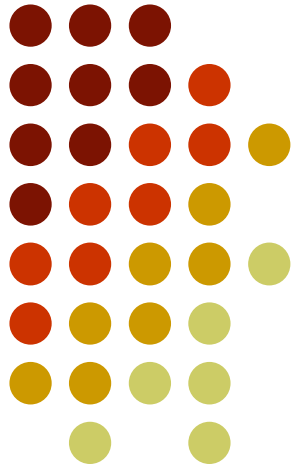
Risk and Return

Chapter 4



Outline

- Risk and return
- Risk reduction through diversification
- CAPM model and beta coefficients
- References: BF Chap 8; PF Chap 11

Return on an Investment

- Return
  - Income
  - Capital appreciation
- Expected return and required return
  - Expected return: incentive for accepting risk

$$\text{Expected rate of return} = \hat{r} = Pr_1 r_1 + Pr_2 r_2 + \cdots + Pr_n r_n$$

$$= \sum_{i=1}^{n} Pr_i r_i$$

  - Required return: the return necessary to induce an individual to make an investment

Sources of Risk

- Risk is the uncertainty associated with earning the expected return
- The total risk of an investment can be divided into two components:
  - Firm-specific risk—unique to a firm or industry
  - Market risk—economic risk
- The following relationship exists:

Total risk = Firm-specific risk + Market risk

Market Risk versus Firm-Specific Risk

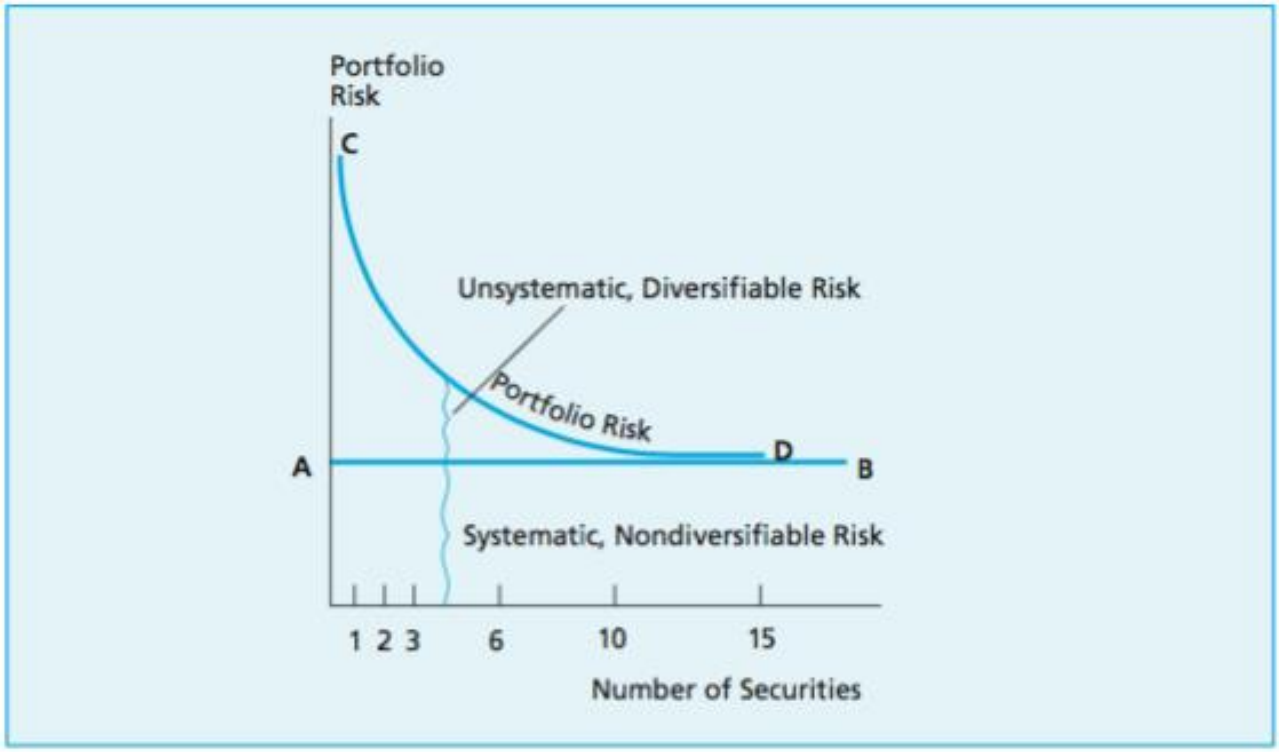
- Market risk
  - That part of a security's risk that cannot be eliminated through diversification because it is associated with economic, or market factors that systematically affect all firms
  - Systematic risk; nondiversifiable risk

