Lecture 8

Cost of Capital

Dr. Tao Yuan
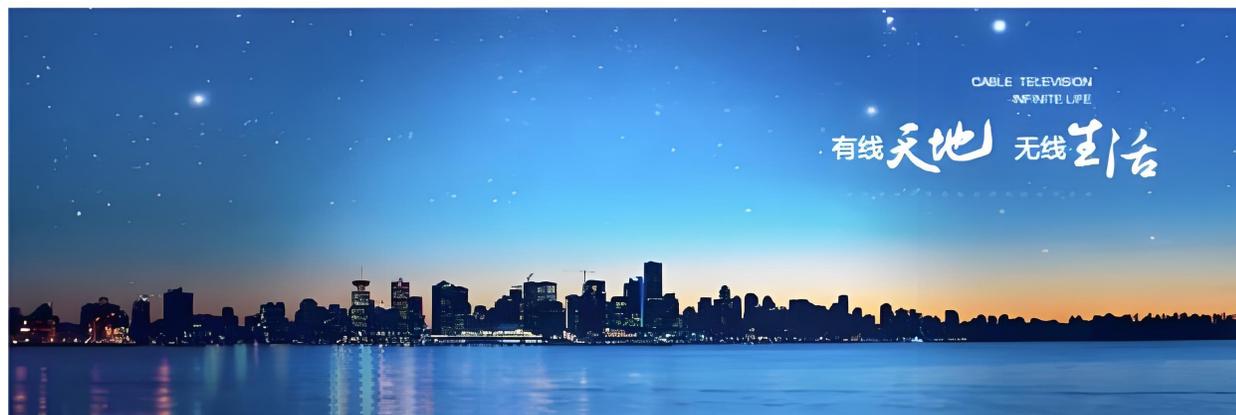
Nanjing University Business School

14 Oct 2025

Bond Financing

热 烈 庆 祝

江苏省广电有线信息网络股份有限公司

2024年公开发行科技创新公司债券（第一期）成功发行！

创2024年江苏省AAA主体3年期债券最低利率！

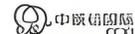| 债券简称	发行规模	发行期限	主体	景面利率
24苏广K1	5亿元	3年	AAA	2.77%

发行人： JSCN 江苏有线　独家主承销商/簿记管理人/受托管理人： 华泰联合证券 HUATAI UNITED SECURITIES

评级机构： 中诚信国际 CCXI　会计师事务所： 真立会诚　律师事务所： ALLBRIGHT 锦天城
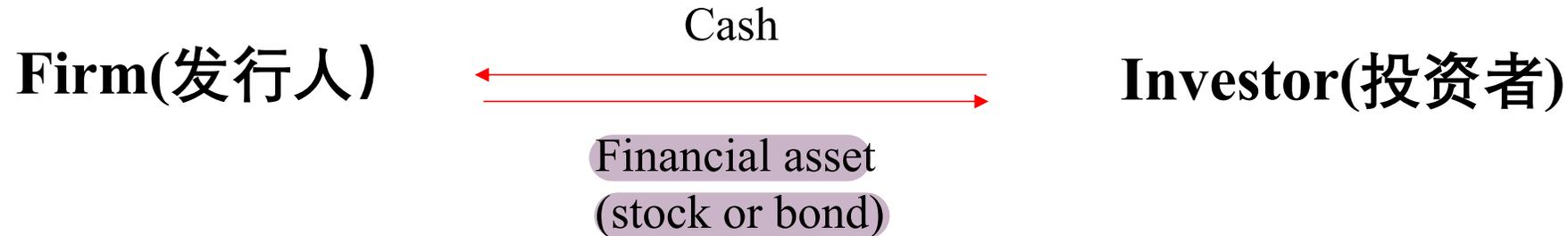
- What is the cost to the firm?

