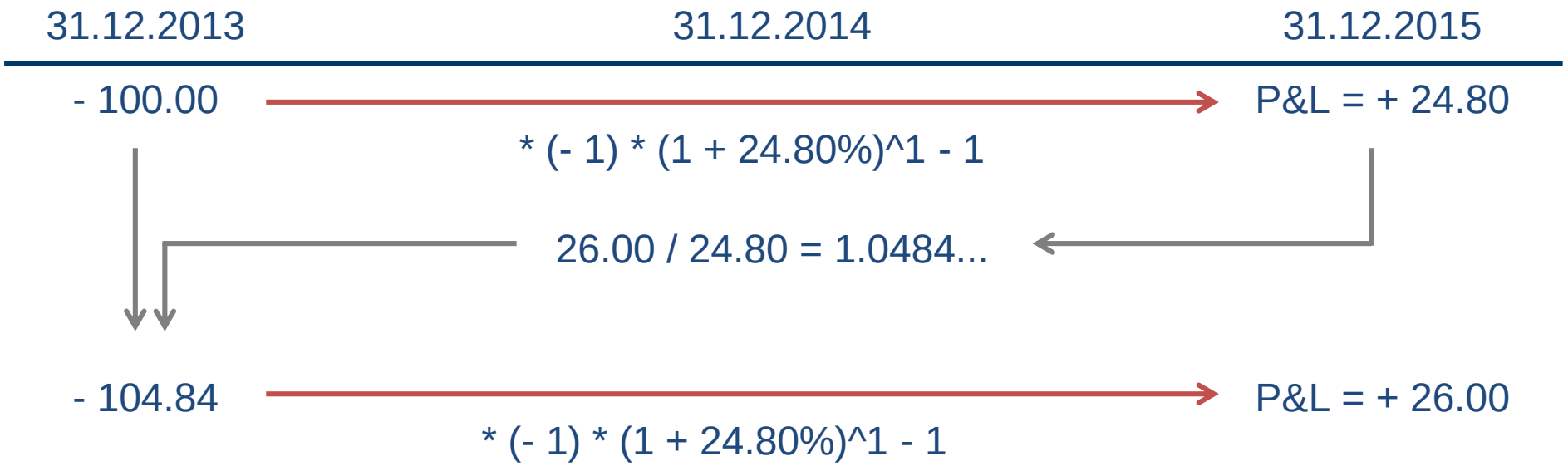
AIC for TWR (1/3)

- Often TWR is also used to measure the return from an investor's perspective.
- But like with the IRR, this would imply certain reinvestment assumptions which needs to be considered if evaluating the investment performance.
- The implicit reinvestment assumption of the TWR methodology with respect to the interim external cash flows is that:
  1) Cash inflows are financed at an interest rate (finance rate) that is identical to the future cumulated TWR.
  2) Cash outflows are reinvested at an interest rate (reinvestment rate) that is identical to the future cumulated TWR.
- Like with the IRR, the TWR reinvestment assumptions are normally unrealistic.
- As a solution realistic reinvestment assumptions what would lead to a Modified TWR and Modified IRR.

AIC for TWR (2/3)



AIC for TWR (3/3)



What do we know about the average invested capital (12/13)

- There is not one measure for the AIC.
- The AIC is (normally) based on unrealistic reinvestment or financing assumptions.

	IRR	MWR	TWR
Reinvestment rate	Total period IRR	Total period MWR	Remaining TWR
Financing rate	Total period IRR	Total Period MWR	Remaining TWR

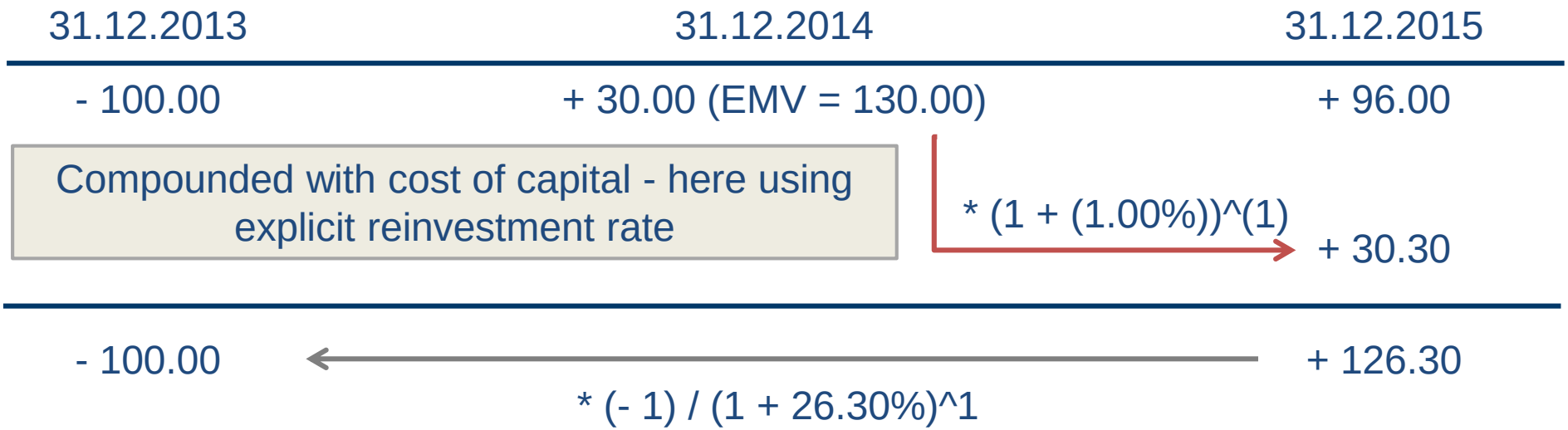
- The actual or relevant AIC depends on the used return methodology and its implied assumptions – on reinvestment and financing rates as well as on the method for the compounding.

What do we know about the average invested capital (13/13)

- The actual or relevant AIC is independent from the used return methodology if explicit compounding assumptions are used.

	IRR	MWR	TWR
Reinvestment rate	Rate 1	Rate 1	Rate 1
Financing rate	Rate 2	Rate 2	Rate 2

AIC for any return measure with explicit assumptions



	IRR	MWR	TWR
Return	26.30%	26.30%	24.80% (resp. 26.30%)
AIC	98.86	98.86	98.86

considering reinvestment

Findings (1/2)

- Considering the general formula for the return measurement:

$$Return = \frac{Gain\ and\ loss}{Average\ invested\ capital}$$

=> AIC can be directly derived by transforming the general formula for the return measurement

$$Average\ invested\ capital = \frac{Gain\ and\ loss}{Return}$$

=> and the fact that gain and loss as well as the inputs for cash flows are given, the return measurement methodology determines the implied compounding rates – the reinvestment and the financing rate – and compounding method (linear or continuous).

Findings (2/2)

- AIC within TWR calculation has no meaning and is therefore not usable as management information.
- Therefore, do not show any average invested capital figure within a (TWR) return attribution report.
- In general: Do not show a measure if it is not clear what the measure means and how it is calculated.

Discussion

Discussion


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

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