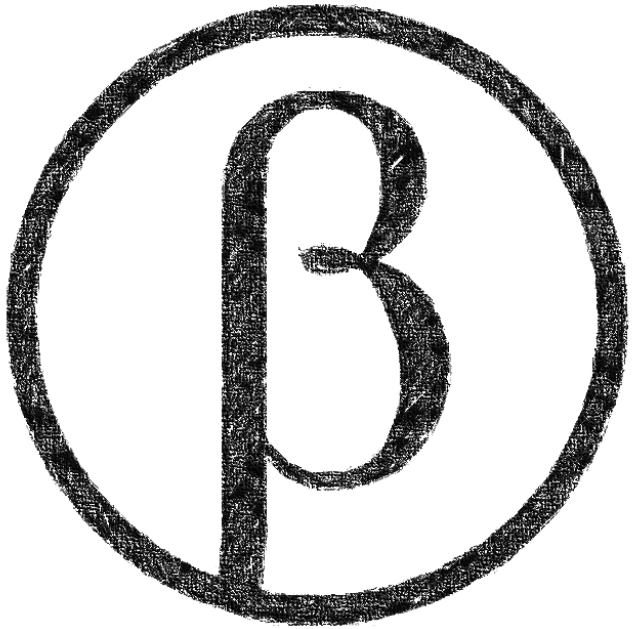
Time Variance of Risk-Factors Effects



MBA 2014 - Andreas Heier

Presentation: July 25th 2014 1:15 PM

Structure

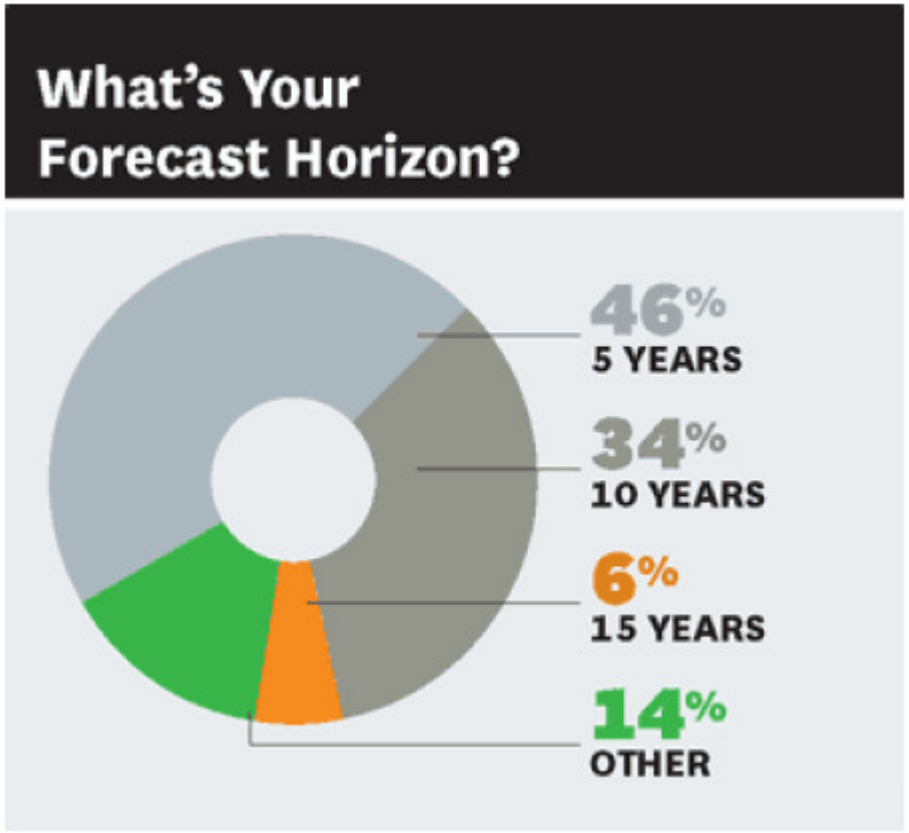
- ✓ Motivation
- ✓ Econometric Approach
  - ✓ Method
  - ✓ Estimation
- ✓ Results of Estimation
  - ✓ Market Results
  - ✓ Case 1: Lanxess
  - ✓ Case 2: Merck

✓Motivation

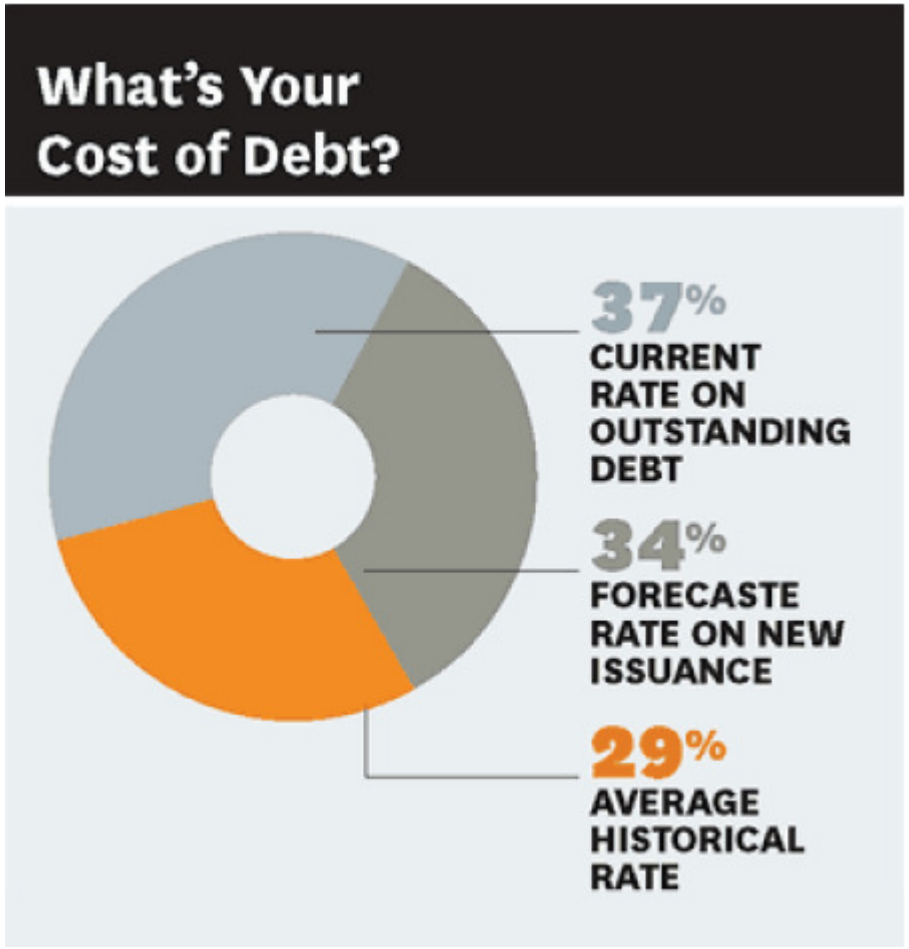
U.S. Survey: Cost of Capital

- ✓ How do U.S. Companies estimate their Cost of Capital ?
- ✓ Forecast-Horizon
- ✓ What´s the Cost of Debt ?
- ✓ What´s your Debt-to-Equity Ratio ?
- ✓ What Risk-Free rate to use ?
- ✓ ***What´s your Beta-Period ?***