Equity Financing

- **烽火通信：拟向特定对象发行股票募资金额不超过15亿元(Primary)**

  烽火通信科技股份有限公司（600498）于2024年10月12日披露向特定对象发行股票预案。该公司计划向特定投资者募集资金不超过15亿元人民币，扣除发行费用后，这些资金将全部用于增强公司的流动资金，以支持日常运营和发展。
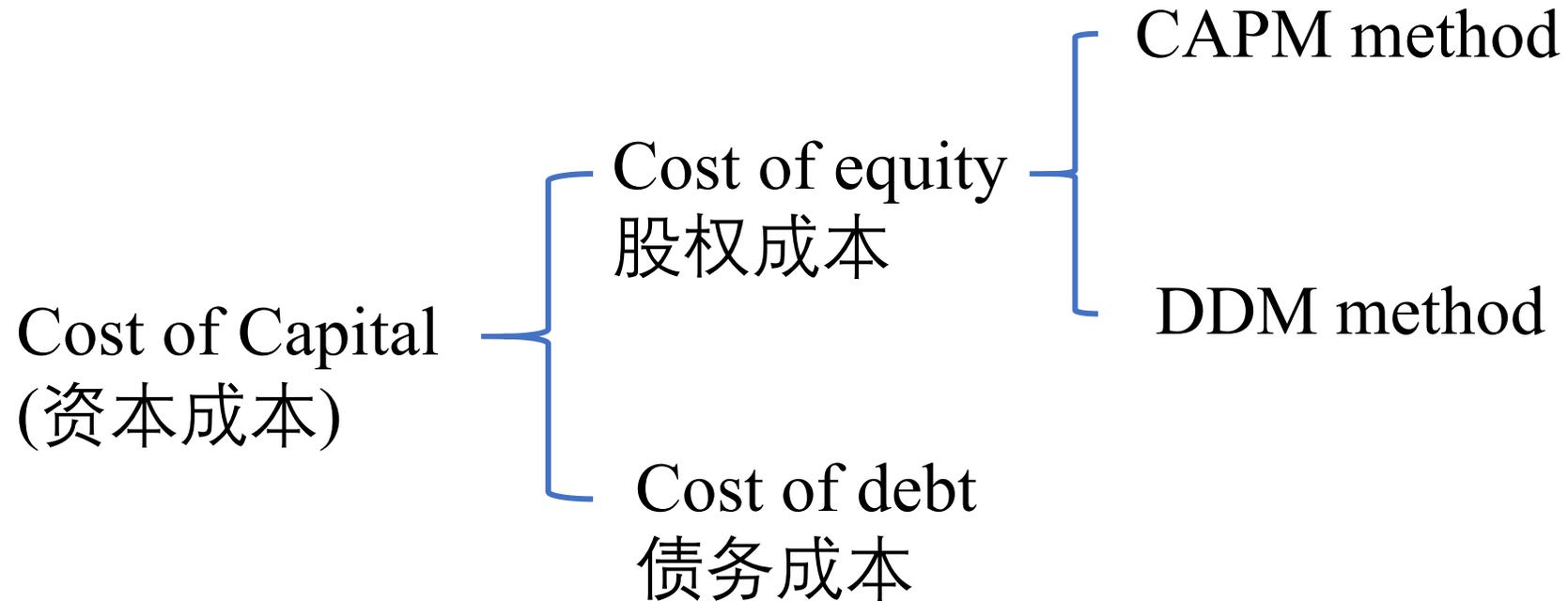
- What is the cost to the firm?

Cost of Capital

Cash

Firm(发行人） ← **Investor(投资者)**

Financial asset
(stock or bond)

- Cost of capital to a firm = expected return of investors=required return
- Required return: the minimum return that must be received for an investment to be considered.
- Expected return: the return that the investor thinks they can generate if the investment is made.
- If an investment is valued correctly, required return =expected return and NPV=0.

Cost of Capital

- Remember Asset=Liability+Equity, we have:

Cost of Capital
(资本成本)