Market Risk versus Firm-Specific Risk

- Firm-specific risk
  - That part of a security's risk associated with random outcomes generated by events, or behaviors, specific to the firm
  - It can be eliminated through proper diversification
  - Unsystematic risk; diversifiable risk

Unsystematic Risk and Total Risk

- Unsystematic risk declines as more securities are added to the portfolio
- Systematic market risk is not affected by diversification



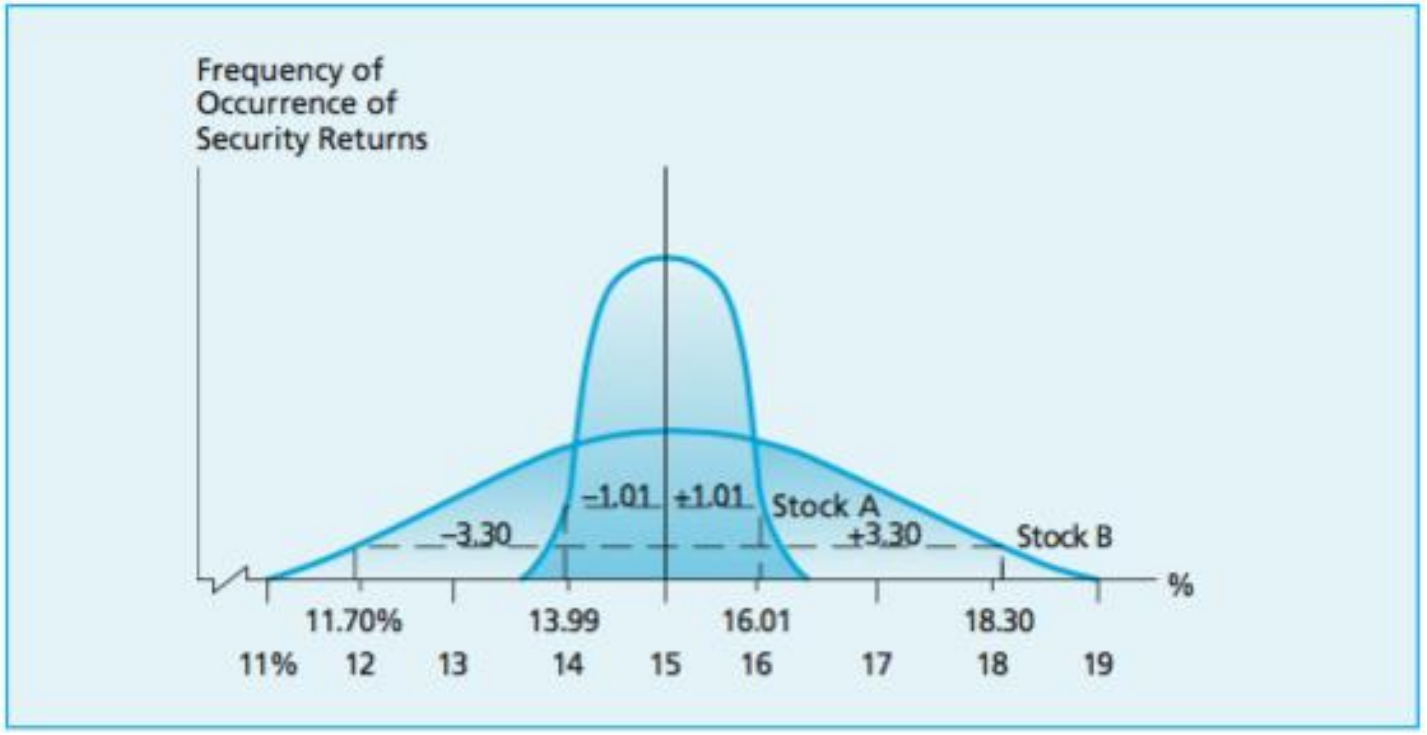
Measures of Risk

- Standard deviation
  - Measure of dispersion around an average value
- Coefficient of Variation
  - Standardized measure of risk per unit of return
- Beta coefficient
  - Index of systematic risk
  - Measure of the volatility of a stock's return relative to the market return

