Chapter 13

Risk, Cost of Capital, and Capital Budgeting
风险、资本成本和资本预算

Key Concepts and Skills

- Know how to determine a firm's cost of equity capital
- Understand the impact of beta in determining the firm's cost of equity capital
- Know how to determine the firm's overall cost of capital
- Understand the impact of flotation costs on capital budgeting

Where Do We Stand?

- Earlier chapters on capital budgeting focused on the appropriate size and timing of cash flows.
- This chapter discusses the appropriate discount rate when cash flows are risky.

Assets	Debt Preferred Stock Common Stock

The Cost of Equity Capital – CAPM
运用资本资产定价模型估计权益资本成本

- From the firm's perspective, the expected return is the Cost of Equity Capital:

$$\overline{R}_i = R_F + \beta_i (\overline{R}_M - R_F)$$

- To estimate a firm's cost of equity capital, we need to know three things:

1. The risk-free rate, R_F
2. The market risk premium, $\overline{R}_M - R_F$
3. The company beta, $\beta_i = \dfrac{Cov(R_i, R_M)}{Var(R_M)} = \dfrac{\sigma_{i,M}}{\sigma_M^2}$

Example

- Suppose the stock of Stansfield Enterprises, a publisher of PowerPoint presentations, has a beta of 2.5. The firm is 100% equity financed.
- Assume a risk-free rate of 5% and a market risk premium of 10%.
- What is the appropriate discount rate for an expansion of this firm?

$$\overline{R} = R_F + \beta_i (\overline{R}_M - R_F)$$

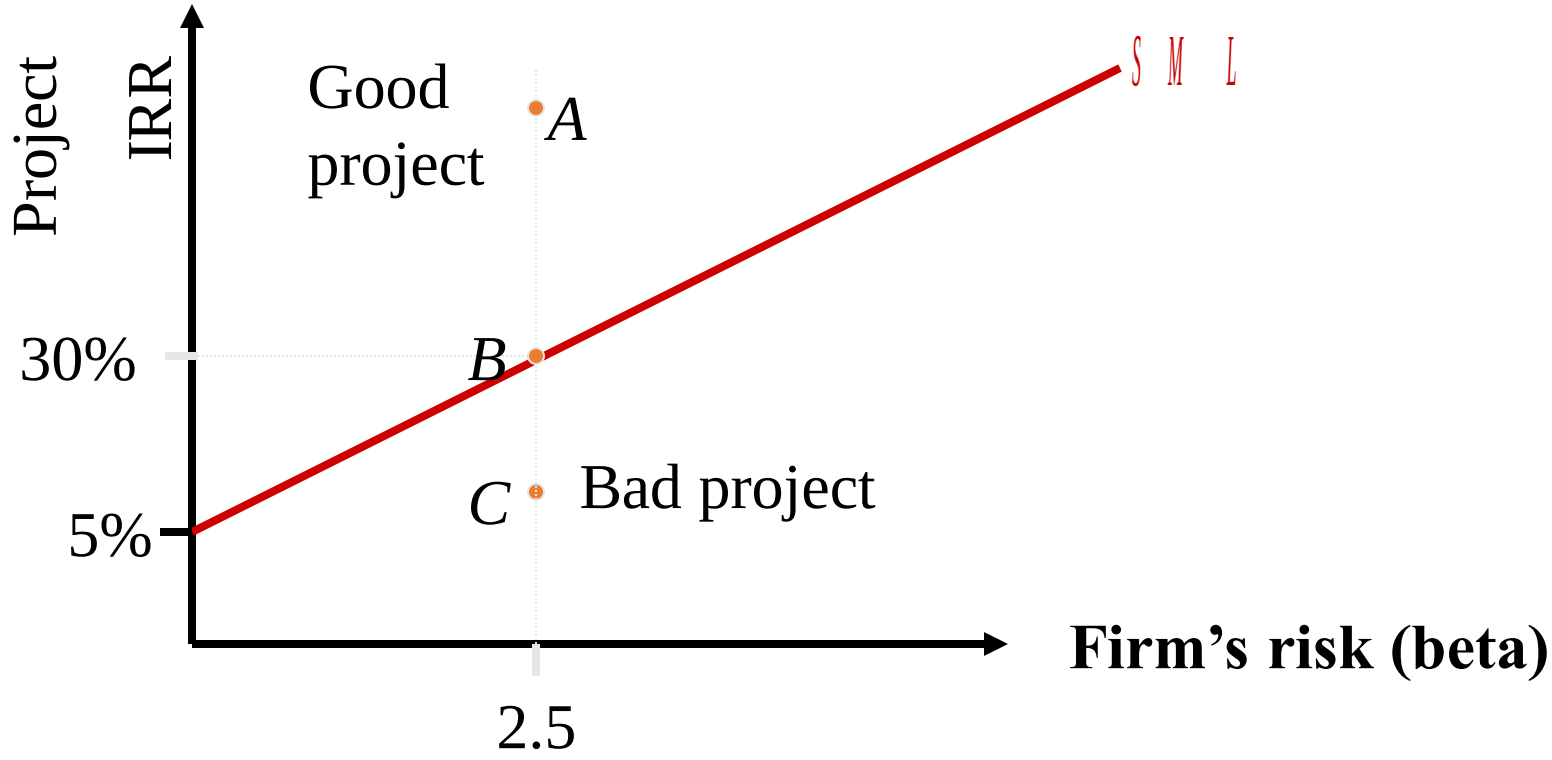
$$\overline{R} = 5\% + 2.5 \times 10\% \qquad \overline{R} = 30\%$$

