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Most cost-benefit analysts either implicitly or explicitly use consumers' preferences as the basis for project evaluation. The opportunity cost of a government project is measured in principle not simply by reference to the supply prices of the inputs that the project absorbs, but by reference to the value that consumers and factor owners would have placed on the alternative use of those inputs if left in the private sector. From this point of view, if taking resources from the private sector means a fall in monopoly profits, in tax receipts, or in the production of external economies, the market wage of those resoures will understate their opportunity cost to consumers; the resources should then be valued at a shadow wage above their market wage. Conversely, if taking the resources from the private sector means a fall in involuntary unemployment, in government subsidies, or in the production of external diseconomies, the resources should be valued at a shadow wage below their market wage.[1] Explicit statements of the principle (and of any principle in cost-benefit analysis) are hard to come by, but Mishan (1971) gives a characteristically careful summary; Harberger's "three basic postulates for applied welfare economics" are consistent with the principle though somewhat broader; and many writers use the principle in their discussion of specific issues.[2]

Externalities aside, the phenomena that give rise to a gap between the supply price of resources and their value to consumers generate flows of income; I shall refer to these income flows as rents, whether received by private agents or public agencies; so rents in this context could refer to monopoly profits, tax receipts, or wages that are higher than the supply price of labor, for example. Straightforward application of the principle described above leads to the conclusion that the opportunity cost of a factor of production being withdrawn from the private sector exceeds its market wage to the extent that it generates rents, so it should be valued at a shadow wage that reflects the rents, for cost-benefit analysis. In Part I of the paper I demonstrate this result.

In Part II I question its relevance. A few economists have recently looked at the implications of assuming that economic agents will compete for the privilege of receiving rents, and will use real resources in the process. Todaro, who looked at the specific issue of a gap between urban and rural wages for unskilled workers, may have been the first of these; and Krueger generalized his insight, showing the underlying identity of a whole class of rent-seeking phenomena and arguing their empirical importance. Her main conclusion is that the welfare cost of a distortion that creates rents may be far greater than what is customarily measured as deadweight loss because of the waste of resources used to compete for rents. Here I demonstrate the obverse: the opportunity cost of a factor that generates rent in its present occupation may be lower than it at first appears, because withdrawing the factor from its present occupation may extinguish rents and thereby free some heretofore wasted resources.

Indeed a simple, strong result obtains: Suppose that competition for rents is so intense that there is no "profit" to rent seeking because payment of market wages to the factors of production devoted to rent seeking fully absorb the rents. Then goods produced in the private sector absorb resources equal in value to their market price, part for production and part for capturing the rent. In those circumstances resources for which a government project must pay $1 would, if left in the private sector, have produced goods worth exactly $1, taking account of the resources absorbed in rent seeking; the shadow wage for the resources should equal the market wage. This is demonstrated in Part II.

I. THE MODEL WITHOUT RENT SEEKING

This model shows that without rent-seeking behavior the opportunity cost for an input exceeds its market price to reflect the rent it generates. First I describe the economy and define costs and benefits for a government project.

A. The Economy

I shall use the following symbols:

$Q = (q_j)$: n - vector of private consumption goods.

$P = (p_j)$: n - vector of market prices for private consumption goods.

$X = (x_i)$: m - vector of privately-owned factors of production, assumed fixed in supply.

$W = (w_i)$: m - vector of market wages for factors.

$F = (f_i)$: m - vector of factors used to produce private output.

$G = (g_i)$: m - vector of factors used to produce government services.

$Y = (y_i)$: m - vector of factors used to seek rents.

$A = (a_{ij})$: m $\times$ n matrix of average input-output coefficients; the a_{ij} may vary both with relative factor prices and with scale of output.

$K = ((k_j))$: n - th order diagonal matrix of average markup ratios of price to average cost. K is defined by $P = KA'W$, where the prime denotes the matrix transpose.

$R = (r_j)$: n - vector of rents, defined as price minus average cost, $R = P - A'W = (K - I)A'W$.

