

# ECON4510 Finance Theory, Lecture 10

## Performance measurement: practice

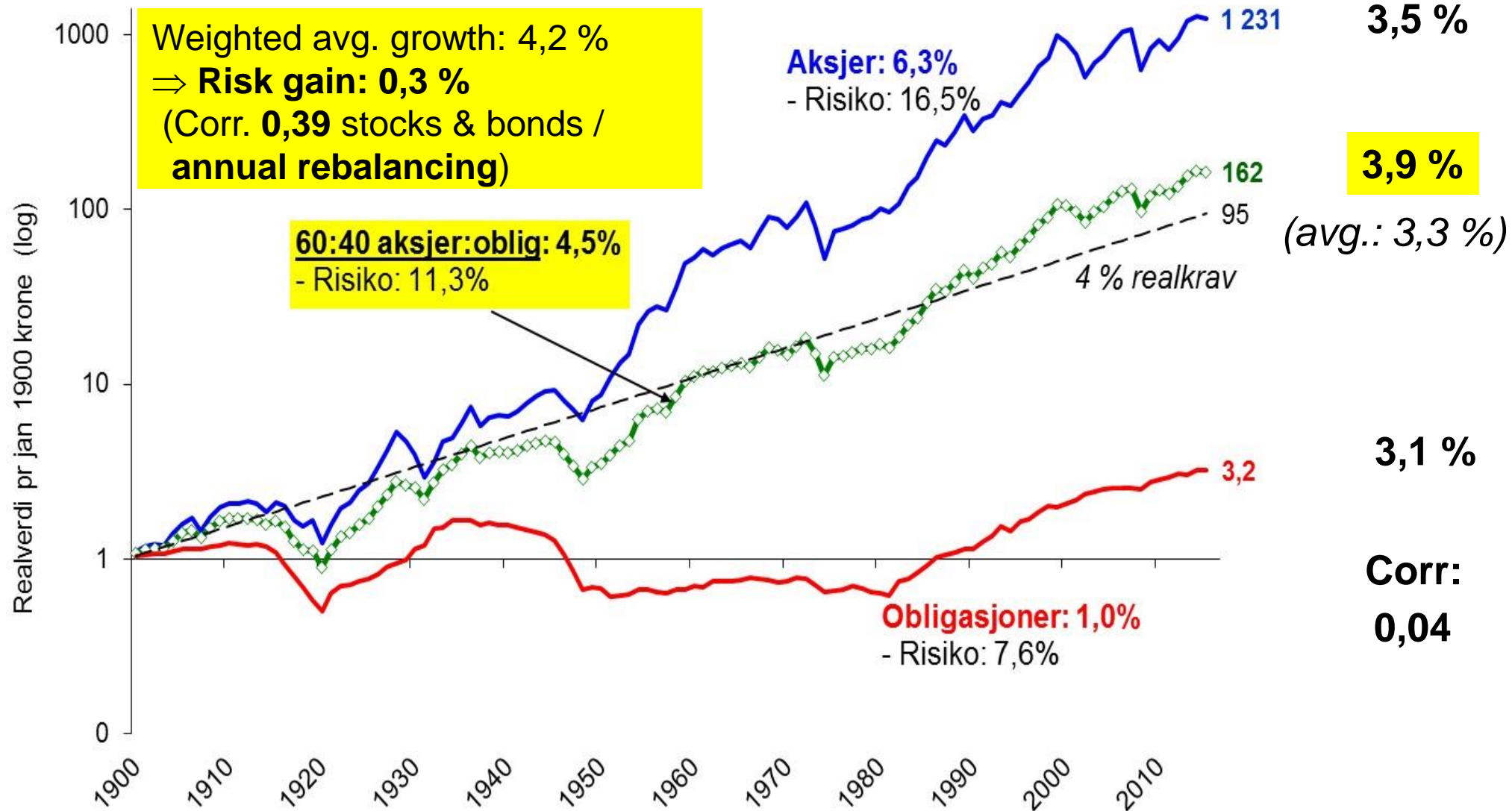
Kjetil Storesletten, April 9 2018

Notes adapted from Prof. Thore Johnsen

- ◆ Performance measurement in practice
- ◆ **Statens Pensjonsfond SPU and SPN**
  - ◆ **SPU: Long term growth and rebalancing**
  - ◆ SPU & SPN: Activ return and risk 1998 – Sep.2015
  - ◆ F&F five-factor model

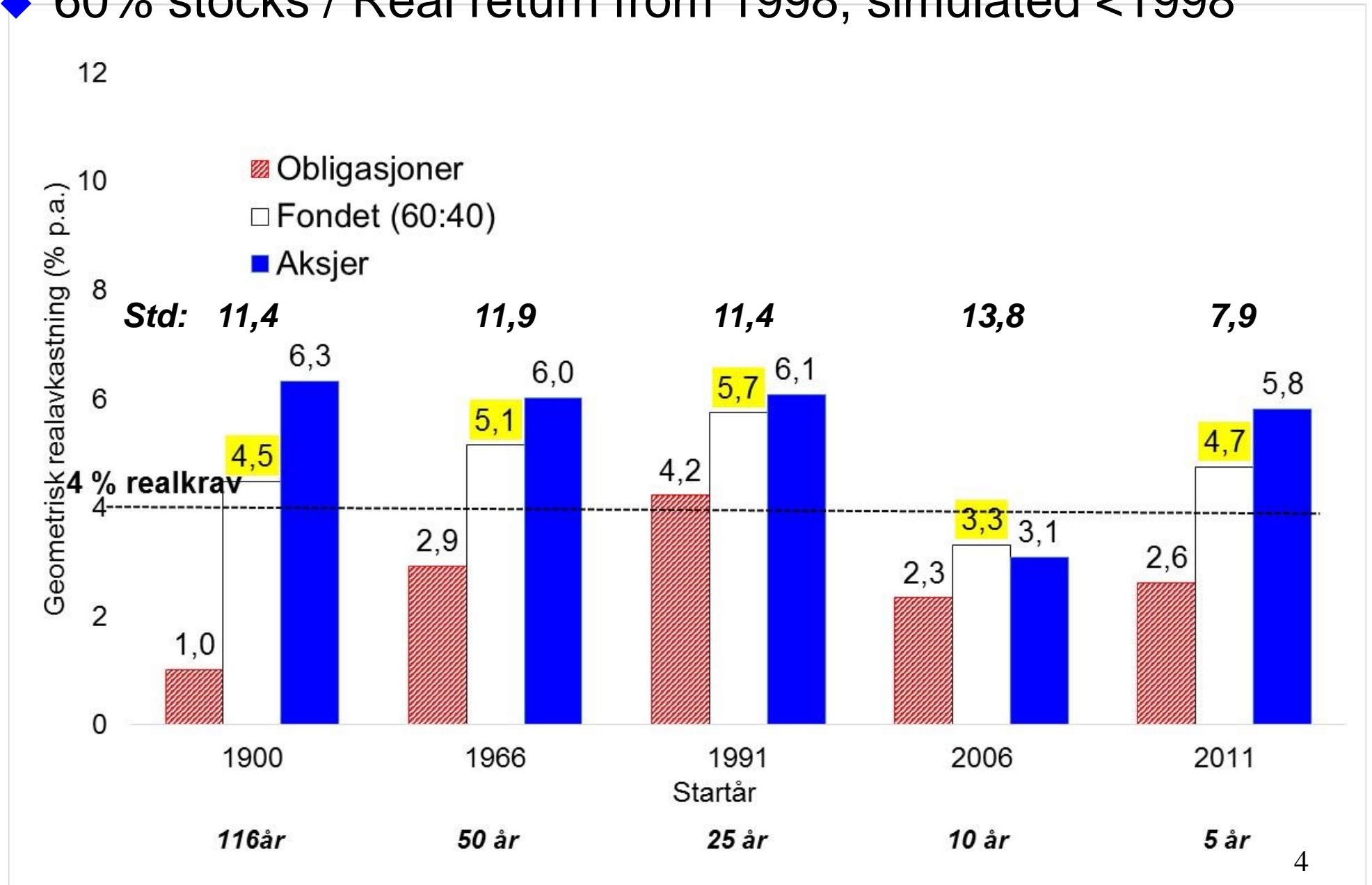
# “Oljefondet” last 116 years: Stocks (*would have*) saved us!

