TOOL #61. THE USE OF DISCOUNT RATES

1. INTRODUCTION

Most new policies or projects result in costs and benefits that arise at different times. For example, building a new railway line has an immediate cost but provides benefits for many years in the future. The social discount rate is used to compare costs and benefits that occur in different time periods from the point of view of society. It is based on different arguments, one is the principle that people prefer to receive goods and services now rather than later, another one on the shadow costs of risk-free capital.

As well as the social discount rate, there is also the question of what discount rates are used by business and households.

2. SOCIAL DISCOUNT RATES AND PRESENT VALUES

A social discount rate is used to convert all costs and benefits to "present values" so that they can be compared. This discount rate is a correction factor applied to costs and benefits expressed in constant prices. Costs and benefits should be based on market prices in the year at which they occur. For example, the capital cost of an investment should be recorded as a cost when the action is undertaken, with any associated operating costs taking place in later years recorded in those years. This approach is in line with the economic principle of opportunity costs where market prices reflect the best alternative uses for goods or services.

The social discount rate is the rate most used in Impact Assessments, as these normally consider costs and benefits together from the point of view of society as a whole (rather than from the point of view of a single stakeholder group). **The recommended social discount rate is 4%**. This 4% rate is in real terms and is applied to costs and benefits expressed in constant prices. It can be easily adjusted for inflation: if instead you are dealing with nominal prices, and inflation is, say, 3% per annum then a 7 % nominal social discount rate (4% rate plus 3% to account for inflation) would be used.

Box 1. Example on the determination of present values using a social discount rate of 4%

- The mathematical expression used to calculate discounted present values is given below where *r* is the discount rate and *n* is a future year:

$$Discount\ factor\ in\ a\ future\ year\ n = \frac{1}{(1+r)^n}$$

- As an example, the present value of €1000 in future years is shown below:

	Year					
	0	1	2	3	4	5
Present Value	€1000	€962	€925	€889	€855	€822

- The above example assumes that €1000 is in today's prices so stripped of inflation.

2.1. Net Present Values (NPV)

Calculating the present value of the *difference* between the costs *and* the benefits provides the **Net Present Value (NPV)** of a policy option. Where such a policy or project generates a positive NPV there would be no obvious reason to prevent it from proceeding so long as the distribution of costs and benefits among different social groups is deemed to be acceptable and all costs and benefits are included in the computation (which is often methodologically challenging).

Box 2. Formula for the determination of Net Present Value

$$NPV = \sum_{i=0}^{i=n} \frac{B_i}{(1+r)^i} - \sum_{i=0}^{i=n} \frac{C_i}{(1+r)^i}$$

Where the Costs and Benefits in a given year i are C_i and B_i respectively over the policy/project lifetime of n years (starting in year 0).

The Net Present Value can be used to distinguish between two competing policy options as shown below.

Box 3. Example to show the calculation of NPV for two competing policy options

Alternative projects A and B are both expected to improve the functioning of an organisation.

Option A: requires €10 million in capital costs initially in order to realise benefits of €2.5 million per annum in the following 4 years.

Option B: requires €5 million in capital costs initially to realise benefits of €1.5 million per annum in the following 4 years.

	Year	0	1	2	3	4	**NPV**
	Discount factor	1.0000	0.9615	0.9246	0.8890	0.8548	
Option A							
	Costs(€ m)	10	0	0	0	0	
	Benefits(€ m)	0	2.5	2.5	2.5	2.5	
	Benefits less costs(€ m)	-10	2.5	2.5	2.5	2.5	
	Present value (€ m)	-10.00	2.40	2.31	2.22	2.14	**-0.93**
Option B							
	Costs(€ m)	5	0	0	0	0	
	Benefits(€ m)	0	1.5	1.5	1.5	1.5	
	Benefits less costs(€ m)	-5	1.5	1.5	1.5	1.5	
	Present value (€ m)	-5.00	1.44	1.39	1.33	1.28	**0.44**

Project B realises a positive NPV of €0.44 million whereas Option A has a negative NPV of - €0.93 million. Project B is preferable therefore.

2.2. **Annualised costs and benefits**

Care needs to be exercised when comparing policies with different time horizons as the use of the net present value criterion is no longer appropriate. To make valid comparisons in such circumstances, it is often useful to calculate the annualised values of costs and benefits of alternative policies. This is defined as the fixed annual steam of income that would be paid by a fixed-interest annuity with the same net present value as the policy. Social discount rates could be applied for this approach as well if the societal perspective is relevant.

