

ECON4510 Finance Theory, Lecture 9

Performance measurement: methodology

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Notes adapted from Prof. Thore Johnsen (NHH)

# Evaluating portfolio managers

## ◆ Performance measurement and evaluation

### – Benchmarking

- traditional peergrouping
  - Risk adjusted return measurement
- Interpretation of historical returns

## ◆ Statens pensjonsfond SPN & SPU

## Traditional evaluation ('peer grouping')
















- ◆ Relative ranking of portfolio managers on period return
  - Distinguish PM type, asset class and investor “style”
  - present ranking for different period length
- ◆ Problemes
  - 'survivorship bias': adjust for exit and entry in period
  - 'small-portfolio bias': no size adjustment implies that sample is dominated by small-cap assets
- ◆ General
  - ex post vs ex ante: what does history imply?
  - Risk differences: what's skill and what's gearing?

# Sharpe's (1991) "arithmetic of active management"

- "it *must* be the case that
  - I. before costs, the return on the average actively managed dollar will equal the return on the average passively managed dollar,
  - II. after costs, the return on the average actively managed dollar will be less...
- These assertions will hold for *any* time period. Moreover, they depend *only* on the laws of addition, subtraction, multiplication and division. Nothing else is required."

# Investment outcome = Skill + Luck

- ◆ Amos Kahneman's «Thinking Fast and Slow»: Yearly rankings of 25 investment advisors for 8 years
- ◆ Average of 28 pairwise correlations = 0.01

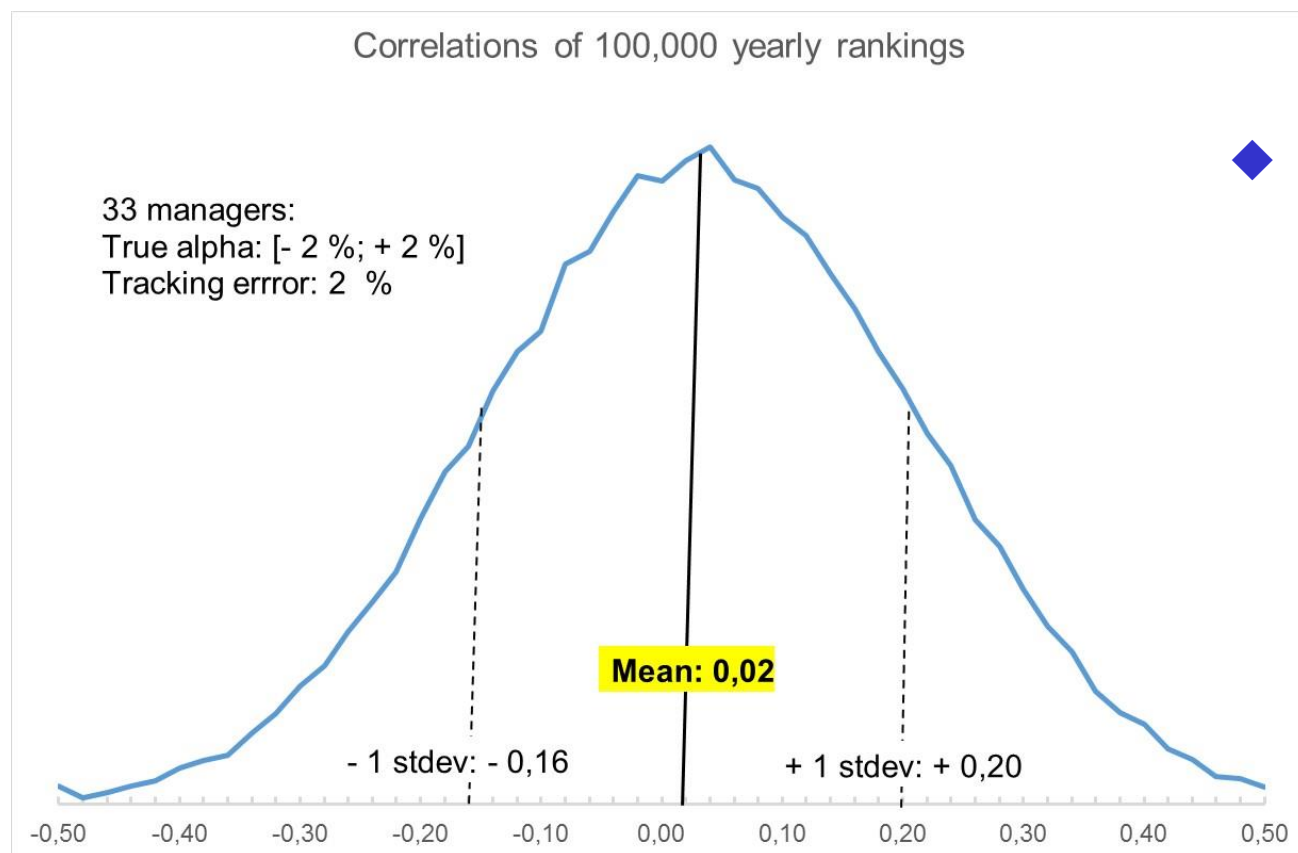
Årsammenlignet		Korrelasjon	
2009	2010	0,15	
2009	2011	-0,01	
2009	2012	0,27	
2009	2013	0,32	
2009	2014	-0,07	
2010	2011	-0,43	
2010	2012	0,23	
2010	2013	-0,18	
2010	2014	0,13	
2011	2012	-0,44	
2011	2013	0,06	
2011	2014	-0,46	
2012	2013	-0,06	
2012	2014	0,33	
2013	2014	0,32	
<b>Gjennomsnitt</b>		<b>0,01</b>	