Example

Suppose Stansfield Enterprises is evaluating the following independent projects. Each costs $100 and lasts one year.

Project	Project β	Project's Estimated Cash Flows Next Year	IRR	NPV at 30%
A	2.5	$150	50%	$15.38
B	2.5	$130	30%	$0
C	2.5	$110	10%	-$15.38

Using the SML



An all-equity firm should accept projects whose IRRs exceed the cost of equity capital and reject projects whose IRRs fall short of the cost of capital.

The Risk-free Rate 无风险收益率

- Treasury securities are close proxies for the risk-free rate.
- The CAPM is a period model. However, projects are long-lived. So, average period (short-term) rates need to be used.
- The historic premium of long-term (20-year) rates over short-term rates for government securities is 2%.
- So, the risk-free rate to be used in the CAPM could be estimated as 2% below the prevailing rate on 20-year treasury securities.

The Market Risk Premium 市场风险溢价

- Method 1: Use historical data
- Method 2: Use the Dividend Discount Model

  - Market data and analyst forecasts can be used to implement the DDM approach on a market-wide basis （if the firm's dividends are expected to grow at a constant rate, g）

$$R = \frac{D_1}{P} + g$$

  - the annual expected return on a stock is the sum of the dividend yield (Div/ P) over the next year plus the annual expected growth rate in dividends
  - Just as this formula can be used to estimate the total expected return on a stock, it can be used to estimate the total expected return on the market as a whole. The first term on the right-hand side is easy to estimate, since a number of print and Internet services calculate the dividend yield for the market. For example, The Wall Street Journal recently stated that the average dividend yield across all stocks in the Standard and Poor's (S&P) 500 Index was about 2.1 percent

Estimation of Beta

Market Portfolio - Portfolio of all assets in the economy. In practice, a broad stock market index, such as the S&P 500, is used to *represent* the market.

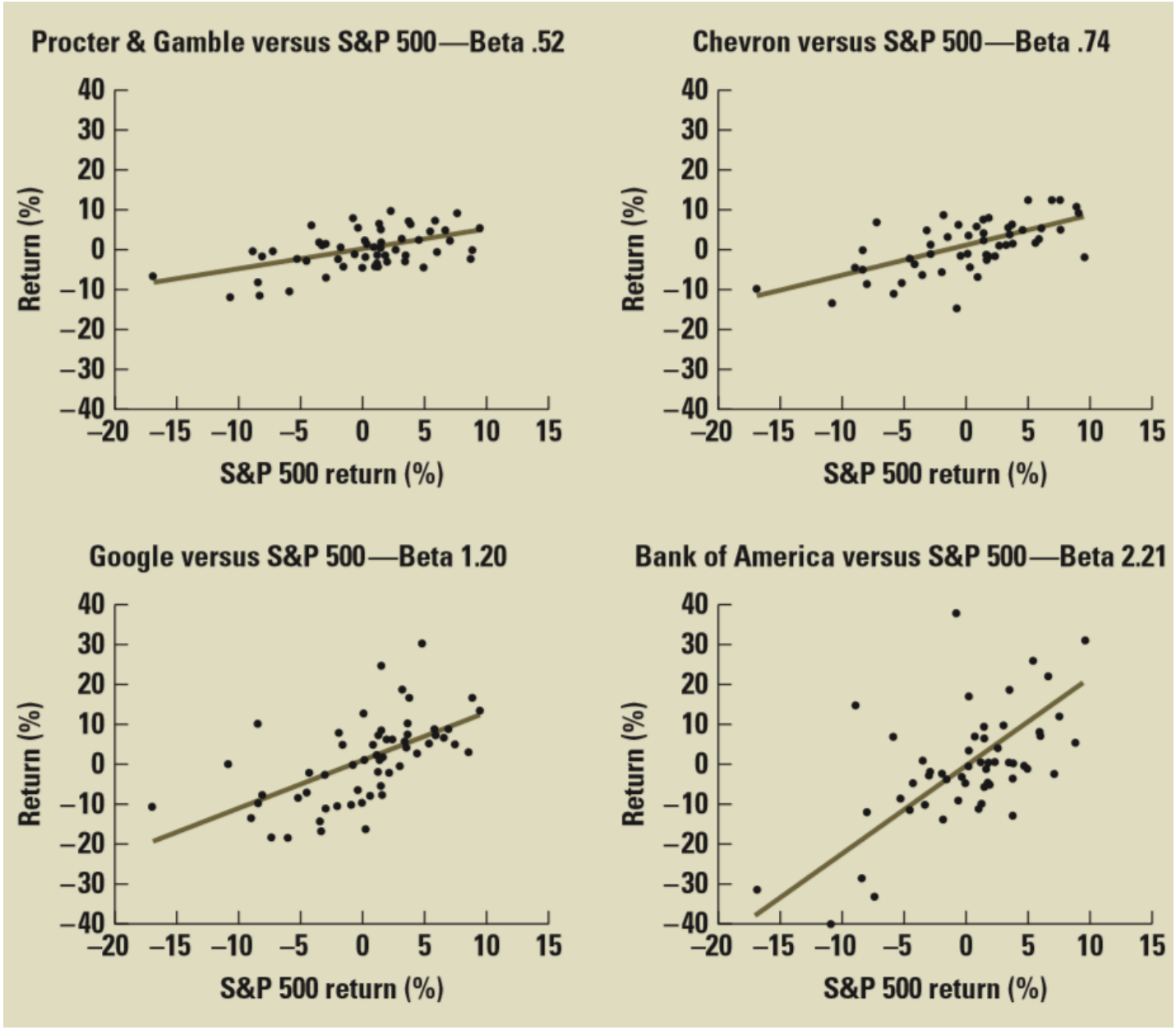
Beta - Sensitivity of a stock's return to the return on the market portfolio.

