

Cost Benefit Analysis

Some basic concepts and issues

As our society becomes more sophisticated, complex and integrated, societal issues are increasingly interlinked and these relationships are also better recognised. Legislation has to follow suit and the impact of legislative measures needs to be considered within a whole complex system. Invariably the legislator will be faced with many different options to choose from.

Generally, new legislation imposes new constraints on some parts of society, entailing additional costs or loss of revenue. This has to be weighed against the potential benefits that the measures are meant to bring about. A Cost Benefit Analysis or CBA must therefore be part of a sound legislative process. This seemingly straightforward statement, however, hides a complex reality. CBA can be considered at different levels of sophistication. Questions need to be answered and choices made at every step of the process.

The Clean Air For Europe (CAFE) programme aims at an integrated assessment of the role of multiple factors on air quality and related health and environmental effects in Europe. CBA has been made part of this assessment and a specific methodology is being developed. CONCAWE is closely involved in the process.

In this article we use an example from daily life to highlight the concepts and main challenges associated with analysing costs and benefits, and look at how these play out in the case of the CAFE programme.

Options to fulfil a need: getting from A to B

Imagine you have found a new job which requires you to travel from A to B and you need to select a means of transport. You are faced with a whole range of options e.g. public transport, a car, a motorcycle, a bicycle or travelling by foot. Then more choices may need to be

made: first or second class on the train, buying a new or second-hand car, leasing, etc. Being a sensible person you want to choose the 'best' option. But how can you define what you mean by 'best'?

At this point, it is important to realise that personal preferences, prejudice, emotional or political reasons may lead you to reject certain options at the outset or even make a choice up front. In this case further analysis or discussions are redundant, but you may have missed an opportunity to select the 'optimal' solution.

Costing the options

Cost is a ubiquitous parameter in our lives. Our means being limited, this is invariably one of the first factors that we consider. Because cost is so pervasive we are quite good at estimating it and data to help us is usually at hand.

After collecting all the relevant cost information, you can simply select the means of transport that is cheapest for your situation and go for that option. This approach could be called a *cost-effectiveness analysis*.

Identifying the benefits: what do I get for my money?

Although all the means of transport you are considering will get you from A to B, each of these options will have a number of benefits and drawbacks associated with it, e.g. perceived safety, level of protection from adverse weather conditions, travel time, risk of delays, noise level, maintenance and servicing issues, environmental impact, ease of use, availability outside working days, and so on.

Making an exhaustive list of all these 'benefits' is actually quite difficult. It is easy to overlook one of the aspects. Personal preferences will also play an important role, and

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what is perceived as a benefit by some might be construed as irrelevant or even as a drawback by others.

Trying to rank your options taking these benefits into account is even harder. They are usually qualitative rather than quantitative, so comparing them is likely to be a subjective process where, again, personal preferences play an important role.

At any rate this 'benefit identification' stage needs to be done with an open mind, avoiding predetermined opinions and choices.

Valuing the benefits

Money is the standard exponent of value. If we can assign a monetary value to benefits that we intuitively feel have different worths, we have a common objective metric for calculating benefits (positive or negative) and also for comparing them with costs. This approach constitutes a full cost benefit analysis and it is claimed by some to provide an objective comparison of all options.

So far so good, but this is actually where the problems start. If identifying benefits can be a difficult and subjective exercise, allocating a monetary value to them is even more arduous. For example a shorter travel time would be seen by most of us as a benefit, but what is it worth? Using your hourly pay rate may be an option, but you are unlikely to get more money if your travel time is reduced. So you may get to spend more time with your family? But how much is this worth? Clearly, whatever the methodology adopted, value judgements have to be made.

Faced with these questions, economists sometimes try to measure the value of non-monetary benefits in terms of lost (or gained) income or incurred (or saved) expenditures (e.g. medical costs).



Another common approach is based on a seemingly clear concept: the value of any 'product' is nothing other than the amount of money that people are willing to pay for it. We simply have to ask people, by means of a survey, what they are prepared to pay for, in this case, a twenty minute saving in travel time, and this enables us to find a monetary value of a unit of time. This is referred to as the willingness-to-pay (WTP) value.

Even in the best of circumstances, with a carefully designed public survey, sound statistical analysis, etc., results are usually very dependent on the questions actually being asked, how they are formulated and on the sample of the population selected. WTP cannot therefore be construed as constituting an objective measure of the value of a certain item. At best it can be

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considered as an indication with a large range of uncertainty that calls for an extensive sensitivity analysis.

In practice these issues are often confounded by the fact that the reporting of the results of such surveys lacks transparency, leaving out essential details of the methodology used.