2015 DNgrafikk/Kilde: Prof. Ola Kvaløy/Oslo Børs VPS

- ◆ Replicated on 6 yearly rankings of 33 Active Norwegian mutual funds (2009 – 14) by prof. Ola Kvaløy
- ◆ Avg. Corr. = 0.01 of the 15 pairs
- ◆ Two claims about active managers:
  - They are paid for luck not skill
  - They can't beat the market (?)

## «Mean Veil»: You can only *estimate* the risk

- ◆ 33 managers: True **alpha** uniformly distributed between - 2 % and + 2%. common tracking error (**TE**) 2 %.
- ◆ Information Ratio ( $IR = \text{Alpha}/\text{TE}$ ) between -1.0 and +1.0
  - ⇒ Need relatively few years to separate the truly good from the truly bad



- ◆ No information in yearly rankings

# Measurement relative to benchmark index

- ◆ Difference return and -risk
- ◆ Why?
  - Distribute responsibility on owner and manager
  - Defines portfolio manager's choice set
  - Comparisons over time between managers
  - Attribution analysis
    - Security selection, allocation, currency

# Risk adjusted performance measures

- ◆ Absolute return/risk (vs risk free); macro measures:
  - Sharpe (SR)
    - Modigliani<sup>2</sup> (M<sup>2</sup>)
  - *Morningstar* (relative peer-group)
- ◆ Relative return/risk (vs benchmark); micro measures
  - Treynor (TR)
    - adjusted (TR\*)
  - Alpha
  - Information rate (IR)
    - Appraisal ratio (AR)