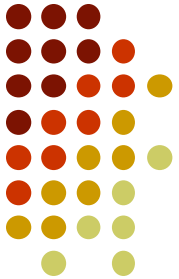
Standard Deviation

$$\text{Standard deviation} = \sigma = \sqrt{(r_1 - \hat{r})^2 Pr_1 + (r_2 - \hat{r})^2 Pr_2 + \cdots + (r_n - \hat{r})^2 Pr_n}$$

$$= \sqrt{\sum_{i=1}^{n} (r_i - \hat{r})^2 Pr_i}$$



Portfolio Standard Deviation



- Depends on
  - Each asset's variability
  - Each asset's weight in the portfolio
  - Correlation (ρ) among the returns
- Risk reduction
  - Combining stocks that are not perfectly positively correlated will reduce portfolio risk through diversification
  - The smaller the positive correlation, the greater the reduction of risk from adding another investment

Coefficient of Variation

- Calculated as the standard deviation divided by the expected return

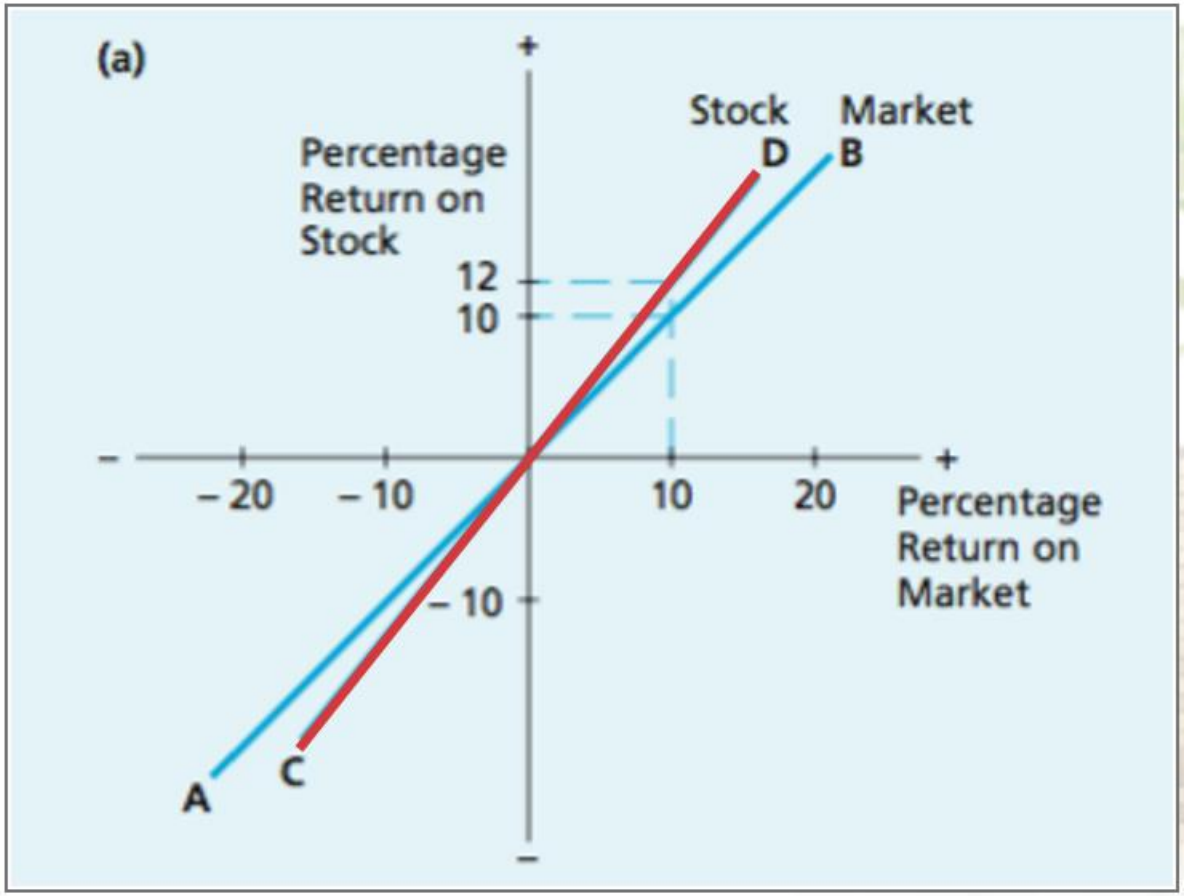
$$\text{Coefficient of variation} = \text{CV} = \frac{\text{Risk}}{\text{Return}} = \frac{\sigma}{\hat{r}}$$