Cost of equity
股权成本

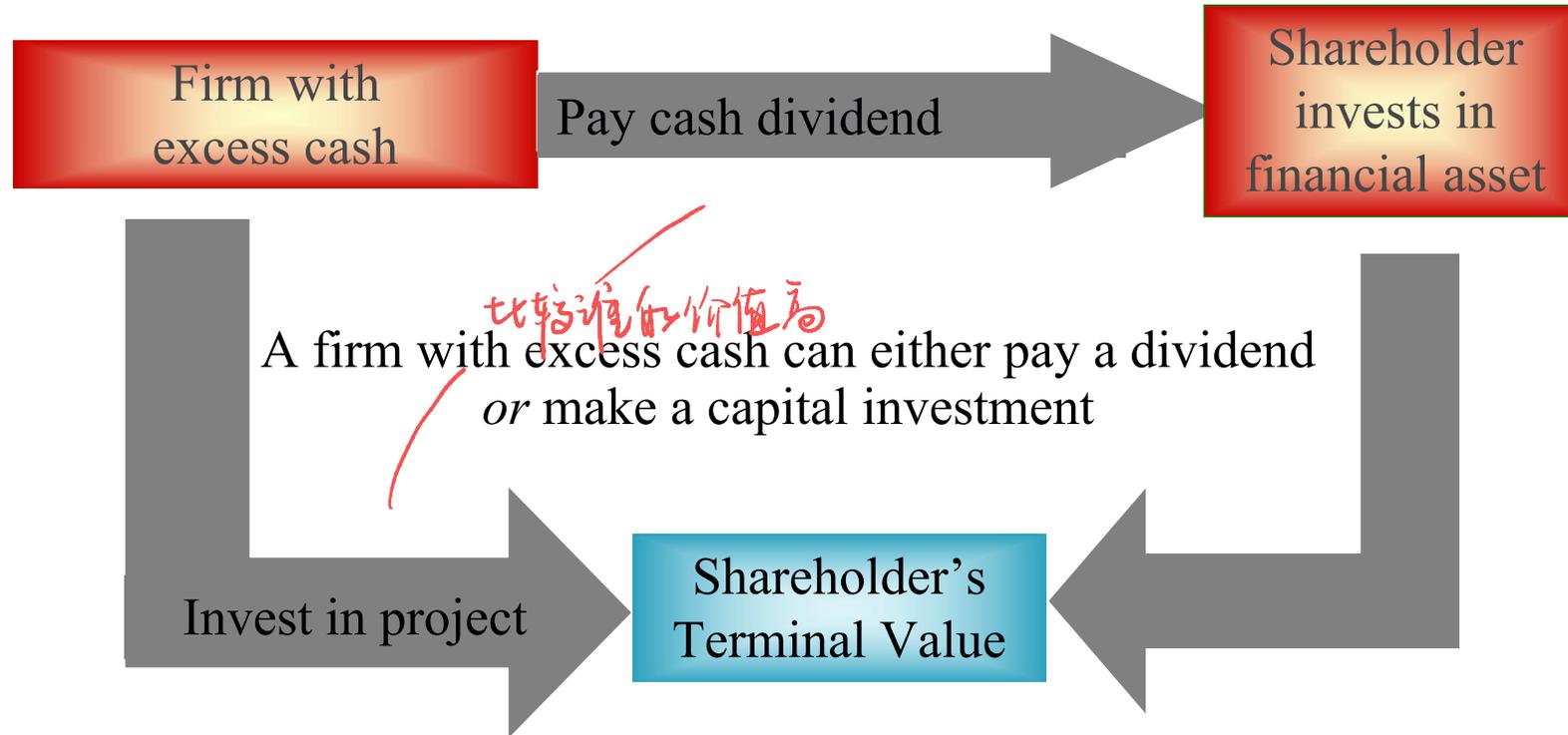Cost of debt
债务成本

CAPM method

DDM method

Cost of Equity

- The Firm issues shares to new shareholders to raise money, but the ownership of old shareholder is diluted. 稀释

- The cost to firm by issuing equity is the cost to old shareholder due to dilution, and also equals to the payoff to new shareholders:
  - Dividend payout to new shareholders 分红
  - Capital gain to new shareholders 资本利得

Quick Question: If equity issuing is costly, why a firm would do that, or why old shareholder should agree?

Cost of equity capital and discount rate

| Firm with excess cash | → Pay cash dividend → | Shareholder invests in financial asset |

A firm with excess cash can either pay a dividend *or* make a capital investment

比较谁的价值高

Invest in project →

Shareholder's Terminal Value

Stockholders can choose to reinvest the dividend in risky *financial* assets or invest in a project. The expected return on a capital-budgeting project should be at least as great as the expected return on a financial asset of comparable risk. Otherwise, the project should not be taken.

Capital Asset Pricing Model 资产定价模型

The Capital Asset Pricing Model (CAPM):

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

非预期值.

Expected return on a security	=	Risk-free rate	+	Beta of the security	×	Market risk premium

☐ $\overline{R}_i$: expected return on a security

☐ $\overline{R}_M$: expected return on the **market portfolio（市场投资组合）**. We can use the return on market index (S&P 500, 沪深300, 恒生指数) to proxy for it.

☐ R_F: Risk-free rate. We can use the yield on treasury bond to proxy for it.

☐ β_i: Beta measures the responsiveness of a security to movements in the market portfolio (i.e., systematic risk).

