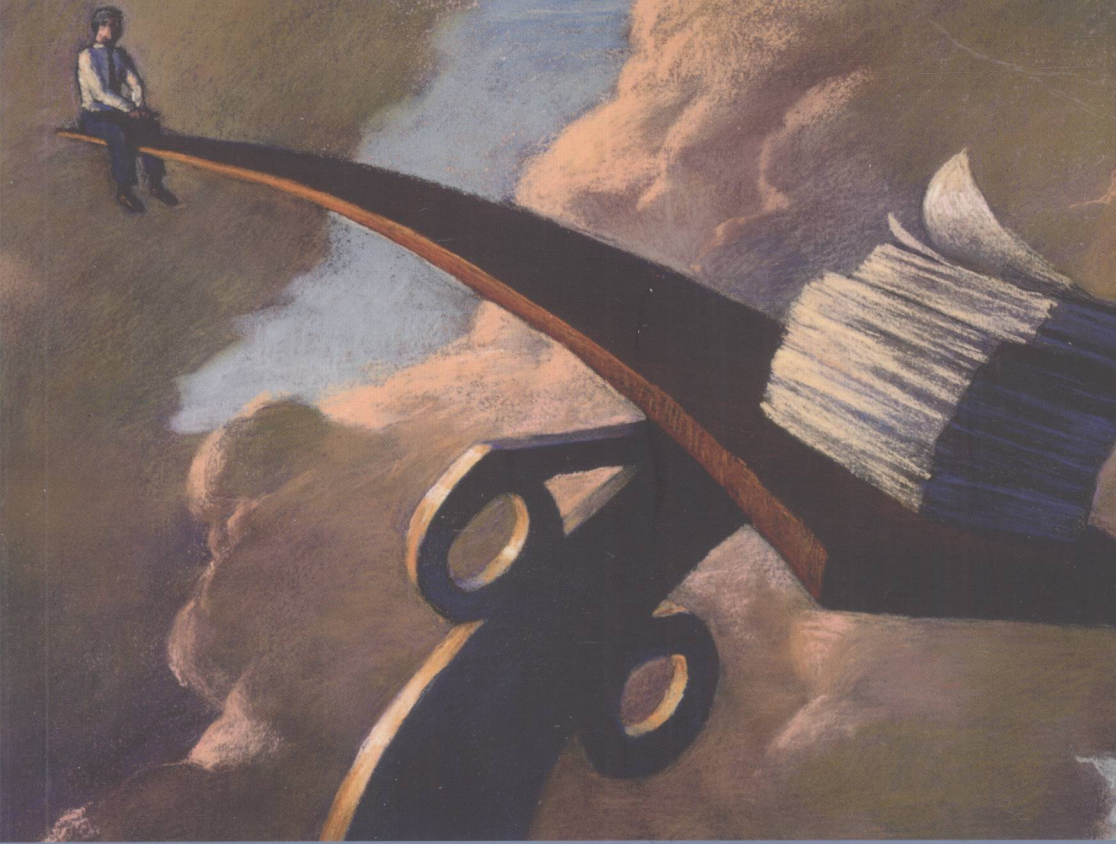

Cost Benefit Analysis

Fifth Edition

E.J. Mishan & Euston Quah

Cost–Benefit Analysis
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Cost–Benefit Analysis
5th Edition

Cost–benefit analysis (CBA) is the systematic and analytical process of comparing benefits and costs in evaluating the desirability of a project or programme – often of a social nature. CBA is fundamental to government decision making and is established as a formal technique for making informed decisions on the use of society's scarce resources. It attempts to answer such questions as whether a proposed project is worthwhile, the optimal scale of a proposed project and the relevant constraints. CBA can be applicable to transportation projects, environmental and agricultural projects, land-use planning, social welfare and educational programmes, urban renewal, health economics and others.

The timely 5th edition, examines new work in the discipline, with relevant examples and illustrations as well as new and expanded chapters, to include:

- non-market goods valuation
- the impact of uncertainty
- transportation economics
- investment appraisal
- environmental economics
- evaluation of programmes and services

The 5th edition continues to build on the successful approach of previous editions, with lucid explanation of key ideas, the simple but effective expository short chapters and an appendix on various useful statistical and mathematical concepts and derivatives.

Cost–Benefit Analysis (5th edition) will be a valuable source and guide to international funding agencies, governments and interested professional economists.

For this edition, **E.J. Mishan** has been joined by **Euston Quah** of Nanyang Technological University. New themes explored include the impact of game theory on CBA.

Preface to the fifth edition

Following precedent, this fifth edition of *Cost–Benefit Analysis* addresses itself primarily to the 'mature student', at least to the conscientious student, who is primarily concerned with understanding the rationale and the limitations of basic methods. The exposition, however, continues to remain informal, proceeding in the main through numerical illustrations and with only occasional recourse to simple notation.