- ◆ 60% stocks / Asset return: Real from 1998, simulated <1998
- ◆ Risk dampening rebalancing

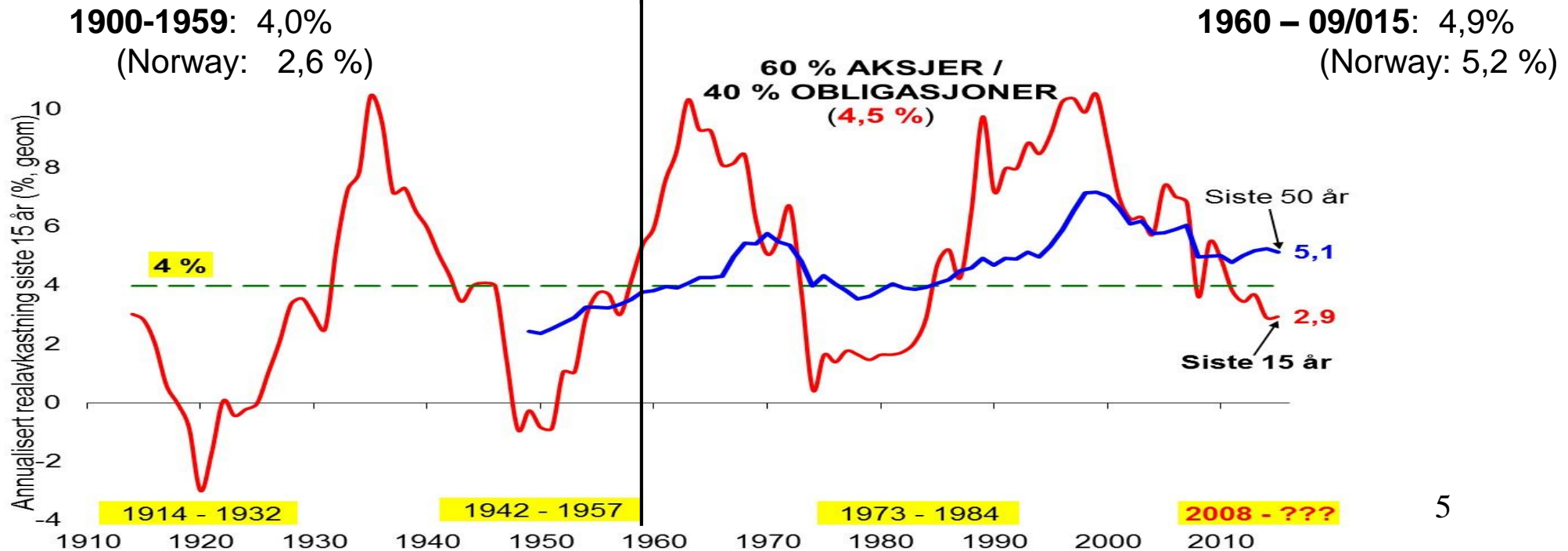
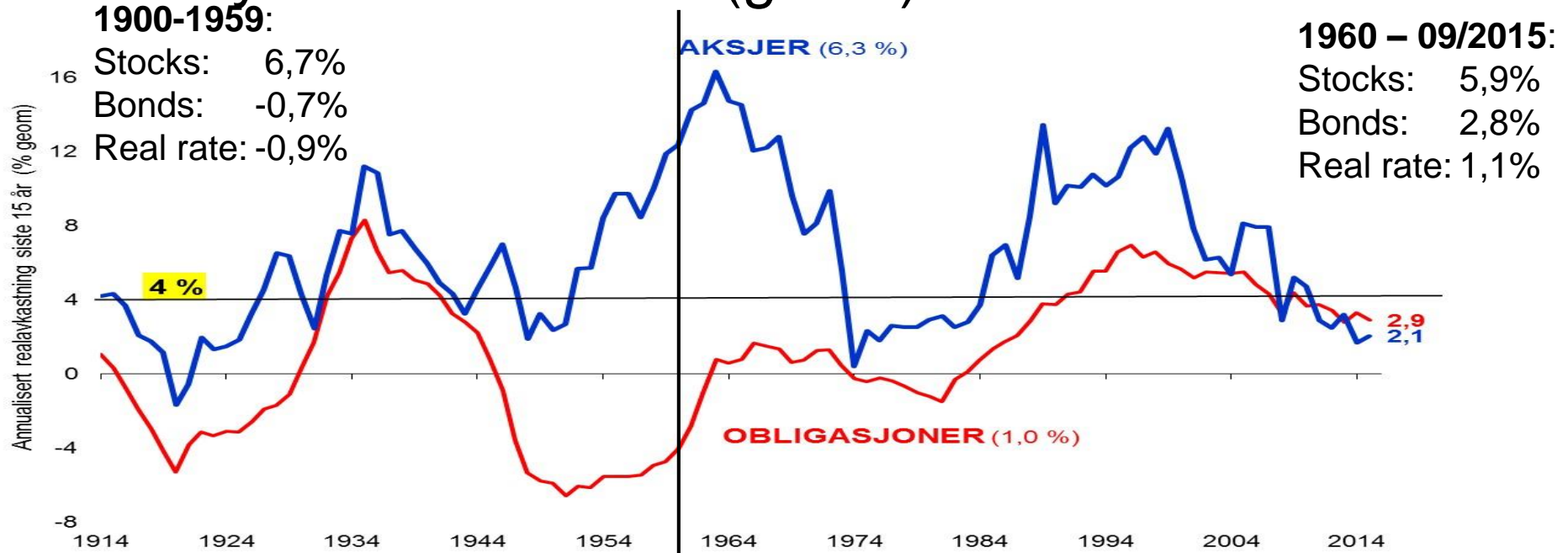


# SPU's real growth (geom): different periods until 09/2015

- ◆ 60% stocks / Real return from 1998, simulated <1998



# SPU: 15-years' real return (geom) 1900 – 09/2015



- ◆ Performance measurement in practice
- ◆ **Statens Pensjonsfond SPU and SPN**
  - ◆ SPU: Long term growth and rebalancing
  - ◆ **SPU & SPN: Activ return and risk 1998 – Sep.2015**
  - ◆ F&F five-factor model

**Table 23** Contributions to relative return on equity and fixed-income investments from investment strategies from 2013–2016. Annualised. Percentage points

	Equity	Fixed income	Cross-asset allocation	Total
Fund allocation	-0.03	-0.14	0.04	-0.13
Internal reference portfolio	-0.01	-0.14	0.00	-0.15
of which systematic factors	0.02			0.02
of which universe expansion	0.00	-0.09		-0.09
Allocation decisions	-0.02	0.00	0.04	0.02
Security selection	0.07	0.00		0.07
Internal security selection	-0.02	0.00		-0.02
External security selection	0.09			0.09
Asset management	0.17	0.08	0.00	0.25
Asset positioning	0.12	0.08	0.00	0.20
Securities lending	0.05	0.00		0.06
<b>Total</b>	<b>0.21</b>	<b>-0.06</b>	<b>0.04</b>	<b>0.20</b>

**Table 24** Contributions to relative return from equity investment activities, 1999–2012. Annualised. Percentage points

	Contribution <sup>1</sup> to relative return
Relative return on equity investments	0.54
Contribution to relative return from internal management	0.22
Contribution to relative return from external management	0.32

