CHAPTER 21

Capital Budgeting
and
Cost Analysis

CAPITAL BUDGETING

- Working closely with accountants, top executives have to figure out how and when to best allocate the firm's financial resources among alternative opportunities to create future value for the company. Because it is hard to know what the future holds and how much projects will ultimately cost, this can be a challenging task, but it is one that managers must constantly confront.
- This chapter explains the different methods managers use to get the "biggest bang" for the firm's "buck" in terms of the projects they undertake.

CAPITAL BUDGETING, CONT'D

- Capital budgeting is the process of making long-run planning decisions for investments in projects.
- In much of accounting, income is calculated on a period-by-period basis.
- In choosing investments, managers make a selection from among multiple projects each of which may span several different periods.
- *Examples on capital budgeting projects.*

FIVE STAGES IN CAPITAL BUDGETING

1. Identify projects—identify potential capital investments that agree with the organization's strategy.
2. Obtain information—gather information from all parts of the value chain to evaluate alternative projects.
3. Make predictions—forecast all potential cash flows attributable to the alternative projects.

FIVE STAGES IN CAPITAL BUDGETING, CONCLUDED

4. Make Decisions by Choosing Among Alternatives - Determine which investment yields the greatest benefit and least cost to the organization.
5. Implement the decision, evaluate performance and learn (generally separated into two phases):
   I. Obtain funding and make the investment selected in stage 4.
   II. Track realized cash flows, compare against estimated numbers and revise plans if necessary.

CAPITAL BUDGETING AND WORKING CAPITAL

- New projects often require additional investments in current assets, such as inventories and receivables.
- Working capital in this chapter refers to the difference between current assets and current liabilities.
- Any additional investment required for a project will be included in that project's cash flows.

FOUR CAPITAL BUDGETING METHODS

1. Net present value (NPV)
2. Internal rate of return (IRR)
3. Payback period
4. Accrual accounting rate of return (AARR)

Methods 1 and 2 (NPV and IRR) are discounted cash flow (DCF) methods.

DISCOUNTED CASH FLOWS

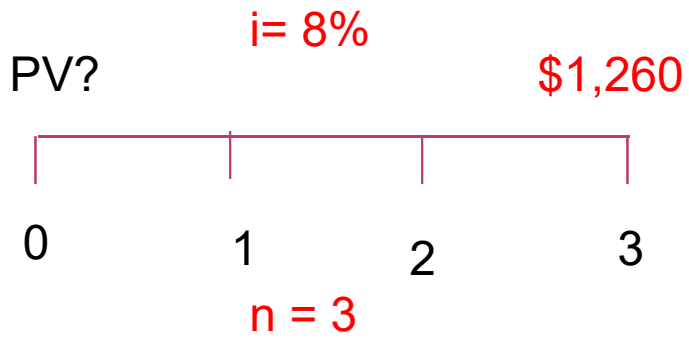
- Discounted cash flow (DCF) methods measure all expected future cash inflows and outflows of a project discounted back to the present point in time.
- The key feature of DCF methods is the time value of money which means that a dollar received today is worth more than a dollar received at any future time.
- The reason is that $1 received today could be invested at, say, 10% per year so that it grows to $1.10 at the end of one year.

PRESENT VALUE CALCULATIONS-EXAMPLES

- 1- Amount (FV)
- 2- Interest Rate (i)
- 3- Time period (n)

PV Tables

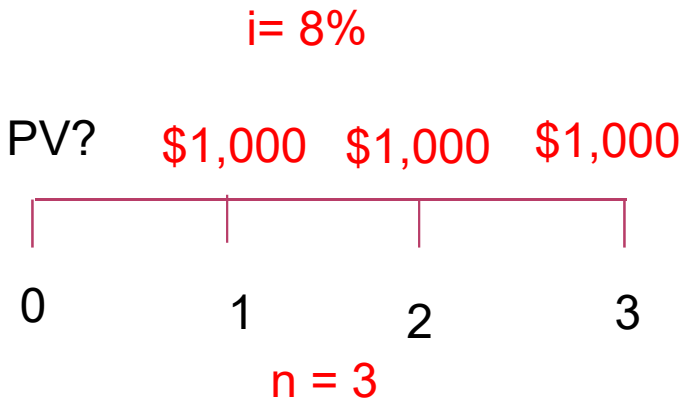
- P.V of $1 (PV of 1 Table)



