Cost-Benefit Analysis, the Environment and Informational Constraints in LDCs*

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I. Introduction

No matter what views one holds about the desirability of cost-benefit analysis, the extent to which it is used both in developed and less developed countries has increased and many advocate its more widespread use (or that of closely related techniques) as a means to decide whether to commit resources to particular projects or of choosing between competing projects when resources are scarce. The technique, which adopts a rational approach to resource-use, attempts to convert the advantages (benefits) and disadvantages (costs) of projects into monetary sums. It follows A.C. Pigou's advice (Pigou) of trying to use the measuring rod of money, and in most formulations relies heavily on the Kaldor-Hicks principle (Little; Dasgupta and Pearce).

Application of the method was first developed in the U.S.A. to evaluate water-resource projects and interest in the method grew in developed countries from the 1950s onwards.[1] However, it was not until the 1970s that considerable efforts were made to extend its use to project evaluation in LDCs. Publications such as

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[1] For a brief historical review, see ch. 1 in Hufschmidt, James, et al.

While Little and Mirrlees include a chapter on externalities they nevertheless have misgivings about paying attention to unpriced aspects of projects. They comment, for example, that,

> "...some economists believe that external economies are of special importance in developing countries: that some industries have important beneficial effects on others in ways which cannot be, or anyway are not, reflected in the price obtainable for the output of the industry, or in the price it pays for its inputs. There has been much speculation and debate on the subject. But there is very little positive evidence. Certainly, there has been much naive wishful thinking..." (Little and Mirrlees, pp. 35-36).

Nevertheless, they concede that if,

> "Project analysers have a suspicion that there may be rather powerful external effects to an individual project, one way or the other, then they should try to quantify them, however roughly. Even a back-of-an-envelope may serve to show that the initial suspicion was unjustified, or that further work might need to be done. If it is thought that the presence of external effects will be strongly claimed by opponents or proponents of a project, every effort to achieve a sensible, albeit rough, quantification should be made. Otherwise, wild exaggeration is all too easy" (Little and Mirrlees, pp. 348-349).

Thus there is only a begrudging recognition of the matter. As for Irvin, he mentions externalities only briefly and makes no reference to public good characteristics of projects so one can only assume that he believes them to be of practically no importance for the economic and social appraisal of development projects (Irvin).

The past comparative neglect of environmental factors in project assessment in LDCs could have its origins in one or more of the following views, some of which can be identified in the literature:

(1) Environmental spillovers are quantitatively smaller in LDCs than in industrialized countries — pollution is essentially a phenomenon of industrialization (Little and Mirrlees, p. 337).
(2) Demand for improved environmental quality is an income elastic good and countries with low per capita incomes will therefore give greater weight to raising material incomes than

tified in which it is important to take account of environmental factors in LDCs even on such limited grounds that failure to do so will reduce indigenous material incomes. However, the compilation of cost-benefit analyses and the collection of information is not costless and this needs to be specifically taken into account.

The purpose of this paper is to discuss environmental factors, paying particular attention to some methods that have been suggested, or might be used, to deal with informational constraints on the use of CBA in LDCs. Consideration of these matters is important because, as pointed out by Hufschmidt and co-authors, there are, in developing countries:

"(1)Inadequacies in the technical economic and administrative expertise available for the planning and implementation of environmental management programmes;
(2) Widespread market failures which require extensive use of shadow prices to replace market prices;
(3) Minimal participation in environmental quality planning, either by the general public or by many affected governmental agencies...;
(4) Inadequacies in environmental, economic and social data, including difficulties in data collection and processing and lack of knowledge of past trends and baselines, which limit the quality of the analysis;
(5) Wide diversity of cultural values, which increases the difficulty of social evaluation of environmental quality effects." (Hufschmidt, James, et al.).

The problem has also been commented on by Hanson who points out that, "a general complaint in developing countries, including Indonesia, concerns the lack of basic information needed for adequate resource and environmental information" (Hanson).

II. Surrogate Prices and Shadow Prices

Where markets do not price commodities within a country or

World Conservation Strategy with Examples from Australian Experience," *Environmental Conservation* (in press, 1983). For some discussion of the importance of taking environmental factors into account in LDCs see C. Pearson, "Incorporating Environmental Considerations in Development Planning," pp. 167-182 in Hufschmidt and Hyman.

