Chapters 11&12 -- Capital Budgeting

- Capital budgeting
- Project classifications
- Capital budgeting techniques
- Cash flow estimation
- Risk analysis in capital budgeting
- Optimal capital budget

- Capital budgeting
  Strategic business plan: a long-run plan that outlines in broad terms the firm’s basic strategy for the next 5 to 10 years

  Capital budgeting: the process of planning expenditures on assets with cash flows that are expected to extend beyond one year

- Project classifications
  Replacements:
  Need to continue current operations
  Need to reduce costs

  Expansions:
  Need to expand existing products or markets
  Need to expend into new products or markets

  Others: safety/environmental projects, mergers

- Capital budgeting techniques (Chapter 11)
  (1) Net present value (NPV): present value of future net cash flows, discounted at the cost of capital
  \[ NPV = \sum_{t=0}^{N} \frac{CF_t}{(1 + r)^t}, \text{ where } r \text{ is the cost of capital, } CF_t \text{ is the cash flow in time } t \]

  (2) Internal rate of return (IRR): rate of return a project earns (a discount rate that forces a project’s NPV to equal zero)
  \[ NPV = \sum_{t=0}^{N} \frac{CF_t}{(1 + IRR)^t} = 0 \]

  Problems associated with IRR:
  Multiple rates of return and unrealistic reinvestment rate assumption
(3) Modified internal rate of return (MIRR): discount rate at which the present value of initial cost is equal to the present value of the terminal value

(4) Payback period: the length of time (years) required for an investment’s cash flows to cover its cost

(5) Discounted payback period: the length of time (years) required for an investment’s cash flows, discounted at the investment’s cost of capital to recover its cost

Examples: basic data for projects L and S

<table>
<thead>
<tr>
<th>Table 11-1</th>
<th>Data on Projects S and L</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>WACC for both projects:</td>
</tr>
<tr>
<td>4</td>
<td>10%</td>
</tr>
<tr>
<td>5</td>
<td>Years:</td>
</tr>
<tr>
<td>6</td>
<td>Initial Cost:</td>
</tr>
<tr>
<td>7</td>
<td>After-Tax, End of Year Net Cash Inflows, CFj:</td>
</tr>
<tr>
<td>8</td>
<td>Total Inflows</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>13</td>
<td>4</td>
</tr>
<tr>
<td>14</td>
<td>-1,000.00</td>
</tr>
<tr>
<td>15</td>
<td>$500</td>
</tr>
<tr>
<td>16</td>
<td>$400</td>
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<td>17</td>
<td>$300</td>
</tr>
<tr>
<td>18</td>
<td>$100</td>
</tr>
<tr>
<td>19</td>
<td>$1,300</td>
</tr>
<tr>
<td>20</td>
<td>$1,475</td>
</tr>
</tbody>
</table>

(1) NPV approach

TI BAII plus or TI BAII plus professional (CF function)
Press CF first, then press 2nd, followed by pressing CLR WORK
CF0 = -1,000, enter ↓; C01 = 500, enter ↓; F01 = 1, ↓; repeat the same procedure to enter C02 = 400, C03 = 300, and C04 = 100; press NPV, you see I = 0.0000; enter 10, press enter and ↓; you will see NPV = 0.0000; press CPT (on the up left corner); NPV = 78.8198 (keep 4 decimals)

Exercise: check NPV_L = 100.40

Decision rule: if NPV > 0, accept the project; if NPV < 0, reject the project
Independent vs. mutually exclusive projects

Independent projects are projects with cash flows that are not affected by the acceptance or rejection of other projects.

Mutually exclusive projects are a set of projects where only one can be accepted.

What if L and S are mutually exclusive?
Choose L because $NPV_L > NPV_S$.

In general, you should choose the project with the highest positive NPV.

If they are independent, you should choose both because NPV for both > 0.

(2) IRR approach

TI BAII plus or TI BAII plus professional (CF function)
Press CF first, then press 2nd, followed by pressing CLR WORK.
CF0 = -1,000, enter ↓; C01 = 500, enter ↓; F01 = 1, ↓; repeat the same procedure to enter C02 = 400, C03 = 300, and C04 = 100; press IRR, you will see IRR = 0.0000; press CPT (on the up left corner); IRR= 14.4888 (keep 4 decimals).

Exercise: check $IRR_L = 13.5492\%$

Decision rule: if IRR > r, accept the project; if IRR < r, reject the project where r is the hurdle rate (the required rate of return for the project).

Multiple IRRs: the situation where a project has two or more solutions (or IRRs).

