Lecture 4

Capital Budgeting

资本预算

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Capital Budgeting（资本预算）

- What is capital budgeting?
  - Companies evaluate major projects and investments and decide whether to undertake it or not.
- Examples:
  - Purchase of new equipment
  - Open a new plant
  - Develop a new product
- How to make the decision?
  - NPV, IRR, pay back period……
  - But, we need to predict the project's future cash inflows and outflows, and choose the right discount rate

Relevant Cash Flow in Capital Budgeting

- The most difficult part in capital budgeting is to estimate future cash flows.
- We now consider the specific items related to cash flows of a project in the complex real world.
  - Incremental cash flows matter—not accounting earnings. 增量现金流 / not 会计收益 (权责发生制)
  - Sunk costs do not matter. 沉没成本
  - Opportunity costs matter. 机会成本
  - Side effects matter. 外部性
  - Taxes matter: we want incremental after-tax cash flows.
  - Inflation matters. 通胀

Cash Flows—Not Accounting Income

- Always discount cash flows, not earnings, when performing a capital budgeting. Earnings do not represent real money that you can spend.
- Use incremental cash flows: difference between the cash flows with the project and cash flows without the project.
- Much of the work in evaluating a project lies in taking accounting numbers and generating cash flows.

Sunk Cost（沉没成本）

- Sunk costs: a cost that has already occurred, regardless of whether take the project or not.
- Suck costs are not incremental cash outflows and are thus irrelevant for capital budgeting.
- For example, consulting fee before making the investment decision.

咨询费

Opportunity Cost（机会成本）

- Opportunity costs: if the asset is used in the new project, potential revenues from alternative uses are lost.
- Opportunity costs *do* matter. The increase of cash flow in the new project causes the decrease of cash flow in other projects.
- For example, the sale of the warehouse if the project is not taken.

Quick Question: if taking the project, you lose the return by investing the money in the capital market (e.g., bank deposits). Is this an opportunity cost?

Financing Cost（融资成本）

为什么不计入？

- An investment project can be financed from various sources.
  - Internal cash flow
  - Debt financing
  - Equity financing

Asset | L 债权 / E 股权

- These financing sources are not free, but at some cost: opportunity cost, interest expense, dividend, price increase. It reflects the required return on the firm from the side of capital market.
  - Firm's financing cost = required return of investors

- Financing cost is not included in the calculation of cash flow, but is reflected in the discounted rate. Higher financing cost, higher discount rate.

Side Effects

侵蚀(-) 协同(+)

- Side effects include erosion and synergy. They should be taken account for the incremental cash flow.
- Erosion: a new product reduces the sales of existing products. For example, the influence of Iphone 17 on Iphone 16.
- Synergy: a new product increase the sales of other ones. For example, the influence of Iphone on Apple Music.

Cash Flows From The Project

- Free cash flow (FCF): under going concern assumption, free cash flow is the cash flow left to shareholders and debtholders.
  - "Free" means the firm is free to spend the money.
  - This is the number that we discount in capital budgeting.

- Going concern assumption: the firm will continue its business in the near future. It means certain investment in fixed assets and working capital is required.

- **Free Cash Flow = EBIT – Tax + Depreciation – △WC – Capex**

Free Cash Flow

- **Free Cash Flow = EBIT – Tax + Depreciation – △WC – Capex**

Part 1 Part 2

- Part 1: Cash flow from the investment project.
  - Interest expense is not included since it is a financing cost reflected in discount rate

- Part 2: Required expenditures to support the operation of the project
  - Capital Spending (**Capex**) : investment in fixed assets
  - Change in Net Working Capital (**△WC**): investment in working capital

Capital Budgeting: Example

Textbook 6.2: The Baldwin Company

- Costs of marketing test (already spent): $250,000 (250K)
- Current market value of proposed factory site (which we own): $150,000
- Cost of bowling ball machine: $100,000 (depreciated according to MACRS 5-year)
- Increase in net working capital: $10,000
- Production (in units) by year during 5-year life of the machine: 5,000, 8,000, 12,000, 10,000, 6,000
- Price during first year is $20; price increases 2% per year thereafter.
- Production costs during first year are $10 per unit and increase 10% per year thereafter.

Sunk cost and opportunity cost

- **Sunk cost**
  - The 250K marketing test cost
  - No need to consider it.
- **Opportunity cost**
  - If we take the project, we lose the 150K selling cash flow of the factory site.
  - We assume: the market value of the factory site remains the same at the end period and the company sell the factory site eventually.
  - Two cash flows: initial opportunity cost and selling income at the end period.

Capex and △WC

	Year 0	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*
Investments:						
(1) Bowling ball machine	–100.00					21.76
(2) Accumulated depreciation		20.00	52.00	71.20	82.72	94.24
(3) Adjusted basis of machine after depreciation (end of year)		80.00	48.00	28.80	17.28	5.76
(4) Opportunity cost (warehouse)	–150.00					150.00
(5) Net working capital (end of year)	10.00	10.00	16.32	24.97	21.22	0
(6) Change in net working capital	–10.00		–6.32	–8.65	3.75	21.22
(7) **Cash Flow part 2** (1) + (4) + (6)]	–260.00		–6.32	–8.65	3.75	192.98

Capex

△WC

Unit (1,000)

Capex and Working Capital

- **Fixed asset**
  - Two cash flows: initial purchase and selling income at the ending period. Note: selling the machine incurs taxes.
  - Ending book value: Original purchase price of the machine less depreciation equals $5,760.
  - Assume that the ending *market* value of the capital investment at year 5 is $30,000. Capital gains tax due is $8,242 = [0.34 * ($30,000 – $5,760)]. The after-tax salvage value is $30,000 – 8,242 = $21,758.