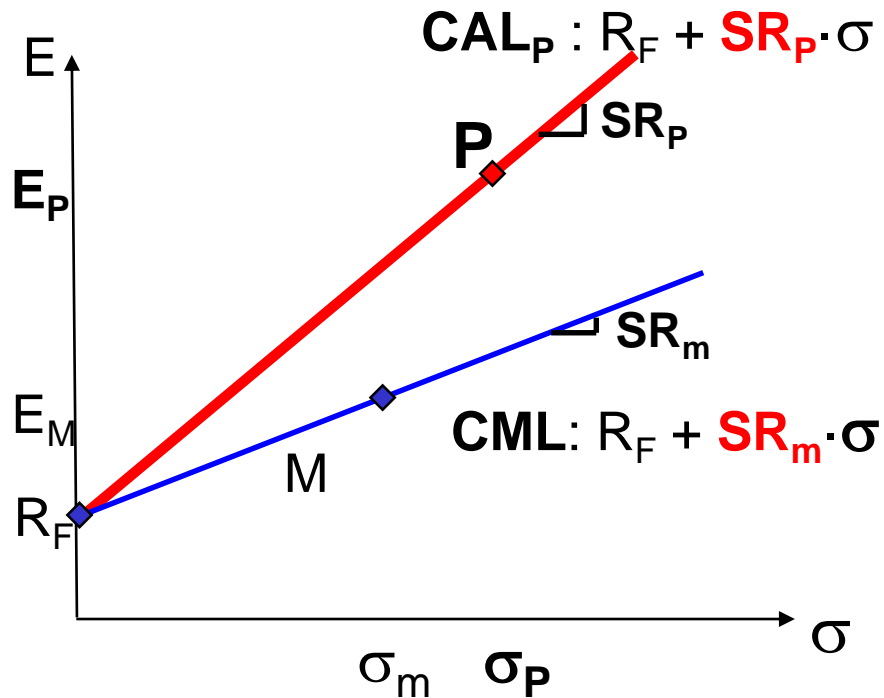


# Performance measure 1: Reward to variability

- ◆ Macro level
- ◆ Max SR  $\Leftrightarrow$  M-V preferences

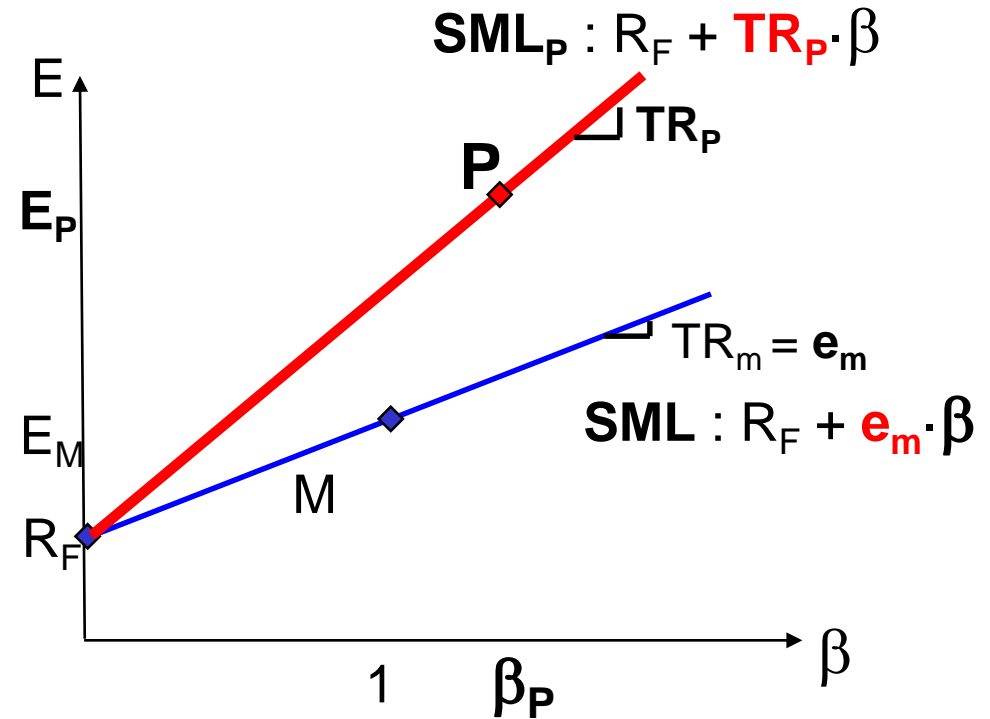
- ◆ Micro level; diversified owner
- ◆ Max TR  $\Leftrightarrow$  CAPM