- the accuracy of the beta coefficient is suspect when too few observations are used
- because firms may change their industry over time, observations from the distant past are out of date
- we use five years of monthly data to measure beta

Estimation of Beta

$$\beta = \frac{Cov(R_i, R_M)}{Var(R_M)}$$

Estimation of Beta



Using an Industry Beta 行业beta系数的运用

- Imagine a financial executive at Automatic Data Processing trying to estimate the firm's beta. Because beta estimation is subject to large, random variation in this volatile industry, the executive may be uncomfortable with the estimate of .70.
- However, the error in beta estimation on a single stock is much higher than the error for a portfolio of securities. Thus, the executive of Automatic Data Processing may prefer the average industry beta of .97 as the estimate of his or her own firm's beta

Company	Beta
Microsoft	1.00
Apple, Inc.	1.22
Automatic Data Processing	.70
Oracle Corp.	1.09
Computer Sciences	1.15
CA, Inc.	.97
Fiserv, Inc.	1.07
Accenture, Ltd.	.79
Symantec Corp.	.91
Paychex, Inc.	.84
Equally weighted portfolio	.97

SOURCE: www.reuters.com

Assuming a risk-free rate of 1.0 percent and a risk premium of 7 percent, Automatic Data Processing might estimate its cost of equity capital as:

$$1.0\% + .7 \times 7\% = 5.9\%$$

However, if Automatic Data Processing believed the industry beta contained less estimation error, it could estimate its cost of equity capital as:

$$1.0\% + .97 \times 7\% = 7.79\%$$

Using an Industry Beta

- While there is no formula for selecting the right beta, there is a very simple guideline.
- It is frequently argued that one can better estimate a firm's beta by involving the whole industry.
- If you believe that the operations of the firm are similar to the operations of the rest of the industry, you should use the industry beta.
- If you believe that the operations of the firm are fundamentally different from the operations of the rest of the industry, you should use the firm's beta.
- Do not forget about adjustments for financial leverage.

Beta, Covariance and Correlation

$$\beta_i = \frac{Cov(R_i, R_M)}{\sigma^2(R_M)} = \rho \frac{\sigma(R_i)}{\sigma(R_M)}$$

- Beta is qualitatively similar to the covariance since the denominator (market variance) is a constant.
- Beta and correlation are related, but different. It is possible that a stock could be highly correlated to the market, but it could have a low beta if its deviation were relatively small.