The economy consists of a single consumer who behaves as a competitive buyer (an economy with many consumers is considered below in section E). For the purchase of private consumption goods Q, he faces prices P which are not necessarily equal to marginal production costs. In addition he is supplied with a vector of government services produced by a vector of inputs G, financed by a lump-sum tax. Government services may enter utility directly, they may affect utility indirectly by changing the cost of production in the private sector, or both.

The consumer supplies a fixed vector X of factors of production for which he receives a wage vector W. Where A is the average input-output matrix and $F \leq X$ is the vector of factors required to produce private consumption goods,

$$F = AQ \quad .$$

A is not assumed to be constant; it may depend both on relative factor prices and on scale of output. Average costs of production for each industry are given by the vector $A'W$, where the prime denotes the matrix transpose, and $R = P - A'W$, assumed nonnegative, is the vector of rents.

A government project is represented by an increase in G from G^1 to G^2, with an offsetting withdrawal of factors from the private sector. The required fall in the consumption of private goods is accomplished by a rise in the lump-sum tax. Private consumption falls from Q^1 to Q^2 as a result of the tax; in the absence of rent-seeking, factors saved by this reduction are given by

$$F^1 - F^2 = A^1Q^1 - A^2Q^2 \quad . \tag{1}$$

I shall assume that the factors required for the government project equal the factors released from the private sector:

$$G^2 - G^1 = F^1 - F^2 \quad . \tag{2}$$

B. The Cost-Benefit Criterion

Cost and benefit of the project may be defined in terms of the consumer's expenditure function $e(u, P, G)$. The value of e is the lowest expenditure required to attain utility level $u = u(Q, G)$ for specified values of P and G (for simplicity of notation I let G, the vector of inputs used by the government, serve as an indicator of the direct government services provided to the consumer, if any). I assume that the consumer is in competitive equilibrium, so that his actual expenditure is as shown by the expenditure function; then where superscript values 1 and 2 denote values before and after the project, respectively, we have

$$e^t \equiv e(u^t, P^t, G^t) = P^t \cdot Q^t , \qquad t = 1, 2 \quad .$$

Define

$$e^3 = e(u^1, P^2, G^2) ;$$

e^3 is the expenditure needed to attain the initial utility level after the government project. Now we can measure the cost of the project by $c = e^1 - e^2$ (the reduction in private spending required to finance the project), and the benefit by $b = e^1 - e^3$ (the largest reduction in private spending that the consumer would accept in order to finance the project).

Proposition 1. Given the assumption that the consumer is in competitive equilibrium, the net benefit of the project, $b - c$, is equal to the consumer's compensating variation in income from the project (CV); and

$$b - c \gtrless 0 \quad \text{according as} \quad u^2 - u^1 \gtrless 0 \ .$$[3]

Proof: Immediate from the definition of CV, since

$$b - c = e(u^2, P^2, G^2) - e(u^1, P^2, G^2) \quad .$$

C. The Role of Rents

In this section I shall assume that factor wages are unaffected by the project,[4] and omit the superscript on W.

The project cost $e^1 - e^2$ may be written

(3) $$c = P^1 \cdot Q^1 - P^2 \cdot Q^2 \quad .$$

This is the reduction in private consumption expenditure resulting from the project; it is not in general equal to the project's accounting cost which, from (1) and (2), may be written

$$W \cdot (G^2 - G^1) = W \cdot (A^1 Q^1 - A^2 Q^2) \quad .$$

If price equals marginal cost equals average cost both before and after the government project we have

$$P^t = A^{t\prime} W \, , \qquad t = 1, 2 \, ,$$

and the accounting cost of the project (inputs used, valued at market wages) equals the opportunity cost (the value of consumer goods given up, measured at market prices).