## Sharpe



- ◆ "Reward to variability":  
 $SR = e / \sigma$

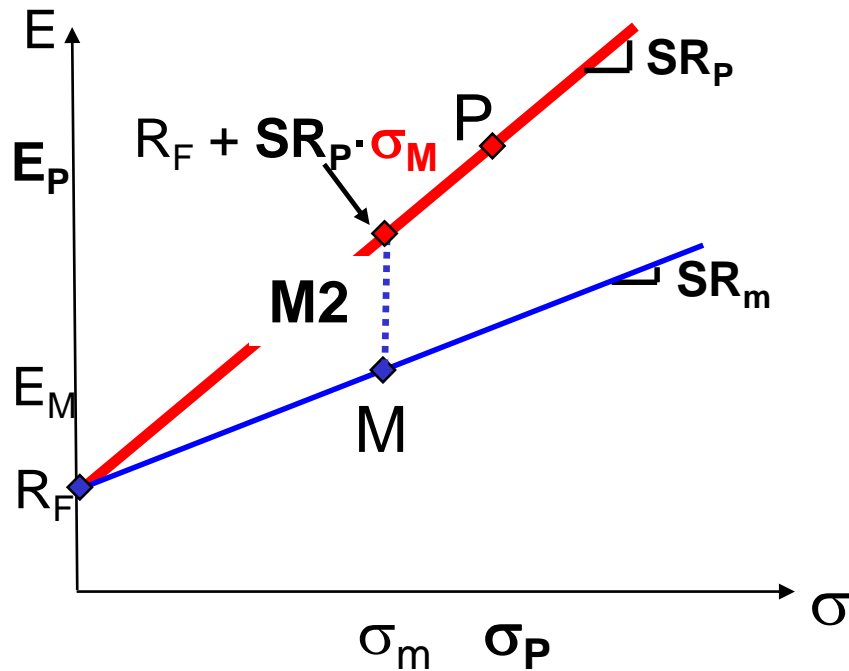
## Treynor



- ◆ "Reward to  $\beta$ -variability":  
 $TR = e / \beta$

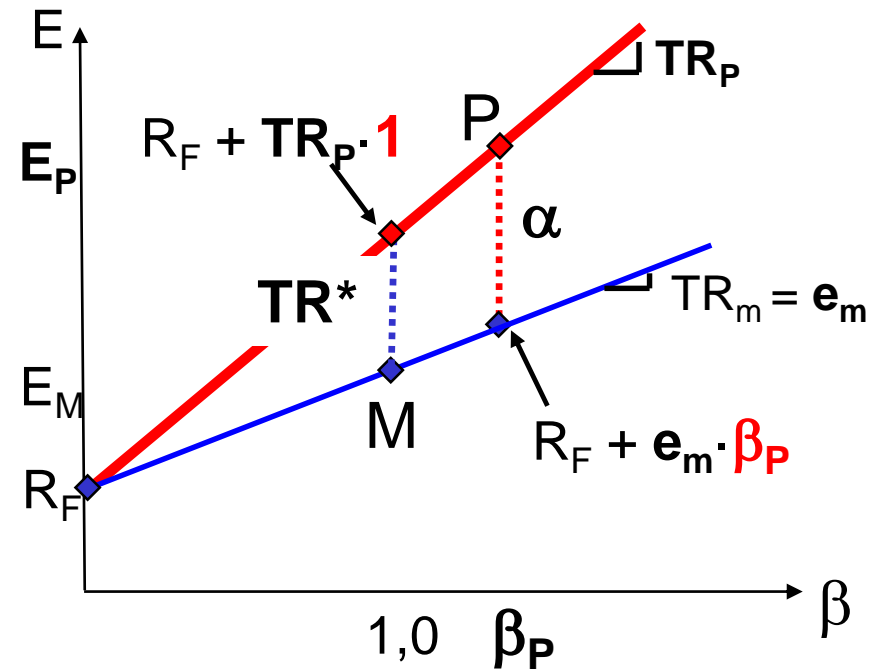
# Performance measure 2: Risk Adjusted Performance

**M2**  
(rel.  $\sigma_M$ )



◆  $M2 = e_P \cdot (\sigma_m / \sigma_P) - e_m$   
 $= [SR_P - SR_m] \cdot \sigma_m$

