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BENEFIT-COST ANALYSES OF FEDERAL PROGRAMS

A COMPENDIUM OF PAPERS

SUBMITTED TO THE

SUBCOMMITTEE ON PRIORITIES AND ECONOMY IN GOVERNMENT

OF THE

JOINT ECONOMIC COMMITTEE
CONGRESS OF THE UNITED STATES

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LETTERS OF TRANSMITTAL

DECEMBER 29, 1972.

To the Members of the Joint Economic Committee:

Transmitted herewith for the use of the Members of the Joint Economic Committee and other Members of Congress is a compendium of papers entitled "Benefit-Cost Analyses of Federal Programs."

The volume contains studies of several Federal programs from a benefit-cost point of view. They are intended to illustrate the usefulness of benefit-cost analysis in evaluation of public programs and to illustrate ways in which present analytical methods might be improved.

WILLIAM PROXMIRE,
Chairman, Joint Economic Committee.

DECEMBER 28, 1972.

Hon. WILLIAM PROXMIRE,
Chairman, Joint Economic Committee, Congress of the United States, Washington, D.C.

DEAR SENATOR PROXMIRE: Transmitted herewith is a compendium of 11 papers entitled "Benefit-Cost Analyses of Federal Programs."

This volume contains papers on a variety of programs, ranging from natural resource development to manpower training. They are intended to illustrate the usefulness of benefit-cost analysis in the decisionmaking process, and ways in which the analysis could be improved.

The committee is particularly fortunate in being able to include a survey of Federal program evaluation practices conducted by Senator William V. Roth, Jr. This survey illustrates the lack of adequate program evaluation practices among the executive departments and the independent agencies. It should be especially interesting to Members of Congress because Senator Roth suggests specific ways Congress can encourage the executive branch to correct the weaknesses in agency evaluative and analytical practices.

The compendium was prepared under the general supervision of Mr. Richard Kaufman, of the committee staff, assisted by Mr. Douglas Lee. Dr. Robert Haveman, of the University of Wisconsin, provided valuable advice. The committee is grateful to the experts who have given generously of their time in preparing the papers that make up the compendium.

The views expressed in the compendium are those of the contributors and do not necessarily represent the views of committee members or staff.

JOHN R. STARK,
Executive Director, Joint Economic Committee.

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REPORT ON A SURVEY OF FEDERAL PROGRAM EVALUATION PRACTICES

By Hon. William V. Roth, Jr., *a U.S. Senator From the State of Delaware*

I. Remarks on Federal Program Evaluation

Public Program Analysis and Evaluation for the Purposes of the Executive and the Congress

This report presents the findings of a study initiated by my staff and me in July of 1971. At that time we directed a questionnaire to 41 Federal agencies, seeking to put together a general picture of program evaluation and analysis in these agencies. This study seemed to us to be necessary to determine what sorts of improvements were needed in the information used by the executive and legislative branches in the allocation of scarce national resources. Much of the work in preparing this report has been performed by two very competent college student interns under the direction of a full-time member of my staff.

My entire approach to program evaluation and analysis is a common sense one. I intend the term "evaluation" to refer primarily to a process which measures the success of ongoing activities. Obviously there is an analytical aspect to this. The expression "analysis" has a broader meaning—including the consideration of hypothetical situations in planning for the future. Decisionmaking based on analysis is what I am really advocating—be it in the Congress or the Executive. To my common sense way of looking at it, this would be decisionmaking following upon a breakdown of problems into their constituent parts; an assembling of all pertinent, available facts; and the tying together of causes and effects.

My interest in making sure that the executive branch and the Congress have adequate evaluation and analysis to back up their decision making is derived from a desire to find a practical path to true fiscal responsibility. Evaluation and analysis contribute to this end by allowing us to better determine whether programs are accomplishing their intended goals; how these programs could be improved; and what new programs should be undertaken in the future.

Adequate analysis and evaluation would also permit us to compare the relative costs and achievements of various programs managed by one or a number of agencies. Any rational allocation of scarce public resources requires that some sort of cost-effectiveness or cost-benefit analysis be performed.

I have been led to an interest in the use of evaluative program data also as a result of my concern that sufficient program information be available for use by grant users. When I discovered that such user-

oriented material was not always adequate, I began to wonder if agencies were collecting and using output data. Grant-users, legislators, political-level executives, and program coordinators all stand to gain from improved program information of all sorts.

The use of analytical techniques is subject to a number of dangerous distortions. These include over-objectification, over-systematization, and use for advocacy by program managers and political executives. We must keep in mind that it is especially difficult to gauge whether social programs are successful. These programs necessarily have multiple goals which in their ultimate form are very hard to measure. Further, I think we need to guard against the erection of complicated formal structures of analysis which have no impact on decisionmakers.

Despite these pitfalls, my staff and I still feel that a reasonable, flexible approach to evaluation and analysis can contribute much to fiscal responsibility. This was President Nixon's argument when in a May 1970 memorandum to agency heads, he urged wider use of program evaluation. In initiating our survey of Federal evaluation practices, we did not wish to advocate any particular approach or technique. We mainly hoped to get some feeling for the extent and nature of evaluation activities in the Federal Establishment as a whole.

In July of 1971 my staff directed a questionnaire to 41 Federal agencies. We received written replies from 39 of these. In this questionnaire we concentrated especially on practices involved in evaluating ongoing Federal domestic assistance programs. However, as the staff proceeded with personal interviews and other contacts with agency evaluation people and interested parties, our scope of interest broadened to include the evaluation and analysis of most governmental activity.

I would now like to summarize the findings of our survey. The report we have prepared contains general summaries of the agency responses, as well as reports on each agency's reply. We have, of course, been limited by the accuracy and completeness of the agency responses. To as great a degree as possible we have simply summarized what the agencies have told us. Of course, in some instances it has been necessary to apply an amount of judgment in piecing together information from the direct answers as well as accompanying documents. It is also important to realize that the general summaries of the agency responses are necessarily only approximations of reality.

It seems to me most essential that agencies make serious efforts to define the short- and long-term goals of their programs. There is no denying the fact that legislative authorizations often do not pin down the purposes of authorizations. Further, by their nature those governmental efforts with social objectives usually have multiple objects. These realizations do not lead me to accept the often-made argument that we therefore cannot really assess the accomplishments of social programs.

An agency cannot possibly pursue its responsibilities in any coherent fashion without some goal orientation. Of course, it is usually possible to define and measure immediate outputs such as number of houses built, number of persons trained, etc. To accomplish the same with ultimate goals such as the improvement of housing or employment opportunities for a particular group in the society is a much taller order.

According to our survey, the definition of objectives and goals is is not a highly developed art among the executive departments and the independent agencies. Immediate outputs seem to be more frequently defined, and the large executive departments have gone somewhat further in this direction than the usually smaller independent agencies.

Once goals and objectives are outlined, techniques must be selected with which to determine whether agency efforts are meeting these standards. Among the major executive departments immediate outputs appear to be measured for most programs in a majority of departments. Ultimate effectiveness seems to be rather infrequently gaged. Turning to the independent agencies, again, immediate output was said to be assessed somewhat more commonly than ultimate effects. The extent of output measurement, of any sort, was reported as considerably more limited by these agencies than by the executive departments.

Program outputs must be related to program costs in order to effectively use program evaluation and analysis to determine priorities and allocate scarce resources. In other words, one must be able to categorize expenditures in the same terms as program activities. This process is of course complicated by the fact that Congress appropriates money in "input" terms, defined by organizational structure.

Our survey found the major executive departments to be further along than the other organizations in making use of cost benefit or effectiveness study. Nevertheless, in both cases many agencies said that they did not apply this technique to most of their activities or did not provide us with useful respnses to the query. As regards the use of some sort of formal PPBS by agencies, such use was almost nonexistent among independent agencies, while four executive departments claimed to do so.

In constructing our questionnaire to the agencies, we felt that is was essential to find something out about the organization of evaluation and analysis within various agenices. It only makes sense that there must be a proper distribution of resources between program operators and agencywide management. This distribution should allow program people to make use of their great knowledge of program operations for self-guidance and the guidance of top decisionmakers. Yet these top decisionmakers need to be able to reflect independently on this data and recommendations. To do this, they must have both independent informational as well as analytical resources. It just does not make sense to allow the civil servants who operate programs day-by-day and who may be conscientiously committed to them, to make final decisions about their role in an agency's overall effort.

Few executive departments or independent agencies, in response to our letter, described their evaluation apparatus as centralized. Decentralization seems to be the order of the day. Most departments and almost half the agencies noted the existence of a central unit with major evaluatory-analytical responsibilities. It is important that each agency determine, with guidance from the Executive Office of the President, what sort of formal structure of evaluation and analysis best meets its needs.

Sheer numbers of analysts, of course, may not be as important as their quality. For example, it is my understanding that the Department

of Health, Education, and Welfare considers a small staff of analysts to be adequate for that Department's needs. The Department of Agriculture has 11 analysts of 15 professionals in its Office of Planning and Evaluation, and the Department of Commerce's Office of Budget and Program Analysis disposes of the services of 20 out of a total of 147 evaluation personnel.

I am most hopeful that the Federal Government will in the future take more interest in encouraging State and local government capacity to manage intergovernmental aid minus extensive Federal requirements. Following upon this concern, in our questionnaire we asked agencies to comment on their efforts to foster evaluative ability among State and local grant recipients. Both executive departments and independent agencies made it clear that almost no programs to support improvements in evaluation and analysis exist. Similarly, almost no functional programs permit the use of money for such purposes.

If we were to help our States and localities develop more capacity for self-criticism, we might be able to eliminate much of the expensive redtape and bureaucracy now involved in administering Federal domestic assistance. As a consequence some of those at all levels of government who had formerly administered the endless requirements associated with categorical grants might be trained to access the accomplishments of grants-in-aid. It is interesting to note that a few departments and agencies have given evaluation responsibilities to their regional organizations.

It has always seemed to me that the improvement of evaluative and analytical practices in the Federal Establishment could best be achieved through the budget process. If the Office of Management and Budget, and for that matter the Congress, were to demand more analytical support for agency budgetary requests, I think we would see at least an increase in the amount of analysis and evaluation in the agencies. The quality of this might also improve if OMB and Congress possessed the ability to spot check its validity.

OMB involves itself in agency program evaluation primarily through: Issue letters which task agencies on special problems; the requirements for evaluative support set in OMB Circular A–11; studies it undertakes on its own; the work of the budget examiners; and through guidance provided to agencies by OMB's Evaluation Division. All evidence, including exchanges with OMB and the responses of agencies to our letter, lead to the conclusion that OMB involvement with substantive evaluation at the agency level is not great. Likewise, there is not a great deal of evidence indicating extensive independent substantive evaluation of agency activities by OMB.

With this laissez-faire attitude, it is difficult for me to understand how the executive can have adequate information to make tradeoffs among possible expenditures. Of course, we are all aware of the fact that the Office of Management and Budget has a tremendous number of tasks to perform—most of which it does quite well. A letter from Director Shultz of the OMB, presented as a part of the report, reveals some useful information concerning his agency's impact on Federal evaluation practices. Perhaps there is a role for the Domestic Council to play in offering leadership to the agencies, especially as regards to the evaluation of domestic assistance programs.

The General Accounting Office is an existing agency which provides independent evaluations of programs to Congress, as well as assistance to executive agencies. At a later time I plan to treat the question of increased evaluative and analytical resources for the National Legislature. A rather small portion of the executive departments, and an even smaller portion of the independent agencies, indicated in response to our inquiry that GAO was actively or regularly involved in evaluating the substantive accomplishments of their programs. They also stated that the Comptroller General's interest in their programs was quite often of a fiscal-procedural nature.