Determinants of Beta

- Business Risk
  - Cyclicality of Revenues 收入的周期性
    - The revenues of some firms are quite cyclical. That is, these firms do well in the expansion phase of the business cycle and do poorly in the contraction phase
    - Because beta measures the responsiveness of a stock's return to the market's return, it is not surprising that highly cyclical stocks have high betas.
  - Operating Leverage 经营杠杆
- Financial Risk
  - Financial Leverage 财务杠杆

Cyclicality of Revenues

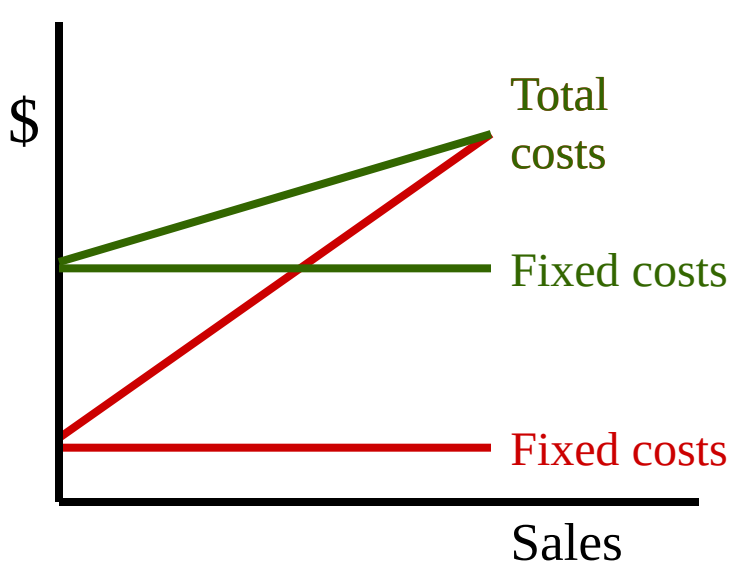
- Highly cyclical stocks have higher betas.
  - Empirical evidence suggests that retailers and automotive firms fluctuate with the business cycle.
  - Transportation firms and utilities are less dependent on the business cycle.
- Note that cyclicality is not the same as variability—stocks with high standard deviations need not have high betas.
  - Movie studios have revenues that are variable, depending upon whether they produce “hits” or “flops,” but their revenues may not be especially dependent upon the business cycle.

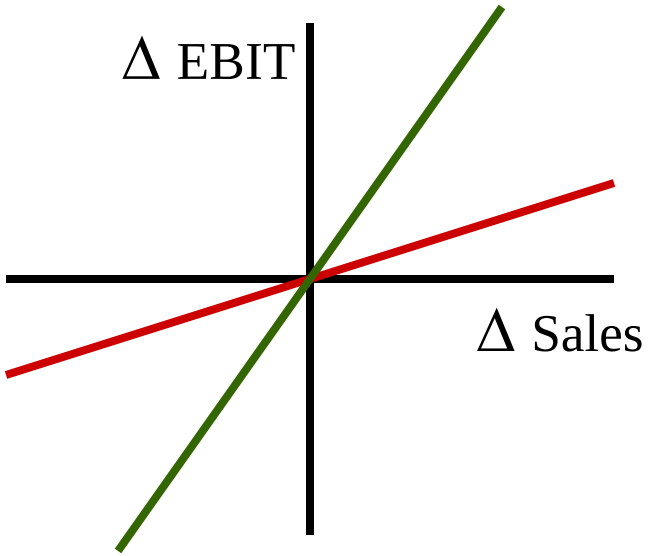
Operating Leverage

- The degree of operating leverage measures how sensitive a firm (or project) is to its fixed costs.
- Operating leverage increases as fixed costs rise and variable costs fall.
- Operating leverage magnifies the effect of cyclicality on beta.
- The degree of operating leverage is given by:

$$DOL = \frac{\Delta \text{ EBIT}}{EBIT} \times \frac{\text{Sales}}{\Delta \text{ Sales}}$$

Operating Leverage





- Operating leverage increases as fixed costs rise and variable costs fall
- Firms with high fixed costs and low variable costs are generally said to have high operating leverage. Conversely, firms with low fixed and high variable costs have low operating leverage. Operating leverage magnifies the effect of the cyclicality of a firm's revenues on beta. That is, a firm with a given sales cyclicality will increase its beta if fixed costs replace variable costs in its production process

Financial Leverage and Beta

- Operating leverage refers to the sensitivity to the firm's fixed costs of *production*.
- Financial leverage is the sensitivity to a firm's fixed costs of *financing*.
- The relationship between the betas of the firm's debt, equity, and assets is given by:

$$\beta_{Asset} = \frac{\text{Debt}}{\text{Debt + Equity}} \times \beta_{Debt} + \frac{\text{Equity}}{\text{Debt + Equity}} \times \beta_{Equity}$$

- Financial leverage always increases the equity beta relative to the asset beta.

Example

Consider Grand Sport, Inc., which is currently all-equity financed and has a beta of 0.90.

The firm has decided to lever up to a capital structure of 1 part debt to 1 part equity.

