THE DATE OF DISCOUNTING IN COST-BENEFIT STUDIES

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The date to which costs and benefits should be discounted in order to provide "present value" figures for cost-benefit studies is a question on which opinions differ. Perhaps the most frequent procedure is to discount to the date at which the proposed project is to start; another convention is to discount to the date when the decision on the project is expected to be taken. These practices may appear sensible, but they have no real rationale. The "start date" of the project is often one of the elements comprising the study, and so may well be variable over a considerable time range. Similarly, it is well known that dates of decision are often revised considerably—again in the light of the evidence presented in the cost-benefit study. There is, therefore, no natural date of discounting.

Theoretically, indeed, the date to which costs and benefits are discounted is quite arbitrary. Choice of date cannot affect the relative difference in net discounted value between options. The particular date chosen merely defines the *units* of measurement of the study. If, for example, one chose to discount values to 1982 rather than 1975, and the rate of discount were 10%, this would simply mean that the 1982 values would be almost double those of 1975.

IMPORTANCE OF A SENSIBLE DATE

But if the date is arbitrary and merely defines the unit of measurement—for example, 1982 pounds rather than 1975 pounds—it is open to any investigator to choose the year 1900 or the year 2050. Yet we should be surprised to see an example of a date so far outside the record of costs and benefits that are being forecast. The objection of any cost-benefit investigator would normally be that the differences in 1900 pounds would be "too small"—and similarly for 2050 the pounds would be "too large". Somehow the numbers would give the wrong impression.

The main reason for concern is that cost-benefit studies never manage to quantify in money terms all the effects of a project. In the final cost-benefit figures we capture only a fraction of the consequences. We may know, for example, that in discounted values project I is numerically better than project II, but that the general amenity effects of project I are much worse than those of II. We may even be able to give some quantitative measure of the differential over time, but it may not be possible to translate these quantities into pounds. The decision then will be made by trading off the larger net discounted gains on I against the differential future amenity costs. Money is compared with future amenity.

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It is, therefore, important to ensure that the unit of measurement of the money is in terms that all of us readily conceive—that is, the current pound in the pocket. Indeed, since cost-benefit studies are normally passed to a decision-making body which will be concerned with judging such trade-offs, there is a real need for conveying the information in a form that is readily appreciated and that is consistent with normal everyday concepts. A pound should be called a pound.

CHOICE OF DATE BY THE ROSKILL COMMISSION

An important illustration of the need for an appropriate date appeared in the examination of the cost-benefit study associated with the (Roskill) Commission on the Third London Airport. The date at which the new airport would be needed was one of the main questions in the terms of reference of the Commission. In its Report the Commission recommended that, as far as it could ascertain in December 1971, the authorities should plan for the first runway to open in 1980. Thus the Commission expected that, subject to revision as subsequent events unfolded, the third airport would rapidly grow in the 1980s and 1990s. The quantified elements of costs and benefits were included in the net present value calculations, whereas non-quantified costs and benefits (such as the destruction of certain amenities) were left to be compared in the final assessment with the relative quantified money costs of each site.

Clearly there were many "natural" dates for discounting the costs and benefits. First, 1973 might be the obvious one, since substantial costs would have been incurred from that date. On the other hand the first "output" would not appear until 1980—and that might be thought to be another natural base. But both these dates had the disadvantage that they were not at the centre of the time profile of the unquantified disbenefits which were thought to accrue. Thus, if one chose 1973, one would have to consider a trade-off of 1973 pounds against (average) 1982 disamenity. Clearly it helped the Commission to get both on the same basis—and it was most convenient to move the date of discounting to 1982.

It is important to emphasise that in the decision-making process there was no objective attempt to evaluate "amenity" in quantitative terms. But in deciding how much the public is prepared to pay for a certain amenity it is most helpful to the decision maker to have both in the same time frame. The decision making process, being based on the comparison of net present values, could then sensibly include discussion of how much one should pay for the avoidance of certain disamenities.