Reinvestment rate assumptions: NPV approach is based on the assumption that cash flows can be reinvested at the project’s risk-adjusted WACC, where the IRR approach is based on the assumption that cash flows can be reinvested at the project’s IRR.
(3) MIRR approach

(1) Compound each future cash inflow to the “terminal year”, using WACC
(2) Add all the future values to get “terminal value”
(3) Calculate I/YR to get MIRR

Decision rule: if MIRR > r, accept the project; if MIRR < r, reject the project
where r is the hurdle rate (the required rate of return for the project)
NPV profile: a graph that shows the relationship between a project’s NPV and the firm’s cost of capital

**FIGURE 11-5** NPV Profile for Project S

When \( r < 14.4888\% \), NPV for S is positive, which means that the project will be accepted.

When \( r > 14.4888\% \), NPV for S is negative, which means that the project will be rejected.
NPV profiles for project L and S

**FIGURE 11-6** NPV Profiles for Projects S and L

![Graph showing NPV profiles for projects L and S with crossover rate at 10%]

<table>
<thead>
<tr>
<th>Cost of Capital</th>
<th>NPV$_S$</th>
<th>NPV$_L$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>$300.00</td>
<td>$475.00</td>
</tr>
<tr>
<td>5</td>
<td>180.42</td>
<td>268.21</td>
</tr>
<tr>
<td>10</td>
<td>78.82</td>
<td>100.40</td>
</tr>
<tr>
<td>Crossover</td>
<td>11.975</td>
<td>42.84</td>
</tr>
<tr>
<td>IRR$_L$</td>
<td>13.549</td>
<td>15.64</td>
</tr>
<tr>
<td>IRR$_S$</td>
<td>14.489</td>
<td>0.00</td>
</tr>
<tr>
<td>15</td>
<td>-8.33</td>
<td>-37.26</td>
</tr>
<tr>
<td>20</td>
<td>-83.72</td>
<td>-151.33</td>
</tr>
</tbody>
</table>

Crossover rate: the cost of capital at which the NPV profiles of two projects cross and thus, at which the projects’ NPVs are equal

How can you calculate the crossover rate (11.9748%)?

If the cost of capital is less than 11.9748%, L is a better project.
If the cost of capital is greater than 11.9748% (but less than 14.4888%), S is a better project.
Ranking problem (conflict): NPV approach and IRR approach sometimes will lead to different rankings for mutually exclusive projects.

For example, using NPV approach, project L is better than project S if the cost of capital is 10% (L has a higher NPV than S). On the other hand, using IRR approach, S is better than L (S has a higher IRR than L).

If ranking problem occurs use NPV approach to make the final decision.

Main conditions to cause conflicts:
- Timing of cash flows
- Scale of cash flows

(4) Payback period approach

**FIGURE 11-7** Payback Calculations

<table>
<thead>
<tr>
<th>Project S</th>
<th>Years</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cash flow</td>
<td>-1,000</td>
<td>500</td>
<td>400</td>
<td>300</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Cumulative cash flow</td>
<td>-1,000</td>
<td>-500</td>
<td>-100</td>
<td>200</td>
<td>300</td>
</tr>
<tr>
<td>Payback S = 2 + 100/300 =</td>
<td>2.33</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project L</th>
<th>Years</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cash flow</td>
<td>-1,000</td>
<td>100</td>
<td>300</td>
<td>400</td>
<td>675</td>
</tr>
<tr>
<td></td>
<td>Cumulative cash flow</td>
<td>-1,000</td>
<td>-900</td>
<td>-600</td>
<td>-200</td>
<td>475</td>
</tr>
<tr>
<td>Payback L = 3 + 200/675 =</td>
<td>3.30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[
\text{Payback} = \text{# of years prior to full recovery} + \frac{\text{unrecovered cost}}{\text{cash flow in full recovery year}}
\]

Decision rule:
- If payback < maximum payback, then accept the project.
- If payback > maximum payback, then reject the project.

Weaknesses:
- Arbitrary maximum payback
- Ignores time value of money
- Ignores cash flows after maximum payback period
(5) Discounted payback period approach

**FIGURE 11-8** Discounted Payback Calculations at 10% Cost of Capital

<table>
<thead>
<tr>
<th>Project S</th>
<th>Years</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash flow</td>
<td>$-1,000$</td>
<td>$500$</td>
<td>$400$</td>
<td>$300$</td>
<td>$100$</td>
<td></td>
</tr>
<tr>
<td>Discounted cash flow</td>
<td>$-1,000$</td>
<td>$455$</td>
<td>$331$</td>
<td>$225$</td>
<td>$68$</td>
<td></td>
</tr>
<tr>
<td>Cumulative discounted CF</td>
<td>$-1,000$</td>
<td>$-545$</td>
<td>$-215$</td>
<td>$11$</td>
<td>$79$</td>
<td></td>
</tr>
<tr>
<td>Discounted payback $S = 2 + 215/225 = 2.95$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project L</th>
<th>Years</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash flow</td>
<td>$-1,000$</td>
<td>$100$</td>
<td>$300$</td>
<td>$400$</td>
<td>$675$</td>
<td></td>
</tr>
<tr>
<td>Discounted cash flow</td>
<td>$-1,000$</td>
<td>$91$</td>
<td>$248$</td>
<td>$301$</td>
<td>$461$</td>
<td></td>
</tr>
<tr>
<td>Cumulative discounted CF</td>
<td>$-1,000$</td>
<td>$-909$</td>
<td>$-661$</td>
<td>$-361$</td>
<td>$100$</td>
<td></td>
</tr>
<tr>
<td>Discounted payback $L = 3 + 361/461 = 3.78$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Step 1:* discount future cash flows to the present at the cost of capital (round to the nearest whole dollar)*