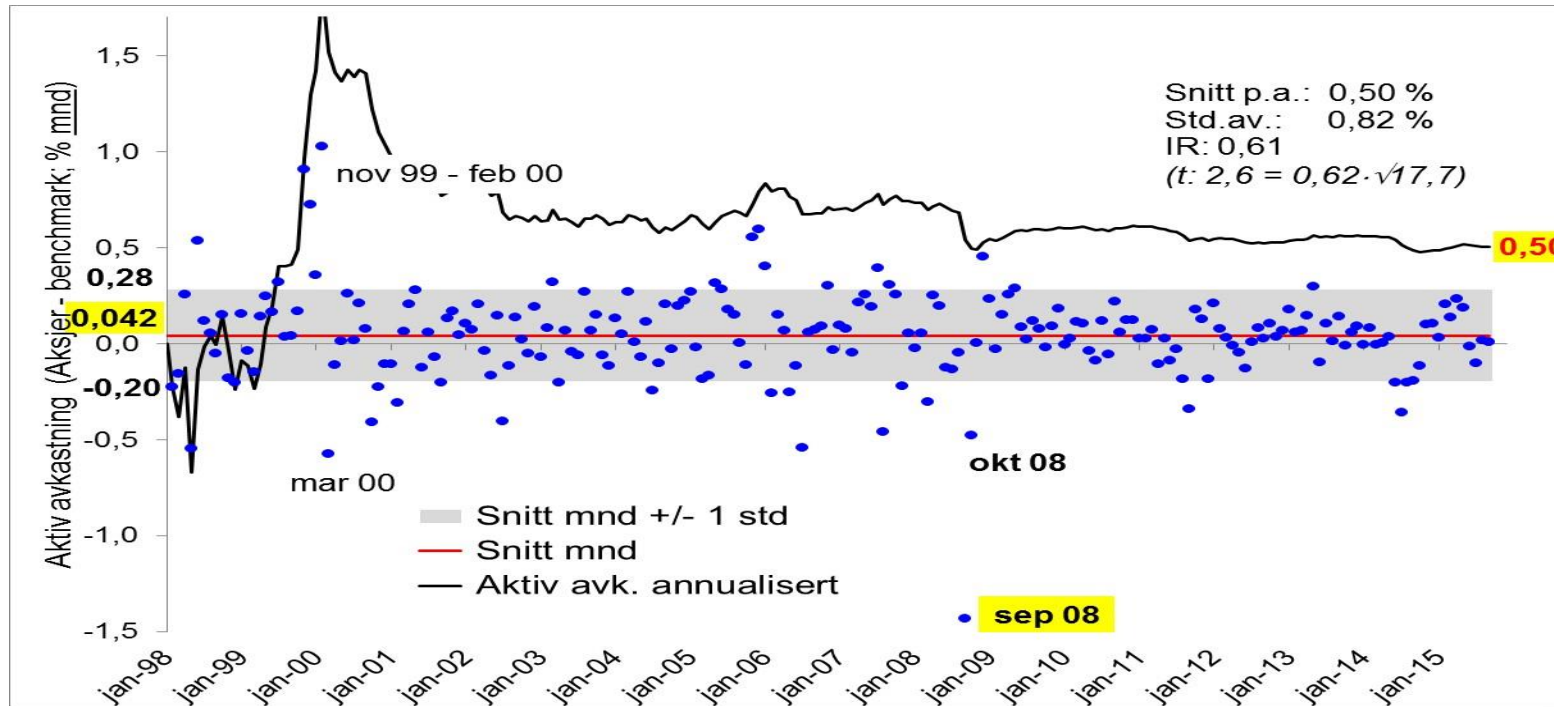
<sup>1</sup> Based on aggregated profit and loss.

**Table 25** Contributions to relative return from fixed-income investment activities, 1998–2012. Annualised. Percentage points

	Contribution <sup>1</sup> to relative return
Relative return on fixed-income investments	0.21
Contribution to relative return from internal management	0.42
Contribution to relative return from external management	-0.21

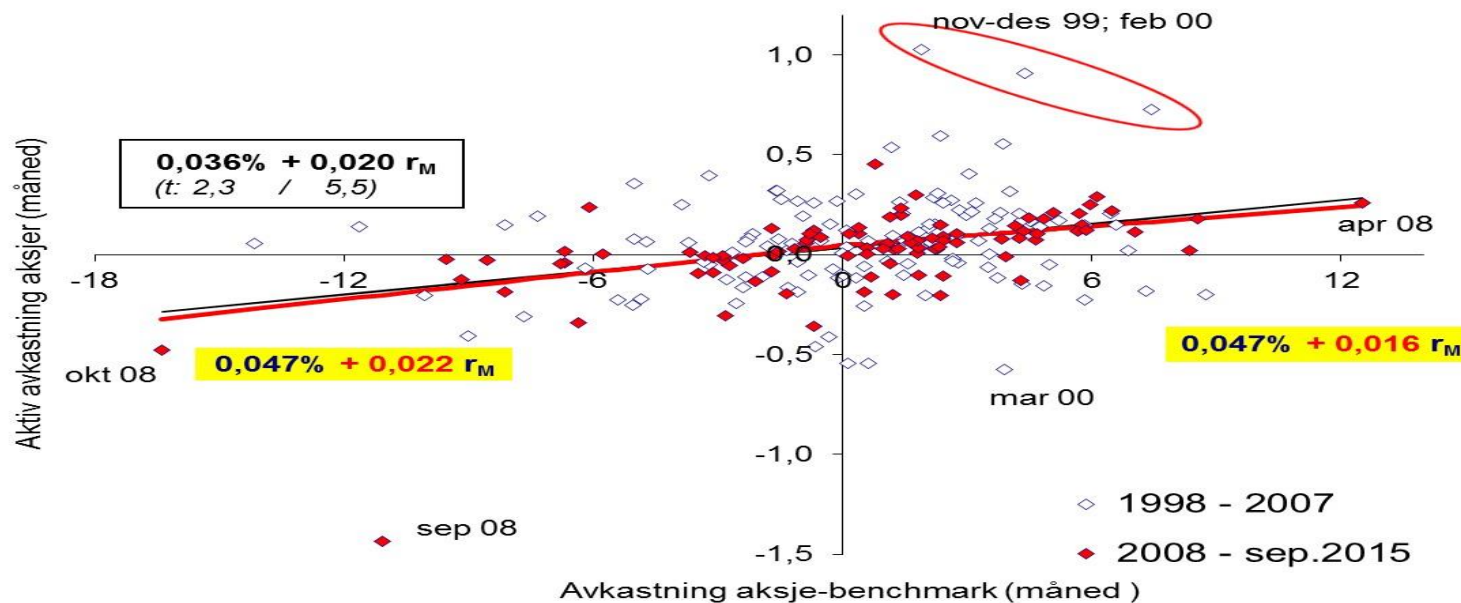


# NBIM: «Active» return on stocks Feb 98 – Sep 15



Relatively stable and significant active excess return:  
avg. 0,042% pr month  
or **0,50 % p.a.**