While the opportunity cost of a project can be measured directly from (3), information coming to the cost-benefit analyst usually focuses on the inputs required for the project rather than on the outputs to be foregone, and it is customary to estimate cost by reference to the inputs, substituting for the market wage vector W a shadow wage vector W^* such that

$$c = W^* \cdot (G^2 - G^1) \quad .$$

To see how W^* may be determined, define $K = ((k_i))$ as the diagonal matrix showing the ratio of price to average cost for each sector, and suppose that K is not affected by the project. That is, suppose

(4) $$P^t = KA^{t\prime}W, \quad t = 1, 2 \quad .$$

<u>Proposition 2</u>. Given an economy in which equations (1) - (4) hold, with K and W both constant, the opportunity cost for a government project can be measured as

(5) $$c = W^* \cdot (G^2 - G^1) \quad .$$

Appropriate (but not uniquely appropriate) values for the shadow wages w_i^* are given by

(6) $$w_i^* = w_i \textstyle\sum_j b_{ij} k_j / \sum_j b_{ij}, \quad i = 1, \ldots, m,$$

where

(7) $$b_{ij} = a_{ij}^1 q_j^1 - a_{ij}^2 q_j^2 \quad .$$

Proposition 2 says that the ratio of the shadow wage to the market wage for factor i is a weighted average of the k_j (price/cost ratio for sector j); the weight on k_j measures the share of factor i released to the project by sector j, as total private spending is reduced to accommodate the increased public activity.

Example: If for each 10 workers hired by the government project four come from a sector in which the value of their marginal product (VMP) was 1.5 times the wage and six come from a sector in which VMP was twice the wage, then the shadow wage should be 1.8 times the market wage:

$$w^*/w = (4/10) \times 1.5 + (6/10) \times 2 = 1.8 \quad .$$

Proof of Proposition 2: If we assume that the project cost can be written as in (5), then from (3) and (5) using (1), (2) and (4) we derive an equation relating W^* to W:

$$(8) \qquad W^* \cdot (A^1Q^1 - A^2Q^2) = W \cdot (A^1KQ^1 - A^2KQ^2) \quad .$$

This is a single equation in m variables and therefore is not sufficient to define the individual shadow wages w_i^*. However each side of (8) is an inner product of m-vectors. The rule expressed by equations (6) and (7) comes from forcing equality of these inner products term-by-term; clearly the resulting shadow wages are not unique.

Note that, if rents are positive, the project cost $W^* \cdot (G^2 - G^1)$ exceeds the tax required to finance the project. $W \cdot (G^2 - G^1)$ is required in new lump-sum taxes, and will be returned to the consumer's budget as wage payments from the government. The loss in rent

$$(W^* - W) \cdot (G^2 - G^1) = W \cdot [A^1(K - I)\, Q^1 - A^2\, (K - I)Q^2]$$

is a net loss in national income as rent-generating activities are reduced.

D. Variable Wages

The analysis of section C is based on an assumption of constant factor prices; that is the customary assumption for analyses that refer to shadow wages. When it is dropped it is no longer necessary to assume a constant ratio of price to average cost. We will substitute for (4) the more general relation

$$P^t \cdot Q^t = W^t \cdot F^t + R^t \cdot Q^t, \qquad t = 1,\ 2 \tag{9}$$

where R is a vector of rents. Equation (9) simply specifies that revenue is divided into factor costs and rents. With factor prices changing as a result of the project it is no longer desirable to define project cost as a sum of shadow wages times factor quantities as in (5). But rents still affect costs as before.

Proposition 3. Given an economy in which equations (2), (3) and (9) hold, the opportunity cost for a government project may be measured as the sum of three components:

(a) the accounting cost of the project, $W^2 \cdot (G^2 - G^1)$;

(b) the loss of income suffered by factors originally working in the private sector,[5] due to the wage change, $(W^1 - W^2) \cdot F^1$;

(c) the loss of rents occasioned by the project,

$$R^1 \cdot Q^1 - R^2 \cdot Q^2 \quad .$$

<u>Proof</u>: From (3), using (2) and (9), we have

$$\text{(10)} \quad c = P^1 \cdot Q^1 - P^2 \cdot Q^2 = W^2 \cdot (G^2 - G^1) + (W^1 - W^2) \cdot F^1 + (R^1 \cdot Q^1 - R^2 \cdot Q^2) \quad .$$

E. Many Consumers

If all consumers face the same prices and wages, most of the analysis of the preceding sections is unaffected: If cost, benefit and net benefit to society are defined as the sum of those to individuals and those to each individual are defined as in section B, the equations of sections C and D may be reinterpreted in terms of aggregates. The main difference between the single-consumer case and the many-consumer case is unfortunately in the relevance of the analysis. With one consumer there is an unambiguous link between CV and the underlying change in utility: they have the same sign. With many consumers the corresponding link between CV and the underlying change in welfare is more tenuous.