PV = 1,260 * PVF at 8% for 3 periods (0.794)
= $1,000

PRESENT VALUE CALCULATIONS-EXAMPLES

- P.V of Ordinary Annuity



PV = 1,000 * PVF - OA at 8% for 3 periods (2.577)
= $2,577

DISCOUNTED CASH FLOWS, CONT'D

- DCF methods use the required rate of return (RRR), which is the minimum acceptable annual rate of return on an investment.
- RRR is internally set, usually by upper management, and typically represents the return that an organization could expect to receive elsewhere for an investment of comparable risk.
- RRR is also called the discount rate, hurdle rate, cost of capital, or opportunity cost of capital.

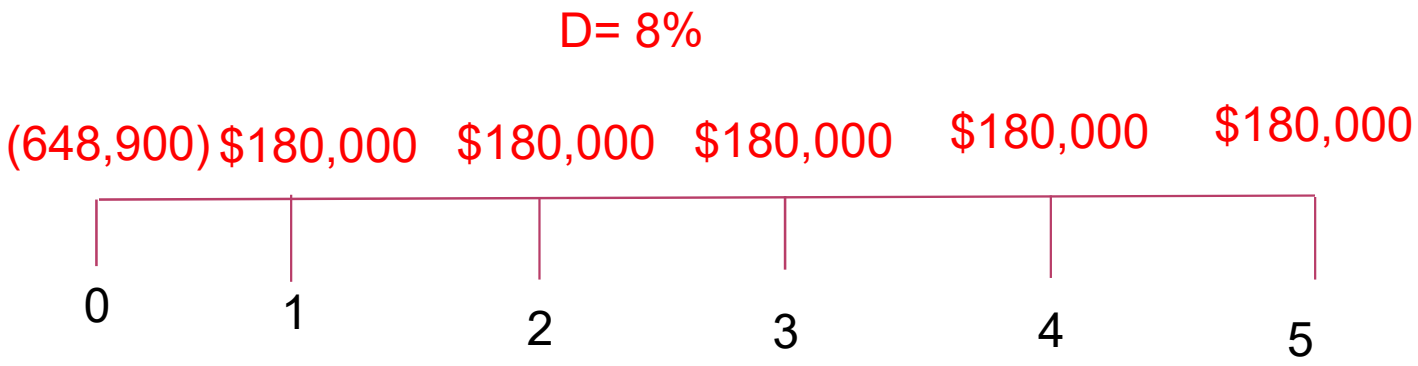
NET PRESENT VALUE (NPV) METHOD

- The NPV method calculates the expected monetary gain or loss from a project by discounting all expected future cash inflows and outflows back to the present point in time, using the RRR.
- Based on financial factors alone, only projects with a zero or positive NPV are acceptable.
- We'll use three steps for the NPV method.

THREE-STEP NPV METHOD

1. Draw a sketch of the relevant cash inflows and outflows. (see right side of next slide)
2. Discount the Cash Flows using the Correct Compound Interest Table from Appendix A and Sum Them.
3. Make the Project Decision on the Basis of the Calculated NPV (zero or positive should be accepted because the expected rate of return equals (zero) or exceeds the required rate of return.)