$$-0,02 \cdot (R_B - R_F) = 3,9 \%$$

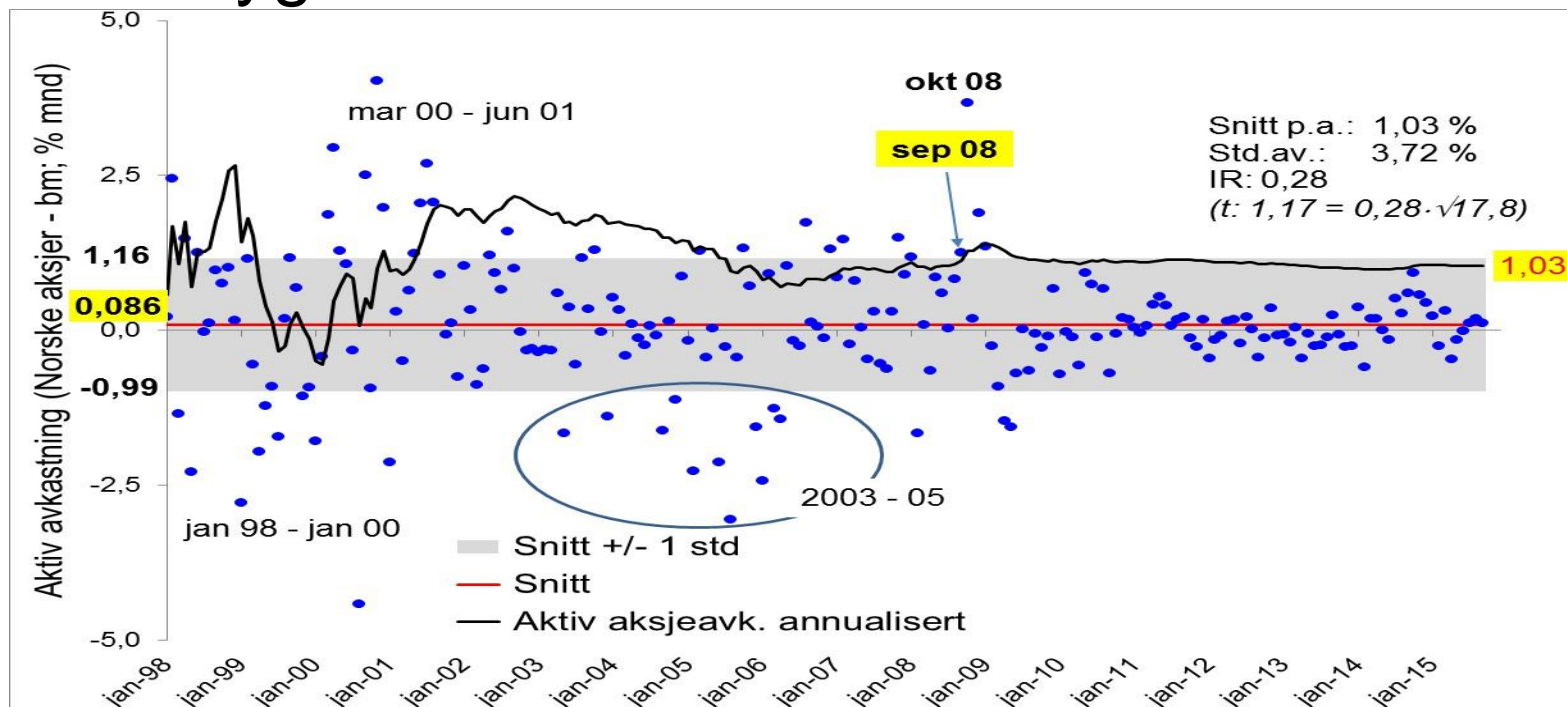


Diff.return beta = 0,02  
against benchmark  
(i.e.,  $\beta_p = 1,02$ )

⇒ Alpha = 0,036 % pr month  
or **0,43 % p.a.**

**Steeper down than up**

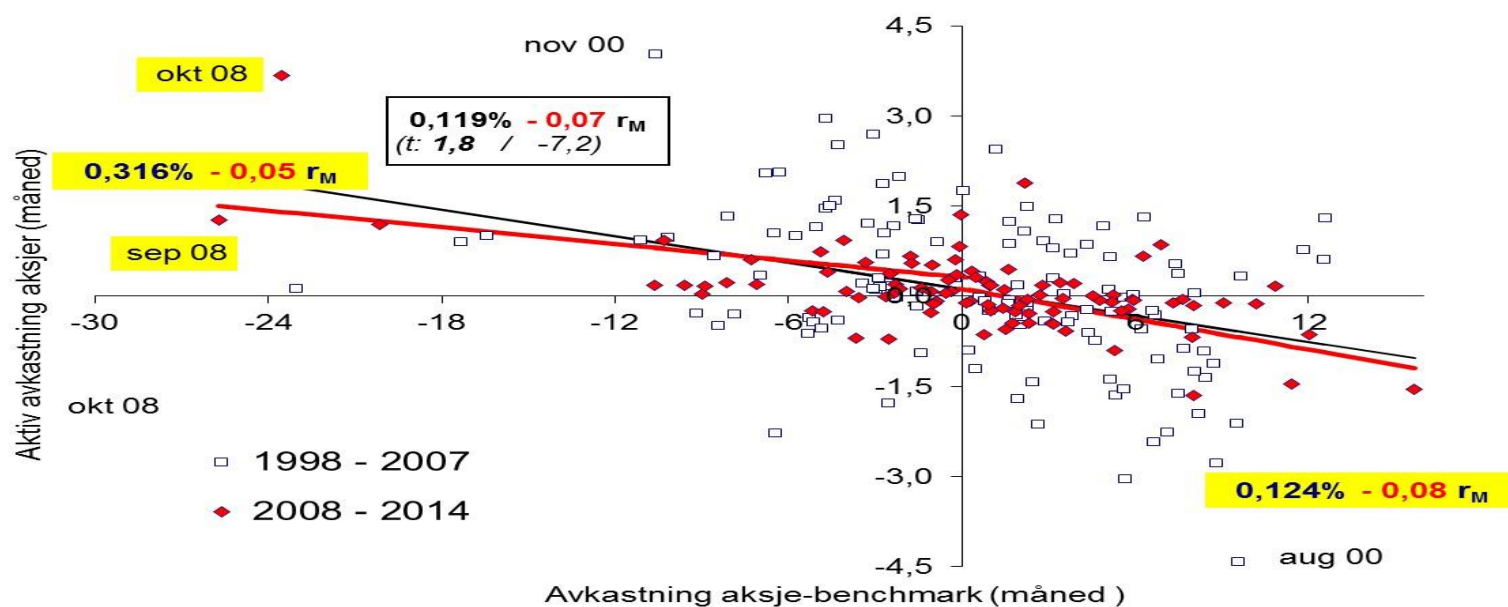
# Folketrygdfondet: Active return on stocks Feb 98 – Sep 15



Relatively stable but insignificant active excess return:  
 avg. 0,086% pr month  
 or 1,03 % p.a.

$$+0,07 \cdot (R_B - R_F)$$

5,4 %



Diff.return beta = - 0,05  
 against benchmark  
 (i.e.,  $\beta_p = 0,95$ )

⇒ Alpha = 0,036 % pr month  
 or 1,42 % p.a.

**Slower down than up**

# SPU (Oljefondet) Feb.1998 – Sep.2015

(annualiserte tall; i valuta)

feb.1998 - sep.2015

	Fond	Aksjer	Rente
Aktiv avkastning	0,28	0,50	0,13
Aktiv risiko	0,73	0,82	1,09
<b>IR</b>	<b>0,39</b>	<b>0,61</b>	<b>0,12</b>
<i>t(aktiv avk)</i>	<i>1,64</i>	<i>2,57</i>	<i>0,50</i>
Andel gevinst-måneder	0,65	0,63	0,60
Snitt gevinst / snitt tap	0,81	0,97	0,76
<i>Seriekorr aktiv avk.</i>	<i>0,52</i>	<i>0,18</i>	<i>0,69</i>
Beta	1,06	1,02	1,00
Alfa	0,10	0,43	0,14
Residual risiko	0,61	0,77	1,09
<b>AR</b>	<b>0,17</b>	<b>0,55</b>	<b>0,13</b>
<i>t(alfa)</i>	<i>0,70</i>	<i>2,33</i>	<i>0,53</i>
R2	99,4 %	99,7 %	89,7 %
<i>BM avkastning: Snitt(R<sub>B</sub>-R<sub>F</sub>)</i>	<i>3,26</i>	<i>3,92</i>	<i>2,65</i>
<i>BM risiko: σ(R<sub>B</sub>-R<sub>F</sub>)</i>	<i>7,20</i>	<i>14,85</i>	<i>3,28</i>
<b>Attribusjon:</b>			
<b>Andel av aktiv avkastning</b>			
Beta-bidrag	64 %	15 %	-7 %
Alfa-bidrag	36 %	85 %	107 %
<b>Andel av aktiv risiko</b>			
Beta-bidrag	30 %	13 %	0 %
Alfa-bidrag	70 %	87 %	100 %

average( $R_P - R_B$ )

