Chapter 6 Discounting Benefits and Costs in Future Time Periods

Net Present Value

is a way of comparing the value of money now with the value of money in the future. In the CBA, we compare the projects or policies with benefits and costs that arise in <u>different time</u> periods by using <u>discount rate</u>. <u>Social discount rate</u> is normally used at the CBA.

Discount Rate

Discount rate reflects the time value of money. In financial analysis, the rate is determined in the market rate of interest. In cost benefit or public project analysis, the rate is social time preference which accounts for intergenerational equity concerns with the view that government has an obligation to provide welfare of unborn generations.

Net Present Value (NPV) of a Project

The discount sum of all future benefit less than the discount sum of all future costs over the appraisal period.

$$NPV = \sum_{t=0}^{t=n} \frac{B_t - C_t}{(1+i)^t} = \sum_{t=0}^{t=n} \frac{B_t}{(1+i)^t} - \sum_{t=0}^{t=n} \frac{C_t}{(1+i)^t} = PVB - PVC$$
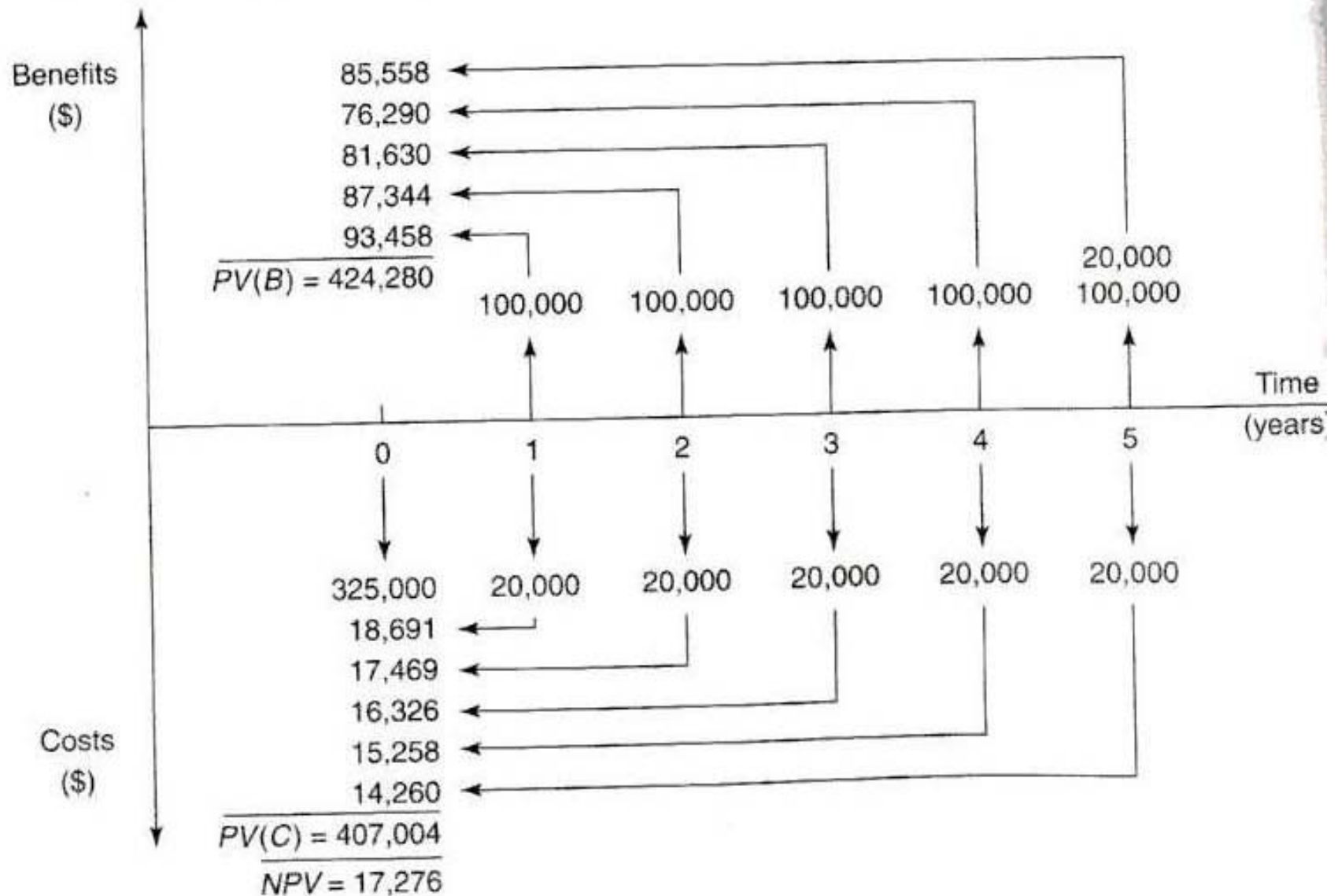
Project life runs from 0 to n

B: Undiscounted benefit in time period t

C: Undiscounted cost in time period t

i : Social discount rate

* NPV is the prime indicator of social benefit, <u>where project alternatives are mutually exclusive</u>.