- Useful where investments differ in both risk and expected returns

Beta Coefficients

- Beta = 1.0 Stock's return has same volatility as the market return
- Beta > 1.0 Stock's return is more volatile than the market return
- Beta < 1.0 Stock's return is less volatile than the market return.

Beta > 1.0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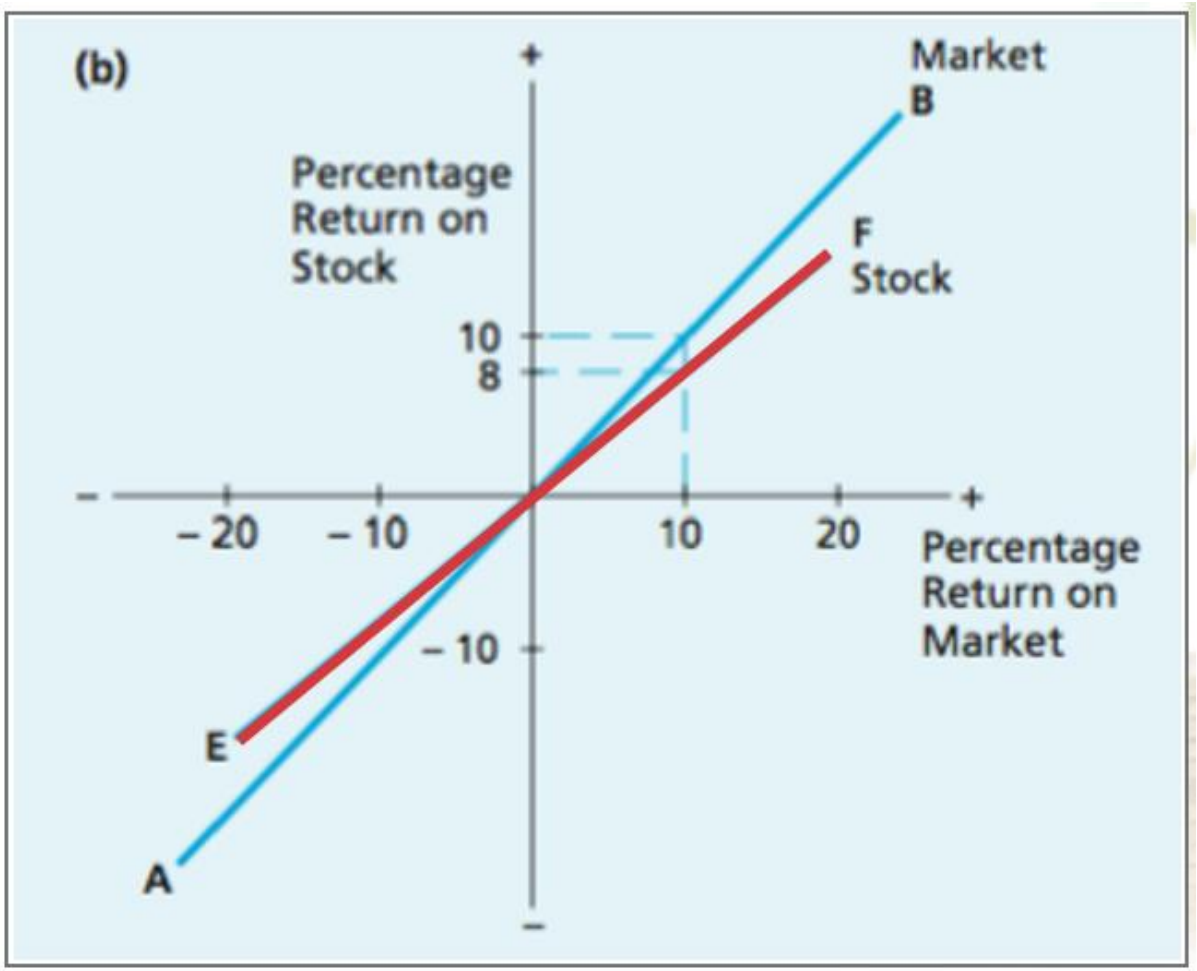
Beta < 1.0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Beta Coefficients