*Step 2:* follow the steps similar to payback period approach

Decision rule: similar to that of payback period

Weaknesses:
- Arbitrary maximum discounted payback period
- Ignores cash flows after maximum discounted payback period

Decision criteria used in practice

**Table 11-2** Capital Budgeting Methods Used in Practice

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NPV</td>
<td>0%</td>
<td>0%</td>
<td>15%</td>
<td>75%</td>
</tr>
<tr>
<td>IRR</td>
<td>20%</td>
<td>60%</td>
<td>65%</td>
<td>76%</td>
</tr>
<tr>
<td>Payback</td>
<td>35%</td>
<td>45%</td>
<td>5%</td>
<td>57%</td>
</tr>
<tr>
<td>Discounted Payback</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>29%</td>
</tr>
<tr>
<td>Other</td>
<td>45%</td>
<td>25%</td>
<td>15%</td>
<td>NA</td>
</tr>
<tr>
<td>Totals</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

• Cash flow estimation (Chapter 12)
  Guidelines when estimating cash flows:
  Use after tax cash flows
  Use increment cash flows
  Changes in net working capital should be considered
  Sunk costs should not be included
  Opportunity costs should be considered
  Externalities should be considered
  Ignore interest payments (separate financing decisions from investment decisions)

  \[ FCF = [EBIT \times (1 - T) + \text{depreciation}] - [\text{capital expenditures} + \Delta \text{NOWK}] \]

  \[ EBIT \times (1 - T) = \text{net operating profit after tax} = \text{NOPAT} \]
  \[ \Delta \text{NOWK} = \text{change in net operating working capital} \]

Steps in estimating cash flows:
(1) Initial outlay
(2) Differential (operating) cash flows over project’s life
(3) Terminal cash flows
(4) Time line and solve

Example: an expansion project
- Allied is considering purchasing an equipment. The cost is $900,000 (t = 0). The inventory will increase by $175,000 and account payable will increase by $75,000 (the net change in operating working capital will be $100,000).
- The project will last for 4 years. Allied forecasts of sales of 537,000 units in year 1 (t = 1), 520,000 units in year 2 (t = 2), 505,000 units in year 3 (t = 3), and 490,000 in year 4 (t = 4). The unit price is $10.
- The fixed cost is $2,000,000 each year and the variable cost to product each unit is $5.092 for year 1 (t = 1), $5.391 for year 2 (t = 2), $5.228 for year 3 (t = 3), and $6.106 for year 4 (t = 4).
- Allied will use MACRS and straight line depreciation methods to compare the results
- After 4 years, Allied expects a salvage value of the equipment to be $50,000. The company expects to fully recover the NOWC of $100,000
- The tax rate for the firm is 40%
- The project’s WACC is estimated to be 10%

Question: Should Allied take the project?
Since NPV is positive, Allied should take the project. Allied should use MACRS to depreciate the new equipment since NPV for the project will be higher.
Cash flow estimation: a new project

The president of Real Time, Inc. has asked you to evaluate the proposed acquisition of a new computer. The computer’s price is $40,000 and there will be another $2,000 for shipping and installation. The computer falls into MACRS 3-year class (Use 33%, 45%, 15%, 7% depreciation schedule). Purchase of the computer would require an increase in net working capital of $2,000. The computer would increase the firm’s before-tax revenues by $20,000 per year but would also increase operating costs by $5,000 per year. The computer is expected to be used for 3 years and then be sold for $15,000. The firm’s marginal tax rate is 40%, and the project’s cost of capital is 14%.

a) What is the net initial outlay (at time t = 0)?
b) What are the operating cash flows over 3 years?
c) What is the terminal value (not including the operating cash flow in year 3)?
d) Should the firm purchase the new computer?

Answer:
a) \( CF_0 = 40,000 + 2,000 + 2,000 = $44,000 \)
b) \( CF_1 = (20,000 - 5,000) * (1 - 0.40) + 42,000 * 0.33 * 0.4 = $14,544 \)
\( CF_2 = $16,560 \)
\( CF_3 = $11,520 \)
c) \( TCF_3 = 15,000 - (15,000 - 42,000*0.07)*0.4 + 2,000 = $12,176 \)
Total cash flow in year 3 = 11,520 + 12,176 = $23,696
d) \( NPV = - $2,505.60 < 0, IRR = 10.84% < 14\% \)

Since NPV < 0, do not take the project.