This much can be said: If CV is positive for a project <u>and</u> if it improves the income distribution (in a sense to be made precise below), then the project increases welfare. We must admit the possibility, though, that a project with negative CV could still increase welfare because it improves the income distribution by more than enough to compensate for its technical inefficiency (for example, a scheme to redistribute income through taxes and subsidies that cause distortions); and of course a project with positive CV might worsen the distribution of income by so much as to be undesirable.

To make these ideas precise, let $u = (u_h)$ and $v = (v_h)$ represent vectors of individual utility levels, with individuals indexed by h; and let welfare be measured by an individualistic welfare function $w(\cdot)$ that obeys

<u>Assumption 1</u> (Pareto principle):

If $u_h \geqq v_h$, for all h, with the strict inequality holding for at least one h, then $w(u) > w(v)$.

Now consider a government project that changes society's utility vector from u^1 to u^2, and suppose that the aggregate compensating variation is positive, <u>i.e.</u>,

(11) $$\Sigma_h CV_h = \Sigma_h [e_h(u_h^2, P^2, G^2) - e_h(u_h^1, P^2, G^2)] > 0 \quad .$$

Here is a definition of an improvement in the distribution of income.

<u>Definition</u>: A project satisfying (11) improves the distribution of income if it is possible to invent a hypothetical "intermediate" project, denoted by utility vector v, such that

(12) $$\Sigma_h [e_h(v_h, P^2, G^2) - e_h(u_h^1, P^2, G^2)] = 0$$

(13) $$v_h \leqq u_h^2, \quad \text{all } h$$

(14) $$w(v) > w(u^1) \quad .$$

Condition (12) says that the hypothetical project is created from the actual one by throwing away project benefits, until the aggregate net benefit is reduced to zero. Condition (13) says that this must be done in such a way as to make no one better off than in the actual project; and (14) says that the new project, which has aggregate CV of zero, nevertheless improves welfare. The definition of improvement in the distribution of income based on these conditions is a relatively weak one.

Example: In a three-person economy, consider a project that changes (cardinal, interpersonally comparable) utilities from

$$u^1 = (10, 10, 1)$$

to

$$u^2 = (100, 9, 2) \quad .$$

Now consider

$$v = (10, 9, 2) \quad ,$$

and suppose that $w(v) > w(u^1)$. Then by the definition proposed above, the actual project improves the distribution of income.

The definition rules out envy; but this seems to me to be an appropriate companion to the Pareto principle. Moreover, given the use to which it is put below, weakness in the definition is a virtue.

Proposition 4. If the social welfare function obeys assumption 1, then a project for which $CV > 0$, and which improves the distribution of income, increases welfare.

Proof: Immediate. In the notation used above, there exists a utility vector v such that

$$w(v) > w(u^1)$$

$$u^2 \geqq v , \quad u^2 \neq v \quad .$$

Then by the Pareto principle,

$$w(u^2) > w(v) > w(u^1) \quad .$$

Within the framework of the new welfare economics, I do not believe that more can be said in support of the cost-benefit criterion than is given by Proposition 4, for the case of many consumers.[6] In another framework, however, there may be other justifications for the criterion. In particular if we eschew welfare economics and instead adopt the fiscal exchange paradigm for government activity, the cost-benefit criterion may be interpreted as a "constitutional" provision (see Buchanan) to limit the extent to which the government can use physical investment projects as a device to redistribute income.

