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Forum

Pangloss, Pandora and Pareto for the Aspiring Benefit-Cost Analyst

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"Can you help me with a benefit-cost analysis of these land-use alternatives, Jack?"

"I'd be happy to try. How much do you know about benefit-cost analysis and how long do we have?"

"I don't know anything about it and I need to finish by the end of next week."

This situation confronts me numerous times each year. After many years of trying to help I'm surprised to find that my task has become not easier but harder. But perhaps this *in fora* exploration of one man's problems may shed some light on the quite remarkable development of benefit-cost analysis over recent years and some rather conflicting experiences in its application.¹ I approach this exploration primarily as a teacher (who would like to be able to help), as a continuing student of the subject (who would like to be able to understand all the conflicts and paradoxes), as a practitioner (who would appreciate a clear, unambiguous, universally-applicable cookbook) and as a researcher (who has a particular interest in the valuation of benefits and cost).

Rather than attempt a complete review of developments, I consider a few of the problems faced by the would-be analyst and his "adviser".² So first we search for a text which presents the necessary principles to solve the inevitable conceptual and analytical issues. From this Pangloss world of texts we turn, in section 2, to the Pandora's box of literature.³ Then in section 3 we consider just a few of the important lessons from Pareto's basic concept. The final section summarizes the causes of my increased difficulties, reviews some possible solutions and presents the reactions of the aspirant to benefit-cost analysis.

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¹ One sort of reason for these increased problems must be my own background, skills and traits. I ignore this on the Fraseristic ground that others can judge this sort of reason better than I. Another kind of reason may be the changing background of the aspiring analyst—with more non-economists more recently. For simplicity I'll assume that aspiring analysts have remained equally competent over the years.

² There have been many important developments in benefit-cost analysis for developing countries. These developments rest on the observation that market prices tend to be grossly distorted. These developments are not considered here in order to concentrate on problems more relevant to Australia.

³ None of the editorial staff who read the manuscript knew the meaning of "Pangloss"—hence this footnote. Pangloss was a European philosopher who lived in the Middle Ages. The major theme of his arguments was to rationalize present situations, whatever they were, as the best of all possible worlds. For completeness I also provide the meaning of Pandora's box. Greek mythology claims a woman, Pandora, was made by Zeus to punish the human race. Zeus gave her a box from which she let loose all the desirable evils that afflict mankind. Only hope remained at the bottom of the box.

1 Pangloss' world of texts

Over the last ten years, there has been a very great increase in the number of benefit-cost texts and some 15 are now available. Apparently then an analyst should be able to find a single text of direct application to his area. But this Pangloss' world, where the present situation seems to be the best of all possible situations, is accompanied by frustrations for both the aspiring analyst and his adviser.⁴

Two of the first texts were collections of conference papers. *Program Budgeting and Benefit-Cost Analysis: Cases, Text Readings* (Hinrichs and Taylor, 1969) concerns public expenditure analysis in general. Although American and more concerned with post offices than land use, there are four very useful chapters on the role of benefit-cost analysis, Baumol's gem promoting opportunity cost discount rates and two instructive forestry examples. My enthusiasm for the empirical relevance of this collection encouraged me to purchase the collection by Kendall (1971), *Cost-Benefit Analysis*. This volume includes an uneven paper by Turvey on the development of the art, eight papers on applications to health services, three to defence research and development, three to transport, two to investment but only three to land use. This text contains much for the researcher and teacher who have some overall grasp of the topic. But unfortunately for the agricultural economist, the book strongly reflects its origin in the 1969 Symposium of the NATO Scientific Affairs Committee.

Layard (1972) collected 18 journal articles in his *Cost-Benefit Analysis*. These papers cover the key concepts with a strong section on the social rate of discount. This collection is well suited to researcher, teacher and student in a third or fourth-year University course. But regrettably perhaps, the articles are too rigorous and theoretical for the practitioner and would-be analyst.