Since the firm will remain in the same industry, its asset beta should remain 0.90.

However, assuming a zero beta for its debt, its equity beta would become twice as large:

$$\beta_{Asset} = 0.90 = \frac{1}{1+1} \times \beta_{Equity}$$

$$\beta_{Equity} = 2 \times 0.90 = 1.80$$

Advantages and Disadvantages of SML

- Advantages
  - Explicitly adjusts for systematic risk
  - Applicable to all companies, as long as beta is available
- Disadvantages
  - Must estimate the *expected* market risk premium, which does vary over time
  - Must estimate beta, which also varies over time
  - Relies on the past to predict the future, which is not always reliable

Dividend Discount Model 股利折现模型

$$R = \frac{D_1}{P} + g$$

- The DDM is an alternative to the CAPM for calculating a firm's cost of equity.
- The DDM and CAPM are internally consistent, but academics generally favor the CAPM and companies seem to use the CAPM more consistently.
  - This may be due to the measurement error associated with estimating company growth.

Advantages and Disadvantages of Dividend Growth Model

Advantage:

- Easy to understand and use

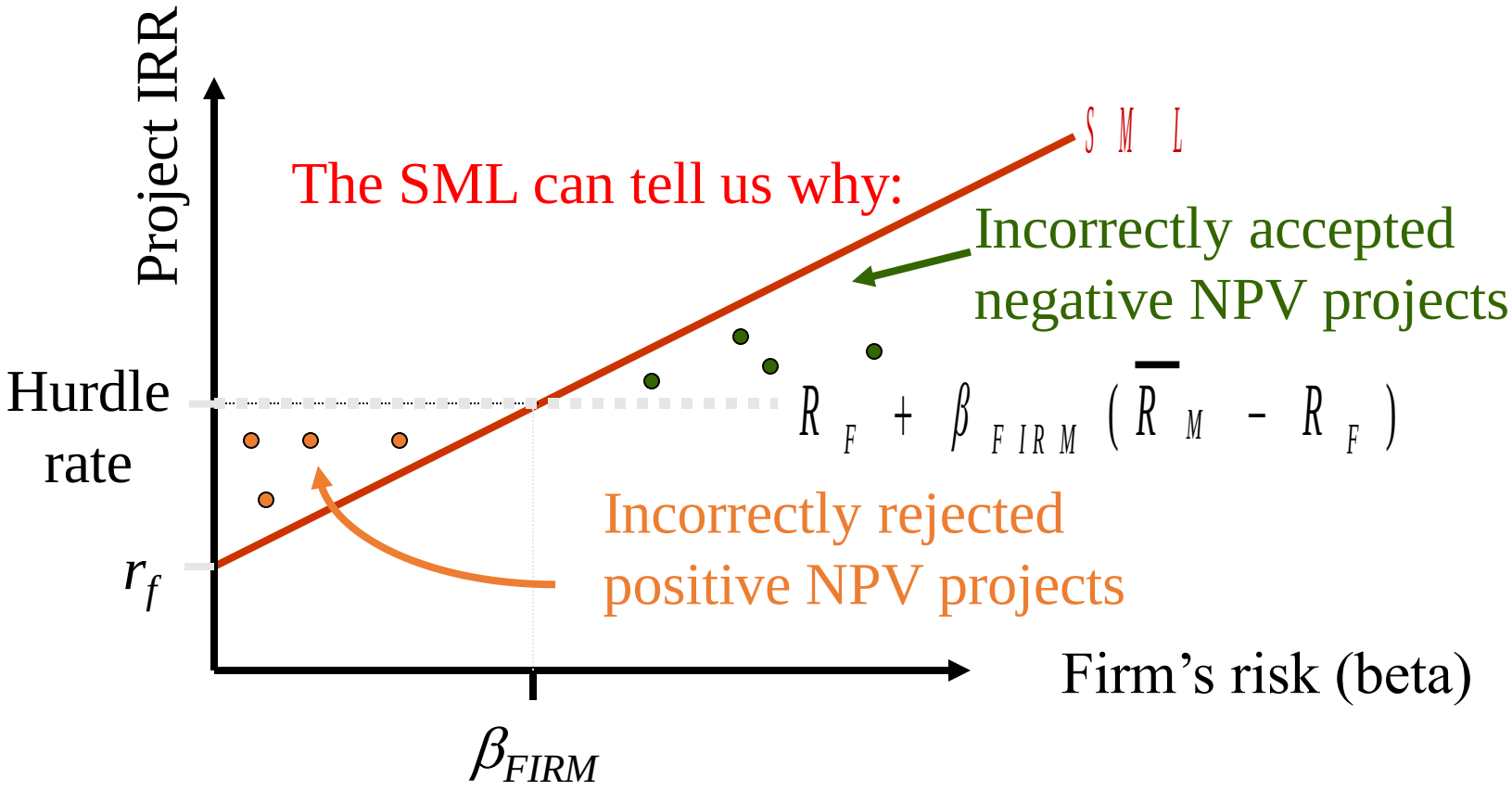
Disadvantages:

- Only applicable to companies currently paying dividends
- Not applicable if dividends aren't growing at a reasonably constant rate
- Extremely sensitive to the estimated growth rate – an increase in g of 1% increases the cost of equity by 1%
- Does not explicitly consider risk

Cost of Capital for Divisions and Projects

- How should we estimate the discount rate for a project whose risk differs from that of the firm? The answer is that each project should be discounted at a rate commensurate with its own risk. For example, let's assume that we use the CAPM to determine the discount rate
- Unless all projects in the corporation are of the same risk, choosing the same discount rate for all projects is incorrect.

Capital Budgeting & Project Risk
部门和项目的资本成本



Capital Budgeting & Project Risk

Suppose the Conglomerate Company has a cost of capital, based on the CAPM, of 17%. The risk-free rate is 4%, the market risk premium is 10%, and the firm's beta is 1.3.

$$17\% = 4\% + 1.3 \times 10\%$$

This is a breakdown of the company's investment projects:

1/3 Automotive Retailer b = 2.0

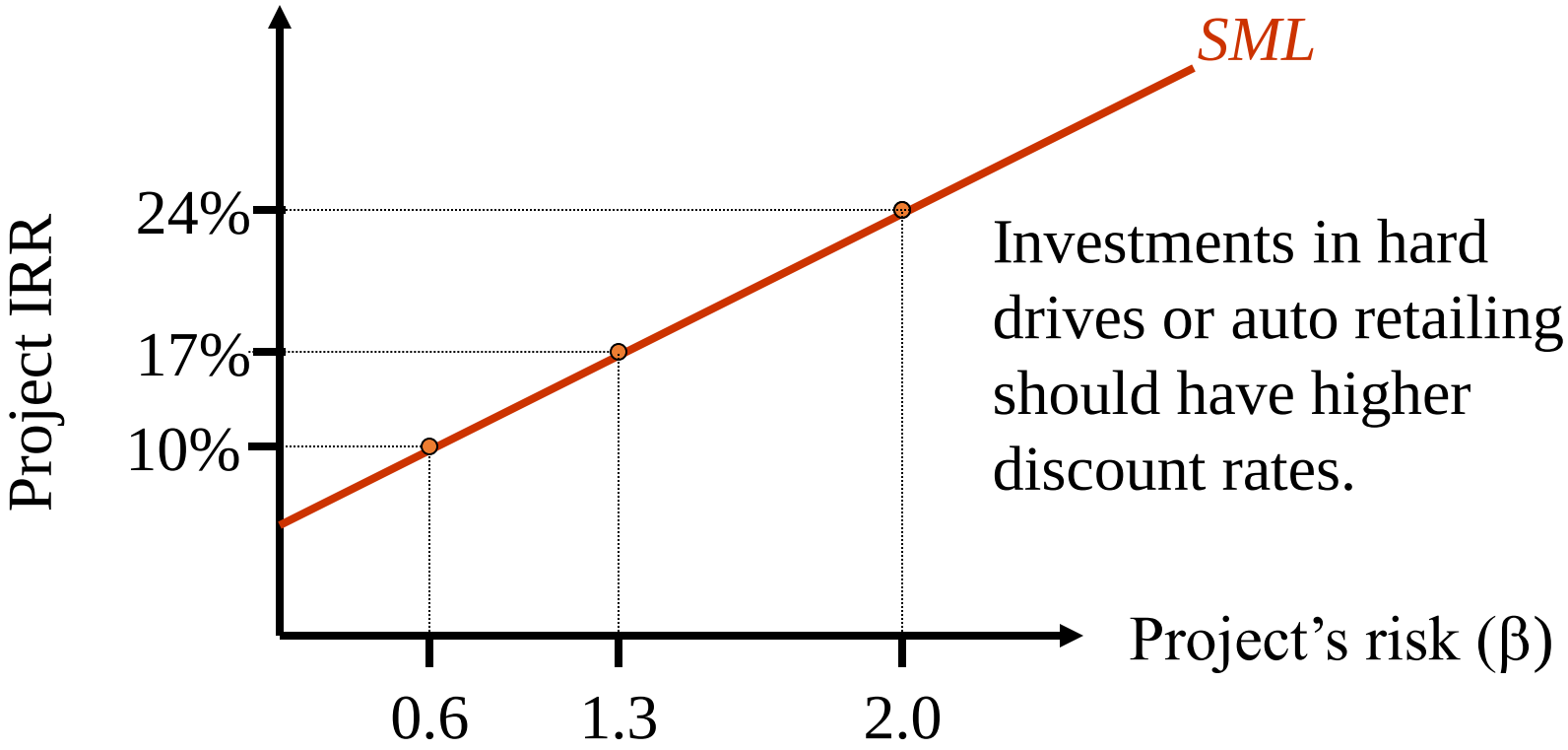
1/3 Computer Hard Drive Manufacturer b = 1.3

1/3 Electric Utility b = 0.6

average b of assets = 1.3

When evaluating a new electrical generation investment, which cost of capital should be used?

