Chapter 8
Lecture # 1-3

- **Overview of Chapter 8**
- **A Typical CFD for Evaluation of a New Project**
- **Profitability Criteria for Project Evaluation**

Overview of Chapter 8

Title: Profitability Analysis

Topics:

- A Typical CFD for Evaluation of a New Project
- Profitability Criteria for Project Evaluation
- Comparing Several Large Projects
- Comparing Investment Alternatives
- The Concept of Risk
- Evaluation of Equipment Alternatives
- Profit Margin

A Typical CFD for Evaluation of a New Project

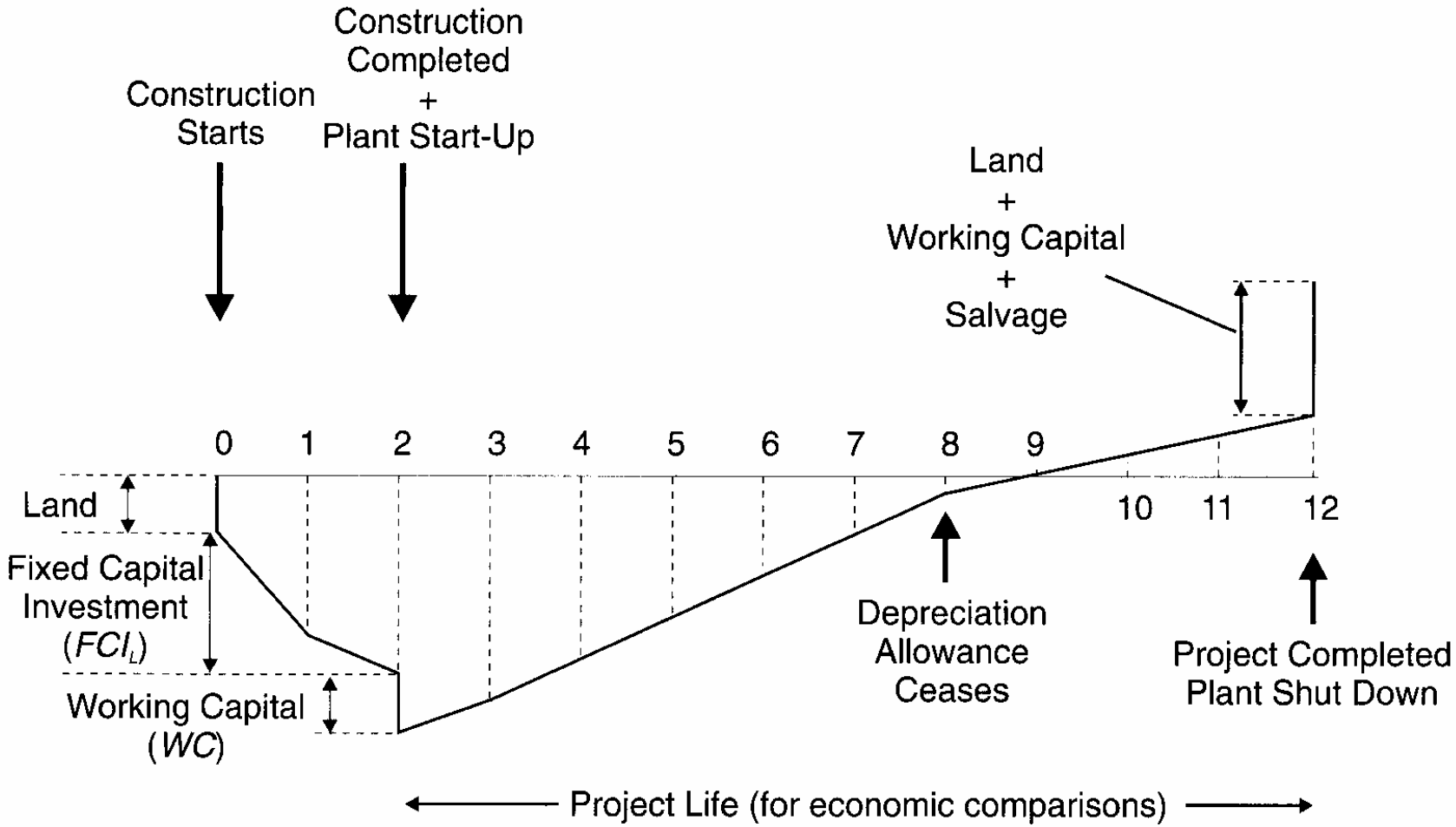

Figure 8.1 A Typical Cumulative Cash Flow Diagram for the Evaluation of a New Project