The first comprehensive texts on basic principles did not appear until the early 1970's even though the subject matter had settled by the early 1960's—witness the substantial similarity of content between the Prest and Turvey review paper (1965) and the subsequent works (e.g., Pearce, 1971; Peskin and Seskin, 1975; and Sugden and Williams, 1978). In 1971 came Mishan's basic work *Cost-Benefit Analysis: An Informal Introduction*—which was neither introductory nor informal. Mishan gave a full, rigorous treatment of the nature and role of surplus concepts, adaptation of Pareto optimality to the real world and discounted cash flow techniques. In 1972 Unwin published Mishan's much shorter *Elements of Cost-Benefit Analysis*. Both texts discuss popular methods of coping with uncertainty (cut-off periods, risk premia, conservative data and the use of probabilities). But for the new analyst, the shorter text omitted some of the most useful chapters of the first book—the first 30 pages where Mishan showed how to frame problems in terms of the net social benefit model. Pearce's short *Cost-Benefit Analysis* (Pearce, 1971) covers the same ground but much more concisely, more precisely and in the apparently more logical sequence of welfare basis—discounting criteria—valuation of benefits and costs—risk and uncertainty.⁵ Apparently Pearce saw the need for a longer, more-detailed,

⁴ An immediate frustration from the plethora of texts is their unavailability—for various reasons. For example, I have yet to study Sassone and Schaffer (1978) and Irvin (1978).

⁵ Mishan (1972) and Pearce (1971) actually cover the same ground in the same sequence. But Mishan has twenty lengthily-labelled chapters while Pearce has nine concisely-labelled chapters. To a surprisingly large number of students the overall effect is that Pearce is simpler and more logical.

more-theoretical text so he combined with Dasgupta to produce *Cost-Benefit Analysis: Theory and Practice* (Dasgupta and Pearce, 1972). This text belies its title because it contains little of practical relevance, but basic welfare theory is very well covered in Chapters 1 to 3. Both student and would-be analyst are frustrated by these four texts. None of them shows how to apply theory to practice, but perhaps none were designed specifically to do this—notwithstanding Dasgupta and Pearce's (1972) title.

These theoretical texts were followed by more practical and area-oriented books and so the practitioner should have recently become less frustrated. The year 1978 brought *The Principles of Practical Cost-Benefit Analysis* (Sugden and Williams, 1978). The authors start from the (hopefully) familiar concept of discounting and proceed to conventional surplus concepts and valuation. Their attention to the application of concepts and their many simple examples and exercises are appealing and useful to student, practitioner and researcher. An even more pragmatic text is Frost (1971), *How to Use Cost Benefit Analysis in Project Appraisal*. Without any theoretical bases whatsoever, Frost shows how to (a) display an analysis, (b) quantify future benefits and (c) value benefits and costs in social terms. The author then goes beyond most conventional works in introducing (a) some notions of multiple-objective planning (scoring and outranking) to aggregate money and non-money values, and (b) weights on different kinds of net benefit. Frost has substantially achieved his objective of a non-technical manual for the practitioner and has, in fact, provided a very useful book. Most aspiring analysts quickly enthuse about this text and its "usefulness". But a teacher might sound a word of warning for something Frost never did and never set out to do. Frost's guidelines apply to Frost's problems and cannot readily be generalized to other problems without some knowledge of theory. For example the reader may well receive the impression that market prices equal total (and not marginal) willingness to pay.

Recent area-oriented texts include *Cost-Benefit Analysis and Water Pollution Policy* (Peskin and Seskin, 1975) and *Cost Benefit Analysis and Environmental Problems* (Abelson, 1979). Peskin and Seskin's text is an edited collection and so fails to cover the theory and practice in a systematic way—but its orientation appeals to water pollution specialists.

Abelson argues strongly for benefit-cost analysis over alternative planning methods such as environmental impact statements and planning balance sheets. He states that benefit-cost analysis is more comprehensive, more philosophically coherent, more ethically acceptable, accounts for individual preferences more acceptably and provides more relevant information for decisions. Even though these justifications seem lightly supported in the text, the book is worth recommending to aspiring analysts for these arguments alone.⁶ Abelson seems to cover the welfare bases rather lightly and each concept is presented afresh without really showing how each can be drawn from the basic notions of Pareto optimality and net social benefit. Nevertheless, the clear treatment of three Australian examples of soil conservation, sand mining and airport location, make this an important book for the agriculturally—and environmentally—oriented aspirant.