**Alpha vs Treynor\***  
(rel.  $\beta_P$ ) (rel.  $\beta_M$ )



◆  $TR^* = e_P / \beta_P - e_m$   
 $= [TR_P - e_m] \cdot 1,0$

◆  $\alpha = e_P - e_m \cdot \beta_P$   
 $= [TR_P - e_m] \cdot \beta_P$

## Performance measure 3: IR and AR

- ◆ Information rate (IR) scales active excess return by active risk; '**tracking error**'

(both measured relative to benchmark portfolio)

$$IR_P \equiv \frac{\bar{R}_P - \bar{R}_B}{\sigma(\tilde{R}_P - \tilde{R}_B)}$$

- ◆ Appraisal Ratio (AR) scales alpha by diversifiable risk

$$AR_P = \frac{\alpha_P}{\sigma(\varepsilon_P)} \quad \text{'Signal to Noise'}$$
$$\alpha_P + \tilde{\varepsilon}_P = \tilde{R}_P - (R_F + \boldsymbol{\beta}_P \cdot [\tilde{R}_B - R_F])$$
$$= \tilde{R}_P - \tilde{R}_B \quad ; \text{if } \boldsymbol{\beta}_P = \boldsymbol{\beta}_B$$

## IR vs AR

$$\tilde{R}_P - \tilde{R}_B = \alpha + \tilde{\varepsilon}_P + (\beta_P - \beta_B) \cdot [\tilde{R}_M - R_f]$$

### ◆ General

Diversified B

$$IR_P = \frac{\alpha_P + (\beta_P - \beta_B) \cdot e_M}{[\sigma(\varepsilon_P)^2 + (\beta_P - \beta_B)^2 \cdot \sigma_M^2]^{1/2}}$$

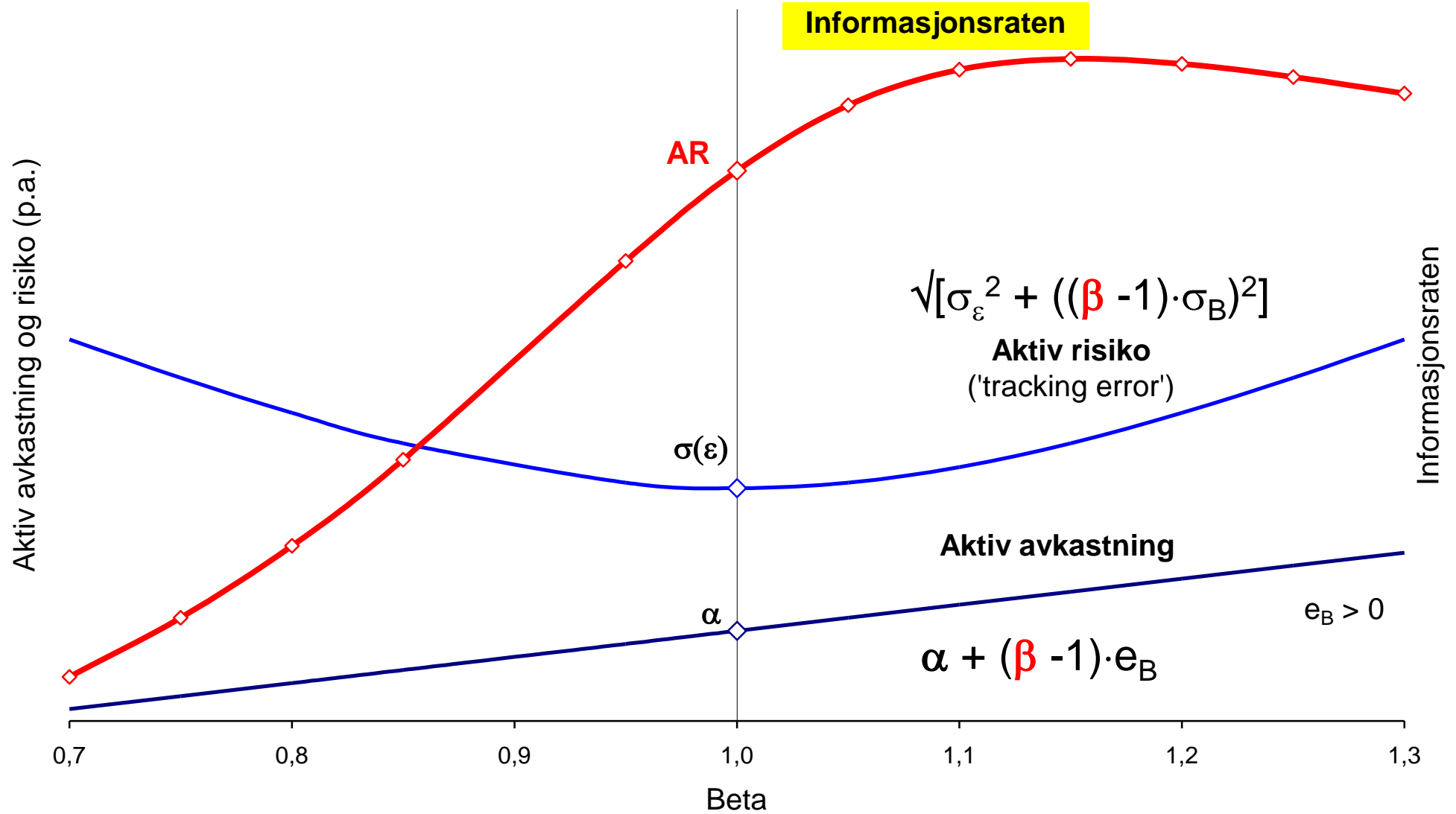
### ◆ Only alpha-bets ( $\beta_P = \beta_B$ )