Capital Budgeting & Project Risk



$$R = 4\% + 0.6 \times (14\% - 4\%) = 10\%$$

10% reflects the opportunity cost of capital on an investment in electrical generation, given the unique risk of the project.

Cost of Debt 债务资本成本

- Method 1 = Compute the yield to maturity on existing debt
- Method 2 = Use estimates of current rates based on the bond rating expected on new debt
- The cost of debt is NOT the coupon rate
- Adjust for the tax deductibility of interest expense
  - Why have we tax-adjusted the cost of debt while we did not tax-adjust the cost of equity? Because, while firms can deduct their interest payments before paying taxes, dividends are not tax deductible

Cost of Preferred Stock 优先股资本成本

- Preferred stock is a perpetuity, so its price is equal to the coupon paid divided by the current required return.
- Rearranging, the cost of preferred stock is:
  - $R_P = C / PV$

The Weighted Average Cost of Capital 加权资本成本

$$WACC = (E/V) * R_E + (P/V) * R_P + (D/V) \times R_D \times (1 - T_C)$$

Where:

Weights

- **(E/V) = % of common equity in capital structure**
- **(P/V) = % of preferred equity in capital structure**
- **(D/V) = % of debt in capital structure**

Component costs

- **R_E = firm's cost of common equity**
- **R_F = firm's cost of preferred equity**
- **R_D = firm's cost of debt**

T_C = firm's corporate tax rate

Example: International Paper

- First, we estimate the cost of equity and the cost of debt.
  - We estimate an equity beta to estimate the cost of equity.
  - We can often estimate the cost of debt by observing the YTM of the firm's debt.
- Second, we determine the WACC by weighting these two costs appropriately.

Example: International Paper

- The industry average beta is 0.82, the risk free rate is 3%, and the market risk premium is 8.4%.
- Thus, the cost of equity capital is:

$$R_S = R_F + \beta_i \times (\overline{R}_M - R_F)$$

$$= 3\% + .82 \times 8.4\%$$

$$= 9.89\%$$

Example: International Paper

- The yield on the company's debt is 8%, and the firm has a 37% marginal tax rate.
- The debt ratio is 32%

$$R_{WACC} = \frac{S}{S+B} \times R_S + \frac{B}{S+B} \times R_B \times (1 - T_C)$$

$$= 0.68 \times 9.89\% + 0.32 \times 8\% \times (1 - 0.37)$$

$$= 8.34\%$$

8.34% is International's cost of capital. It should be used to discount any project where one believes that the project's risk is equal to the risk of the firm as a whole and the project has the same leverage as the firm as a whole.

Practice Problems

The General Store has a cost of equity of 15.8 percent, a pre-tax cost of debt of 7.7 percent, and a tax rate of 32 percent. What is the firm's weighted average cost of capital if the debt-equity ratio is 0.40?

Practice Problems

The General Store has a cost of equity of 15.8 percent, a pre-tax cost of debt of 7.7 percent, and a tax rate of 32 percent. What is the firm's weighted average cost of capital if the debt-equity ratio is 0.40?

$$R_{WACC} = \frac{S}{S+B} \times R_S + \frac{B}{S+B} \times R_B \times (1 - T_C)$$

$$R_{WACC} = \frac{1}{1+0.4} \times .158 + \frac{0.4}{1+0.4} \times .077 \times (1 - .32)$$

Risk-Adjusted WACC

- A firm's WACC reflects the risk of an **<u>average</u>** project undertaken by the firm
  - "Average" ➡ risk = the firm's current operations
- Different divisions/projects may have different risks
  - The division's or project's WACC should be adjusted to reflect the appropriate risk and capital structure

Using WACC for All Projects

- What would happen if we use the WACC for all projects regardless of risk?
- Assume the WACC = 15%

		Decision
Project	IRR	WACC=15%
D	17%	Accept
E	18%	Accept
F	12%	Reject

Using WACC for All Projects

- Assume the WACC = 15%
- Adjusting for risk changes the decisions

	Required		Decision	
Project	Return	IRR	WACC=15%	Risk Adj
D	20%	17%	Accept	Reject
E	15%	18%	Accept	Accept
F	10%	12%	Reject	Accept