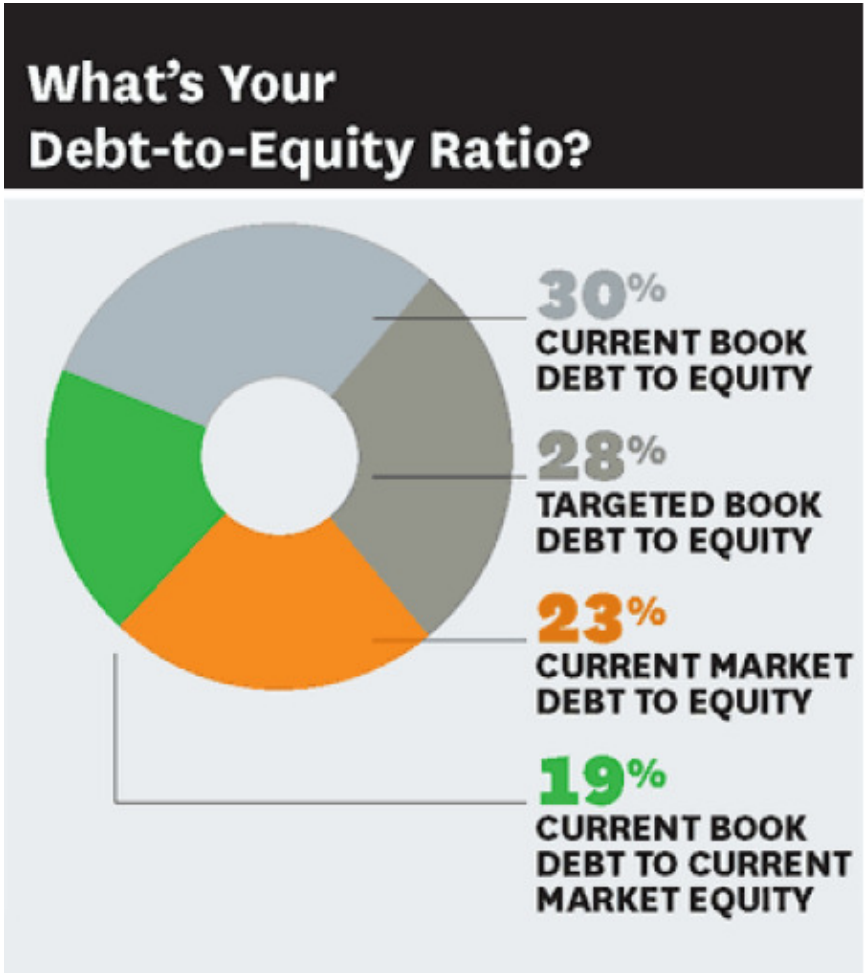
U.S. Survey: Cost of Capital



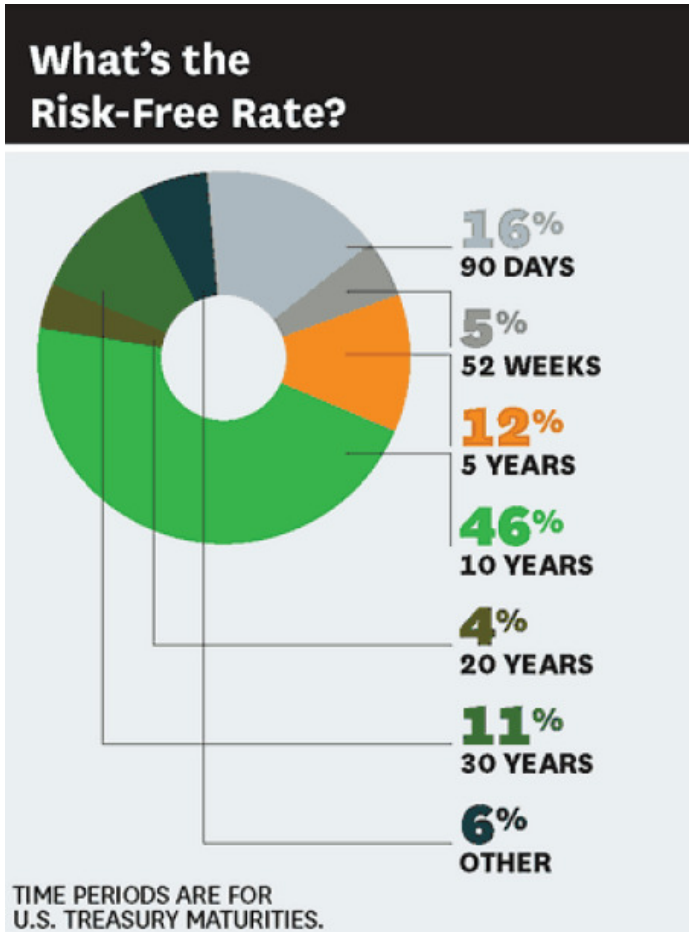
U.S. Survey: Cost of Capital



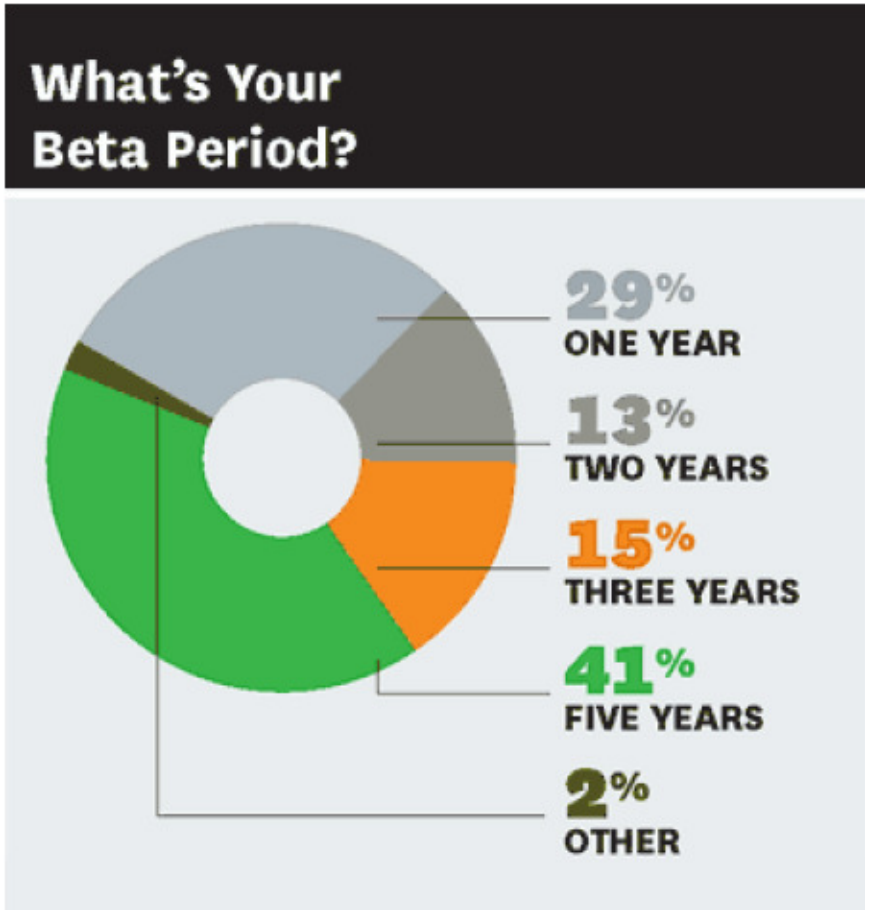
U.S. Survey: Cost of Capital



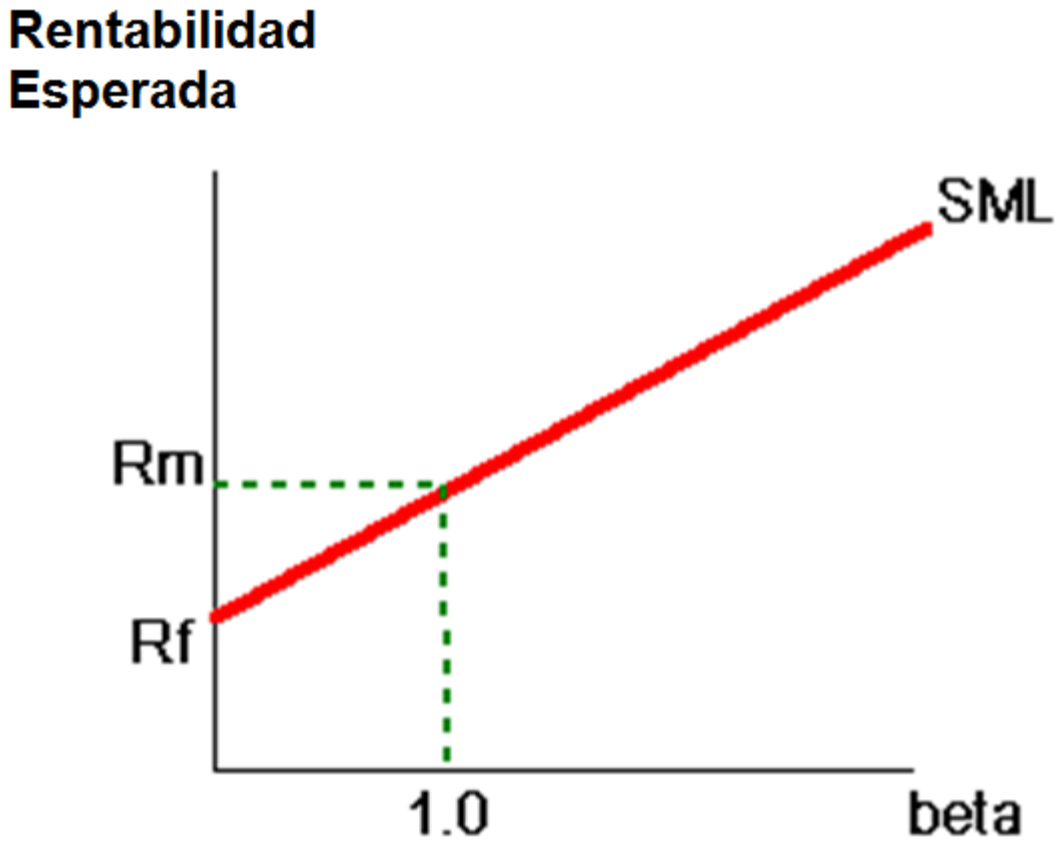
