Chapter 8. Cost benefit analysis

Social welfare functions are generally not much help for the day-to-day problems of project evaluation. However, welfare economics does provide the basis for **cost-benefit analysis**: a set of practical procedures for evaluating potential projects. In this way resources can be allocated to a project as long as the marginal social benefit exceeds the marginal social cost.
To compare costs and benefits in different time periods, their **present value** must be computed. The present value is the value today of a given amount of money to be paid or received in the future. To find the value of money today one year in the future, you multiply by one plus the interest rate. To find the value of money one year in the future today, you divide plus one plus the interest rate.

Future value of one amount: $FV = \$R \times (1+r)^T$

Present value of one amount: $PV = \$R / (1+r)^T$

Present value of an income stream: $PV = R0 + R1/(1+r) + R2/(1+r)^2 + \ldots + RT/(1/r)^t$

R = investment
r = interest rate (discount factor)
T = time (in years)

The dollar values R can both be nominal or real amounts. With nominal amounts, the market interest rate increases by an amount approximately equal to the expected rate of inflation from r percent to (r+ π) percent.

Present value of an income stream (Nominal terms)

$$PV = R0 + \frac{(1+\pi)R1}{(1+\pi)(1+r)} + \frac{(1+\pi)R2}{(1+\pi)(1+r)^1} + \cdots + \frac{(1+\pi)R2}{(1+\pi)(1+r)^T}$$

The moral of the story is that you obtain the same answer whether real of nominal magnitudes are used. It is crucial, however, to use both consistently. Then inflation cancels out.
A project is admissible only if its net return is positive, benefits exceed costs. In project evaluation, the calculation of the **net present value** of a project can be useful.

Net present value:

$$NPV = B0 - C0 + \frac{(B1 - C1)}{(1 + r)} + \ldots + \frac{(BT - CT)}{(1 + r)^T}$$

B = benefits, C = costs, r = discount rate, T = time (years)
The **net present value criteria** for project evaluation are that:

- A project is admissible only if NPV > 0
- When two projects are mutually exclusive, choose the one with the higher NPV

Several criteria other than the present value are often used for project evaluation:

- **Internal rate of return (p)**
  The internal rate of return (p) is the discount rate that makes the NPV=0. The project is admissible if the internal rate of return exceeds the actual discount rate (p > r). When two projects are mutually exclusive, choose the one with the higher value of p. However, if projects differ in size, the internal rate of return can be misleading. A big project with a low p may make more money than a small one with a high p.
- **Benefit-cost ratio = B/C (NPVBENEFITS/NPVCOSTS)**
  A project is admissible if the benefit-cost ratio exceeds one. However, the ratio is useless in comparing different projects. By manipulating definitions of costs or benefits, any project can be given a high B/C (e.g. a benefit is a cost reduction)

Choosing the discount rate is critical in cost-benefit analyses. The discount rate reflects opportunity costs, so it depends on where the money for the project comes from. In public sector analyses, there are three possible measures for the discount rate:

- **Before-tax private rate of return**
  Money is extracted from private sector investment. The opportunity cost of the government project equals the rate of return in the private sector.
- **After-tax private rate of return**
  Money is extracted from consumption. Because the after-tax rate of return measures what an individual loses when consumption is reduced, dollars that come at the expense of consumption should be discounted by the after-tax rate of return.
  Because funds for the public sector reduce both private sector consumption and investment, a natural solution is to use a weighted average of both.
- **Social discount rate**
  Measure the valuation that society places on consumption that is sacrificed in the present. The social discount rate may be lower than the market rates of return for several reasons:
  - *Concern for future generations*
    The public sector should care about the future generations as well. The private sector ignores future generations and is only concerned with its own welfare.
  - *Paternalism*
    People may not know their own best interests. The government forces them to consume less in the present en, in return, they have more in the future (and they will be thankful afterwards).
  - *Market inefficiency*
    Investments can create positive externalities and will be underprovided by private markets.

It appears that it is hard to pick the right discount rate for the public sector. The best procedure is a **sensitivity analysis**. It evaluates the present value of a project over a range of different discount rates and examines whether or not the present value stays positive for all reasonable values of r.

Valuing public benefits and costs

In private firms, benefits are the revenues received and costs are they payments for inputs. This is more complicated for the government because market prices may not reflect social benefits and costs. There are several possibilities for measuring the benefits and costs in the public sector:

- **Market prices**

If the government uses inputs/produces outputs that are traded in competitive private markets, market prices should be used. Market prices reflect the marginal costs of production and the marginal value to consumers.

- **Shadow prices**

However, often market imperfections exist and the prices for the commodities don't reflect its marginal costs anymore. The *shadow price* of such a commodity is its underlying social marginal cost. It is the price adjusted for market imperfections (like a monopoly, taxes or unemployment) and it depends on how the economy responds to the government intervention.

- **Consumer surplus**

If large government projects change equilibrium prices, the consumer surplus can be used to measure the benefits. The consumer surplus reflects the amount by which the sum that individuals would have been willing to pay exceeds the sum they actually have to pay.

- **Inferences from economic behaviour**

For non-traded commodities, there is no market data available. The value can sometimes be inferred by observing people's behaviour. In this way people's willingness to pay for such commodities can be estimated.

- *Value of time*

  A common way of to estimate the value of time is to take advantage of the theory of leisure-income choice. People work up to the point where the subjective value of leisure is equal to the income they gain from one hour of work. However, often people can't choose their hours of work and not all uses of time from a job are equivalent.

- *Value of life*

  The value of life can be estimated for instance by examining the difference in wages for dangerous and safe jobs or the market prices for safety devices – how much people are willing to pay to reduce the probability of death.

Often, (future) costs and benefits are uncertain and risky. In such a case it is best to convert them into **certainty equivalents** – the amount of certain income the individual would be willing to trade for the set of uncertain outcomes generated by the project.
Certain intangible benefits and costs simply cannot be measured. It is hard to attain these benefits, but the best possibilities seem to be:

- Exclude them in a cost-benefit analysis and then calculate how large they must be to reverse the decision.
- **Cost-effectiveness analysis**: a systematic study of the costs of the various alternatives to find the cheapest way possible.

Tresh (2002) has noted some other common errors in cost-benefit analysis:

- **Chain-reaction game**
  Secondary benefits are included to make a proposal appear more favourable, without including the corresponding secondary costs. It counts as benefits changes that are merely transfers.
- **Labor game**
  Wages are viewed as benefits rather than costs of the project, because the project 'creates' employment.
- **Double-counting game**
  Some benefits are incorrectly counted twice.

Distributional considerations

There is a discussion about giving consideration to the question of who receives the benefits and bears the costs of a public sector project.

- Some argue that if the net present value of a project is positive, it should be undertaken regardless of who gains and who loses. This is because as long as the NPV is positive, the gainers could compensate the losers and still enjoy a net increase in utility (potential Pareto improvement). This notion is called the **Hicks-Kaldor criterion**.
- Others oppose that because the goal of the government is to maximize social welfare, the distributional implications of a project should be taken into account.