Profitability Criteria for Project Evaluation

3 Bases for Evaluation of Profitability

1. Time
2. Cash
3. Interest Rate

Profitability Criteria for Project Evaluation

- Non-discounted methods do not consider the time-value of money.
- Not recommended for evaluating new, large projects

Profitability Criteria for Project Evaluation

Non-Discounted Profitability Criteria

- Time Criterion.

Payback Period (PBP)

PBP = Time required, after start-up, to recover the fixed capital investment, FCI_L, for the project

The shorter the PBP, the better.

Profitability Criteria for Project Evaluation

Non-Discounted Profitability Criteria

- Cash Criterion.

Cumulative Cash Position (CCP)

CCP = Worth of the project at the end of its life

Cumulative Cash Ratio (CCR)

$$CCR = \frac{\text{Sum of All Positive Cash Flows}}{\text{Sum of All Negative Cash Flows}}$$

CCR > 1 implies that the project is potentially profitable.

Profitability Criteria for Project Evaluation

Non-Discounted Profitability Criteria

- Interest Rate Criterion.

Rate of Return on Investment (ROROI)

$$ROROI = \frac{\text{Average Annual Net Profit}}{\text{Fixed Capital Investment } (FCI_L)}$$

The higher the value of ROROI, the better.

Profitability Criteria for Project Evaluation

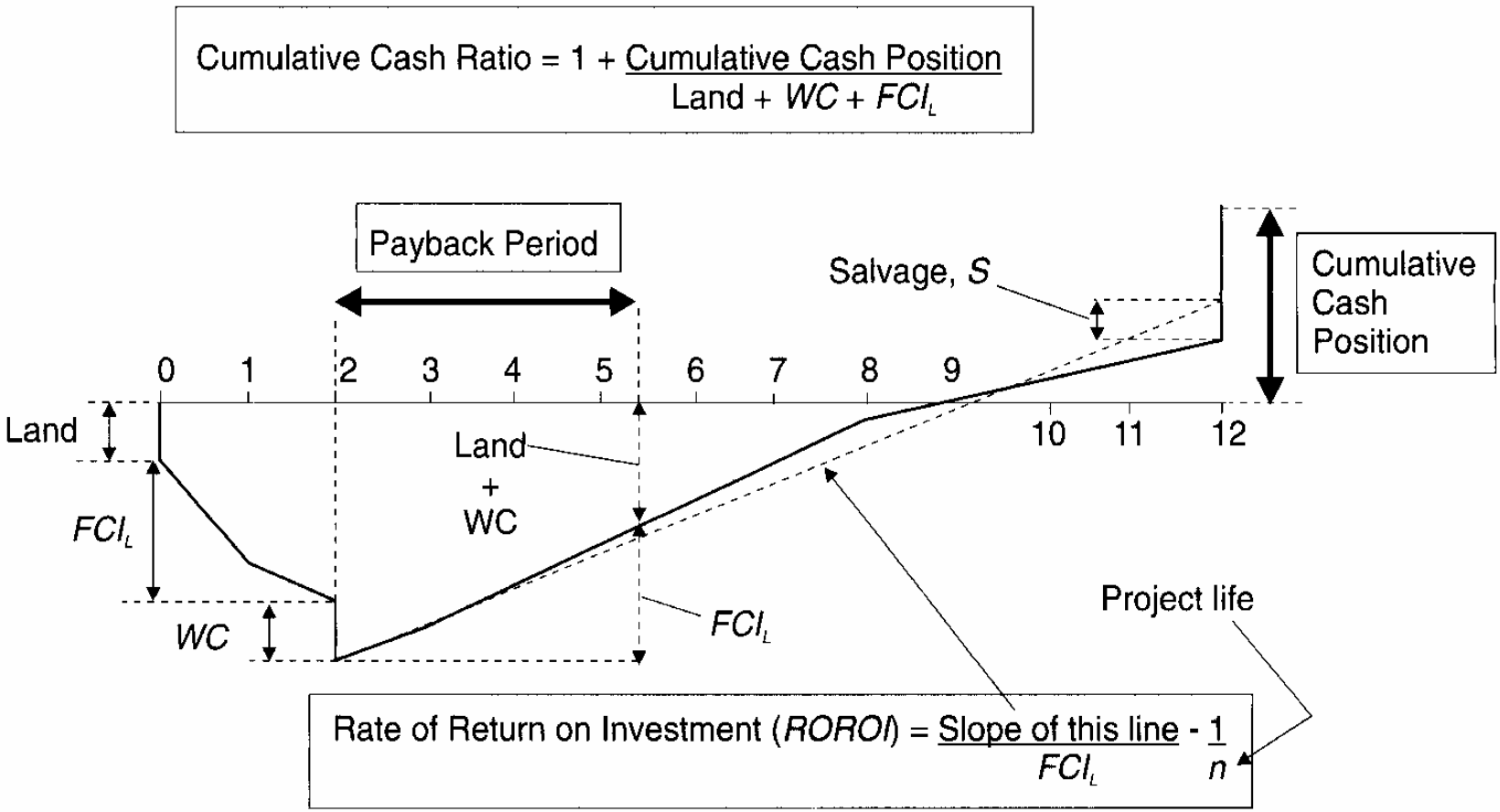

Figure 8.2 Illustration of Nondiscounted Profitability Criteria

Profitability Criteria for Project Evaluation

Example 8.1

A new chemical plant is going to be built and will require the following capital investments (all figures are in $ million):