U.S. Survey: Cost of Capital



U.S. Survey: Cost of Capital



Capital-Asset-Pricing-Model



$$r_a = r_f + \beta_a (r_m - r_f)$$

- Uncertainty
- Only one factor

What is the right β ?

- ✚ Widely accepted
- ✚ Easy to apply

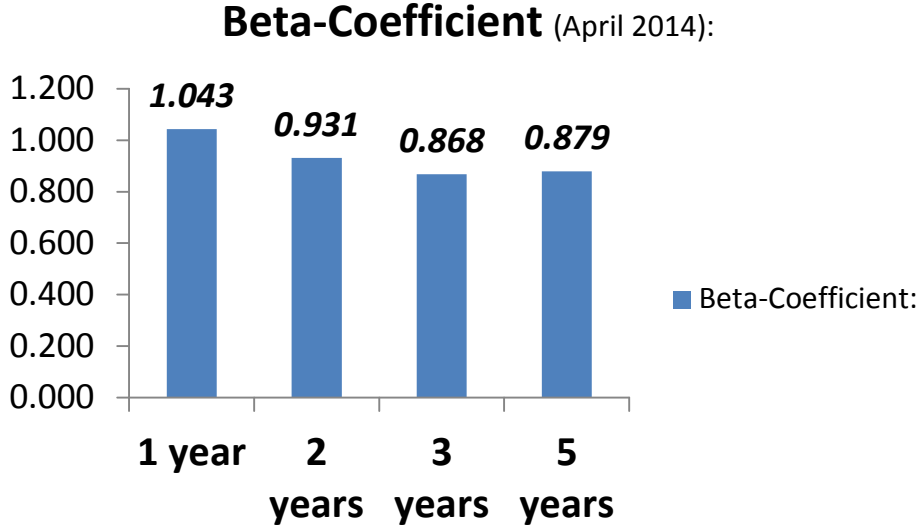
What is the right β ?