Beta

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

Expected return

R_M

R_F

1.0

β
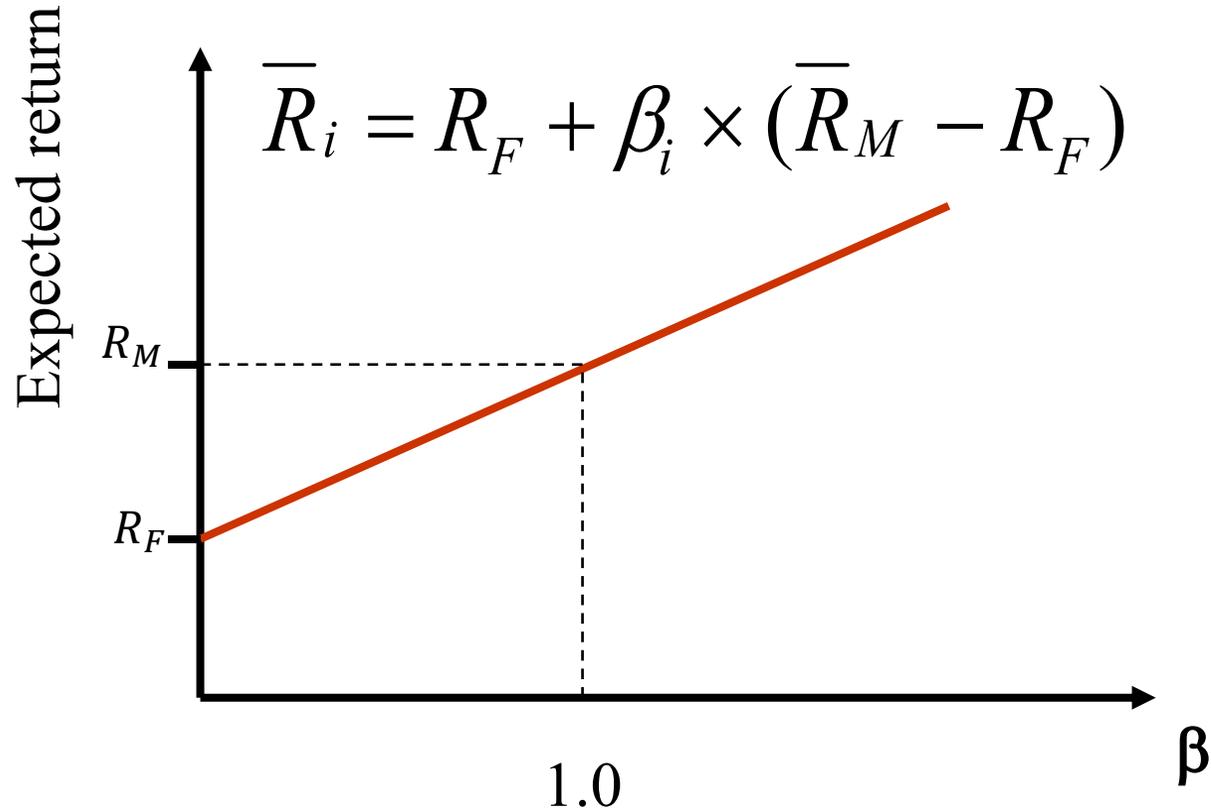
Security Market Line (SML)

☐ The model is to predict the future return of a stock. The input variables should be predicted.

☐ If $\beta_i = 0$, then the expected return is R_F. If $\beta_i = 1$, then $\overline{R}_i = \overline{R}_M$. Some stocks can have negative Beta.

☐ β_i is typically positive. The movement of most individual stock is in the same direction with the whole market.

☐ Higher beta, higher systematic risk.

Market Portfolio

- Ideally, market portfolio is the portfolio of all stocks outstanding in the market. However, in practice, it is too costly to hold all the stocks. We choose some representative ones.