Example: a replacement project

- Data for both old and new machines
  Sale revenue: $2,500
  Expected life of the old and new machines: 4 years
  WACC: 10%
  Tax: 40%

- Data for old machine
  Salvage value today: $400
  Old labor, materials, and other costs per year: $1,000
  Old machine depreciation: $100 (straight-line method)

- Data for new machine
  Cost of new machine: $2,000 (MACRS depreciation, 33%, 45%, 15% and 7%)
  New labor, materials, and other costs per year: $400

Question: Should the firm buy the new machine to replace the old machine?
Since NPV for the project is positive, the firm should take the replacement project.

- Risk analysis in capital budgeting
  Adjusting the cost of capital for risk

  Project stand-alone risk: the risk of a project as if it were the firm’s only project

  Project’s within-firm risk: the amount of risk that a project contributes to the firm
Project’s market risk: the risk that a project contributes to the market, measured by the project’s beta coefficient

Pure play method to estimate a new project’s market risk

Identify firms producing only one product that is the same as your project is going to produce and estimate betas for these firms; average these betas to proxy for your project’s beta: use CAPM to estimate your project’s required rate of return

Methods to incorporate risk into capital budgeting

Risk-adjusted cost of capital: use the beta risk to estimate the required rate of return for the project and use that rate as the discount rate to evaluate the project; the higher the risk, the higher the discount rate

- Optimal capital budget
  The annual investment in long-term assets that maximizes the firm’s value

  Capital rationing: the situation in which a firm can raise a specified, limited amount of capital regardless of how many good projects it has

<table>
<thead>
<tr>
<th>Project</th>
<th>Initial investment</th>
<th>NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$5,000,000</td>
<td>$1,000,000</td>
</tr>
<tr>
<td>B</td>
<td>$3,000,000</td>
<td>$600,000</td>
</tr>
<tr>
<td>C</td>
<td>$2,000,000</td>
<td>$500,000</td>
</tr>
</tbody>
</table>

The firm should choose projects B and C to maximize firm’s value

- Exercise
  Chapter 11
  ST-1 and ST-2
  Problems: 7 and 12
  Chapter 12
  ST-1 and ST-2
  Problems: 2, 7, and 9
Chapter 13 -- Capital Structure and Leverage

- Capital structure
- Business risk vs. financial risk
- Break-even analysis
- Determining the optimal capital structure
- Capital structure theories

- Capital structure
  The mix of debt, preferred stock, and common equity that is used by a firm to finance its assets

  The optimal capital structure: the capital structure that maximizes the company’s stock price (or minimizes the company’s overall cost of capital, WACC)

  Capital structure changes over time

- Business risk vs. financial risk
  Business risk: the riskiness inherent in the firm’s operations if it uses no debt
  It is measured by the variability of expected ROE (ROA)

  Business risk depends on:
  Competition
  Demand variability
  Sales price variability
  Input cost variability
  Ability to develop new products
  Operating leverage
  Foreign risk
  Regulations

  Operating leverage: the extent to which the fixed costs are used, the higher the fixed costs, the higher the operating leverage, the higher the business risk

  Financial risk: the additional risk placed on stockholders as a result of the firm’s decision to use debt

  Financial leverage: the extend to which fixed income securities are used
FIGURE 13.2 Illustration of Operating Leverage

Plan A

- Revenues and Costs (Thousands of Dollars)
- Sales Revenues
- Operating Profit (EBIT)
- Total Operating Costs
- Operating Loss
- Break-Even Point (EBIT = 0)
- Fixed Costs

Plan B

- Revenues and Costs (Thousands of Dollars)
- Sales Revenues
- Operating Profit (EBIT)
- Total Operating Costs
- Operating Loss
- Break-Even Point (EBIT = 0)
- Fixed Costs

Plan A

- Price: $2.00
- Variable costs: $1.50
- Fixed costs: $20,000
- Assets: $200,000
- Tax rate: 40%

Plan B

- Price: $2.00
- Variable costs: $1.00
- Fixed costs: $60,000
- Assets: $200,000
- Tax rate: 40%

