CORPORATE FINANCIAL MANAGEMENT

PART III CAPITAL INVESTMENT DECISION

(chapter 8-11)

Chapter 11

The Cost of Capital

Introduction

1. Weighted Average Cost of Capital
2. Component Costs
3. Marginal Cost of Capital

1. Weighted Average Cost of Capital

- Cost of capital
  - What the firm must pay for capital
  - The return required by investors
  - Minimum rate of return required on new investments
  - Determined in the capital markets
  - Depends on the risk associated with the firm's activities

Equal to the equilibrium rate of return demanded by investors in the capital markets for securities of that degree of risk

Continued…

- Weighted Average Cost of Capital: k_a
  - Discount rate used when computing the NPV of a project of average risk
  - Hurdle rate used in conjunction with the IRR
  - Based on the **after-tax** cost of capital
  - Obtained from the weighted costs of the individual components
  - Weights equal to the proportion of each of the components in the target capital structure

Continued…

$$k_a = \frac{E}{B+E+P_f}(k_e) + \frac{B}{B+E+P_f}(k_i) + \frac{P_f}{B+E+P_f}(k_p)$$

Example with \$3 in bonds, \$6 in equity, and \$1 in preferred stock

$$k_a = \frac{6}{3+6+1}(k_e) + \frac{3}{3+6+1}(k_i) + \frac{1}{3+6+1}(k_p)$$

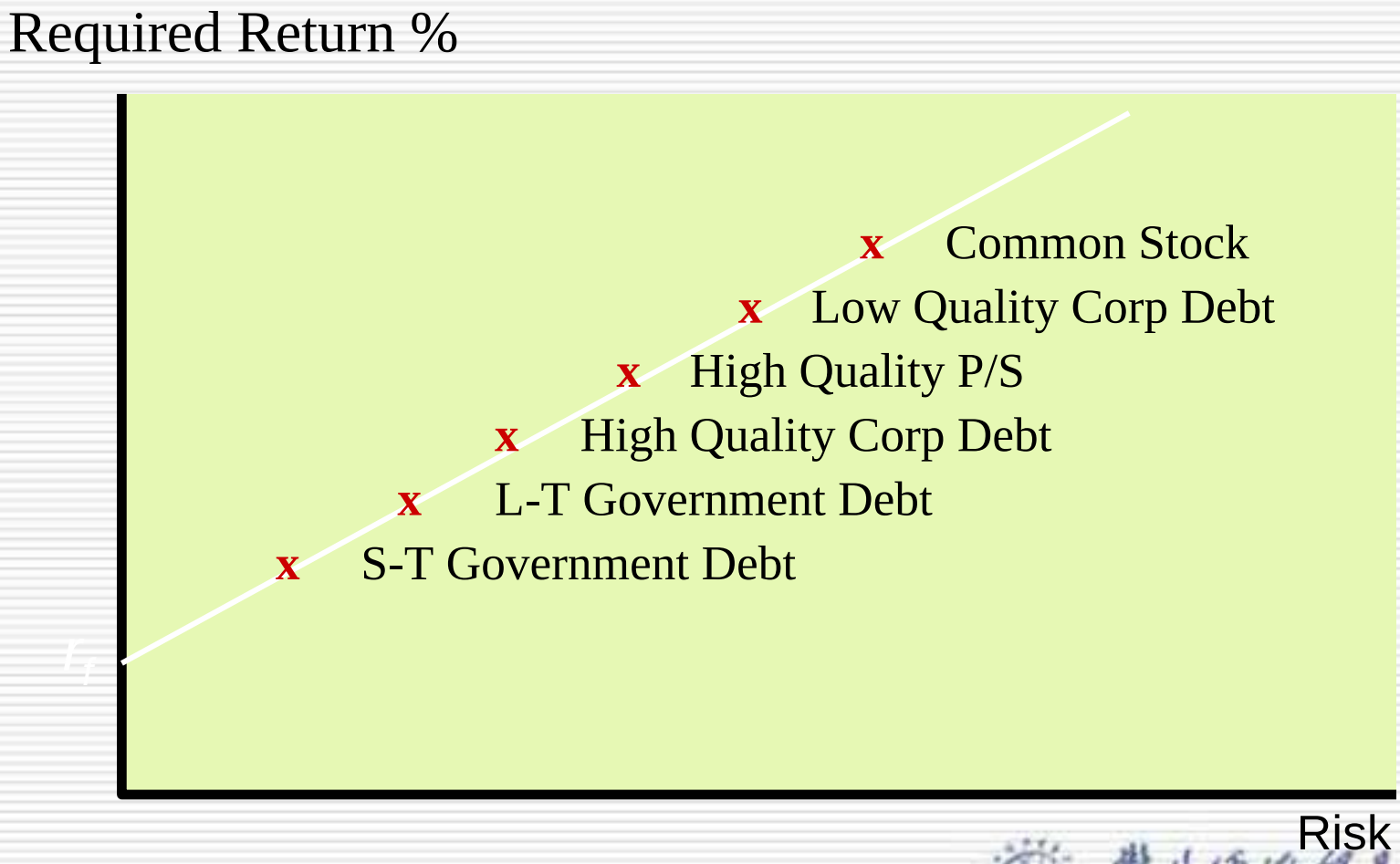
$$k = W(k_e) + W(k_i) + W(k_p)$$

$$k = 60\%(k_e) + 30\%(k_i) + 10\%(k_p)$$

Continued…

- Risk vs. required return trade-off : Required return = rf + Risk premium
  - rf = risk-free rate
    - Real rate of return determined by supply and demand
    - Plus a premium for the effects of inflation
  - Components of the risk premium
    - Business risk -**associated with the amount of operating leverage**
    - Financial risk -**associated with the use of financial leverage**
    - Marketability risk -**refers to the ability to quickly buy and sell**
    - Interest rate risk -**arising from changes in interest rates**
    - Seniority risk -**due to the priority of a security's claim on assets**

