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Water Resource Investment and the Public Interest

By

ROBERT H. HAVEMAN

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This very interesting volume provides a thorough analysis of the economic efficiency and income distribution effects of a major program of public expenditures—namely the Corps of Engineers program from 1946 to 1962. The analysis represents constructive and imaginative application of welfare economics to the tasks of (1) quantitatively evaluating the likely effects of the Corps program; (2) assessing the methods of project evaluation which have been important in the formulation of that program; and (3) developing improved criteria for public investment.

The three opening chapters provide some history of the Corps' program and its growth since 1824, a description of the evaluation-authorization-appropriation process through which a project must pass, and substantial evidence that the Congress, while placing some weight on economic efficiency as manifested in the benefit-cost ratio, has given major attention to the income redistributive and developmental impacts that projects are expected to have. The analysis of data on 150 projects authorized in the 1960 Omnibus Bill and twenty-nine projects for which funds were subsequently appropriated makes it clear that programs of greater economic efficiency could be constructed from the projects available for consideration. Income redistribution is exhibited by showing that the ten states receiving the highest per capita appropriations for Corps projects in the seventeen year period 1946-1962 were all low income southern states, and that a close, inverse relationship existed between per capita income and per capita appropriations across all fifty states. More conclusive evidence is presented by further taking into account the likely incidence of the cost of the Corps program by state. Per capita appropriations less per capita tax contributions for the financing of the Corps program ("net per capita flow of funds") was inversely related to per capita income levels. The analysis does not, at this stage, attempt to assess which income classes within the lower income states would receive net benefits from Corps projects.

Recognizing that construction appropriations and tax contributions, while measuring current net flow of funds, fail to account for

the flow of benefits and costs over the life of the project, the author then analyzes in detail the state-by-state incidence of the present values of benefits and costs for the Corps' general construction program in the South. The result is a clear demonstration that the South has experienced a substantial redistribution of income (as represented by the present value of the stream of net project benefits) the magnitude of which has been increasing over time: from 16.8 million dollars in 1946 to 175.3 million dollars in 1962. The per capita results for the period varied considerably state by state: from 157 dollars for Arkansas and 132 dollars for Kentucky to minus 13 dollars for North Carolina. The analysis assumes that the Corps' estimates of project benefits and costs are correct.

The analysis of redistribution effects of the Corps' program is followed, in Chapter Five, by an analysis of the allocative efficiency of the program in the South as represented by the projects completed or under construction from 1946 to 1962. Extensive critical comment is directed toward present applications of benefit-cost analysis. Five possible improvements in procedure are suggested: (1) increasing the interest rate to a more realistic level; (2) increasing the interest rate but extending the project life to 100 years ("to preserve the long-term perspective of the program": Eckstein-Krutilla); (3) using a low interest rate to reflect possible social time preference but requiring the B/C ratio to exceed or equal 1.4 (Eckstein); (4) changing the criterion to the internal rate of return and requiring that rate to exceed or equal 6 per cent (McKean), and (5) increasing the discount rate for benefits and *decreasing* the discount rate for costs to reflect the effects of risk (Haveman). The effects of imposing these changes on the evaluation of the 147 Corps projects are then determined. A summary of results is given in the table below.

Results of Alternative Evaluation Methods on 147 Projects

<i>Method</i>	<i>Number of Projects Failing Test</i>	<i>Per Cent Federal Project Funds</i>	<i>Weighted B/C Ratio (or rate of return)</i>	<i>Modal B/C Interval (or rate interval)</i>
Corps' B/C	3	4	1.67	1.00-1.19
4.5% interest	47	42	1.30	0.80-0.99
5.5% over 100 years	60	44	1.20	0.80-0.99
2.5% with B/C \geq 1.4	57	43	—	1.20-1.39
Rate of return \geq 6%	84	60	(6%)	(4.0-4.9%)
Risk allowance	79	50	1.1	0.80-0.99

Any of these improved procedures, if accepted by Congress as the proper method of evaluation, would have resulted in the rejection of a substantial part of the Corps' program. Sixty-two projects representing 42 per cent of total funds would have been accepted under all the methods, 45 representing 42 per cent of funds would have been rejected by all (except the original Corps' B/C analysis), and the remaining 40 had mixed fates according to the method applied. By the test of being rejected by at least 3 of the 5 possible procedures, 63 projects representing 44 per cent of the funds (640 million dollars) should not have been undertaken from an efficiency point of view. The net benefits accruing to the South from this 640 million dollar expenditure amounted to only 340 million dollars, that is, an income redistribution to the South of 340 million dollars was obtained at a cost of 640 million dollars.

What can one conclude? Clearly, if efficient projects were available in the South or even if pure income transfers were possible, the same redistribution could have been obtained at a lesser cost. But what if such conditions did not obtain? In that event, and given that social welfare is an increasing function of income redistribution in favor of lower income recipients, little can be said as to whether the program was inefficient. To gauge efficiency in a way which takes income distributional effects into account, one must have an appropriate welfare function.

Since welfare functions are difficult to find in the literature (or in Congress), the author constructs one by following a hint from Eckstein that the effective marginal income tax rate schedule reflects society's evaluation of the marginal worth of income to different income classes. The result, while involving an arbitrary normalizing procedure, is a scale of "welfare equivalent weights" to be attached to dollar benefits and costs received, and borne by members of different income classes: 2.28 for incomes under 1,000 dollars to 0.27 for incomes of 1 million dollars or more. Combining this scale with plausible assumptions about the intra-state distribution of benefits and costs, Haveman first re-evaluates the nationwide Corps program (1946-1962) on a state-by-state basis, finding that, nationwide, it had a positive welfare impact of between 1.5 billion and 4.7 billion dollars, depending on whether benefits were assumed to be distributed equally or as present income *intra-state*. Secondly, the 147 projects in the South were re-evaluated, using 5.5 per cent interest over 50 years on the welfare-weighted benefits and costs. The result was that 25 projects representing 18 per cent of the funds

failed to achieve a modified benefit-cost ratio of 1.0. The modal B/C interval was 1.0-1.19. Thirty-two projects are accepted by the welfare criterion which were previously rejected on a pure efficiency basis.

Overall, the study shows that the Corps' program has exhibited significant allocational inefficiencies but that these have been mitigated in part by favorable distributional gains. Alternative criteria have been compared, and a possible social welfare function has been created.

Of necessity, the empirical analysis utilized the Corps' estimates of benefits and costs relating to projects. By their nature, benefits exhibit greater futurity and uncertainty than costs, and it is widely suspected that Corps estimates exaggerate benefits and understate costs. Even if these biases did not exist, recognition should be given to the differing degrees of uncertainty in these two components of benefit-cost analysis. In an appendix, Haveman defends his procedure of increasing the discount rate for benefits and decreasing the rate for costs. This seems to be an area where much additional work is needed. Rather than proceeding along ad hoc lines of altering discount factors, more extensive use of formal econometric models for forecasting benefits and costs seems called for, *i.e.* procedures which would permit explicit confidence intervals of forecast to be computed. More sophisticated decision rules, either along classical or Baysean lines, could then be used for project acceptance.

The uncertainty relating to benefits and costs points to the need for ex post facto analysis of the performance of public investment projects to further our understanding of their impacts and the degree of variability of the impacts, and ultimately to improve evaluation procedures. Only with such analyses, set in an institutional framework which encourages objectivity and enforces responsibility, can an "invisible hand" counterpart of the market be established in the public sector.

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