Cost of land, L = \$10.0
Total fixed capital investment, FCI_L = \$ 150.0
Fixed capital investment during year 1 = \$90.0
Fixed capital investment during year 2 = \$60.0
Plant start-up at end of year 2
Working capital = 20% of FCI_L = (0.20)(\$150) = \$30.0 at end of year 2

Profitability Criteria for Project Evaluation

The sales revenues and costs of manufacturing are given below:

Yearly sales revenue (after start-up), R = \$75.0 per year

Cost of manufacturing excluding depreciation allowance (after start-up),

COM_d = \$30.0 per year

Taxation rate, t = 45%

Salvage value of plant, S = \$10.0

Depreciation use 5 year MACRS

Assume a project life of 10 years.

Calculate each nondiscounted profitability criteria given in this section for this plant.

Profitability Criteria for Project Evaluation

Table E8.1 Nondiscounted After-Tax Cash Flows for Example 8.1 (All Numbers in 10^6)

End of Year (k)	Investment	d_k	$FCI_L - \Sigma d_k$	R	COM_d	$(R\text{-}COM\text{-}d_k)\times(1\text{-}t)+d_k$	Cash Flow	Cumulative Cash Flow
0	(10)*	-	150.00	-	-	-	(10.00)	(10.00)
1	(90)	-	150.00	-	-	-	(90.00)	(100.00)
2	(60 + 30) = (90)	-	150.00	-	-	-	(90.00)	(190.00)
3	-	30.00	120.00	75	30	38.25	38.25	(151.75)
4	-	48.00	72.00	75	30	46.35	46.35	(105.40)
5	-	28.80	43.20	75	30	37.71	37.71	(67.69)
6	-	17.28	25.92	75	30	32.53	32.53	(35.16)
7	-	17.28	8.64	75	30	32.53	32.53	(2.64)
8	-	8.64	0.00	75	30	28.64	28.64	26.00
9	-	-	0.00	75	30	24.75	24.75	50.75
10	-	-	0.00	75	30	24.75	24.75	75.50
11	-	-	0.00	75	30	24.75	24.75	100.25
12	10 + 30 = 40	-	0.00	85	30	30.25	70.25	170.50