<table>
<thead>
<tr>
<th>Demand</th>
<th>Probability</th>
<th>Units Sold</th>
<th>Dollar Sales</th>
<th>Operating Costs</th>
<th>Operating Profits (EBIT)</th>
<th>Net Income</th>
<th>ROE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terrible</td>
<td>0.05</td>
<td>0</td>
<td>$0</td>
<td>$20,000</td>
<td>($20,000)</td>
<td>($12,000)</td>
<td>(6.00)%</td>
</tr>
<tr>
<td>Poor</td>
<td>0.20</td>
<td>40,000</td>
<td>80,000</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0.00%</td>
</tr>
<tr>
<td>Normal</td>
<td>0.50</td>
<td>100,000</td>
<td>200,000</td>
<td>170,000</td>
<td>30,000</td>
<td>18,000</td>
<td>9.00%</td>
</tr>
<tr>
<td>Good</td>
<td>0.20</td>
<td>160,000</td>
<td>320,000</td>
<td>250,000</td>
<td>60,000</td>
<td>36,000</td>
<td>18.00%</td>
</tr>
<tr>
<td>Wonderful</td>
<td>0.05</td>
<td>200,000</td>
<td>400,000</td>
<td>320,000</td>
<td>80,000</td>
<td>48,000</td>
<td>24.00%</td>
</tr>
<tr>
<td>Expected value</td>
<td>100,000</td>
<td>$200,000</td>
<td>$170,000</td>
<td>$30,000</td>
<td>$16,000</td>
<td>9.00%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operating Costs</th>
<th>Operating Profits (EBIT)</th>
<th>Net Income</th>
<th>ROE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terrible</td>
<td>($20,000)</td>
<td>($12,000)</td>
<td>(6.00)%</td>
</tr>
<tr>
<td>Poor</td>
<td>0</td>
<td>0.00</td>
<td>0.00%</td>
</tr>
<tr>
<td>Normal</td>
<td>170,000</td>
<td>30,000</td>
<td>18.00%</td>
</tr>
<tr>
<td>Good</td>
<td>250,000</td>
<td>60,000</td>
<td>36.00%</td>
</tr>
<tr>
<td>Wonderful</td>
<td>320,000</td>
<td>80,000</td>
<td>48.00%</td>
</tr>
<tr>
<td>Expected value</td>
<td>$200,000</td>
<td>$16,000</td>
<td>9.00%</td>
</tr>
</tbody>
</table>

- Standard deviation of Plan A: $24,698, 7.41%
- Standard deviation of Plan B: $49,396, 14.82%
- Coefficient of variation: 0.82, 0.82, 1.23, 1.23

Notes:

a. Operating costs = Variable costs + Fixed costs.
b. The federal-plus-state tax rate is 40%, so NI = EBIT(1 − Tax rate) = EBIT(0.6).
c. ROE = NI/Equity. The firm has no debt, so Assets = Equity = $200,000.
d. The break-even sales level for Plan B is not shown in the table, but it is 60,000 units or $120,000.
e. The expected values, standard deviations, and coefficients of variation were found using procedures discussed in Chapter 8.
• Break-even analysis
  Variable costs: vary with the output
  Fixed costs: not vary with the output

  Notation:
  \( V \): variable cost per unit
  \( Q \): the number of units sold
  \( P \): price
  \( F \): fixed costs

  \[ \text{Break-even level of sales: } Q_{BE} = \frac{F}{P - V} \]

  Example: \( F = 100,000; \ V = 6; \ P = 10 \)
  \( Q_{BE} = 25,000 \text{ units; } P^*Q_B = 250,000 \) (break-even sales)

• Determining the optimal capital structure
  WACC and capital structure change

  \[ \text{WACC} = w_d(r_d)(1-T) + w_c(r_s), \text{ assuming no preferred stock} \]
  \[ = (D/A)^*(r_d)^*(1-T) + (E/A)^*(r_s) \]

  where \( D/A \) is the debt-to-asset ratio (also called debt ratio) and \( E/A \) is the equity-to-asset ratio (also called equity ratio) and \( D/A + E/A = 1 \)

  You are going to choose \( D/A \) or \( E/A \) to minimize \( \text{WACC} \)

  Cost of debt increases with debt; cost of equity increases with debt; beta increases with debt (since higher debt increases the risk of bankruptcy)

  \[ \text{Hamada equation: } b_l = b_u [1 + (1-T)(D/E)] \text{ or } b_u = b_l \frac{1}{[1 + (1-T)(D/E)]} \]

  We observe \( b_l, T, D/E \) ratio, therefore we can figure out \( b_u \). We then vary \( D/E \) to figure out \( b_l \) at different capital structure. We apply CAPM to find the required rates of return and stock prices at different capital structure to find the optimal capital structure that maximizes the stock price (or minimizes the WACC)

  Note: EPS maximization is not the goal of a firm and usually the maximum EPS doesn’t occur at the same capital structure where the stock price is maximized or the WACC is minimized.
The optimal capital structure occurs when the firm has 40% of debt and 60% of equity. At that capital structure, the stock price is maximized (at $22.22) and WACC is minimized (at 11.04%).

EPS is maximized when the firm has 50% debt and 50% equity.
- Capital structure theories
  Assumptions: perfect capital markets with no taxes, homogeneous information, EBIT is not affected by using debt, and investors can borrow at the same rate as corporations

Irrelevance theory (MM 58): capital structure doesn’t matter; the capital structure does not affect stock price or the overall cost of capital

The effect of taxes (MM 63): if corporate taxes are considered, stock price and overall cost of capital will be affected by the capital structure. The higher the debt, the lower the overall cost of capital, the higher the stock price.