Continued…



2.Component Costs

- Cost of Debt

$k_i = k_d (1 - T)$ Interest is tax deductible

- Cost of Preferred Stock

$k_p = D_p / P_{net}$ Dividends are not tax deductible

P_{net} : Net of issuance costs

Continued…

- Cost of internal equity capital
  - $k_e = D_1/P_0 + g$

    Cost of R/E using constant dividend g
  - $k_e = r_f + \beta_j(r_m - r_f)$ CAPM
  - Risk premium on debt approach Add %
- Cost of external equity

$$k'_e = D_1/P_{net} + g \qquad P_{net} = P_0(1 - f)$$

课堂案例分析讨论

7：百事可乐公司的资本成本

3. Marginal Cost of Capital

- Marginal Cost of Capital
  - the firm's weighted average cost of capital associated with its next dollar of total new financing
- Computation procedure
  - Step 1: Calculate the cost of capital for each individual component
  - Step 2: Calculate breakeven point(X): the level of total new financing at which the cost of one of the financing components rise

    X = Amount of low cost funds available for each source/

    Proportion of source in target Capital Structure
  - Step 3: Calculate the weighted marginal cost of capital

Chapter 8

Capital Budgeting and
Cash Flow Analysis

Introduction

1. Key terms and concepts in capital budgeting
2. Basic framework for capital budgeting
3. Generating capital investment project proposals
4. Calculation of cash flow

1. Key terms and concepts in capital budgeting

- Capital budgeting
  - the process of planning for purchases of assets whose returns are expected to continue beyond one year
- Capital expenditure
  - A cash outlay expected to generate a flow of future cash benefits for more than a year
- Classification of projects
  - Independent: Acceptance or rejection has no effect on other projects
  - Mutually Exclusive: Acceptance of one automatically rejects the others
  - Contingent: Acceptance of one project is dependent upon the selection of another.

1. Key terms and concepts in capital budgeting

- Availability of funds: fund constraint /capital rationing
  - Setting limits on Capital expenditures
  - Reason: Most companies have a limited amount of dollars available for investment

2.Basic framework for capital budgeting

- Economic Theory says: **Expand** output until marginal revenue equals marginal cost Capital budgeting
- In Capital Budgeting
  - **Invest** in the most profitable projects first
  - Continue accepting projects as long as the rate of return exceeds the Marginal Cost of Capital (MCC)
- Four steps of capital budgeting process
  - generation of proposals
  - estimation of cash flows
  - evaluation and selection of alternatives
  - postaudit or review

3. Generating capital investment project proposals

- Investment projects can be generated by
  - growth opportunities
  - cost reduction opportunities
  - meeting legal requirements
  - meeting health and safety standards
- Project size and decision-making process: decentralized decision-making function

4. Calculation of cash flow

- Principles of Estimating Cash Flows
  - Cash flow should be measured on an incremental basis
  - Cash flow should be measured on an after-tax basis
  - All the indirect effects of a project should be included in the cash flow calculations
  - Sunk costs should not be considered
  - The value of resources used in a project should be measured in terms of their opportunity costs

...continued

- Computing the Net Investment(NINV)

Step 1 Cost plus installation and shipping

Plus

Step 2 Increases in net working capital

Minus

Step 3 Net proceeds from sale of existing assets

Plus or minus

Step 4 Taxes associated with the above sale

plus

Step 5 Opportunity cost of resources owned

Equals

NINV

Remember to check out the tax consequences

Tax Consequences at the End of a Project's Life

Case 1	Sale = book value	No tax consequences
Case 2	Sale < book value	Tax savings = Loss x marginal tax rate
Case 3	Sale > book value	Tax = Gain x marginal tax rate
Case 4	Sale > original cost	Tax = (Gain + capital gain) x marginal tax rate

...continued

- Computing the Net Investment(NINV)
  - **The key is** to focus on marginal cash flows, so pay attention to **the difference** between the CF **with** the investment and the CF **without** the investment

$$
\begin{aligned}
& NCF \\
& = \Delta OEAT + \Delta Dep - \Delta NWC \\
& = [(R_W - R_{WO}) - (O_W - O_{WO}) - (Dep_w - Dep_{wo})](1-T) \\
& + (Dep_w - Dep_{wo}) - \Delta NWC \\
& = (\Delta R - \Delta O - \Delta Dep)(1-T) + \Delta Dep - \Delta NWC \\
& = (\Delta R - \Delta O)(1-T) + \Delta DepT - \Delta NWC
\end{aligned}
$$

...continued

- Computing Terminal Cash Flows
  - Recovery of after-tax salvage value
  - Recovery of net working capital: all recovered in the last year of the project

NOTES

  - 在寿命期结束时要考虑*残值的回收*和*净营运资本的回收*
  - 有关残值征税问题，各国均有不同的规定。因此，在做资本预算时应根据具体情况来确定

...continued

- Interest charges and net cash flows
  - interest charges should not be deducted from the estimated cash flows
    - Investment and financing decisions normally should be made independently of one another
    - Double counting of interest cost can be avoided
- Depreciation
  - systematic allocation of the cost of an asset over more than one year
  - noncash expense and has effect on income tax to pay
  - higher depreciation rate—>higher depreciation —>lower taxable income—>lower tax cash outflow—>higher cash inflow

...continued

- Cases
  - **CASE1: Asset Expansion Projects**: requires a firm to invest funds in additional assets in order to increase sales(or reduce costs) p326
  - **Case2：Asset Replacement Projects**: involves retiring one asset and replacing it with a more efficient asset p328
  - Problems in cash flow estimation: uncertainty associated with cash flows/ the intentional or unintentional introduction of bias into the estimation procedure

Chapter 9

Capital Budgeting: Decision Criteria and Real Option Considerations

Introduction

1. Capital Budgeting Decision Models
2. Reviewing and postauditing an accepted project
3. Capital rationing and the capital budgeting decision
4. Inflation and capital expenditures
5. Equivalent Annual Cost (EAC)
6. Real Option in Capital Budgeting

1. Capital Budgeting Decision Models

- Payback period (PB)
  - The period of time required for the cumulative cash inflows(net cash flows)from a project to equal the initial cash outlay(net investment)
  - Equation
    - When net CFs are unequal,

    PB= Net Investment/ Annual net CFs
    - When net CFs are unequal, interpolation is required
  - Decision rule
    - $n \leq N$, accept
    - $n > N$, reject

...continued

- Advantages and disadvantages
  - easy and inexpensive to use
  - provides a crude measure of project risk
  - provides a measure of project liquidity
  - ignores the timing of cash flows
  - ignores cash flows beyond the PB period
  - has no explicit tie to the goal of shareholder wealth maximization