NPV METHOD, EXAMPLE



- Net Initial Investment (Net I): $648,900
- Annual Cash Flow (ACF): $180,000
- NPV = sum of PV of all ACF – Net I
  = 18,000 * 3.993 – 648,900
  = $69,840

NPV > 0 ACCEPT

INTERNAL RATE OF RETURN (IRR) METHOD

- The IRR Method calculates the discount rate at which an investment's present value of all expected cash inflows equals the present value of its expected cash outflows.
- We are looking here for the rate of return that makes NPV = 0.
- A project is accepted only if the IRR equals or exceeds the RRR.

IRR METHOD, CONT'D

- Managers or analysts solving capital budgeting problems typically use a **calculator or computer program** to provide the internal rate of return, but a more **manual trial and error approach** can also provide the answer.
- Trial and error approach:
  - Use a discount rate and calculate the project's NPV. Goal: find the discount rate for which NPV = 0
    1. If the calculated NPV is greater than zero, use a higher discount rate.
    2. If the calculated NPV is less than zero, use a lower discount rate.
    3. Continue until NPV = 0.

IRR METHOD, EQUAL ACF

Net I	$648,900
ACF	$180,00
Project Life	5 years

Step 1: PVF- OA = 648,900 / 180,000
= 3.605

Step 2: Go to PV-OA table and search for the factor under 5 years.
IRR = 12%

COMPARING THE NPV AND IRR METHODS

- NPV is generally preferred because its use leads to shareholder value maximization.
- NPV is expressed in dollars, not in percentages; IRR projects cannot be added or averaged to represent the IRR of a combination of projects.
- The NPV value can always be computed for a project.
- NPV method can be used when the RRR varies over the life of the project.

COMPARING THE NPV AND IRR METHODS, CONCLUDED

- IRR is more prone (than NPV) to indicate erroneous decisions.
  - IRR implicitly assumes that project cash flows can be reinvested at the project's rate of return.
  - NPV accurately assumes that project cash flows can only be reinvested at the company's required rate of return.

  Still, the IRR method is widely used.

PAYBACK METHOD, OVERVIEW

- The Payback method measures the time it will take to recoup, in the form of expected future cash flows, the net initial investment in a project.
- Like the NPV and IRR methods, the payback method does not distinguish among the sources of cash flows.
- Shorter payback period are preferable.
- Organizations choose an acceptable project payback period. Generally, the greater the risk, the shorter the payback period should be.
- The payback method is easy to understand.
- The two weaknesses of the payback method are:
  - Fails to recognize the time value of money.
  - Doesn't consider the cash flow beyond the payback point.

PAYBACK METHOD, CALCULATION

- With uniform cash flows:

$$\text{Payback Period} = \frac{\text{Net Initial Investment}}{\text{Uniform Increase in Annual Future Cash Flows}}$$

Payback period = 648,900 / 180,000
= 3.6 years (3 years and 7 months)

Accept / Reject: depending on the cutoff period
If cutoff period is 4 years, then accept.

PAYBACK METHOD, CALCULATION

- With non-uniform cash flows:
  - add cash flows period-by-period until the initial investment is recovered; count the number of periods included for payback period.

Time	CFs	Unrecovered Net I
0	($100)	(100)
1	40	(60)
2	30	(30)
3	60	
4	90	

Payback period = 2 years + 30/60 = 2.5 years

- It is relatively simple to adjust the payback method to incorporate the time value of money by discounting the expected future cash flows before performing the calculations. (Discounted Payback Period)

ACCRUAL ACCOUNTING RATE OF RETURN METHOD (AARR)

- The AARR method divides the average annual [accrual accounting] income of a project by a measure of the investment in it.
- That "measure of the investment" in the project can vary company by company.
- Also called the accounting rate of return.
- The AARR method is similar to the IRR method in that both calculate a rate-of-return percentage; however, the IRR method is generally regarded as better than the AARR.