The trade-off model: corporate taxes are considered and firms may fail
Costs of financial distress include bankruptcy-related costs
Benefits from tax shields

The greater the use of debt, the larger the fixed interest charges, the greater the probability that a firm will go bankruptcy. At the same time, the greater the use of debt, the larger the tax shields.

\[ V_L = V_U + PV(\text{tax shields}) - PV(\text{financial distress and agency costs}) \]
Implication of trade-off model:
Higher-risk firms should borrow less
Firms with tangible assets can borrow more
Firms in higher tax bracket can borrow more

Signaling theory: asymmetric information means that investors and management have different information. Any change in capital structure reveals inside information. For example, a firm issues new stock to raise money is viewed as a negative signal which causes stock price to drop.

- Exercise
  ST-1, ST-2, and ST-3
  Problems: 2, 4, 6, and 9*

Problem 9: assets of $5 million and no debt; tax rate is 40%; NI is $1 million; dividend payout ratio is 40%; NI is expected to grow at 5% per year (constant); 200,000 shares outstanding; and WACC is 13.4% (cost of equity, r_s is 13.4%) Considering recapitalization: issue $1 million debt at a cost of 11% before tax and use the proceeds to buy back stocks; the new cost of equity will rise to 14.5%

Question a: What is the current stock price?

The current dividend per share D_0 = $400,000/200,000 = $2.00
Since the growth rate is 5% then dividend next year D_1 = $2.00*(1 + 5%) = $2.10
Therefore, P_0 = D_1/(r_s – g) = $2.10/(0.134 – 0.05) = $25.00

Question b: What would be the stock price after recapitalization?

Step 1 Calculate EBIT before the recapitalization:
EBIT = $1,000,000/(1 – T) = $1,000,000/0.6 = $1,666,667
Note: The firm is 100% equity financed, so there is no interest expense

Step 2 Calculate net income (NI) after the recapitalization:
[$1,666,667 – 0.11($1,000,000)]*0.6 = $934,000

Step 3 Calculate the number of shares outstanding after the recapitalization:
200,000 – ($1,000,000/$25) = 160,000 shares

Step 4 Calculate D_1 after the recapitalization:
D_0 = 0.4*($934,000/160,000) = $2.335
D_1 = $2.335(1.05) = $2.45175

Step 5 Calculate P_0 after the recapitalization:
P_0 = D_1/(r_s – g) = $2.45175/(0.145 – 0.05) = $25.81
Chapter 14 -- Dividend Policy

- Dividend vs. retained earnings
- Dividend policy: three basic views
- The clientele effect
- The information content or signaling hypothesis
- Dividend policy in practice
- Dividend payment procedures
- Factors influencing dividend policy
- Stock repurchase, stock dividends and stock splits

- Dividend vs. retained earnings
  Dividend payout ratio vs. profit retention ratio: a review
  Higher dividends mean lower retained earnings, which means lower growth rate and less capital gains

- Dividend policy: three basic views
  Dividend policy: to determine the optimal payout ratio to maximize the stock price

   View 1: dividend policy is irrelevant (Irrelevance Theory by MM 1961)
   Assumptions: perfect capital markets with no taxes, no transaction costs, no flotation costs, etc.
   Result: dividend policy doesn't matter; dividend policy does not affect the stock price or the overall cost of capital

   View 2: high dividends increase stock price (Bird-in-the-hand theory 1979)
   Result: investors feel more secure to receive cash dividends than the income from capital gains. Therefore, the higher the cash dividend, the better the stock

   View 3: low dividends increase stock price (Tax differential theory 1979)
   The tax rates on cash dividends were higher than the tax rates on long-term capital gains before 2003. In addition, capital gains tax can be delayed until the stocks are sold (time value of money) or can be avoid if stocks are passed to beneficiaries provided the original owner passes away.
   Result: the lower the cash dividend, the better the stock
- The clientele effect
  Different dividend policies will attract different investors

- The information content or signaling hypothesis
  Information asymmetry: insiders and outsiders have different information

  Dividends reveal some inside information about firm's future profitability. By increasing dividends, managers signal to the market that the firm will have enough earnings to support future projects.

  Result: an increase in dividend is regarded as a good signal, which causes the stock price to go up.

- Dividend policy in practice
  Residual dividend model
  A model that states that the dividends to be paid should equal to the capital left over after financing of profitable investments.