$$IR_P = \frac{\alpha_P}{\sigma(\varepsilon_P)} = AR_P$$

### ◆ Only beta-bets ( $\sigma(\varepsilon_P) = 0 = \alpha_P$ )

$$IR_P = \frac{e_B}{\sigma_B} = SR_B$$

# Beta factor in IR



# Sharpe - Alpha - Treynor - Appraisal - IR

- ◆ SR / TR / IR: owner gears excess return by borrowing/lending at  $R_f$

⇒ Alpha: sign is most interesting (on its own)

- ◆ SR / IR: macro level

- ◆ Treynor / Alpha / IR / AR: micro level (subportfolios)

- Treynor/Alpha: total portfolio is diversified

- IR / AR: subportfolios taking bets over and above indexed core portfolio ('core' + 'satelites')

- ◆ Max SR / TR / IR: can active portfolio be scaled?

⇒

1. Free shorting benchmark (e.g. risk free debt)
2. No obstacles to scaling active management

Is manager skilled?  $E(R - R_B) = \mathbf{E(r) > 0}$  ?

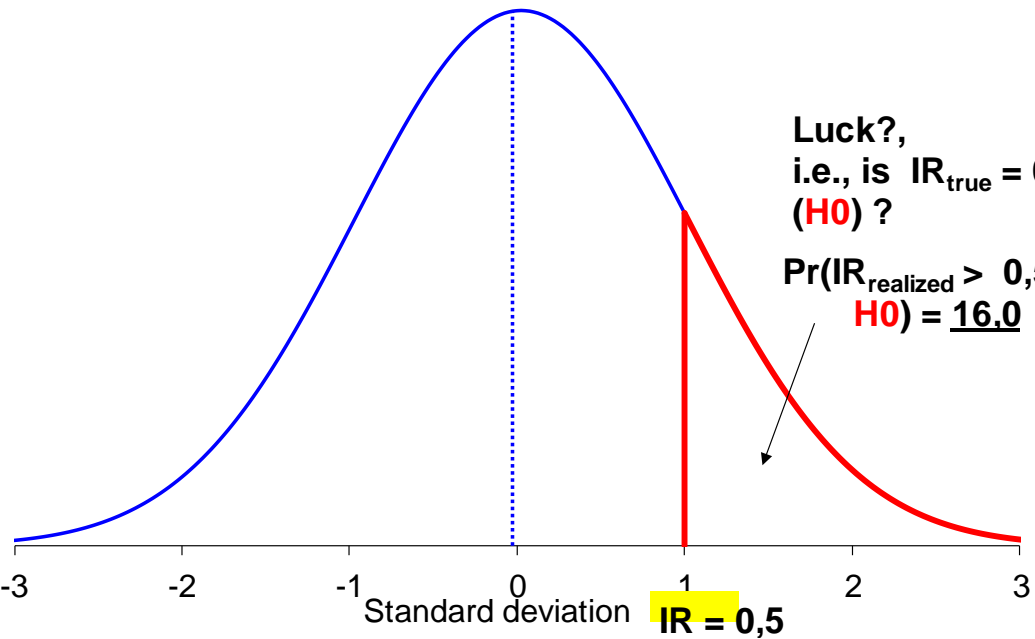
- Measured average excess return  $\bar{r}$