⁶ For the same reason the book is especially worth recommending to aspirants who lack an economic background.

Australian Project Evaluation (McMaster and Webb, 1978) is a collection of 21 essays on benefit-cost analysis in Australia. Eleven essays cover some basic principles in an applied manner and the remaining ten are Australian case studies. This 1978 text is a timely and useful addition to the would-be analyst's own library even though only two case studies concern rural land use and the principles are only partially covered.

Unfortunately the diligent student will discover Gittinger (1972), *Economic Analysis of Agricultural Projects*. Gittinger covers project identification and discounting exceptionally well and he is exclusively concerned with land use. But the notions of net social benefits and consumer's surplus receive no treatment and unpriced benefits are covered in only one page.⁷ The student therefore gets the impression that benefit-cost analysis concerns just the discounting of money revenues and money costs. Each year I fight a battle to dispel this notion which is all-too-common among non-economists. Regrettably then I avoid recommending Gittinger.

The two-week analyst needs a single book that provides basic theory, derives principles from this theory and shows how to apply the principles to agricultural or environmental land use. Clearly there are a large number of possible texts. So like Pangloss in his best of all possible worlds, teacher, student, analyst and practitioner all start to search for that single text. Even this brief review indicates that there is no such book. This surprises me—because the market is distinct and large. It also frustrates me—because I always end up preparing a different reading list for each would-be analyst.

For a semester-length University course all the texts are possibilities. But for the two-week analyst, Mishan (1971) is too long, Dasgupta and Pearce (1972) too confusing, Gittinger (1972) too dangerous and Sugden and Williams (1978) too challenging. This leaves a combination of sections from Mishan (1972) or Pearce (1971), from McMaster and Webb (1978) and from an area-oriented text like Abelson (1979) or Peskin and Seskin (1975).

2 Pandora's box of literature

Even with his basic texts, the would-be analyst usually needs to consult the vast literature to pursue particular points. The vastness, of course, reflects healthy debate and a healthy methodology. Equally, the vastness is beneficial to teacher and researcher with time to try to synthesize and understand it. But to beginning student and aspiring analyst, the very vastness is only the first problem. The literature is confused (choice of criteria), divided (choice of discount rate), and full of theoretical traps (consumer's surplus) and analytical quagmires (the internal rate of return). Like Pandora's box, the literature contains everything anyone could desire but only the hopeful two-week analyst should open it. Consider just the three areas of choice of criteria, choice of interest rate and valuation of benefits through consumer's surplus.

2.1 The great debate on criteria

The would-be analyst and student quickly discover the three relevant criteria but take much longer to find the following three possible guidelines on selection. (a) Net present value maximizes net benefits when capital is unlimited. This criterion is theoretically correct because society has this objective

⁷ Another eight pages provide a superficial cover of shadow pricing for developing countries.

and faces no capital constraint. (b) In practice, government departments do face capital constraints. The benefit-cost ratio maximizes net benefits in the presence of capital constraints and so this appears to be the appropriate criterion in practice. (c) The internal rate of return can be an analytical nightmare. Jensen (1969) ably demonstrated its many shortcomings (like several answers) but many, including the Bureau of Agricultural Economics, still advocate and use it (as, for example, B.A.E., 1973).

The analyst should surely follow Turvey's (1963) dictum and select the criterion that best follows the relevant objectives and constraints. Presumably then he would choose the benefit-cost ratio. This conclusion was as obvious before the great criteria debates of the sixties and seventies as it is now. Time spent on the great volumes of this literature seems of little help to the aspiring analyst. But worse, the debates fail to clarify the important problem of multiple objectives and the fact that no criterion perfectly fits reality.

2.2 The continuing debate on discount rates

The two-week analyst consults his basic texts and discovers the two opposing theories for the discount rate—social opportunity cost and social time preference. The division of opinion on which theory is appropriate sends him scurrying for an Australian model or guideline to indicate an appropriate rate. This search for a single rate is quickly frustrated. Indeed at roughly the same time two authoritative Australian statements advised the quite different rates of 5.5 per cent (Commonwealth Treasury, 1966) and 10 per cent (Bureau of Roads, 1968).