Ex. Library Information System Accounting

Benefits ($)

```
85,558  ◄──────────────────────────────────────┐
76,290  ◄──────────────────────────────┐
81,630  ◄──────────────────────┐
87,344  ◄──────────┐
93,458  ◄──┐                                      20,000
PV(B) = 424,280    100,000   100,000   100,000   100,000   100,000
                      ▲          ▲          ▲          ▲          ▲
                      │          │          │          │          │
```

Time (years)

```
──────┼──────────┼──────────┼──────────┼──────────┼──────────┼──────
      0          1          2          3          4          5
      │          │          │          │          │          │
      ▼          ▼          ▼          ▼          ▼          ▼
   325,000    20,000     20,000     20,000     20,000     20,000
    18,691  ◄──┘
    17,469  ◄──────────┘
    16,326  ◄──────────────────┘
    15,258  ◄──────────────────────────┘
    14,260  ◄──────────────────────────────────┘
```

Costs ($)

$$PV(C) = 407,004$$

$$NPV = 17,276$$

Social discount rate is 7%.

FIGURE 6-5 Time Line of the Net Social Benefits of the Library Information System
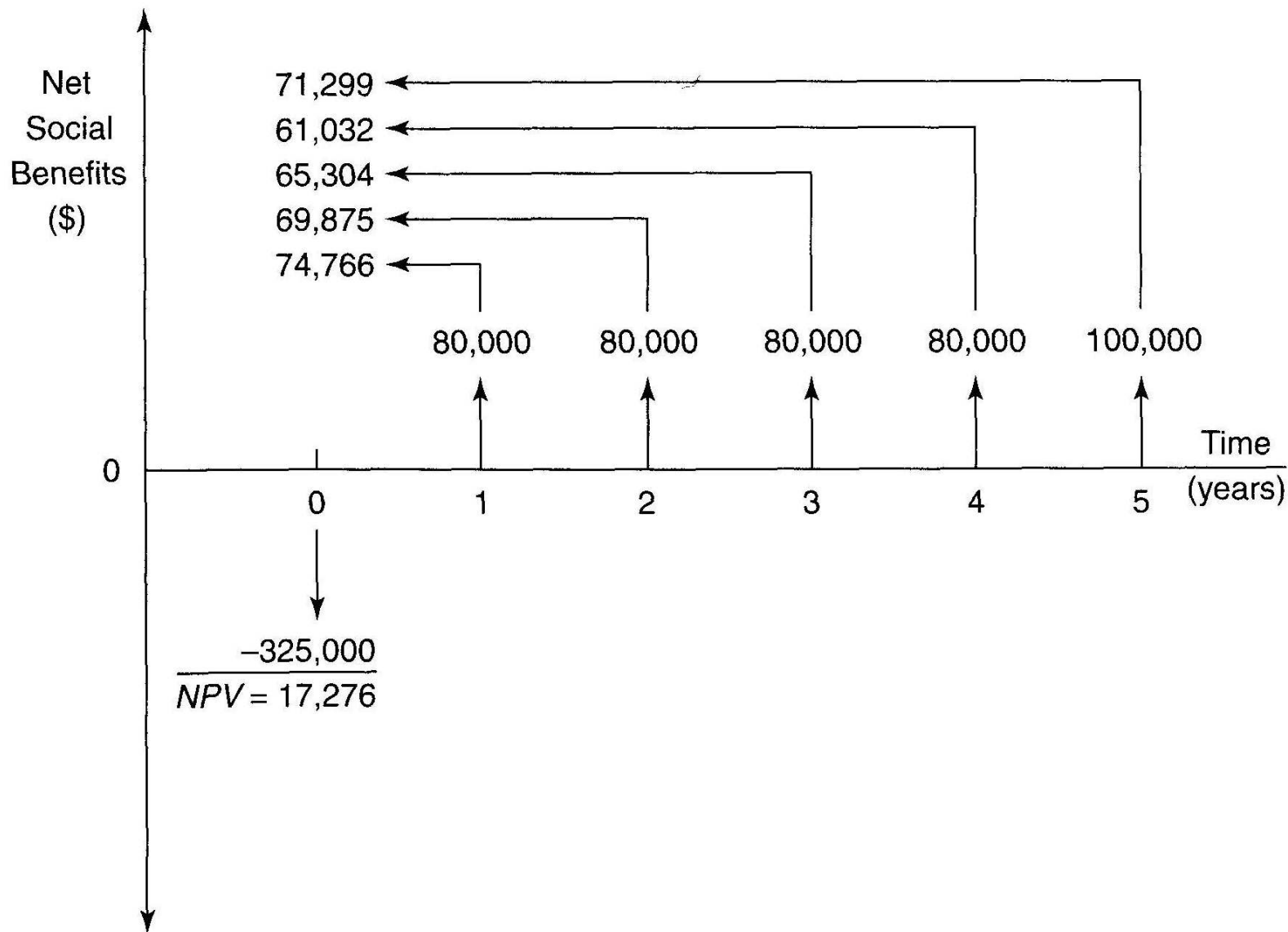
Methods for Estimating Horizon Values

Useful Life (discounting period) + present value of <u>Horizon Values.</u>

$$NPV = \sum_{t=0}^{k} \frac{NB_t}{(1+i)^t} + PV(H_k)$$ Value at the end of discounting horizon

1. Simple Projection

2. Salvage Value (or Liquidation Value)

3. Depreciated Value

4. Initial Construction Cost

5. Equal to Zero

Sensitivity Analysis in Discounting

Internal Rate of Return (IRR) $IRR: \displaystyle\sum_{t=0}^{t=n} \frac{B_t - C_t}{(1+i)^t} = 0$

Average rate of return on investment costs over the discount period.

FIGURE 6-7   Sensitivity Analysis: *NPV* of the Library Information System as a Function of the Discount Rate