…continued

- Net present value (NPV)
  - Definition: the present value of the stream of expected net cash flows from the project minus the project's net investment
  - Equation:

$$NPV = \sum_{t=1}^{n} \frac{NCF_t}{(1+k)^t} - NINV$$

$$= \sum_{t=1}^{n} NCF_t \times PVIF_{k,t} - NINV$$

  - Decision rule
    - NPV≥0，accept
    - NPV≤0，reject

...continued

- Advantages and disadvantages
  - most conceptually correct approach, consistent with the goal of shareholder wealth maximization
  - considers both the magnitude and the timing of cash flows over the project's entire expected life
  - indicates whether a proposed project will yield the rate of return required by the firm's investors
  - the concept of NPV is not easy to understand

...continued

- Internal rate of return (IRR)
  - Definition: the discount rate that equates the present value of the net cash flows from a project with the present value of the net investment(the discount rate that causes a project's NPV to equal zero)
  - Equation:

$$\sum_{t=1}^{n} \frac{NCF_t}{(1+r)^t} = NINV$$

  - Decision rule
    - IRR≥cost of capital，accept
    - IRR≤cost of capital，reject

…continued

- Advantages and disadvantages
  - the concept is easy to understand
  - considers both the magnitude and the timing of cash flows over the project's entire expected life
  - possibility of multiple IRR(in these cases the NPV method should be used)
  - sometimes gives decision that conflicts with NPV

...continued

- Profitability index (PI)
  - Definition: the ratio of the present value of expected net cash flows over the life of a project to the net investment
  - Equation:

$$PI = \frac{\sum_{t=1}^{n} NCF_t /(1+k)^t}{NINV}$$

  - Decision rule
    - PI≥1，accept
    - PI≤1，reject

...continued

- Advantages and disadvantages
  - some benefits as the NPV
  - useful to guide decisions in capital rationing problems
  - sometimes gives decision that conflicts with NPV

...continued

- Evaluating Decision Criteria
  - NPV versus IRR
    - For independent projects: the two methods give the same accept-reject signals
    - For mutually exclusive projects: they may be in conflict