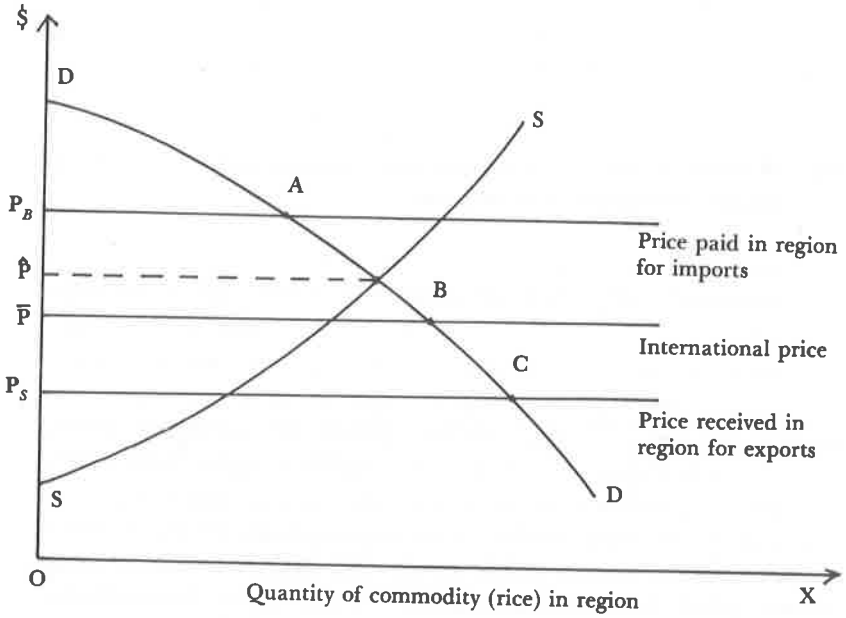

Figure 1

Even ignoring questions of exchange rate distortion, international prices can be poor surrogate prices for valuing changes in production in remote areas or regions of LDCs if substantial transaction costs must be incurred to participate in international or distant markets. The appropriate shadow price in such circumstances may well be considerably above the international price (above B) but can also be below it. However, the appropriate shadow price in the case formulated always falls in the range $P_S \leqslant P \leqslant P_B$, that is, between the price received in the regioin for exports and the price to be paid in the region for imports.

Of course one must be careful not to become preoccupied with the calculation of appropriate shadow prices to the neglect of other considerations. One of the dangers of the Central Office of Project Evaluation (COPE) suggested by Little and Mirrlees is that it may become overly concerned with academic matters to the neglect of infield considerations especially as far as rural projects are concerned. Project officers may tend to remain in the cities and not become familiar with local conditions. Theoretical

countries than in developed ones. Dixon and Meister come to the conclusion that,

> "Applying these techniques in many developing countries will be challenging. Greater suspicion towards interviewers may exist, as well as greater difficulty in understanding hypothetical alternatives. Making clear presentations of the problem, the choices, and the method of payment of compensation will be essential. Different techniques can be applied in the same setting to see if the results are similar. In any event, considerable experimentation with the techniques will be required in developing countries before the utility of these survey-based techniques can be determined." (Hufschmit, James, et al., p. 254)

IV. The Balance of Information

In most cost-benefit analyses economists need to cooperate with others outside their discipline or operate as part of an interdisciplinary team. Economic data are only part of the data used in CBA. Depending on the problem, apart from economic data, there is usually a need for biological, technical and other natural science data as well as additional social science material. It needs to be realized that we rarely have perfect knowledge in any of these areas. Therefore, in using our limited resources for CBA, decisions have to be made about the development of an appropriate data base. What balance should be aimed for between adequacy of economic data and other data when it is necessary to make a trade-off between the two? CBA based upon perfect economic data but shaky non-economc data may be useless, and *vice-versa*. The project-evaluation leader needs to see that an appropriate balance is achieved in the data base.

Conceptually, the problem can be considered by means of Figure 2. Suppose that a given budget has been allocated to evaluate a particular project. Assume that this sum amounts to OA. Then line AE in Figure 2 is the budget line indicating the possible trade-off in expenditure in gathering economic data and in obtaining non-economic data, for example, hydrological or other natural science data. The line KCL is an iso-expected value curve of information, from a set, which for the time being, we

is another matter. It remains to be seen whether useful rules of thumb can be devised for dealing with the balance of information problem. Furthermore, consideration should be given to the optimal sequence in which to collect different types of information. In some instance, there may be little point in collecting economic information until sufficient non-economic data is to hand. In addition, the quality of the non-economic data obtained can be expected to influence the appropriate pattern of collection of economic data.

V. The Optimum Amount of Information, Calculation and Accuracy

Not only is there a problem of obtaining the best balance of information but also of deciding how much information to collect and the extent to which to process it.

It is well known it is not optimal (rational) to seek perfect information if the gathering or processing of information involves a cost. Baumol and Quandt, for example, have pointed out that it is only rational to collect and process information up to the point where the marginal cost of doing so is equal to the marginal expected benefit from the extra information, assuming that the decision-maker aims to maximize expected net gain (Baumol and Quandt). If the marginal costs of evaluating projects are higher in LDCs than in developed countries, this tends, other things equal, to make less evaluation optimal in developing countries. This is also the case if the marginal benefits from evaluation tend to be lower in LDCs, for instance, because CBA recommendations may be more commonly ignored in the political process.

It is pertinent to note that the scope for bounded rational behavior is much greater than is commonly supposed. For example, it may be known that available resources are such that it will definitely be optimal to undertake all projects with an anticipated return of x percent or more. This being so, as soon as it is established that a project has a return of x% or more it is irrational (in terms of the costs of extra calculation and the fact that extra precision is of zero extra value) to try to calculate the return any more precisely. Similarly, it may be known that resource constraints are such (and reasonable expectations about availability

firm, cost plus pricing may be more rational than pricing based on equating marginal cost and marginal revenue.