$$\beta = \frac{\mathrm{Cov}(r_a, r_b)}{\mathrm{Var}(r_b)}$$

Trading Information	
Stock Price History	
Beta:	1.14
52-Week Change[3]:	N/A
S&P500 52-Week Change[3]:	16.40%
52-Week High (Apr 2, 2014)[3]:	604.83
52-Week Low (Apr 28, 2014)[3]:	502.80
50-Day Moving Average[3]:	567.63
200-Day Moving Average[3]:	551.23

July 2014

Google Inc. (GOOG)



✓Econometric Approach

✓Method

State space model for time-varying parameter CAPM-Model

- Consider the following time series model for asset i return in period t:
- $y_{it} = \dot{\alpha}_{it} + \beta_{it} y_{m,t} + \sigma_{\varepsilon} \varepsilon_{it}$
- $\dot{\alpha}_{it+1} = \dot{\alpha}_{it} + \sigma_{\eta 1} \eta_{1,it}$
- $\beta_{it+1} = \beta_{it} + \sigma_{\eta 2} \eta_{2,it}$
- for $t = 1, \dots, T$, where $\varepsilon_{it} \sim N(0,1)$, $\eta_{1,it} \sim N(0,1)$, $\eta_{2,it} \sim N(0,1)$ are independent; $\boldsymbol{y_{it}}$ is the daily stock return minus the risk free rate;
  $\boldsymbol{y_{m,t}}$ is the daily stock index return minus the risk free rate representing the common market factor

State space model for time-varying parameter CAPM-Model

- In the *Capital Asset Pricing Model (CAPM)*, the $\dot{\alpha}$ coefficient is zero. However, in practice, we may estimate non-zero $\dot{\alpha}$ coefficients. **$\dot{\alpha}$ is interpreted as mispricing on the financial market** and it is called the active return on the financial asset.

State space model for time-varying parameter CAPM-Model

- In the Capital Asset Pricing Model (CAPM), the β coefficient measures the sensitivity of the asset return to the common market factor.
- As this factor influences all firms on the market, it represents the impact of general economic conditions in the economy and their impact on investors´ views about how these influence firm value.

✓Econometric Approach

✓Estimation

Estimation by the maximum likelihood method

Log likelihood function:

- $\ln L = \sum_{t=1}^{T} \ln f(y_t|Y_{t-1}) =$
- $-\frac{TN}{2}\ln(2\pi) - \frac{1}{2}\sum_{t=1}^{T}(\ln|F_t| + v_t'(F_t)^{-1}v_t)$

✓ The parameter estimates maximize the log likelihood function. The optimization procedure is done numerically

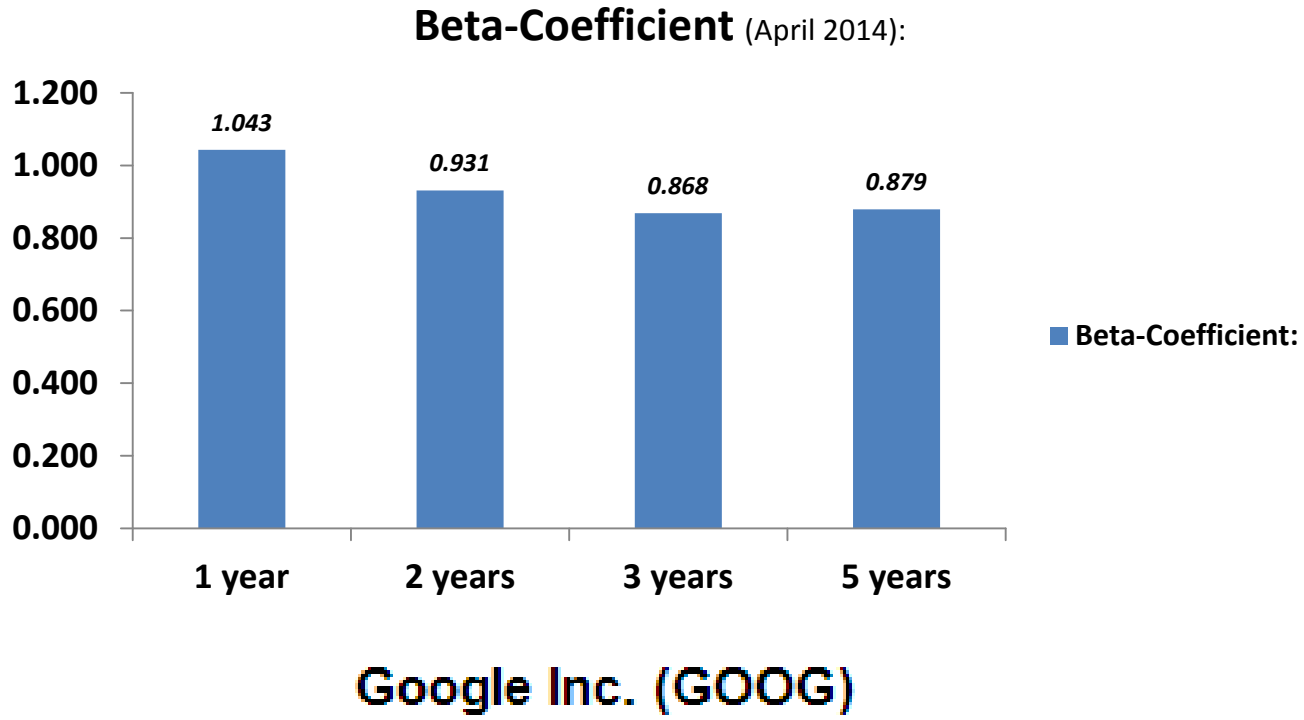
✓ ln *L* is computed by the Kalman filter procedure

Kalman-Filter-Approach (1)