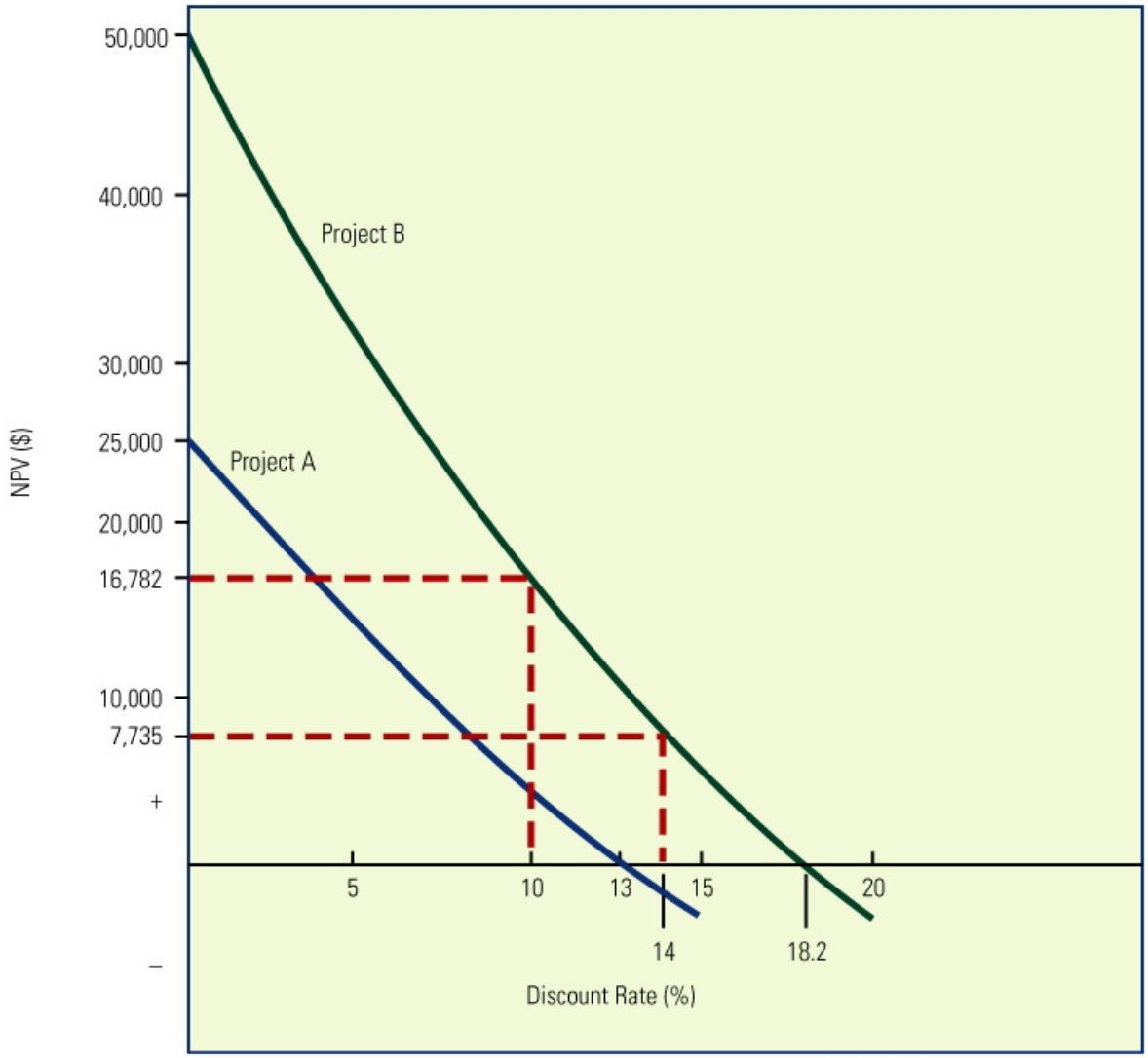
...continued

COMPARISON

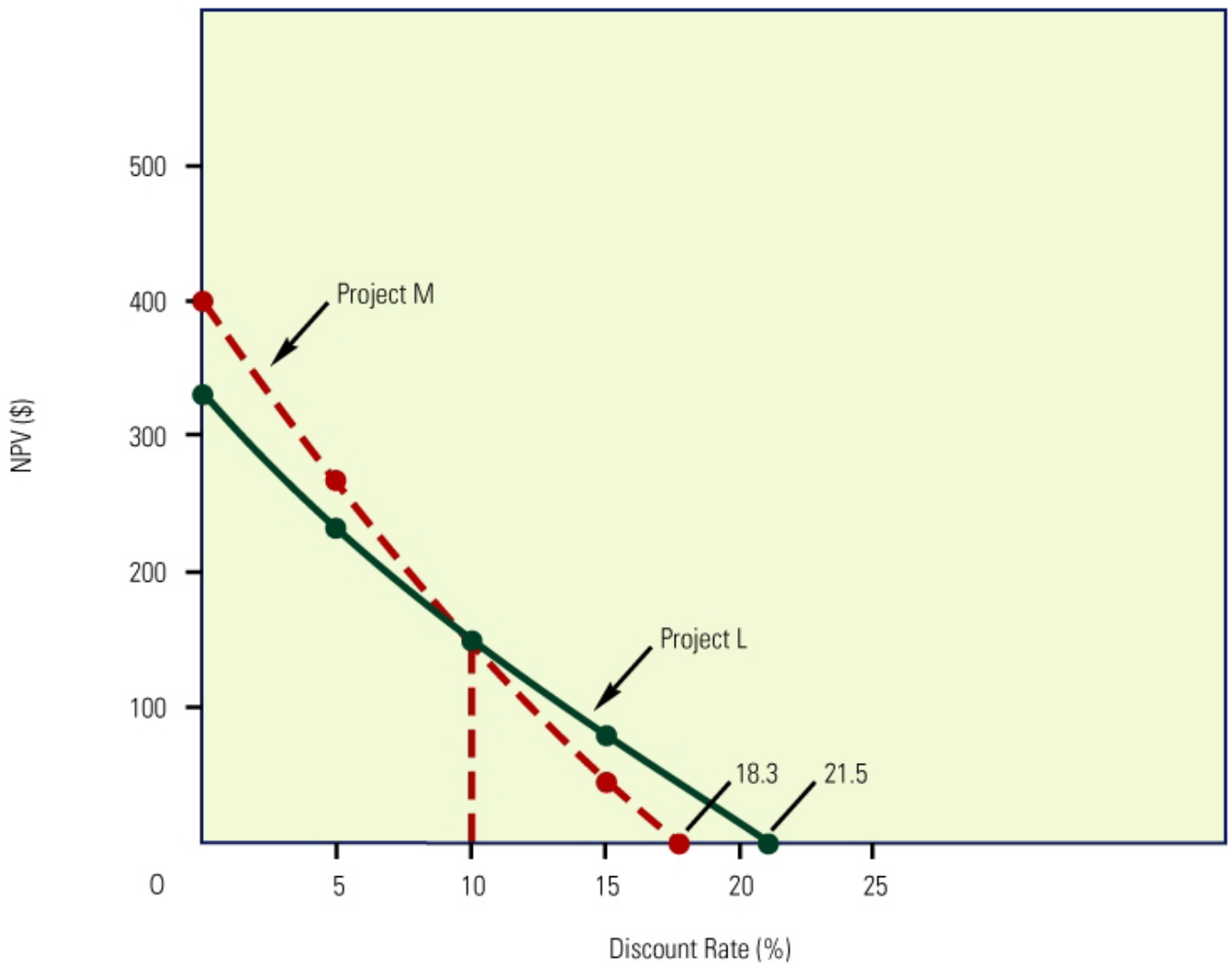
- on a purely theoretical basis, NPV is the better approach to capital budgeting.
  - ✓ more conservative and realistic reinvestment rate (NPV:cost of capital/IRR: computed IRR)
  - ✓ More preferable to projects with non-conventional cash flows(which may have zero or more than one IRR)
  - ✓ Consistent with shareholders' wealth maximization goal
- Evidence suggests that in practice, many firms prefer to use IRR.
  - ✓ general disposition of business people toward rates of return rather than actual dollar returns
  - ✓ People tend to find NPV more difficult to use because it does not really measure benefits relative to the amount invested

If NPV and IRR disagree, NPV is preferred.

NPV Profiles: Relationship Between the Net Present Value and the Internal Rate of Return for Projects A and B



NPV Profiles: Net Present Value versus Internal Rate of Return for Mutually Exclusive Alternatives



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- NPV versus PI
  - For independent projects: the two methods give the same accept-reject signals
  - For mutually exclusive projects: they may be in conflict
    - ✓ no capital constraint(rationing)—>NPV criteria—> largest NPV leads to maximization of shareholder wealth
    - ✓ capital constraint(rationing)—>PI criteria—>indicates the maximization of the returns per dollar of investment

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Case 3：一家专门研究编制所得税申报单的公司正在考虑两个投资方案，方案实施的详细情况如下：

表1：单位： 美 元

	电子计算机	劳务合同
设备(发票价格)	8,472	10,500
运费	678	380
安装费	850	120
人员培训费	2,800	
办公用品库存量增加	200	
工资备用金增加	1,000	
税前收益和节约成本额	5,000	8,000
折旧（直线法）		
	使用年限3年 残值等于账面价值	使用年限4年 残值等于账面价值
	1,000	7,000

边际税率：50%

2. Reviewing and postauditing an accepted project

- Objectives of postaudits and reviews
  - Assist management in uncovering biases in the project analysis procedure of a firm
  - Assist management in making abandonment decisions for projects that are not performing up to expectations

3. Capital rationing and the capital budgeting decision

- Capital constraint
  - Self-imposed constraint
  - Externally-imposed constraint
- Single-period capital budgeting constraint: PI method
  - Steps to make decisions(when projects are separable)
    - Step 1: Calculate the PI for projects
    - Step 2: Order the projects from the highest to the lowest PI
    - Step 3: Accept the projects with the highest PI until the entire capital budget is spent

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- If the firm may not be able to utilize its entire capital budgeting and projects are not separable,management may choose among three alternatives:
  - Search for another combination of projects that increase the NPV
  - Attempt to relax the funds constraint
  - Dispose of Excess funds(Invest in short-term securities/Reduce outstanding debt/Pay dividends to shareholders