$\sigma(R_P - R_B)$

$IR \cdot \sqrt{17,7}$

avg( $R_P - R_B$ ) - (**b**-1)·avg( $R_B - R_F$ )

$[\sigma(R_P - R_B)^2 - (\mathbf{b}-1)^2 \cdot \sigma(R_B - R_F)^2]^{0,5}$

$\alpha / \sigma(\epsilon_P)$

average( $R_B - R_F$ )

$\sigma(R_B - R_F)$

$(\beta-1) \cdot \text{avg}(R_B - R_F) / \text{avg}(R_P - R_B)$

$\alpha / \text{avg}(R_P - R_B)$

$[(\beta-1) \cdot \sigma(R_B)]^2 / \sigma(R_P - R_B)^2$

$\sigma(\epsilon_P)^2 / \sigma(R_P - R_B)^2$

# SPU (Oljefondet) stocks Feb.1998 – Sep.2015 (annualized)

◆ 1-factor:  $r_P - r_B = (\beta - 1) \cdot r_B + \text{Alpha}_{\text{CAPM}} + \varepsilon$

Annualiserte tall; 17,7 år feb.1998 - sep.2015

	Aktivt bidrag ( $R_P - R_B$ )			Risikojustert bidrag				
	Snitt	Std	IR	Beta	Alfa	$\sigma(\varepsilon_P)$	AR	R2
Aksjer	<b>0,50</b>	0,82	<b>0,61</b>	<b>1,020</b>	<b>0,43</b>	0,77	<b>0,55</b>	0,997
<i>t(17,4 år)</i>	<b>2,6</b>			5,5	<b>2,3</b>			

Attribusjon (% av snitt og varians aktiv avkastning):

Avkastning	100		15	85
Risiko		100	12	88

$(\beta - 1) \cdot \text{avg}(r_B) / \text{avg}(r_P - r_B)$   
 $\alpha / \text{avg}(r_P - r_B)$   
 $[(\beta - 1) \cdot \sigma(r_B)]^2 / \sigma(r_P - r_B)^2$   
 $\sigma(\varepsilon_P)^2 / \sigma(r_P - r_B)^2$

◆ 3-factor:  $r_P - r_B = (\beta_M - 1) \cdot r_B + \beta_{\text{SMB}} \cdot r_{\text{SMB}} + \beta_{\text{HML}} \cdot r_{\text{HML}} + \text{Alpha}_{\text{FF}} + \varepsilon$

Annualiserte tall; 17,7 år feb.1998 - sep.2015

	Aktivt bidrag ( $R_P - R_B$ )			Beta			Risikojustert bidrag			
	Snitt	Std	IR	BM	SMB	HML	Alfa	$\sigma(\varepsilon_P)$	AR	R2
Aksjer	<b>0,50</b>	0,82	0,61	<b>1,02</b>	<b>0,04</b>	<b>-0,03</b>	<b>0,35</b>	0,67	<b>0,51</b>	0,998
<i>t(17,7 år)</i>	<b>2,6</b>			5,2	6,3	-6,0	<b>2,1</b>			

Attribusjon (% av snitt og varians aktiv avkastning):

Avkast.	100			13	22	-3	69
Risiko		100		9	13	11	67

Risk attribution assumes uncorrelated risk factors

## ◆ Risk premia and risk

Portefølje	BM	SMB	HML
Snitt( $R - R_F$ )	4,42	3,92	2,85
$\sigma(R - R_F)$	15,1	14,8	7,7

Global F&F-faktorer from FINdep for 1998 – Sep 2009.  
Then US F&F-faktorer

# SPU versus SPN 1998 - Sep.2015

## ◆ SPU

(annualiserte tall; i valuta)

	feb.1998 - sep 2015		
	Fond	Aksjer	Rente
Aktiv avkastning	0,28	0,50	0,13
Aktiv risiko	0,73	0,82	1,09
<b>IR</b>	<b>0,39</b>	<b>0,61</b>	<b>0,12</b>
<i>t(aktiv avk)</i>	<i>1,64</i>	<i>2,57</i>	<i>0,50</i>
Andel gevinst-måneder	0,65	0,63	0,60
Snitt gevinst / snitt tap	0,81	0,97	0,76
<i>Seriekorr aktiv avk.</i>	<i>0,52</i>	<i>0,18</i>	<i>0,69</i>
Beta	1,06	1,02	1,00
Alfa	0,10	0,43	0,14
Residual risiko	0,61	0,77	1,09
<b>AR</b>	<b>0,17</b>	<b>0,55</b>	<b>0,13</b>
<i>t(alfa)</i>	<i>0,70</i>	<i>2,33</i>	<i>0,53</i>
R2	99,4 %	99,7 %	89,7 %
<i>BM avkastning: Snitt(<math>R_B - R_F</math>)</i>	<i>3,26</i>	<i>3,92</i>	<i>2,65</i>
<i>BM risiko: <math>\sigma(R_B - R_F)</math></i>	<i>7,20</i>	<i>14,85</i>	<i>3,28</i>

## ◆ SPN (fond og norske)

(annualiserte tall; NOK)

	jan.1998 - sep 2015		
	Fond	Aksjer-N	Rente-N
Aktiv avkastning	0,43	1,03	0,24
Aktiv risiko	1,26	3,72	0,83
<b>IR</b>	<b>0,34</b>	<b>0,28</b>	<b>0,28</b>
<i>t(aktiv avk)</i>	<i>1,43</i>	<i>1,17</i>	<i>1,20</i>
Andel gevinst-måneder	0,53	0,53	0,58
Snitt gevinst / snitt tap	1,19	1,12	0,92
<i>Seriekorr aktiv avk.</i>	<i>0,14</i>	<i>0,09</i>	<i>0,10</i>
Beta	0,93	0,93	0,85
Alfa	0,66	1,42	0,55
Residual risiko	1,09	3,34	0,73
<b>AR</b>	<b>0,61</b>	<b>0,43</b>	<b>0,75</b>
<i>t(alfa)</i>	<i>2,56</i>	<i>1,80</i>	<i>3,17</i>
R2	98,3 %	97,4 %	91,3 %
<i>BM avkastning: Snitt(<math>R_B - R_F</math>)</i>	<i>3,32</i>	<i>5,36</i>	<i>2,14</i>
<i>BM risiko: <math>\sigma(R_B - R_F)</math></i>	<i>9,00</i>	<i>22,36</i>	<i>2,77</i>

# SPN (FTF) Norwegian stocks Jan.1998 – Sep.2015 (annualized)

◆ 1-factor:  $r_P - r_B = (\beta - 1) \cdot r_B + \text{Alpha}_{\text{CAPM}} + \varepsilon$

Annualiserte tall; 17,8 år jan.1998 - sep.2015

	Aktivt bidrag ( $R_P - R_B$ )			Risikojustert bidrag				
	Snitt	Std	IR	Beta	Alfa	$\sigma(\varepsilon_P)$	AR	R2
Aksjer	1,03	3,72	0,28	0,93	1,42	3,35	0,43	0,974
<i>t</i> (17,8 år)	1,17			-7,1	1,79			

Attribusjon (% av snitt og varians aktiv avkastning):

Avkast.	100							
Risiko		100						

Annotations:

- $(\beta - 1) \cdot \text{Snitt}(r_B) / \text{Snitt}(r_P - r_B)$  points to Beta
- $\alpha / \text{Snitt}(r_P - r_B)$  points to Alfa
- $[(\beta - 1) \cdot \sigma(r_B)]^2 / \sigma(r_P - r_B)^2$  points to AR
- $\sigma(\varepsilon_P)^2 / \sigma(r_P - r_B)^2$  points to R2

