Project and Enterprise Financing

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Lectures 6, 7, and 8: Equity Financing: Overview

Content

1. Equity Instruments
2. Return Calculation
3. Risk Quantification
4. Basics of Modern Portfolio Theory
5. Market Model
6. **CAPM**
7. **Multifactor Models**
8. **Market Efficiency and Market Anomalies**

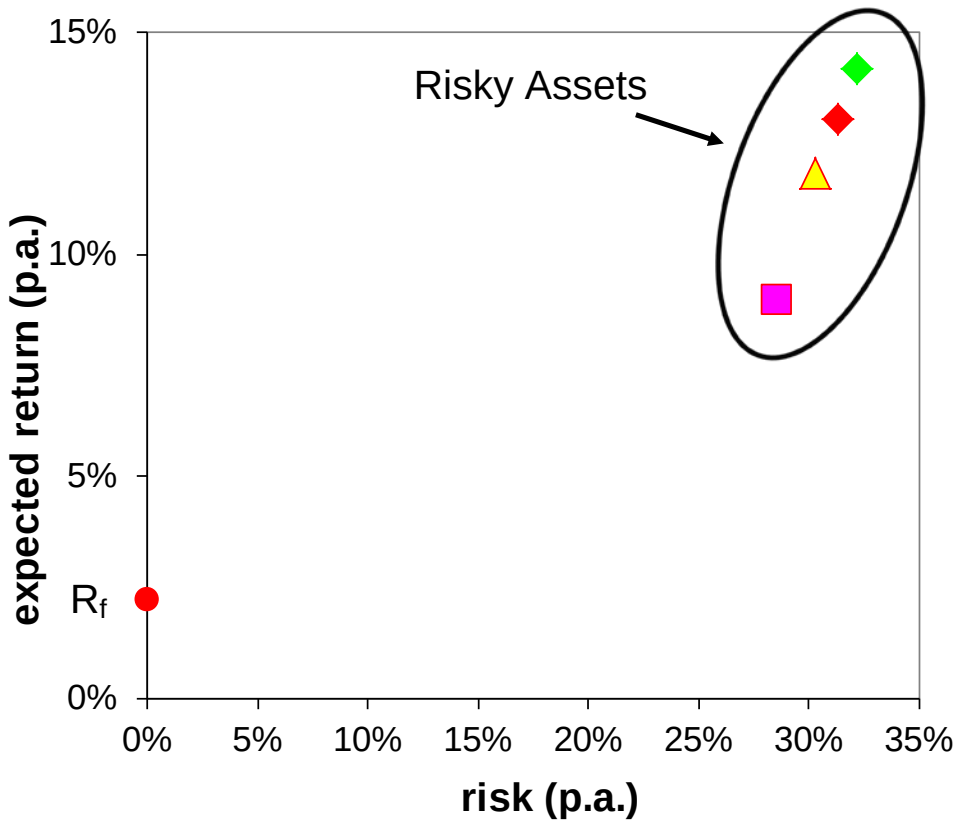
6. CAPM

6.1 Capital Market Line

- CAPM: Sharpe (1964), Lintner (1965) and Mossin (1966)
- Extension: Portfolio of **risky** assets **+** one **riskless asset** (**R_F**).
- Riskless assets: $\sigma_F = 0$
- Proxy for **R_F**: **Treasury Bills** with a maturity of 1-3 months
- Investor: Can choose between investing in the **riskless asset** and one **risky portfolio** (tangential portfolio **M**).

CAPM – Adding a risk-free security

- Government or Treasury securities (with highest rating) are considered to have (nearly) zero default risk.
- As the risk of even a default free bond increases with maturity (consider e.g. 'duration' as risk measure), a riskless asset has to have a short maturity.
- Thus, 1-3 months **Treasury Bills** can be used as basis to generate the risk free rate (they have (nearly) zero volatility).
- R_f is the risk free rate. This corresponds to the point R_f on the return-axis.



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❍ Adding a risk-free security: Starting point

- Suppose you can lend (and borrow) at this risk-free rate. This alters the investment opportunities available to you, as you can now combine the risk-free asset with risky assets.

- Assume you invest **(1-x_D) % risk-free** and the rest **(x_D) %** in a portfolio *D* of **risky** securities.

- What is the **expected return** and **risk** from this investment?

Portfolio of the riskless asset and an **arbitrary** risky asset D:

$$E[R_P] = (1 - x_D) \cdot R_F + x_D \cdot E[R_D]$$

$$\sigma_P^2 = (1 - x_D)^2 \cdot \sigma_F^2 + x_D^2 \cdot \sigma_D^2 + 2 \cdot (1 - x_D) \cdot x_D \cdot \rho_{F,D} \cdot \sigma_F \cdot \sigma_D$$

As $\sigma_F = 0$: $\sigma_P^2 = x_D^2 \cdot \sigma_D^2$ or $\sigma_P = x_D \cdot \sigma_D$ and $x_D = \dfrac{\sigma_P}{\sigma_D}$

Expected performance:

$$E[R_P] = \left(1 - \frac{\sigma_P}{\sigma_D}\right) \cdot R_F + \frac{\sigma_P}{\sigma_D} \cdot E[R_D]$$

$$E[R_P] = R_F - \frac{\sigma_P}{\sigma_D} \cdot R_F + \frac{\sigma_P}{\sigma_D} \cdot E[R_D]$$

$$E[R_P] = R_F + \frac{E[R_D] - R_F}{\sigma_D} \cdot \sigma_P$$

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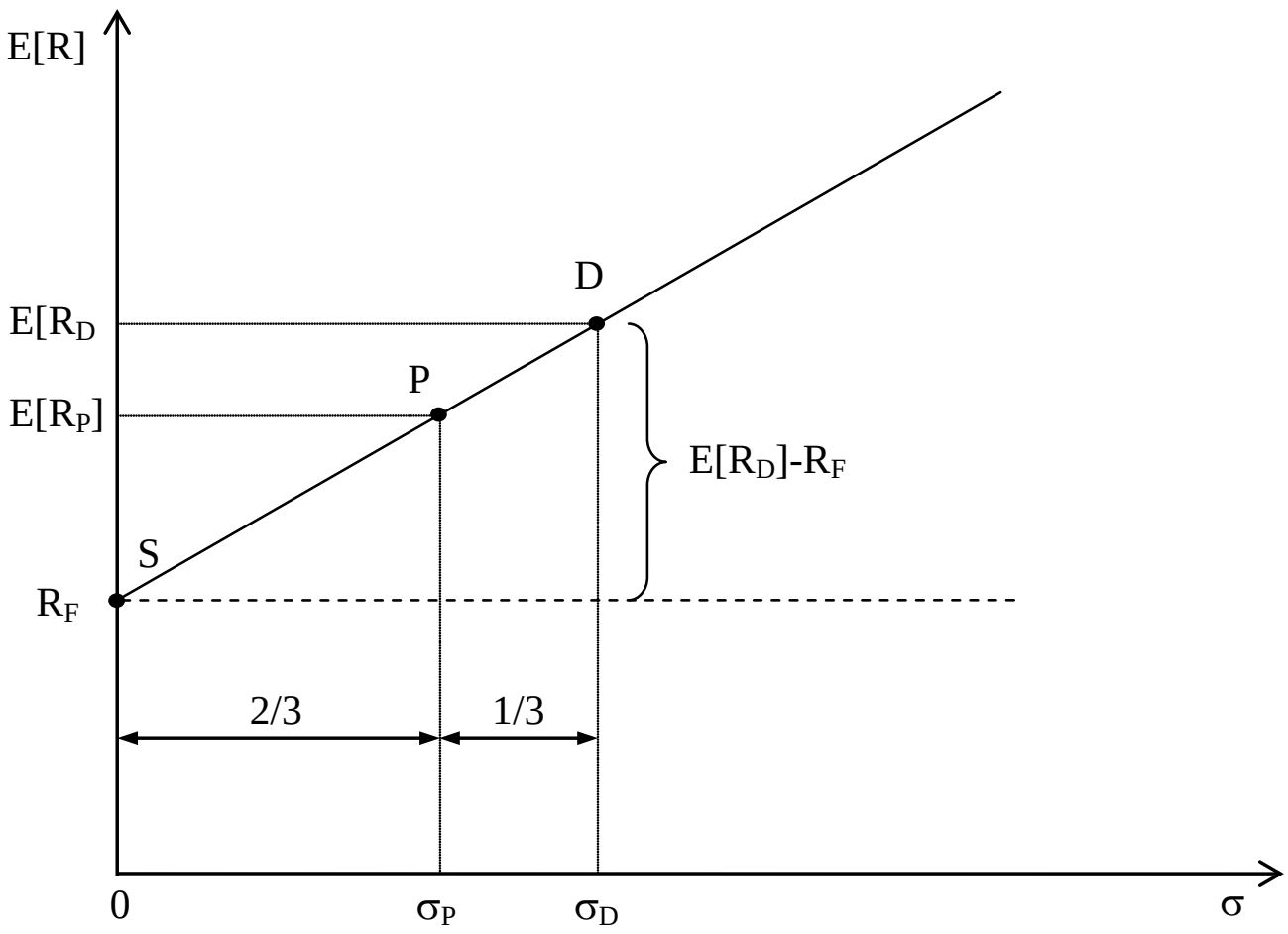

Between *S* and *D*: long *S* (max 100%) and long *D* (max 100%)

To the right of *D*: short *S* and long *D* (above 100%)

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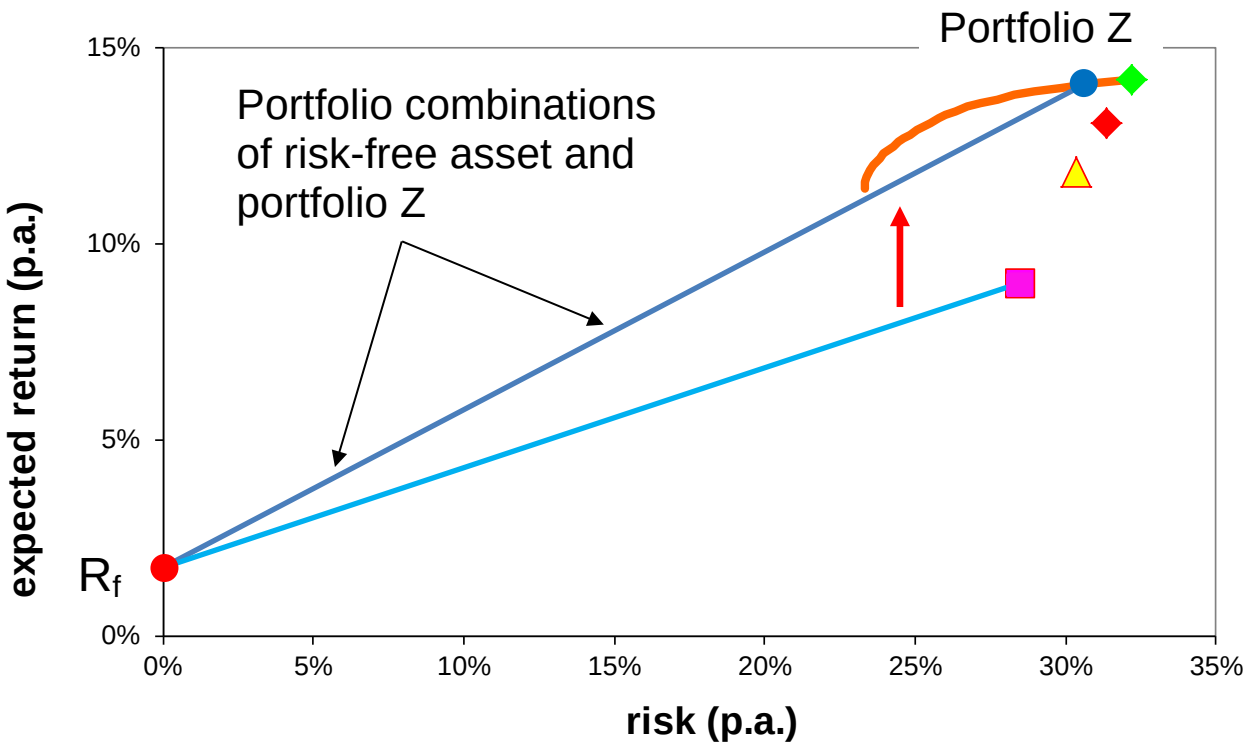
❍ Adding a Risk-Free Security: Investment set

The combinations of the risk-free asset and the portfolio Z are **not efficient**.



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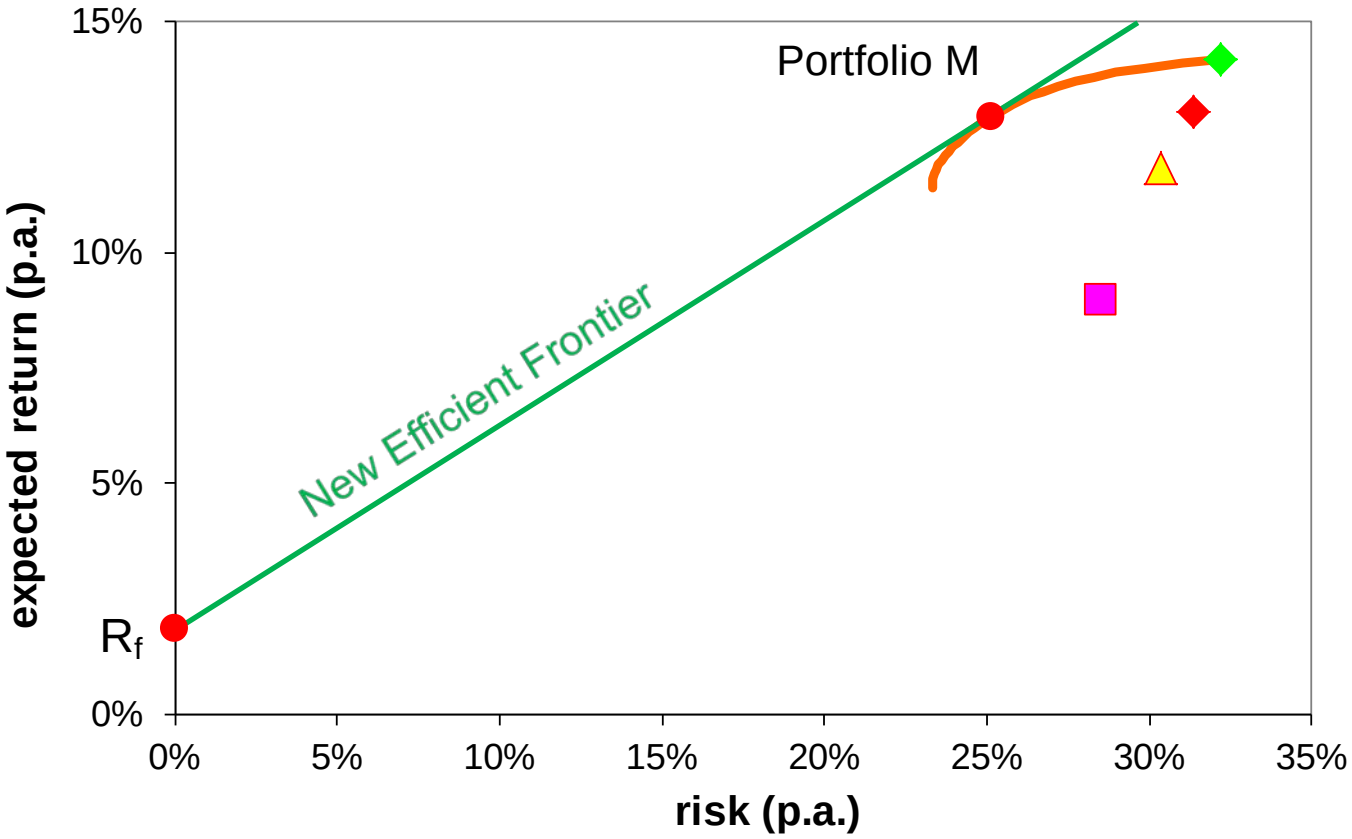
If we combine the risk-free asset with portfolio M, all combinations on the **green line** are **efficient**!!!



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❍ Portfolio M: Components

Portfolio ***M*** components (%):

$x_{BMW} = 35$

$x_{EON} = 5$

$x_{Henkel} = 30$

$x_{Siemens} = 30$

Expected return: $\mathbf{E}(R_M) = 12.88\%$

Risk: $\sigma_M = 25.06\%$

$R_F = 2\%$

Portfolio ***M*** is called the **market portfolio** or **tangency portfolio**.