- Shanghai Stock Exchange Composite Index (上证指数): all stocks traded in SHEX.
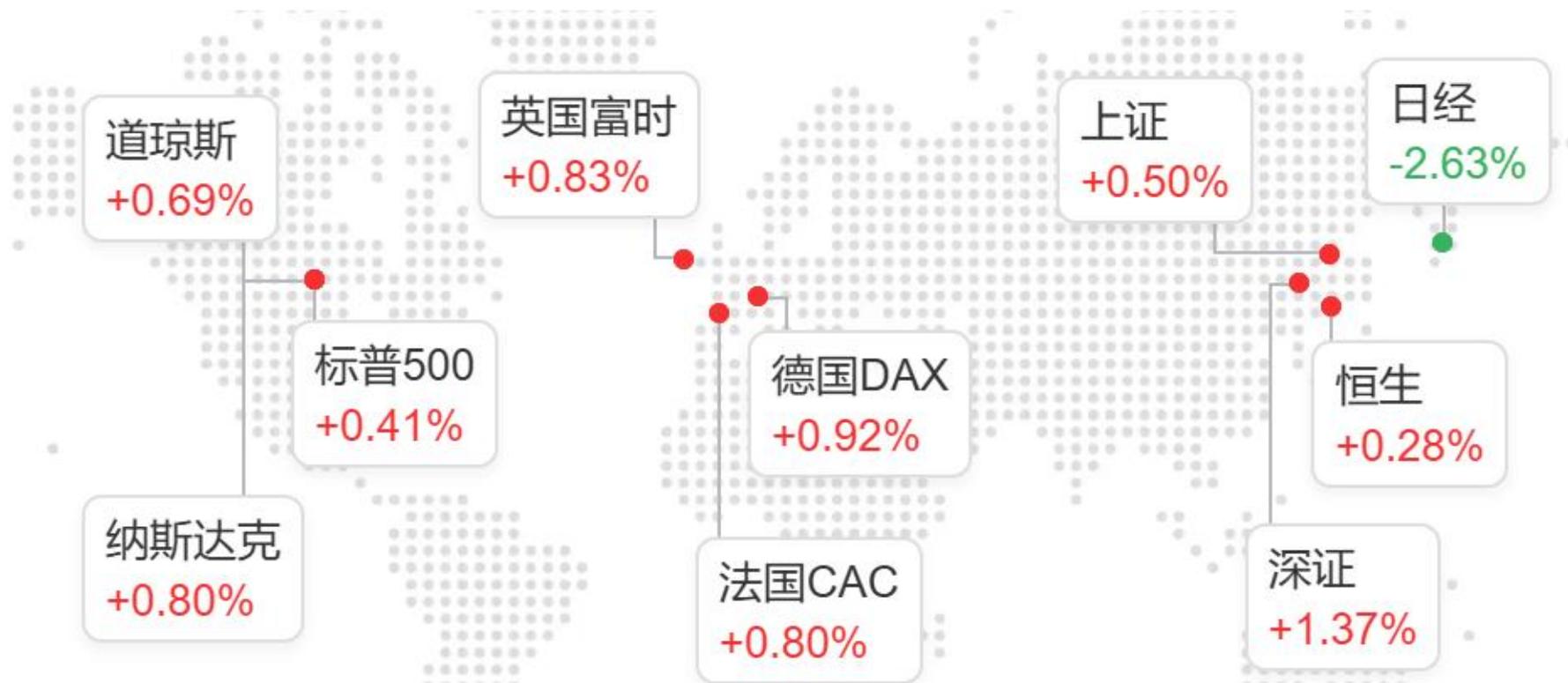
Global Market Index

- S&P 500: the 500 largest companies listed in the U.S. stock exchanges.

道琼斯
+0.69%

英国富时
+0.83%

上证
+0.50%

日经
-2.63%

标普500
+0.41%

德国DAX
+0.92%

恒生
+0.28%

纳斯达克
+0.80%

法国CAC
+0.80%

深证
+1.37%

Cost of capital: CAPM Method

● From the firm's perspective, the expected return is the cost of equity capital. We are predicting future returns:

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

● To estimate a firm's cost of equity capital, we need to know three things in the *future*:

1. The risk-free rate, R_F

2. The market risk premium $\overline{R}_M - R_F$

3. The company beta, $\beta_i = \dfrac{Cov(R_i, R_M)}{Var(R_M)} = \dfrac{\sigma_{i,M}}{\sigma_M^2}$

CAPM: Example

Suppose the stock of Stansfield Enterprises, a publisher of PowerPoint presentations, has a beta of 1.5. The firm is 100% equity financed. Assume a risk-free rate of 3% and a market risk premium of 7%. What is the appropriate discount rate for an expansion of this firm?

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

$$\overline{R}_s = 3\% + 1.5 \times 7\%$$

$$\overline{R}_s = 13.5\%$$

Risk-free rate

- To estimate expected return using CAPM, we need three input variables: risk free rate, beta, and expected market return. But, how could we get these variables?

- Risk-free rate: The expected return on financial assets with no risk.

- The riskiness of financial assets: Treasury bond < Corporate bond < Stock

- Treasury securities are close proxies for the risk-free rate.

Market return

- Method 1: Use historical data of return on market index (backward looking)
  - □ Arithmetic mean
  - □ Geometric mean

- Method 2: Use the Dividend Discount Model (forward looking)

$$R_s = \frac{D_1}{P} + g \qquad \rightarrow \text{growth rate.}$$

- □ All the variables are measured for the aggregate market level, not for individual stock
- □ Market data and analyst forecasts can be used to implement the DDM approach on a market-wide basis

Estimate beta

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

线性回归.

- **Market Portfolio**: Portfolio of all securities in the market. In practice, a broad stock market index, such as the S&P 500, 沪深300, is used to *represent* the market.

- **Beta**: We assume beta is quite stable for the same stock and thus we can use *historical* data. We can estimate the beta as the sensitivity of a stock's return to the return on the market portfolio.

Estimate beta

We use historical return data to estimate beta. What are the problems with it?

● Problems

  ☐ We assume beta is stable, but it may vary over time.
  ☐ The sample size on historical data may be inadequate.
  ☐ Betas are influenced by changing financial leverage and business risk.

● Solutions

  ☐ Problems 1 and 2 can be moderated by more sophisticated statistical techniques.
  ☐ Problem 3 can be lessened by adjusting for changes in business and financial risk.
  ☐ Look at average beta estimates of comparable firms in the industry.

