Cost Benefit Analysis - Aspirations V's Reality.

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Cost Benefit Analysis is the primary tool for calculating the viability of projects in both the private and public sectors. However, as Clare McAndrew makes clear, like so much of economic theory, its results are only as accurate as the assumptions underlying them.

Economic theory assumes rational individuals who make decisions based on comparisons of benefits and costs. For the private agent choices between projects are relatively straightforward. However, for public sector projects the choice becomes more complex, as decision makers must consider what will best satisfy the interests and objectives of society as a whole. Cost benefit analysis (CBA) has been developed to help evaluate public policy issues, and extends this notion to the realm of government decisions by including all social benefits and costs in the process. For a given proposal, CBA attempts to identify all potential gains and losses, convert these to monetary units, and then compare them, on the basis of decision rules, to determine the project's desirability (Nas, 1996).

Welfare economics provides the theoretical foundation for the framework of CBA, as it is based on evaluating alternative economic situations from the point of view of social welfare. Within this framework, the basic criteria for deciding whether a project (any use or saving of resources) will increases social welfare, is based on the Pareto optimal criterion i.e. an action is desirable if it makes at least one person better off without making anyone worse off. A more workable rule, generally used as it justifies any reallocations as long as net benefits increase, is the Hicks-Kaldor compensation principle. This states that a project should be undertaken if it is possible 'in principle' to obtain a Pareto improvement via a set of money transfers between the gainers and the losers from the project i.e. gainers could fully compensate losers and still be better off (Sugden and Williams, 1978). Efficiency criteria ignore 'who' gains and loses, and it is the exclusion of such distributional and equity considerations that constitutes a major limitation of basic CBA, as it can only aid decision making and not replace political judgement.

The other major limitation of CBA is that the results of any calculations in a study are only as good as the estimated values of the costs and benefits incorporated in them. The following discussion will look at some of the difficulties in these valuations, along with the issue of distribution and possibilities for its resolution. Finally the costs and benefits of CBA itself will be reviewed to try to define the reality of its scope, concluding as stated by Zerbe and Dively, "...decisions are

made by decision makers, and benefit cost analysis is property regarded as an aid to decision making and not the decision itself ..." (Zerbe and Dively, 1994:2).
The basic aim and definition of CBA is to maximise the present value (PV) of all benefits less the PV of all costs, subject to specified constraints. The basic questions that need to be addressed are therefore:

- which costs and benefits to include?
- how will they be valued?
- at what rate will future costs and benefits be discounted to reflect the PV?
- what are the relevant constraints? (Prest and Turner, 1972)

The answers to these questions provide the basic principles of CBA and will be considered in turn.

Which Benefits and Costs?

In private investment appraisal consideration needs only to be given to a firm's own private benefits, or profit, and costs. However, in the arena of public investment, the scope of those affected considerably widens, including beneficiaries from the project (which may include both users and non-users who may enjoy indirect benefits), those who will incur losses, and more generally every tax paying citizen who is providing the funds for it. Hence CBA looks at overall social benefits and costs.

The main reason that these may diverge from private costs is due to the existence of externalities or 'spillover' effects on third parties. Externalities are costs and benefits from consumption or production that do not accrue to that consumer or producer, and hence are not reflected in market prices, but affect the profit, or utility of external agents (Johansson, 1992).

Mishan (1988) states that due to the limits on internalising these effects into the market, CBA must recognise, quantify and include them in project appraisals. An important distinction needs to be made between 'technological' externalities (which alter the production or consumption possibilities of others), and 'pecuniary' externalities (which operate via changes in market prices). As the latter involve transfers or distributional effects, and no real change in aggregate welfare, they are traditionally excluded from CBA. A common example is that of road improvement schemes increasing the profits of garages along their routes. (Perkins, 1994). These rises are associated with profit falls in garages on nearby and now inferior routes, hence involving no net benefits.

Therefore CBA sets out to identify all of the benefits and costs - internal / external, direct / indirect, and tangible / intangible, to measure the total impact of a project on society, excluding those that are purely pecuniary. CBA also concentrates on 'economic costs' i.e. the value that resources used in the project

could generate in their next best use, and not historic costs that have no relevance to current resource allocation decisions.