Promotion of several simplifying “devices” has complicated the adviser's work without simplifying things for the student or practitioner. Many studies, particularly recent work by the Bureau of Agricultural Economics (1973), display results for a range of rates. This and other studies estimate internal rates of return. Neither of these devices can lead to definitive advice on choice of projects without knowledge of an appropriate rate of discount. Suggestions that discount rates should vary with risk or with the life of the project (McKay, 1976) further complicate matters for the newcomer and, in any case, seem inappropriate. So the aspiring analyst becomes more confused the more he reads.

Some of this confusion is often removed, deliberately or otherwise, by the rediscovery of the need for inflation-free rates. We've always known that real, or inflation-free, rates must accompany real prices in an analysis. But this tenet has often been obscured (or actually forgotten) in analyses. More recently Hanke, *et al.* (1975), have explored this principle and shown how to convert observed (or unreal) market rates to real rates.

This rediscovery and the little exercises that Hanke, *et al.*, use may still leave a wide range of rates. But it seems to make the notion of interest much clearer to the student who quickly recognizes the possibility of logical, conceptually-sound, upper and lower bounds.

2.3 The emerging discussion on consumer's surplus

The analyst must try to value *all* benefits and costs and so must consider unpriced things like water quality and wildlife diversity as well as priced things like agricultural output. Valuation of unpriced things has much to frustrate student, practitioner and researcher. But paradoxically perhaps, frustrations

for some often provide inspiration for others, like Sinden and Worrell's (1979) work on the valuation problem. Successful valuation requires identification of the appropriate consumer's surplus concepts and application of a technique to measure this surplus. Some developments in these two areas are now considered.

The conventional change in output has usually been the marginal change that was neither irreversible nor completely removed the good from the market. Total willingness to pay for an extra unit was an uncomplicated measure of the surplus from the change. But recent discussions and applications have introduced new sorts of output change and concerned different property-rights situations. The same concept of willingness to pay is no longer the sole appropriate concept. So student, practitioner, teacher and researcher alike must return to Hick's four basic concepts (1943) and to Machlup's (1957) expansion to ten to identify the appropriate concept of benefit.

The would-be analyst very quickly discovers two or three dozen recent articles on these surplus concepts. Almost as quickly he asks do the different concepts matter anyway? Unfortunately for him they do, because Sinden (1978) showed differences of 2/1 between them and Meyer (1979) has shown differences of 20/1. The recognition and application of the need for different surplus concepts must be regarded as a useful development and very possibly a substantial development in view of these differences. But the "adviser" must become acquainted with much more, and perhaps more difficult, literature.

The task of applying and measuring the appropriate surplus concept presents different sorts of problems. At the outset, student and practitioner usually consider valuation to be impossible. But the teacher can quickly show that valuation of priced and unpriced things rest on the same economic principles. The next problem is to find techniques to apply the principles and this illustrates another kind of substantial development and another kind of paradox. Over the last decade a vast array of such techniques has been developed and "popularized" (Sinden and Worrel, 1979). But each technique rests on slightly different conceptual premises and although all work well in their particular situations, none is a panacea.

The teacher must therefore promote the view that all the techniques are appropriate in their niche.⁸ The teacher should try to demonstrate that useful progress to valuation may well be made with some technique. This demonstration is helped by the large gap between what is done in practice and what is possible. Illustrations of some apparently successful valuations help this demonstration, but data previously collected by the analyst usually do not. Invariably the aspiring analyst has collected some data already and usually a small increment to what he did could have given large increments in useful value information. Two-week rescue jobs are difficult and often undesirable.

2.4 A limited overview

What has this great literature accomplished and how does it affect the would-be analyst? The healthy volume and vigour of the discussion has clarified most issues—but hasn't really solved many of them. The debates have produced different levels of progress on each issue and the remaining divisions disillusion most would-be analysts.

⁸ This promotion is not always easy because many writers vociferously promote just a few or even a single method.