4. Inflation and capital expenditures

- In general, relatively high levels of inflation tend to reduce the level of capital expenditures in the economy
- The general capital budgeting procedures can be applied with equal validity in a inflationary environment as long as the estimates of revenues and costs used in the capital budgeting process include expected price and cost increases

5. Equivalent Annual Cost (EAC)

- 在无税收条件下
  - 若某项设备价值Qn ，耐用年限n，资本成本K，则可求得该项投资每年应负担的成本A。由年金现值公式

$$Qn = A\frac{1-(1+K)^{-n}}{K} \Rightarrow \quad A = \frac{Q_n \times K}{1-(1+K)^{-n}} \qquad (1)$$

  - 若设备的操作维修费每年为C，则A+C为年平均成本(2)
  - 若含有残值S，则年平均成本为

$$A = (Q_n - S)\left[\frac{1-(1+K)^{-n}}{K}\right]^{-1} + S \times K \qquad (3)$$

- 在税收条件下，折旧D和操作成本C要考虑可减税，残值S考虑税后残值

Case4:

H公司正在考虑购进新机器替换现有的存货。现有两种机器A和B可供选择，两种机器的有关情况如下：

方案	A	B
设备价值	$49,000	$72,000
折旧方法	直线	直线
寿命期	5年	10年
账面价值	5年后$4,000	8年折旧完毕
年操作成本	$25,000	$24,000
寿命期终残值	$10,000	残值=拆迁费
税率	40%	40%
资本成本(K)	12%	12%

机器B在6年底有一次大修理，大修理费为$18,000，机器A和B有相同的风险和收益，请问H公司应选择哪种机器？

6.Real Option in Capital Budgeting

课堂案例分析讨论

8：追加投资决策中的实物期权

Chapter 10

Capital budgeting and risk

Introduction

1. Risk Type: Total project risk versus portfolio risk
2. Adjusting for total project risk
3. Adjusting for beta risk in capital budgeting
4. Optimal capital budgeting

1. Risk Type: Total project risk versus portfolio risk

- Total Project risk
  - The risk that a project will perform below expectations
  - can be measured by the standard deviation or the coefficient of variation of cash flows from a project
  - Some of the risk can be diversified away
- Beta risk (Portfolio risk)
  - Depends on the risk of the project relative to the market-portfolio
  - Beta risk cannot be diversified away

2. Adjusting for total project risk

- NPV-Payback approach
  - Decision rule:to accept projects that have positive NPV and paybacks of less than some stated number of years
  - Advantages and disadvantages
    - simple and inexpensive
    - payback criterion is subjective and not directly related to variability of returns from a project
    - some projects are most risky than others during start-up periods
    - may cause a firm to reject some actually acceptable projects

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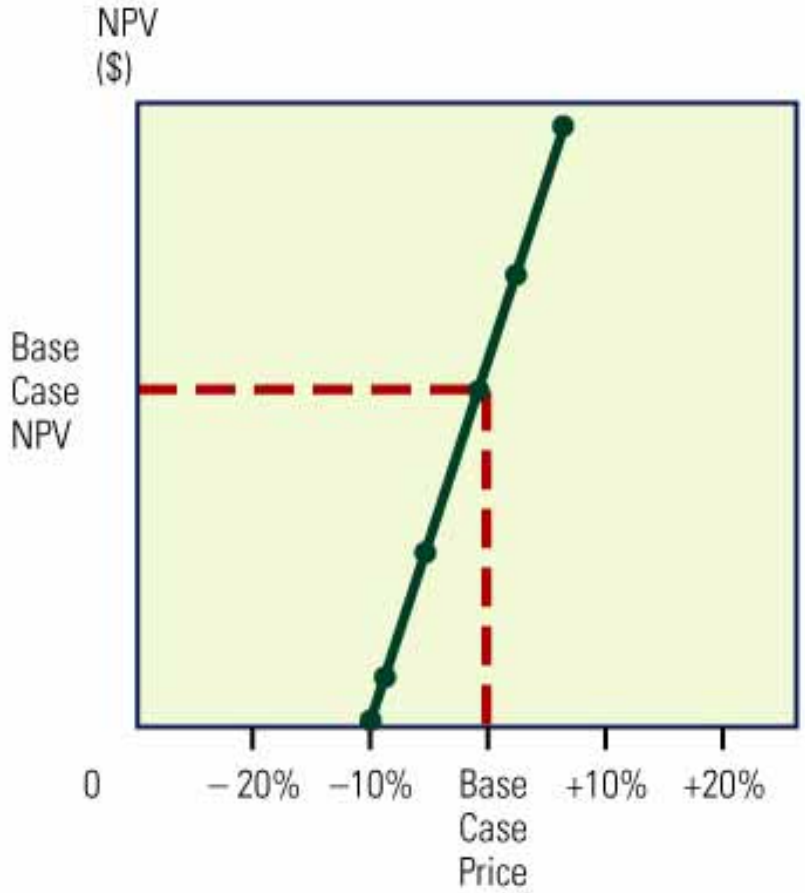
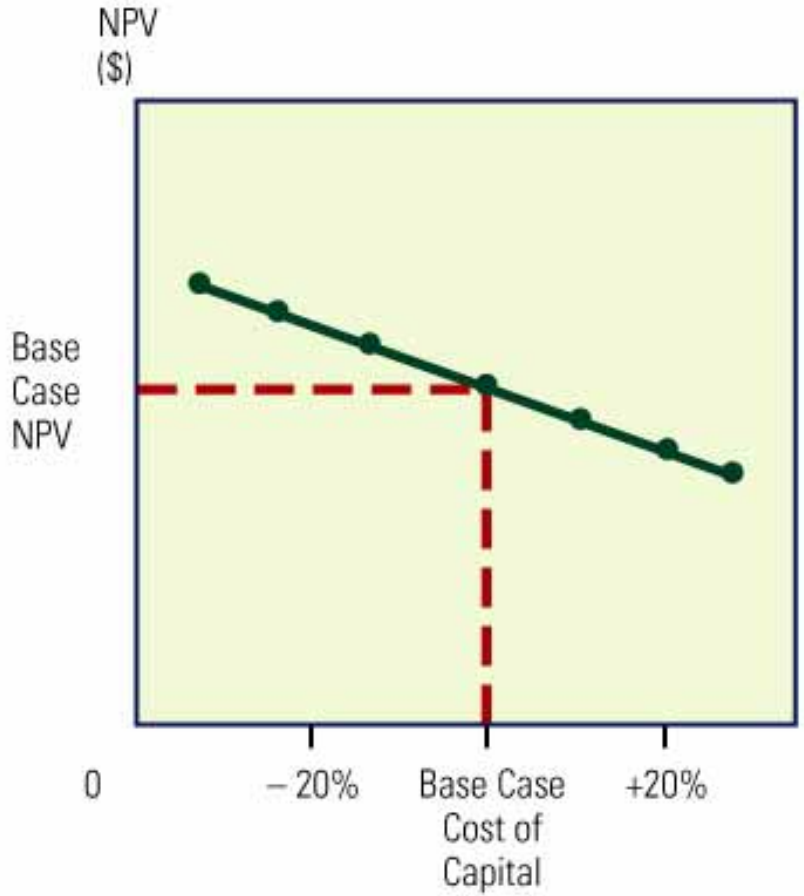
- Sensitivity analysis
  - a procedure that calculates the change in net present value given a change in one of the cash flow elements to identify which variables the NPV/IRR seems most sensitive to
  - Useful to make sensitivity curves to show the impact of changes in a variable on the project's NPV
  - Electronic spreadsheets and financial modeling make sensitivity analysis easy to perform