Profitability Criteria for Project Evaluation

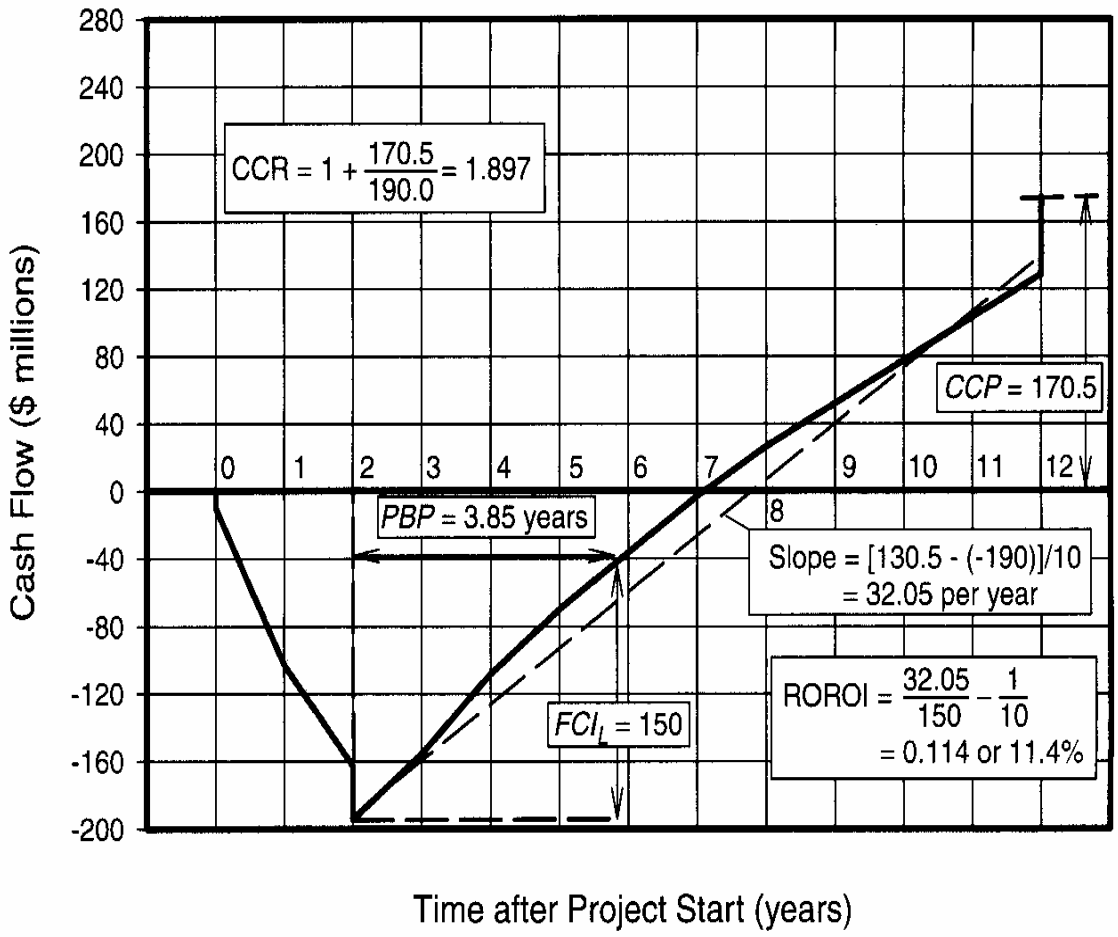

Figure E8.1 Cumulative Cash Flow Diagram for Nondiscounted After-Tax Cash Flows for Example 8.1

Profitability Criteria for Project Evaluation

The discrete and cumulative nondiscounted cash flows for each year are given in Table E8.1. Using this data, the cumulative cash flow diagram is drawn, Figure E8.1.

The method of evaluation for each of the criteria is given on Figure E8.1 and in Table E8.1.