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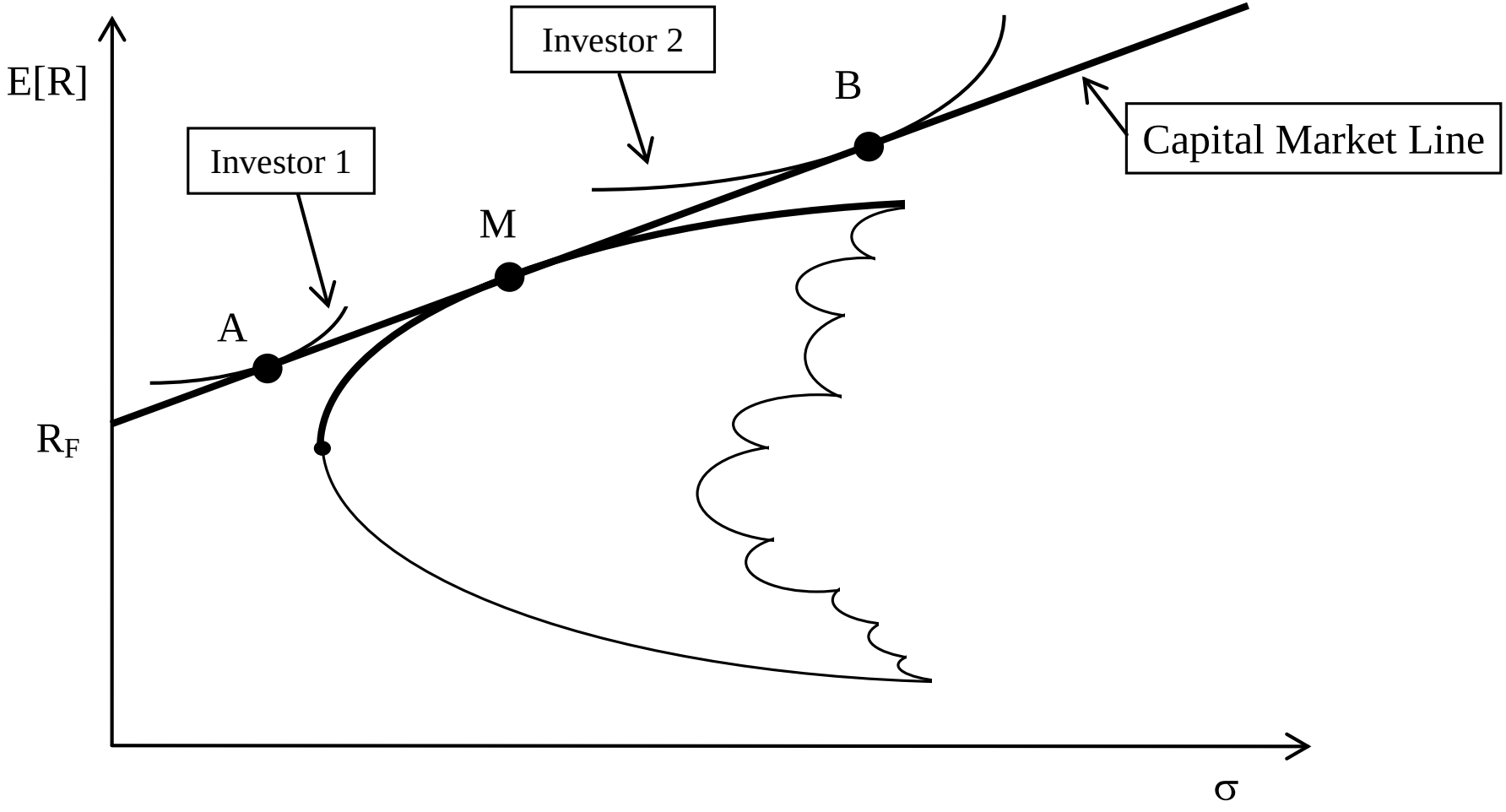
❍ Adding a Risk-Free Security: The Capital Market Line (CML)

- **Only one risky portfolio** is relevant (portfolio M).
- **Portfolio M** corresponds to the **point of tangency** between the line through the risk-free asset and the efficient frontier of risky assets.
- All portfolios between R_F and M are portfolios composed of the risk-free asset and M.
- The **new efficient frontier with the risk-free asset** is called the capital market line (**CML**). The capital market line is the line from R_F through the point M.
- The presence of a risk-free asset lets one attain **better risk/return points** than when there is no risk-free asset.



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- If an investor places **100%** of his portfolio in the market portfolio **M**, he/she would have the same expected return and expected risk as the market portfolio.

- If an investor puts **less than 100%** in the market portfolio and the remainder in the risk free asset (lending money to the government), he/she would have a portfolio with expected return and risk **lower** than that of the market portfolio (e.g. portfolio *A* above).

- If investors desire to take on **more risk**, they can **borrow** at the risk-free rate and **invest more than 100%** of their assets in the market portfolio (part of the CML right to the portfolio M). Such a portfolio would have a higher expected return and risk than the market portfolio (e.g. portfolio *B* above).

- Every investor selects such a combination of R_F and M that **maximizes** his/her **utility**

- Thus, the investment decision takes place only between ***M* and *R_F*** (Two-Fund-Theorem)

- **M**: **Value weighted portfolio** of all risky assets (market portfolio)

- Proxies for M: Value weighted stock indices (e.g.: ATX, DAX, S&P 500)

- Thus, if all investors have the same assets to choose, then everyone will invest in the same portfolio M of risky assets!

- Assume an idealized model of the markets, in which all the world's risky assets are included in the investor opportunity set and one risk-free asset exists, allowing both more and less risk averse investors to find their optimal portfolio along the capital market line.

- Then everyone in the world would want to hold precisely the same portfolio of risky assets.

- That portfolio, identified at the point of tangency, represents some portfolio mix of the world's assets (market portfolio).

The portfolio of all (rational) investors will then be on the CML. The slope of the CML is equal to:

$$\frac{E[R_M] - R_F}{\sigma_M} = \text{Market price of risk (price or premium for one unit of risk)}$$

Expected return of the CML portfolio P:

$$E[R_P] = R_F + \frac{E[R_m] - R_F}{\sigma_m} \cdot \sigma_P$$

or

$$E[R_P] - R_F = \frac{E[R_m] - R_F}{\sigma_m} \cdot \sigma_P$$

Risk premium ($E[R_P] - R_F$) = market price of risk · risk of the portfolio (σ_P)

Expected performance = Compensation for **consumption delay** (R_F) + Compensation for **risk** taking

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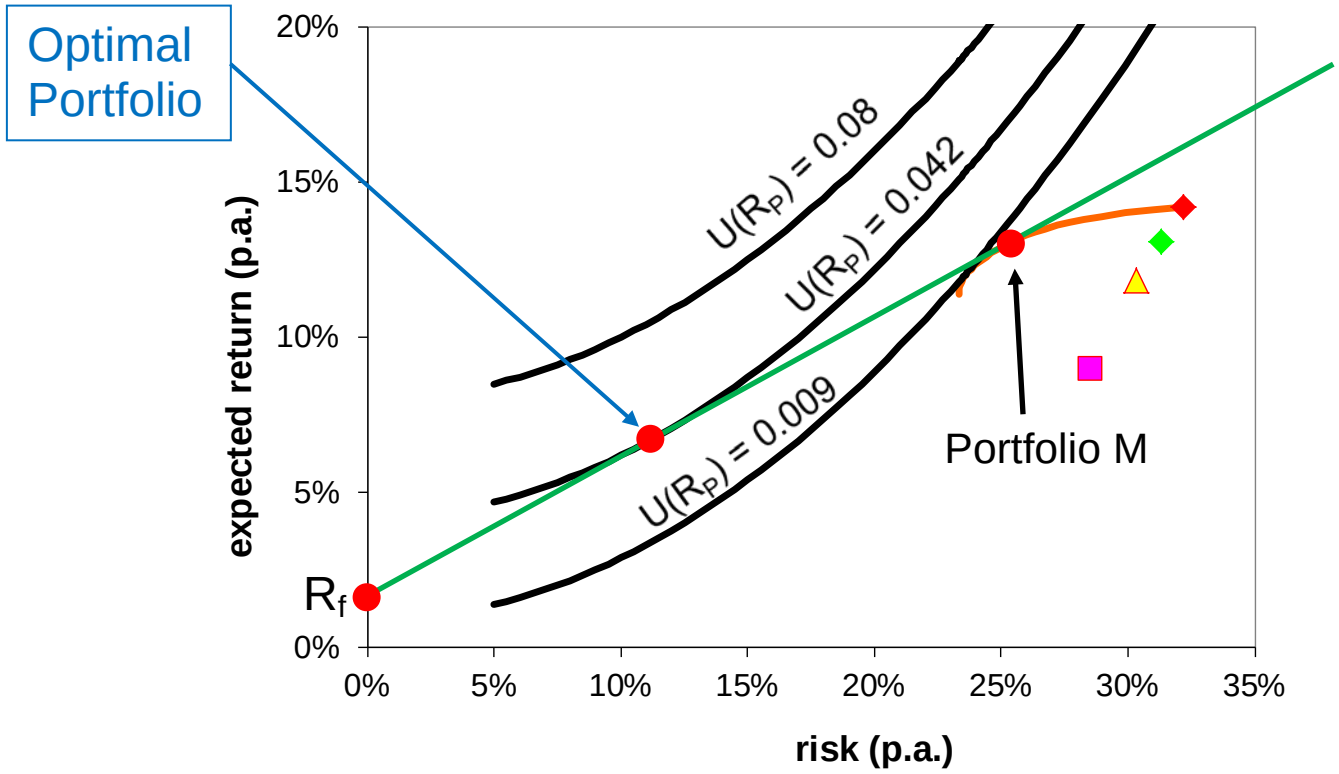
❍ Optimal portfolio on the CML

Assuming a utility function $U(R_P) = \boldsymbol{E}(R_P) - 0.5 \cdot A \cdot \sigma^2_P$ with $\boldsymbol{A = 4}$, we get the following indifference curves and the optimal portfolio with 56% investment in R_F:



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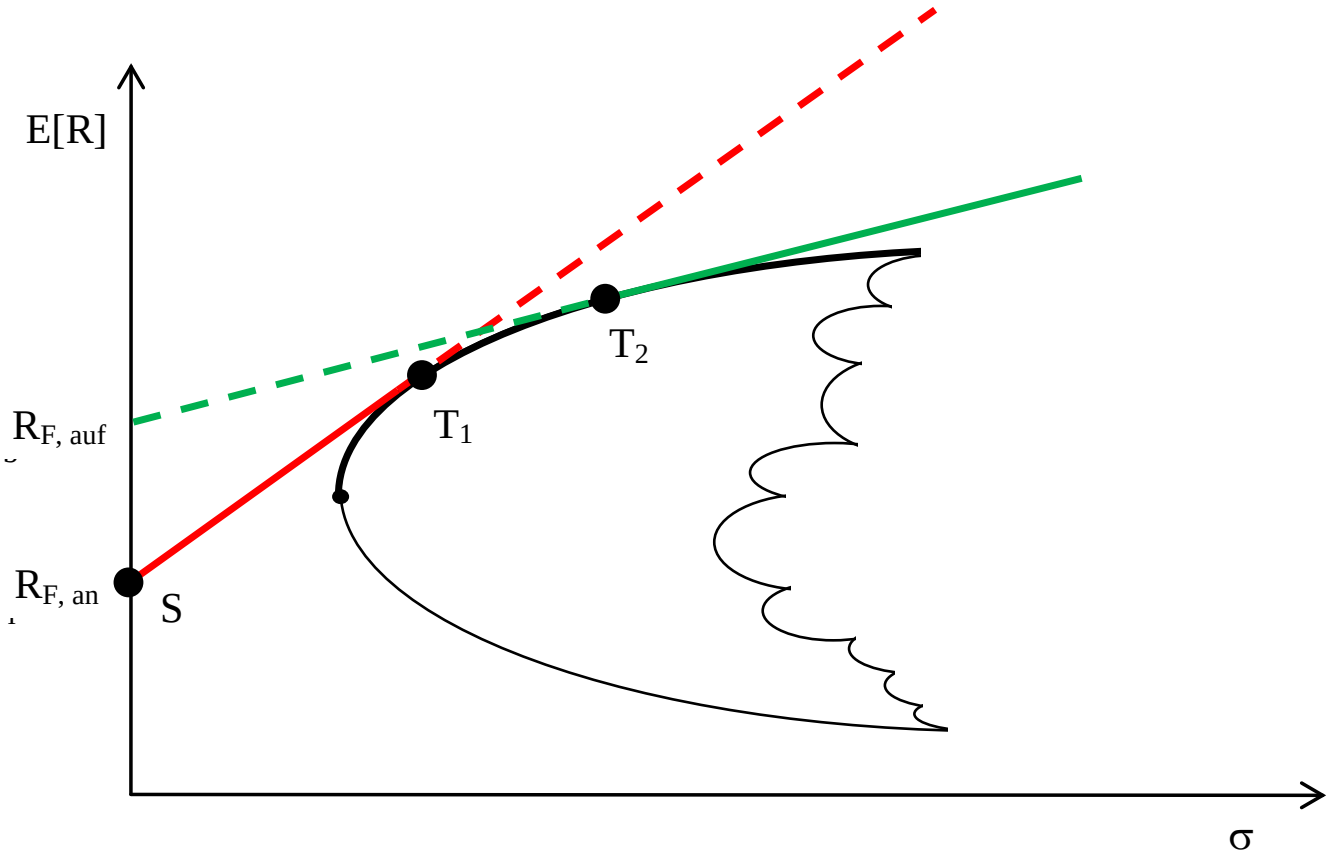
- Slope of the CML = market price of risk
- Slope of the CML: Changes (over time) with the risk aversion level of investors
- A changing risk aversion of investors leads to a change in the form of the efficient frontier of risky assets.
- An increasing risk aversion: Efficient Frontier of risky assets shifts upwards so that the risk premium per unit of risk increases

➔ Prices have to drop so that the risk premium increases.

In case the lending rate ($R_{F,l}$) < borrowing rate ($R_{F,b}$):



- No unique tangency portfolio exists
- CML: Segment *S* to T_1, T_1 to T_2, segment to the right of T_2.

6.2 Security Market Line (SML)

Example: Three investors (Charly, Olivia, Jack) decide between portfolio *M* and the risk free asset (R_F):

		M	R_F	Beta (β_P)
Charly	high risk aversion	0 %	100 %	0.0
Olivia	average risk aversion	50 %	50 %	0.5
Jack	low risk aversion	100 %	0%	1.0

Expected return of M: 8% p.a.; R_F = 1% p.a.

What return can the three investors expect?

Charly: $E[R] = 1.0 \cdot 1\% + 0.0 \cdot 8\% = 1\%$

Olivia: $E[R] = 0.5 \cdot 1\% + 0.5 \cdot 8\% = 4.5\%$

Jack: $E[R] = 0.0 \cdot 1\% + 1.0 \cdot 8\% = 8\%$

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- From this example we can conclude for the **expected portfolio return**:

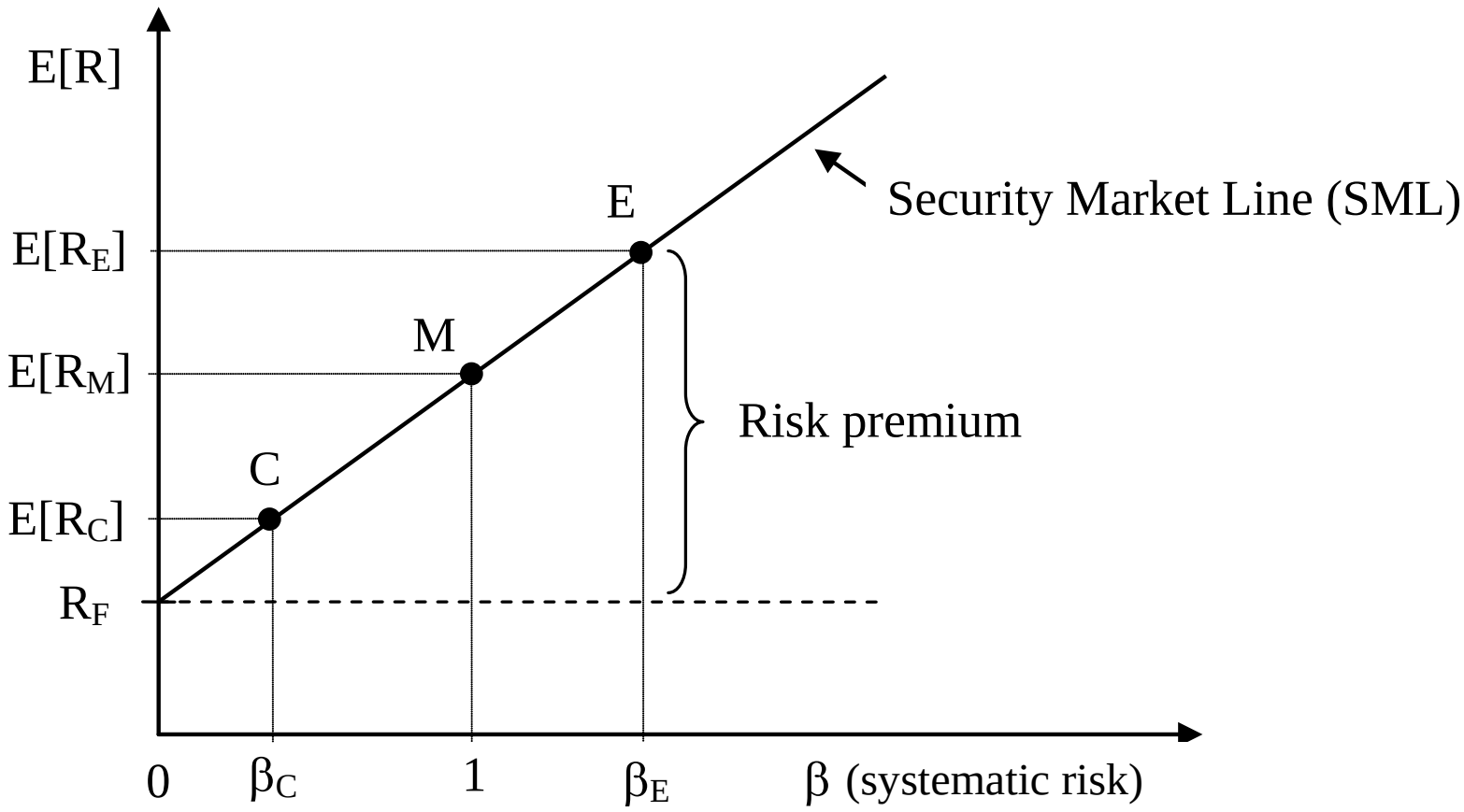
$$E[R_P] = (1-\beta_P)\cdot R_F + \beta_P \cdot E[R_M]$$

$$E[R_P] = R_F + \underbrace{\beta_P \cdot (E[R_M] - R_F)}_{\text{Risk premium of portfolio P}} = \textbf{Security Market Line (SML)}$$

- **($E[R_M]$ - R_F) = market risk premium** (**5.7%** p.a., for 1990-2002, global average; see Dimson et al. (2003))

- **SML:** The **expected return** of an asset or a portfolio of assets is a **linear function** of the asset's (portfolio's) **systematic risk (β)**.