$$t_{\bar{r}} = \frac{\bar{r}_P}{\sigma(\tilde{r}_P) / \sqrt{n}} = \mathbf{IR} \cdot \sqrt{n}$$

Example:  $\mathbf{IR = 0,5}$  and  $\mathbf{n = 4}$

$$\Rightarrow t = 0,5 \cdot \sqrt{4} = \mathbf{1,0}$$

Luck or skill



Luck?,  
i.e., is  $IR_{true} = 0$   
( $H_0$ ) ?

$Pr(IR_{realized} > 0,50 /$   
 $H_0) = \mathbf{16,0}$

Approx.  $Pr(IR \geq 0,5 \mid IR_{true} = 0)$

$$\cong 50\% - t \cdot \mathbf{34\%} = \mathbf{16\%}$$

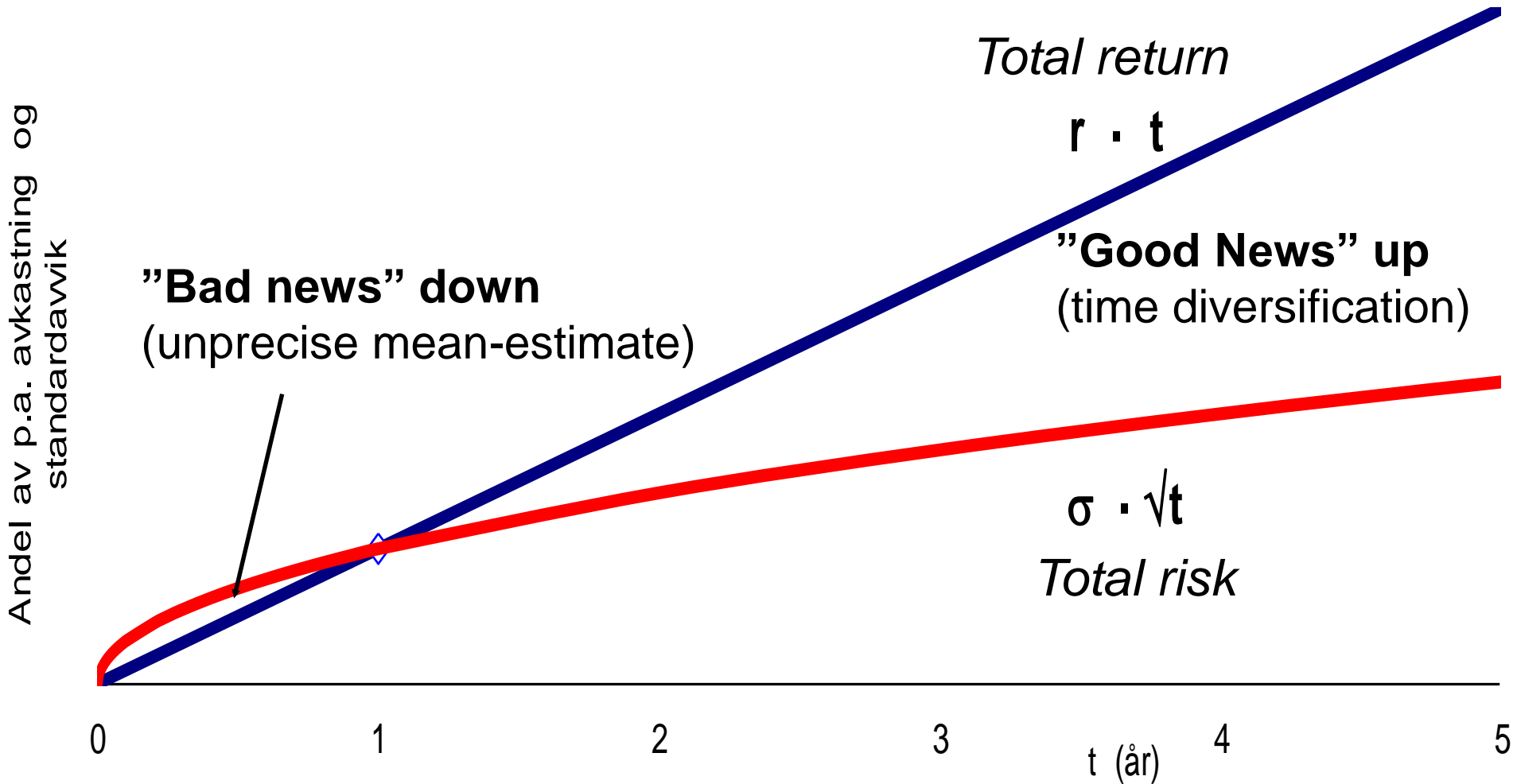
Using normal distribution,  
since precisely estimated std.dev