3. SENSITIVITY ANALYSIS USING LONG-TERM DISCOUNT RATES

In general, it is not appropriate to use alternative social discount rates, as using the 4% rate consistently in Impact Assessments and an evaluation ensures coherence and comparability. However, it may be appropriate to undertake sensitivity analysis of the social discount rate when it is applied over long time frames. This is because discounting at even modest rates (i.e. 4%) reduces the value of costs and benefits effectively to zero over very long time periods. This can be criticised because it excludes future generations from consideration in today's decisions.

For example, in assessments with very long time frames, an alternative lower social discount rate which decreases with time should be considered in addition to the fixed rate of 4%. Such a reducing rate better reflects individuals' perceptions, uncertainties about the economy in the future and the concerns that constant-rate discounting shifts unfair burdens of social cost onto future generations[744].

Such sensitivity analysis can have significant impacts on the present value of benefits for some projects/policies with long lifetimes:

The long term benefits of new road infrastructure would be emphasised with a declining discount rate which makes road infrastructure investment more attractive;

The long term social cost of biodiversity loss increases with a declining discount rate as damage much further into the future is given a greater weight.

4. COSTS FROM THE PERSPECTIVE OF PRIVATE CAPITAL AND ECONOMY WIDE MODELLING

There is widespread consensus that the social discount rate is usually lower than the discount rate that should be used for individual companies or households, who are unable to diversify risk as effectively as society as a whole. The social discount rate is only used, therefore, when looking at issues from the societal point of view. For example, a higher discount rate should be used when trying to assess the behaviour of a company in respect of an investment decision. This would essentially be the internal rate of return required to trigger an investment. For a business, a good proxy is the Capital Asset Pricing Method, which takes account of both the costs of capital and the riskiness of the investment. In some cases, the

[744] For example, in the IPCC WG3 report 2014 "a consensus favours using declining risk-free discount rates over longer time horizon." The UK Government utilises a 3.5% discount rate for periods up to 50 years which declines to 1.0% share the time horizon exceeds 300 years.

Weighted Average Cost of Capital could also be used[745]. Higher discount rates may also apply for households when deciding on whether to make an investment due to a range of factors: such as finance costs and other behavioural constraints like split incentives (e.g. landlord/tenant), short time horizons, risk averseness, information asymmetries or other obstacles or barriers.

4.1. Assessment of costs from the point of view of a regulated sector

An alternative approach is the consideration of costs from the point of view of a particular economic sector, typically undertaken in a **Cumulative Cost Assessment**. This is a partial approach which does not look at benefits. The costs are the regulatory costs that affect the sector. For example, investment costs would be estimated by the costs of financing (which depends on the approach for financing them) and at the time when those financing payments are made.

When looking at the affordability impacts from the point of view of a regulated sector, it may be necessary to present the capital investment costs annuitized over time, so that they can be compared to other cash flows (e.g. income). In such a case, a discount rate representing the financing costs for the relevant sector should be used.[746] This approach can be used in addition to an analysis from the social point of view, as it can provide additional relevant information.

4.2. Economy wide modelling

Economy wide modelling provides a complementary approach to assessments made from the point of view of society or from a regulated sector. This is useful when the policy options have significant impacts for multiple sectors and for the economy as a whole. The approach allows monetary flows and constraints across the whole economy to be examined as well as the indirect impacts of measures across sectors. It also allows information on the affordability of a given policy for economic actors to be identified which can be used in addition to or, in certain cases where it is a cross sectoral policy, instead of the usual determination of societal costs.

Models can, therefore, be used to simulate 'real world' behaviour including its limitations and barriers as well as society-wide limitations regarding the use of scarce resources reflected in opportunity costs and risk averseness. This can be explicitly done through macroeconomic modelling that takes into account scarcity of financial resources within the model but also through partial equilibrium modelling tools that look at the economy wide measures but use exogenously determined private discount rates that reflect risk aversion, opportunity cost and other barriers. A common example is energy system modelling where sector-specific discount rates can be much higher than the 4% social discount rate. If private discount rates are adapted according to different policy options, the links between the market failures targeted by the

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[745] The Weighted Average Cost of Capital consists broadly of a risk free rate plus the Beta for the sector times the equity risk premium. Its value is not affected by a firm's choice between chosen equity and debt funding to fund investment.

[746] The discount rate used when deciding whether to invest may be different to the actual cost of financing as it includes other factors, barriers or risks. For a firm, the cost of financing would be the Weighted Average Cost of Capital. However, "hassle" or transaction costs are a valid cost category and so can be included as such in an analysis.

policy option and the impact on the sector-specific discount rate should be clearly demonstrated and documented. Lower discount rates should only be used if it can be shown that a policy option can indeed address the relevant market failures, and care should be taken that costs comparisons across scenarios are still possible in a relevant and meaningful way.

Economy-wide modelling to assess affordability for sectors or cost-effectiveness (or the economy for economy wide modelling) is best achieved using a sector-specific discount rate for annuitizing capital costs.