Stability of beta

- Most analysts argue that betas are generally stable for firms remaining in the same industry.

- That is not to say that a firm's beta cannot change. Beta can changes due to:
  - ☐ Changes in product line
  - ☐ Changes in technology
  - ☐ Deregulation
  - ☐ Changes in financial leverage

Financial Leverage and Beta

● **Financial leverage** is the sensitivity to a firm's fixed costs of *financing*. It can be measured using debt-to-equity ratio or debt-to-asset ratio.

● Financial leverage always increases the **equity beta** relative to the asset beta:

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

□ **Debt beta** can be assumed to be zero as return on debt does not vary with stock market return.

□ **Asset beta** is measured from the asset side, has noting to do with the capital structure. It is usually fixed across an industry.

Financial leverage and 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 50% debt to 50% 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:

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

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

Stock valuation: Recall

Assume that dividends will grow at a constant rate, g, forever, *i.e.,*

$$\text{Div}_1 = \text{Div}_0(1+g)$$

$$\text{Div}_2 = \text{Div}_1(1+g) = \text{Div}_0(1+g)^2$$

$$\text{Div}_3 = \text{Div}_2(1+g) = \text{Div}_0(1+g)^3$$

Since future cash flows grow at a constant rate forever, the value of a constant growth stock is the present value of a growing perpetuity:

$$P_0 = \frac{\text{Div}_1}{R-g}$$

Note: Not Div_0!

Cost of equity: Dividend discount method

Rearrange:

$$R_s = \frac{D_1}{P} + g$$
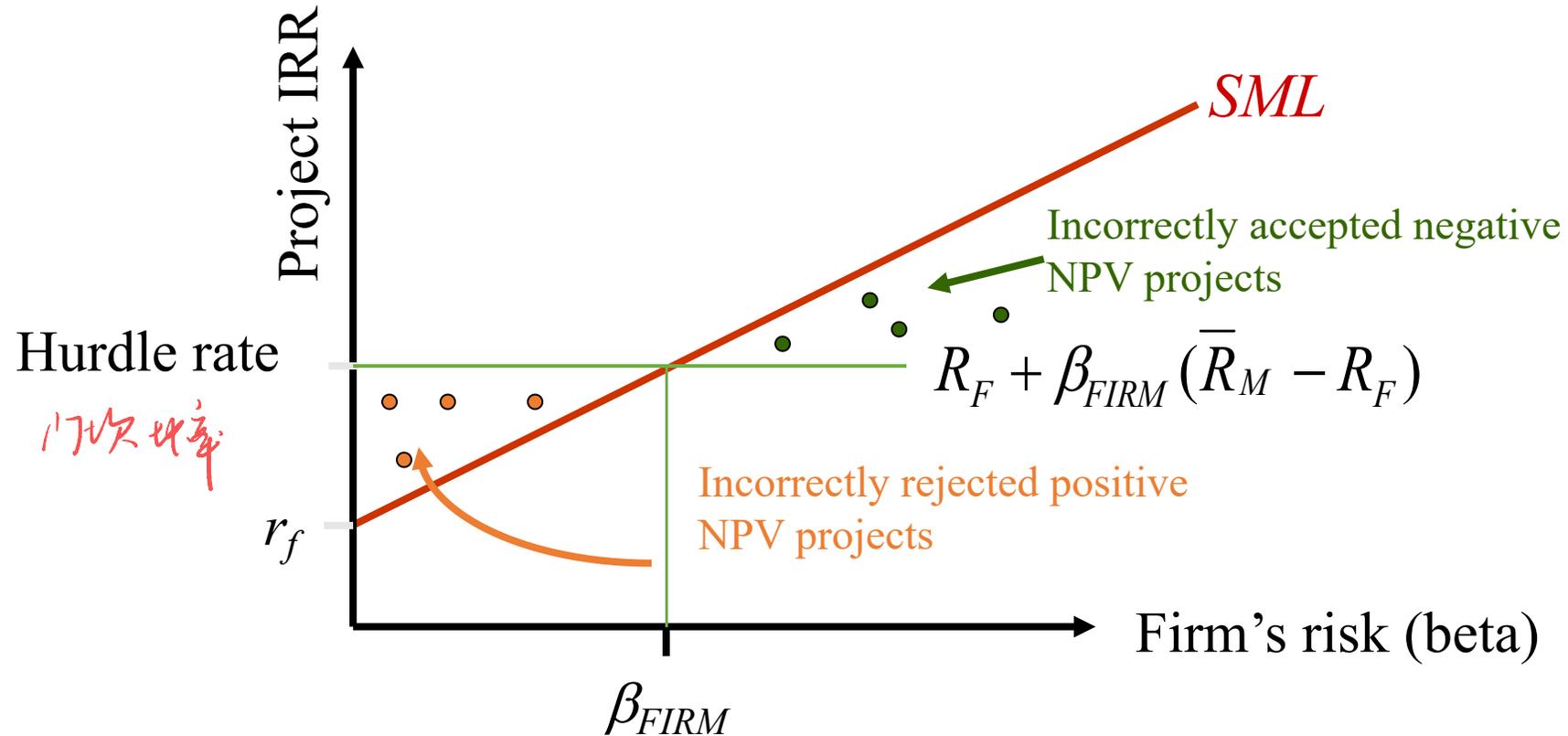
- We can recover the expected return on a single stock using information on dividend and current stock price.