◆ 3-factor:  $r_P - r_B = (\beta_M - 1) \cdot r_B + \beta_{\text{SMB}} \cdot r_{\text{SMB}} + \beta_{\text{HML}} \cdot r_{\text{HML}} + \text{Alpha}_{\text{FF}} + \varepsilon$

Annualiserte tall; 17,8 år jan.1998 - sep.2015

	Aktivt bidrag ( $R_P - R_B$ )			Beta			Risikojustert bidrag			
	Snitt	Std	IR	BM	SMB	HML	Alfa	$\sigma(\varepsilon_P)$	AR	R2
Aksjer	1,03	3,72	0,28	0,92	-0,07	-0,02	1,47	3,19	0,46	0,977
<i>t</i> (17,8 år)	1,17			-8,3	-4,5	-1,8	1,93			

Attribusjon (% av snitt og varians aktiv avkastning):

Avkast.	100									
Risiko		100								

Risk attribution assumes uncorrelated risk factors

## ◆ Risk premia and risk

Portefølje	BM	SMB	HML
$\text{Snitt}(R - R_F)$	6,39	5,36	-1,30
$\sigma(R - R_F)$	21,0	22,4	13,6

BM: Fond's benchmark (OSEBX from 2006)  
 SMB: OSESX – OSEBX  
 HML: MSCI OSE Value – Ose Growth 14



## Faktor risk and/or factor return?

- ◆ Compensated risk faktors or mispricing / (temporary) luck
  - ⇒ Size, value, and liquidity: compensation for catastrophe risk
  - ⇒ Momentum: puzzle!
- ◆ Lack of stability: problematic to apply risk adjustment as return requirement. But useful in portfolio management
- ◆ Should results in portfolio management be adjusted for F&F, etc. if this is not explicitly agreed to in advance?

- Ang, Goetzmann & Schaefer (2009): NBIM  
- Dahlquist, Polk, Priestley, Ødegård (nov 2015),  
Principles for Risk Adjustment of Performance Figures

- ◆ Performance measurement in practice
- ◆ **Statens Pensjonsfond SPU and SPN**
  - ◆ SPU: Long term growth and rebalancing
  - ◆ SPU & SPN: Activ return and risk 1998 – Sep.2015
  - ◆ **F&F five-factor model**



# Fama-French 5-factors 1980 – 2015 Sep

## ◆ Return generating factors:

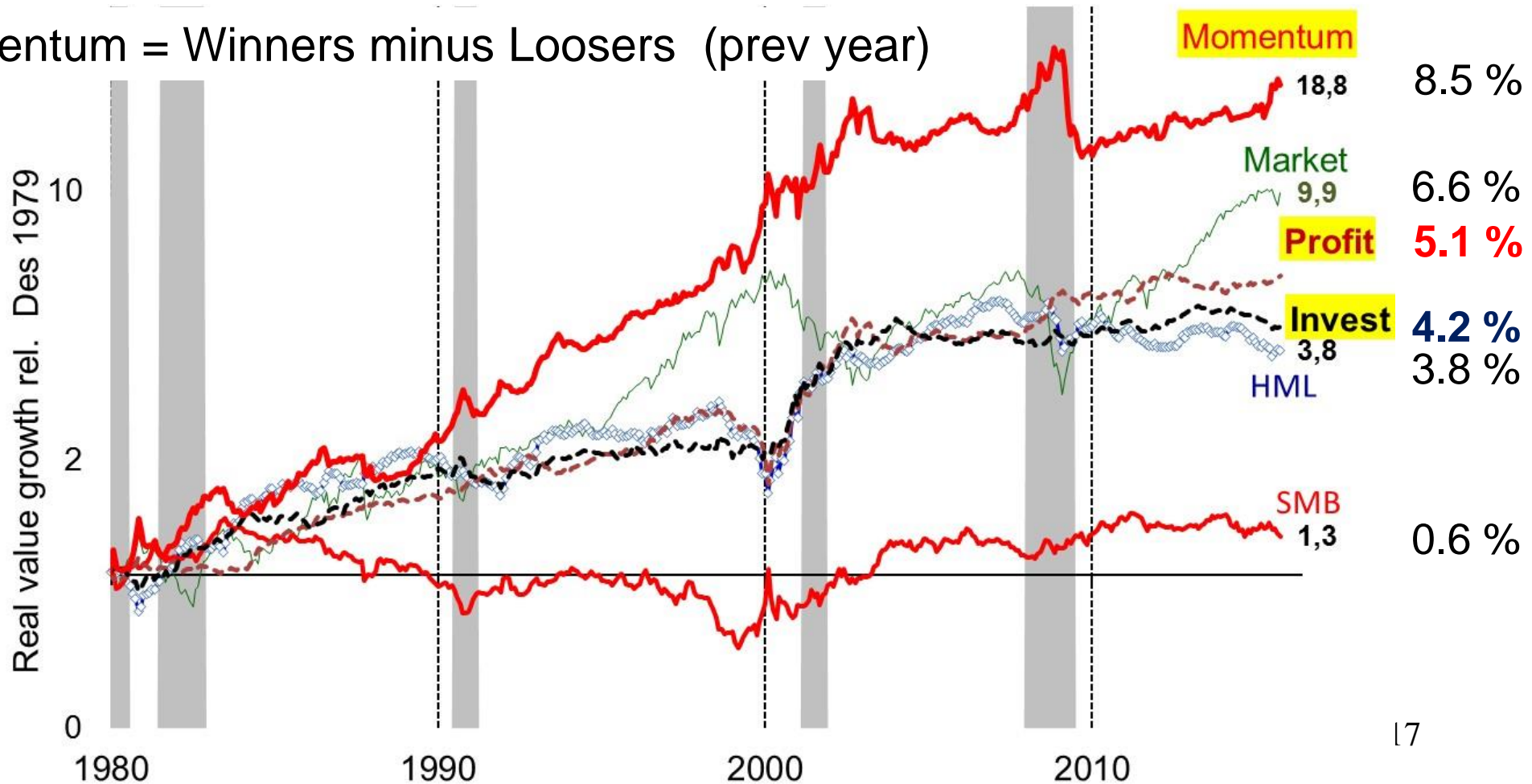
SMB = Small minus Large

HML = Value minus Growth (B/P high - low)

Profitability = High minus Low RoE (prev year)

Investment = Low minus High Inv. (prev year)

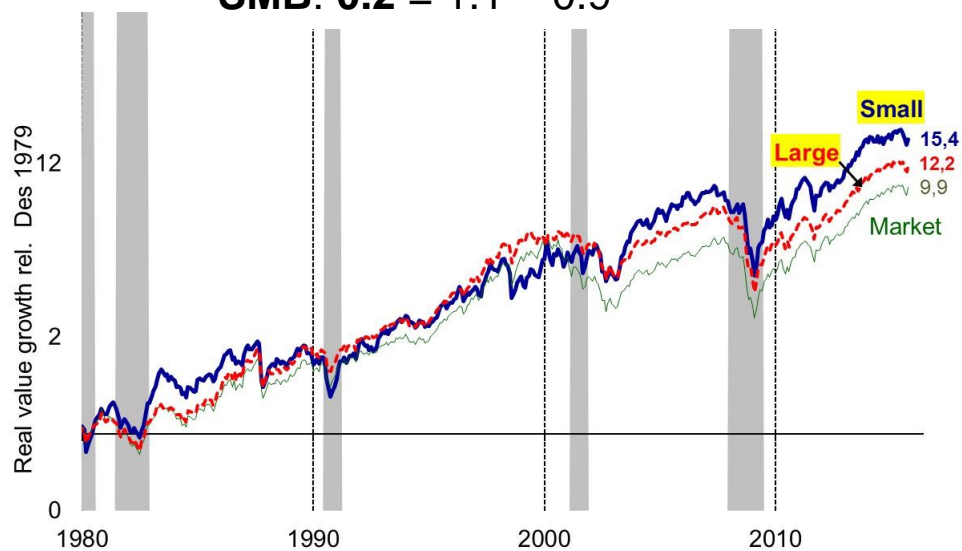
Momentum = Winners minus Losers (prev year)