- **CAPM:** A <u>risk premium</u> is **only** paid for <u>systematic risk</u>! Unsystematic risk can be eliminated by building a portfolio (<u>diversification effect</u>).



$\beta_i = \sigma_{i,m}/\sigma_m^2$: The expected return of an asset does not depend on its total risk (σ_i), but rather depends only on its covariance with the market.

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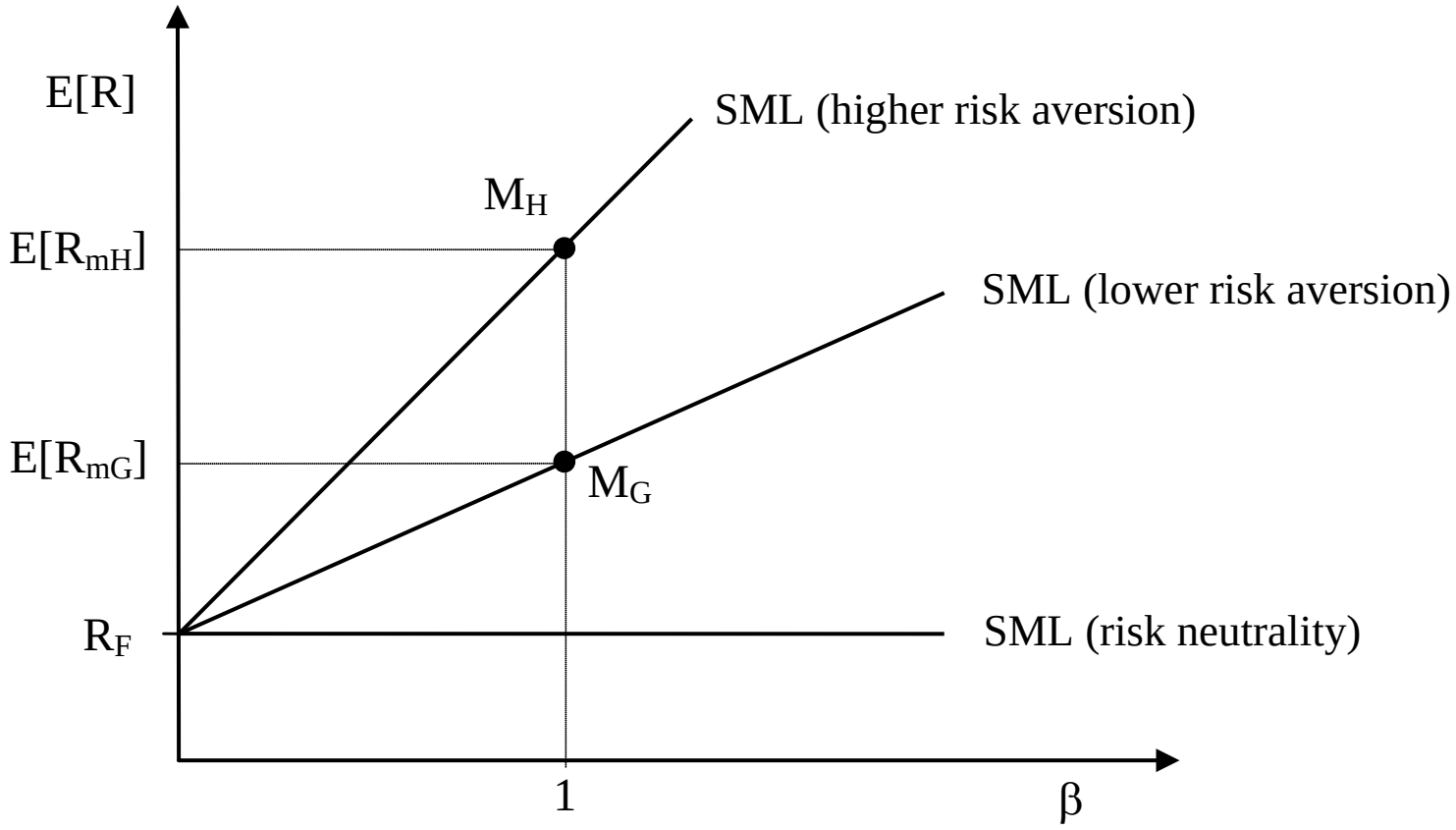
- Slope of the SML: Measure for the average degree of risk aversion
- Higher risk aversion: Steeper SML, higher risk premium for a particular β



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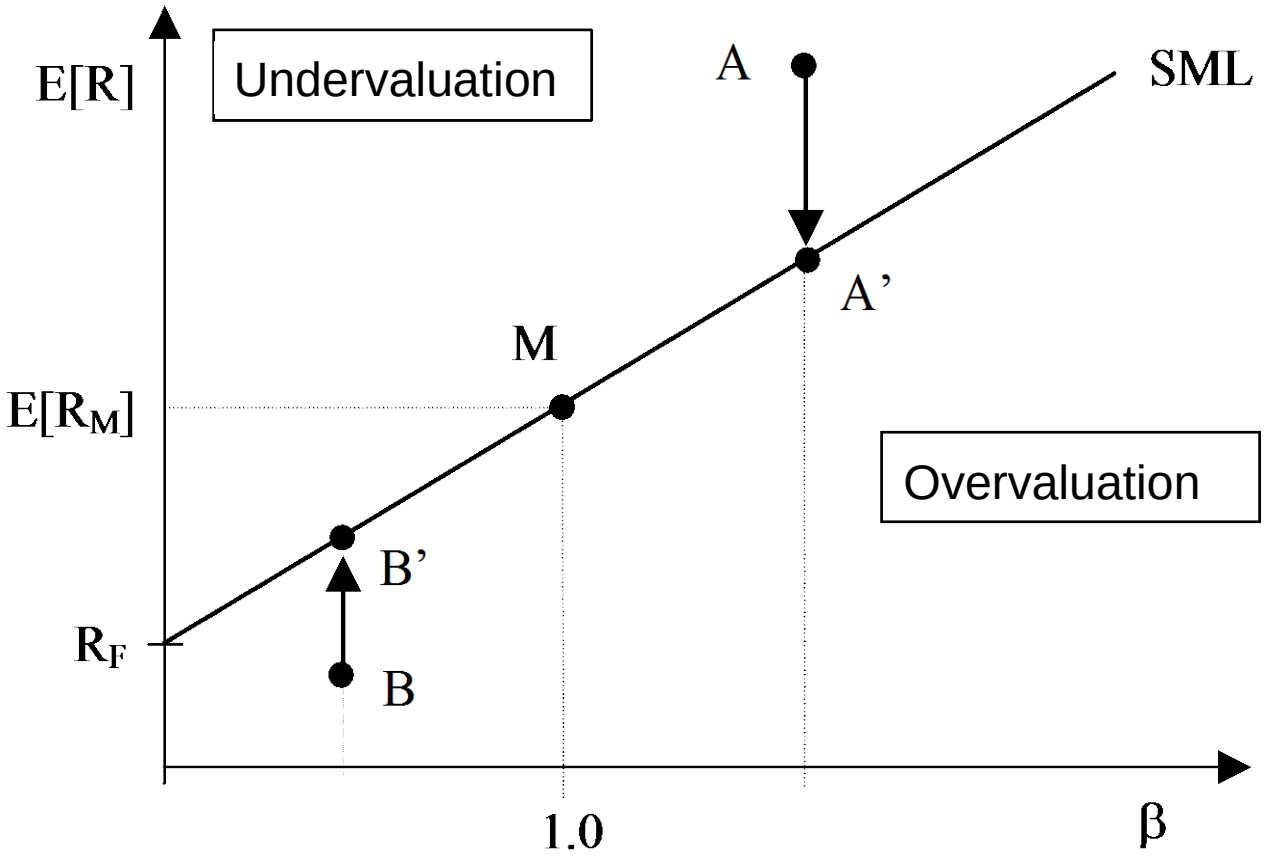
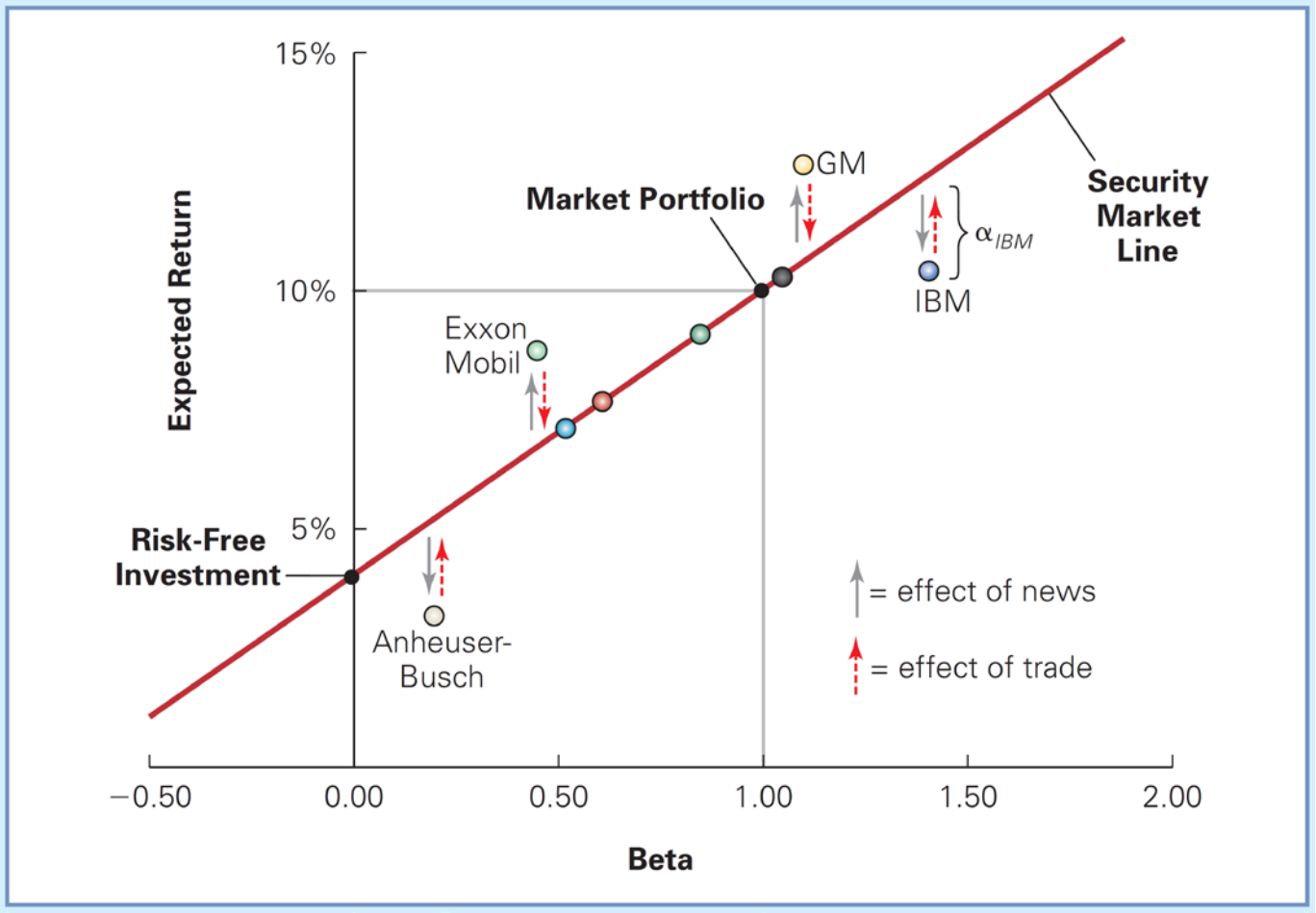
- CAPM: In equilibrium all securities are on the SML
- In case a security is temporary not on the SML: adjustment process



Example: Deviations from the SML[1]



[1] Source: Berk and DeMarzo (2014), Corporate Finance, 3rd edition, p. 439.

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Security *B* is overvalued ➔ adjustment process:

$$E[R_B]\uparrow = \frac{E[Price_{B,t=1} - Price_{B,t=0}\downarrow]}{Price_{B,t=0}\downarrow} = \frac{E[\Delta Price_{B,t=0}]\uparrow}{Price_{B,t=0}\downarrow}$$

Security A is undervalued ➔ adjustment process:

$$E[R_A]\downarrow = \frac{E[Price_{A,t=1} - Price_{A,t=0}\uparrow]}{Price_{A,t=0}\uparrow} = \frac{E[\Delta Price_{A,t=0}]\downarrow}{Price_{A,t=0}\uparrow}$$

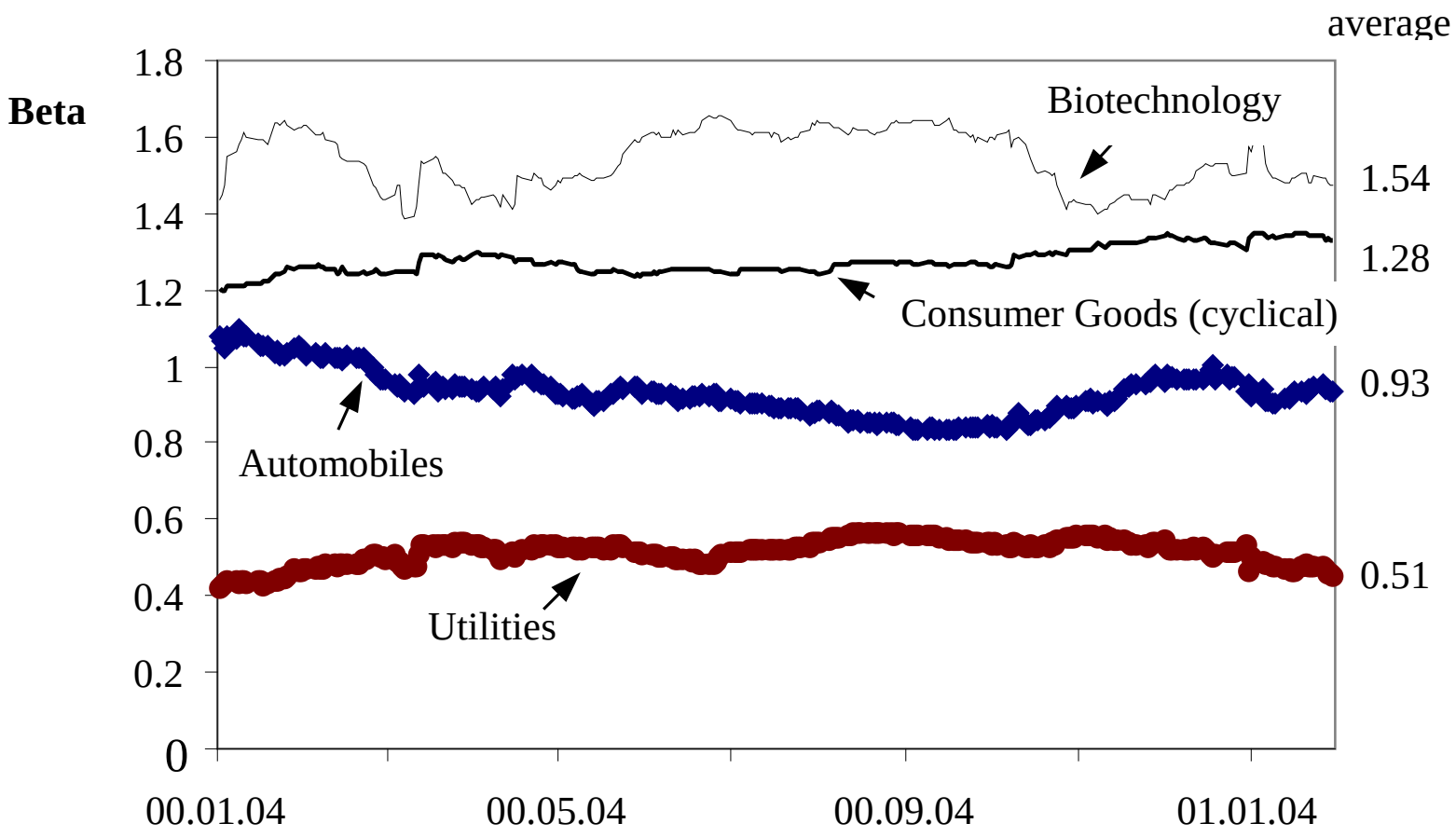
Portfolio Beta

- The Beta of a portfolio is the linear weighted combination of the Betas of the portfolio components:

$$\beta_P = \sum x_i \beta_i$$

Portfolio Beta: Industry examples

Development of beta for some German industries in the year 2000



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7. Multiple-Factor Models

- *Single-index model*: The price development of risky assets is explained by **one factor** (market as factor (market model)).