II. RENT SEEKING

Two general mechanisms have been suggested whereby rent seeking uses resources (see Krueger). In the first, each unit of rent goes to the agent who devotes the most resources to acquiring it; in the second rents are distributed randomly among those who compete for them, with the expected value of rent to be obtained by any agent proportional to the resources he devotes to rent seeking. Examples of the first mechanism are the allocation of sales or import licenses in proportion to the productive capacity of the license seeker (excess capacity represents the rent-seeking resource use), the award of jobs which provide rent[7] to the candidates with the best educational background (over-education represents the rent-seeking resource use) and any of a number of practices of monopolies to exclude entry. Examples of the second, "random," mechanism are the allocation of urban jobs among unemployed rural emigrants in the Todaro model, or the use of lobbying to influence the allocation of tax revenues to specific expenditure programs.[8]

Under the first, "winner-take-all" mechanism, there will be continuing incentive for new candidates to enter and capture the rents by spending more, so long as rents exceed the market wage for the factors needed to capture those rents. Under the second, "random" mechanism, there will be a similar continuing incentive for new candidates to enter so long as the expected return exceeds the opportunity cost, provided that rent-seekers are risk neutral.

I shall use the term <u>competition</u> in rent seeking to mean a situation in which the market value of resources devoted to rent seeking equals the total value of the rents (with an appropriate adjustment for a risk premium in the case of risk aversion, considered below). In this section I consider the implications for measurement of project costs of competitive rent-seeking behavior.

A. The Simplest Case

In this section I consider the effect of rent-seeking behavior on the economy described in proposition 2, with constant factor prices (W) and constant price/cost ratios (K). Equations (1), (3) and (4), assumed to hold in the earlier discussion, still hold. Only equation (2) specifying the full-employment condition is changed, to

$$G^2 - G^1 = (F^1 + Y^1) - (F^2 + Y^2) \quad , \tag{15}$$

where Y^t represents the vector of factors used for rent seeking in situation t. Equation (15) says that the factors absorbed by the government are those released by the private sector. Because with constant factor prices there is no market mechanism to assume this outcome it must be based on an assumed coincidence. The simplest such coincidence is that the mix of factors used in private-sector production, in rent seeking and in government production is identical; the assumption is attractive only for a model with a single factor of production, but in order to postpone consideration of variable wages, I shall make it here.

I shall further assume that rent seekers are risk neutral. Then competitive rent seeking implies

$$W \cdot Y^t = R^t \cdot Q^t = W \cdot A^t(K - I)Q^t , \qquad t = 1, 2 \tag{16}$$

where R is the vector of unit rents (price minus average cost). Equation (16) says that rents are fully absorbed by payments to factors engaged in rent seeking.

Proposition 5. Given an economy in which (1), (3), (4), (15) and (16) hold, the opportunity cost for a government project can be measured as

$$c = W \cdot (G^2 - G^1) \quad . \tag{17}$$

The accounting cost of the project equals its opportunity cost, and factors of production should in this circumstance be valued at market wages for cost-benefit analysis, despite the presence of rents in the economy.

Proof: From (1) and (16) we have

$$W \cdot (F^t + Y^t) = W \cdot A^t K Q^t , \qquad t = 1, 2 \quad .$$

(17) follows, using (3), (4) and (15).

B. Variable Wages

I now drop the assumption that factor proportions are the same for rent seeking as for production. I maintain the assumption of equation (15) that the government absorbs factors in the same proportion that they are released by the private sector, but this is now an equilibrium condition rather than a coincidence, possibly brought about by shifts in relative wages and in markups.

I preserve the assumption of risk-neutrality among rent seekers; then competitive rent seeking implies

$$W^t \cdot Y^t = R^t \cdot Q^t , \qquad t = 1, 2 \tag{18}$$

(this is modified from (16) only to admit variable wages).

Proposition 6. Given an economy in which equations (3), (9), (15) and (18) hold, the opportunity cost for a government project may be measured as the sum of two components:

(a) the accounting cost of the project, $W^2 \cdot (G^2 - G^1)$;

(b) the loss of income suffered by factors originally working in the private sector, due to the wage change, $(W^1 - W^2) \cdot (F^1 + Y^1)$.