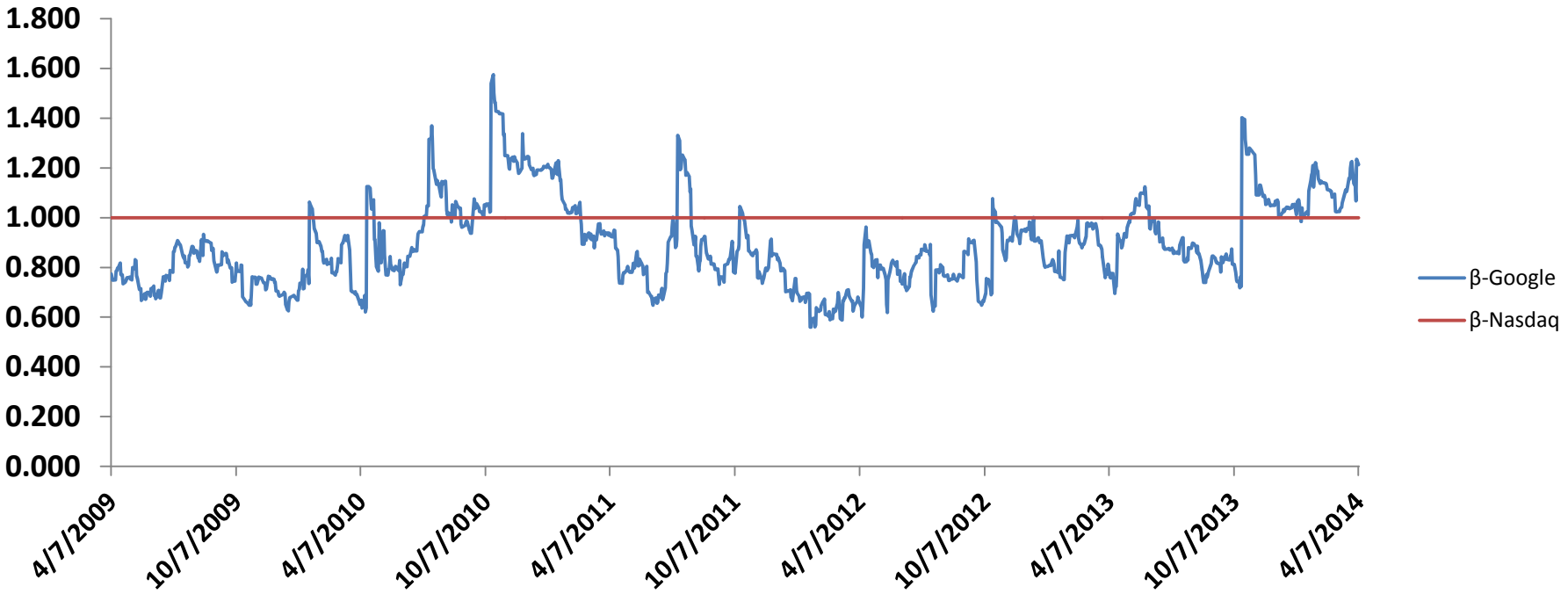
- ✓ The Kalman filter was introduced by Kalman (1960)
- ✓ Kalman filter is a method of computation for the evaluation of the likelihood of data
- ✓ It is used because the econometric model of this thesis is a special case of the Linear Gaussian State Space Model These models are estimated by maximum likelihood method employing the Kalman filter Technique