Payback Period (PBP) = 3.85 years

Cumulative Cash Position (CCP) = $\$ 170.5 \times 10^6$

Cumulative Cash Ratio (CCR) = 1.897

Rate of Return on Investment ($ROROI$) = 11.4 %

Profitability Criteria for Project Evaluation

Discounted Profitability Criteria

- **Time Criterion.**

Discounted Payback Period (PBP)

DPBP = Time required, after start-up, to recover the fixed capital investment, FCI_L, required for the project with all cash-flows discounted back to time zero.

The project with the shortest DPBP is the most desirable.

Profitability Criteria for Project Evaluation

Non-Discounted Profitability Criteria

- **Cash Criterion.**

Net Present Value (NPV)

NPV = Cumulative discounted cash position at the end of the project.

Present Value Ratio (PVR)

$$PVR = \frac{\text{Present Value of All Positive Cash Flows}}{\text{Present Value of All Negative Cash Flows}}$$

PVR > 1 implies that the project is potentially profitable.

Profitability Criteria for Project Evaluation

Non-Discounted Profitability Criteria

- **Interest Rate Criterion.**

Discounted Cash Flow Rate of Return (DCFROR)

DCFROR = Interest or Discount Rate for which the Net Present Value of the project is equal to zero

If DCFROR is higher than the internal discount rate, then the project is considered profitable .

Profitability Criteria for Project Evaluation

Example 8.2

For the project described in Example 8.1, determine the following discounted profitability criteria:

a. Discounted Payback Period (*DPBP*)

b. Net Present Value (*NPV*)

c. Present Value Ratio (*PVR*).

Assume a discount rate of 0.1 – (10% p.a.)

Profitability Criteria for Project Evaluation

Table E8.2 Discounted Cash Flows for Example 8.2 (All Numbers Are in Millions of $)

End of Year	Non-Discounted Cash Flow	Discounted Cash Flow	Cumulative Discounted Cash Flow
0	(10.00)	(10)	(10.00)
1	(90.00)	$(90)/1.1 = (81.82)$	(91.82)
2	(90.00)	$(90)/1.1^2 = (74.38)$	(166.20)
3	38.25	$38.25/1.1^3 = 28.74$	(137.46)
4	46.35	$46.35/1.1^4 = 31.66$	(105.80)
5	37.71	$37.71/1.1^5 = 23.41$	(82.39)
6	32.53	$32.53/1.1^6 = 18.36$	(64.03)
7	32.53	$32.53/1.1^7 = 16.69$	(47.34)
8	28.64	$28.64/1.1^8 = 13.36$	(33.98)
9	24.75	$24.75/1.1^9 = 10.50$	(23.48)
10	24.75	$24.75/1.1^{10} = 9.54$	(13.94)
11	24.75	$24.75/1.1^{11} = 8.67$	(5.26)
12	70.25	$70.25/1.1^{12} = 22.38$	17.12