AARR METHOD FORMULA

Accrual Accounting Rate of Return	=	Average Annual After-Tax Operating Income / Net Initial Investment

Average Annual After Tax O.I = Average ACF – Depreciation Expenses

Net I	$650,000
ACF	$180,000
PPE	$600,000
Project Life	5 years

$$AARR = \frac{180{,}000 - (600{,}000/5)}{650{,}000}$$

$$= 9.23\%$$

AARR METHOD, ADVANTAGES AND DISADVANTAGES

- Firms vary in how they calculate AARR.
- Easy to understand, and uses numbers reported in financial statements.
- Does not track cash flows.
- Ignores time value of money.
- When different methods lead to different rankings of projects, more weight should be given to the NPV method because the assumptions made by the NPV method are most consistent with making decisions that maximize a company's value.

RELEVANT CASH FLOWS IN DCF ANALYSIS

One of the biggest challenges in capital budgeting, particularly DCF analysis, is determining which cash flows are relevant in making an investment selection.

- Relevant cash flows are the differences in expected future cash flows as a result of making the investment.
- A capital investment project typically has three categories of cash flows:
  1. Net initial investment.
  2. After-tax cash flow from operations.
  3. After-tax cash flow from terminal disposal of an asset and recovery of working capital.

Cash flow sketch (table): Net I and ACF

NET INITIAL INVESTMENT

- Three components of net-initial investment cash flows:

1. Initial machine investment.
2. Initial working capital investment.
3. After-tax cash flow from current disposal of old machine.

CASH FLOW FROM OPERATIONS

- Two components of cash flow from operations:

1. Annual after-tax cash flow from operations (excluding the depreciation effect).
2. Income tax cash savings from annual depreciation deductions.
   - For economic-policy reasons, tax laws specify which depreciation methods and which depreciable lives are permitted. When there is a legal choice, take the depreciation sooner rather than later because this will increase a project's NPV.

CASH FLOW FROM TERMINAL DISPOSAL OF INVESTMENT

- Two components of Terminal Disposal of Investment:

1. After-tax cash flow from terminal disposal of asset (investment).
2. After-tax cash flow from recovery of working capital (liquidating receivables and inventory that was needed to support the project).

RELEVANT CASH FLOW SKETCH - QUESTION

To illustrate relevant cash flow analysis, consider a more complex version of the Vector example with these additional assumptions:

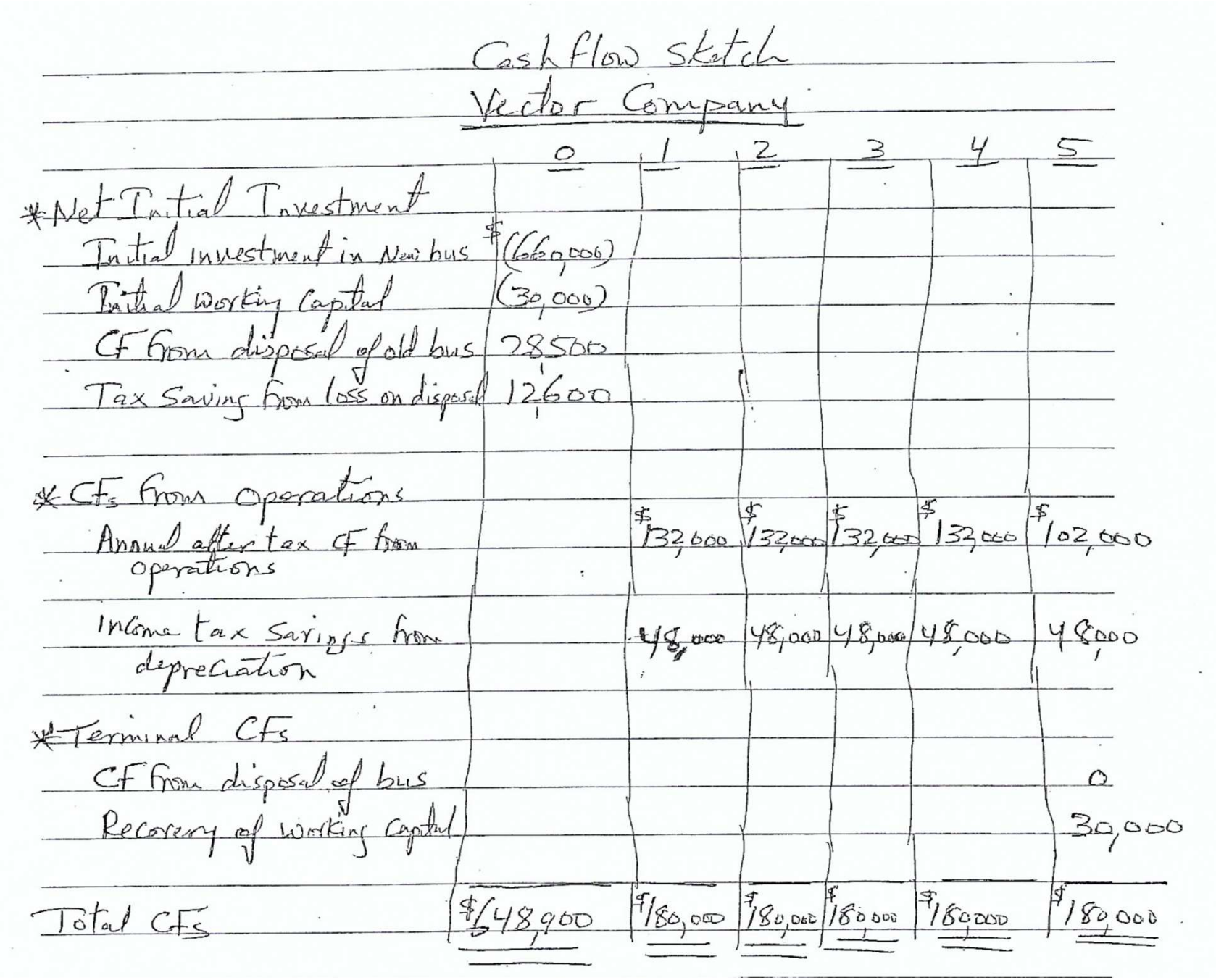
- Vector is a profitable company. The income tax rate is 40% of operating income each year.
- The before-tax additional operating cash inflows from the hybrid bus are $220,000 in years 1–4 and $170,000 in year 5.
- For tax purposes, Vector uses the straight-line depreciation method and assumes there is no terminal disposal value of the bus.
- Gains or losses on the sale of depreciable assets are taxed at the same rate as ordinary income.
- The tax effects of cash inflows and outflows occur at the same time that the cash inflows and outflows occur.
- Vector uses an 8% required rate of return for discounting after-tax cash flows.

The data for the buses follow:

	Old Bus	New Hybrid Bus
Purchase price	—	$660,000
Current book value	$60,000	—
Current disposal value	28,500	Not applicable
Terminal disposal value five years from now	0	0
Annual depreciation	12,000[a]	132,000[b]
Working capital required	6,000	36,000

[a]$60,000 ÷ 5 years = $12,000 annual depreciation.
[b]$660,000 ÷ 5 years = $132,000 annual depreciation.

RELEVANT CASH FLOWS SKETCH -ANSWER



Cash flow sketch
Vector Company

	0	1	2	3	4	5
* Net Initial Investment						
Initial investment in New bus	$(660,000)					
Initial working capital	(30,000)					
CF from disposal of old bus	28,500					
Tax saving from loss on disposal	12,600					
* CFs from operations						
Annual after tax CF from operations		$132,000	$132,000	$132,000	$132,000	$102,000
Income tax savings from depreciation		48,000	48,000	48,000	48,000	48,000
* Terminal CFs						
CF from disposal of bus						0
Recovery of working capital						30,000
Total CFs	$(48,900)	$180,000	$180,000	$180,000	$180,000	$180,000