✓Results of Estimation

What is the right β ? – Part 2

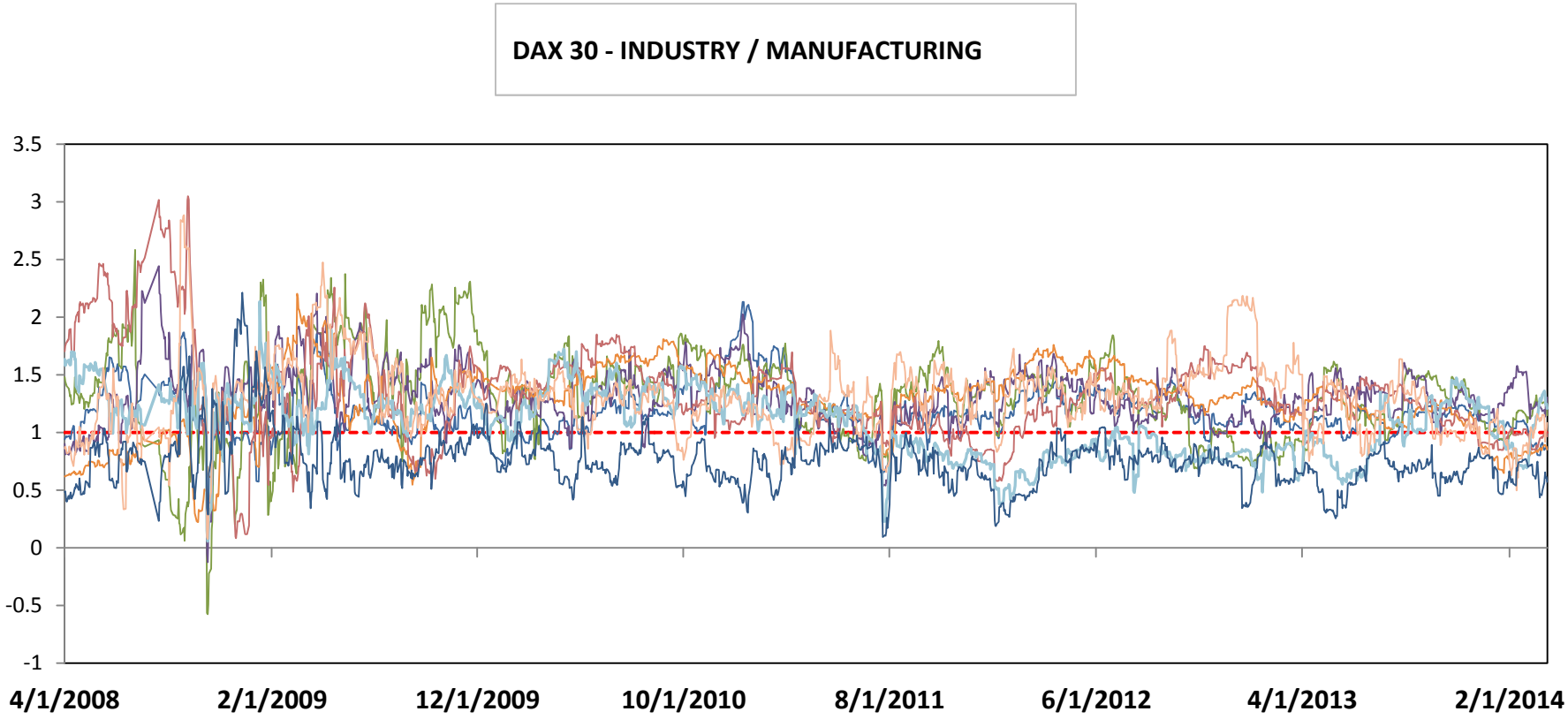


What is the right β ? – Part 2

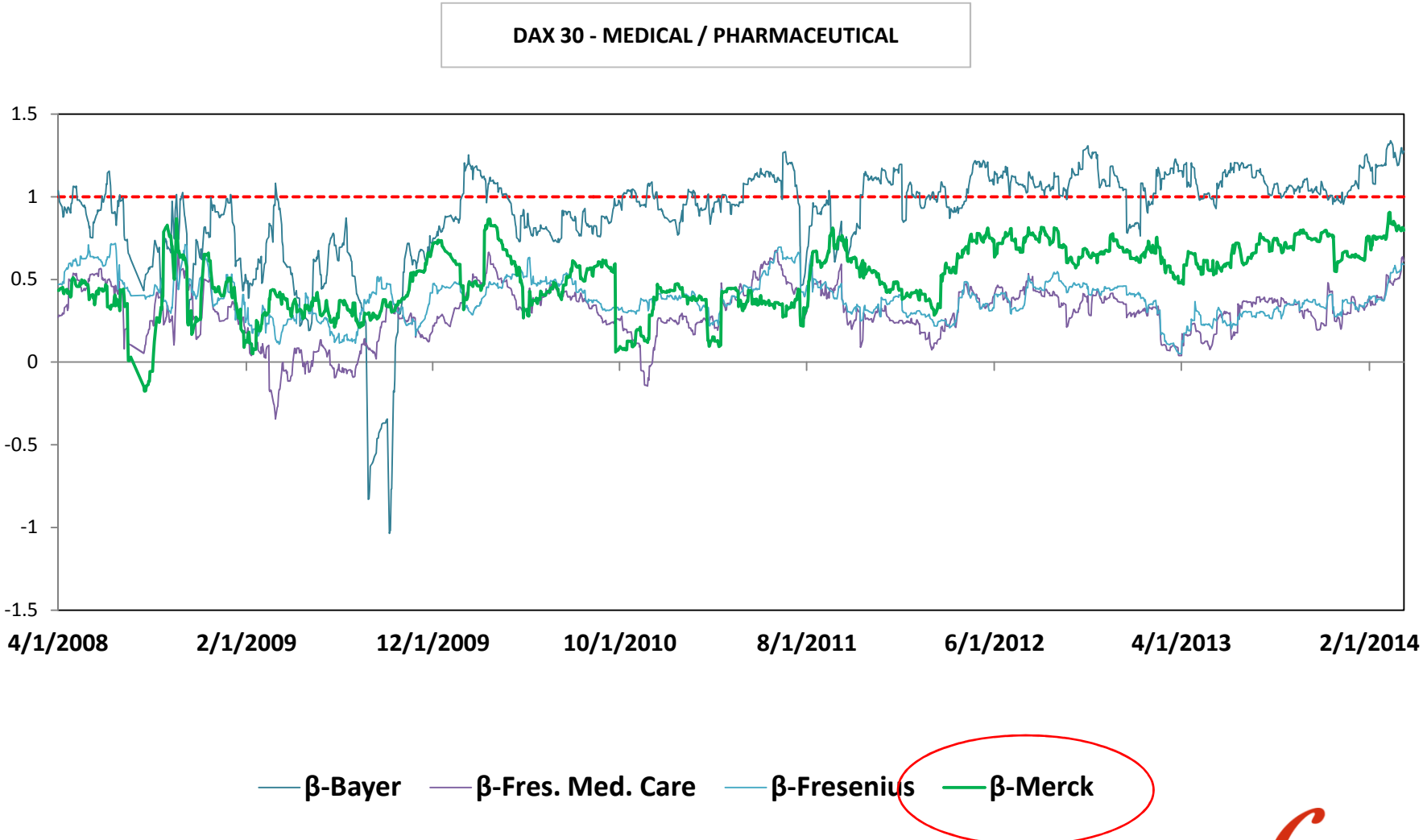


German DAX-30

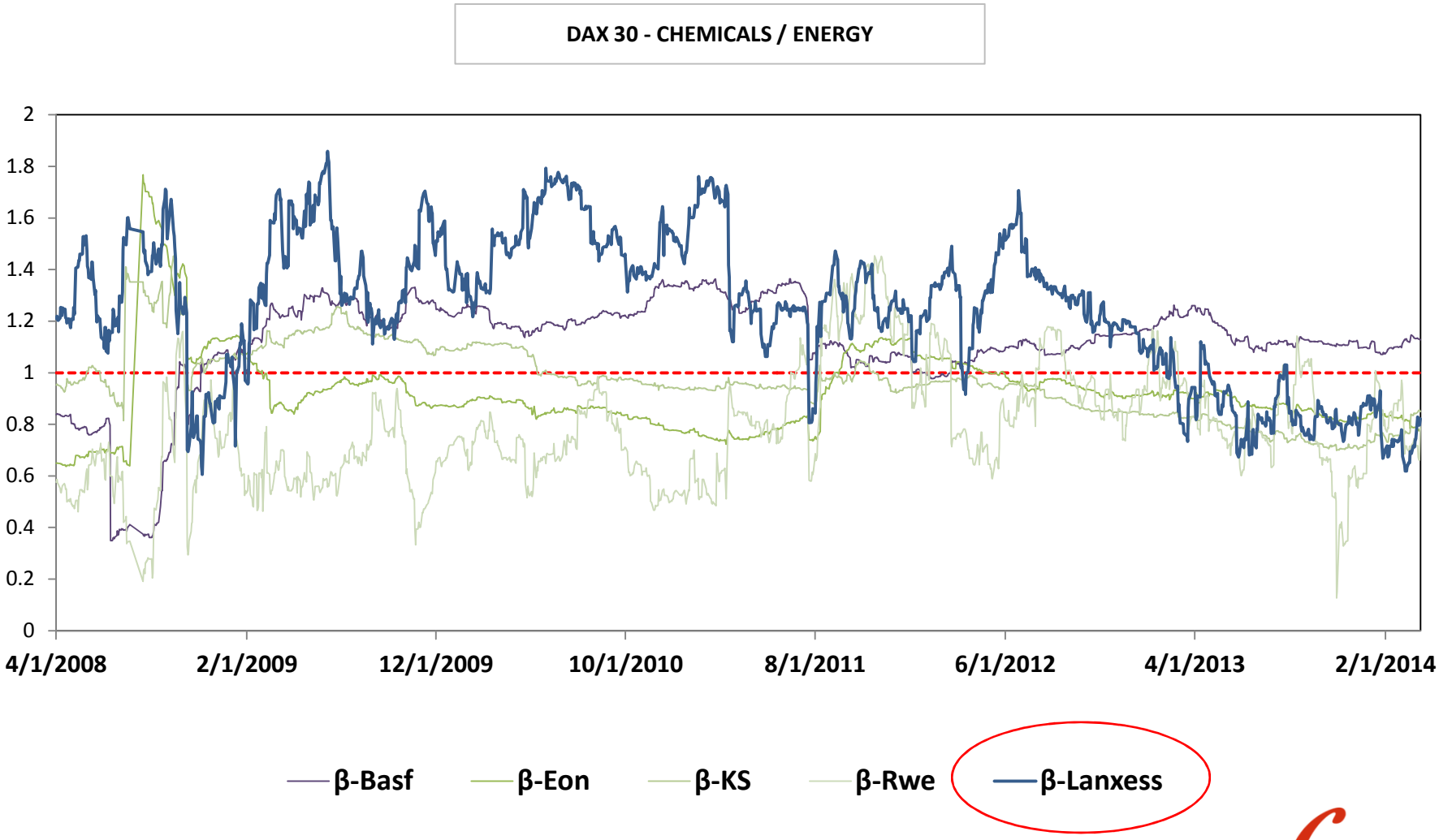
Kalman-Filter-Application on DAX30



Kalman-Filter-Application on DAX30



Kalman-Filter-Application on DAX30



Linear Regresion vs. Time Series

- ✓ Estimation of 1 year return with CAPM
- ✓ β-4 years static vs. β-Time Series

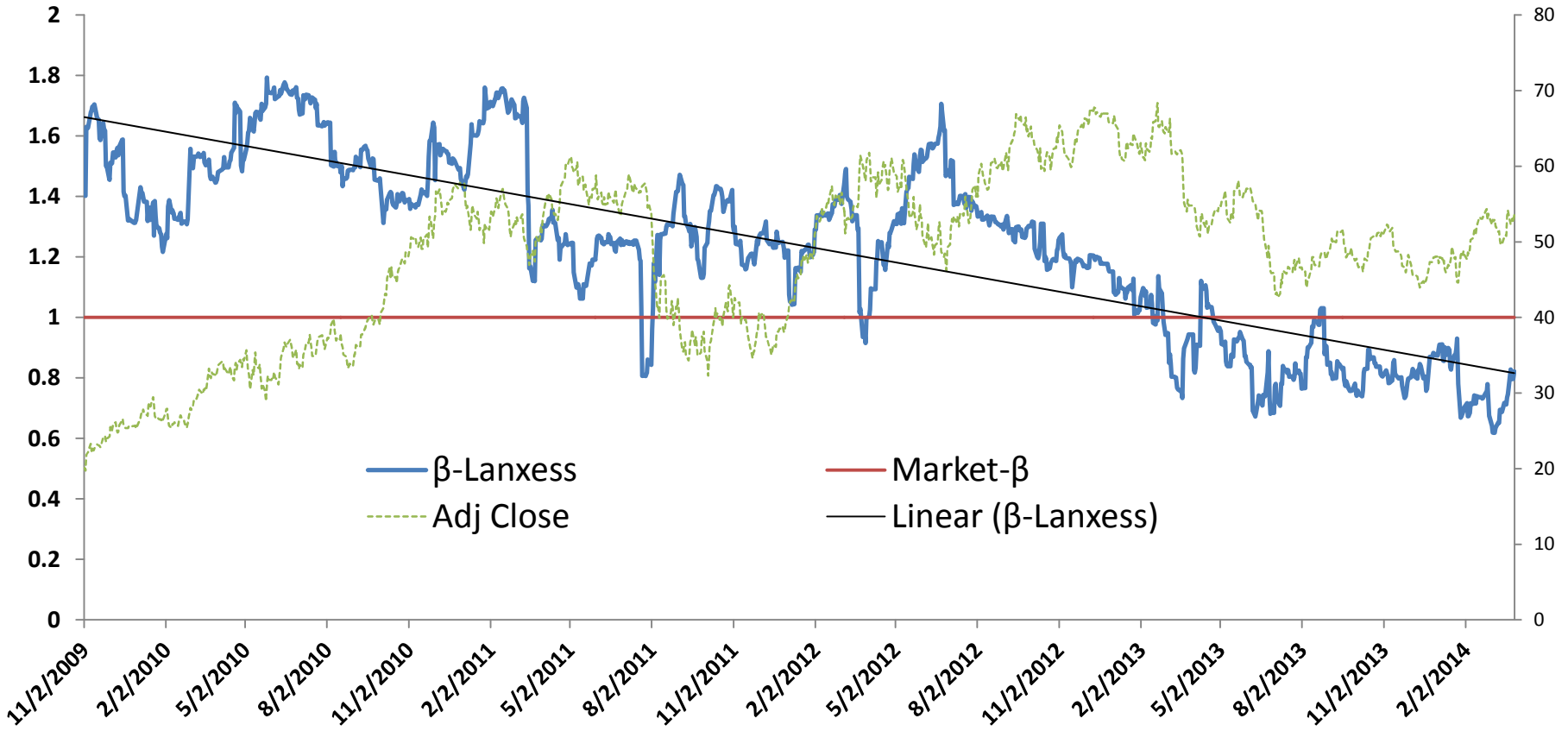
- ✓ ***Will considering the β of the time series lead to a more precise future return estimation ?***