- **Net working capital**
  - Working capital is given. We need to calculate the changes in working capital in each year.
  - The sum of net working capital changes is zero across the project life.

Cash Flow from Operations

	Year 0	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*
Income:						
(8) Sales Revenues		100.00	163.20	249.70	212.24	129.89

We next need the cash flow part1, which is generated from the operations of the project! Recall that production (in units) by year during the 5-year life of the machine is given by:

(5,000, 8,000, 12,000, 10,000, 6,000).

Price during the first year is \$20 and increases 2% per year thereafter.

Sales revenue in year 2 = $8{,}000 \times [\$20 \times (1.02)^1] = 8{,}000 \times \$20.40 = \$163{,}200$.

Capital Budgeting: Example

	Year 0	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*
Income:						
(8) Sales Revenues		100.00	163.20	249.70	212.24	129.89
(9) Operating costs		50.00	88.00	145.20	133.10	87.85

- Again, production (in units) by year during 5-year life of the machine is given by:

(5,000, 8,000, 12,000, 10,000, 6,000)

- Production costs during the first year (per unit) are \$10, and they increase 10% per year thereafter.

$$\text{Production costs in year 2} = 8{,}000 \times [\$10 \times (1.10)^1] = \$88{,}000$$

Capital Budgeting: Example

	Year 0	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*
Income:						
(8) Sales Revenues		100.00	163.20	249.70	212.24	129.89
(9) Operating costs		-50.00	-88.00	-145.20	-133.10	-87.85
(10) Depreciation		-20.00	-32.00	-19.20	-11.52	-11.52

↘ related to tax fee.

Depreciation is calculated using the Modified Accelerated Cost Recovery System (shown at right).

Our cost basis is $100,000.

Depreciation charge in year 4

= $100,000 × (.1152) = $11,520.

Year	ACRS %
1	20.00%
2	32.00%
3	19.20%
4	11.52%
5	11.52%
6	5.76%
Total	100.00%

Capital Budgeting: Example

	Year 0	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*
		Income:				
(8) Sales Revenues		100.00	163.20	249.70	212.24	129.89
(9) Operating costs		-50.00	-88.00	-145.20	-133.10	-87.85
(10) Depreciation		-20.00	-32.00	-19.20	-11.52	-11.52
(11) Income before taxes		30.00	43.20	85.30	67.62	30.53
		[(8) – (9) - (10)]				
(12) Tax at 34 percent		-10.20	-14.69	-29.00	-22.99	-10.38
(13) Net Income		19.80	28.51	56.30	44.63	20.15

Now we obtain the incremental cash flow incurred by taxes.

Capital Budgeting: Example

	Year 0	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*
(1) Sales Revenues		$100.00	$163.20	$249.70	$212.24	$129.89
(2) Operating costs		-50.00	-88.00	-145.20	-133.10	-87.85
(3) Taxes		-10.20	-14.69	-29.00	-22.99	-10.38
(4) **Cash Flow Part 1** [(1) – (2) – (3)]		39.80	60.51	75.50	56.15	31.67
(5) **Cash Flow Part 2**	–260		–6.32	–8.65	3.75	192.98
(6) **Incremental CF** [(4) + (5)]	–260	39.80	54.19	66.85	59.90	224.65

$$NPV = -\$260 + \frac{\$39.80}{(1.10)} + \frac{\$54.19}{(1.10)^2} + \frac{\$66.85}{(1.10)^3} + \frac{\$59.90}{(1.10)^4} + \frac{\$224.65}{(1.10)^5}$$

$$NPV = \$51.59$$

Methods to Calculate Cash Flows

Assume no interest expense

- Top-Down Approach (direct method)
  - Sales – Costs – Taxes
  - Do not subtract non-cash deductions
- Bottom-Up Approach
  - NI + Depreciation
- Tax Shield Approach
  - (Sales – Costs)(1 – T) + Depreciation*T

Inflation

- Inflation is an important fact of economic life and must be considered in capital budgeting.

- Fisher equation:

$$(1 + \text{Nominal Rate}) = (1 + \text{Real Rate}) \times (1 + \text{Inflation Rate})$$
$$\cong \text{Nominal Rate} - \text{Inflation Rate}$$

- In capital budgeting, one must compare real cash flows discounted at real rates or nominal cash flows discounted at nominal rates.

Risk Analysis

The key in capital budgeting is to estimating the cash flows and discount rate. However, the estimation may not be with certain. We want to see how the results change if the input variables vary.

- **Sensitivity tests**: how NPV changes when input variables changes. For example, how NPV changes if revenues increase 10%.
- **Scenario tests**: different scenarios happen with a probability. For example, in different scenarios, cash flows are different.
- **Monte Carlo simulation**: define input variables using probability distributions. It is a step beyond either sensitivity analysis or scenario analysis. The name is from the famous European casino.

Monte Carlo Simulation

- Step 1: Specify the Basic Model
- Step 2: Specify a Distribution for Each Variable in the Model
- Step 3: The Computer Draws One Outcome
- Step 4: Repeat the Procedure, e.g., 10,000 times.
- Step 5: Calculate NPV

Please see the SpreadSheet for a specific example!