- *Multiple-factor model*: **Additional/other factors** are used to increase the explanatory power

General form of a multiple-factor model:

$$R_i = a_i + b_{i1} \cdot F_1 + b_{i2} \cdot F_2 + b_{i3} \cdot F_3 + \ldots + b_{iK} \cdot F_K + \varepsilon_i$$

R_i represents th return of asset i,
b_{ij} is the sensitivity parameter (Beta) of asset i regarding factor j,
F_j is the realization of factor j (factor return)

Characteristics:

(i) The residual term (unsystematic return component) has an expected value of zero:

$$E[\varepsilon_i] = 0 \quad \forall\, i$$

(ii) The covariance between factor returns is zero (i.e., factor returns are assumed to be uncorrelated).

(iii) The covariance between the residual term (ε_i) and factor returns is zero.

(iv) The covariance between the residual terms of risky assets is zero.

The latter implies that the factors explain 100% of all systematic price movements and, thus, that ε_i depicts only unsystematic (firm specific) price changes.

7.1 Arbitrage Pricing Theory (APT)

- In the CAPM single factor asset pricing model, the index or benchmark is the market portfolio, measured by a market index.
- The **APT**, developed by Stephen Ross (1976), introduces **multiple risk factors** into the assessment of expected returns.
- Each of the factors captures **different aspects of risk**.
- Risky asset returns **follow a factor structure** if they can be expressed as:

$$R_i = \alpha_i + b_{i1}F_1 + b_{i2}F_2 + b_{i3}F_3 + \ldots + b_{in}F_n + \varepsilon_i,$$

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where α_i is a constant for asset i

F_k is a systematic factor

b_{ik} is the sensitivity of the ith asset to factor k, also called factor loading,

ε_i is the risky asset's idiosyncratic random shock with mean zero.

- **Idiosyncratic shocks** are assumed to be **uncorrelated** across assets and uncorrelated with the factors.

- The APT states that if asset returns follow a factor structure then the following relation exists between expected returns and the factor sensitivities:

$$\mathbf{E}(R_i) = R_f + b_{i1}RP_1 + b_{i2}RP_2 + b_{i3}RP_3 + \ldots + b_{in}RP_n$$

where RP_k is the risk premium of factor k, and R_f is the risk-free rate

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- Thus, the expected return of a risky asset is a **linear function** of the assets sensitivities to **n factors**.

- Note that the total **number of factors** may **never surpass the total number of assets** (in order to avoid the problem of matrix singularity).

- More formally, the APT is based upon the **assumption** that there are (additional) **macro-economic factors** that influence security returns. No matter how thoroughly you diversify, you **can not avoid these factors**.

- The APT claims that investors will "price" these factors precisely because they are sources of risk. That is, they will demand **compensation** in terms of expected return for holding securities **exposed to these risks**. Just like the CAPM, this exposure is measured by the factor betas.

- The APT suggests that a stock's return is determined by **arbitrageurs** seeking to **exploit** perceived **differences** in the **prices of securities** that present the **same degree of risk**.

❍ APT and CAPM

- The APT differs from the CAPM in that it is less restrictive in its assumptions.

- It assumes that each investor will hold a unique portfolio with its own particular array of betas, as opposed to an identical "market portfolio".

- In some ways, the CAPM can be considered a "special case" of the APT in that the SML represents a single-factor model of the asset price, where beta is exposed to changes in value of the market.

❍ APT Factors

- As with the CAPM, the factor-specific betas are found via a **linear regression** of **historical security returns** on the corresponding **factors**.

- Unlike the CAPM, the APT does **not reveal the identity** of its priced factors; the **number and nature** of these factors is likely to **change over time** and **between economies**.

- Thus, **identifying the 'correct' factors** is an **empirical issue**.

- Guidelines for **characteristics required** of potential **factors**:

  (a) The impact on asset prices via their **unexpected movements**
  (b) They should represent **undiversifiable influences**
  (c) **Timely and accurate information** on these variables is available
  (d) The **relationship** between risky asset and factor should be **economically justifiable**

- **Chen, Roll and Ross (1986)** identified several macro-economic factors beeing significant in explaining security returns:

  - surprises in **inflation**;
  - surprises in **industrial production**;
  - surprises in **changes in default premium** in corporate bonds;
  - surprises in shifts of the **yield curve**.

- Instead of macro-economic factors also **indices** or spot (futures) **market prices** may be used. They have the advantage being **reported at low frequency** (e.g. monthly).

- Sometimes indices are derived via a **factor analysis**.

- More **direct "indices"** that are often used are:
  - **Short term** interest **rates**;
  - The **difference** in **long-term** and **short-term** interest rates;
  - Diversified **stock indices** (e.g. FT all share index, S&P 500 index);
  - **Crude oil** prices
  - **Gold** prices (or other precious metals)
  - **Base metal** prices (e.g. copper)
  - **FX** rates
- The linear factor model structure of the APT is also used by asset and risk managers, e.g. like MSCI Barra.

APT Factor Model: Priced factors for Austrian companies

- Term structure: Difference between government bond yield and Treasury Bill rate
- FX index
- OECD Leading indicators
- Net capital movement of Austrian investment funds
- Proxy for the German economy

APT: Benefits and Drawbacks

Benefits:

- The APT is not as restrictive as the CAPM in its requirement about risky portfolios.
- It allows multiple sources of risk that can provide an explanation of what moves stock returns.

Drawbacks:

- The APT demands that investors **perceive the risk sources**, and that they can **reasonably estimate** factor sensitivities.
- In fact, professionals and academics **cannot agree** on the **identity of the risk factors**, and the more betas you have to estimate, the **more statistical noise** you must live with.

7.2 Fama-French 3-Factor Model

Observation: 2 classes of stocks have a tendency to perform better than the market

(i) **small cap** stocks and (ii) stocks with a **high book-to-market equity ratio** (B/M; called value stocks, in contrast to growth stocks)

$$R_{p,t} - R_{f,t} = \alpha + \beta_M \cdot (R_{M,t} - R_{f,t}) + \beta_{SML} \cdot SMB_t + \beta_{HML} \cdot HML_t + \varepsilon_t$$

with:
- $R_{p,t}$: Return of portfolio p in period *t*
- $R_{f,t}$: Riskless return in period *t*
- $R_{M,t}$: Market return in period *t*
- SMB_t: Size factor (small minus big) in period *t*
- HML_t: Book-to-market factor (high minus low) in period *t*

- A portfolio generates excess returns if it has a positive and statistically significant alpha.

- *SMB* (*small minus big*) is a **zero-investment portfolio** that is **long** on small capitalization (cap) stocks and **short** on large cap stocks. Similarly, *HML* (*high minus low*) is a **zero-investment portfolio** that is **long** on high book-to-market (B/M) stocks (*value stocks*) and **short** on low B/M stocks (*growth stocks*). They measure the **historic excess returns** of small caps over big caps and of value stocks over growth stocks.

- Historical values may be accessed on Kenneth **French**'s web page.

- The Fama-French three factor model **explains over 90%** of the diversified portfolios returns, compared with about 70% given by the CAPM (within sample).

- The **signs of the coefficients** suggest that **small cap** and **value** portfolios have **higher expected returns** - and arguably higher expected risk - than those of large cap and growth portfolios.

❍ Some results from tables of the Fama and French 3-factor model paper

See also Fama and French (1993): *Common Risk Factors in the Returns on Stocks and Bonds*, Journal of Financial Economics, Volume 33, Issue 1, pages 3–56.

- **1-factor (market) model**: next page

- **3-factor model**: page thereafter

- **1-factor (market) model**

$$R(t) - RF(t) = a + b[RM(t) - RF(t)] + e(t)$$

Dependent variable: Excess returns on 25 stock portfolios formed on size and book-to-market equity

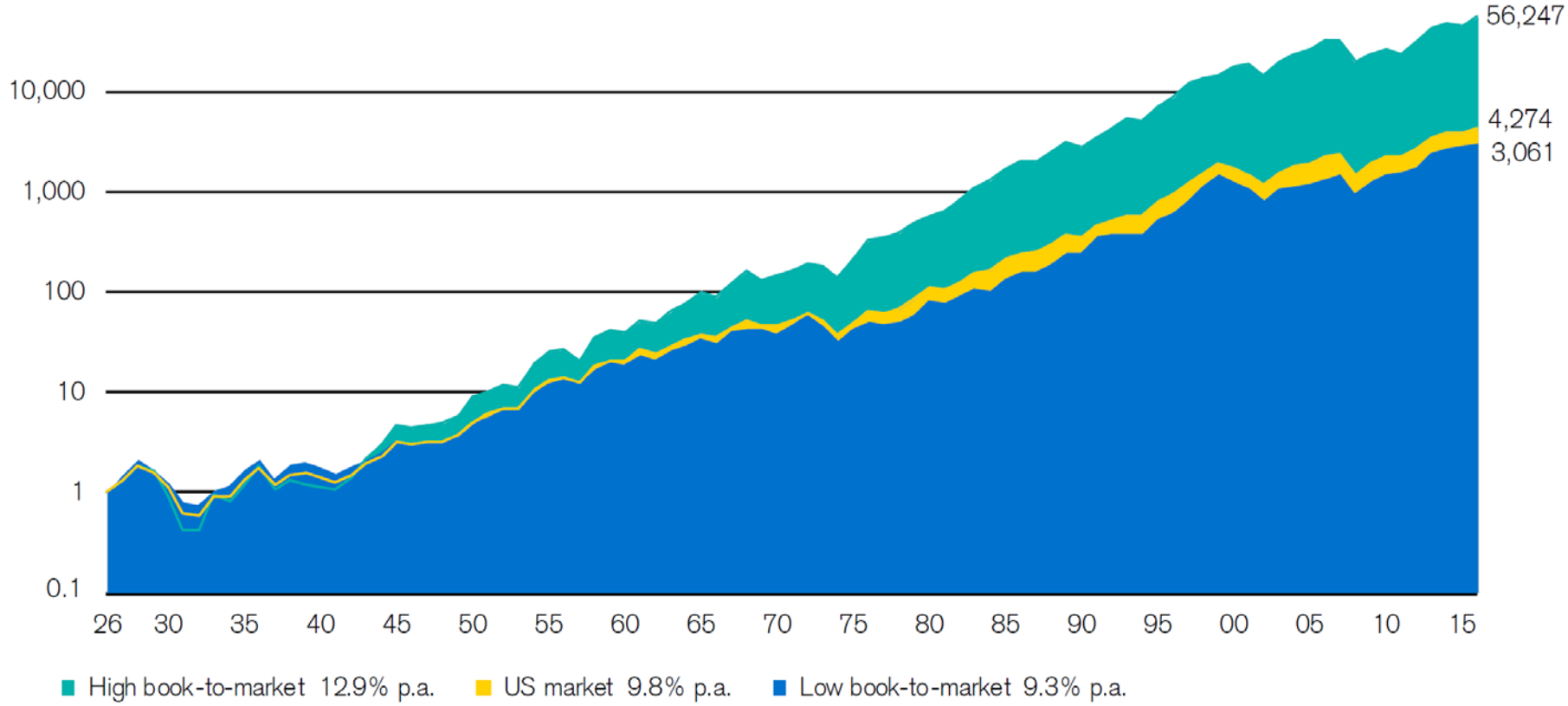
Size quintile	Book-to-market equity (BE/ME) quintiles									
	Low	2	3	4	High	Low	2	3	4	High
			b					$t(b)$		
Small	1.40	1.26	1.14	1.06	1.08	26.33	28.12	27.01	25.03	23.01
2	1.42	1.25	1.12	1.02	1.13	35.76	35.56	33.12	33.14	29.04
3	1.36	1.15	1.04	0.96	1.08	42.98	42.52	37.50	35.81	31.16
4	1.24	1.14	1.03	0.98	1.10	51.67	55.12	46.96	37.00	32.76
Big	1.03	0.99	0.89	0.84	0.89	51.92	61.51	43.03	35.96	27.75
			R^2					$s(e)$		
Small	0.67	0.70	0.68	0.65	0.61	4.46	3.76	3.55	3.56	3.92
2	0.79	0.79	0.76	0.76	0.71	3.34	2.96	2.85	2.59	3.25
3	0.84	0.84	0.80	0.79	0.74	2.65	2.28	2.33	2.26	2.90
4	0.89	0.90	0.87	0.80	0.76	2.01	1.73	1.84	2.21	2.83
Big	0.89	0.92	0.84	0.79	0.69	1.66	1.35	1.73	1.95	2.69

- **3-factor model**:

Size quintile	Book-to-market equity: Low	2	3	4	High
			b		
Small	1.04	1.02	0.95	0.91	0.96
2	1.11	1.06	1.00	0.97	1.09
3	1.12	1.02	0.98	0.97	1.09
4	1.07	1.08	1.04	1.05	1.18
Big	0.96	1.02	0.98	0.99	1.06
			s		
Small	1.46	1.26	1.19	1.17	1.23
2	1.00	0.98	0.88	0.73	0.89
3	0.76	0.65	0.60	0.48	0.66
4	0.37	0.33	0.29	0.24	0.41
Big	– 0.17	– 0.12	– 0.23	– 0.17	– 0.05
			h		
Small	– 0.29	0.08	0.26	0.40	0.62
2	– 0.52	0.01	0.26	0.46	0.70
3	– 0.38	– 0.00	0.32	0.51	0.68
4	– 0.42	0.04	0.30	0.56	0.74
Big	– 0.46	0.00	0.21	0.57	0.76
			R^2		
Small	0.94	0.96	0.97	0.97	0.96
2	0.95	0.96	0.95	0.95	0.96
3	0.95	0.94	0.93	0.93	0.93
4	0.94	0.93	0.91	0.89	0.89
Big	0.94	0.92	0.88	0.90	0.83

$$R(t) - RF(t) = a + b\cdot[RM(t) - RF(t)] + s\cdot SMB(t) + h\cdot HML(t) + e(t)$$

Better performance of US Value Stocks (higher book value/market value ratio), 1926-2016:[2]



[2] Source: Dimson, Marsh, and Staunton, Credit Suisse Global Investment Returns Yearbook 2017 – Summary Edition, p. 21.