Sensitivity Curves





斜率表明：NPV对每一输入量变化的敏感程度，斜率越大，NPV对变量变化的敏感性越大，风险就越大。

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- Scenario analysis
  - Considers the impact of simultaneous changes in key variables on the desirability of an investment project
  - Major Steps
    - Estimate the expected NPV

      Optimistic Pessimistic Most likely
    - Estimate the Probability of **each**
    - Compute the expected NPV
    - Compute the standard deviation (SD) of the NPV

...continued

- Advantages and disadvantages
  - easy to estimate the impact of various scenarios on the expected performance of a project
  - look only at limited number of alternative scenarios
  - difficult and subjective to determine the possibilities

Case5:

Market Size	10 million
Market Share	0.01
Unit Price	$3,750
Unit Variable Cost	$3,000
Fixed Cost	$30 million

Assumption: Initial investment = $150 million

Depreciation: straight line (10 years)

T = 50% K=10%

...continued

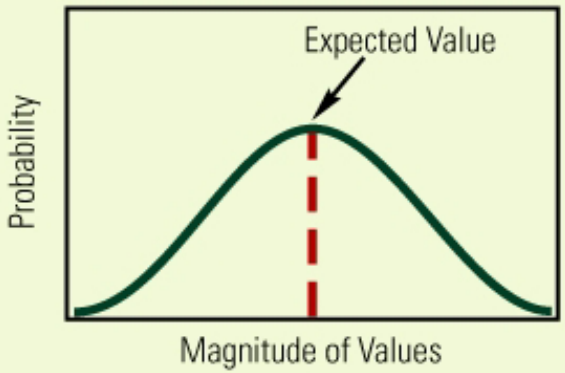
- Simulation analysis
  - more appropriate for analyzing larger projects
  - Major Steps
    - Estimate the probability distribution of each element which influences the CFs of a project

      Elements: Number of units sold/Market price/Unit production costs NINV/Unit selling cost/Project life/Cost of capital
    - Calculate the NPV using randomly chosen numerical values for the elements
    - Repeat the process until a probability distribution of the NPV can be estimated

An Illustration of the Simulation Approach

Steps:

1. Estimate probability distribution of each input variable:



Probability Distributions for:

- Price
- Number of Units Sold
- Unit Production Cost
- Unit Selling Cost
- Annual Depreciation

2. Combine input variables into a mathematical model to compute the NPV of the project.
3. Select at random a value of each input, based upon the probability distributions specified in Step 1.
4. Compute the project's NPV.
5. Repeat Steps 3 and 4 many times to arrive at the following:
   a. The project's expected (mean) NPV.
   b. The standard deviation of the project's NPV

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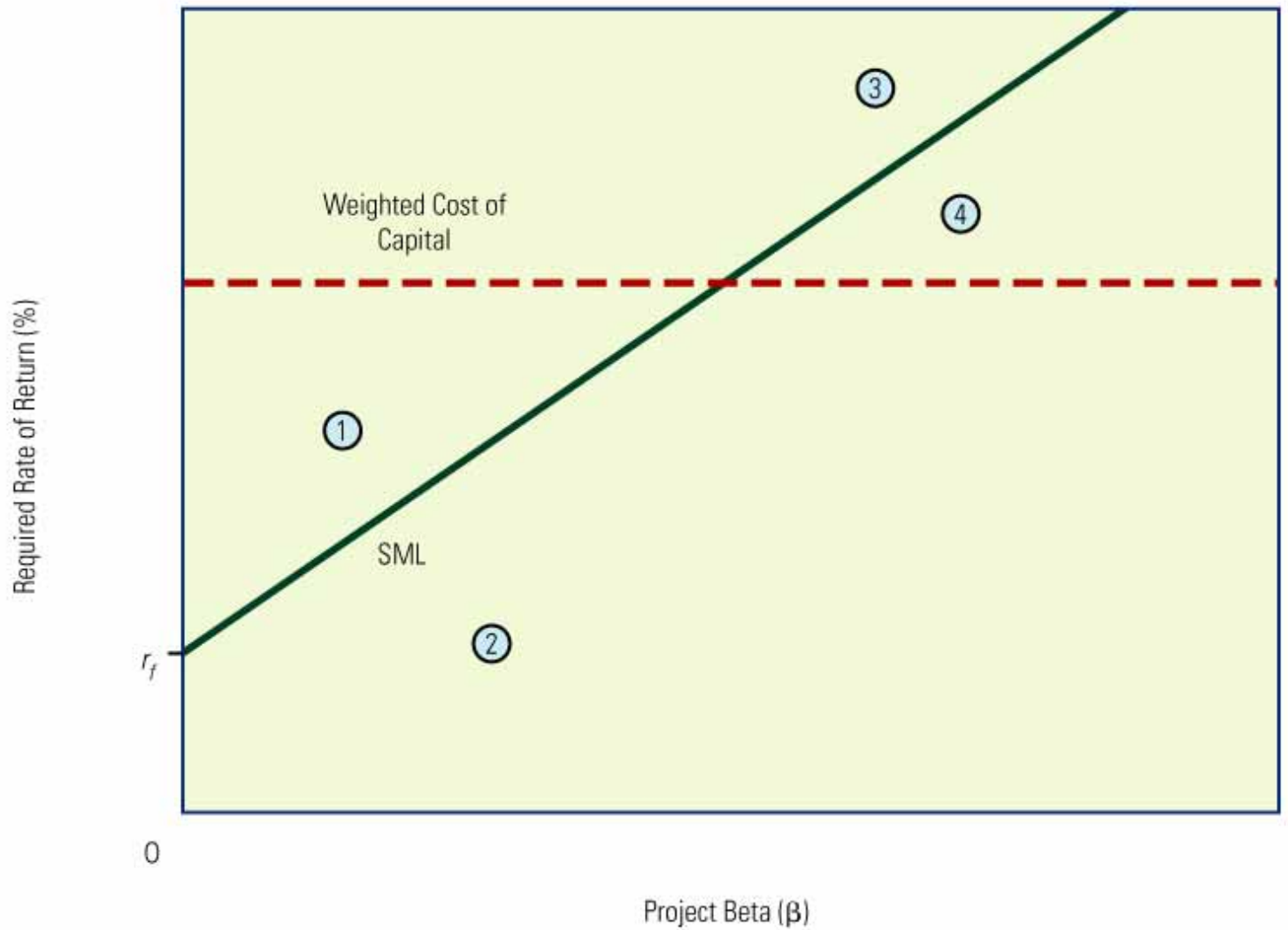
- risk-adjusted discount rate approach
  - adjusts for risk by varying the rate at which the expected cash flows are discounted when determining a project's NPV
  - Equation:

    $k_a^* = r_f$ + risk premium

    $$NPV = \sum_{t=1}^{n} \frac{NCF_t}{(1+k_a^*)^t} - NINV$$

  - Preferable to the weighted cost of capital approach when the projects under consideration differ significantly in their risk characteristics

Risk-Adjusted Discount Rate versus Weighted Cost of Capital



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Case6:

项目	风险程度	现金流量	寿命期	Co
1	低	20,000	5	70,000
2	一般	60,000	5	220,000
3	最高	100,000	5	250,000

各项目调整后的贴现率分别为10%、12%和20%，则NPV为:

NPV1 = ?

NPV2 =?

NPV3 = ?

...continued

- Certainty equivalent approach
  - adjusts for risk by converting the expected risky cash flows to their certainty equivalents (by using certainty equivalent factors)and then computing the NPV of the project

3. Adjusting for beta risks in capital budgeting

- Basic considerations
  - A firm is thought of as a portfolio of assets (projects), each having its own Beta
  - the systematic risk of the firm (Firm Beta) is the weighted average of the systematic risk of the individual assets (Project Betas)
  - When considering the systematic risk of individual projects, the beta concept can be used to determine risk-adjusted discount rates for individual projects

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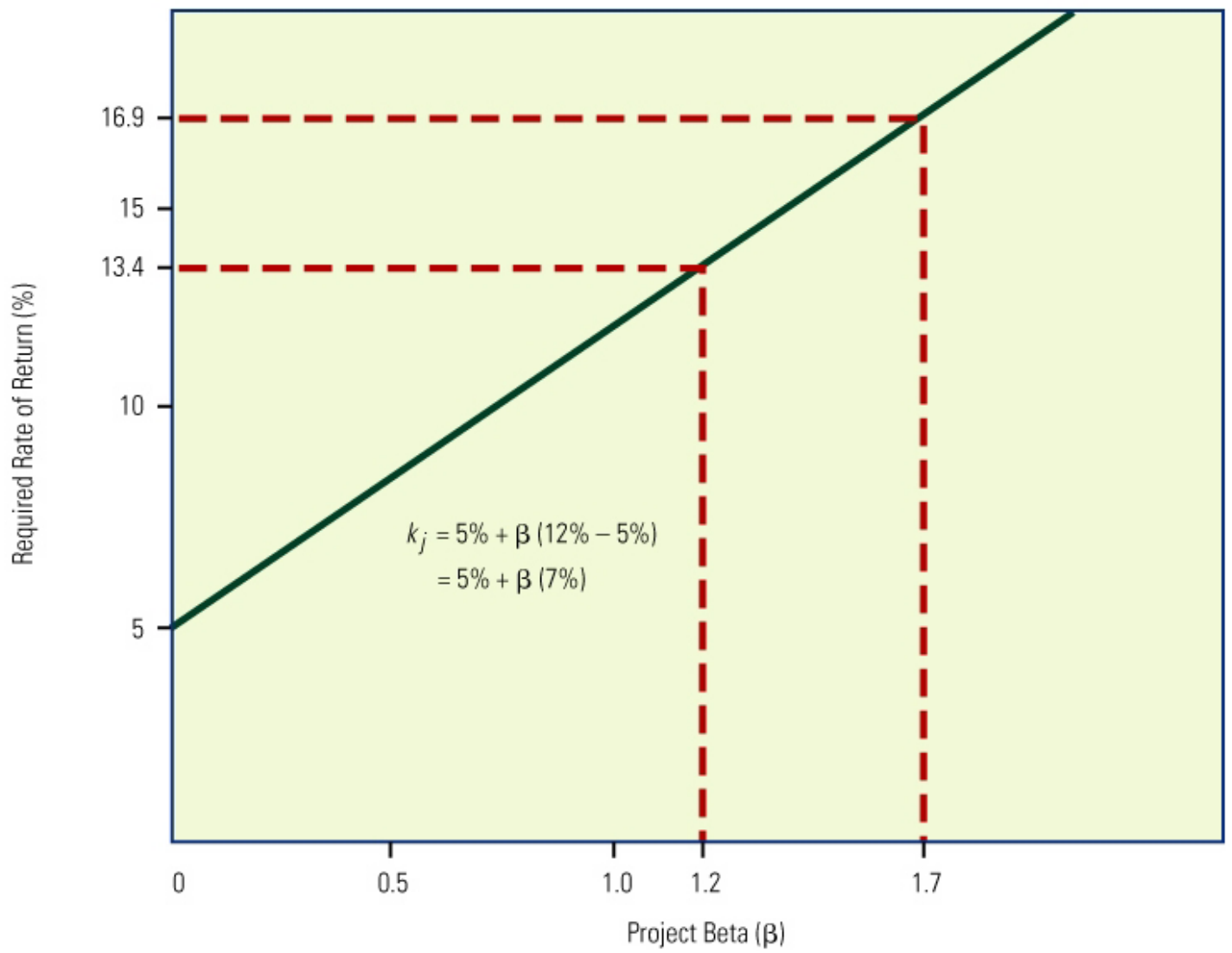
- The all-equity case
  - The project's risk-adjusted discount rate is found with the SML equation