Profitability Criteria for Project Evaluation

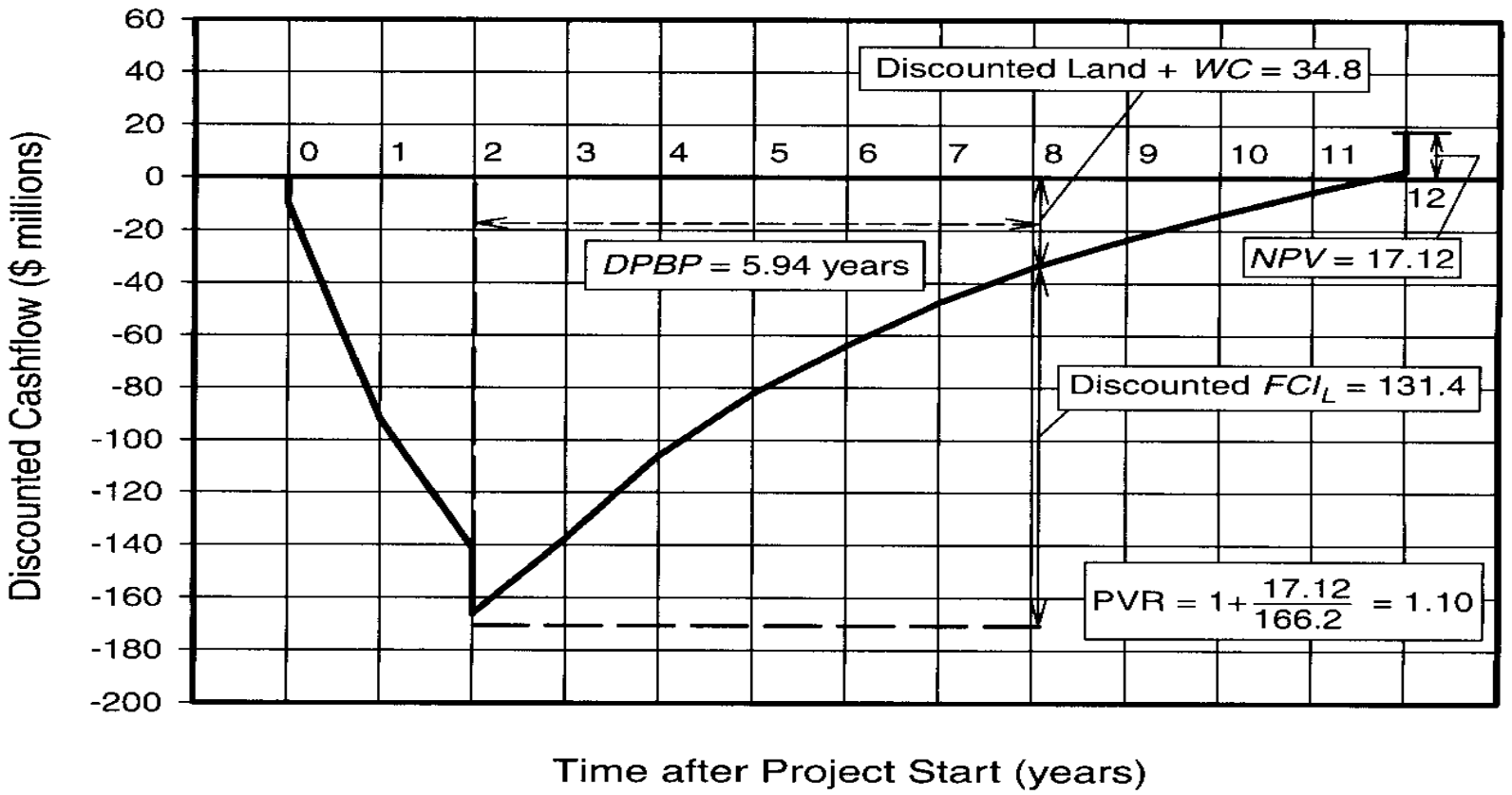

Figure E8.2 Cumulative Cash Flow Diagram for Discounted After-Tax Cash Flows for Example 8.2

Profitability Criteria for Project Evaluation

The cumulative discounted cash flows are shown on Figure E8.2 and the calculations are given in Table E8.2 from these sources the profitability criteria are given as:

a. Discounted Payback Period (*DPBP*) = 5.94 years

b. Net Present Value (*NPV*) = $\$17.12 \times 10^6$

c. Present Value Ratio (*PVR*) = 1.10

Profitability Criteria for Project Evaluation

Example 8.3

For the problem presented in Examples 8.1 and 8.2, determine the discounted cash flow rate of return (*DCFROR*).

The *NPV*s for several different discount rates were calculated and the results are shown in Table E8.3.

Table E8.3 NPV for Project in Example 8.1 as a Function of Discount Rate

Interest or Discount Rate	NPV ($ million)
0%	170.50
10%	17.12
12%	0.77
13%	–6.32
15%	–18.66
20%	–41.22