# Long and short factor portfolios: Average growth p.a.

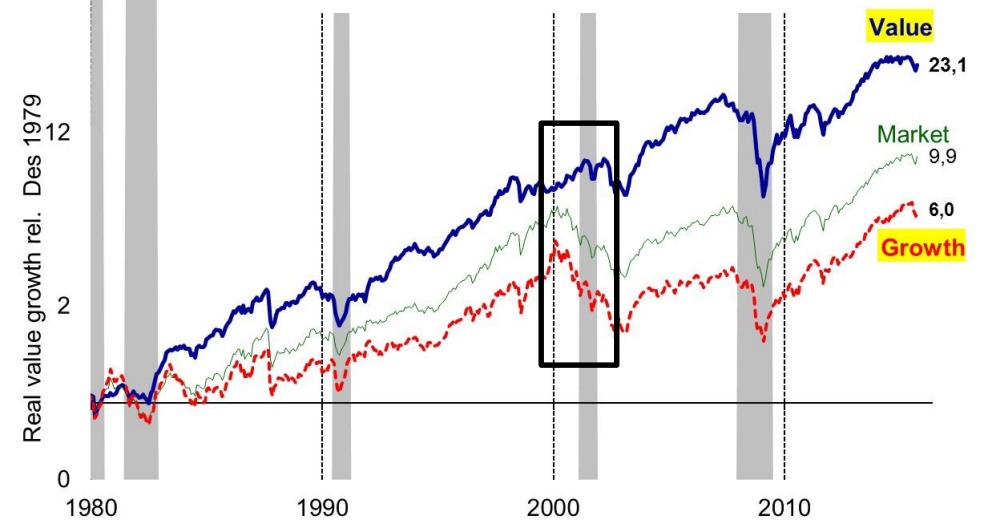
**SIZE (SMB)**

**SMB: 0.2 = 1.1 – 0.9**



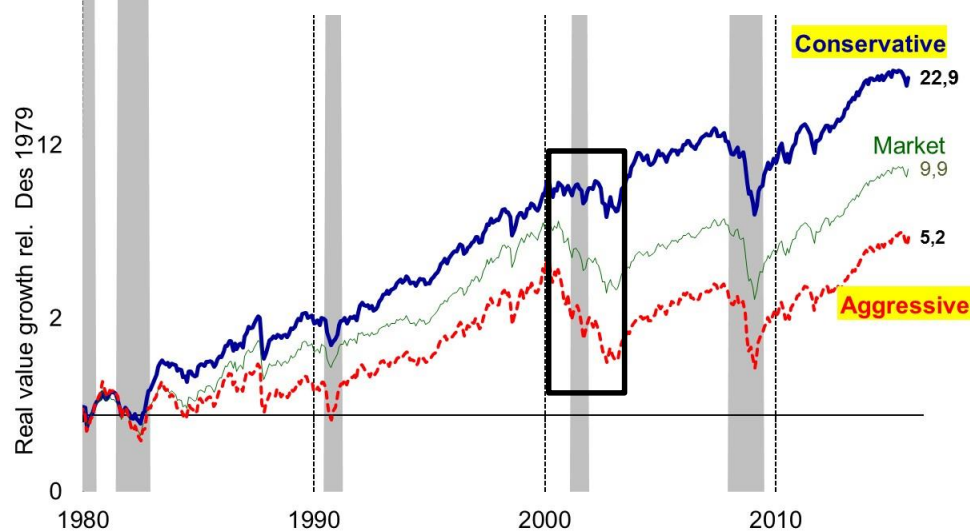
**VALUE (HML)**

**HML: 3.8 = 9.1 – 5.1**



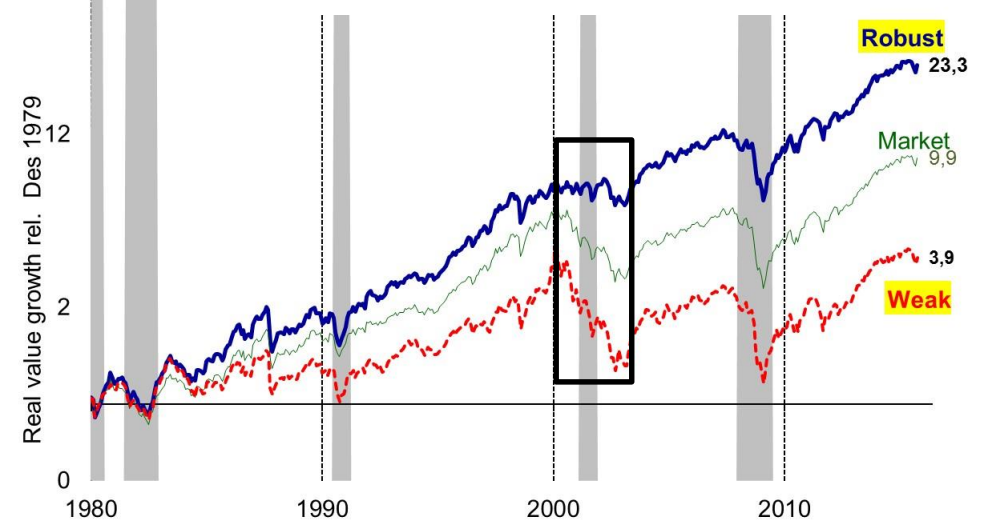
**INVESTMENT (CMA)**

**CMA: 5.1 = 9.2 – 3.9**



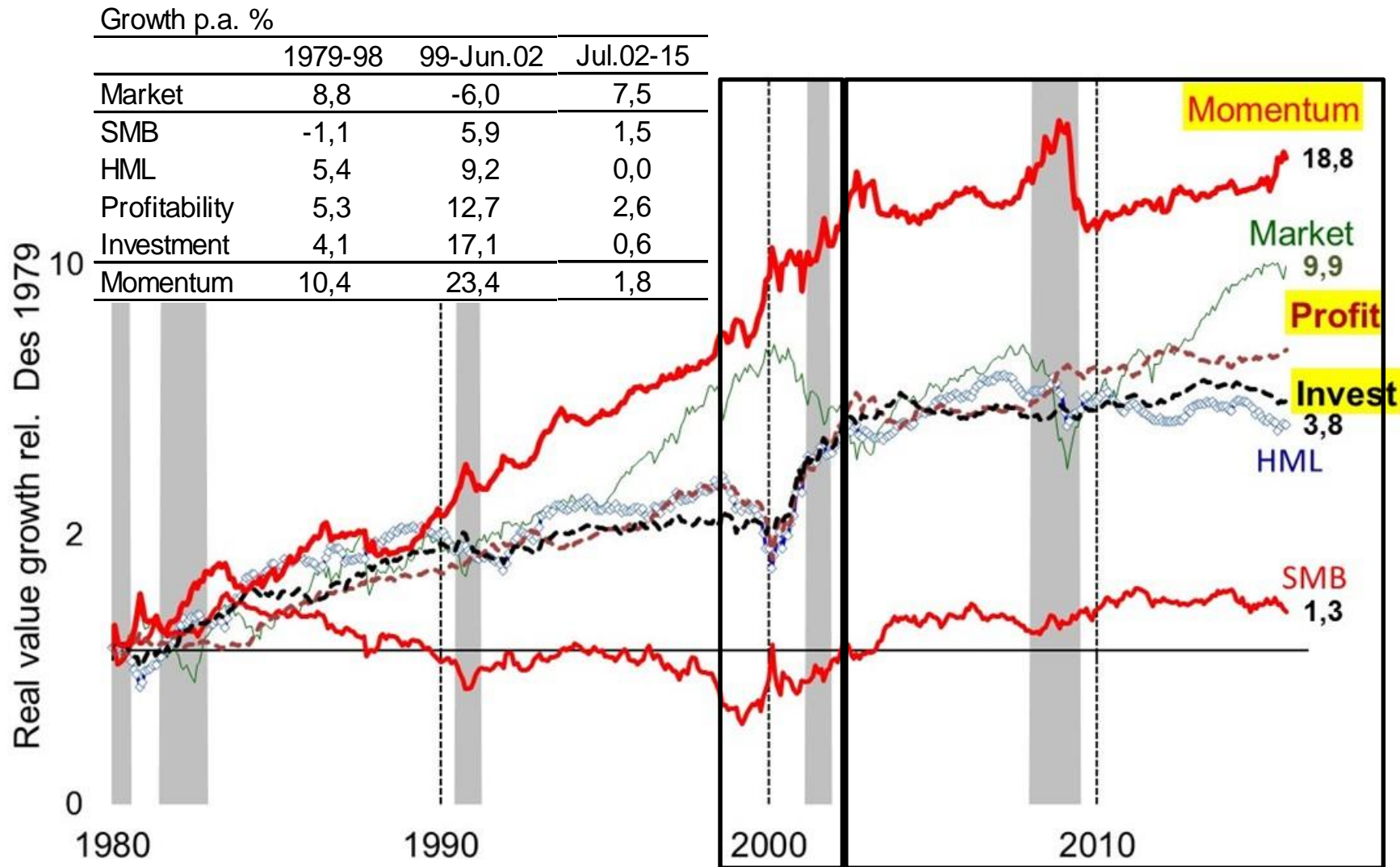
**PROFITABILITY (RMW)**

**RMW: 4.2 = 9.1 – 4.7**



# Fama-French 5-factors: Lack of stability

- ◆ Cyclical break (rel. to market) in dot.com-period 1999 - 2002
- ◆ Disappearing non-market factor returns thereafter



Jan 99 – Jun 02

# Fama-French 5-factors: Risk factors or inefficiencies

- ◆ Empirical factors: «Data with little or no theory»
- ◆ Cyclical & structural (?) breaks
  - The size factor disappeared after the first F&F paper