❍ The Carhart four-factor model

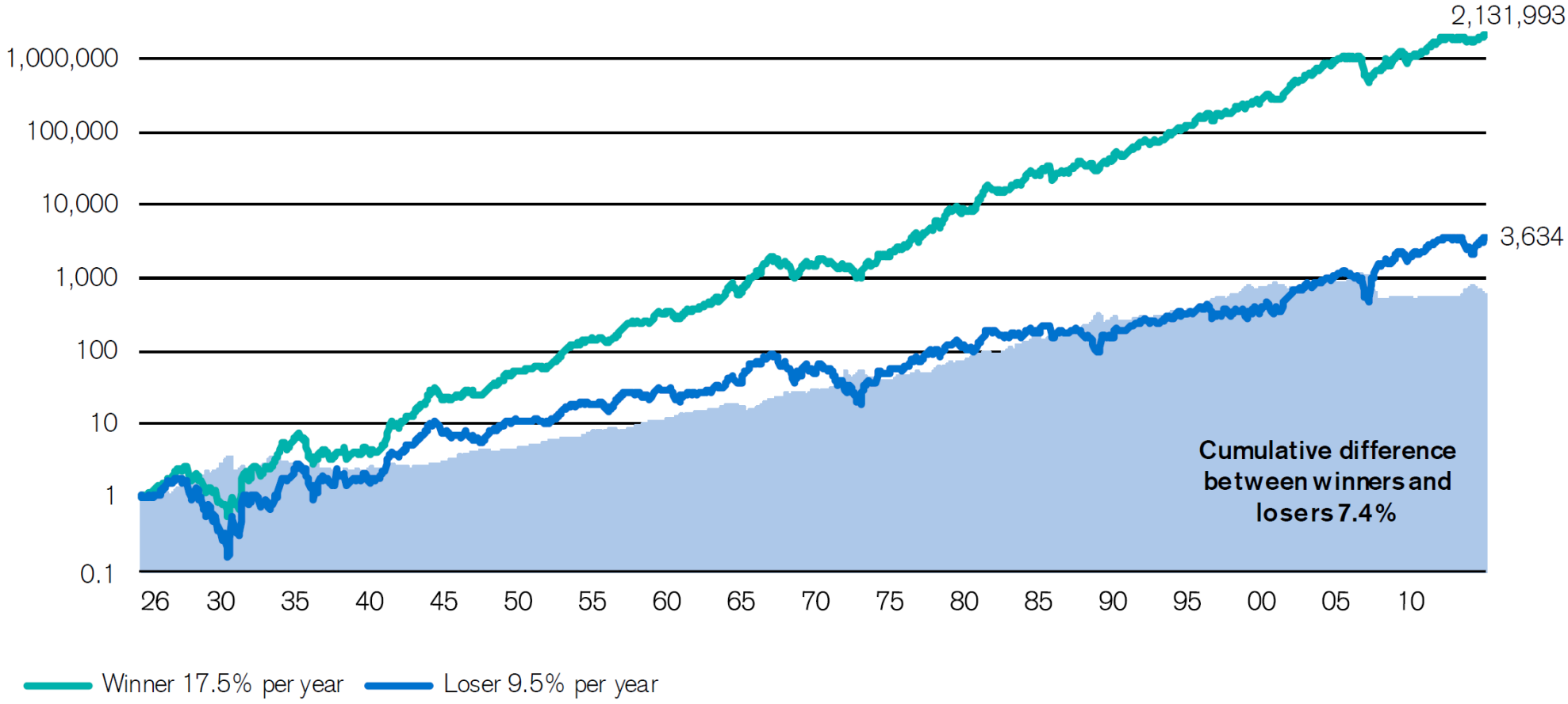
The Carhart 4-factor model (Carhart, 1997) is an extension of the Fama-French 3-factor model. It includes an additional **momentum factor** (UMD):

$$R_{p,t} - R_{f,t} = \alpha + \beta_M \cdot (R_{M,t} - R_{f,t}) + \beta_{SML} \cdot SMB_t + \beta_{HML} \cdot HML_t + \beta_{UMD} \cdot UMD_t + \varepsilon_t$$

UMD is a zero-cost portfolio that is **long** previous 12-month return winners and **short** previous 12-month loser stocks.

Momentum: Using the trend as an investment decision

Momentum Strategy (US stocks), Winner vs Loser:[3]



[3] Source: Dimson, Marsh, and Staunton, Credit Suisse Global Investment Returns Yearbook 2017 – Summary Edition, p. 22.

8. Market Efficiency and Market Anomalies

8.1 Efficient Market Hypothesis (EMH)

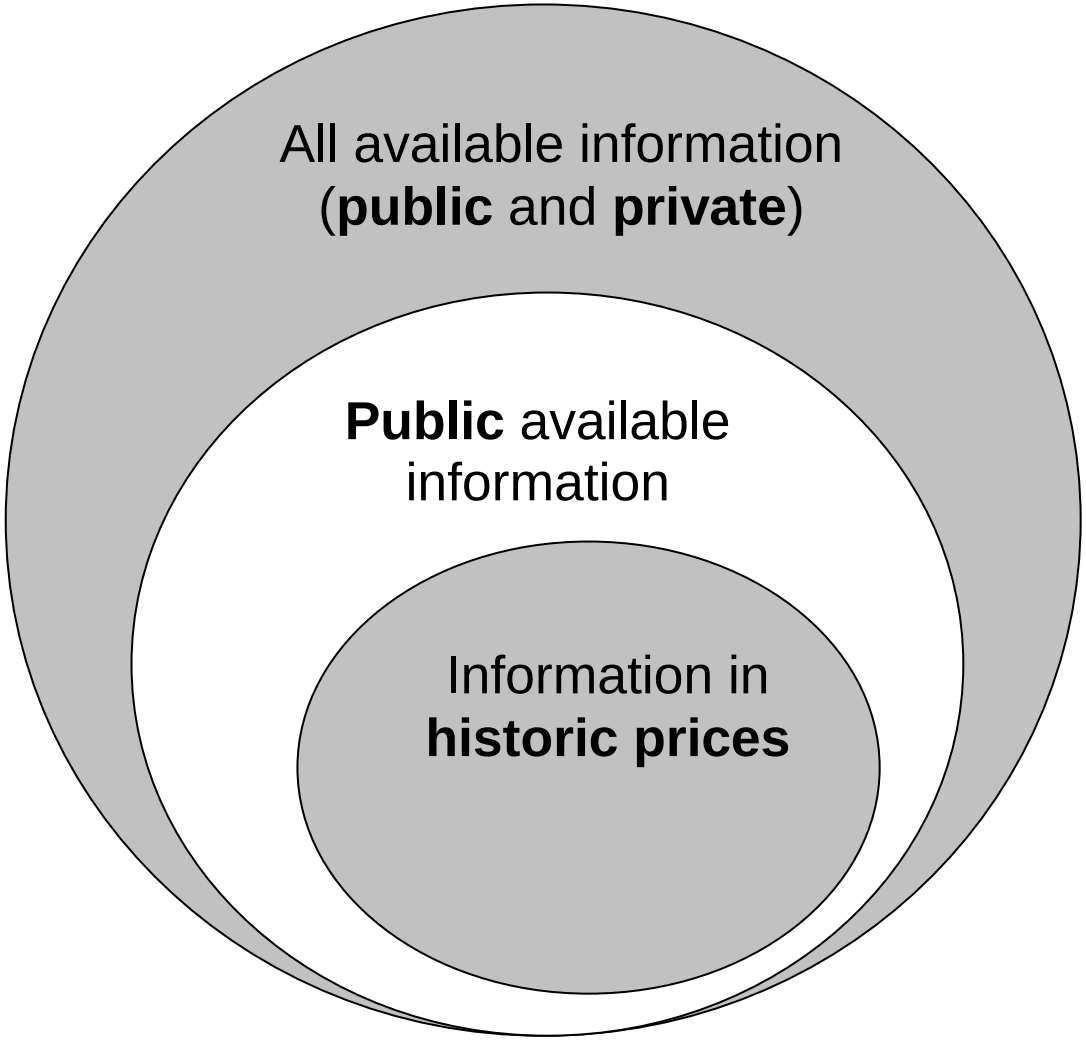
- **Are financial markets efficient?**
  - How quick is new information incorporated into prices?
  - Which kind of information is contained in market prices?

- **Efficient Market Hypothesis (Fama (1970)):**
  - Weak form: Stock prices already reflect all **information** that can be **derived** by examining market **trading data**: Past prices, trading volume, etc. Thus, trend analysis is **fruitless**.
    If market data convey reliable signals about future performance, all investors have learned already to exploit the signals.

- Semistrong form: All **public available information** regarding the prospects of a firm must already be **reflected in** stock **price**.
  Such information include: Past prices, fundamental data on the firm's products, quality of management, balance sheet data, patents held, earnings forecasts, accounting practice, etc.

- Strong form: Stock prices reflect **all available information** (relevant to the firm), **private** (insider) as well as all **public available** information.
  Thus, this version is quite extreme. One could argue that corporate officers have access to 'secret' information long enough before public release to enable them to profit from trading on that information. However, supervisors (e.g. SEC) try to prevent insiders from profiting by exploiting their privileged position.

- **Types of information:**



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❍ Implication 1

- **Weak** form: Every kind of '**technical analysis**' is **inefficient**.
- **Semistrong** form: Every kind of **analysis** based on **public** available **information** is **worthless**.
- **Strong** form: Also the use of **private** (insider) **information** is **worthless**.

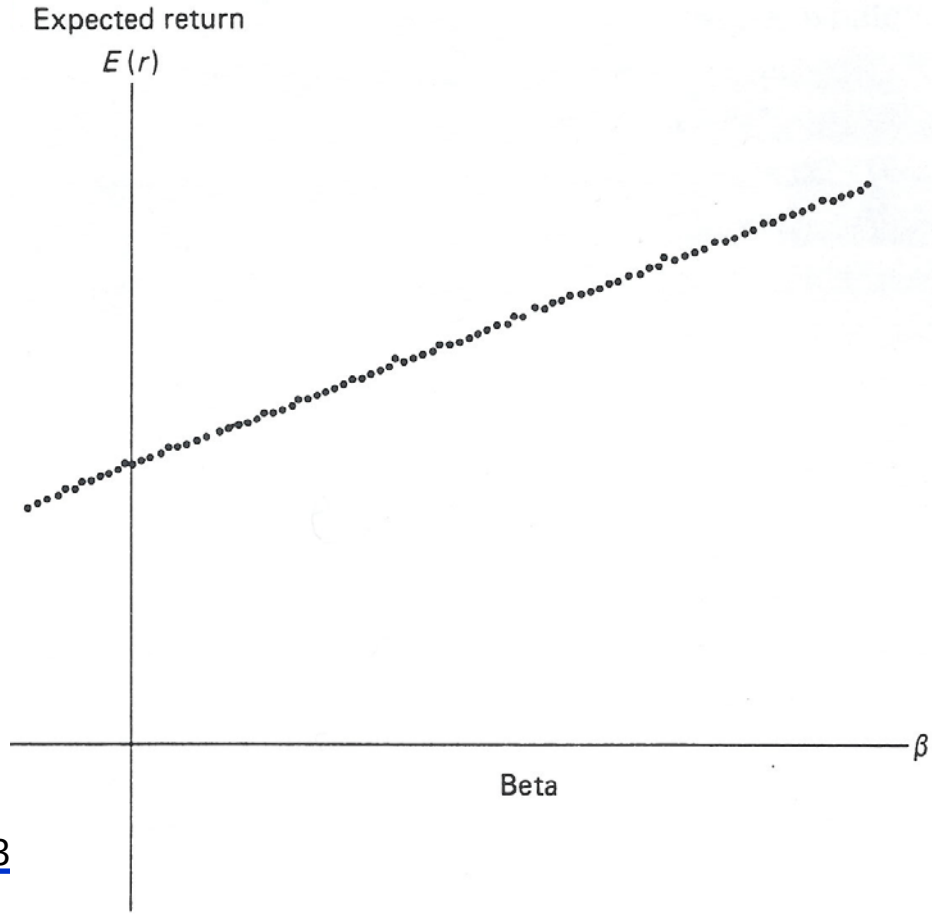
❍ Implication 2: Expected return and risk[4]

Let us assume: All investors invest in mean-variance efficient portfolios and the structure of stock prices is that of the simple version of the CAPM.

Case A: Market is strong form efficient

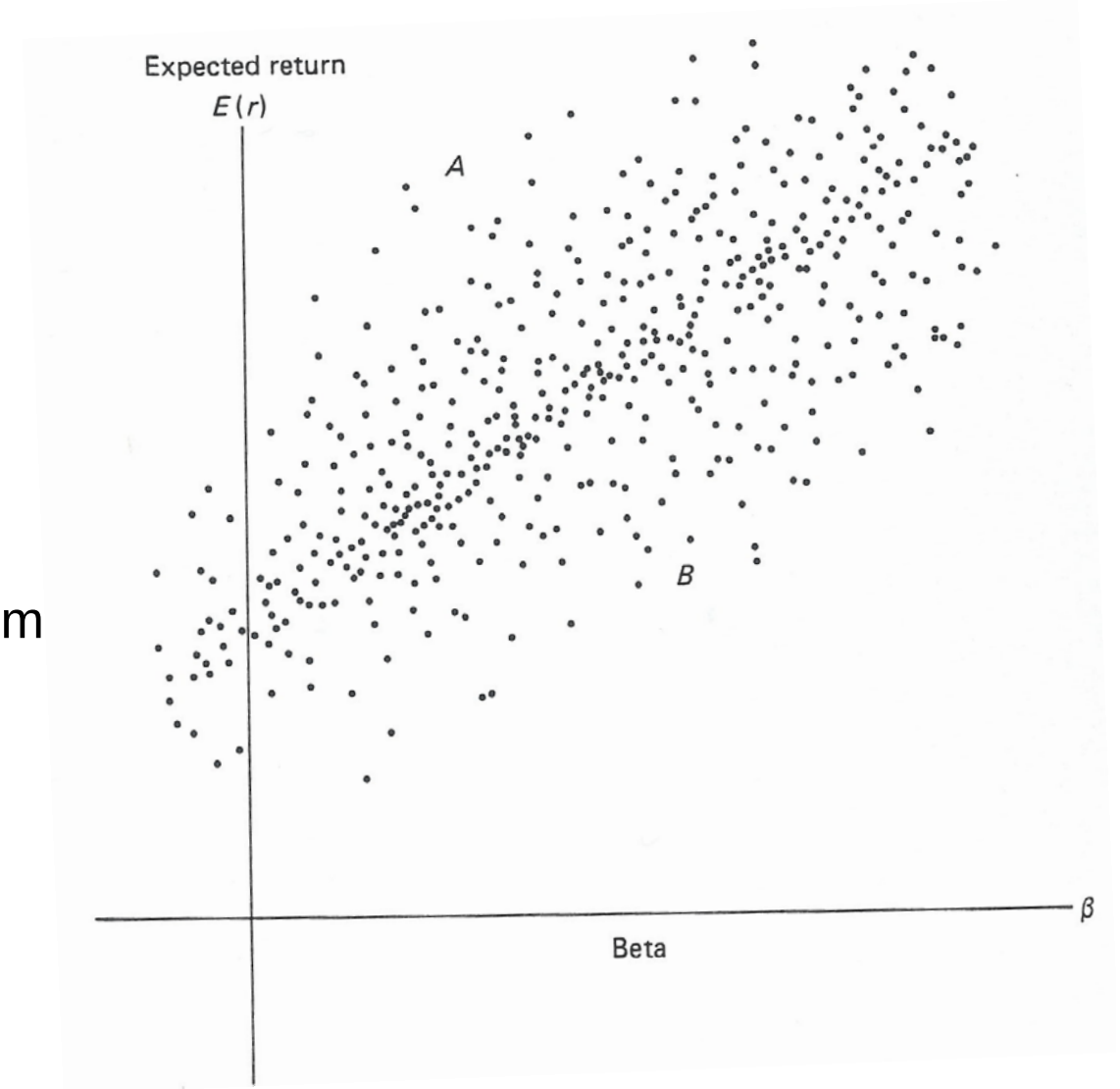
➔ Security prices reflect all public and private available information

(a) Public and private information is used in valuing securities.



[4] Adoped from Haugen, 1993, Modern Investment Theory, p. 63

(b) Only public information is used in valuing securities.



➔ Firms A and B (see figure) seem to be incorrectly valued.

➔ BUT: The analysis is based on an incomplete information set.

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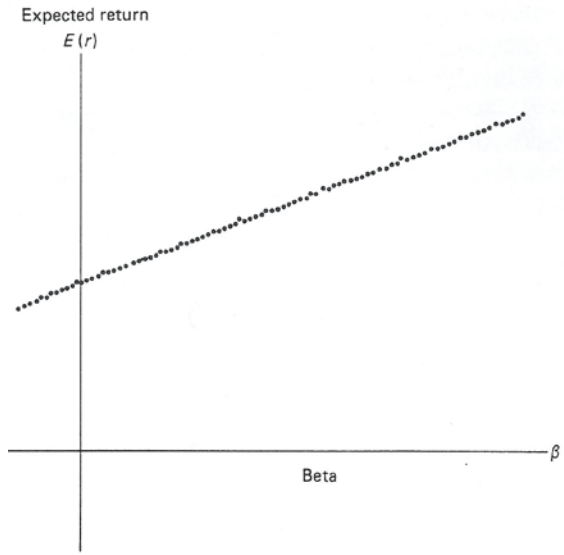
Case B: Market is <u>semistrong form</u> efficient

(a) If only public available information is used in the analysis.

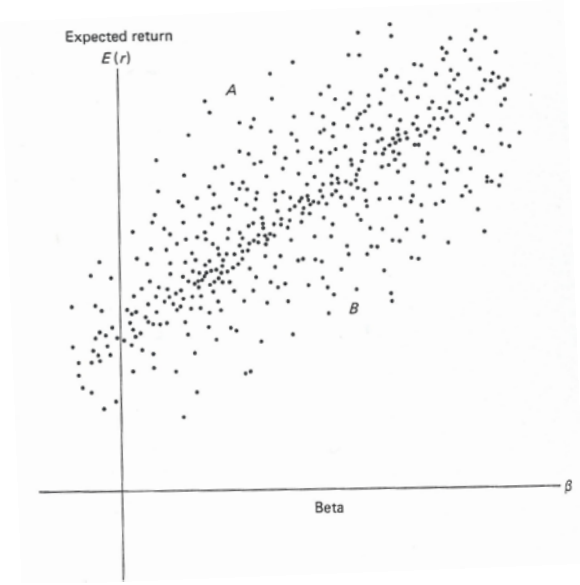
➔ Result: As in the first figure



(b) If public and private information is used in the analysis.

➔ Result: As in the second figure

➔ Now we really have **identified over- and undervalued** securities, and we would make a lot of money as an analyst.