No adjustment to the accounting cost is required for the change in rents occasioned by the project, as in proposition 3.

Proof: Directly from (3), using (9), (15) and (18), with a little manipulation, we have

$$(19) \qquad c = W^2 \cdot (G^2 - G^1) + (W^1 - W^2) \cdot (F^1 + Y^1) \quad .$$

In comparing this result with that of proposition 3, keep in mind that for economy of notation identical symbols for wages and factor quantities are being used to describe two different regimes in the two propositions. Both wages and total private sector employment of all factors would have to be identical in the two regimes to claim that the first two cost components in (10) are equal to the two cost components in (19), so we cannot in general assert that the project cost is lower by the amount of the rent adjustment when there is rent seeking; but such an assertion is not relevant to my purpose. My interest is in the procedure to be used in estimating project cost, and proposition 6 shows that the additional step of estimating the change in rents, as part of the measure of cost, is inappropriate if there is competitive rent-seeking. The conclusion parallels that of Section A, where factor prices are constant.

C. Risk Aversion

Risk neutrality by rent seekers is not essential to the argument. Suppose that rents are assigned exclusively by the "random" mechanism, and suppose that agents engaged in rent seeking are indifferent between receiving, for each unit of factor i, a wage of w_i with certainty and an expected return of $w_i + v_i$ through the gamble of rent seeking. Then where $V = (v_i)$ we must substitute for (18) the equilibrium condition

$$(20) \qquad (W^t + V^t) \cdot Y^t = R^t \cdot Q^t \quad .$$

When private output is reduced from Q^1 to Q^2, rent seeking will be reduced, but part of the loss in rent is offset by a gain that comes through reduced uncertainty. This gain could be treated as an additional benefit to the project, but it is useful to instead consider it as a reduction in cost. Under the assumption that the value of V is not affected by the reduction in the scale of rent-seeking or by the government project itself, the compensating variation in income for the reduced uncertainty is $V \cdot (Y^1 - Y^2)$; i.e., this measures the reduction in expected gains that rent-seekers will willingly trade for reduced uncertainty.[9] With V constant, then, and using the convention that the benefit of risk reduction is to be recorded as a reduction in cost rather than an increase in benefit, we substitute for equation (3);

$$c = P^1 \cdot Q^1 - P^2 \cdot Q^2 - V \cdot (Y^1 - Y^2) \quad . \tag{21}$$

<u>Proposition 7</u>. Given an economy in which equations (9), (15), (20) and (21) hold, project cost is measured by equation (19), just as in the case of risk neutrality.

<u>Proof</u>: Substituting (9) and (20) into (21) we have

$$c = W^1 \cdot (F^1 + Y^1) - W^2 \cdot (F^2 + Y^2) \quad .$$

Then using (15), this can be rewritten as in (19).

Except for possible complications caused by the scale of the project changing the degree of risk aversion in the economy, the basic result still holds: with competitive rent seeking the opportunity cost of the project should not include an adjustment for rents.

III. SUMMARY AND CONCLUSION

In the context of a government project that diverts inputs from the private sector, I have given a formal justification for the practice of using shadow wages for factors that differ from market wages in order to reflect the value to the consumer of private sector output foregone; I have also provided the obvious extension of this analysis to a case in which wages change as a result of the government project. I have then shown that the justification given depends for its validity on an assumption that no resources are devoted to rent seeking.

I define competitive rent seeking as a situation in which market wage payments to the rent-seeking factors of production completely exhaust the value of the rents (possibly discounted for the uncertainty of their receipt). When there is competitive rent seeking, there should be no correction to the factor cost of a project to account for changes in rents. The reason is that the value of resources devoted to production plus rent seeking equals the value of the goods produced, so that each dollar of foregone consumption frees one dollar of resources. While I have not shown the algebra, it is clear that intermediate cases -- between competitive rent seeking and no rent seeking -- lead to intermediate shadow wages.