  Example:
  Target capital structure: 70% debt, 30% equity to raise funds
  The firm now needs $1,200,000 and has NI = $450,000
  Question: what should be the amount of dividend?
  Answer: $1,200,000*(0.3) = $360,000 should be raised from equity (retained)
  Dividend = NI - R/E = 450,000 - 360,000 = $90,000
  Question: If the company has 1,000,000 shares outstanding, what is DPS?
  Answer: DPS = $0.09/share

Example: T&W's dividend payout ratio under residual dividend policy

<table>
<thead>
<tr>
<th>Table 14-2</th>
<th>T&amp;W's Dividend Payout Ratio with $60 Million of Net Income When Faced with Different Investment Opportunities (Dollars in Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>INVESTMENT OPPORTUNITIES</td>
<td>Poor</td>
</tr>
<tr>
<td>Capital budget</td>
<td>$40</td>
</tr>
<tr>
<td>Net Income (NI)</td>
<td>$60</td>
</tr>
<tr>
<td>Required equity (0.6 × Capital budget)</td>
<td>24</td>
</tr>
<tr>
<td>Dividends paid (NI – Required equity)</td>
<td>$36</td>
</tr>
<tr>
<td>Dividend payout ratio (Dividends/NI)</td>
<td>60%</td>
</tr>
</tbody>
</table>

*With a $150 million capital budget, T&W would retain all of its earnings and issue $30 million of new stock.

Alternatives:
- Constant dividend payout ratio
- Stable dividend per share
- Low regular dividend plus extras when time is good
• Dividend payment procedure
  Declaration date
  Holder-of record date
  Ex-dividend date: two business days prior to the holder-of record date
  Payment date

<table>
<thead>
<tr>
<th>Declaration</th>
<th>Ex-div</th>
<th>Record</th>
<th>Payment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

  Tax implications: if you buy the stock before Ex-dividend date, you will receive dividend (but you pay a higher price); if you buy the stock after Ex-dividend date, you will not receive dividend (but you pay a lower price).

• Factors influencing dividend policy
  Constraints:
  Bond indenture
  Preferred stock restrictions
  Impairment of capital structure: dividends cannot exceed the balance sheet item R/E
  Availability of cash
  Penalty tax on improperly accumulated earnings

  Investment opportunities:
  Profitable investment opportunities
  Possibility of accelerating or delaying projects

  Alternative sources of capital:
  Cost of selling new stock
  Ability to substitute debt for equity
  Control of the company

  Effects of dividend policy on cost of equity

• Stock repurchase, stock dividend and stock splits
  Stock repurchase: reduction of shares outstanding
  Internal investment opportunity
  Capital structure
  Increase in EPS
  Ownership
  Tax advantage

  Stock dividend: a distribution of shares up to 25% of the number of shares currently outstanding, issued on a pro rata basis to the current stock holders
Stock splits: a stock dividend exceeding 25% of the number of shares currently outstanding

After stock dividend or stock split, the number of shares outstanding increases, earnings per share, dividend per share, and stock price all decline

Why stock dividends and/or stock splits?
Conserve cash
Optimal stock price range
Positive signals
Higher total value

- **Exercise**
  ST-1 and ST-2
  Problems: 1, 2, 3, 4, 5 and 6*

Problem 6: a firm has three independent projects, each of them requires $5 million investment:

- Project H (high risk)  Cost of capital = 16%  IRR = 20%
- Project M (medium risk)  Cost of capital = 12%  IRR = 10%
- Project L (low risk)  Cost of capital = 8%  IRR = 9%

The optimal capital structure is 50% debt and 50% equity. The expected net income (NI) is $7,287,500. If the firm adopts the residual dividend model, what will be the firm’s dividend payout ratio?

Answer: the firm should choose Projects H and L since IRR > cost of capital for both H and L, which means that the firm needs to raise $10 million

According to the optimal capital structure:
$10 million*(0.5) = $5 million will be raised from debt
$10 million*(0.5) = $5 million will be raised from equity (retained from NI)

Dividends = NI - R/E = 7,287,500 - 5,000,000 = $2,287,500
Payout ratio = Dividends / NI = 2,287,500 / 7,287,500 = 31.39%
Chapter 15 -- Working Capital Management

- Working capital, net working capital, and net operating working capital
- Current asset investment and financing policies
- Cash conversion cycle
- Cash and marketable securities
- Inventories
- A/R and A/P (trade credit)
- Bank loans

- Working capital, net working capital, and net operating working capital
  Working capital refers to current assets
  Net working capital = current assets - current liabilities
  Net operating working capital = current assets - (current liabilities - notes payable)

- Current assets investment and financing policies
  Current assets investment policy: how much current assets a firm should have
  Relaxed current asset policy: carry a relatively large amount of current assets along with a liberal credit policy with a high level of A/R
  Restricted current asset policy: carry constrained amount of current assets along with restricted credit policy
  Moderate current asset policy: in between the relaxed and restricted policies

![Figure 15-1: Current Asset Investment Policies (Millions of Dollars)](image)

<table>
<thead>
<tr>
<th>Policy</th>
<th>Current Assets per $100 of Sales</th>
<th>Turnover of Current Assets: Sales/CA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relaxed</td>
<td>$30</td>
<td>3.3x</td>
</tr>
<tr>
<td>Moderate</td>
<td>23</td>
<td>4.3</td>
</tr>
<tr>
<td>Restricted</td>
<td>16</td>
<td>6.3</td>
</tr>
</tbody>
</table>

Note: The sales/current assets relationship is shown here as being linear, but the relationship could be curvilinear.