Bringing in risk

If assigning a monetary value to a benefit can be difficult, the problem is even more acute when it comes to valuing risk.

Most activities entail an element of risk, for instance a health risk, risk of accident, disease or even death. In our simple example this could be the risk of having an accident. The CBA methodology leads us to evaluate the change in such risk between options, and to put a monetary value on that change. This implies, of course, that the risk can be identified.

There are two points which make a monetary valuation of these classes of benefit very difficult when using the willingness-to-pay approach. Firstly, the abstract concept of risk or change in risk is often difficult for people to fully understand. Experience has shown that using a survey technique to get people to put a value to certain changes in risk can lead to results with a very large spread and which are sometimes even clearly inconsistent, if not meaningless.

The second is actually an ethical issue: when valuing the change in risk in terms of health or mortality, one is often faced with such concepts as the Value of a Statistical Life (VOSL) or the Value of a Life-Year (VOLY). Although it can be argued that these are not an attempt to place a value on actual human life, it is clear that the CBA methodology raises some deep-running ethical issues and controversies, which are still being debated in literature.

Broadening the scope

In your endeavour to find the preferred way to travel to work, you may have opted for a relatively expensive

option because you valued highly aspects such as comfort, time, etc. Your analysis of this particular issue led you to spend extra money on this, but you have not necessarily considered what else you could have done with that extra money (e.g. a holiday, new clothes or a donation to charity). This was outside the scope of your investigations and has therefore been ignored. If you had considered some of these broader options at the time, the outcome might have been different.

This illustrates another issue with CBA in that, although it appears to use an all-inclusive approach to analyse the different options, it actually always limits attention, not only to known benefits, but also to a certain specific context. Making a balanced decision still requires a sense of judgement which tries to take the whole picture into account.

CBA in the context of the CAFE programme

The objective of the CAFE programme is to analyse the combined effects of the various sources of air pollutants on air quality and its consequent effects on health and the environment, before proposing additional measures to alleviate these consequences. CBA is an important part of the CAFE programme. However, all the issues discussed above have also to be dealt with in this context.

The actions required to put air quality improvement measures in place will be clearly identified e.g. reduction of emission limits for stationary or mobile sources, more stringent fuel specifications etc. They will translate into new physical installations, plants, systems. It will therefore be possible to estimate the costs, expressed, e.g. in terms of capital expenditure, operating costs, etc. with a reasonable degree of certainty.

Estimating the benefits is much more challenging. The first challenge is to estimate the magnitude of the effects. The level of emissions will depend on many factors such as the economic activity, the performance of emission control systems, consumer choices, etc. Translation of emissions into air quality parameters requires complex modelling at the EU level, which itself

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carries a large degree of uncertainty. The relationship between levels of pollutants and actual health or environmental effects is notoriously difficult to establish with any degree of certainty. The required epidemiological studies are lengthy and fraught with methodological difficulties when attempting to isolate the effect of one particular factor from a myriad of others.

The second challenge is to assign a monetary value to the estimated health effects. The willingness-to-pay methodology has been proposed in the context of CAFE, bringing with it all the complex issues described in the previous sections.

In such a process preconceived ideas and value judgments will inevitably play an important role, although not explicitly. Rigorous analysis and full transparency of the process are essential if an unbiased result is to be reached.

In any case, it is clear that the uncertainty attached to the benefits will always be much higher than that attached to the costs. It is crucial that the impact of such uncertainty be evaluated. The use of appropriate sensitivity scenarios is essential. The same methods as those used to address the uncertainties in the Commission's Integrated Assessment Modelling approach (IAM) within CAFE could perhaps also be applied to the CAFE CBA.

Another temptation is to use the exercise to include other aspects such as visibility, damage to buildings, etc. which are not directly relevant to the CAFE project, i.e. the impact of emissions on air quality and related health effects. The CAFE scope and methodology are already extremely complex and the effort should not be diluted by including these other aspects.

Conclusions

While CBA is a conceptually attractive methodology, it is difficult to apply in practice. The costs of compliance with measures can generally be estimated with a reasonable degree of confidence and accuracy. Benefits, on the other hand, are often difficult to identify or to relate to the proposed measure with any level of certainty, and are frequently intangible. The CBA methodology therefore quickly finds its limits when it comes to attributing a monetary value to such benefits. In the context of CAFE the impact of air quality on human health and the real societal benefits associated with the reduction of certain air pollutants is a case in point. Taken out of context, CBA results can create a false sense of clarity and precision. Making balanced decisions about air quality measures with the overall aim of minimising risk for society as a whole calls for sound judgement and good communication between all parties involved.