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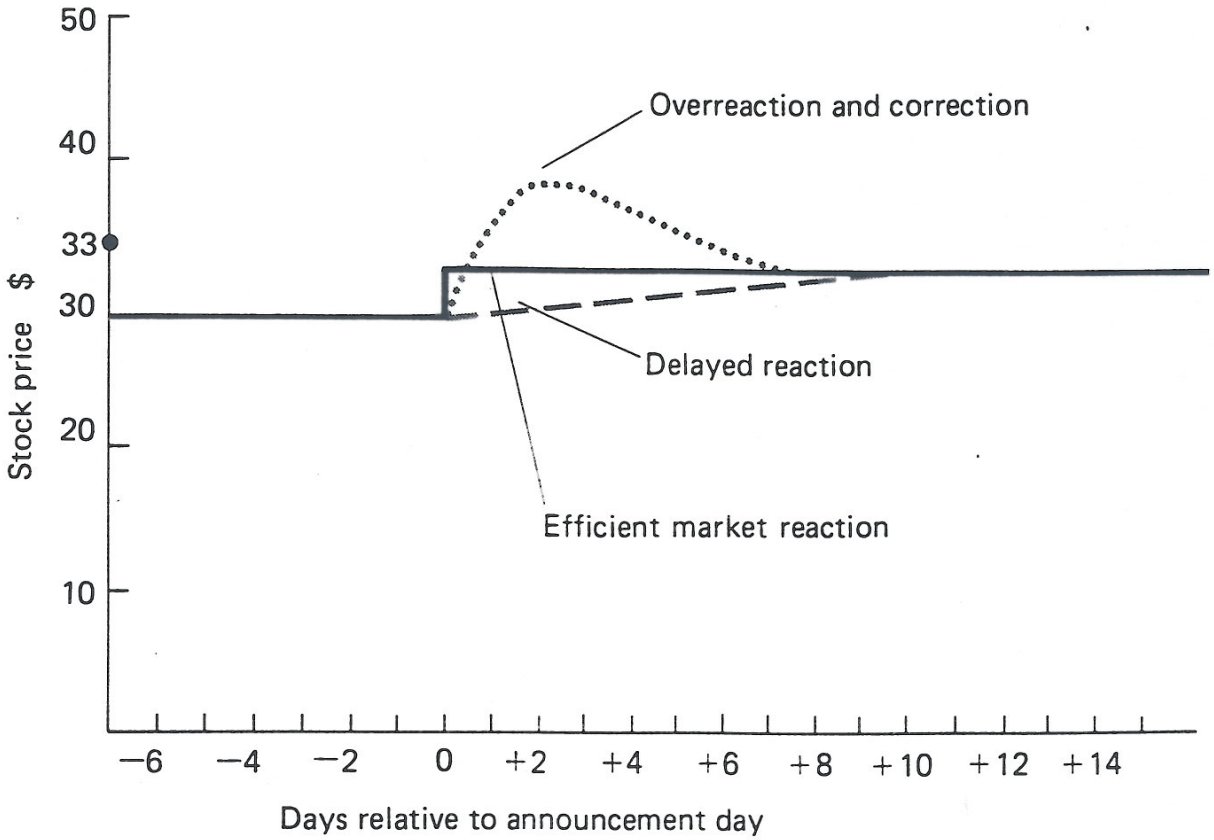
❍ Features of efficient markets:

- Quick and exact adjustments of the price level to new information.
- Price changes are random in relation to the own price history.
- The exploitation of supposed over- or under-valuations does not generate a risk adjusted excess return in the long run.

- Stock price reaction to new information: efficient vs inefficient market[5]



[5] Adoped from Haugen, 1993, Modern Investment Theory, p. 643.

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8.2 Event Studies: Methodology

An event study describes a technique of empirical financial research that enables an observer to assess the **impact of a particular event** on a firm's stock price.

In a **rational market**: The effect of an event will be reflected **immediately** in prices (i.e. within a short period of time).

Typical examples of events:

Mergers, increase or decrease of dividend payments, stock splits, announcements of earnings, launching of derivative securities, etc.

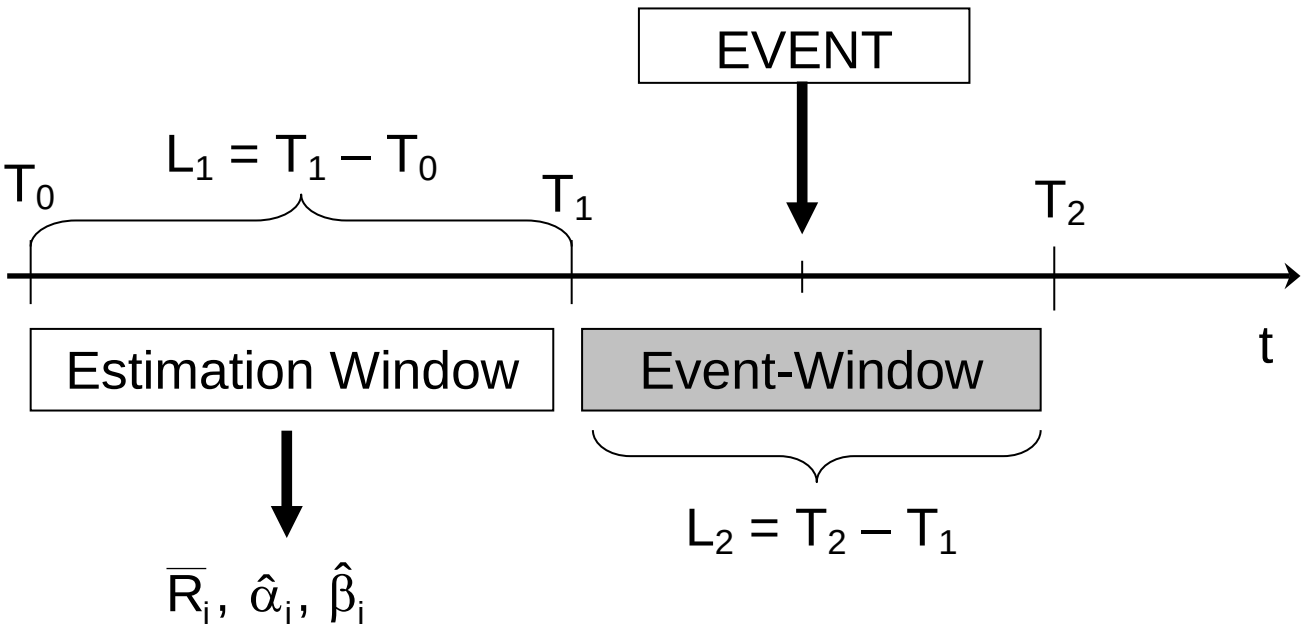
Problem: The stock price reacts permanently to all kinds of information (e.g. about econ. growth, inflation, interest term structure changes, etc.)

Aim: Extraction of the impact of a particular event on share prices.

(a) General procedure

- Define the event (e.g. merger).
- Define the event-window (e.g. announcement day of a merger).
- Select the sample of relevant firms (country origin, stock exchange, industry, etc.)
- Measure abnormal returns (ARs) for sample firms.
- Specify research hypotheses.
- Aggregate abnormal returns.

(b) Event, estimation period, and event-window



Often used values for L_1 and L_2:

L_1: 100 to 250 trading days
L_2: $\pm$ 20 trading days around the event

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(c) Estimation of normal and abnormal (excess) returns[6]:

General: $AR_i = R_i - E[R_i]$

Abnormal return = realized return – normal return (without event)

Mean-adjusted return: $AR_{i,t} = R_{i,t} - \overline{R}_i$

Market-adjusted return: $AR_{i,t} = R_{i,t} - R_{m,t}$

Market Model-adjusted return: $AR_{i,t} = R_{i,t} - \hat{\alpha}_i - \hat{\beta}_i \cdot R_{m,t}$

[6] See, e.g. Brown und Warner (JF, 1985), MacKinlay (JEL, 1997).

(d) Aggregation of ARs[7]:

- **Through time for company i**

$$CAR_i(\tau_1, \tau_2) = \sum_{t=\tau_1}^{\tau_2} AR_{i,t}$$ Cumulative Abnormal Returns

$$\sigma^2_{CAR_i}(\tau_1, \tau_2) = (\tau_2 - \tau_1 + 1) \cdot \sigma^2_{\varepsilon_i}$$ Variance of CARs (if L_1 is large)

$$CAR_i(\tau_1, \tau_2) \sim N\left(0, \sigma^2_{CAR_i}(\tau_1, \tau_2)\right)$$

[7] See e.g. Brown und Warner (JF, 1985), MacKinlay (JEL, 1997).

Cross sectional

$$\overline{AR}_t = \frac{1}{N}\sum_{i=1}^{N} AR_{i,t}$$

N … number of firms

$$Var\left(\overline{AR}_t\right) = \frac{1}{N^2}\sum_{i=1}^{N}\sigma_{\varepsilon_i}^2$$

(if L_1 = large)

$$\overline{CAR}(\tau_1,\tau_2) = \sum_{t=\tau_1}^{\tau_2}\overline{AR}_t$$

$$Var\left(\overline{CAR}(\tau_1,\tau_2)\right) = \sum_{t=\tau_1}^{\tau_2} Var\left(\overline{AR}_t\right)$$

- ➔ Cross sectional aggregation over all sample firms
- ➔ Firm specific price movements are ‘diversified away‘
- ➔ Systematic effect for all sample firms: the EVENT

OR: Calculate $CAR_i(\tau_1, \tau_2)$ for each firm first and then aggregate

$$\overline{CAR}(\tau_1, \tau_2) = \frac{1}{N}\sum_{i=1}^{N} CAR_i(\tau_1, \tau_2)$$

$$Var\left(\overline{CAR}(\tau_1, \tau_2)\right) = \frac{1}{N^2}\sum_{i=1}^{N} \sigma_i^2(\tau_1, \tau_2)$$

Example[8]

Information content of quarterly earnings announcements

30 DJI firms, January 1989 – December 1993 (5Y)

600 announcements (= 5Y*4Q*30 stock)

Each announcement: good news, no news, bad news

[8] See MacKinlay (JEL, 1997).

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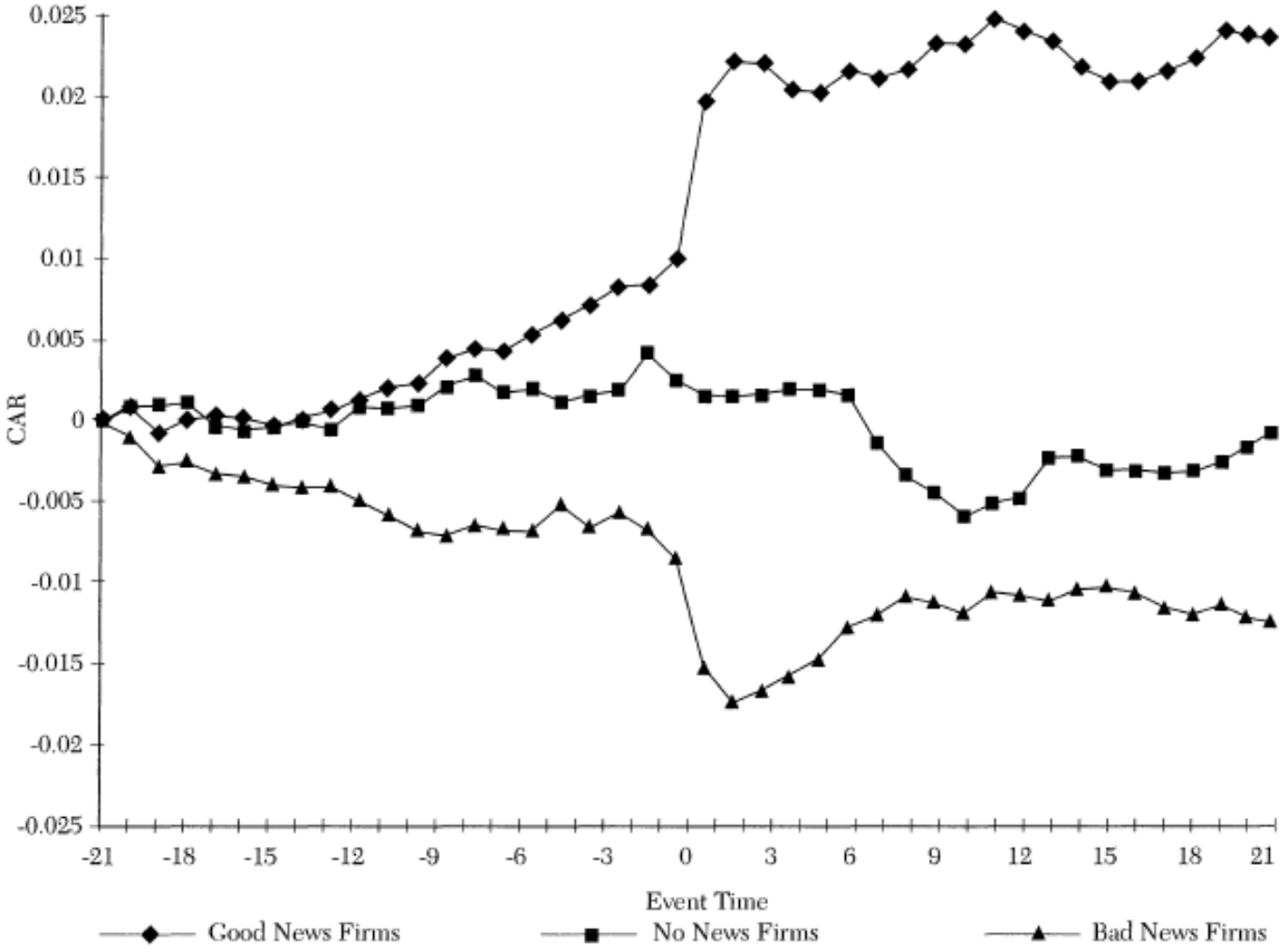
CARs: Market Model-adjusted returns



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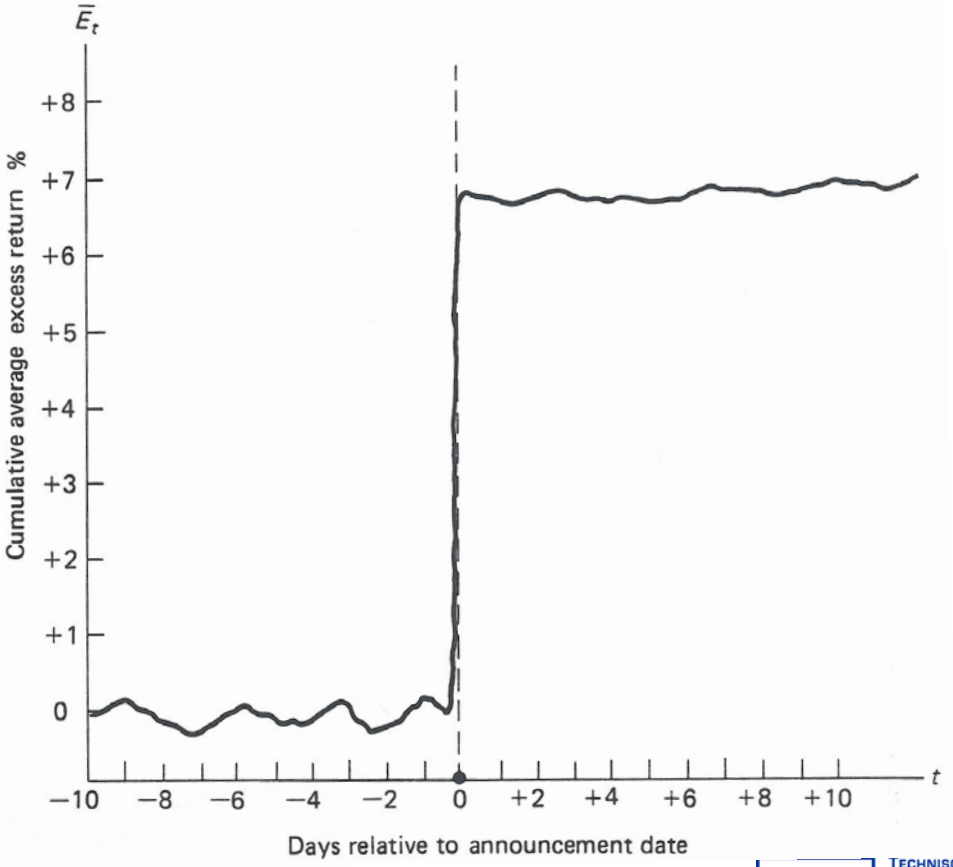
8.3 Announcement Effects

(a) Reaction to new information in case of semistrong-form efficiency

The price reacts to new information only on the announcement day (t = 0).