Current asset financing policy: the way current assets are financed
FIGURE 15-2  Alternative Current Asset Financing Policies

a. Moderate Approach (Maturity Matching)

- Dollars
- Temporary Current Assets
- Permanent Level of Current Assets
- Fixed Assets

- Short-Term, Nonspentaneous Debt Financing
- Long-Term Debt plus Equity plus Spontaneous Current Liabilities

b. Relatively Aggressive Approach

- Dollars
- Temporary Current Assets
- Permanent Level of Current Assets
- Fixed Assets

- Short-Term, Nonspentaneous Debt Financing
- Long-Term Debt plus Equity plus Spontaneous Current Liabilities

c. Conservative Approach

- Dollars
- Marketable Securities
- Permanent Level of Current Assets
- Fixed Assets

- Short-Term Financing Requirements
- Long-Term Debt plus Equity plus Spontaneous Current Liabilities
Permanent assets vs. temporary assets
Permanent assets: to be held for more than one year
Temporary assets: to be held for less than one year

Maturity matching approach: a policy that matches asset and liability maturities and it is a moderate policy

Aggressive approach: uses more short-term, non-spontaneous debt financing
Conservative approach: uses more long-term debt and equity financing

Permanent assets should be financed by intermediate and long-term debt, preferred stock, and common stock.

Temporary assets should be financed by notes and short-term loans.

- Cash conversion cycle
  (1) The cash conversion cycle (CCC)
The average length of time funds are tied up in working capital or the length of time between paying for working capital and collecting cash from the sale of the working capital
(2) Inventory conversion period (days of sales in inventory, DSI)
The average time required to convert materials into finished goods and then sell them
(3) Average collection period (ACP)
The average length of time required to convert the firm’s receivables into cash
(4) Payables deferral period (days of payable outstanding, DPO)
The average length of time between the purchase of materials and labor and the payment of cash for them
The relationship is: \( DPO + CCC = DSI + ACP \), or \( CCC = DSI + ACP - DPO \)

Minimizing working capital: speeding cash collection (reducing ACP), increasing inventory turnovers (reducing DSI), and slowing down cash disbursement (increasing DPO)

- **Cash and marketable securities**
  Refer to currency and demand deposits in addition to very safe and highly liquid marketable securities that can be sold quickly at a predictable price and thus be converted to bank deposits

- **Inventories**
  Include supplies, raw materials, work-in-process, and finished goods

- **A/R and A/P (trade credit)**
  A/R: funds due from customers

  Credit policy: a set of rules that includes credit period, discounts, credit standards, and collection policy

  Credit terms: for example, 2/10, net 30 means that the firm allows a 2% price discount if payment is received within 10 days of the purchase; if the discount is not taken, the full payment is due in 30 days

  Credit score: a numerical score from 1 to 10 that indicates the likelihood that a person or business will pay on time

  A/P (trade credit): debt arising from credit sales and recorded as an account receivable by the seller and as an account payable by the buyer

  Trade credit may be free or it may be costly. For example, the terms 2/10, net 30 are offered when a firm makes the purchase on its credit card. Assuming 365 days per year,

  \[
  \text{Nominal annual cost of trade credit} = \frac{\text{discount} \times 365}{100 - \text{discount} \times \frac{\text{credit days} - \text{discount days}}{365}}
  \]

  \[
  = \frac{2 \times 365}{100 - 2 \times \frac{30 - 10}{365}} = 37.24\%
  \]
• Bank loans
  Promissory note: a document specifying the terms and conditions of a loan

Line of credit: an agreement in which a bank agrees to lend up to a specified maximum amount of funds during a designated period

Cost of bank loans:

\[
\text{Annual Percentage Rate (APR)} = \frac{\text{interest}}{\text{principal}} \times \frac{\text{time}}{\text{time}}
\]

For example, if XYZ borrows $1,000 for 3 months and repays the principal plus $30 interest at maturity, assuming 30 days per month and 12 months per year, then

\[
\text{APR} = \frac{30}{1,000} \times \frac{1}{90/360} = 12\%
\]

Annual Percentage Yield (APY)

\[
\text{APY} = (1 + \frac{i}{m})^m - 1
\]

APY = 12.6% for XYZ

Accrued wages and taxes

Commercial papers: unsecured, short-term promissory notes issued by large firms

• Exercise
  ST-1 and ST-2
  Problems: 1, 3, and 4