It should be noted, however, that the GAO has considerably increased its involvement in the evaluation of program accomplishments in recent years. By 1973 GAO estimates that of their 3,000 professional staff members about 32 percent will be involved in reviews of program effectiveness and program results. According to the same estimates only 10 percent of professional staff is currently concerned with purely fiscal audits. Comptroller General Staats has presented his view of the General Accounting Office's role in program evaluation in a letter included in this report.

It is clear that GAO has plenty of work to do and does much of it effectively. However, the Congress needs to have more independent evaluation of the impact of Federal governmental activity—by GAO, the Library of Congress, its own committees, or perhaps by some other body. The Legislative Reorganization Act of 1970 clearly assigns to the Comptroller General and the Library of Congress additional responsibility to perform substantive evaluations.

In our questionnaire we also inquired as to whether Federal bodies depended primarily on evaluation in house by full-time staff or on studies contracted out to private consulting firms, research foundations, or universities. A good majority of agencies throughout the Federal establishment reported that they depend primarily on in-house evaluation and analysis. There are only a few instances, such as with HUD's model cities supplemental grants, where program money is available for evaluation. Equally uncommon is the situation, such as with a number of HEW programs, where Congress or the Executive has earmarked specific funds for this function. One percent of program funds for HEW health programs and several Social and Rehabilitation Service programs is set aside by Congress for evaluation.

Besides on occasion allocating specific funds for the assessment of program accomplishments, the Congress in the 1967 Office of Economic Opportunity Amendments gave explicit instructions that the Director of OEO make a continuing effort to evaluate OEO efforts. These same amendments required evaluation by the Comptroller General.

In conclusion, it has been my hope that through these comments I can call attention to the need for the executive branch to improve and extend its attempts to measure the accomplishments of governmental activities and weigh these accomplishments against their costs. I feel that the study conducted by my staff suggests serious weaknesses in agency evaluative and analytical practices.

We in Congress can encourage the executive agencies to move in this direction in the course of committee hearings and by earmarking, where appropriate, program funds for evaluation and analysis when authorizing programs. We could also demand extensive analytical

support for requests for funds and authorizations. At the same time, we must turn to the improvement of our own capacity to use and independently generate analysis and evaluation. These are tools which, when sensibly put to use, greatly increase the possibility of making the maximum use of public funds.

II. Copy of Questionnaire Sent to 41 Agencies

U.S. Senate,
Washington, D.C., July 26, 1971.

Dear _____: I am gathering information for a study of program evaluation in Federal agencies which concerns itself with the whole process of evaluation, from the collection and reporting of raw data to the final comparative cost-benefit/effectiveness analyses. I would sincerely appreciate your cooperation in providing any available information in the following specific areas of concern:

1. How many domestic assistance programs as defined by the 1971 Office of Management and Budget Catalog of Federal Domestic Assistance does the agency administer?

To what extent are agency activities readily defined in terms of objectives and outputs conducive to measurement and evaluation of effectiveness (for example, PPB program structures or building block format)? How many programs are operated and monitored in terms of definite output measures and goals? (Note: "Output measures" does not describe measures of expenditure, but rather the ultimate results of these expenditures.)

2. For which programs are expenditure and output data evaluated (i.e., in terms of cost-effectiveness, alternative approaches, experimental variations, program side effects, efficiency, improved program strategies)?

3. How are the tasks of evaluation organized and distributed within the department/agency?

(*a*) How is the department/agency evaluation staff arranged (in terms of size and scope of activity)?

department/agency office of evaluation?

bureau and program evaluation staffs?

For State and locally administered programs, have evaluation staffs been developed at the State and local levels? Are there program funds authorized specifically for this purpose? (What is the role of State and local personnel in reporting or evaluating information?)

(*b*) What has been the role of OMB in evaluating department/agency programs?

independently of agency staff?

in cooperation with agency staff?

(*c*) What has been the scope of GAO activity in doing evaluation studies of department/agency programs?

(*d*) To what extent have evaluation studies been contracted out?

(*e*) To what extent are date reporting and evaluation performed by:

participating program staff?

independent staffs?

4. How has the evaluation staff been funded?

(*a*) individual program authorizations specifying evaluation studies of the program?

(*b*) the Secretary or director's administrative staff appropriations? (Were the funds utilized specifically designated for program evaluation in the budget authorization?)

(*c*) other?

5. Is evaluative information made available or could it be made available upon request for use by the legislative branch in considering authorization and funding levels of the various programs? (How much evaluative information is covered by executive privilege?)

6. Are there any projected innovations in the area of program evaluation in the agency?

Any suggestions, further information or examples concerning program evaluation would be greatly appreciated. Please direct such information to Kent Peterson of my staff.

Sincerely,

WILLIAM V. ROTH, Jr.,
U.S. Senate.

III. LIST OF AGENCIES RESPONDING TO QUESTIONNAIRE

Executive Departments

Department of State.
Department of the Treasury.
Department of Defense.
Department of Interior.
Department of Agriculture.
Department of Commerce.
Department of Labor.
Department of Health, Education and Welfare.
Department of Housing and Urban Development.
Department of Transportation.
Department of Justice.

Agencies

The Appalachian Regional Commission.
Atomic Energy Commission.
United States Civil Service Commission.
Environmental Protection Agency.
Equal Employment Opportunity Commission.
Farm Credit Administration.
Federal Power Commission.
General Services Administration.
Indian Claims Commission.
Inter-American Social Development Institute.
National Advisory Council on the Education of Disadvantaged Children.
National Aeronautics and Space Administration.
National Capital Housing Authority.
National Science Foundation.
Office of Economic Opportunity.
Overseas Private Investment Corporation.

Postal Service.
President's Council on Physical Fitness and Sports.
Securities and Exchange Commission.
Small Business Administration.
Tennessee Valley Authority.
U.S. Commission on Civil Rights.
U.S. Information Agency.
U.S. Tariff Commission.
Veterans' Administration.
Washington Metropolitan Area Transit Authority.
Water Resources Council.
Federal Home Loan Bank Board.

Note.—The following agencies were sent questionnaires, but did not reply in time to have their responses covered by this report:
Federal Trade Commission.
National Capital Planning Commission.

IV. Letter Regarding Program Evaluation Sent to Director George P. Shultz of the Office of Management and Budget

U.S. Senate,
Washington, D.C., July 22, 1971.

Attention: Mr. William A. Niskanen, Jr., Assistant Director for Evaluation.

Hon. George P. Shultz,
Director, Office of Management and Budget, Executive Office Building, Washington, D.C.

Dear Mr. Shultz: I am gathering information for a study of program evaluation in Federal agencies which concerns itself with the whole process of evaluation, from the collection and reporting of raw data to the final comparative cost-benefit/effectiveness analyses. I would sincerely appreciate your cooperation in providing any available information in the following specific areas of concern:

1. What is the size and structure of the OMB evaluation staff? What is the scope and distribution of OMB evaluation activity? Are there any projected innovations?

2. What is the relationship between the OMB evaluation staff and the evaluation staffs of the agencies?

(*a*) How are the "tasks" of evaluation distributed between the two levels? (For example, data collection, program analyses, comparative program analyses, and so forth.)

(*b*) What are the pressures acting on evaluation staffs at the two levels which might tend to decrease objectivity? An agency program analysis office has been described as "wearing two hats," it is initially "critical" toward an agency's programs, but then serves as an advocate of those programs vis-a-vis OMB. How does the OMB evaluation staff overcome these informational difficulties at the agency level? Are there similar distortive pressures within OMB?

(*c*) Where should the emphasis for expanding and improving program evaluation be focused in view of the need for objective evaluative information?

(1) Enlarging agency evaluation staffs?

(2) Expanding the evaluation staff at the OMB level?

3. What are the procedures providing for a comparative overview in analyzing:

(*a*) Programs with a similar goal?

(*b*) Diverse groups of programs serving different goals?

4. How are the procedures for program evaluation integrated into the budgeting cycle?

(*a*) How much evaluative information is requested from the agencies in the budgeting process? (samples of relevant budget circulars)

(*b*) How much *"useful"* evaluative information *is provided* by the agencies in the budgeting process?

5. What is the role of the OMB evaluation staff in making or contributing to policy decisions? What are the structures and procedures involved in OMB's impact on policymaking? What, in your view, should the relationship between evaluation and policy-formation be?

6. What is the present OMB policy in using "executive privilege" to cover evaluative information? What is the impact of executive privilege on the quality of program evaluation information in the executive branch? If evaluative information were to be made public, would program evaluations then become less or more objective? (Should Congress develop its own office of program evaluation? If such a congressional office were established, at what levels of the evaluation process could data be shared, if at all?)

7. What is your reaction to Senator Mondale's proposal (S. 5—the Full Opportunity and National Goals and Priorities Act) which would create a Council of Social Advisers to perform an evaluative, policy—recommending role in analyzing Federal activity in areas of social concern?

What evidence could you give that adequate evaluation is being done in this area already by the present OMB/agency evaluation staff structure?

Any assistance you can provide on this important subject will be greatly appreciated.

Sincerely,

WILLIAM V. ROTH, Jr.,
U.S. Senate.

V. DIRECTOR SHULTZ'S RESPONSE TO SENATOR ROTH'S LETTER

EXECUTIVE OFFICE OF THE PRESIDENT,
OFFICE OF MANAGEMENT AND BUDGET,
Washington, D.C., September 15, 1971.

Hon. WILLIAM V. ROTH, Jr.,
U.S. Senate,
Washington, D.C.

DEAR SENATOR ROTH: I value your interest in the Federal evaluation process and your support of our efforts to improve the information and analysis available to Federal policy officials. John Collins and Kent Peterson met with our Assistant Director for Evaluation, Bill Niskanen, to provide a general background for our response to your specific questions.

1. What is the size and structure of the OMB evaluation staff? What is the scope and distribution of the OMB evaluation activity? Are there any projected innovations?

The OMB Evaluation Division has 18 authorized positions, divided equally between a Special Projects Branch and an Evaluation Techniques Branch. Each professional staff member has a primary responsibility for one domestic program area and also contributes to the evaluation of selected Government-wide management and procedural problems. The major projected innovation is to give the Evaluation Division the responsibility for structuring the OMB Spring Reviews that provide the policy and budget guidance for agency preparation of their proposed budgets.

It is important to recognize that evaluation is a management technique that includes performance audits of existing programs, management information systems, and analysis of the costs and effects of proposed programs and policies. In this sense, most of the OMB staff is involved in evaluation. The specific role of the Evaluation Division is to improve the quality of evaluation throughout OMB by developing criteria, improving analytic techniques, assisting the other divisions, and by performing special projects.

2. What is the relationship between the OMB evaluation staff and the evaluation staffs of the agencies?

In general, this relationship is professional and informal, primarily involving the sharing of data, research results, analytic methods, and perceptions of problems. The OMB Evaluation Division does not supervise or specifically monitor the budgets and activities of the agency evaluation staffs. One developing aspect of this relation is the development and promulgation of evaluation guidelines in specific program areas; these guidelines are usually developed jointly by the OMB and agencies' evaluation staffs and are incorporated in OMB circulars.

(*a*) How are the "tasks" of evaluation distributed between the two levels? (e.g., data collection, program analyses, comparative program analyses, etc.)

Most of the data collection and program analyses are, and should be, conducted by the agency evaluation staffs and by the university and contract research community. OMB tries to assure that the specific studies of most direct interest to the Executive Office are performed, either by organizing a special project or by tasking an agency. The primary formal instrument for tasking an agency is an Issue Letter; these letters are now prepared in the summer for a response by the following spring and are usually restricted to studies of major importance. The OMB program examiners are continuously tasking the agencies for data and studies with a shorter deadline or of lesser importance.