- Individual stock betas
  - May change over time
  - Tendency to move toward 1.0, the market beta
- Portfolio betas
  - Weighted average of the individual asset's betas

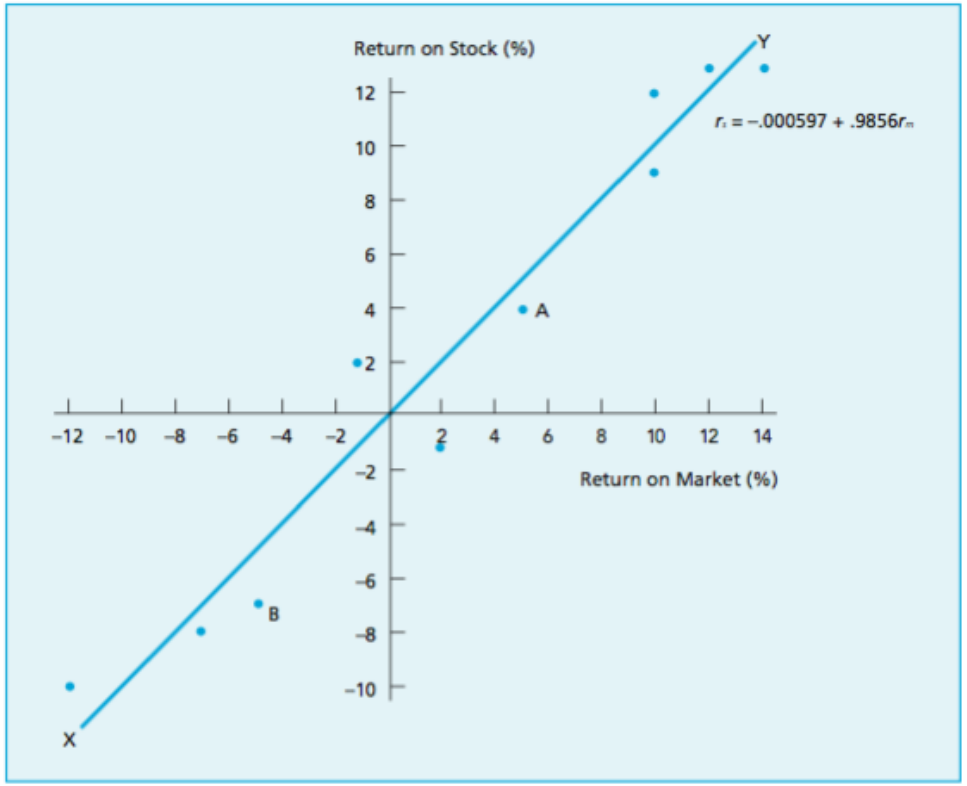
$$\beta_p = w_1\beta_1 + w_2\beta_2 + \ldots + w_N\beta_N$$

$$= \sum_{j=1}^{N} w_j\beta_j$$

  - May be more stable than individual stock betas

Estimation of Beta Coefficients

- Regression equation
  - Relating return on the stock and the return on the market



Capital Asset Pricing Model (CAPM)

- CAPM specifies the relationship between risk and return.
- CAPM makes the theoretical trade-off between risk and return operational.
- Risk-adjusted required return on a stock