Pure Play Approach

- Find one or more companies that specialize in the product or service being considered
- Compute the beta for each company
- Take an average
- Use that beta along with the CAPM to find the appropriate return for a project of that risk
- Pure play companies difficult to find

Subjective Approach

- Consider the project's risk relative to the firm overall
  - If the project is riskier than the firm, use a discount rate greater than the WACC
  - If the project is less risky than the firm, use a discount rate less than the WACC

Subjective Approach - Example

Risk Level	Discount Rate	
Very Low Risk	WACC – 8%	7%
Low Risk	WACC – 3%	12%
Same Risk as Firm	WACC	15%
High Risk	WACC + 5%	20%
Very High Risk	WACC + 10%	25%

Flotation Costs

- Flotation costs represent the expenses incurred upon the issue, or float, of new bonds or stocks.
- These are incremental cash flows of the project, which typically reduce the NPV since they increase the initial project cost (i.e., CF_0).

  Amount Raised = Necessary Proceeds / (1-% flotation cost)

- The % flotation cost is a weighted average based on the average cost of issuance for each funding source and the firm's target capital structure:

$$f_A = (E/V)* f_E + (D/V)* f_D$$

Flotation Costs - The Basic Approach

- The Spatt Company, an all-equity firm, has a cost of equity of 20 percent. Because this firm is 100 percent equity, its WACC and its cost of equity are the same. Spatt is contemplating a large-scale $100 million expansion of its existing operations. The expansion would be funded by selling new stock.
- Based on conversations with its investment banker, Spatt believes its flotation costs will run 10 percent of the amount issued. This means that Spatt's proceeds from the equity sale will be only 90 percent of the amount sold. When flotation costs are considered, what is the cost of the expansion?

$$\$100 \text{ million} = (1 - .10) \times \text{Amount raised}$$
$$\text{Amount raised} = \$100 \text{ million}/.90 = \$111.11 \text{ million}$$

Calculating the Weighted Average Flotation Cost

Calculating the Weighted Average Flotation Cost The Weinstein Corporation has a target capital structure of 80 percent equity and 20 percent debt. The flotation costs for equity issues are 20 percent of the amount raised; the flotation costs for debt issues are 6 percent. If Weinstein needs $65 million for a new manufacturing facility, what is the true cost including flotation costs?

We first calculate the weighted average flotation cost, f_o:

$$\begin{aligned} f_o &= S/V \times f_S + B/V \times f_B \\ &= 80\% \times .20 + 20\% \times .06 \\ &= 17.2\% \end{aligned}$$

The weighted average flotation cost is 17.2 percent. The project cost is $65 million without flotation costs. If we include them, then the true cost is $65 million/$(1 - f_o)$ = $65 million/.828 = $78.5 million, again illustrating that flotation costs can be a considerable expense.

Flotation Costs

Flotation Costs and NPV Photochronograph Corporation (PC) manufactures time series photographic equipment. It is currently at its target debt–equity ratio of .55. It's considering building a new $50 million manufacturing facility. This new plant is expected to generate aftertax cash flows of $6.7 million a year in perpetuity. The company raises all equity from outside financing. There are three financing options:

1. *A new issue of common stock:* The flotation costs of the new common stock would be 8 percent of the amount raised. The required return on the company's new equity is 14 percent.
2. *A new issue of 20-year bonds:* The flotation costs of the new bonds would be 4 percent of the proceeds. If the company issues these new bonds at an annual coupon rate of 8 percent, they will sell at par.
3. *Increased use of accounts payable financing:* Because this financing is part of the company's ongoing daily business, it has no flotation costs, and the company assigns it a cost that is the same as the overall firm WACC. Management has a target ratio of accounts payable to long-term debt of .20. (Assume there is no difference between the pretax and aftertax accounts payable cost.)

What is the NPV of the new plant? Assume that PC has a 35 percent tax rate.

Flotation Costs

- $R_{WACC} = (1/1.55)(.14) + (0.55/1.55)[(.20/1.2)\ R_{WACC} + (1/1.2)(.08)(1 – .35)]$
- $R_{WACC} = .1123$
- Flotation costs = (1/1.55)(.08) + (0.55/1.55)[(.20/1.2)(0) + (1/1.2)(.04)] = .0634
- Amount raised cost = $50,000,000/(1 – .0634)
- NPV = –$53,386,912 + ($6,700,000/.1123) = $6,251,949

Quick Quiz

- How do we determine the cost of equity capital?
- How can we estimate a firm or project beta?
- How does leverage affect beta?
- How do we determine the weighted average cost of capital?
- How do flotation costs affect the capital budgeting process?