CHOOSING A SENSIBLE DATE

For a first approach to the problem, let us suppose that we actually know the time path and value of the amenity differences between projects I and II. If Q_t is the absolute difference in calendar year t, we solve for γ in the equation

$$\sum_{t=A}^{T} \frac{Q_t}{(1+r)^{t-\gamma}} = \sum_{t=A}^{T} Q_t$$

where r is the rate of interest and A and T are the first and last years of the project. The calendar year γ is that to which the amenity stream has to be discounted if it is to have a present value equal to the sum of the undiscounted stream. Its significance is that decision-makers may find it difficult to think in terms of discounted amenity effects and easier to think in terms of the undiscounted $\Sigma\, Q_t$. Provided the non-amenity effects are discounted to year γ, decision-makers can safely compare the discounted sum of these quantified differences with their own best estimate of $\Sigma\, Q_t$.

However, the problem arises for the very reason that we have no reliable estimates of the amenity effects for any long time period. We normally have only vague ideas about them, and such ideas are rarely formulated in compatible units—"it will make a noise and spoil the view". That is why the effects are not directly included in the cost-benefit calculation, but instead we attempt to do the calculation in such a way that the quantitative result can be usefully compared with intuitive feelings about amenities. For this purpose all we need is some idea of the relative time profile of the effects on amenity.

A simple approach is to assume that non-valued amenity differences have a time profile which is the same as the differential cost stream (C_t) or the benefit stream (B_t), or some combination of the two. Suppose we regard the cost stream (C_t) as that which has the time profile most closely correlated with that of the non-valued elements. Then we should find γ in the equation

$$\sum_{t=A}^{T} \frac{C_t}{(1+r)^{t-\gamma}} = \sum_{t=A}^{T} C_t$$

In other words γ would correspond roughly to the middle of the differential cost stream. In addition, this simple solution would have the advantage that the present value of the differential cost stream in the final calculation would correspond to the sum of differential costs as they appear in the current year's budget.

So far we have discussed only the choice between two projects, where there is only one time profile of differences. Clearly if there are three or more projects the formal solution will, in principle, give a different date for each pair. In practice, however, such problems are not likely to be important, and a rough approximation will usually suffice.

ANNUAL VALUES

A more serious point is that we are still expecting a good deal of sophistication on the decision-maker's part. He has to compare the present value of the quantified items with his feelings about the undiscounted sum of the unquantified items over the life of the project. However, he would probably find it easier to think in terms of annual values rather than of aggregations of values over time. This suggests an alternative approach which might be more useful if the amenity differences (Q_t) were thought to have a very simple time profile. Suppose, for example, that Q_t were a constant (Q). Then it would be best to express the quantified differences between projects I and II as an annuity (D) so that

$$\sum_{t=A}^{T} \frac{D}{(1+r)^t} = \sum_{t=A}^{T} \frac{B_t - C_t}{(1+r)^t}$$

This annuity (D) is then compared directly with the estimated annual amenity difference (Q). Alternatively, if the amenity stream is expected to grow at a constant rate g per annum, we could represent the quantified differences by a stream $D_A (1 + g)^{t-A}$ having a present value equal to that of the quantified items in the project. Thus we find D_A from

$$\sum_{t=A}^{T} \frac{D_A(1 + g)^{t-A}}{(1 + r)^t} = \sum_{t=A}^{T} \frac{B_t - C_t}{(1 + r)^t}$$

If the decision-maker judged that the amenity gains from project II in the first year exceeded D_A he should choose project II, but not otherwise.

The advantage of this conversion to an annual basis is that it is not affected by the date at which the present values are computed. For this reason there are many occasions when present values can usefully be translated into simplified equivalent annual flows.

But this is only useful when the amenity effects have a simple time path, so that the quantified elements can usefully be represented by another time stream which either dominates or is dominated by the stream of the amenity. In other cases there is no escaping the date-of-discount problem, and the procedure advocated above eliminates at any rate one problem which would otherwise face the decision-maker.