(*b*) What are the pressures acting on evaluation staffs at the two levels which might tend to decrease objectivity? An agency program analysis office has been described as "wearing two hats," it is initially "critical" toward an agency's programs, but then serves as an advocate of those programs vis-a-vis OMB. How does the OMB evaluation staff overcome these informational difficulties at the agency level? Are there similar distortive pressures within OMB?

The agencies and OMB obviously have somewhat different institutional objectives—the agencies to promote programs for which they are responsible and OMB to constrain total spending and balance programs across the Government—and their respective evaluation staffs are bound to reflect these objectives. This problem is somewhat tempered by a developing sense of professional standards in the analytic community. In recognition of this problem, OMB's study requests to the agencies are increasingly restricted to information that does not directly threaten the agency's fundamental interests. In addition, OMB relies heavily on studies conducted outside of the Government and on studies by the OMB staff to provide parallel sources of information and analysis. We may not be sufficiently aware of similar distortive pressures within OMB, but it is probable that our current budget orientation sometimes makes us unduly critical of some spending proposals.

(*c*) Where should the emphasis for expanding and improving program evaluation be focused in view of the need for objective evaluative information?

(1) Enlarging agency evaluation staffs?

(2) Expanding the evaluation staff at the OMB level?

At the present time, there does not appear to be a general shortage of analysts in either the agencies or OMB. The primary present challenge is to make more effective use of the potentially available analyses by improving our review processes and, pending these procedural changes, an increase in the supply of analysts will not increase the amount of analysis that is effectively used. In contrast, there may be a greater payoff to increasing the number and quality of analysts working for Congress, an action that would also improve the quality of analysis in the executive branch.

3. What are the procedures providing for a comparative overview in analyzing—

(*a*) Programs with a similar goal?

(*b*) Diverse groups of programs serving different goals?

Most programs serve several goals, some of which are not well defined. Indeed, the necessary coalition for approval of a major program usually includes parties who support the program for quite different reasons. In recognition of the several goals of most Federal programs, OMB is increasingly using several different formats for reviewing the Federal budget and activities. These several formats include the necessary agency and appropriation aggregation, several types of program aggregations, resource-type aggregations, and selected Government-wide overviews of economic and management issues. We are developing review procedures to give increasing attention to the distributive consequences of Federal activities—by income class, demographic group, region, etc.—as well as the incentive effects on the various parties involved in carrying out Federal programs. Our review procedures are still in an experimental state, subject to the necessary procedures to review and publish the budget, but we believe we are working toward a more informative and effective process.

4. How are the procedures for program evaluation integrated into the budgeting cycle?

(*a*) How much evaluative information is requested from the agencies in the budgeting process? (Samples of relevant budget circulars.)

(*b*) How much *"useful"* evaluative information *is provided* by the agencies in the budgeting process?

Program Evaluation materials are submitted at several stages of the budget cycle. The results of major studies prepared by the agencies in response to the Issue Letters as well as studies performed within OMB receive greatest attention in the Spring Reviews. Agencies submit some program evaluation materials with their proposed budgets, both in response to OMB circular A–11 and to frequent informal requests by the program examiners. Some program evaluation material, prepared either by the agencies or within OMB, is included in the program books for the Fall Reviews. A representative Issue Letter and a copy of circular A–11 are enclosed. The usefulness of agency program evaluation information varies enormously; in general, the basic information on which the agency analysis is based is more useful to us than their analysis and conclusions.

5. What is the role of the OMB evaluation staff in making or contributing to policy decisions? What are the structures and procedures involved in OMB's impact on policymaking? What, in your view, should the relationship between evaluation and policymaking be?

The OMB Evaluation Division has no direct policy responsibility; its primary contribution to policymaking is to assure that the OMB policy officials have the best possible information and analysis on management and budget issues. OMB's impact on policymaking, of course, derives entirely from the powers of the President, and OMB's unique role as the only comprehensive staff in the Executive Office. Evaluation can be one of several important inputs to policymaking, but cannot be a substitute for the critical political decisions; evaluation should not be expected to resolve issues when there is a fundamental disagreement on objectives among well-informed parties.

6. What is the present OMB policy in using "executive privilege" to cover evaluative information? What is the impact of executive privilege on the quality of program evaluation information in the executive branch? If evaluative information were to be made public, would program evaluations then become more or less objective? Should Congress develop its own office of program evaluation? If such a congressional office were established, at what levels of the evaluation process could data be shared, if at all?

The President's policy is to use "executive privilege" to the minimum extent consistent with the full and frank discussion of policy alternatives within the executive branch and with the necessary coordination of administration proposals and consistent, of course, with the normal restrictions on classified material. In general, clearly, individual requests would have to be considered on a case-by-case basis.

As a general rule, the availability of the backup component studies might probably increase the objectivity of these studies, as they would be subject to review by a larger professional audience with, possibly, a wider range of interests. The release of studies that directly lead to a policy recommendation by appointed officials, however, would reduce the frankness of the internal policy discussion.

Because, generally, the basic data on which executive branch analysis is based would also be available to Congress, there would not seem to be any particular need for a separate congressional office of program evaluation, apart from existing committee staffs, but of course Congress would have to judge that for itself.

7. What is your reaction to Senator Mondale's proposal (S. 5—the Full Opportunity and National Goals and Priorities Act) which would create a Council of Social Advisers to perform an evaluative, policy recommending role in analyzing Federal activity in areas of social concern? What evidence could you give that adequate evaluation is being done in this area already by the present OMB/agency evaluation staff structure?

We do not favor the creation of a Council of Social Advisers as proposed by Senator Mondale. A council of this nature without a specific program or policy focus would most likely evolve into spokesmen for specific policies and would usually be excluded from the primary decision processes. In addition to the agency evaluation staffs, it is important to recognize that the Executive Office review of social programs and policies now benefits from the contribution of the Domestic Council staff, the Council of Economic Advisers, the Office of Science and Technology, and the Council on Environmental Quality as well as OMB, and these staffs include able social scientists from a range of professional disciplines.

I hope that these answers are responsive to your requests. Bill Niskanen can follow up on more details if this would be valuable. Again, thank you for your interest and understanding.

Sincerely,

(S) GEORGE P. SHULTZ,
Director.

VI. LETTER FROM COMPTROLLER GENERAL ELMER B. STAATS TO SENATOR ROTH REGARDING GENERAL ACCOUNTING OFFICE'S ROLE IN FEDERAL PROGRAM EVALUATION

COMPTROLLER GENERAL OF THE UNITED STATES,
Washington, D.C., May 5, 1972.

B-161740.

Hon. WILLIAM V. ROTH, Jr.,
U.S. Senate, Washington, D.C.

DEAR SENATOR ROTH: I appreciate the opportunity afforded me to look over the report which summarizes your findings dealing with Federal program evaluation practices. As mentioned in my letter to you of April 20, you may wish to include a copy of this letter in your report.

I certainly share your view that program evaluation and analysis can contribute much to fiscal responsibility and for this and other reasons most of our audit effort over the past several years has focused on the evaluation of management of Federal programs and the assessment of whether these programs are accomplishing the purposes which Congress intended them to accomplish.

The principal objective of the General Accounting Office is to render maximum assistance to the Congress, its committees, and

Members, consistent with our responsibilities as an independent, nonpolitical agency. Meeting this objective with our limited resources requires the judicious selection of assignments and the most efficient utilization of available staff in the conduct of those assignments. Therefore, except as otherwise required by statute or external requests, our basic audit policy is to direct available resources and talents to the areas in which they can be most effectively used to fulfill the greatest apparent need and benefit to the Government.

Implementation of our audit policy results in considerable audit coverage of some Federal programs while very little audit effort will be devoted to other programs. For instance, we have performed a number of program evaluations at the Environmental Protection Agency and the Departments of Defense; Health, Education, and Welfare; Interior; Agriculture; and Housing and Urban Development because these departments have many substantive ongoing programs which have a considerable impact on a large number of people and require sizable amounts of Federal funds. On the other hand, independent agencies such as the Inter-American Social Development Institute and the Overseas Private Investment Corporation have been in operation for only a little over a year and accordingly our work in these agencies has not been extensive at this point in time.

We are directing more of our efforts to providing the Congress and the Federal agencies with information on the progress made in achieving program objectives and on possible alternative approaches to accomplishing the objectives intended by Congress. For fiscal years 1971 through 1973 we estimate that of our 3,000 professional staff members about 21 percent, 28 percent, and 32 percent, respectively, were, or will be, concerned with reviews of program effectiveness and program results. In addition, a substantial portion of our manpower is expended on management evaluations which are designed to achieve greater economy and efficiency in Federal Government operations. Less than 10 percent of our professional staff is concerned with purely fiscal audits.

A significant part of our work is done in response to specific requests by committees of the Congress, often in direct support of their legislative or legislative oversight responsibilities. As a current and important example, we are supporting the Joint Economic Committee in its study of welfare programs by measuring, in six geographic areas, the extent to which poor persons receive benefits from the multitude of Federal programs intended for their aid. To the best of our knowledge, this effort is unique. Also, we have recently evaluated and will shortly report on the impact of a basic change, provided for by present legislation, in the method of distributing funds for maternal and child health programs on the provision of services to program beneficiaries. This work was done at the request of the House Ways and Means and Senate Finance Committees to assist in their consideration of the need for modifying the legislation.

Many of our reviews are concerned with important domestic programs. Following are some examples of our more recent efforts in this area.

1. We reported to the Congress that the solid waste demonstration grant program had limited impact in improving the solid waste disposal problem in the Nation.

2. A report to be issued to the Congress this month will discuss the progress and problems in reducing air pollution from automobiles.

3. A recently issued report to the Congress evaluates the effect of Federal expenditures on the economy of Johnson County, Ky. A similar study, undertaken at the request of Senator Edward Brooke, resulted in a report on our evaluation of the impact of Federal programs on economic development, employment, and housing in New Bedford, Mass.

4. Our report to the Congress on civil defense in the United States provided an evaluation of the development of a nationwide fallout shelter system.

5. In a report to the Congress last month, we assessed the dimensions of insanitary conditions in the food manufacturing industry.

6. Over a recent 3-month period, we issued five reports to the Congress on our assessment of the impact of the teacher corps program at various locations in the United States, and we will shortly issue a report on the impact of the program nationwide.

7. A report which will shortly be issued to the Congress will discuss how enforcement of housing codes can enhance achievement of the Nation's housing goal.

8. Two recent reports to the Congress provided evaluations of the housing and education programs for the American Indian.

These examples represent a small portion of the audit effort which we are devoting to program evaluations. We have already provided you with a copy of our annual report for fiscal year 1971. I am providing separately a partial listing of reports which we have issued during about the past 3 years, or which will be issued in the next month or two, on the agencies involved in your study. This listing includes about 200 reports directed to the status and/or accomplishments of Federal programs. From the information included in our annual report and in the listing, I think you will agree that our efforts in the area of program evaluations have been quite extensive.

It is obvious that some agency responses to your questionnaire were not complete concerning our past efforts in evaluating their programs. Some of the responses apparently were prepared by agency people who were not familiar with our work. Overall, I think it would be fair to say that our total effort in program evaluations has been quite substantial and that our progressive increase of both total and multidiscipline staff resources which we have applied in this area in the last 6 years evidences our deep interest in such evaluations. This is not to say that more should not be done. On the contrary, as you note in your report, the Legislative Reorganization Act of 1970, as well as other recent legislative actions, will require the General Accounting Office to place even greater emphasis on program evaluations.

We appreciate your interest in this subject and hope that you will support our program evaluation efforts. If we can be of any further assistance, please do not hesitate to call.

Sincerely yours,

ELMER B. STAATS,
Comptroller General of the United States.

VII. EXPLANATION OF REPORTS ON AGENCY RESPONSES

1. *Number of domestic programs.*—According to 1971 OMB Catalog of Federal Domestic Assistance.