There is a need to devise and explore appropriate rules of thumb and surrogate optimizing procedures for CBA given the extra costs entailed in more sophisticated approaches to CBA. Appropriate short-cut procedures may be of particular value to Third World countries.

Here the possibilities for two such procedures are discussed assuming that the net social returns (expressed in terms of net present value) from projects depend upon their scale. These alternative possibilities are:

(1) Each project undertaken is on a scale that maximizes the net social return per dollar of funds allocated to it.
(2) The size of all projects undertaken is adjusted so that the return per dollar allocated to each is equal and declining.

The ideal maximizing procedure, given the scale factor and assuming that projects are independent, is to allocate funds only to those projects for which the net social return is positive; secondly, to ensure that for all projects in which investment occurs the level of investment in each equates their net marginal social returns, and thirdly ensures that net marginal social returns are declining.[7] Priority in allocating funds should be given to those projects with the highest maximum return per dollar. What benefits are likely to be forgone by adopting one of the alternative procedures mentioned above and which could be favored on information grounds?

Maximizing Net Social Return per Dollar from Each Project Undertaken

Consider the procedure of adopting the scale for each project that maximizes its net social return per dollar invested and selecting projects by giving priority to those with highest returns until all funds are allocated (Assume that the last project selected, the one with the smallest maximum return per dollar amongst those selected, gives a positive return). This procedure, compared to the

[7] For more detailed discussion on appropriate optimization procedures for cost-benefit analysis, see Dixon, Hufschmidt, et al.

of the hatched areas plus the dotted ones. Other things equal, the steeper are the marginal return functions the closer are the $\hat{x}$-values to the $\bar{x}$-values and the smaller is this area of loss. Furthermore, the less divergent are these values, the smaller is the amount of funds left over for investment in other projects that would not be undertaken in the ideal maximization case, because they give an inferior return.

In the case illustrated, the returns lost (foregone) on projects I and II are offset to some extent by returns from investment of $x = (\bar{x}_1 - \hat{x}_1) + (\bar{x}_2 - \hat{x}_2)$ in project III. This adds an amount equal to the rectangle indicated by crosses. Consequently, allowing for this offset, the net reduction in aggregate net benefits from using the optimum individual scale procedure is equal to the sum of the dotted areas in Figure 3. If the return of project III is lower than $A_3(x_3)$, the reduction in aggregate net benefits will be greater. For example, if it is $A_3'(x)$, the extra 'loss' is equivalent to that part of the area of the rectangle shown by crosses above the broken line. The 'loss' will be greater the further returns from project III (other projects) fall below the return from ideal projects.

Equating Average Returns (Returns per Dollar) rather than Marginal Returns

In some circumstances, information may be such that it is more convenient to equate returns per dollar (average returns) for each project undertaken rather than equate marginal returns. If so, when will this procedure give a close approximation to the ideal result?

If, for all projects that would be undertaken using the ideal allocative approach, average returns from each project exceeds marginal returns by the same constant at the ideal allocation of funds for each project, this surrogate procedure results in an ideal allocation of funds. The surrogate procedure maximizes aggregate net benefit subject to the constraint imposed by available funds.

This can be illustrated by Figure 4. It is supposed that funds of $X = \bar{x}_1 + \bar{x}_2$ are available for allocation between two projects I and II. Interpreting the curves shown in Figure 4 in a similar way to those for Figure 3, it is ideal to allocate $\bar{x}_1$ to project I and $\bar{x}_2$ to project II. This allocation of funds ensures that marginal returns are equalized and declining.

dependently determined and only a limited amount of information is needed to do this. Application of the second procedure requires more information and calculation than the first procedure, but the required information may still be easier to obtain than that needed for marginal analysis.

In practice, we should also be investigating actual rules of thumb for CBA that have evolved and considering whether or not they can be justified on rational grounds. For instance, it seems often to be the rule that projects involving small outlays are not investigated or only cursorily evaluated. If there are economies of scale in evaluation and some fixed cost in doing any investigation, this may be justified. However, where many similar small projects are being undertaken, albeit independently, there is likely to be a case for a general evaluation of them. This may provide rules that can be applied quickly and easily to the individual projects. Even if the individual projects are small, it also needs to be borne in mind that individually or collectively they may have a substantial environmental impact.

VII. Concluding Comments

Environmental considerations in project evaluation in LDCs are more important than has been recognized in the past. Environmental spillovers from projects can have significant effects on the level of material production and appropriated economic gains so that even from a narrow point of view there is a case for not neglecting them. However, the collection and evaluation of environmental information in LDCs is costly and the assessment of economic benefits involving environmental effects frequently entails the calculation of shadow or surrogate prices or occasionally the use of direct surveys. Such methods leave room for inaccuracy, and in common with much cost-benefit analysis, require *creative* thought for most individual projects evaluated. Even if precise CBA could be justified on economic grounds (which it cannot be) in many LDCs there is insufficient expertise to use such refined methods, especially in micro-states, some of which have populations of less than 10,000.[9] There is therefore a case for in-

[9] Some of these problems are discussed in Tisdell and Fairbairn.

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