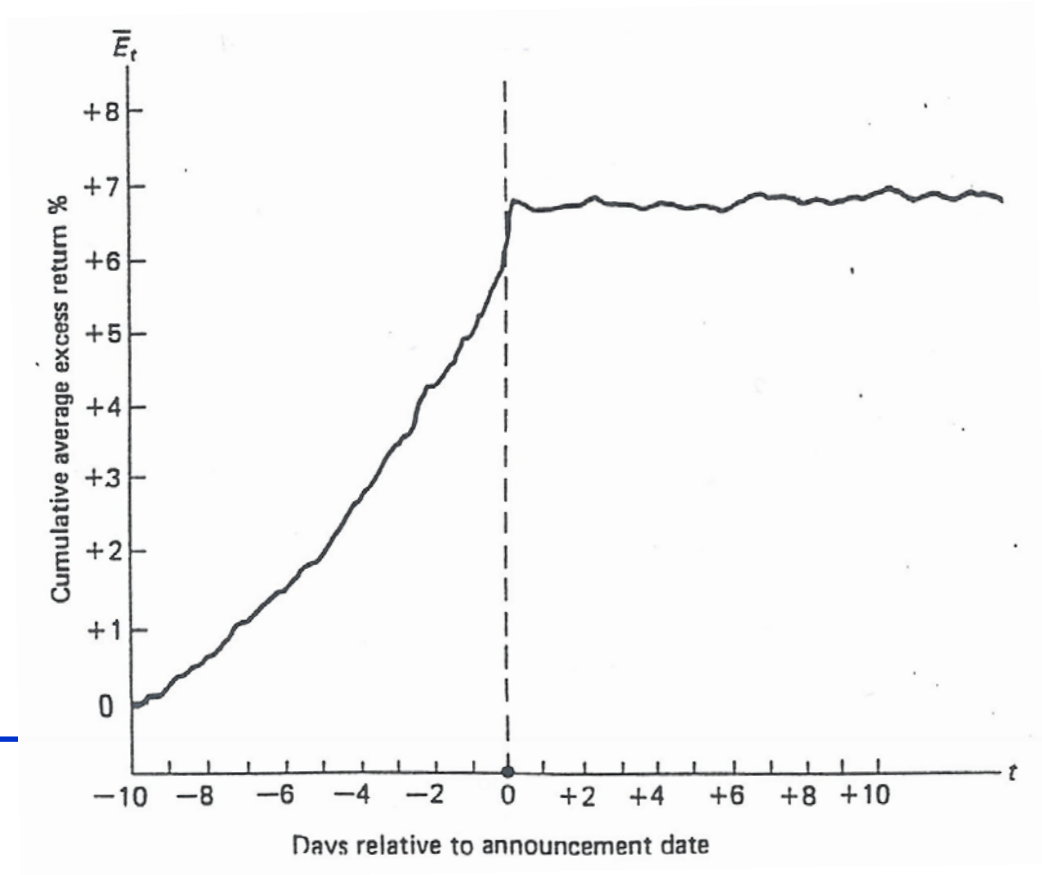
Thereafter average CARs should not change any more.

Private information is not included in prices before t = 0 (announcement day).



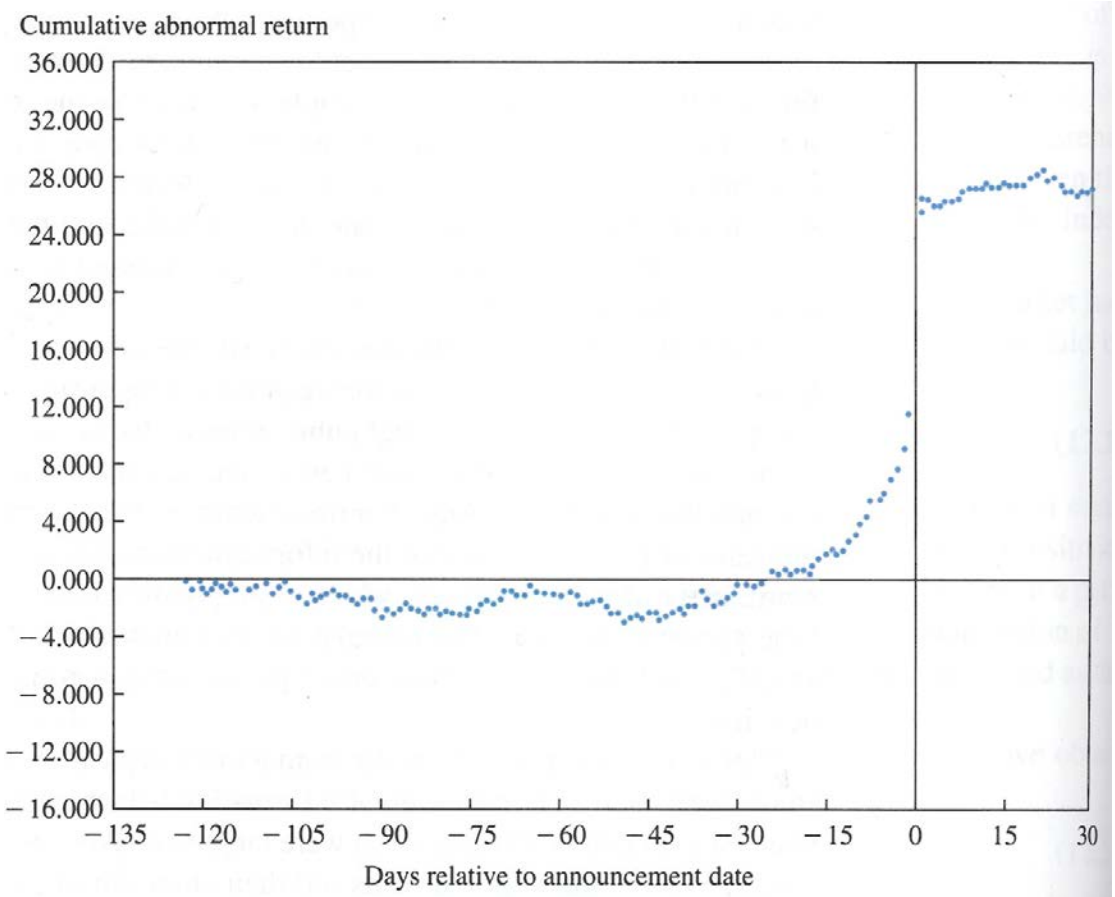
(b) Reaction to new information in case of strong-form efficiency

Private information about the event may influence the price already before the date of public announcement. This will not happen for all firms at the same time relative to t = 0 (event date). Thus, the average CAR changes gradually over time.



(c) Further Examples:

- **Takeover announcement effect (Keown/Pinkerton, JF 1981)[9]**



[9] Sample of 194 target firms (Bodie et al., Investments, 1996, p. 354)

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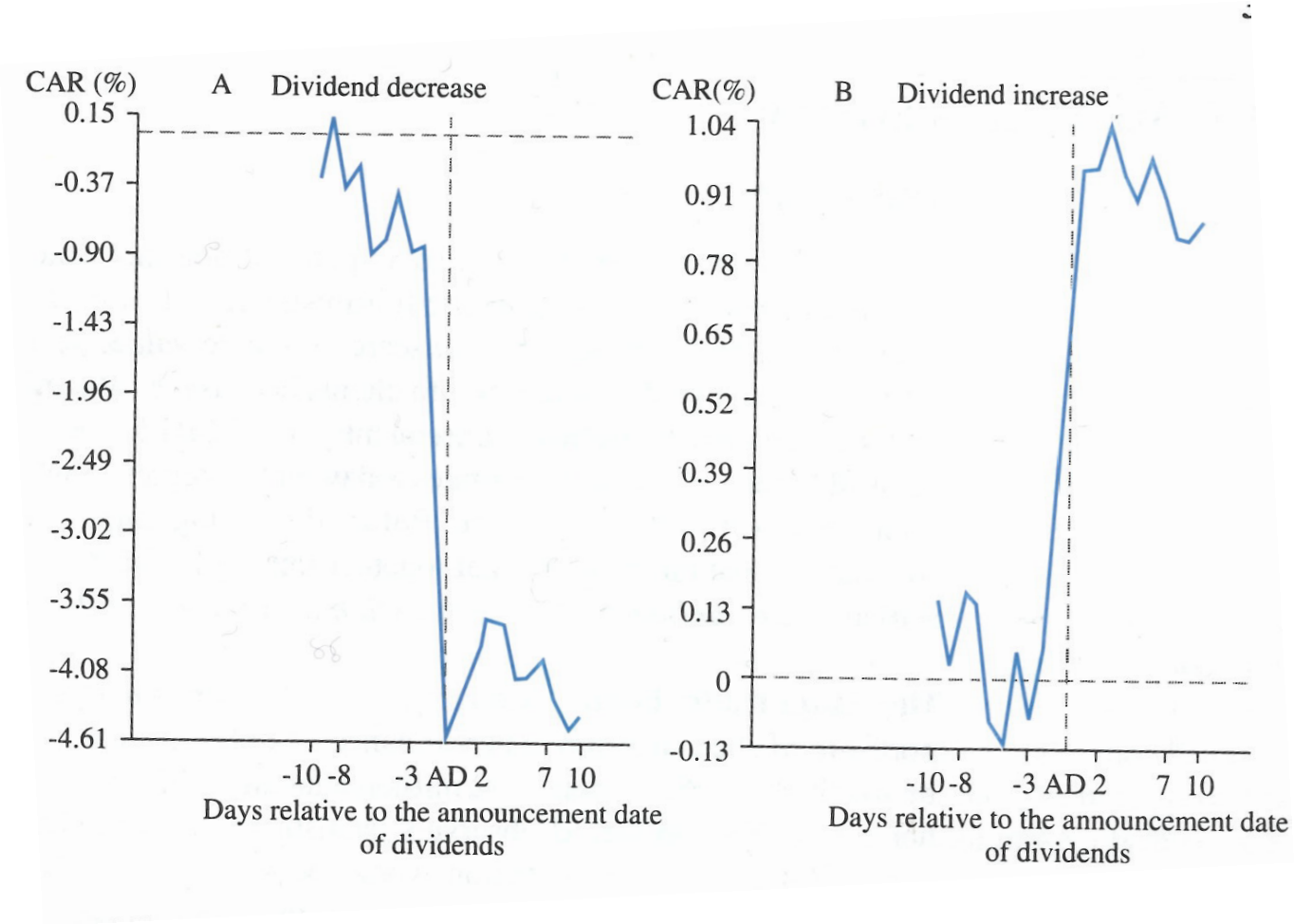
- **Dividend announcement effect (Aharony/Swary, JF 1980)[10]**



[10] Bodie et al., Investments, 1996, p. 355).

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8.4 Effect of Director's Dealings

Based on Aussenegg and Ranzi, 2008, 'Corporate Insider Trading and the Short-Run Price Impact of Private Information in Continental Europe', available at: http://ssrn.com/abstract=1265772

(a) Motivation

❍ **Starting point: Informational asymmetry**

- Corporate insiders (e.g., managers, supervisory board members)
- Outsiders (investors)

➔ Expectation: **Insiders are better informed** about the 'true' value of their company

❍ Insider Trading

- Occurs, when insiders buy/sell shares in their own company
- Not forbidden
  - But: Forbidden is the use of insider knowledge
  - One important aspect to protect outsiders

    ➔ Disclosure of corporate insider trades

- **Disclosure requirements of insider trades**
  - U.S. since 1934, and U.K. since 1976
  - EU
    - Harmonization of disclosure requirements
    - Market Abuse Directive (2003/6/EC)
      - All insider have to disclose their trades immediately (2-5 days)
      - e.g., current U.S. regulation; 2 trading days
- **Aim of this study**
  - To investigate whether
    - The **disclosure** of corporate insider trades has an **impact on the price performance** of (continental) European companies.

(b) Literature

- **Most studies:**
  - Insiders are able to earn significant abnormal returns (first weeks after trading/disclosure)
    - U.S.: Finnerty (1976, JF), Seyhun (1986, JFE), Lakonishok and Lee (2001, RFS), Aktas et al. (2008, JB&F)
    - U.K.: Pope et al. (1990, JBF&A), Fidrumc et al. (2006, JF)
    - Netherlands: Aktas et al. (2007, WP)
    - Germany: Klinge et al. (2005, WP), Dymke and Walter (2007, WP), Betzer and Theissen (2007, EFM forthcoming: abnormal returns especially prior to earnings announcements)

(c) Hypotheses

- **Hypothesis 1**
  - Insider buying (selling) shares generate
    - Positive (negative) **abnormal returns** (after disclosure)
- **Hypothesis 2**
  - This effect **drops over time** (as markets might get more efficient)
- **Hypothesis 3**
  - This effect is more pronounced for **small firms**
    - Higher informational asymmetry

- **Hypothesis 4**
  - This effect is more pronounced for **larger trades**
    - Might reveal more private information
- **Hypothesis 5**
  - This effect is more pronounced if **more insiders** trade
    - Might reveal more private information
- **Hypothesis 6**
  - No differences between German and French law countries
    - Beck et al. (2003, JCE): German law countries: less inform. asymm.
    - Leuz et al. (2003, JFE): French law countries: less inform. asymm.

(d) Data

- **7 continental European countries**

Country	Public disclosure required since	Transactions Purchases	Sales	Total	Fraction
Austria	May 2005	658	294	952	5.8%
Belgium	May 2006	337	441	778	4.7%
France	Mar 2006	1,201	1,414	2,615	16.0%
Germany	Jul 2002	3,127	2,545	5,672	34.6%
Italy	Jan 2003	2,328	1,331	3,659	22.3%
Netherlands	Oct 2005	328	356	684	4.2%
Switzerland	Jul 2005	670	1,358	2,028	12.4%
		8,649	7,739	16,388	100.0%

Total number of companies: 1,242

(e) Methodology

- **Event study approach**
  - Abnormal Return (AR) for transaction *i*:

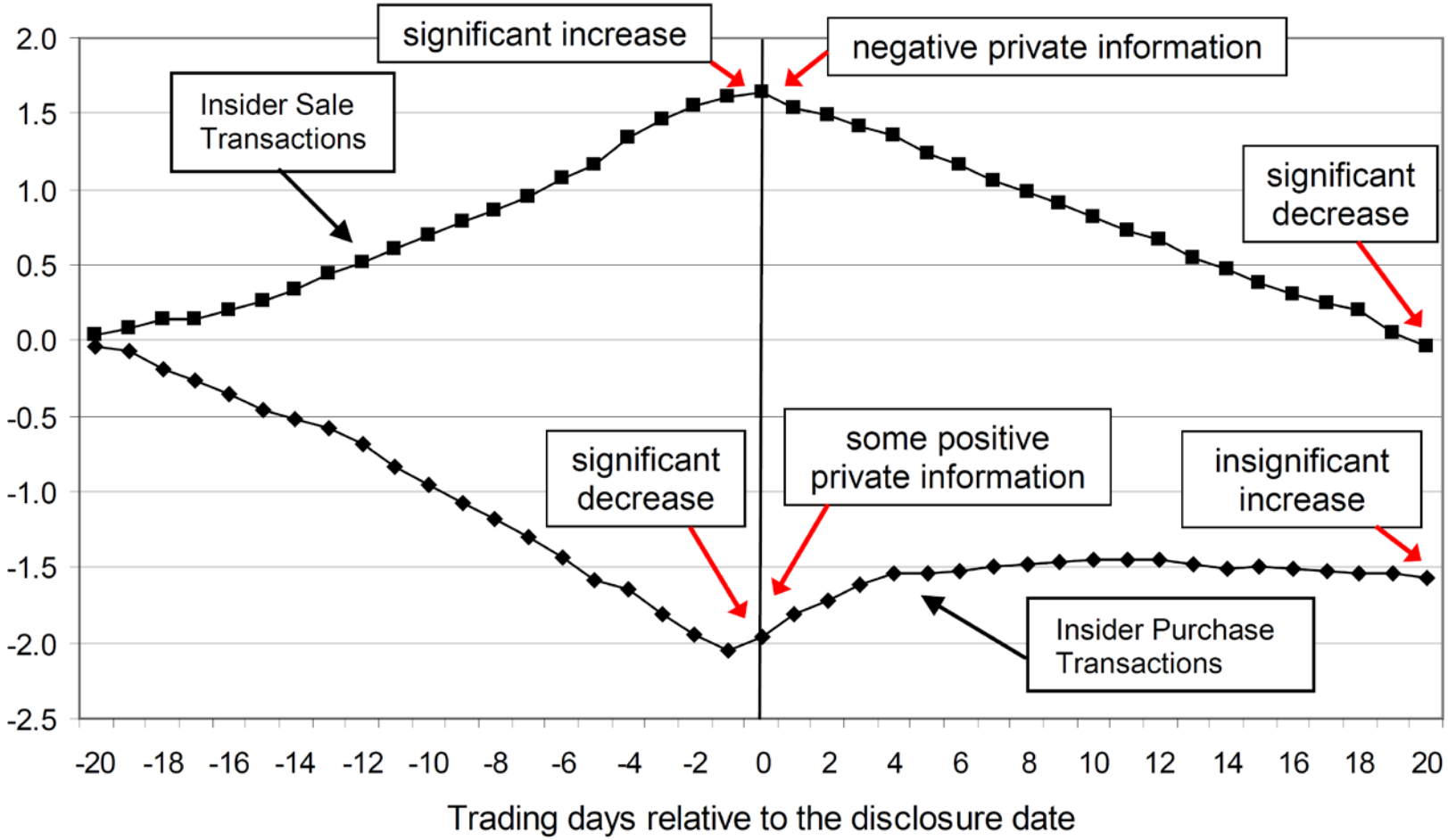
    $AR_i = R_i - E[R_i]$

    Abnormal return = realized return – normal return (without event)