It seems to me that there is little question that rent seeking is important in real economies. Krueger has made a persuasive case for the pervasiveness of the phenomenon, and although she did not explicitly consider tax receipts as rents, when one considers the extent of lobbying (e.g., over competing uses for the highway trust fund) and efforts devoted to capturing Federal grants and contracts (e.g., by universities) it is clear that there is significant use of resources in this area.

These observations do not justify a claim that real-world rent seeking is competitive. But that claim fits very comfortably into a theory that assumes individual rationality, and we should at least ask "if rent seeking is not competitive, why not?" Barriers to entry into rent seeking would not provide a satisfactory answer, since it simply pushes the question one step further back (the hypothetical barriers would themselves create a second-order rent-seeking opportunity). Lack of information on the availability of rents might offer a formal justification for noncompetitive rent seeking that is compatible with individual rationality, but it would require a more elaborate model than the one used here to explore the issue.

I conclude that the prescription based on competitive rent seeking, to ignore rents in calculating project costs, may or may not be correct; but the alternative prescription based on no rent-seeking activity is wrong.

FOOTNOTES

1. This approach is sometimes rejected for commodity taxes and subsidies on grounds that the government usually imposes them for a reason: to offset externalities, or for sumptuary purposes, for example. See Little and Mirrlees (section 12.5).

2. See, for example, Das Gupta, Marglin and Sen (pages 50 - 51, 63), Harberger (1974, page 54ff), McKean (page 38ff) and Prest and Turvey (pages 692 - 694).

3. The equivalent variation in income,

$$EV = e(u^2, P^1, G^1) - e(u^1, P^1, G^1)$$

gives an alternative measure of net benefit which, like CV, has the same sign as $(u^2 - u^1)$. EV has an additional virtue not shared by CV: it gives an ordinal measure of utility change, so it can be used to compare projects; see Chipman and Moore. CV seems to be more widely used in the literature of cost-benefit analysis, so I have used it here; but the project cost would be defined in the same way under either alternative, so the subsequent discussion would be unaffected.

In the text I have not explicitly treated possible external effects of the project, but they can easily be added: simply define a vector of environmental variables E and write

$$e^t = e(U^t, P^t, G^t, E^t), \quad t = 1, 2 \quad .$$

Definitions of cost and benefit generalize in an obvious way, and the subsequent discussion of project cost is again unaffected because external effects are treated as (positive or negative) benefits and do not affect the cost.

4. When first introduced in connection with equation (2), the requirement that resources released from the private sector equal resources absorbed by the government project appeared innocuous. When I impose the assumption of constant factor prices, I am assuming that, if there are two or more factors of production, a great coincidence occurs so that factors are released by the private sector in just the right proportions to be absorbed by the government project. The assumption is dropped below in section D.

5. What about the wage loss for factors originally employed in the public sector? Those are irrelevant, and do not appear in the calculation because such wage changes are offset by opposite changes in the lump-sum tax. Note that the adjustment for wage changes takes the particularly simple form of (change in wage) times (quantity) because I have assumed that factor supplies are inelastic.

6. However some writers claim that the cost-benefit criterion is equivalent to a compensation test, despite Boadway's counter-example. See Boadway; his interchange with Foster, and Mishan (1976).

7. Rent in this case could represent an excessive salary or an opportunity to receive bribes, thus sharing in the rents generated through government activity; see Krueger, pages 292 - 293.

8. This example motivated my labeling tax revenues as rents, contrary to custom. A disturbing extension of the example suggests that all cost-benefit analysis of government projects might be misleading: if alternative mooted projects are the object of resource-using lobbying activities, the lobbying could under varying assumptions use up part, all, or in excess of the total social benefit to be obtained from the selected project. That possibility raises more issues than can be treated in a footnote, however.

9. This discussion applies strictly only to the case of a single factor owner. If there are many agents seeking rents, with different degrees of risk aversion, equation (20) would still describe equilibrium but the aggregate compensating variation in income from risk reduction would not necessarily be equal to $V \cdot (Y^1 - Y^2)$. A more detailed specification of the economy would be required for analysis of that case.

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