✓Results of Estimation

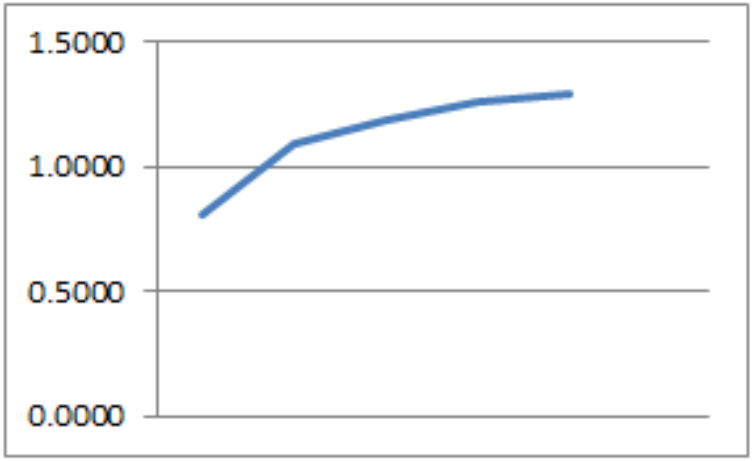
✓ Case 1: Lanxess

LANXESS

- ✓Special Chemicals
- ✓Bayer AG Spin-Off
- ✓Foundation 2004 – Since 2013 Dax-Company
- ✓Headquarter in Cologne, Central Germany
- ✓17,000 Employees
- ✓€ 8,300 Million Sales


2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
80
70
60
50
40
30
20
10
0
β-Lanxess
Market-β
Adj Close
Linear (β-Lanxess)
11/2/2009
2/2/2010
5/2/2010
8/2/2010
11/2/2010
2/2/2011
5/2/2011
8/2/2011
11/2/2011
2/2/2012
5/2/2012
8/2/2012
11/2/2012
2/2/2013
5/2/2013
8/2/2013
11/2/2013
2/2/2014