Economists familiar with the fourth edition will at once notice that the several simplified examples of cost–benefit calculations, presented in its introductory Part I, have now been removed. At the time when the first edition was being prepared (1970), cost–benefit analysis was not so familiar a subject, and few economics departments included it in their list of courses. It seemed then advisable to prepare the students' minds for the need of the various techniques that were to follow. With the passage of time, we must recognize that initial presentations of simplified cost–benefit examples are no longer necessary.

In this new edition, therefore, we have reverted to the more traditional practice of beginning a textbook with an introductory Part I on Scope and method; in our case, a decision that has required, *inter alia*, the removal of some chapters of the fourth edition, and parts of some other chapters, to this introductory Part I, where they are now more comfortably lodged, for it is incumbent in this Part I that the authors make clear just how the economist's conceptions of costs and benefits differ from those employed in the business world. To the layman and the politician, the notion of gains and losses may seem evident enough for transactions between a limited number of people. It is far from evident, however, when calculations of gains and losses have to be made for whole communities, whether or not the individuals are directly engaged in some project or programme.

As for the remaining parts in this fifth edition, apart from correcting some minor errors in the fourth edition, some rearrangement of the chapters has taken place and, occasionally, what appeared there as two consecutive chapters has been combined here to form a single chapter: all this, and more, in the endeavour to make the exposition in this new edition more lucid and concise.

It may be noted, in particular, that Part IV (on 'External effects') now ends with an extended chapter in which the possibly quite different outcomes from using a calculation based on the CV^{21} measure, instead of the CV^{12} measure,

are elaborated and illustrated. Again, in our Part V (on 'Investment criteria'), a searching comparison of the implications and the limitations of the various criteria in common use cannot be undertaken without taking up far more space than any of the other parts. In this connection, the two chapters devoted to explaining the proposed normalization procedure (in compounding net benefits forward to a terminal date), regarded as a technique superior to any of the popular discounted-present-value criteria for evaluating a stream of net benefits, have been entirely re-written to make it more comprehensible.

After much reflection, it seemed to us that some of the chapters in the fourth edition, in particular that on the Scitovsky Paradox and that on Second-Best, would be better relegated to expanded Appendices. There they are included with a number of other Appendices that, although not central to a proper exposition of cost–benefit analysis, touch on sources of misunderstanding or of common error in some popular treatments of the subject.

It may be unnecessary to remark that no significant theoretical novelty is to be found in this edition, or indeed in earlier editions. Inasmuch as cost–benefit analysis is, in fact, no more than an assembly of concepts and techniques culled from mainstream economic theory, in particular from that branch known as Welfare Economics, it is not surprising that the subject itself cannot boast of theoretical innovation.

Apart from proposals for the gathering and refinement of data, the development of cost–benefit analysis over the years has centred, in the main, on controversies over the propriety of concepts, over proxies for their measurement and over the appropriateness of the techniques employed to determine the ranking of alternative public projects. With regard to all such issues, our overriding concern remains that of examining the validity of the key concepts in use, of making explicit the limitations of the usual proxies adopted for their measurement and of checking for consistency the various techniques employed in any cost–benefit calculation.

We are aware, of course, that although purporting to be both a guide to, and a critique of, cost–benefit methods, this resulting volume is somewhat slimmer than other popular cost–benefit manuals. There are several reasons for this. One is that we are studiously economical in our choice of tables, diagrams and other such schema that seem to exert a fascination on some writers. Another is that we do not undertake to test the reader's understanding of the material in each chapter by including pages of questions (and answers). Although we do not deny that repeated elaboration of such features can be helpful in impressing on the more plastic minds of beginners who are eager to be inducted into 'the mysteries of the craft', there is always the danger that the sheer mass of material and formulae in these bulkier manuals may also act to intimidate or to bewilder hapless students so that, in the end, they 'cannot see the woods for the trees'.

We also note that, in some of the more ambitious textbooks, there are extended reports of cost–benefit studies already undertaken for existing programmes or projects. Their value, however, is limited unless the methods used in such studies are also subjected to fastidious examination. Since this, in fact, is not the case,

the reader might like to know that a companion volume to this fifth edition is currently being prepared, one that, indeed, subjects the selected case studies to critical assessment.

The co-author of this fifth edition, Professor Euston Quah, needs no introduction to economists who keep abreast of the growing literature in Environmental Economics. He is currently editor of *The Singapore Economic Review* and, in the past few years, has been active in arranging cost–benefit courses for the cohorts of economics students at the National University of Singapore: courses that have been based on the material now contained in the present edition, which has, incidentally, benefited from students' 'feedback'. We should like to acknowledge Dr Lim Boon Tiong from the National University of Singapore for his invaluable advice, as well as Mr Lim Sze How for all the fieldwork and multitude of tasks that he has undertaken in the course of writing and organizing the material used in this book, and it is indeed to his credit that things got organized. We should also like to thank Ms Khatini binte Anuar for much of the secretarial work that accompanied this project and, last but not least, we must thank Robert Langham and colleagues at Routledge for their suggestions and support throughout.