2. *General description.*—A general comment on the quality of goal definitions, evaluative technique and organization, and also a mention, when necessary, of those characteristics of the agency program which are considered to prevent workable evaluation.

3. *Definition of goals and objectives.*—The degree to which the agency defines the short- and long-range goals of its programs, specifically in the short range the definition of output, and other productivity indexes, objectives.

4. *Technique of evaluation.*—The manner in which the agency measures productivity, effectiveness, and benefit to society against the costs of the program.

5. *Organization.*—The institutional structure for evaluation. How centralized or decentralized? What resources are available to the agency head? Who bears the primary responsibility for evaluation-independent staff or program staff? Also, specific numbers in specific staff evaluation functions.

6. *State-local evaluation.*—Are any grant funds available for State and local governments to evaluate their efforts under grants-in-aid or in general? What does the agency know about State and local capability in this area?

7. *OMB role.*—The role of the Office of Management and Budget in evaluating agency programs or in providing advice and direction in this area. Has this participation been independent or in cooperation with agency staff?

8. *GAO role.*—Scope of General Accounting Office activity in evaluating agency programs. To what degree have these been reviews of fiscal management and procedures in general, and to what degree reviews of the substantive accomplishments of programs?

9. *In-house versus contracts.*—How much evaluation is done by agency personnel and how much by contract or grant?

10. *Funding.*—How are funds for evaluation authorized—earmarked funds, administrative appropriations, agency heads' office appropriations, program funds, research and development appropriations, et cetera?

11. *Availability to Congress.*—The proportion of evaluative materials available to Members and committees of Congress. What are the procedures for making such data available? What role does executive privilege play in the release of evaluative materials?

12. *Innovations.*—The innovations projected by the agency in the evaluation field.

13. *Date of reply.*—Date on the agency reply to Senator Roth's questionnaire.

Note.—It should be kept in mind that in putting together the summaries of the agency responses, there has been an effort to rely mainly on information supplied by the agencies themselves. The accuracy of such information will, of course, reflect the accuracy and care taken by agencies in preparing their responses. It has often been necessary, however, to piece together the implications of agency replies, contained in both the answers to our questionnaire and in supporting materials submitted. Thus, some of the agency summarizations contain an amount of judgement on our part.

The reader will soon discover that the quality of information supplied by the executive agencies varies from agency to agency, as well as from topic to topic. In numerous cases, particular agencies provide no information in answer to certain questions. Also, particular questions may not apply to certain agencies.

VIII. Summary of Responses

Summary of responses of Executive Departments [1]

[11 departments included, 8 agencies in Department of Transportation]

	Executive departments [3]	DOT agencies [2]
3. Definition of goals and objectives:		
Ultimate goals defined:		
All programs	2	2
Most programs	2	1
Some programs	3	2
Output defined:		
All programs	2	2
Most programs	2	2
Some programs	5	4
4. Technique of evaluation:		
Some sort of PPBS	4	2
Cost benefit/effectiveness:		
Most programs	5	2
Some programs	3	3
Output measured:		
Most programs	5	3
Some programs	4	2
Ultimate effectiveness measured:		
Most programs	1	0
Some programs	3	1
5. Organization (of evaluation):		
Centralized or decentralized:		
Decentralized	6	4
Not clearly centralized or decentralized	3	2
Centralized	2	2
Existence of central office with major evaluatory responsibilities	9	5
Top-ranking evaluation official reported as an assistant agency head	3	1
Size of central evaluation staffs:		
State:		
Inspector General of Foreign Assistance (persons)		52
Agency for International Development (persons)		6
Defense:		
Systems Analysis (persons)		100
Comptroller (persons)		45
Administration (persons)		9
Installations and Logistics (persons)		1
Agriculture:		
Departmental level, Office of Planning and Evaluation (persons)		15
10 larger agencies (total persons)		28
Smaller agencies (total man-years)		8.4
Commerce: Central, Office of Budget and Program Analysis (persons)		[4] 20
HEW:		
Central, Assistant Secretary for Planning and Evaluation (persons)		6
Agencies (total persons)		116

See footnotes at end of table.

Summary of responses of Executive Departments [1]—Continued

[11 departments included, 8 agencies in Department of Transportation]

	Executive departments [3]	DOT agencies [2]
5. Organization—Continued		
Size of central evaluation staffs—Continued		
DOT Agencies:		
Coast Guard: Chief of Staff's Office		[5] 28
Federal Highway Administration		[6]
National Transportation Safety Board		[7]
Urban Mass Transportation Administration: Central, R. & D. Systems Analysis and Office of Program Planning (persons)		12
National Highway Traffic Safety Administration (persons on total staff)		50
Federal Railroad Administration: Central Program Planning Division (persons)		4
Departments with evaluation capability at the regional level	4	1
6. State-local evaluation: [8]		
Federal money available for evaluation by State and local governments:		
None	7	3
Program money	1	2
Specific funds	0	1
Other	1	0
7. OMB role:		
General comment by agencies:		
Considerable	1	1
Some	2	1
Limited	5	5
None	0	1
Normal fiscal budgetary involvement	2	6
Involvement in substantive accomplishments of programs:		
Considerable	1	2
Some	1	0
Limited	3	1
OMB does independent evaluation	3	1
OMB does evaluation in cooperation with agency	[9] 7	[9] 3
8. GAO role:		
General comment by agencies:		
Active or regular	3	4
Some	2	1
Limited	4	3
Fiscal-procedural involvement	4	7
Substantive involvement:		
Considerable	1	1
Some	2	1
Limited	1	0
9. In-house evaluation versus contracts: [10]		
Mainly or all in-house evaluation	6	5
Mainly out-of-house contracted evaluation	2	0
Considerable use of contracts	0	3
10. Funding: [11]		
Source of evaluation funds:		
General appropriations (salaries and expenses, administrative, operating expenses, agency head's office, research and development, etc.)	7	8

See footnotes at end of table.

Summary of responses of Executive Departments [1]—Continued

[11 departments included, 8 agencies in Department of Transportation]

	Executive departments [3]	DOT agencies [2]
10. Funding—Continued		
Source of evaluation funds—Continued		
Program money	2	3
Some funds, either general appropriations or program money, specifically earmarked for evaluation by Congress or the agency	2	0
11. Availability of evaluations to Congress: [12]		
All readily available	2	2
Generally available	1	3
Limitations on availability (as regards internal working papers, case-by-case approval, OMB approval needed, some classified)	3	2
Not generally available	1	1
12. Innovations in evaluation:		
Number of agencies where specific improvements in evaluation practices are mentioned	7	5

[1] It should be noted that in putting together the agency summaries as well as in this further summarization, there has been an effort to rely mainly on information supplied by the agencies themselves. The accuracy of such information will, of course, reflect the accuracy and care taken by agencies in preparing their responses. It has often been necessary, however, to piece together the implications of agency replies, contained in both the answers to our questionnaire and in supporting materials submitted. Thus, some of the agency summarizations contain an amount of judgment on our part.

[2] The agencies contained in the Department of Transportation are reported separately, since this is the way DOT answered our questionnaire.

[3] Since it is difficult to quantify the responses summarized in this report, these numbers should be taken only as general indications of reality. Under most of the categories dealt with in this summary, an agency will be counted under as many subcategories as its response yields information about. For instance, under "Definition of Goals and Objectives," an agency may or may not define both its ultimate goals and its immediate objectives. Many agencies provide no usable information on a number of questions, and are thus not counted.

[4] Of total of 147 persons.

[5] Of total of 50 persons.

[6] Small central staff.

[7] Little independent staff.

[8] As regards this category, and certain others, the question may not be applicable to some agencies if, for instance, they have no State or locally administered programs. This appears to be the case with the Department of State and a couple agencies of the Department of Transportation.

[9] One limited.

[10] The first and third categories are not mutually exclusive.

[11] Funds for evaluation may come from a number of sources in any particular agency.

[12] This response was the only one for which the Office of Management and Budget attempted to encourage an administrationwide reply.

Summary of Responses of Independent Agencies [1]

[29 Agencies Included, Office of Economic Opportunity Falls Within the Executive Office of the President]

	Number of Agencies
3. Definition of goals and objectives:	
Ultimate goals defined:	
All programs	[3] 1
Most programs	1
Some programs	7
Very limited or not at all	14
Output defined:	
All programs	2
Most programs	3
Some programs	6
Very limited or not at all	15
4. Technique of evaluation:	
Some sort of PPBS	4
Cost benefit/effectiveness:	
Most programs	3

See footnotes at end of table.

Summary of Responses of Independent Agencies [1]—Continued

[29 Agencies Included, Office of Economic Opportunity Fall Within the Executive Office of the President]

	Number of Agencies
4. Technique of evaluation—Continued	
Cost benefit/effectiveness—Continued	
Some programs	7
Very limited or not at all	14
Output measured:	
Most programs	4
Some programs	8
Very limited or not at all	14
Ultimate effectiveness measured:	
Most programs	0
Some programs	6
Very limited or not at all	17
5. Organization (of evaluation):	
Centralized or decentralized:	
Decentralized	8
Not clearly decentralized or centralized	13
Centralized	8
Existence of central office with major evaluatory responsibilities	12
Top-ranking evaluation official reported as an assistant agency head	4
Size of central evaluation staffs:	
Appalachian Regional Commission (Division of Regional Program Planning and Evaluation) (persons)	3
Atomic Energy Commission (Division of Program Analysis) (program staff vary from 1–8)	7
District of Columbia Redevelopment Land Agency (Evaluation Division of Office of Management and Evaluation) (persons)	4
Equal Employment Opportunity Commission (Office of Program Planning and Evaluation) (persons)	9
National Advisory Council on the Education of Disadvantaged Children (staff director and research secretary)	1
Office of Economic Opportunity:	
Office of Planning, Research, and Evaluation (persons)	18
Office of Program Development (persons)	9
Office of Health Affairs, Division of Program, Planning, and Evaluation (persons)	5
Office of Legal Services, Planning, Technical Assistance and Evaluative Division (persons)	3
Office of Operations, Headquarters (persons)	3
Each of 10 Regions (persons)	1
Overseas Private Investment Corporation (Vice President for Corporate Planning) (persons)	5
Small Business Administration (Assistant Administrator for Planning, Research, and Analysis) (persons)	6
U.S. Information Agency:	
Office of Director, Resources Analysis Staff (persons)	15
Office of Research and Assessment (persons)	86
Washington Metropolitan Area Transit Authority (Office of Program Control) (persons)	10
Federal Home Loan Bank Board (Office of Bank Management) (persons)	2
Number of agencies with evaluation capability at the regional level	5

See footnotes at end of table.

Summary of Responses of Independent Agencies [1]—Continued

[29 Agencies Included, Office of Economic Opportunity Fall Within the Executive Office of the President]

	Number of Agencies
6. State-local evaluation: [4]	
Federal money available for evaluation by State and local governments:	
None	14
Program money	1
Specific funds	0
Other	1
7. OMB role:	
General comment by agencies:	
Considerable	4
Some	7
Limited	7
None	3
Normal fiscal budgetary involvement	6
Involvement in substantive accomplishments of programs:	
Considerable	3
Some	7
Limited	3
OMB does independent evaluation	6
OMB does evaluation in cooperation with agency	13
8. GAO role:	
General comment by agencies:	
Active or regular	5
Some	5
Limited or not at all	16
Fiscal-procedural involvement	10
Substantive involvement:	
Considerable	3
Some	4
Limited or not at all	13
9. In-house evaluation versus contracts: [5]	
Mainly or all in-house evaluation	19
Mainly out-of-house contracted evaluation	1
Considerable use of contracts	7
10. Funding: [6]	
Source of evaluation funds:	
General appropriations (salaries and expenses, administrative, operating expenses, agency head's office, research and development, etc.)	19
Program money	6
Some funds, either general appropriations or program money, specifically earmarked for evaluation by Congress or the agency	3
11. Availability of evaluations to Congress: [7]	
All readily available	6
Generally available	11
Limitations on availability (as regards internal working papers, case-by-case approval, OMB approval needed, some classified)	8
Not generally available	0
12. Innovations in evaluation:	
Number of agencies where specific improvements in evaluation practices are mentioned	11

Note: See footnotes 1, 3, 4, 5, 6, and 7 for "Summary of Responses of Executive Departments." As regards footnote 4, a number of independent agencies do not appear to have programs administered by State and local governments. These include: District of Columbia Redevelopment Land Agency, Farm Credit Administration, Indian Claims Commission, Inter-American Social Development Institute, National Advisory Council on the Education of Disadvantaged Children, National Capital Housing Authority, Overseas Private Investment Corporation, Postal Service, Securities and Exchange Commission, U.S. Information Agency, and U.S. Tariff Commission.