- The **expected market return** can be calculated using the aggregate dividend and prices.

- D_1 is the dividend payout in **next period**.

- R_s is the expected return on a stock.

- g is the constant growth rate on dividend.

- P is the current stock price.

Comparison between CAPM and DDM

- 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.

- The CAPM explicitly adjusts for risk and it can be used on companies that do not pay dividends.

Project risk and firm Risk

Project IRR

SML

Incorrectly accepted negative NPV projects

Hurdle rate

门收地率

$R_F + \beta_{FIRM}(\overline{R}_M - R_F)$

Incorrectly rejected positive NPV projects

r_f

β_{FIRM}

Firm's risk (beta)

The risk of a project can be different from the risk of the overall firm. A firm that uses one discount rate for all projects may over time increase the risk of the firm while decreasing its value.

Project risk and firm risk: Example

Suppose the Conglomerate Company has a cost of capital, based on the CAPM, of 11.1%. The risk-free rate is 2%, the market risk premium is 7%, and the firm's beta is 1.3.

$$11.1\% = 2\% + 1.3 \times 7\%$$

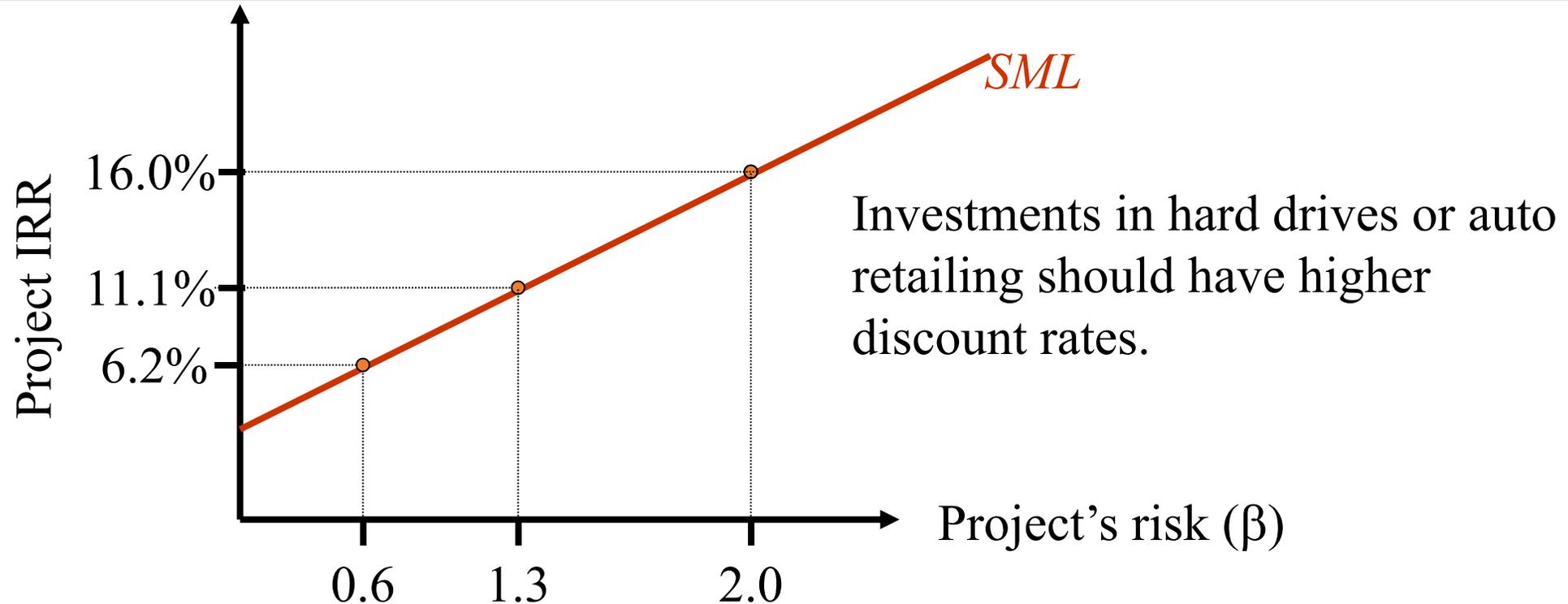This is a breakdown of the company's investment projects:

1/3 Automotive Retailer $\beta = 2.0$

1/3 Computer Hard Drive Manufacturer $\beta = 1.3$

1/3 Electric Utility $\beta = 0.6$

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

Project risk and firm risk: Example

SML

Investments in hard drives or auto retailing should have higher discount rates.