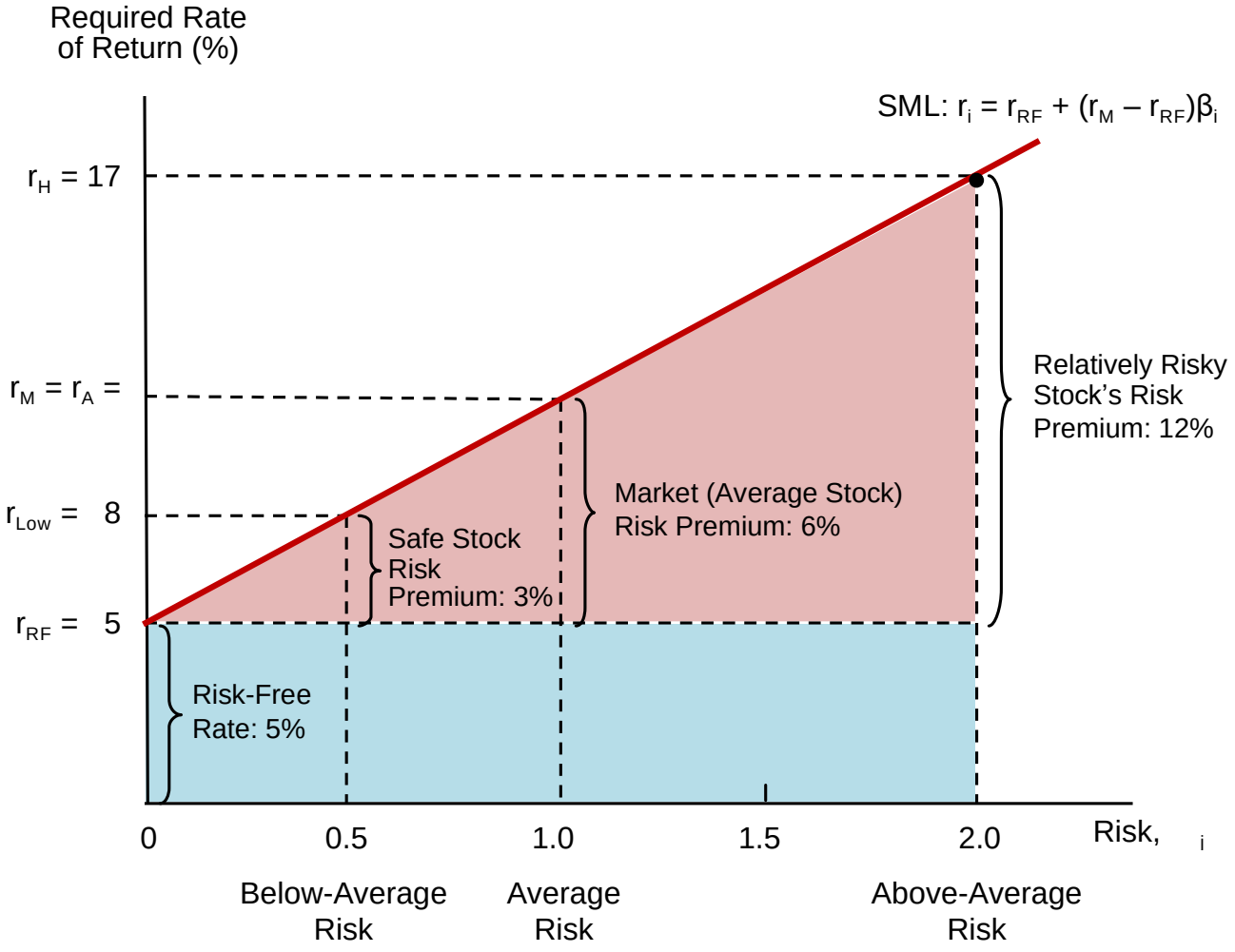
$$r_s = r_{RF} + (r_M - r_{RF})\text{beta}$$

  - $r_M - r_{RF}$ = risk premium on the market
  - $r_s - r_{RF}$ = risk premium on stock s

Required Rate of Return for a Stock

- Security market line (SML)
  - The line that shows the relationship between risk as measured by beta and the required rate of return for individual securities