IX. Reports on Responses of Executive Departments

Department of State

1. *Number of domestic programs.*—Seven programs listed by OMB, and 37 AID country programs.

2. *General description.*—AID programs and Department activities related to consular and administrative areas are evaluated, AID better than others. The seven Department programs, perhaps with the exception of the claims against foreign governments program, are considered not to be conducive "to measurement and evaluation of effectiveness."

3. *Definition of goals and objectives.*—AID activities are defined by "inputs, outputs, project purpose and program goal." Overall Department activities are reviewed in light of foreign policy objectives. None of the domestic aid programs are defined by goals or by output measurement.

4. *Technique of evaluation.*—PPBS considered to have been inadequate to quantitatively gage the effectiveness of the attainment of objectives. A new system—Policy Analysis and Resource Allocation (PARA)—is now being implemented to judge priorities in allocation and to improve efficiency. PARA does not cover the seven programs, however, which are not evaluated in terms of output or effectiveness measurement.

5. *Organization.*—Centrally, the Office of Inspector-General "conducts a continued evaluation program"—12 inspectors of overseas activities and 40 employees. The Department essentially depends on self-evaluation by each separate agency. Claims against foreign governments are evaluated within the office of the Assistant Legal Advisor for International Claims. AID—Director of Program Evaluation—six professionals and a program evaluation officer at each regional bureau—together these two meet biweekly as a program evaluation committee. "Evaluation in AID is decentralized."

6. *State-local evaluation.*—None.

7. *OMB role.*—"* * * involved primarily in the budgetary aspects of program evaluations in State." Also, has worked with Department staff in discussion of new programs.

8. *GAO role.*—The GAO "plays an active role in evaluating the Department's overseas programs." Reviews of AID focus on financial and management audits.

9. *In-house versus contracts.*—"* * * occasionally used in AID for in-depth evaluations"; Department itself has not gone out of house.

10. *Funding.*—Department's evaluation funded by salaries and expenses appropriations, though the Office of Inspector General of Foreign Assistance (IGA), as authorized, is funded through AID, military assistance program and Peace Corps appropriations. Cultural exchange evaluation will be funded in 1972 through the Mutual Educational and Cultural Exchange Act of 1961 budget. AID evaluations are funded through program and project authorizations.

11. *Availability to Congress.*—"Could be made available upon request." However, "internal working papers" could be withheld under executive privilege if it is felt that it is information incompatible to the security of the United States as defined by the President. The IGA reports are now available upon request.

12. *Innovations.*—PARA system, to integrate decisionmaking with resource allocation—no alteration, nevertheless, to output or cost-effectiveness.

13. *Date of reply.*—October 7, 1971.

Department of the Treasury

1. *Number of domestic programs.*—5 listed by OMB.
2. *General description.*—OMB currently reviewing the appropriateness of listing these Treasury programs, as they are of a service nature, provided to a "narrow group of service customers."
3. *Definition of goals and objectives.*—Focus in Treasury Department measurement is on both productivity and mission performance. However, definition of outputs varies in extent from agency to agency. In general, however, most Department activities have defined goals and objectives.
4. *Technique of evaluation.*—The Treasury Department employs some 30 different measurement systems. These 30 systems fall in the following four categories: Type A, manpower planning measures—to forecast labor requirements; Type B, unit cost measure—ratio of work units produced to production cost; Type C, work measure—comparison of units produced by a work center and some performance standard; Type D, productivity index—final output of an organization divided by total inputs.
5. *Organization.*—Nothing clear is stated. However, there are several implications which seem to indicate that the Department evaluation function is decentralized, with each individual agency directing the scope and intensity of the function within itself.
6. *State-local evaluation.*—No information provided.
7. *OMB role.*—No indication of the extent of involvement, though from the reply it is obvious that they are concerned. A joint study with GAO of Federal measurement systems was the catalyst which produced a compilation and overall evaluation of Department measurement systems.
8. *GAO role.*—No indication aside from the joint study mentioned above.
9. *In-house versus contracts.*—Nothing explicit, though as no mention was made of contract studies, and as Department evaluation is generally extensive, contract evaluation is probably limited if not nonexistent.
10. *Funding.*—No information provided.
11. *Availability to Congress.*—No information provided.
12. *Innovations.*—"* * * today's search for better measurement focuses on individual and organizational efficiency, and also on mission accomplishment."
13. *Date of reply.*—August 13, 1971.

Department of Defense

1. *Number of domestic programs.*—DOD administers 40 OMB programs.
2. *General description.*—A decentralized evaluation system, in which the degree to which goals are defined and output measured in cost-effectiveness terms varies.
3. *Definition of goals and objectives.*—Some programs are operated with regard to specific goals and objectives; no mention, however, was made of output goals, though output measurement has been integrated into PPBS.
4. *Technique of evaluation.*—DOD employs an extensive PPBS, composed of 62 measurement systems; however, there has been no

implementation of an overall productivity measurement system, though cost-effectiveness and cost-benefit studies are done relative to resource allocation. Also, DOD had devised an input/output measurement system as a way of measuring cost-effectiveness, though this system is not applied to intelligence, to health and environment programs, or with respect to the Defense contract audit agency.

5. *Organization.*—Program evaluation is decentralized. The Office of the Secretary of Defense: Assistant Secretary (Systems Analysis)—100 analysts; Assistant Secretary (Comptroller)—five senior analysts for data systems and 40 analysts who review the budget and deal with OMB; Assistant Secretary (Administration)—nine analysts on intelligence programs; Assistant Secretary (Installations and Logistics)—one officer coordinating the review of the Logistics Performance Measurement and Evaluation System reports; Defense Productivity Measurement Office (DPMO)—no specified numbers.

Army.—No specific program evaluation staff. *Navy*—no specified number, though the Office of the Chief of Naval Operations has programing and budgetary personnel; also, the Office of Program Appraisal maintains a small staff. *Air Force*—highly decentralized approach; no specific evaluation staff, though cost-effectiveness studies are performed by the Office of the Assistant Chief of Staff Studies and Analysis and by the Cost and Economic Analysis Division of the Office of the Comptroller of the Air Force.

Agencies.—(1) Defense Contract Audit Agency—no evaluation staff. (2) Intelligence Agency—no evaluation staff. (3) National Security Agency—Office of Assistant Director for Resource Management responsible for evaluation, no number. (2) Nuclear Agency—no staff. (5) Communications—Comptroller of the Defense communications agency coordinates evaluation. Thus, generally program staffs perform basic evaluation, though, with PPBS and program memorandum systems, this information is reviewed higher up.

6. *State-local evaluation.*—No mention made.

7. *OMB role.*—OMB reviews budget in cooperation with DOD staff analysts, but also maintains an independent approach; occasionally performs program evaluations.

8. *GAO role.*—Usually limited to fiscal analysis and rarely deal with performance or with cost effectiveness or cost benefit, now developing a program evaluation capability; does evaluate programs under the Logistic Performance Measurement and Evaluation System; since January 1, 1971, GAO has issued more than 100 evaluative reports on Navy programs; limits intelligence evaluation to manpower utilization and language training studies; maintains resident audit at National Security Agency.

9. *In-house versus contracts.*—Unable to determine the extent of contracting for evaluation; the preponderance of on-going evaluation in-house.

10. *Funding.*—Funds are not appropriated specifically for evaluation, either for staffs or for programs, in DOD budget.

11. *Availability to Congress.*—Available through the submission of acquisition reports, through GAO studies, Congressional hearings or by request. These requests would be handled on a case-by-case basis, due to classification.

12. *Innovations.*—New data bases and cross program methodologies planned for intelligence; revision of logistics performance measurement and evaluation system, including goal review and upgrading of performance objectives; input/output measures are in early stages of

development and further refinement is planned; several areas of innovation within the military departments are currently being pursued.

13. *Date of reply.*—September 17, 1971.

Department of Interior

1. *Number of domestic programs.*—89 programs listed by OMB.
2. *General description.*—No information provided.
3. *Definition of goals and objectives.*—No information provided.
4. *Technique of evaluation.*—No information provided.
5. *Organization.*—Office of Assistant Secretary for Program Policy provides "evaluation-type studies," "economic analyses" of programs on "natural and environmental resource issues," and advice and coordination of "planning, program development, and review function." Office of Survey and Review provides "top level review and analysis in the area of financial management and in other management" areas in departmentwide activities. Apparently program Assistant Secretaries and bureau heads still have a role.
6. *State-local evaluation.*—No information provided.
7. *OMB role.*—No information provided.
8. *GAO role.*—No information provided.
9. *In-house versus contracts.*—No information provided.
10. *Funding.*—No information provided.
11. *Availability to Congress.*—No information provided.
12. *Innovations.*—Office of Assistant Secretary for Program Policy.
13. *Date of reply.*—September 21, 1971.

Department of Agriculture

1. *Number of domestic programs.*—85 OMB programs.
2. *General description.*—Revision of program structure based on OMB-McKinsey study in process. PPBS installed in some States and urban governments using DoA programs, in addition to which State agricultural experiment stations are funded for evaluations.
3. *Definition of goals and objectives.*—All Department programs have been defined in terms of objectives and outputs.
2. *Technique of evaluation.*—Output measures are used extensively, in addition to studies of impact on target groups and, where possible, "ultimate results" are studied. Expenditure and output data are evaluated in all areas listed in questionnaire. Where Department of Agriculture feels output measures impractical, systems capability measures, based on level-of-effort measurement, are employed. Ultimate result studies are used in connection with special studies.
5. *Organization.*—Office of Planning and Evaluation coordinates evaluation—15 full-time staff. Each agency required to have competent staff to analyze effectiveness of programs. For the 10 agencies, 28 full-time; smaller agencies have a total professional staff effort of 8.4 man-years. The Economic Research Service, under the Director of Agricultural Economics, contributes to program evaluation. In addition, project research under each program is conducted, based on cost/benefit ratios, etc., by the project staff.
6. *State-local evaluation.*—PPBS in some States and large urban governments using DoA programs, yet Agriculture has no information on extent of evaluation. State experiment stations do evaluation, most financed by States themselves. State extension also evaluated, funded by Federal, State, and local funds. *No program funds from*

Department of Agriculture are appropriated or authorized for State or local level evaluation.

7. *OMB role.*—Annually request special studies, or data on specific programs. Role has been limited, advisory rather than directive or critical, and Agriculture has received little feedback from studies conducted and submitted to OMB. Some improvement in the last year. No OMB studies independent of Department.

8. *GAO role.*—GAO reviews audit oriented rather than cost/benefit or goal- and objective-oriented evaluation. Specific areas of program abuse have been investigated.

9. *In-house versus contracts.*—Limited use of contracted evaluation, variable among agencies.

