Chapter Summaries

Chapter 20: Cost-Benefit Analysis

Chapter 20 begins with the point that capital is durable. An investment in plant or equipment, whether private or public, is expected to yield a stream of net benefits well into the future. The immediate problem in evaluating the investment is that dollars of benefit or cost received or spent in different years are not equivalent, and this is true even if there is no inflation and perfect certainty about future costs and benefits. The underlying reason why dollars over time are not equivalent is that people and firms have saving and investment opportunities at some rate of return, r.

1. If people can invest at an annual rate of return r, then a dollar today is equivalent to \$1(1 + r) dollars one year from now. Alternatively, the present value of \$1 received (or spent) one year from now is \$1/(1 + r).
2. In general, the present value of \$X received n years from now is $\$X/(1 + r)^n$. Computing the present value of the stream of future benefits and costs makes them equivalent to the dollars of investment used to buy the capital today. r is the discount rate and $1/(1 + r)^N$ is the discount factor for year N. r serves as the opportunity cost of funds in the present value calculation.
3. The present value of an investment is defined as $PV_I = -I_0 + \sum_{i=1}^{N} \frac{R_i}{(1+r)^i}$, where I_0 = the initial investment cost at time zero, R_i = the net benefits (benefits – costs) received at time i, r = the rate of return available generally to the investors (the owners of the firm for a private investment), and N is the last year in which the investment yields a net benefit. This is also called *the present value formula*.
4. The decision rule for evaluating an investment project expressed in terms of the present value of the investment is:
   a. If $PV_I > 0$, invest. The project has higher net benefit than investing the sum I_0 at rate r.

b. If $PV_I = 0$, the investors are just indifferent between making the investment and investing the sum I_0 at rate r.
c. If $PV_I < 0$, do not invest. Investing the sum I_o at rate r has a higher net benefit than investing in the project.

5. The text made the following comments on the present value of an investment:
    a. If r varies over time, such that the appropriate discount rates are $r_1, \ldots, r_i, \ldots, r_N$, then the discount factor for year n is $\frac{1}{\prod_{i=1}^{n}(1+r_i)}$.
    b. The *internal yield* (rate of return) on an investment is the discount rate, , that sets $PV_I = 0$. Investment projects should be ranked by their present value, and not by , if funds are limited since only the present value calculation accounts for the scale of the investment projects being evaluated.
    c. Inflation makes no difference to the calculation of PV_I since it increases the numerator and denominator by the same inflation factor. Therefore, investment projects can be evaluated using nominal or real values.
    d. If the initial investment cost, I_0, is spread out over a number of years, as for an education, then the investment costs in future years also have to be discounted to present value.

The chapter then notes that the government's cost–benefit analysis is more difficult than a firm's analysis of its private investments.

6. Government cost–benefit analysis and firms' private investment analysis share two common features. Each must determine the appropriate discount rate, r, to use in computing the present value of an investment, and each must confront the problem of uncertainty with regard to future values of r and the future net benefits R_i.
7. Additional factors associated with the evaluation of government projects that tend to be absent in the evaluation of private investments are the inability to use market prices to evaluate some or all of the benefits and costs, the need to consider the distribution of benefits and costs, and political factors that introduce bogus benefits and costs into the analysis.

The chapter next describes three fundamental principles of cost–benefit analysis.

8. At best, cost–benefit analysis can offer only practical guidance to policy makers. There is no such thing as a theoretically correct cost–benefit analysis because the evaluation of government investments depends on the attributes of the projects and the underlying economy in which the investments take place. No one can capture all

the features of an economy that might influence how costs and benefits should be evaluated.

9. The analyst should try to quantify as many of the elements of the present value formula as possible. This involves identifying the sources of the benefits and costs, using state-of-the-art techniques to evaluate the benefits and costs, and avoid including bogus benefits and costs.
10. The cost–benefit analysis should assume full employment of resources. Its goal is to help identify the best use of society's scarce resources, which the full employment assumption facilitates.

The chapter then considers each component of a cost–benefit analysis.

The public rate of discount

11. One view is that the public rate of discount r should reflect the opportunity cost of taking funds from the private sector. Under full employment, increases in government spending come at the expense of private consumption and private investment. The cost of forgoing private consumption is the consumers' MRS between current and future consumption, measured by the after-tax rate of return to saving, r_{AT}. The cost of forgoing private investment is the producers' MRT between current and future output, the productivity of private investment, measured by the before-tax rate of return, r_{BT}. Therefore, $r_{public} = \left(\frac{\Delta C}{\Delta G}\right) r_{AT} + \left(\frac{\Delta I}{\Delta G}\right) r_{BT}$. r_{AT} is much lower than r_{BT} because of taxation.
12. Another view is that the public rate of discount is the marginal social rate of time preference between the future and the present, and that the cost of tax distortions should be accounted for by increasing the initial investment cost, I_0. Furthermore, the marginal social rate of time preference is less than the consumers' marginal rate of substitution between current and future consumption, for two reasons: there are externalities to saving that individuals ignore and current generations do not give enough weight to future generations, particularly those generations not yet born.
13. One prominent model used for second-best analysis implies the *opportunity cost view* of the public rate of discount. Moreover if the supply of capital to a nation is perfectly elastic, then the public rate of discount is $r_{BT.}$
14. A survey of 2,160 economists by Marty Weitzman asking them for their preferred public rate of discount found a wide range of disagreement. The preferences ranged from –3% to 27%.
15. The U.S. Office of Management of the Budget uses a discount rate of 7% for most public projects.