    $k_e^* = r_f + (r_m - r_f)\,\beta$
  - Note: The Beta used here is the individual project Beta, not the firm Beta!

Risk-Adjusted Discount Rates and the SML



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- The equity and debt case
  - risk-adjusted discount rate should reflect the project's equity requirement and the debt return requirement for the funds expected to be used to finance the project
  - Steps to compute risk-adjusted discount rate

  (see next page)

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- Compute unleveraged/pure project beta

$$\beta_u = \frac{\beta_l}{1 + (1 - T)(B / E)}$$

- Compute the leveraged beta associated with the project according to the proposed target capital structure for the project

$$\beta_l = \beta_u [1 + (1 - T)(B / E)]$$

...continued

- Compute the required return on the equity portion of the project by using SML

$$k_e = r_f + \beta_l (r_m - r_f)$$

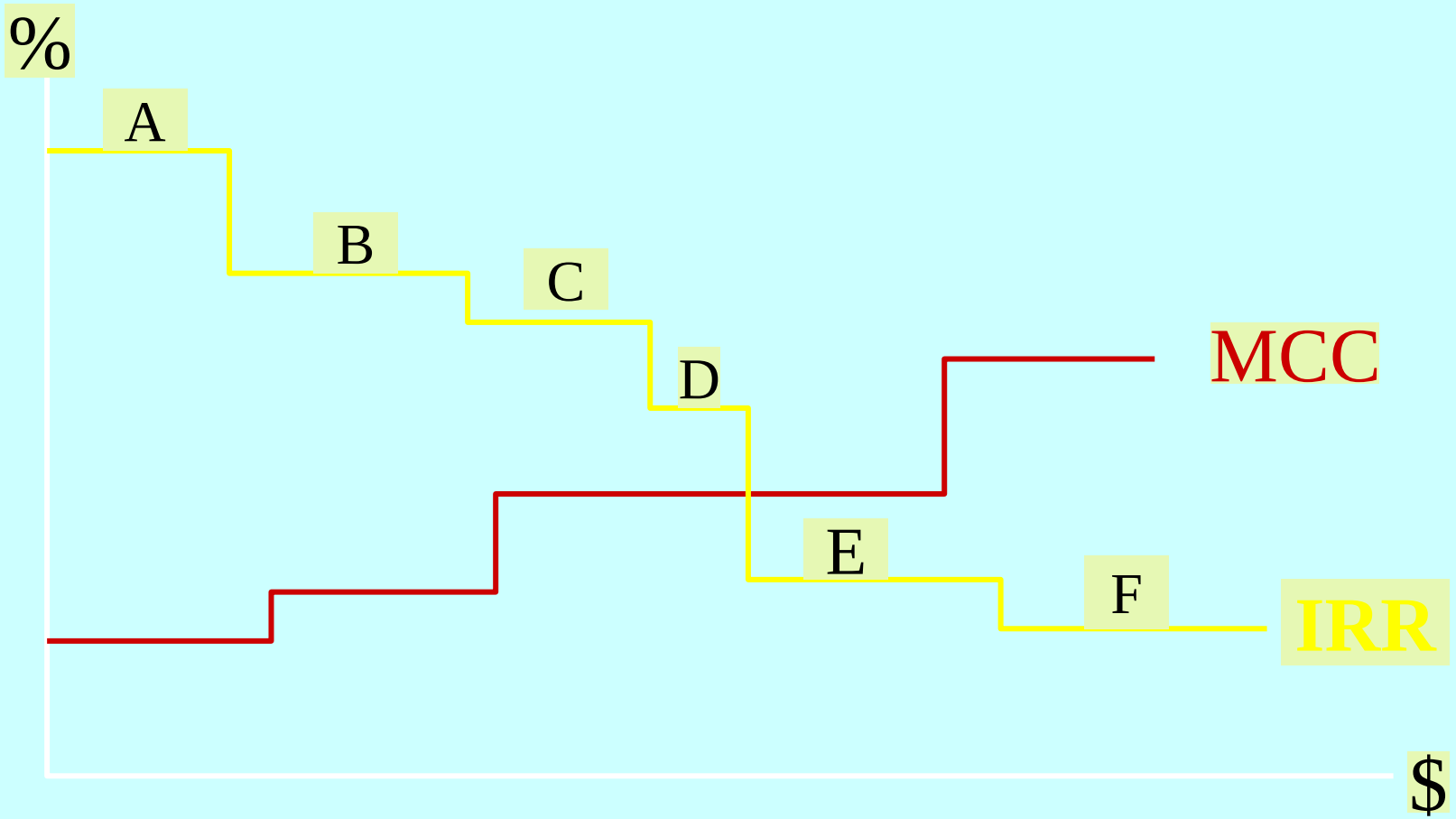
- Compute the weighted average of the debt and equity costs,that is, the risk-adjusted discount rate

$$k_a^* = k_d \times \frac{B}{B+E} + k_e \times \frac{E}{B+E}$$

4. Optimal capital budgeting

- Compare the expected project returns (Investment Opportunity Schedule —IOS)to the company's MCC schedule
- Accomplished by plotting the returns expected from the proposed capital expenditure projects against the cumulative funds required
- Cost of funds may increase with the amount of financing required

Optimal Capital Budget
(combination of MCC schedule and IOS schedule)



Optimal capital budget contains all projects for which the expected return lies above the MCC

Determining the Optimal Capital Budget