10. *Funding.*—Analytic staff is funded by appropriations from the Office of the Secretary. Agency staffs are funded by appropriations for agency administrative expenses.

11. *Availability to Congress.*—Availability and extent of executive privilege blanket determined by OMB guidelines. Distribution of evaluative information outside of executive has been "extremely limited."

12. *Innovations.*—Principal innovation is the revision of DoA's program planning and budgeting structure according to McKinsey recommendation. Also, Soil Conservation Service, Commodity Exchange Authority, and the Forest Service are making important evaluation innovations.

13. *Date of reply.*—September 8, 1971.

Department of Commerce

1. *Number of domestic programs.*—59.

2. *General description.*—Science and technology area a 1970 McKinsey pilot project.

3. *Definition of goals and objectives.*—All activities defined in terms of "building blocks" (281) related to agency objectives for 1973 budget.

4. *Technique of evaluation.*—A formal system of evaluation covering the department, which evaluates expenditure and output data. Over 40 in-depth studies are in process. All activities were being defined in terms of building block programs, related to agency objectives, for 1973 budget. An apparent effort to define output goals and more ultimate measures of effectiveness.

5. *Organization.*—Tied to budget and performed at all levels. Office of Budget and Program Analysis, with separate evaluation unit, monitors in-depth studies and conducts special studies for the Secretary. Office of Audits also a part of evaluation process. 20 of 147 evaluation personnel and 24 of 213 budget personnel at department level.

6. *State-local evaluation.*—Planning staffs, with evaluation functions (in-house and contractual) authorized and funded for economic Development Administration districts, Indian tribes, and regional action planning commissions.

7. *OMB role.*—One or two independent in-depth studies each year; selected issue studies in cooperation with agency.

8. *GAO role.*—1970–71, 11 reports and 6 letters—regular evaluations.

9. *In-house versus contracts.*—Most in-house—some contracting, by Economic Development Administration and regional action planning commissions during fiscal year 1970–71.

10. *Funding.*—General administration appropriation.
11. *Availability to Congress.*—Usually available to Congressional Committees. Much done as part of budget, must be cleared by OMB according to Circular A–10. Usually permitted to be released after budget presented.
12. *Innovations.*—Program structure and objectives being refincd; more use of Census and inventory-type data.
13. *Date of reply.*—August 10, 1971.

Department of Labor

1. *Number of domestic programs.*—45 OMB programs.
2. *General description.*—Manpower Administration was a 1970 McKinsey pilot project.
3. *Definition of goals and objectives.*—For most activities these are defined.
4. *Technique of evaluation.*—Formal evaluation with full time staff in minimum wage enforcement and manpower. Informal and periodic for smaller programs. Measures of output and to some extent ultimate effectiveness.
5. *Organization.*—Centralized in Office of Programs Review and Audit and Office of Evaluation. Trying to provide top managerial decisionmaking needs.
6. *State-local evaluation.*—No mention.
7. *OMB role.*—From time to time requests studies in specific areas; results of evaluative studies used in OMB reviews.
8. *GAO role.*—Conducted evaluations of poverty programs and job bank activities.
9. *In-house versus contracts.*—Mostly done through contracts.
10. *Funding.*—Evaluation at program level from administrative expenses, at departmental level from appropriation to Office of Secretary. 1971—$700,000 for staff support and $4,600,000 for contracts in evaluation of manpower programs.
11. *Availability to Congress.*—Evaluative material available to Congress on request.
12. *Innovations.*—Attempting to identify top managements and bring results of evaluation to their attention.
13. *Date of reply.*—October 4, 1971.

Department of Health, Education, and Welfare

1. *Number of domestic programs.*—OMB programs, 302.
2. *General description.*—States that emphasis of program is on short-term performance; thus, objectives are operationally short term. General disenchantment with output measures in favor of measures of ultimate effectiveness.
3. *Definition of goals and objectives.*—Variability as to definition of programs by objectives. Cites social security program as one "not conducive to setting measurable objectives." Apparently a distinction between "broad goals" and measurable objectives. Many programs also have multiple objectives.
4. *Technique of evaluation.*—Broad program planning system, entailing a hierarchical classification system which enables a statement of broad agency goals, beneath which each program is listed and defined as to impact, funding, and measurement of activity-outputs.

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No determination of the number of programs operated in terms of output measures has been made—cites "poor quality" of their output measures as reason.

5. *Organization.*—Management of evaluation resides in the Office of the Assistant Secretary for Planning and Evaluation (ASPE). Guidelines set by ASPE agencies develop evaluation objectives, subject to ASPE approval. Staff—ASPE—6; Office of Education—44; Social and Rehabilitation Service—15; Health Services and Mental Health Administration—16; National Institute of Health—30; Food and Drug Administration—5; Office of Child Development—6. Prior to this year, there was little regional formal evaluation; this year, ASPE received proposals for evaluation studies for fiscal year 1972.

6. *State-local evaluation.*—No mention.

7. *OMB role.*—Not a central role in HEW evaluation. They do their own analysis of selected programs and in the past have asked HEW to address specific problems.

8. *GAO role.*—Very limited in scope, usually involved in evaluation only at the request of members of Congress. In answer to these requests, GAO generally will contract out for such an evaluation.

9. *In-house versus contracts.*—Most evaluations are performed by contract/grant—fiscal year 1970 evaluation funds:

Type of organization:	*Percent of evaluation dollars*
Profit	45
Nonprofit	29
University	21
Government agencies	4
Independent consultants	1

Also, HEW plans to have OEO evaluate certain HEW programs, in addition to joint evaluations in related program areas with other departments.

10. *Funding.*—One percent of program funds authorized by Congress for evaluation of health programs, and several of the Social and Rehabilitation Service. Office of Education program evaluation authorized by Congress in specific amounts for each program. All other areas are funded through salaries and expense funds and research funds. Fiscal year 1971 evaluation fund allotment: 50 percent to directors of program to judge efficiency and effectiveness, 25 percent to offices of planning and evaluation at agency level, and 25 percent to Office of the Secretary for broad overview.

11. *Availability to Congress.*—No executive privilege cover, all available by request.

12. *Innovations.*—(*a*) Planned integration of evaluation with overall planning, (*b*) more rigorous evaluation plan guidance, (*c*) making sure evaluation studies are used in planning, and (*d*) plans to reinforce staff, quantity, and quality.

13. *Date of reply.*—October 18, 1971.

Department of Housing and Urban Development

1. *Number of domestic programs.*—OMB programs, 70.

2. *General description.*—"Broad concept of evaluation" which varies with the needs of the program. New programs are not evaluated until a reasonable volume of cases or projects completed.

3. *Definition of goals and objectives.*—Easier to quantify in housing production areas.

4. *Technique of evaluation.*—Appears as though cost effectiveness only clearly applied to housing production activities. Characteristics of families living in units considered. "Pragmatic" scrutiny in terms of timing, costs, and effectiveness.

5. *Organization.*—An Office of Program Evaluation reporting to the Deputy Under Secretary for Policy Analysis and Program Evaluation at the center. Each assistant secretary has 6–10 evaluation staff and each regional administrator 1–2. Office of Audit provides specific project evaluation assistance. Evaluation takes place at all levels.

6. *State-local evaluation.*—Model city, supplemental grant funds designate a minimum of 3 percent for evaluation by cities, which is reviewed by HUD staff. Most other community development programs do not have these arrangements.

7. *OMB role.*—No mention.

8. *GAO role.*—"Relatively active," but HUD may not be aware of all GAO surveys.

9. *In-house versus contracts.*—Most (about three-fourths) in-house, but some (about one-fourth) contracted. Six contracts/grants for 1971.

10. *Funding.*—Staff evaluation from Secretary's administrative funds; contract studies from administrative or research and technology appropriation. Model cities—earmarked part of supplemental grants funds for contract evaluations: 1970, $3,178,000; 1971, $13,264,000; 1972 $7,700,000 spent on technical assistance and evaluation contracts for model cities. More of this for technical assistance than for evaluation.

11. *Availability to Congress.*—Formal reports "are often" available and "some" contract studies "could be." Much evaluation is informal and thus not really suitable for release.

12. *Innovations.*—An integrated program management system.

13. *Date of reply.*—September 20, 1970.

Department of Transportation

DEPARTMENT WIDE

1. *Number of domestic programs.*—OMB programs, 24.

2. *General description.*—A "flexible" system to allow for wide differences among DOT's programs.

3. *Definition of goals and objectives.*—See individual agencies listed below.

4. *Technique of evaluation.*—See individual agencies listed below.

5. *Organization.*—Seems to be basically organized by constituent agencies. Deputy Under Secretary, centralized internal audit staff, and other staff offices of Secretary conduct departmentwide evaluation.

6. *State-local evaluation.*—See individual agencies listed below.

7. *OMB role.*—See individual agencies listed below.

8. *GAO role.*—See individual agencies listed below.

9. *In-house versus contracts.*—See individual agencies listed below.

10. *Funding.*—See individual agencies listed below.

11. *Availability to Congress.*—See individual agencies listed below.
12. *Innovations.*—"Currently examining . . . planning and evaluation capabilities."
13. *Date of reply.*—September 17, 1971.

FEDERAL AVIATION ADMINISTRATION

1. *Number of domestic programs.*—OMB programs, 4.
2. *General description.*—At time of response were developing a more integrated evaluation system which would monitor programs in output terms. Had an extensive formal and informal system of evaluation.
3. *Definition of goals and objectives.*—All programs defined in terms of objectives conducive to measurement and evaluation of effectiveness. These definitions being revised and strengthened.
4. *Technique of evaluation.*—"All programs" are "evaluated and appraised" but not monitored formally through output measures. Each of five services are an evaluation unit.
5. *Organization.*—Office of Appraisal, reporting to Administrator, is developing an integrated formal system for the agency. All levels take part in evaluation and appraisal, the former being more oriented to the needs of the operating level the latter to higher levels of management. Five different units of evaluation for each service provided. Office of Budget "oriented to respond to program activity as well as appropriation execution * * *."
6. *State-local evaluation.*—No programs for State and local evaluation.
7. *OMB role.*—Evaluates through budget submission and 10 subject matter areas earmarked for analysis.
8. *GAO role.*—Six recent studies discussed.
9. *In-house versus contracts.*—Do use contracted studies.
10. *Funding.*—At agency level, funds come from appropriation for "Director, staff, and supporting services"; program evaluation funded from program money.
11. *Availability to Congress.*—Unclear whether evaluative materials not brought into "legislative and appropriation processes" would be available.
12. *Innovations.*—"The Office of Appraisal has an appraisal and evaluation system order under development that will integrate the total formal evaluative efforts of the agency."

COAST GUARD

1. *Number of domestic programs.*—OMB programs, 2.
2. *General description.*—A PPB system which appears to define outputs and more ultimate objectives. Programs monitored in terms of cost-effectiveness and cost-benefits.
3. *Definition of goals and objectives.*—Output and benefit defined and measured.
4. *Technique of evaluation.*—PPB system which defines outputs and benefits and measures cost-effectiveness.
5. *Organization.*—About 50 positions in planning and programing. "Primary responsibility" with program managers and directors for reporting, but evaluation in Chief of Staff's office. The Plans Evaluation Division (13 persons), Programs Division (15 persons),

and PPB staff in the Chief of Staff's office. Each Coast Guard district employs a planning officer to evaluate programs.

6. *State-local evaluation.*—No State or locally administered programs.

7. *OMB role.*—After-the-fact appraisal. Little in cooperation with Coast Guard. Reviews budget document "independently," but mainly on basis of data supplied by Coast Guard.

8. *GAO role.*—Narrow, specific, and largely procedural, but extensive. May 1969—April 1971 describes seven studies.

9. *In-house versus contracts.*—About half contracted, 7–9 per year. Combination of two modes have led to a major evaluative study of each Coast Guard program in recent years.