  - Market Model
    - ± 20 trading day event window around the disclosure date (= event)
- **Cumulative Abnormal Returns: CARs**
- **Cumulative Realized Returns: CRRs**

(f) Results

❍ CARs around the disclosure date



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❍ Multivariate Analysis: $CAR_{0,20}$ as dependent variable

Independent variables	Purchases	Sales	Hypotheses
Constant	**2.781**	**-8.214**	
Time (2002=1, 2003=2, …)	**-0.278**	**0.28**	2 ✓
Prior Purchase (-20,-1)	0.301	**0.735**	
Prior Sale (-20,-1)	**-0.906**	-0.053	
Number of Insiders trading on same day	-0.245	**-0.347**	5 ✓ (for sales)
Transaction Volume (% of MCap)	0.083	**0.13**	4 × (for sales)
Debt-Total Assets Ratio	0.794	**2.082**	
Firm Size (ln(MCap))	**-0.131**	**0.21**	3 ✓
Book-to-Market Ratio	**1.348**	**0.515**	
Legal Origin (German = 1; French = 0)	**0.974**	**-0.713**	6 ×
F-value	**38.89**	**13.79**	
adj-R2 (%)	3.8	1.5	
Number of Transactions	8,518	7,603	
Bold: significant at the 5%-level			

(g) Conclusion

- **Insider transactions: Generate abnormal returns**
  - 7 continental European countries (16,388 insider deals)
  - Disclosures seem to reveal valuable private information
  - More pronounced for smaller firms
  - More pronounced in German law countries
  - Decreases over time

- **Insiders tend to time their transactions**
  - Selling shares after stock price increases
  - Buying shares after stock price decreases

8.5 Month-of-the-year Effect (average monthly returns in %)[11]

Country	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	All mths.
1. Australia	2.65	−0.58	0.51	0.84	0.97	0.43	0.66	−0.37	−2.39	2.13	−0.85	3.99	0.67
2. Belgium	3.20	1.09	0.40	1.48	−1.36	−0.84	1.44	−1.17	−1.87	−0.69	0.42	0.09	0.17
3. Canada	2.90	0.07	0.79	0.41	−0.96	−0.30	0.69	0.60	−0.06	−0.82	1.44	2.61	0.61
4. Finland	3.62	2.09	2.63	0.95	−0.02	1.55	2.53	0.97	−0.76	0.77	0.61	2.51	N.A.[2]
5. France	3.72	−0.18	1.98	0.94	−0.66	−1.90	1.53	1.03	−1.21	−0.72	0.43	0.15	0.43
6. Germany	1.62	0.55	2.17	0.80	0.15	1.62	2.11	2.18	−0.50	−0.46	0.93	1.42	1.09
7. Hong Kong	7.98	4.22	−2.34	1.86	2.34	2.40	2.74	−0.86	−1.69	3.21	−2.49	5.45	1.90
8. Japan	5.58	1.00	2.90	0.51	0.18	2.51	0.65	0.92	0.13	0.52	1.81	2.48	1.60
9. Korea	0.42	2.10	3.72	0.73	1.65	2.54	2.91	−0.13	−0.01	−0.67	3.02	3.34	1.64
10. Malaysia	1.70	0.21	−0.07	0.11	0.49	0.04	−0.34	−0.38	−0.10	0.45	−0.25	0.54	0.20
11. Netherlands	3.74	−0.53	0.62	2.49	0.54	−1.43	1.02	−1.69	−3.34	−0.96	−0.80	1.48	0.38
12. Singapore	7.81	0.69	0.28	0.54	3.45	1.76	0.71	−1.12	−0.11	−0.23	−0.07	1.91	1.31
13. Spain	3.04	1.99	0.14	0.14	−0.81	0.59	1.47	1.00	−2.02	0.18	0.36	−0.45	N.A.[2]
14. Taiwan	6.26	3.41	2.40	4.97	3.49	1.24	0.88	3.83	4.01	−3.70	0.47	1.63	2.41
15. United Kingdom	3.40	0.69	1.25	3.13	−1.21	−1.69	−1.11	1.88	−0.24	0.80	−0.61	2.06	0.70
16. U.K. FT-A[3]	3.06	0.79	1.15	3.57	−1.00	−0.85	−0.22	2.62	0.03	1.26	0.16	2.34	1.08
17. United States	1.04	−0.41	1.27	0.96	−1.38	−0.56	0.14	0.34	−0.79	0.78	1.03	1.42	0.32
18. U.S. EW[4]	5.08	0.55	1.55	0.44	−1.42	−1.00	0.73	0.72	−0.42	−0.79	1.79	1.37	N.A.[2]

[11] See Hawawini and Keim, 1995, in Jarrow et al., Finance (Handbooks in OR and Management Science), p. 524, and Haugen, 1993, Modern Investment Theory, p. 671.

8.6 Size (Small-Firm) Effect[12]

➔ Mean return of small firms **>** Mean return of large firms

Country:	Australia	Belgium	Canada	Finland	France	Germany	Ireland	Japan	New Zealand	Spain	Switzer-land	Taiwan	United Kingdom
Test period	1958–81	1969–83	1973–80	1970–81	1977–88	1954–90	1977–86	1965–87	1977–84	1963–82	1973–88	1979–86	1958–82
No. of securities [2]	281–937	170	391	50	529–460	All FSE	40	1st sec-tion TSE	about 100	98–140	153	53 to 72	All LSE
No. of size portfolios	10	5	5	10	5	9	5	10	5	10	6	5	10
Market value of largest portfolio of firms divided by market value of smallest portfolio of firma [3]	N.A.	188	67	113	N.A.	N.A.	N.A.	N.A.	60	228	99	17	182
Average monthly return (%) on the smallest portfolio of firms [4]	6.75	1.17	1.67	1.65	1.20	1.54	3.10	2.57	0.69 [7]	0.58 [8]	0.94	0.47 [8]	1.33
Average monthly return (%) on the largest portfolio of firms [4]	1.02	0.65	1.23	0.89	0.30	1.05	2.63	1.37	0.18 [7]	0.02 [8]	0.42	−0.10 [8]	0.93
Size premium (%) (small minus large)	5.73	0.52	0.44	0.76	0.90	0.49	0.47	1.20	0.51 [7]	0.56	0.52	0.57 [8]	0.40
Average risk of smallest portfolio													
– standard beta coefficient [5]	1.04	1.01	N.A.	0.36	N.A.	0.80	N.A.	1.12 [9]	N.A.	N.A.	N.A.	0.79	0.31
– adjusted beta coefficient [6]	N.A.	N.A.	N.A.	0.52	N.A.	N.A.	N.A.	1.22 [9]	0.90	N.A.	N.A.	0.55	0.64
Average risk of largest portfolio													
– standard beta coefficient [5]	0.95	0.98	N.A.	1.00	N.A.	1.08	N.A.	0.81 [9]	N.A.	N.A.	N.A.	0.99	1.01
– adjusted beta coefficient [6]	N.A.	N.A.	N.A.	0.95	N.A.	N.A.	N.A.	0.77 [9]	0.99	N.A.	N.A.	0.72	1.02

[12] See Hawawini and Keim, 1995, in Jarrow et al., Finance (Handbooks in OR and Management Science), p. 502.

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❍ The size effect can primarily be observed in January[13]

Country:	Belgium	Finland	France	Germany	Japan	Taiwan	United Kingdom
Test period	1969–1983	1970–1983	1968–1980	1954–1990	1965–1987	1979–1986	1958–1982
Number of securities [2]	170	40	201	All FSE	1st section TSE	53 to 72	All LSE
Number of size portfolios	5	5	5	9	10	5	10
$\frac{\text{Market value largest portfolio}}{\text{Market value smallest portfolio}}$	188	113	83	N.A.	N.A.	17	182
January return [3] (%) on:							
– Smallest portfolio	5.4	5.9	3.7	2.8	9.5	N.A.	2.3
– Largest portfolio	3.0	2.5	4.4	1.3	2.3	N.A.	3.6
January size-premium [4] (%)	2.4	3.4	–0.7	1.6	7.2	3.4 [6]	–1.3
Rest-of-the-year monthly return [5] (%) on:							
– Smallest portfolio	0.8	1.8	1.4	1.4	1.9	N.A.	1.2
– Largest portfolio	0.4	1.0	0.7	1.0	1.3	N.A.	0.7
Rest-of-the-year size premium (%)	0.4	0.8	0.7	0.4	0.6	0.3 [6]	0.5

[13] See Hawawini and Keim, 1995, in Jarrow et al., Finance (Handbooks in OR and Management Science), p. 525.

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- **Tax-Loss selling as potential explanation for the January-Size effect:**

  Losses are realized before year-end due to tax reasons.

  Free cash (generated due to tax-loss selling) is reinvested at the beginning of the year.

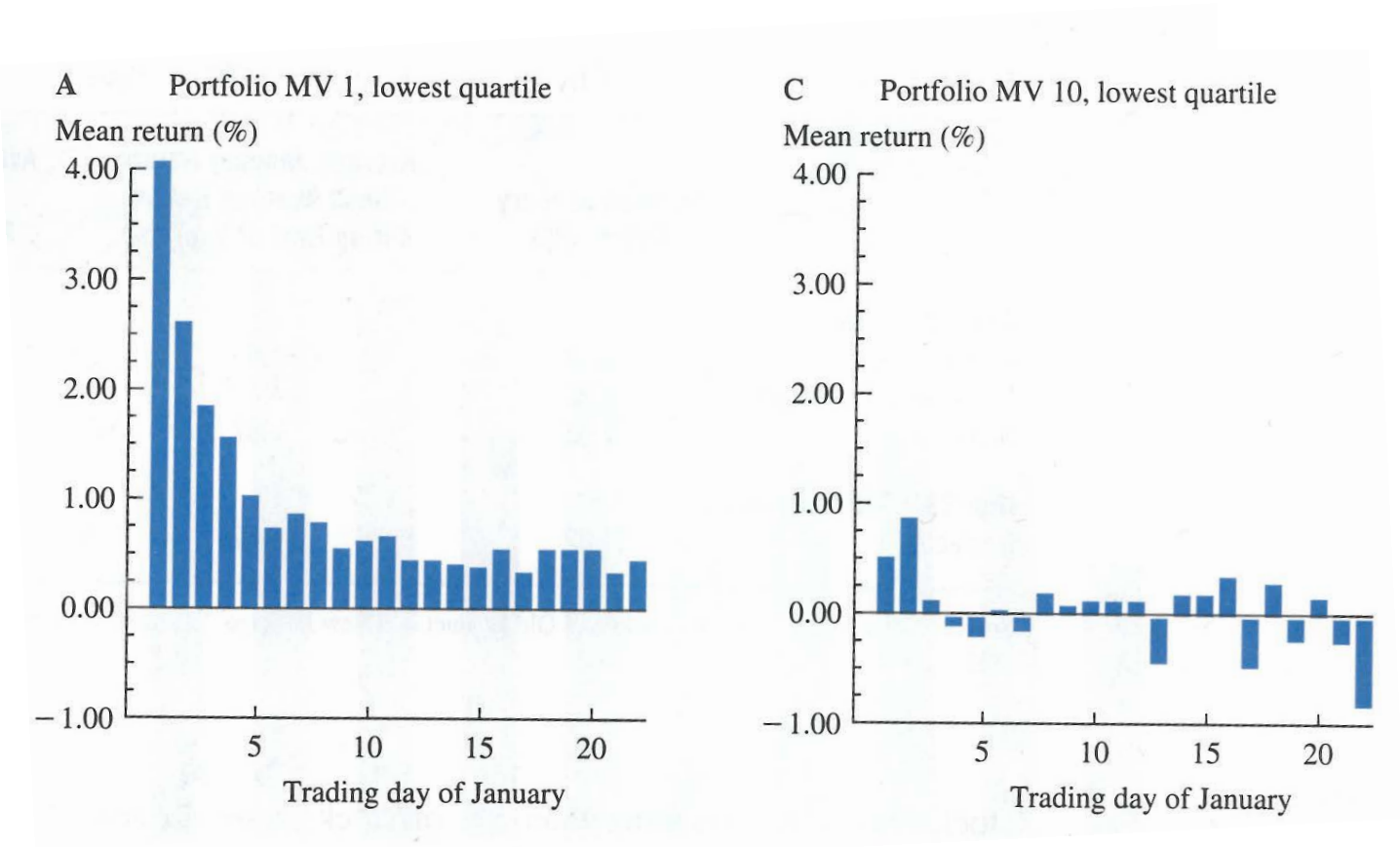
  Small firms have a higher volatility. Thus, tax-loss selling tends to be more profitable for small firms than for large companies.

  Reinganum (JFE, 1983) shows that the January effect is (indeed) most pronounced for small firms with very bad past year performance.

  However, also the January performance of small firms with good past performance tends to be positive, although to a much smaller extent.

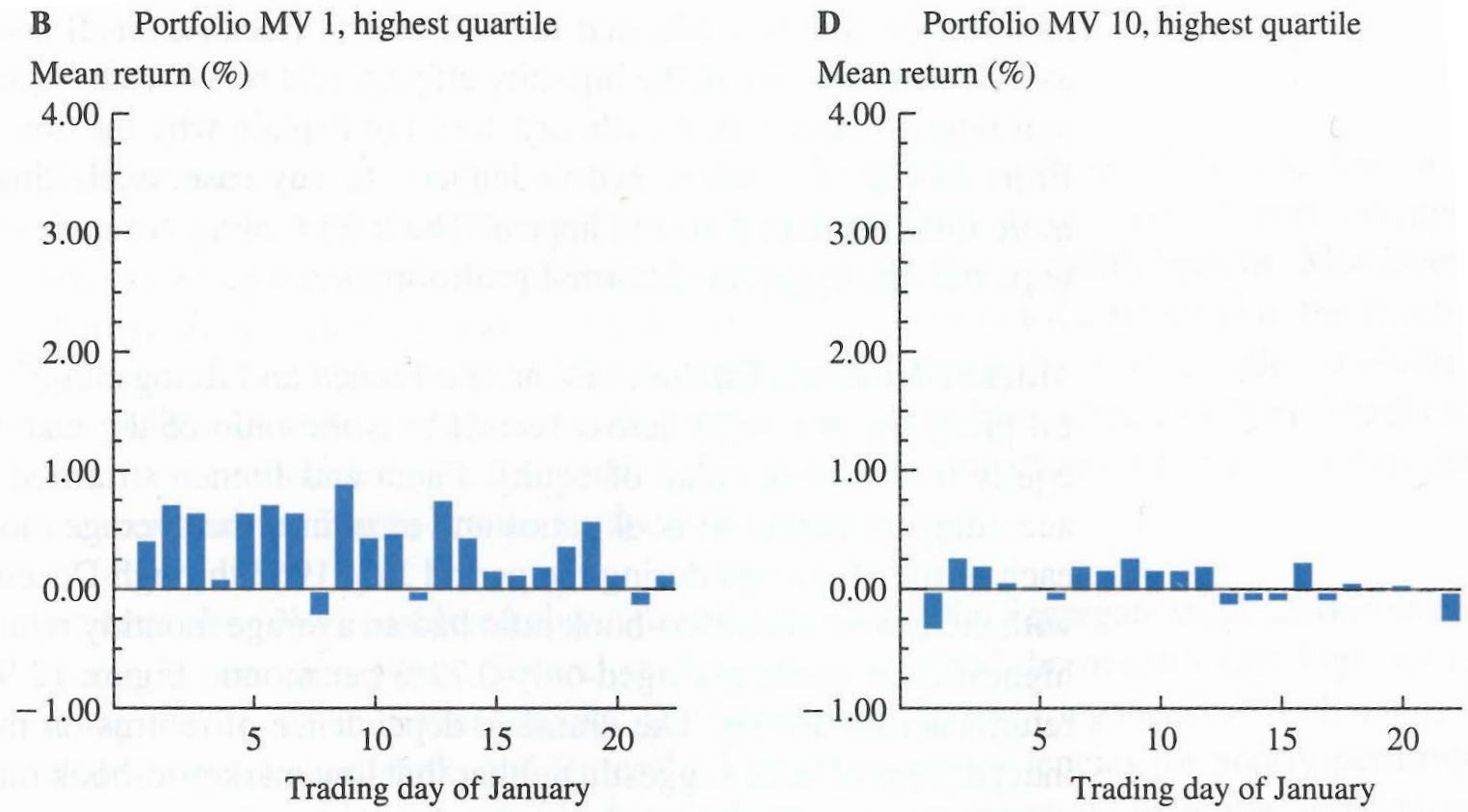
❍ Results of Reinganum (JFE, 1983)[14]

Lowest quartile of the tax-loss selling distribution: Small (MV 1) and large (MV 10) firms



[14] See Bodie et al., Investments, 1996, p.

Highest quartile of the tax-loss selling distribution: Small (MV 1) and large (MV 10) firms



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- **Why are investors not exploiting the January effect?**

  Strategy: Buy in December and sell in January

  Possible reason: Segmentation between institutional and private investors.

  ➔ Institutional investors could exploit the January effect. However, they typically tend to avoid small firms:

  Low liquidity

  No or too few information