E.J.M. and E.Q.

Contents

Part I

Scope and method

1 Introductory remarks[1]

1 No textbook can provide detailed guidance on every aspect of gathering and processing data on the variety of programmes and projects in which cost–benefit analysis (CBA) may be employed. Indeed, attempts by authors to put together increasingly comprehensive textbooks on the subject result in so overloading the students' minds that they 'cannot see the wood for the trees'.

In this introductory text, however, we continue the policy of earlier editions in focusing the student's attention on the crucial concepts and, unavoidably, also on the controversies they engender. The purpose of this stratagem is to enable the conscientious student initially to understand what ideally he should be seeking to measure before resorting to a considered choice among the proxies available or contrived. Our aim, that is, is primarily to sharpen the student's insight into the rationale of the basic fundamental concepts, in the endeavour to develop his judgement in appraising the validity and the usefulness of the diverse techniques employed or proposed in the economic valuation of projects.

2 Let us be clear from the start that the sort of question a CBA sets out to answer is whether one or a number of projects or programmes should be undertaken and, if investable funds are limited, which one, two or more among these specific projects that would otherwise qualify for admission should be selected. Another question that CBA sometimes addresses is that of determining the level at which a plant should operate or the combination of outputs it should produce. In this introductory volume, however, we follow custom in confining our attention chiefly to the former question, about the choice of investment projects.

But why bother with CBA at all? What is wrong with deciding whether or not to undertake any specific investment or to choose among a number of specific investment opportunities, guided simply by proper accounting practices and, therefore, guided ultimately by reference to profitability. The answer is provided by the familiar thesis that what counts as benefits (or profits) and costs to personnel engaged in the activity of a particular segment of the economy – be it a firm, an industry or any private or public organization – does not necessarily coincide

1 A brief history background of CBA is provided in Appendix 1.

with, indeed, is unlikely to coincide with, all the benefits and costs experienced by the individuals residing within an area subject to a CBA. The area to which the analysis is addressed is often the economy of a whole country or nation state. But it can also be a region that encompasses a number of contiguous countries or, alternatively, one or more provinces of a country or even a single town or city. This problem is called the accounting stance. In order to avoid unnecessary verbiage, however, we shall assume henceforth that the area in question is that of the whole country and therefore speak of 'the economy as a whole' or 'society as a whole'.

A private enterprise, or even a public enterprise, comprises only a segment of the economy, often a very small segment. More importantly, whatever the means it employs in pursuing its objectives – whether rules of thumb or more formalized techniques such as mathematical programming or operations research – the private enterprise, at least, is guided by ordinary commercial criteria that require revenues to exceed costs. The fact that its activities are guided by the profit motive, however, is not to deny that it confers benefits on a large number of people other than its shareholders. It also confers benefits on its employees, on consumers, and – through the taxes it pays – on the general public. Yet the benefits enjoyed by these four groups continue to exist only for as long as they coincide with the yielding of profits to the enterprise. If it makes losses, the enterprise cannot survive unless it receives a public subsidy. If it is to survive unaided as a private concern and, moreover, to expand the scale of its operations, it must, over a period of time, produce profits large enough either to attract investors or to finance its own expansion.

There is, of course, the metaphor of the 'invisible hand', the *deus ex machina* discovered by Adam Smith that so directs the self-seeking proclivities of the business world that it confers benefits on society as a whole. And one can, indeed, lay down simple and sufficient conditions under which the uncompromising pursuit of profits acts always to serve the public interest. These conditions can be boiled down to two: that all effects relevant to the welfare of all individuals be properly priced on the market, and that perfect competition prevail in all economic activities.

3 Once we depart from this ideal economic setting, however, the set of outputs and prices to which the economy tends may not serve the public so well as some other set of outputs and prices. In addition to this possible misallocation of resources among the goods being produced, it is also possible that certain goods that can be economically justified are not produced at all, while others that cannot be economically justified continue to be produced. If, for example, technical conditions and the size of the market are such that a number of goods can be produced only under conditions of increasing returns to scale (falling average cost), it is possible that, although some of these goods will be produced by monopolies charging prices above marginal cost, other such goods will not be produced, as there is no single price at which the monopolist can make any profit. But the production of

these latter goods is not necessarily uneconomic. It may simply be the case that the monopolist who sells each good at a single price cannot transfer enough of the benefits from his potential customers to make the venture worthwhile.