10. *Funding.*—Central staff funded out of operating expense, and evaluation studies from Chief of Staff's contingency fund.

11. *Availability to Congress.*—Very little covered by executive privilege. Some apparently must be cleared by OMB.

12. *Innovations.*—Followup on accuracy of prior year's forecasts, improvement of data bank, and simplified "Delphi" techniques.

FEDERAL HIGHWAY ADMINISTRATION

1. *Number of domestic programs.*—OMB programs, 9,

2. *General description.*—Although no longer have a formal PPB system, attempts to appraise all programs in terms of output and measures of ultimate effectiveness.

3. *Definition of goals and objectives.*—Activities generally defined in terms of goals such as efficiency, safety, and environmental effects.

4. *Technique of evaluation.*—Claim to operate and monitor, "to the extent practical," all programs in terms of output and effectiveness measures, although no longer have a PPB system. Expenditures analyzed too.

5. *Organization.*—Office of Program and Policy Planning and Office of Program Review and Investigations have "small staffs" which occasionally use personnel from elsewhere. Emphasis appears to be on "participating program staff."

6. *State-local evaluation.*—Until 1970 no comprehensive effort to improve evaluation of individual projects and data reporting rather than comprehensive evaluation. 1970 Highway Act authorized National Highway Institute to train State and local employees.

7. *OMB role.*—Issues agency guidelines for evaluation and reviews results.

8. *GAO role.*—Continuous—nine studies in first two quarters of fiscal year 1972.

9. *In-house versus contracts.*—Most performed by participating program staff, but some by contract.

10. *Funding.*—Administrative funds.

11. *Availability to Congress.*—"Generally administratively restricted" but could "probably" be made available with OMB approval.

12. *Innovations.*—Feels current methods are adequate.

NATIONAL TRANSPORTATION SAFETY BOARD

1. *Number of domestic programs.*—No OMB programs.

2. *General description.*—Appears to possess an evaluation system which at least makes use of workload measures of output on a regular basis.

3. *Definition of goals and objectives.*—Seem to have defined goals and related workload measures to them.

4. *Technique of evaluation.*—Status of workload items monitored "regularly, in periodic and many impromptu meetings." Cost effectiveness/benefit analysis on a formal basis may be new. Mention use of "tracking" impact of recommendations.

5. *Organization.*—Little separate independent evaluation staff. Program managers, General Manager's staff, and one program review office take part.

6. *State-local evaluation.*—No information provided.

7. *OMB role.*—Does not describe any particular involvement. Mentions informal contracts, budget review, and distribution of papers and documents.

8. *GAO role.*—A number of reviews. Most recent aimed at determining how the Board determines allocation of resources and evaluates effectiveness of recommendations.

9. *In-house versus contracts.*—All in-house.

10. *Funding.*—General administrative appropriations.

11. *Availability to Congress.*—Both evaluative and fiscal data available.

12. *Innovations.*—Developing an expanded evaluation apparatus.

URBAN MASS TRANSPORTATION ADMINISTRATION

1. *Number of domestic programs.*—Six OMB programs.

2. *General description.*—A decentralized system with only limited use of cost effectiveness/benefit studies.

3. *Definition of goals and objectives.*—Definition of programs in terms of output goals difficult in most cases.

4. *Technique of evaluation.*—Expenditure and output evaluated in terms of cost effectiveness/benefit limited to individual research and development projects.

5. *Organization.*—Evaluation is inseparable part of a program manager's responsibility. A new Program Evaluation Division in Office of Program Planning (six professionals) and Systems Analysis Division of R. & D. staff (six professionals) involved in agencywide evaluation.

6. *State-local evaluation.*—Planning assistance funds available.

7. *OMB role.*—Not aware of any OMB participation.

8. *GAO role.*—No evaluation studies—concerned mainly with "criteria for implementing statutory requirements."

9. *In-house versus contracts.*—Some contracts for experimental designs and development of evaluation methodology.

10. *Funding.*—All personnel from S. & E. appropriation; contracts for development of experimental designs from R. & D. program funds; and evaluation studies as part of planning process technical studies program funds.

11. *Availability to Congress.*—Any evaluation data available to Congress and public.

12. *Innovations.*—New Program Evaluation Division; further development of quantitative measurement; and a data collection program which will involve greater State-local participation.

ST. LAWRENCE SEAWAY DEVELOPMENT CORPORATION

1. *Number of domestic programs.*—None.
2. *General description.*—A management information system which produces current information on a biweekly basis for evaluative as well as other purposes.
3. *Definition of goals and objectives.*—One of the purposes of the management information system is the definition of objectives.
4. *Technique of evaluation.*—States that management information system allows the "measurement of the costs and benefits of ongoing and proposed programs."
5. *Organization.*—Centrally organized in Office of Program Control. Performed by independent staff and "participating supervisory personnel in the Office of Operations and Maintenance."
6. *State-local evaluation.*—No information provided.
7. *OMB role.*—Budget review.
8. *GAO role.*—Yearly, commercial-type audit.
9. *In-house versus contracts.*—No contracts.
10. *Funding.*—Salary and expense appropriations.
11. *Availability to Congress.*—No real answer—seems as though DOT and OMB would decide.
12. *Innovations.*—None.

NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

1. *Number of domestic programs.*—One OMB program—involved with Federal Highway Administration in highway safety and development programs.
2. *General description.*—Activities directly administered by States on the whole. Requirement of multiyear State Comprehensive Highway Safety Plan and Annual Highway State Work Program encourage development of evaluation procedures. Three demonstration projects too, which are evaluated.
3. *Definition of goals and objectives.*—Plans encourage definition of objectives. Three demonstration programs have "essential program objectives" identified.
4. *Technique of evaluation.*—Three demonstration programs subject to evaluation by "system analysis techniques." An "evaluation monitoring system" under development.
5. *Organization.*—Evaluation at all levels. Impression given that independent, central capability only now being developed. Central staff is Associate Administrator for Planning and Programming who heads three offices: systems analysis, program planning, and program evaluation. Twenty professional and five clerical personnel on total planning, analysis, programming, and evaluation staff.
6. *State-local evaluation.*—Evaluation an integral part of State and local activity. Funding specifically provided.
7. *OMB role.*—Annual budget review and special studies of specific issues requested.
8. *GAO role.*—Limited. Some reviews of contracts and procurements. Currently conducting in-depth review of motor vehicle programs.

9. *In-house versus contracts.*—Some contracting, but hope to do more in-house. New demonstration programs done in-house.

10. *Funding.*—No specific funding—from regular administration portion of salary and expense appropriation.

11. *Availability to Congress.*—Does not really answer—much regularly provided.

12. *Innovations.*—Evaluation monitoring system; management information system; and planning and control system.

FEDERAL RAILROAD ADMINISTRATION

1. *Number of domestic programs.*—Two OMB programs.

2. *General description.*—Presently "no overall formal program review or program evaluation of ongoing or completed projects." Two areas are organized around PPB procedures.

3. *Defintion of goals and objectives.*—Activities funded from Railroad Research appropriation and Office of High Speed Ground appropriation are defined in terms of output, and to a lesser extent ultimate effectiveness. Other areas are not formally so defined.

4. *Technique of evaluation.*—Cost effectiveness study being developed primarily for planning new projects—will cover 85 percent of activity. Hope that this system will record output and be a basis for evaluation. Staff is sufficient to go into depth only in specific cases.

5. *Organization.*—Program Planning Division in Office of Administrator has only four professionals, thus "bulk of whatever limited data reporting and evaluation" is handled by program staffs.

6. *State-local evaluation.*—No State or local programs.

7. *OMB role.*—"Normal budget review."

8. *GAO role.*—"Limited scope."

9. *In-house versus contracts.*—"Several" in past.

10. *Funding.*—Office of Administrator, salaries and expenses, and program appropriations.

11. *Availability to Congress.*—Most would be public.

12. *Innovations.*—"Basic," "modest" plans. Project planning system being developed.

Department of Justice

1. *Number of domestic programs.*—31 listed by OMB.

2. *General description.*—Agency reply was not specific to questions asked; supporting material, though helpful, was limited in scope.

3. *Definition of goals and objectives.*—Extent to which goals are defined varies among agencies, with the Bureau of Narcotics and Dangerous Drugs good, and practically nonexistent in the Bureau of Prisons.

4. *Technique of evaluation.*—Department has defined four broad categories of measurement systems: "overall productivity indexes"—final outputs divided by physical inputs; "work measures"—physical work units compared to a performance standard; "unit cost measures"—relates physical work units to costs; "manpower planning measures"—method of forecasting manpower requirements. The degree to which any or all of these measures are employed varies among agencies.

5. *Organization.*—Appears to be somewhat decentralized, with functional evaluation being performed by agencies.

6. *State-local evaluation.*—No information provided.
7. *OMB role.*—No information provided, other than the mention of the joint OMB, GAO, CSC project, requiring study of evaluation techniques.
8. *GAO role.*—No information provided, other than the mention of the joint OMB, GAO, CSC project, requiring study of evaluation techniques.
9. *In-house versus contracts.*—No information provided.
10. *Funding.*—No information provided.
11. *Availability to Congress.*—"The question as to how much evaluative information is covered by executive privilege would of necessity be considered on an ad hoc basis."
12. *Innovations.*—"With respect to projected innovations in the area of program evaluation, the Department of Justice constantly seeks better ways of performing that function." Several substantive innovations were mentioned.
13. *Date of reply.*—February 29, 1972.

X. Reports on Responses of Independent Agencies

The Appalachian Regional Commission

1. *Number of domestic programs.*—11 listed by OMB.
2. *General description.*—No agency collects data for the Appalachian Region, thus making program evaluation difficult, though in theory it could be performed.
3. *Definition of goals and objectives.*—Though the Commission has an evaluation staff responsible for definition of productivity goals, this staff "* * * has encountered serious practical obstacles to this approach."
4. *Technique of evaluation.*—The agency has been unable, due to the limitations in data and in suitable methodologies, to make substantial use of sophisticated evaluation techniques such as cost-effectiveness measurement.
5. *Organization.*—The Division of Regional Program Planning and Evaluation, composed of three professionals, is responsible for central evaluation, supplemented by program staff where necessary. Additionally, in several program areas, operational staff are developing evaluation programs, and in several member States an evaluation capability is being developed.
6. *State-local evaluation.*—Nothing mentioned.
7. *OMB role.*—"The OMB has not been directly involved in any formal evaluation of Commission programs."
8. *GAO role.*—Response mentions only that the GAO has conducted one evaluation report, submitted to Congress in May 1971.
9. *In-house versus contracts.*—The Commission uses its own staff where possible; total cost for consultant services has been $135,000 so far.
10. *Funding.*—Staff has been funded by the Federal-State trust fund, and research and demonstration appropriations.
11. *Availability to Congress.*—All final evaluation reports as well as supporting research papers will be published.
12. *Innovations.*—None.
13. *Date of reply.*—August 18, 1971.

Atomic Energy Commission

1. *Number of domestic programs.*—31 listed by OMB.

2. *General description.*— In general, AEC evaluation appears to be extensive and practicable. However, the central staff for analysis, composed of seven professionals, must be hard put to review 31 programs.

3. *Definition of goals and objectives.*—Outputs are readily defined in all manufacturing programs, to a lesser extent in research and development activities, and not at all in basic research activities. For those research activities that are not conducive to output definition, other indicators (for example, man-years) are employed.

4. *Technique of evaluation.*—AEC employs a PPBS, under which all programs undergo evaluation of their costs and output. Alternative strategies are also considered.

5. *Organization.*—At the center, the Division of Program Analysis employs seven professionals. This Division conducts special studies and selective analysis. Studies of programs are generally performed by program analysis staffs, which vary in size from one to eight professionals. These studies are in turn reviewed by the Division of Program Analysis.