Little of substance seems to have been contributed on the choice of criteria. Even though the basis and nature of each criterion is much clearer, choice still rests on traditional long-established guidelines. The debate on the discount rate has produced several very useful empirical demonstrations on how to estimate rates. And the embarrassing rediscovery of the importance of inflation has clarified things and simplified teaching. The debate on consumer's surplus has accelerated, and contributions to valuation continue. New techniques have been contributed and we have learnt that we may have used inappropriate surplus concepts in earlier applications—and so obtained inappropriate estimates.

3 Pareto's set of basics

Ever since he published his *Manual of Political Economy* in 1906, Pareto's concept of a social improvement has underpinned benefit-cost analysis. The difficulties of establishing whether "one person is made better off and no one is worse off" are well-known. The aspiring analyst may politely indicate that this concept is an inoperable truism. But a quick review of some of its associated premises and implications can often demonstrate how the concept can be helpful—and, as a corollary, how benefit-cost analysis can be useful. The following "guidelines" are three such demonstrations.

3.1 Check that the method's premises fit the decision's purposes

The major considerations in a benefit-cost analysis are perhaps the simplest—they are certainly the most fundamental and the first questions that should be asked. What is the purpose of the analysis? How will the findings be used in the decision? And do the fundamental premises of the methodology fit these purposes and uses?

All too often the would-be analyst regards benefit-cost analysis as a mechanistic source of a number that unambiguously measures every dimension of social welfare. This view must be quickly dispelled. The aspiring analyst must appreciate how the methodology rests on a specific ethical concept (Pareto optimality) and specific ethical premises (starting from "individual preferences count" and proceeding to "society maximises net benefits").⁹

These premises show that benefit-cost analysis is fundamentally just an efficiency methodology but possibly a very good efficiency methodology. Nevertheless the only unambiguous policy advice is of the form: alternative X provides the greatest increase in economic efficiency. The aspiring analyst must therefore be quite clear of the relevance of Kelso's statement (1966, p. 36):

" . . . in short, the economists' criterion is a test of the wisdom of a proposed public enterprise only in so far as increased efficiency is the desideratum: even then it is such a test only in terms of the assumed definitions, income distribution, and institutional framework . . .".

The efficiency "numbers", as present values of the net social benefits, do not measure the numerous other dimensions of social welfare. If these other dimensions are important or other premises are relevant, then other techniques must be used or the benefit-cost analysis must be restructured.

⁹ The premise that society maximizes net benefits also rests on acceptance of the Kaldor/Hicks propositions on compensation.

3.2 Understand and use the premises

An understanding of Pareto's concept and the related ethical premises is important *per se*. But this understanding also helps to resolve some analytical problems. Consider the ethical premise that individual preferences count and consider three problems left unsolved by environmental impact assessments.¹⁰ Whose assessment of benefits and costs is relevant? Which individuals should be included? Which benefits and costs should be included? Most current benefit-cost work interprets the premise as follows—individuals are the best judges of their own welfare. So we deduce an answer to the first problem—the individual's assessment of his own benefit is relevant. The Pareto concept implicitly includes all persons. So we deduce answers to the other two problems—all individuals must be included and all benefits and costs must be considered.

Social costs are valued as opportunity costs and this is usually intuitively obvious to the would-be analyst. But the process of valuing social benefits is less obvious so again we can revert to Pareto. The Pareto concept underpins the whole procedure to calculate social benefits. We interpret better-off and worse-off through utilities, we depict ordered utilities as indifference maps, we derive demand curves from indifference maps, and we derive benefit values from these curves. The logic of this sequence always appeals to the aspirant and often helps him understand the notion of social benefits.

Pareto's concept is implemented through the notion of a potential Pareto improvement and through arithmetic aggregation—so benefits are added to costs. The concept therefore provides yet another nudge for net present value and benefit-cost ratio as criteria. These guides to the derivation of criteria and to definitions and measurement of benefits and costs all derive from Pareto's concept and the associated premises—illustrating the coherence and logic of the methodology.