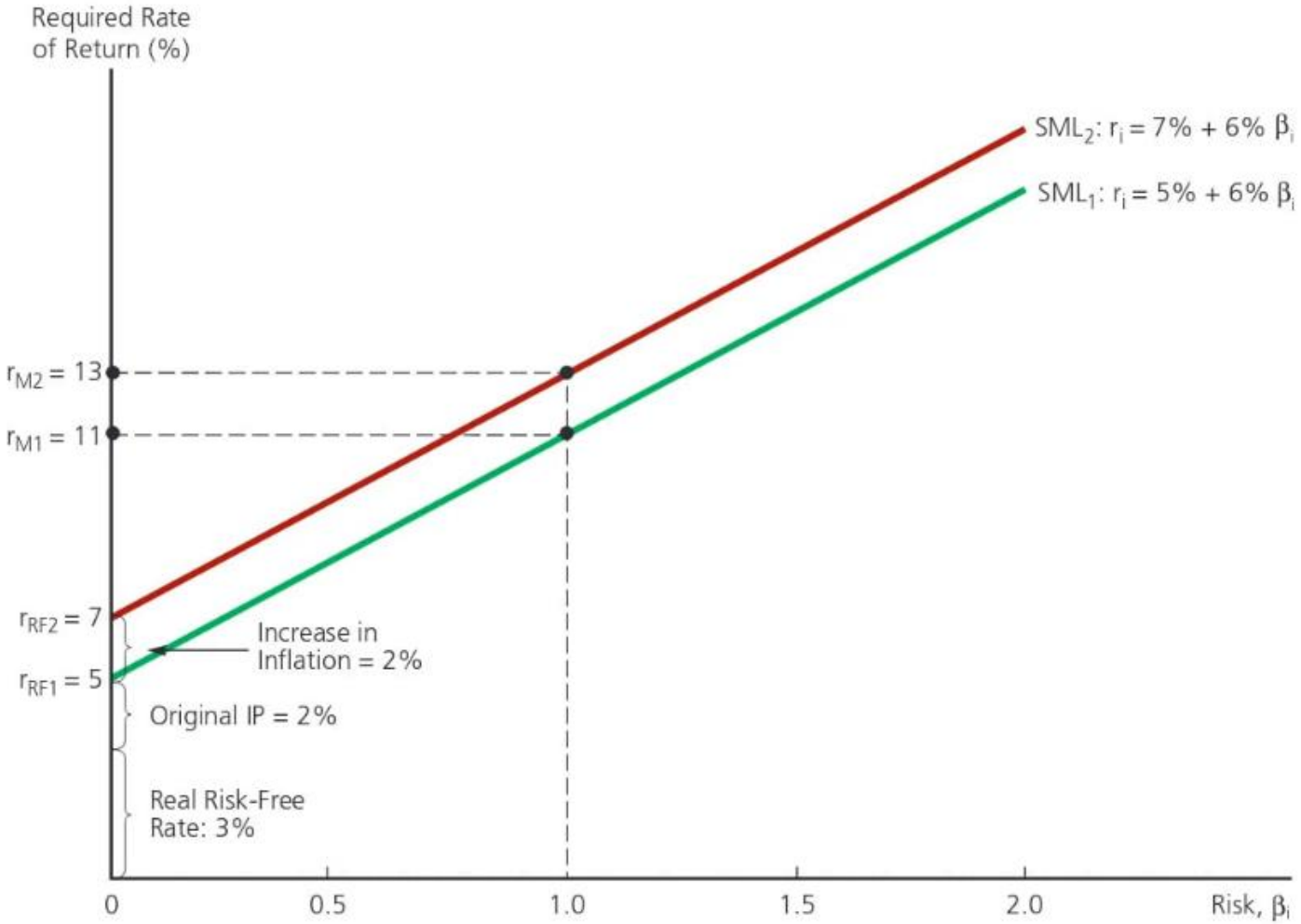
Security Market Line



The Impact of Inflation

- r_{RF} is the price of money to a riskless borrower
- The nominal rate consists of
  - A real (inflation-free) rate of return, r*
  - An inflation premium (IP)
- An increase in expected inflation would increase the risk-free rate, r_{RF}