Profitability Criteria for Project Evaluation

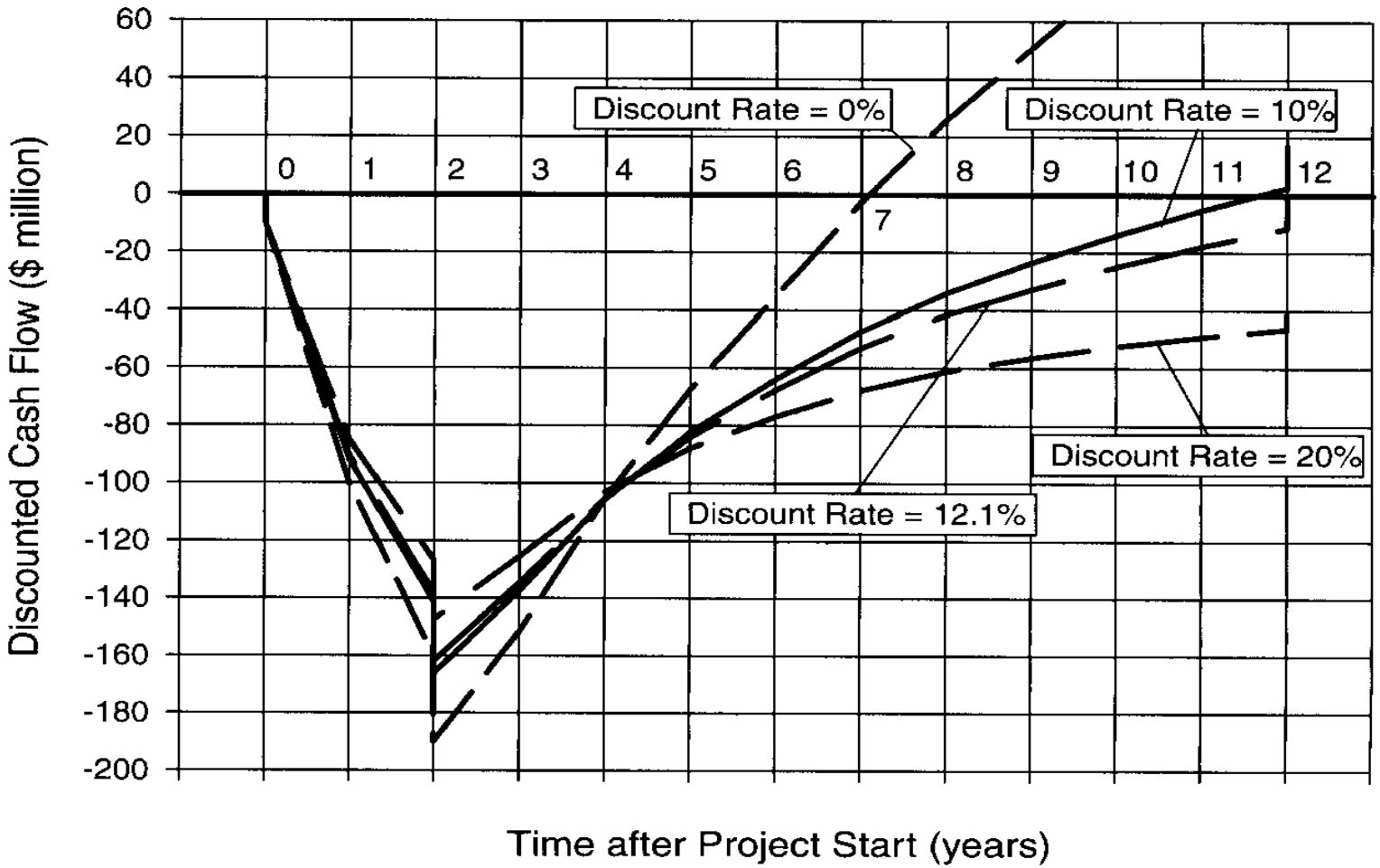

Figure 8.3 Discounted Cumulative Cash Flow Diagrams using Different Discount Rates for Example 8.3

Profitability Criteria for Project Evaluation

The value of the *DCFROR* is found at *NPV* equals 0. Interpolating from Table E8.3 gives:

$$\frac{(DCFROR - 12\%)}{(13\% - 12\%)} = \frac{(0 - 0.77)}{(-6.32 - 0.77)} = 0.109$$

Therefore, $DCFROR = 12 + 1(0.109) = 12.1\%$

An alternate method for obtaining the *DCFROR* is to solve for the value of i in an implicit, nonlinear algebraic expression. This is illustrated in Example 8.4.