How will they be valued?

Private investors rely largely on the valuation of financial outlays and receipts at market prices in appraising costs and benefits. Although financial criteria are important in public sector investment decisions, the wide scope of costs and benefits included can present complexities and problems in evaluation. 'Tangibles' can be valued using competitive market prices, but where market imperfections exist, these may need to be corrected to reflect true social costs or benefits.

Shadow pricing is a technique used in CBA to ensure prices reflect real resource costs, and simply corrects good and factor prices in light of their opportunity cost, and attributes prices to unpriced gains and losses. Shadow prices may be derived by trying to infer prices from similar items in the economy, or the same items in other economies, or alternatively using the implications of expenditure in other policy areas to derive a price, for example, valuing 'life' or accident costs in transport studies, by government expenditure on health care (Barrett, 1982). Some market prices may need only simple adjustments, such as treating input prices net of tax in calculations, as taxes involve transfer payments and not direct societal costs, and therefore are not included in CBA calculations. Shadow pricing may also be needed in valuing the opportunity costs of imports, which may be attributed a higher than market shadow price in countries with balance of payment deficits to reflect their relative scarcity and real resource cost re exports.

A particularly problematic area is in determining the shadow price of previously unemployed labour. The opportunity cost of labour is generally viewed as the output it would have produced if the project had not been undertaken, however, if previously unemployed, a zero or even negative shadow price may be implied. Barker and Buttons (1974) see this as unsatisfactory as workers are not indifferent between being employed or not and, therefore, a better price for the formerly unemployed could be calculated by the amount that would be required to compensate for the disutility of doing the particular job (not necessarily the same as the wage rate).

Problems with valuations are compounded where no market values exist as is the case with externalities and other Intangible effects not priced in the market. Proxy measures are often used to represent these effects in CBA, however, there is considerable disagreement over appropriate evaluation methods, and their validity. A common area of contention is in valuing the cost of externalities such as noise and pollution. Hedonic prices may be used to value the pollution costs in an area, where, for example, a new industrial factory has been built. Values of

identical houses are compared in nonaffected areas, with the price differential representing the externality. However, finding identical houses, classes of property and comparable areas restricts the use of this techniques in practice. House price depreciation was used also to measure the social cost of noise in a CBA for an additional London airport. It was concluded that not only did these calculations involve complex and subjective calculations, but they also understated the social costs for residents close to the airport as, for example, if general noise levels increase everywhere overtime, absolute differences in noise levels may remain constant, but those in affected areas will obviously be much worse off (Barker and Buttons, 1974). Mishan (1988) reiterates this point, stating that loss indices such as these, may record zero social costs as noise levels increase.

Valuation of life is another very important, and much disputed, calculation in CBA, particularly concerning investments in health care and transport. Suggested methods to put a value on human lives potentially lost or saved by projects include (Barrett, 1982- Mishan, 1988):

- Gross output evaluation: discounting the present value of a person's future earnings to assess the loss to the economy on his death.
- Net output evaluation: deducting a persons consumption from the above sum to assess the losses that will accrue overtime to others due to the individuals death. Both of these output approaches, however, ignore evaluation of the losses with the grief and anxiety of potential victims and those left behind, which is undoubtedly significant, but virtually impossible to objectively measure. The net approach could also imply net benefits to society from the deaths of old age pensioners - hardly a palatable policy prescription. In fact, any project that may actually require death poses serious moral questions in establishing net benefits.
- Shadow pricing is used by calculating the value of life implied in public policy decisions re investment expenditures that do increase or decrease lives saved. However, this approach produces wide inconsistencies between different programmes and governments.
- Finally, the insurance principle uses the premiums an individual is willing to pay, and their probability of death from engaging in certain activities, to calculate their valuation on life. However, insurance policies only provide compensation to others, and so may reflect concern for family and friends rather than own life valuation.
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Whatever methods are used, O'Hagan (1995) noted discrepancies of between £2000-£1,000,000 in values between differing countries making it difficult to use CBA comparatively.