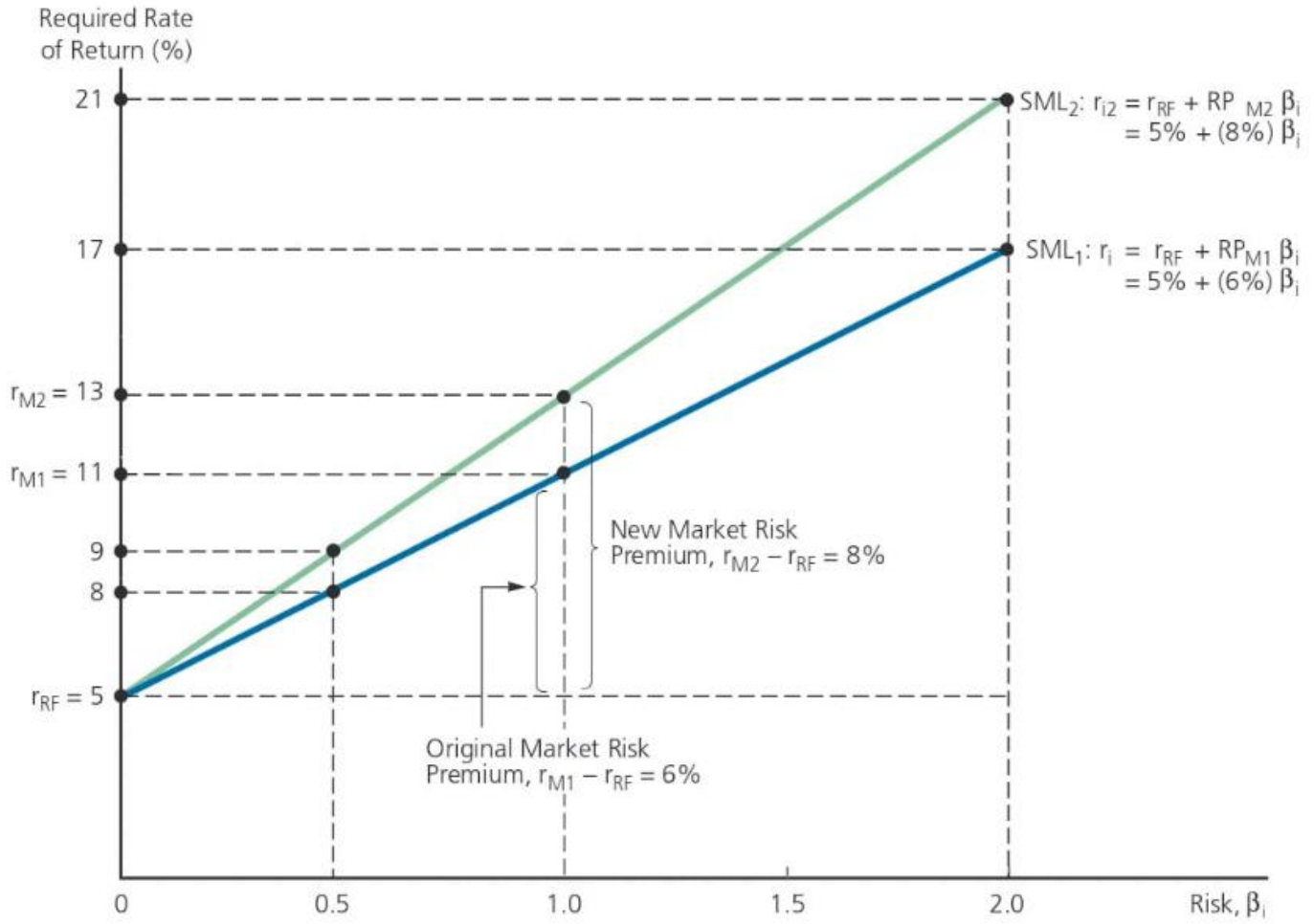
Shift in the SML Caused by a 2% Increase in Inflation



Changes in Risk Aversion

- Risk aversion
  - Risk-averse investors require higher rates of return to invest in higher-risk securities
- The slope of the SML reflects the extent to which investors are averse to risk
- An increase in risk aversion increases the risk premium, which in turn increases the slope

Shift in the SML Caused by Increased Risk Aversion



Word of Caution

- CAPM
  - Based on expected conditions
  - Only have historical data
  - As conditions change, future volatility may differ from past volatility
  - Estimates are subject to error

Summary

- What does it mean to take risk when investing?
  - The chance of receiving a return other than the one expected
- How are the risk and return of an investment related?
  - Riskier investments must offer higher expected returns than less risky investments; otherwise, people will not purchase investments with higher risks.

Summary

- Systematic and unsystematic risk
  - Systematic risks include those types that are related to economic factors, such as interest rate risk, inflation risk, and so forth
    - Cannot be diversified away
  - Unsystematic risks include those types that are related to a specific firm or industry, such as business risk, default risk, and so forth
    - Can be diversified away

Summary

- How is appropriate reward (risk premium) determined?
  - The effects of nondiversifiable risk can be determined by computing the beta coefficient (β) of an investment.
  - An investment's required rate of return can be computed as: $r_i = r_{RF} + (r_M - r_{RF})\beta_i = r_{RF} + (RP_M)\beta_i$