Project IRR

16.0%

11.1%

6.2%

0.6   1.3   2.0

Project's risk (β)

$$R = 2\% + 0.6 \times (7\%) = 6.2\%$$

6.2% reflects the opportunity cost of capital on an investment in electrical generation, given the unique risk of the project.

Cost of debt

- When a firm issues debt, the cost is coupon payment or the required interest rate. For corporate bond, YTM is a good proxy.

- The data can be obtained from the dealer or the OTC bond market. Remember use the current yield, not the historical one.

- Cost of debt is easier to estimate than cost of equity. But we need to adjust for the **tax deductibility of interest expense**

  After-tax cost of debt = **(1- Tax rate)** * Borrowing Rate

Cost of preferred stock

- Preferred stock pays a constant dividend in perpetuity, but do not share the capital gain. It thus do not dilute the ownership of old shareholders.

- The cost to a firm issuing preferred stock is just the dividend payment. It is more similar to bonds than to common stock.

- The price of preferred stock is equal to the coupon paid divided by the current required return. Rearranging, the cost of preferred stock is:

$$R_P = C / PV$$

Weighted Average of Cost of Capital

After we obtain the cost of equity and debt, a firm's overall cost of capital can be represented by the weighted average cost of capital (WACC) :

$$R_{WACC} = \frac{\text{Equity}}{\text{Equity} + \text{Debt}} \times R_{Equity} + \frac{\text{Debt}}{\text{Equity} + \text{Debt}} \times R_{Debt} \times (1 - T_C)$$

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

Firm valuation with WACC

● The value of the **whole firm** is the present value of expected future free cash flow discounted at the WACC.

$$\text{PV}_0 = \frac{CF_1}{1 + R_{\text{WACC}}} + \frac{CF_2}{(1 + R_{\text{WACC}})^2} + \frac{CF_3}{(1 + R_{\text{WACC}})^3} + \cdots + \frac{CF_T + TV_T}{(1 + R_{\text{WACC}})^T}$$

● To find equity value, subtract the value of the debt from the firm value.

● The market value of debt is much more stable than equity, we can use its book value approximately.

Firm valuation: Example

- Good Food is seeking to acquire the Happy Meals. The discount rate and cash flows should be based on which company?

- Good Food has $4 billion in market valued debt and $2 billion in market valued common stock. Its tax rate is 20%. It has estimated its cost of debt as 5% and cost of equity as 10%. The WACC can be calculated as

Financial Component	Market Values	Weights	Cost of Capital	Weighted Average
Debt	$4 billion	2/3	5%(1−.2) = 4%	2/3 × 4%
Equity	$2 billion	1/3	10%	1/3 × 10%
	$6 billion			6% = the weighted average cost of capital

Firm valuation: Example

Happy Meals expects its EBIT to grow 10% a year for the next five years. Increase in net working capital and capital spending are 24% of EBIT. Depreciation will be 8% of EBIT. The perpetual growth rate in cash flow after five years is 2%.

Year	1	2	3	4	5
Earnings before interest and taxes (EBIT)	150	165	181.5	199.7	219.6
− Taxes (20%)	30	33	36.3	39.9	43.9
= Earnings after taxes	120	132	145.2	159.8	175.7
+ Depreciation	12	13.2	14.5	16	17.6
− Capital spending	36	39.6	43.6	47.9	52.7
− Increases in net working capital	36	39.6	43.6	47.9	52.7
= Net cash flows (CF)	60	66	72.6	79.9	87.8

Firm valuation: Example

Since the perpetual growth rate in cash flow after five years is 2%, the terminal value at year 5 of Happy Meals is:

Terminal Value=$87.8 \times 1.02/(0.06-0.02)=2{,}238.9$

The value of Happy Meals is:

$$PV_0 = \frac{\$60}{1.06} + \frac{\$66}{(1.06)^2} + \frac{\$72.6}{(1.06)^3} + \frac{\$79.9}{(1.06)^4} + \frac{\$87.8}{(1.06)^5} + \frac{\$2{,}238.9}{(1.06)^5} = \$1{,}978.2$$