Finally, 'time' is another important intangible often considered to be more important than financial savings in transport investments. The results of CBA's can be highly sensitive to the values placed on work and leisure time. Work time saved from, for example, a faster rail service, is often valued at the amount employers are willing to pay to save their employees time, and a common measure is therefore the appropriate portion of the hourly wage rate, plus any other overheads to employ labour. Such an approach implicitly assumes, however, that the wage rate accurately reflects employee productivity (only true in perfectly competitive labour markets) and that time saved has alternative beneficial uses. It also ignores any value that a worker may place on his journey to work, and ignores the fact that travel time may be used productively (for example, to prepare a report) and therefore should not be valued as highly as time lost to employment.

Another major contention is whether very small time savings should be added, and then aggregated, at an hourly wage rate - for example are 120x30 second time savings equal to the value of 1 hour saved. If very small time savings such as these are eliminated from calculations, rates of return are significantly reduced. Finally in valuing leisure time, travel time saved is not a cost to the 'leisure traveller'. For example, it may involve significant utility to a "Sunday driver", whereas commuters may value such savings highly. Choice studies may be used to look at the value of time implied by commuters choices between fast, expensive travel, and other slow but cheaper means, or some arbitrary fraction of worktime may be selected.

These examples show some of the problems involved in accurately valuing a range of items for CBA, implying that it cannot purport to be a solution for problems in evaluating externalities etc., and can only speed up decision making once these values can be stated (Musgrave, 1972). It is arguable, however, that the true role of CBA is in bringing a number of different effects involved in a project into the decision making process, and ensuring despite inaccuracy that they are at least considered

What discount rate?

Both public and private investments will generally involve incurring costs and receiving benefits in both current and future periods. Due to the time value of money (£1 received today is worth more than £1 received in the future as it may be reinvested in the interim), PV is often used to discount the net benefits of a project giving less weight to benefits the further in the future they are to be received. Net Present Value is used as a criteria to select or reject individual projects, as well as to rank alternatives, as it allows sums received and paid out, at different times, to be measured on a comparable basis.

The question remains as to what rate should be used for discounting in this and other selection techniques. Private firms will often use market interest rates, or institutional lending and borrowing rates, to discount their future net profit streams. For public sector projects it is argued, however, that the discount rate used should reflect the social opportunity cost of funds and resources invested in the project. Pigou (1932) stated that individuals tend to be short-sighted, and hence give less weight to interests of the future (which he coined "defective telescopic faculty"). It is argued, therefore, that to ensure intergenerational equity, a lower than market discount rate should be used to responsibly account for future interests, and allow the passing of a larger stock of investment to future generations. This may be particularly important in considering our current natural resources. However, counter arguments also suggest that future generations will in fact have greater capital stock available to them, and so a lower discount rate may in fact reduce welfare as it creates a bias away from present preferences, and also in favour of public and capital intensive projects (Barrett, 1982).

A suggestion from Eckstein(1958), is to assume that a tax cut represents an alternative to public investment. Therefore by asking different income groups how they would hypothetically use these receipts, and obtaining a weighted average rate of return a socially just discount rate can be calculated. In practice, however, rates often are just based on those prevailing at the time for similar private investment, and often laid out in government guidelines for CBA - for example, in the US the budget office sets a guideline for all CBA to be based on Net Present Value with a real discount rate of 7% (the current average pre-tax rate of return on average private investment) (Nas, 1996).

Finally, risk and uncertainty must be allowed for in forecasting future costs and benefits. A risk premium could be attached to the discount rate to allow for remote benefits to be discounted more than near and more certain ones, or alternatively the time horizon of the project could be limited to reduce risks of changes in supply and demand conditions. Crude adjustments and educated guesses are often used, although, more sophisticated techniques are also available. Sensitivity analysis calculates Net Present Values based on differing sets of likely, pessimistic and optimistic assumptions, allowing the analyst to see how forecasts can change when key factors such as the discount rate or shadow prices are altered. Based on this, they can decide whether the risk implied in the most pessimistic outcome is small enough to justify undertaking the project. However, wide divergences in these three forecasts often make meaningful comparisons difficult. Alternatively, "gaming theory" allows the setting up of decision rules based on the decision makers outlook. A cautious analyst will select projects with the maximum, minimum Net Present Value (the maximin criteria), whereas the Optimist will go for projects with the highest Net Present Value's (the minimax

criteria) (Johansson, 1992). Again relying on a decision maker's temperament is a highly subjective way to account for uncertainties.