  - The yearly factor returns have generally been procyclical, but where countercyclical and highly correlated during the dot.com period 1999 – 2002
  - Very low factor returns following 2002 (relative to the market premium)
- ◆ Strongly countercyclical long-run factor returns, but highly mutually correlated



# Rolling 10- years real growth: Correlations with Market & Value

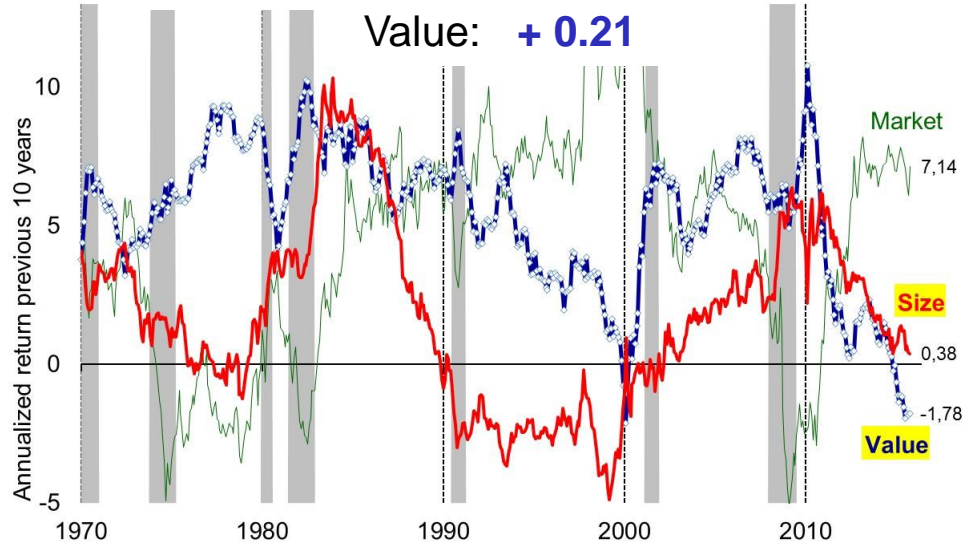
## SIZE vs Value (HML)

Value vs Market: -0.50

## MOMENTUM

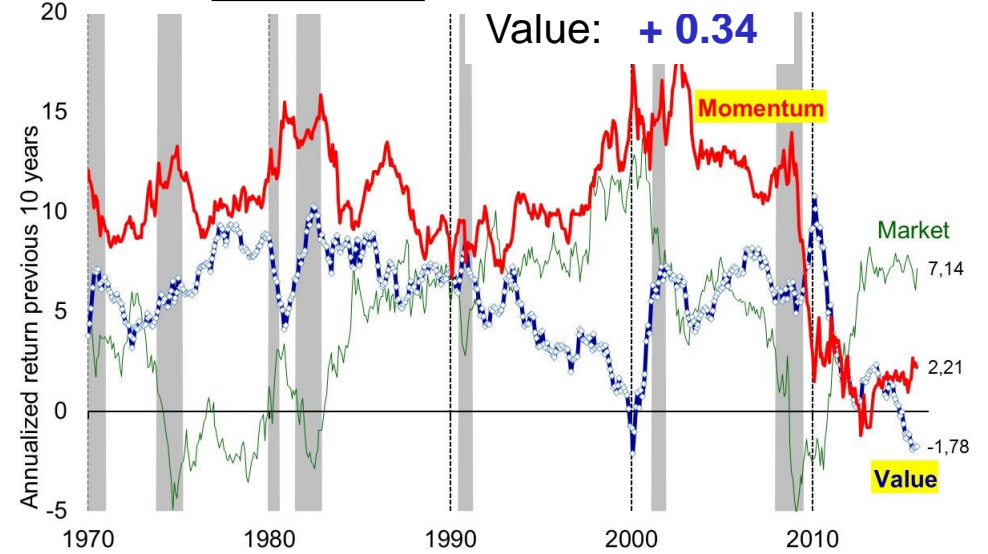
Corr. Size & Market: -0.72

Value: +0.21



Corr. Momentum & Market: +0.27

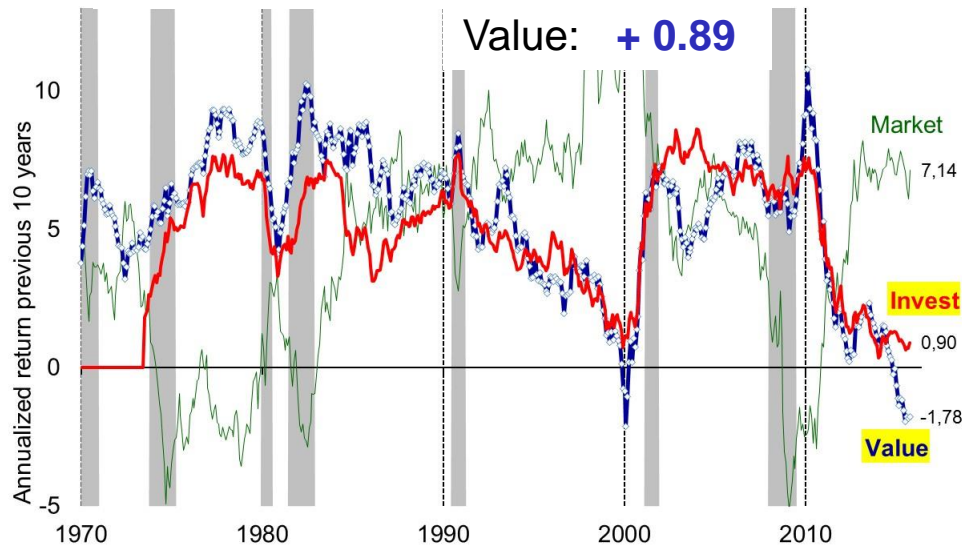
Value: +0.34



## INVESTMENT

Corr. Investment & Market: -0.51

Value: +0.89



## PROFITABILITY

Corr. Profitability & Market: -0.57

Value: +0.75

