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BENEFIT-COST ANALYSIS: A COMMENT

LESTER O. BUMAS
Polytechnic Institute of New York

ABSTRACT

This comment questions David J. Etzold's Benefit-Cost Ratio calculation by referring it to the present value formulation from which it is derived.

David J. Etzold suggests that benefit-cost analysis "should be an integral portion of all environmental systems analyses" in *J. Environ. Sys.*, Vol. 3(3), Winter, 1973. He is surely right on this. All investments, public and private, should be rationally evaluated and the present value calculation affords an excellent way to go about this. The benefit-cost ratio is merely a way of expressing the present value of benefits and costs but the latter can be misleading if its antecedants are neglected. Due consideration of this leads to a correction of Professor Etzold's article.

Equation (1) is the formula for the present value of an investment

$$PV = \sum_{j=o}^{n} \frac{Aj}{(l + i)^{j}} \tag{1}$$

Where,

PV = present value

A = for a public investment, benefits minus costs associated with the subject investment at the end of the jth period; for a private investment, replace the word benefits by revenues (and consider that the difference represents gross profits for the year)

n = The life span of the investment

i = The minimum rate of interest required to justify the investment.

Now note what we have in the numerator a series of positive figures and negative figures. The positive ones are called benefits (or revenues), the negative ones are called costs. Their absolute magnitudes are diminished by the

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discounting process (i.e., dividing by $(1 + i)^j$). These numbers are summed to get the present value. If the sum is positive the rate of return on the investment exceeds *i* and the investment is justified.

Now for the benefit-cost ratio. We could have calculated the present value of the positive members (i.e., benefits or revenues) separately, PV (B), and then do the same for the negative values (i.e., costs), PV (C) Since PV = PV (B)–PV (C), if PV (B) is greater than PV (C), the investment is justified as above. But if this is so then the ratio of PV (B) to PV (C) exceeds one. That ratio is the benefit-cost ratio.

Using Dr. Etzold's language the benefit-cost ratio should have been

$$\text{B-C Ratio} = \frac{\text{Positive benefits + negative costs}}{\text{Positive costs + negative benefits}}$$

More conventionally, a "negative benefit" is a cost and a "negative cost" is a benefit. Then with B_1 = \$4,000,000; B_2 = \$1,400,000 (i.e., really a cost); C_1 = \$2,500,000; C_2 = \$200,000 (i.e., really a benefit):

$$\text{B-C Ratio} = \frac{4{,}000{,}000 + 200{,}000}{2{,}500{,}000 + 1{,}400{,}000}$$

$$= 1.08$$

rather than the 1.13 he calculated.

AUTHOR'S RESPONSE

After reviewing the commentary by Dr. Bumas, along with my article, I conclude that the difference is a matter of semantics.

The basic purpose of my article was to outline an approach toward setting up the framework for performing a B-C Ratio; therefore I deliberately shied away from mathematical notation, for it causes the non-mathematician to tend *not* to read the article. My article was an attempt to entice the non-mathematician into working toward the qualitative aspects of B-C Analysis, by making lists as depicted on Table 1, Page 254.

I considered the reduction in welfare payments (\$200,000) as a *savings* with respect to this particular decision; as a result, it was and should be subtracted from the denominator (costs), as my article presented it.

David J. Etzold