Lanxess	
Beta 1 year	0.8078
Beta 2 year	1.0917
Beta 3 year	1.1910
Beta 4 year	1.2587
Beta 5 year	1.2971



Static Beta (01.04.2008-29.03.2013):	**1.2582**
Expected return daily with static beta:	**0.0337%**
Real avg. Daily return (01.04.2013-28.03.2014):	**0.00713%**
Accuracy:	473%
Expected return daily time series beta 0.5:	**0.0211%**
Accuracy:	296%

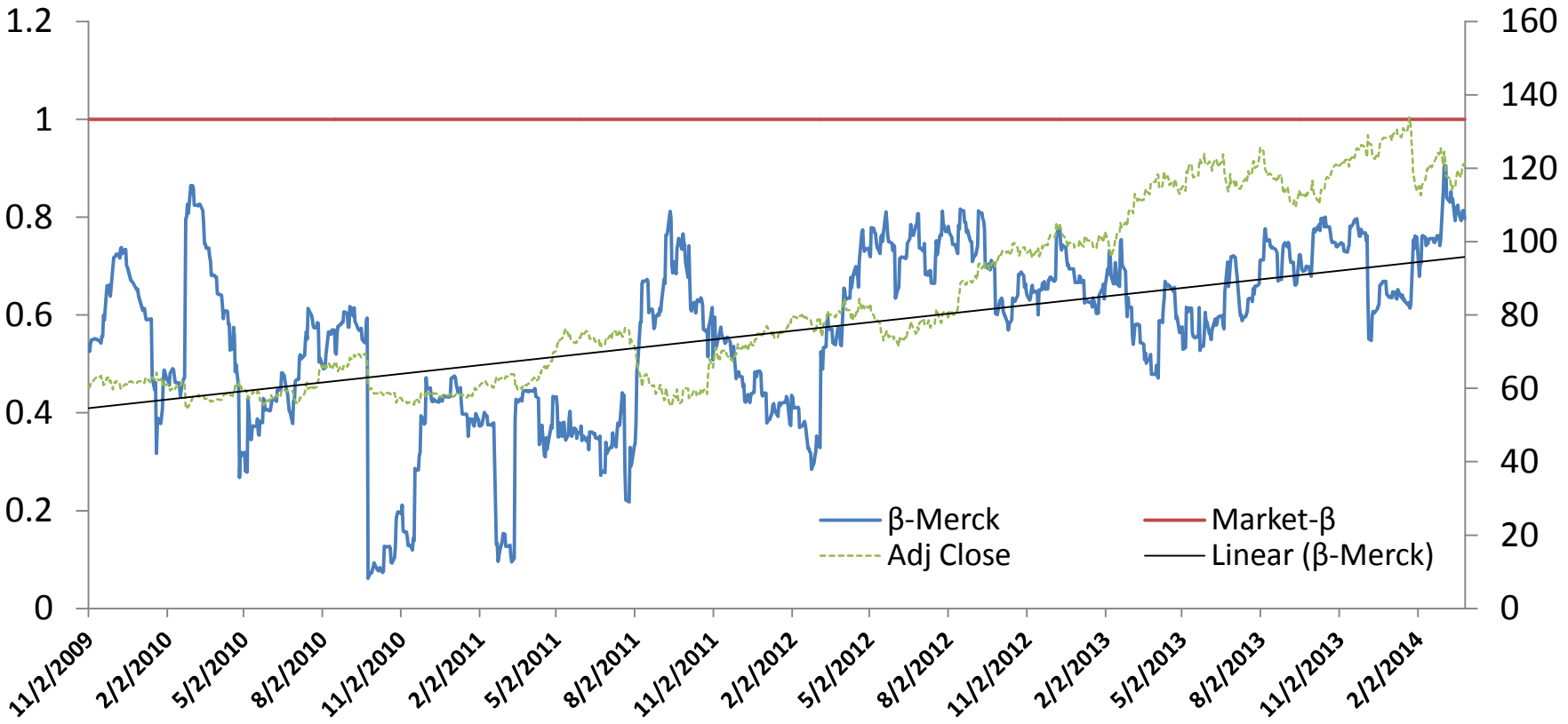
$$r_a = r_f + \beta_a (r_m - r_f)$$

✓Results of Estimation

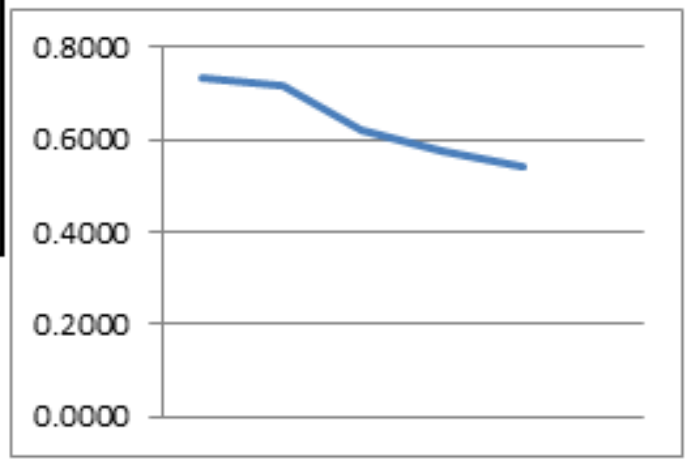
✓ Case 2: Merck AG

- ✓Pharmaceuticals and Chemicals
- ✓Headquarter in Darmstadt, South of Germany
- ✓Founded in 1668, IPO 1995 and since 2007 in DAX
- ✓40,000 Employees
- ✓€ 12,000 Million Sales

Introduction OF COMPANY 2: Merck



Merck	
Beta 1 year	0.7356
Beta 2 year	0.7154
Beta 3 year	0.6190
Beta 4 year	0.5765
Beta 5 year	0.5396



Static Beta (01.04.2008-29.03.2013):	**0.4828**
Expected return daily with static beta:	**0.0162%**
Real avg. Daily return (01.04.2013-28.03.2014):	**0.02593%**
Accuracy:	62.29%
Expected return daily time series beta 0.8:	**0.0233%**
Accuracy:	90.02%

$$r_a = r_f + \beta_a (r_m - r_f)$$

Conclusion: → GAUSS

- ✓ β-average does not always need to be used in CAPM
- ✓ Before CAPM Time-Series should be observed
- ✓ Market risk can have specific tendency and behavior
- ✓ Great Tool for market risk observation
- ✓ ***With time-varying beta coefficient, the estimation of cost of capital can be more precise!***

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