Uncertainty

16. Since individuals are risk averse, on average, uncertain future net benefits should be accounted for at their certainty equivalent values, equal to their expected values less the risk premium that individuals would be willing to pay to turn the uncertain stream of net benefits into a certain stream of net benefits. Willing to pay means yielding the same utility as the expected utility of the uncertain stream of net benefits.

Problems in measuring net benefits

17. *Intangibles* are benefits and costs that cannot be quantified, such as the prestige to a nation of being the first to place a man on the moon. The loss of life that is almost certain to occur in building large government projects such as bridges and dams may or may not be an intangible. It is not an intangible if the government adopts an *ex-ante* view of the loss of life; it is an intangible if the government adopts an *ex-post* view of the loss of life.
18. *Lumpy investments* that lead to discrete changes in prices, such as dams that lower the price of electricity to a region, require measures such as Hicks' equivalent or compensating variations to calculate the value to individuals of the price changes.
19. Economists use many different techniques to try to estimate the value of *non-marketed benefits and costs*. Examples include:
    a. *Identifying the sources* of the benefits of a new superhighway in a rural area for which no toll is charged, such as the decrease in accidents and fatalities and the decreased travel time, and trying to place reasonable values on each of them.
    b. Using *hedonic price estimation* of house values to determine the value people place on living in areas with cleaner air.
    c. Using surveys to ask people how much they value things that cannot be estimated in any other way, such as the cost of oil spills that damage beaches and shorelines. The surveys are called *contingent valuation* because the answers people give are contingent on the conditions posited in the surveys.

Distribution of benefits and costs

20. The distribution of benefits and costs pose a thorny set of issues for cost–benefit analysis.
    a. The pragmatic view is to ignore the distribution of the benefits and costs and simply rank projects on the basis of their aggregate present values. Putting distributional weights on the benefits and costs adds a subjective element to the

analysis that can overwhelm the underlying efficiency properties of the projects. It also has the advantage of being able to use the aggregate market demand curves to evaluate the benefits of a project. This position is theoretically correct only if the distribution is considered optimal or if the government is assumed to be redistributing income lump-sum to satisfy the interpersonal equity condition for a social welfare maximum, such that everyone has the same social marginal utility of income.

b. Realistically, the distribution is unlikely to be optimal and the government is not redistributing lump-sum behind the scenes to make it optimal. Therefore, theory dictates that distributional considerations should be included in determining the present value of an investment. This involves allocating the net benefits by income classes, assigning social marginal utilities of income to each income class, and calculating the present value of an investment as a change in social welfare: W = $\sum_{h=1}^{H} \beta^h PV^h$, where ^{h} = the social marginal utility of income of people in income class h, PV^h = the net benefits received by income class h, W is the change in social welfare, and there are H income classes. Also, demand curves for each income class have to be used to evaluate project benefits.

Bogus benefits and costs

The next section of the chapter discusses the bogus benefits and costs that find their way into cost–benefit analyses, often politically motivated.

21. *Regional multipliers*, in which it is noted that a government project leads to a number of secondary benefits within a region, such as additional stores, restaurants, and the like, to serve the people who construct the project or operate it after it is constructed, and also the increased profits of industries that are related to the project. These secondary benefits are often many times larger than the direct benefits from the project. The inclusion of secondary benefits ignores the countervailing secondary losses that occur as resources leave other uses to work on the project, as must occur under the full employment assumption. Better to assume that the secondary benefits and losses cancel one another and ignore them.
22. *The labor game*, in which the wages paid to construction workers and other workers associated with the project are counted as project benefits when in fact they are part of the costs of the project. Wages are benefits only if the workers would otherwise be unemployed and unemployable, which is almost never the case. Bringing labor costs over to the benefit side can make almost any project look good. Regional multipliers

and the labor game also introduce an undue bias towards favoring larger projects simply because they have larger regional multipliers and employ more labor.

23. *Double counting* benefits and costs, such as using surveys to estimate the loss to people who live near airports from the noise of the aircraft as they take off and land and adding to these losses the decline in the value of the houses near the airport. The decline in the housing values is a result of the noise. Therefore including both forms of loss is double counting.

The chapter concludes by noting that most economists believe public debate over government investment projects would be well served by conducting cost–benefit analyses that: identify the true project benefits and costs; attempt to quantity all the elements of the present value formula that can be quantified using state-of-the-art techniques; and avoid the bogus benefits and costs. Also, cost–benefit analysis should be applied consistently to all prospective projects.