# Does more frequent measurement help?

- ◆ Use e.g. monthly or quarterly data
- ◆ Increases precision of estimate for risk (std. deviation)
  - More information about variance of process
- ◆ ... but does not improve estimate of average return
  - **more, but less precise observations**
  - (geometric return requires only initial and terminal value)



# Time effect for std. deviation: slow both up and down



- ◆ Shorter return period  $\Rightarrow$  Std.deviation increases relative to average  $\Rightarrow$  Reduced precision in measuring average

How many observations do we need for precision?

	Quarter	Year	
	IR		
#obs	0,25	0,5	1,0
1	0,25	0,5	1,0
4	0,5	1,0	<b>2,0</b>
<b>16</b>	1,0	<b>2,0</b>	4
25	1,25	2,5	5
<b>64</b>	<b>2,0</b>	4	8
400	5	10	
625	6		

$$T_{\bar{r}} \approx IR_{\text{periode}} \cdot \sqrt{\# \text{obs}}$$

$$T_{kv} = IR_{kv} \cdot \sqrt{\#kv}$$

$$= \frac{IR_{\text{år}}}{\sqrt{4}} \cdot \sqrt{4 \cdot \# \text{år}} = T_{\text{år}}$$

# Attribution analysis

**Tabell 27** Bidrag fra investeringsstrategiene til aksje- og renteinvesteringenes relative avkastning fra 2013 til 2016. Annualisert. Prosentpoeng

	Aksje- investeringer	Rente- investeringer	Allokering på tvers av aktivaklasser	Totalt
Allokering	-0,03	-0,14	0,04	-0,13
Intern referanseportefølje	-0,01	-0,14	0,00	-0,15
hvorav systematiske faktorer	0,02			0,02
hvorav utvidelse av investeringsuniverset	0,00	-0,09		-0,09
Allokeringsbeslutninger	-0,02	0,00	0,04	0,02
Verdipapirseleksjon	0,07	0,00		0,07
Internt	-0,02	0,00		-0,02
Eksternt	0,09			0,09
Markedseksponering	0,17	0,08	0,00	0,25
Posisjonering	0,12	0,08	0,00	0,20
Utlån av verdipapirer	0,05	0,00		0,06
<b>Totalt</b>	<b>0,21</b>	<b>-0,06</b>	<b>0,04</b>	<b>0,20</b>