What constraints?

Once projects are valued, the final step in appraisal involves considering the constraints on decision making. All decisions will be constrained to some extent by external/physical, legal, and administrative factors. The funds constraints for a private firm will be set out and determined by their finance departments, however, public sector investment decisions are often within constraints of national budgeting.

The suggestion in the introduction that choices can be made between projects using purely economic criteria, as gainers may compensate losers, is rarely applied in practice, and hence, more recent literature on CBA has increasingly considered distribution issues, and how they may be dealt with. Traditional economics is based on assumptions that welfare will increase with any net increase in consumption (measured by willingness to pay), irrespective of the income levels of those who benefit or pay for it. Brent (1996) describes the need for 'social CBA' to undertake social, rather than merely economic evaluations, to include distribution as well as efficiency effects in public sector decisions. Little (1957) suggested reformulation of the Hicks-Kaldor criterion to accept a project only if it has a positive Net Present Value and does not cause any deterioration in income distribution.

As government projects will often have more diverse objectives than purely commercial ones, including in some cases the redistribution of income to target groups or regions, techniques have developed such as attaching weights to the costs and benefits of a project, depending on the income level of the donor or recipient (Perkins, 1994). Deciding on appropriate weights, however, brings yet another stream of complexities into the decision making process. Barker and Buttons (1974) suggest that an inverse scale of progressive tax could be used, as this might provide some indication of the weight society places on income redistribution. However, if the tax system does accurately reflect these views, there would be no need to account for distribution, as the system would automatically adjust to an optimum outcome (suggesting in fact that they don't, and so have little value as weights.)

They also suggest alternative methods to account for distribution such as using a common average value for time savings regardless of income levels, which would favour lower income groups, who may be less willing to pay for time saved or value it less. This involves a questionable assumption that willingness to pay relates directly to utility.

The United Nations (1972) makes the important point that CBA provides a rational framework for project choice, but that decisions must be ultimately made within national parameters, involving the goals, objectives, and value judgements chosen and set out by governments. They suggest that weightings such as these are beyond the realm of the analyst, and should be treated as unknowns in analysis, and presented to relevant political leaders forcing them to reveal their value judgements. In doing this, 'political decisions' are put in the hands of those who are politically responsible and accountable to their electorate, and project analysis cannot 'pretend' to be an apolitical, technical exercise.

Conclusion

Finally, to establish the differences in the aspirations of CBA, and what it can practically do, it is useful to review its limitations and advantages. The discussion reviewed some of the limitations of CBA, looking at issues such as the accuracy of benefit and cost estimates, and the effects of the choice of measurement of, for example, intangibles, on outcomes. It also discussed problems in choosing appropriate discount rates, with the essentially Pigovian assumption that these would diverge from private rates due to far sighted governments, along with selection of appropriate time horizons and dealing with risk and uncertainty. Frost (1971) also points out that when the outcomes of CBA are in dispute with expert opinion, it may be unwise to assume the expert is wrong, as many factors in CBA are open to omission, wrong inclusion or wrong interpretation, and hence cannot replace intuitive dynamic analysis. There is also the consideration of the costs of CBA itself in investigations, computations etc., which may involve considerable time money (although this may be often a lot less than the potential losses from uneconomical decisions).

Williams states that: "...cost-benefit analysis one of the techniques most prone to misunderstanding and misapplication in the hands of the uninitiated - not to mention the unscrupulous..." (Williams, 1973:31). Whilst government appraisals using CBA must make value judgements for 'the common good', with the assumption that they know what this is, failure to make these judgements would prevent the achievement of any solution at all.

CBA as a decision making tool is systematic (in principle involving a comprehensive search for all costs and benefits), quantitative (expressing these in common monetary units for comparative analysis), takes a 'long' view - looking at repercussions in the far as well as near future, and is based on comprehensive theory with clearly stated assumptions. CBA cannot aspire to be objective in principle or practice, as value judgements are inevitable, and should be made explicit and themselves subject to consistent analysis.

CBA does not aspire to make choices or justify them. Its aspirations and objectives are to provide assistance in choice, and when used in this manner it provides an invaluable tool in decision making.

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