Again, certain goods with beneficial, though unpriced, spillover effects also qualify for production on economic grounds; but they cannot be produced at a profit as long as the beneficial spillovers remain unpriced. The reverse is also true and more significant: profitable commercial activities sometimes produce noxious spillover effects to such an extent that, on a more comprehensive pricing criterion, they would be regarded as uneconomic.

The economist engaged in the cost–benefit appraisal of a project is not, in essence then, asking a different sort of question from that being asked by the accountant of a private firm. Rather, the same sort of question is being asked about a wider group of people – who comprise society – and is being asked more searchingly. Instead of asking whether the owners of the enterprise will become better off by the firm's engaging in one activity rather than another, the economist asks whether, by undertaking this project rather than not undertaking it, or by undertaking instead any of a number of alternative projects, net benefits will accrue to a society consisting of all the individuals who reside or work within the area in question.

Broadly speaking, for the more precise concept of revenue to the private firm, the economist substitutes the less precise yet meaningful concept of *social benefit*. For the costs of the private firm, the economist substitutes the concept of *opportunity cost* – the social value foregone when the resources in question are moved away from alternative economic activities into the specific project. For the profit of the firm, the economist substitutes the concept of *excess social benefit over cost* or, in short, net social benefit.

It may be mentioned in passing that it is just possible that within the accounting stance in question the economist is instructed to include benefits that accrue only to a specific group, say to those who are disabled, indigent or single parent families. Irrespective, however, of the political desirability of such an objective, collecting such specific data alone may prove so costly as to raise questions about its feasibility.

Again, it may be held that there are difficulties in calculating the value of benefits that accrue to individuals, or to those members of a family who do not themselves make economic decisions. Yet the economist may reasonably accept as the value of such benefits those that may be calculated from the decisions on their behalf taken by others.

4 Returning to the notion of net social benefit, or excess social benefit over cost which is to be estimated by a CBA, it may be recognized as one referred to in the literature on welfare economics as a *potential* Pareto improvement or, earlier still, as a 'test of hypothetical compensation'. The project in question, that is, may be regarded as an economic improvement if its implementation produces an excess of benefits over losses for the community: one, that is, for which a

costless redistribution of the benefits could make every one affected by the project better off.[2]

More formally, however, the cost–benefit criterion to be adopted can be expressed in simple notation form as $\Sigma V_i > 0$, where $V_1, V_2, \ldots, V_n$ are the net valuations of each of the n persons affected by the project, where a positive V valuation indicates a net benefit, and a negative V valuation a net loss to the person. Clearly, if the aggregate valuations sum to a positive figure, the aggregate of benefits exceeds the losses, and a potential Pareto improvement is realized. (More precise measures of such valuations in the form of compensating variations will be introduced later.)

The above criterion is better regarded as necessary though perhaps not sufficient, inasmuch as it may have to meet some additional political requirement, say, that ΣV exceed a certain figure or else exceed a given benefit–cost ratio.

Another reason why our $\Sigma V > 0$ above may be deemed insufficient is that, as it stands, it makes no provision for the distributional impact of the project. Since a number of ways have been proposed for attaching distributional or other weights to the valuations, none of which, however, we find acceptable, we defer these proposals, and our objections to them, to Chapter 3.

In the meantime, although the criterion we have adopted (simply that the sum of all valuations be positive) is straightforward enough,[3] our difficulties begin once we start to trace all the repercussions and bring them into the calculations. These difficulties, which require extended treatment, are to be found chiefly in the concepts and measurement of consumer surplus and rent, in the distinctions between shadow prices and transfer payments, in evaluating a range of spillover effects, in the choice of investment criteria, and in proposals for dealing with future uncertainty. They are dealt with in that order in the parts that follow.

5 Finally, the reader will appreciate that the techniques employed in CBA can be put to related uses. Public funds used for the financing of education or medical

2 Although this potential Pareto improvement involves no more than an exercise in positive economics, some economists would regard it as having normative implications independent of any political decision. Both the reasons that may be advanced for this view and those for rejecting it will be discussed in Appendix 2.

3 It has frequently been alleged that the Arrow Theorem invalidates the validity of welfare economics and, by extension, that also of CBA. This is a misunderstanding of the scope of that theorem.

The intransitivity that may occur when majority decisions are used to rank alternative policies – an intransitivity easily demonstrated by an example, say, of three alternative policies, A, B, C, to be ranked by three persons (or groups) – can have political implications for countries where decisions are reached by majority rule. But in economics, where persons are assumed not merely to be able to rank alternatives, but also to assign money valuations to units of goods and bads, this sort of intransitivity does not arise.

The possible contradiction in the so-called Kaldor–Hicks test, first pointed out by Scitovsky (1941), however, has no affinity with the above theorem. It arises rather from the relationship between the set of market prices and the distribution of the community's income, as explained in Appendix 3.