

ECNS 432

Ch. 6

Discounting Benefits and Costs in Future Time Periods

- Because pvt. and public projects can have important consequences that extend over time, we often have to compare benefits and costs across time periods.
- To do this, we discount future costs/benefits so that all are in a common metric...which is???

Present value

- Present Value Analysis
 - Compares the current equivalent value of a project, with the current equivalent value of the best alternative project, given prevailing interest rates

Discounting Benefits and Costs in Future Time Periods

- Ex. Suppose the purchase of a plot of land will be worth \$11 million in one year's time. Also suppose the money could be invest at a 5% return.

- Q. What is the PV of the land?

- $PV = \$11,000,000 / (1 + 0.05) = \$10,476,190$

- In general, if the prevailing interest rate is i , then the PV of an amount received in one year, Y , is given by

$$PV = Y / (1 + i)$$

where Y is referred to as a “future value”

- B/c we want to consider both benefits and costs in present value terms, we will often calculate the Net Present Value (NPV) of a project

$$NPV = PV_{\text{benefits}} - PV_{\text{costs}}$$

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- Generally, we need to consider calculating PVs over multiple time periods

- PV of an amount received in 1 year:

$$PV = Y / (1 + i)$$

- PV of an amount received in 2 years:

$$PV = [Y / (1 + i)] * [1 / (1 + i)] = Y / (1 + i)^2$$

- PV of an amount received in 3 years:

$$PV = [Y / (1 + i)] * [1 / (1 + i)] * [1 / (1 + i)] = Y / (1 + i)^3$$

- PV of an amount received in n years:

$$PV = Y / (1 + i)^n$$

where $1 / (1 + i)^n$ is the “discount factor”

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- If a project yields benefits over many time periods, then we adjust our PV calculation in the following manner

$$\begin{aligned} PV_{\text{benefits}} &= B_0/(1+i)^0 + B_1/(1+i)^1 + \dots + B_{n-1}/(1+i)^{n-1} + B_n/(1+i)^n \\ &= \sum_{t=0}^n \frac{B_t}{(1+i)^t} \end{aligned}$$

- Thus, the NPV of a project over multiple time periods is

$$NPV = \sum_{t=0}^n \frac{B_t}{(1+i)^t} - \sum_{t=0}^n \frac{C_t}{(1+i)^t}$$

- NOTE: This is a very useful component to add to your term paper if you are analyzing a project that will likely have long lasting benefits (and/or costs)

Discounting Benefits and Costs in Future Time Periods

Exercise #1 from Ch. 6

- Highway Dept. is considering building a temporary bridge to cut travel time during the 3 yrs. it will take to build a permanent bridge
 - Temporary bridge can be put up in a few weeks at a cost of \$750,000. At the end of 3 yrs., it would be removed and steel sold for scrap. The real net costs of this would be \$81,000
 - Based on estimated time savings and wages, fuel savings, and reductions in accident risks, analysts predict benefits in real dollars would be:
 - 1st yr.: \$275,000
 - 2nd yr.: \$295,000
 - 3rd yr.: \$315,000
 - Dept. regulations require use of a real discount rate = 4%

- A.) Calculate the PV of Net Benefits (NBs) assuming the benefits are realized at the end of each of the 3 yrs.

[work through on board]

- B.) Now, assume the benefits are realized at the start of each year

[work through on board]

- C.) Assume benefits accrue at mid-year

[work through on board]

- D.) Does the temp bridge pass the net benefits test?

- Ans. Depends on when benefits are assumed to occur

- In practice, they are likely to accrue throughout the year, so method c.) is perhaps most appropriate.