All of this, and its relevance, can be fairly readily explained. But the literature explosion has clouded widespread appreciation of these simple notions. Unlike some ecologists and engineers, economists readily state their assumptions and possible violations of their axioms and premises. The two-week analyst gains only a superficial appreciation of such statements but quickly learns of the restrictions they impose. The conclusions from these restrictions (like Arrow's Impossibility Theorem) are often repeated without any clear appreciation of the useful roles of the methodology and statements.

Discussions on assumptions and violations are essential to the immediate use and long-term development of the methodology. But our lengthy exploration of them confuses the would-be analyst and may well promote other methodologies (like environmental impact statements) which require the same assumptions, axioms and premises yet provide less useful information.

So regrettably the two-week analyst must be advised to ignore two-thirds of this literature, return to basic premises, understand the basic principles and apply these thoroughly. The researcher too may benefit from more creative application of basic principles than from attempts to extend them beyond their premises.

¹⁰ Or more importantly, consider three problems viewed as unsolvable by environmental impact assessors.

3.3 Search for partial applications

Discussion of many public issues currently rests on environmental impact assessments or similar exercises that simply list effects. These assessments are useful, and much more useful than no such data base at all! But many discussions could be materially assisted with partial applications of benefit-cost analysis. Consider three possibilities. (a) The social opportunity cost of preserving Terania Creek Forest or Myall Lakes National Park can be estimated, and estimated more readily than the net social benefit of preservation itself. This opportunity cost may materially assist decisions—as Fitzgibbons and Hendrikx (1970) showed with their estimates of the opportunity cost of preserving Cooloola sands. (b) Sometimes the net social benefit of one use can be estimated fairly readily. This estimate can become a threshold against which to compare the net social benefit of other alternatives. These other estimates can be imprecise because a greater than or less than conclusion may sometimes permit a decision. (c) Similarly, orders of magnitude may suffice. For example, the current public debate on the unprofitability of state forestry rests on accounting data in the annual reports. Information on the orders of magnitude of the consumer's surplus of forest benefits, the social benefit of employment and the social opportunity costs of foregone alternative land uses would improve the social relevance and level of the debate (Sinden and Aitken, 1980).

A real role for the analyst lies in such partial application of benefit-cost notions. But such applications seem hard for the aspiring analyst to discern from the literature. So paradoxically, a few simple applications of these notions would materially improve information for decision, but simple applications seem to need considerable analytical experience. This paradox follows the old story that you usually don't have time to write a short paper—it's quicker to write a long one.¹¹

4 Conclusions

Why has my problem of helping the aspiring analyst become more difficult, what might be done and what does the aspirant think about his two weeks of benefit-cost analysis? Let us consider these questions in turn. New kinds of land-use problem are being considered and these require different interpretations of basic concepts (like consumer's surplus and property rights). This I understand, but the reasons for the next of my difficulties eludes me. Each problem seems to raise its own analytical issues and so the lessons from helping the last would-be analyst never satisfactorily solve the issues for the next one. Another two reasons concern the literature. The volume of literature has greatly increased without a similar increase in its relevance or its capacity to solve problems. Finally, texts and articles have been extremely slow to synthesize the literature.

Several things might be done about these difficulties—assuming, of course, that they're not just one man's problems. Analysts could write and journals could publish more reviews of specific aspects of the methodology.¹² Someone might write a book, *Benefit-Cost Analysis for Land Uses in Australia*.

¹¹ I am grateful to the Editor for this apposite analogy.

¹² Such reviews are not always easy to prepare. Sinden and Worrell (1979) took six years (each) to write their book on valuation of benefits and costs.

Theoreticians and practitioners might move closer together. More analyses should see the light of day. And on the negative side, no-one should write a cookbook because the issues are too many, too specific, and an understanding of basic notions and premises is much more important.

The two-week analyst usually has a difficult first few days as we grapple with the premises and try to frame his problem in social terms. His last few days are a frantic effort to write up the analysis. And his final comment about benefit-cost analysis is usually something like this.

“As far as I can see, Jack, what we seek is socially questionable and the way we seek it is conceptually dubious. But what we find is socially indispensable and the way we find it is analytically essential.”

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