6. *State-local evaluation.*—None.

7. *OMB role.*—Evaluation has generally been done independently of AEC staff, though cooperation in special study requests has generally occurred.

8. *GAO role.*—As an example of GAO activity, three evaluation studies were reported to Congress from July 1, 1971 to August 15, 1971.

9. *In-house versus contracts.*—Contracting for evaluation studies has been extensive in several program areas; AEC's Division of Reactor Development and Technology has contracted out $400,000 per year in fiscal year 1969 through fiscal year 1971. Union Carbide Corp. maintains a permanent staff to perform cost-benefit analysis in two AEC plants. Several other private firms are also engaged by AEC.

10. *Funding.*—No separate identification of the evaluation staff is made in budgetary requests, though funds are included under program direction and administration.

11. *Availability to Congress.*—Evaluation information is provided to the Joint Committee on Atomic Energy. Executive privilege will be invoked only by the President on a case-by-case basis.

12. *Innovations.*—None.

13. *Date of reply.*—August 19, 1971.

United States Civil Service Commission

1. *Number of domestic programs.*—Nine listed in OMB 1971 catalog.

2. *General description.*—Apparently the Civil Service Commission misunderstood our questionnaire. They state that their programs are not typical of the grants and assistance programs listed by OMB, and thus, they do not lend themselves to the specific questions of our letter. However, why such programs as 27.003; Federal Employment

for Disadvantaged Youth, 27.004; Federal Employment for Disadvantaged Youth, Summer, 27.005; Federal Employment for the Handicapped, etc., do not lend themselves to questions concerning evaluation is not explained, except that these are "ongoing programs."

3. *Definition of goals and objectives.*—No information provided.

4. *Technique of evaluation.*—No information provided.

5. *Organization.*—Bureau of Personnel Management Evaluation review overall program administrations.

6. *State-Local evaluation.*—No information provided.

7. *OMB role.*—No information provided.

8. *GAO role.*—No information provided.

9. *In-house versus contracts.*—No information provided.

10. *Funding.*—No information provided.

11. *Availability to Congress.*—No information provided.

12. *Innovations.*—No information provided.

13. *Date of reply.*—September 24, 1971.

District of Columbia Redevelopment Land Agency

1. *Number of domestic programs.*—Agency administers no OMB listed programs.

2. *General description.*—The Agency is responsible for District of Columbia urban renewal activity. Its programs and staff are financed from HUD.

3. *Definition of goals and objectives.*—Agency is "production-oriented" and thus almost all activity is operated and monitored in terms of output measures. Both short and long-range objectives are defined.

4. *Technique of evaluation.*—The Agency employs status reporting, impact studies and, as mentioned, extensive output measurement.

5. *Organization.*—Evaluation centralized in the Office of Management and Evaluation, with projected staff in the Evaluation Division of four professionals.

6. *State-local evaluation.*—Not applicable.

7. *OMB role.*—Fairly involved, with frequent contact concerning production goals, etc.

8. *GAO role.*—None to date.

9. *In-house versus contracts.*—Several have been done, though when Evaluation Division is fully staffed, most evaluation will be in house.

10. *Funding.*—Evaluation Division funded from administrative budget, with specific positions identified in requests.

11. *Availability to Congress.*—Could be made available upon request.

12. *Innovations.*—Not as yet.

13. *Date of reply.*—August 13, 1971.

Environmental Protection Agency

1. *Number of domestic programs.*—27 listed by OMB.

2. *General description.*—EPA only recently established, and several of the programs now under its control had no evaluation capability. Currently they are determining their need, with a planned specific unit to be shortly created.

3. *Definition of goals and objectives.*—Still under analysis.

4. *Technique of evaluation.*—EPA has recently developed a cost-effectiveness system, and generally employs experimental testing of alternative strategies.

5. *Organization.*—Assistant Administrator for Planning and Management is central element responsible for evaluation. In addition, each major program will have its own capability. Each regional office, managing State and local programs, has an evaluation capability.

6. *State-local evaluation.*—Nothing mentioned.

7. *OMB role.*—OMB has worked closely with EPA in evaluating programs.

8. *GAO role.*—GAO, in addition to close audit involvement, has completed numerous reviews of EPA programs.

9. *In-house versus contracts.*—None to date.

10. *Funding.*—Funds specifically designated for program evaluation.

11. *Availability to Congress.*—Has been available in past and presumably will continue to be.

12. *Innovations.*—Now developing evaluation techniques that will consider interprogram issues.

13. *Date of reply.*—August 18, 1971.

Equal Employment Opportunity Commission

1. *Number of domestic programs.*—Three listed by OMB.

2. *General description.*—The Commission just recently established a Commission-wide capability for program evaluation, and thus fiscal year 1972 will see the first results from this capability.

3. *Definition of goals and objectives.*—The Commission is now in the process of defining productivity goals for all programs.

4. *Technique of evaluation.*—Program expenditure and output data, evaluated on the basis of cost-benefit and cost-effectiveness measurement systems, are extensively collected.

5. *Organization.*—Office of Program Planning and Evaluation, with nine positions; there is currently no program staff evaluation.

6. *State-local evaluation.*—"* * * some States do evaluate their own programs. * * *" However, effective July 1, 1972 no State or local agency will receive funds from EEOC, "* * * unless it has prepared a long-term plan to maximize the impact of the funds it receives from EEOC."

7. *OMB role.*—OMB has been involved primarily in evaluation of the employment survey programs.

8. *GAO role.*—No record of any particular EEOC program evaluation.

9. *In-house versus contracts.*—Currently a total of 10 contracted research studies (none of which involve Commissionwide programs) and four more are planned for fiscal year 1972.

10. *Funding.*—Funds appropriated under administration expenses, and will be "specifically designated for program evaluation." Evaluation at the headquarters or regional level will be funded from program activity authorizations.

11. *Availability to Congress.*—Most information will be available upon request.

12. *Innovations.*—As mentioned above, the Commission has embarked upon on extensive planning and program evaluation, including cost/benefit and output/input studies.

13. *Date of reply.*—October 18, 1972.

Farm Credit Administration

1. *Number of domestic programs.*—None listed by OMB.
2. *General description.*—No domestic programs, and "accordingly, we have no related evaluation function to perform."
3. *Definition of goals and objectives.*—No information provided.
4. *Technique of evaluation.*—No information provided.
5. *Organization.*—No information provided.
6. *State-local evaluation.*—No information provided.
7. *OMB role.*—No information provided.
8. *GAO role.*—No information provided.
9. *In-house versus contracts.*—No information provided.
10. *Funding.*—No information provided.
11. *Availability to Congress.*—No information provided.
12. *Innovations.*—No information provided.
13. *Date of reply.*—August 30, 1971.

Federal Power Commission

1. *Number of domestic programs.*—Three listed by OMB.
2. *General description.*—The Commission feels that, due to the nature of the programs, involved economic analysis, specifically output and objectives definition and evaluation, is not practical.
3. *Definition of goals and objectives.*—"Many of the Commission's activities are not defined in terms of objectives and outputs which can be readily measured and evaluated as to their effectiveness."
4. *Technique of evaluation.*—Except for a general cost/benefit analysis performed for the Wholesale Natural Gas Service (35.003), expenditure and output data are not evaluated in terms of productivity, cost-effectiveness or alternative approaches.
5. *Organization.*—The little evaluation that is done is performed on a highly decentralized basis within each program by participating program staff.
6. *State-local evaluation.*—None.
7. *OMB role.*—Involvement limited in all three programs to limited budget review, in conjunction with program staff.
8. *GAO role.*—None.
9. *In-house versus contracts.*—None.
10. *Funding.*—While no funds are specifically authorized for evaluation, this function is financed through general staff funds.
11. *Availability to Congress.*—Availability varies for each program with "pertinent information" unrestricted from water resources (35.001) and natural gas (35.003); from electric power (35.002), however, "the nature of the program is not such that evaluative information is available for use in considering authorization on funding levels."
12. *Innovations.*—None, except a program to train regional inspection personnel for water resources.
13. *Date of reply.*—September 23, 1971.

General Services Administration

1. *Number of domestic programs.*—Eight listed by OMB.
2. *General description.*—Evaluation varies with each program, ranging from a good PPBS in those administered by the National

Archives and Records Service (NARS) to functionally nonexistent evaluation in the business services program (39.001).

3. *Definition of goals and objectives.*—Goals and outputs are defined in all programs except business services.

4. *Technique of evaluation.*—Those programs administered by the NARS are evaluated through the PPBS. Business services is evaluated by monthly regional summaries. All other programs employ output evaluation with regard to future planning.

5. *Organization.*—Generally, all evaluation is performed by central offices, with data reporting done by participating program staff.

6. *State-local evaluation.*—None.

7. *OMB role.*—OMB performs no evaluation role with respect to Business Services or those programs (39.004, 39.005, 39.006) administered by NARS. In those administered by the Property Management and Disposal Service (39.002, 39.003, 39.007), OMB acts in cooperation with the program staffs on various studies. The Federal Information Center (39.008) program is evaluated by OMB independently.

8. *GAO role.*—There has been no GAO evaluation of General Services programs, except a limited, periodic evaluation involvement in 39.002, 39.003 and 39.007.

9. *In-house versus contracts.*—None.

10. *Funding.*—GSA authorizes no funds specifically for evaluation. This activity is funded through either general operating expenses or program staff appropriations.

11. *Availability to Congress.*—Generally, all evaluation information can be made available upon request.

12. *Innovations.*—In all programs but 39.002, 39.003 and 39.007 for which new output measures are being developed, there are no innovations planned.

13. *Date of reply.*—September 3, 1971.

Indian Claims Commission

This is a temporary agency concerned with the adjudication of Indian claims arising prior to August 13, 1946.

1. *Number of domestic programs.*—None listed in OMB.

2. *General description.*—As the Commission is temporary, evaluation has not been formalized.

3. *Definition of goals and objectives.*—Work easily defined by outputs and goals, while reply is not explicit, output goals are set to quickly dispose of all claims.

4. *Technique of evaluation.*—"* * * accomplishments are evaluated for general effectiveness, with due allowance for variations in case complexity." Outputs defined readily.

5. *Organization.*—Evaluation "performed as regular duties by the Chief Counsel and his deputies, and reviewed by the Commission."

6. *State-local evaluation.*—None.

7. *OMB role.*—"* * * has cooperated with our staff in evaluation * * *."

8. *GAO role.*—"* * * has evaluated administrative procedures but not our substantive program."

9. *In-house versus contracts.*—None.

10. *Funding.*—No evaluation staff and no funds designated for such appropriated.

11. *Availability to Congress.*—Made available in support of appropriation requests. No executive privilege.
12. *Innovations.*—None.
13. *Date of reply.*—July 29, 1971.

Inter-American Social Development Institute

1. *Number of domestic programs.*—None listed by OMB.
2. *General description.*—ISDI created in 1969, and thus far has funded, no programs, though they are endeavoring to include evaluation processes within the format of those proposed.
3. *Definition of goals and objectives.*—No information provided.
4. *Technique of evaluation.*—No information provided.
5. *Organization.*—No information provided.
6. *State-local evaluation.*—No information provided.
7. *OMB role.*—No information provided.
8. *GAO role.*—No information provided.
9. *In-house versus contracts.*—No information provided.
10. *Funding.*—No information provided.
11. *Availability to Congress.*—No information provided.
12. *Innovations.*—No information provided.
13. *Date of reply.*—August 25, 1971.

National Advisory Council on the Education of Disadvantaged Children

1. *Number of domestic programs.*—Council does not administer any OMB programs.
2. *General description.*—Three-man staff involved "superficially" in the evaluation of the title I programs.
3. *Definition of goals and objectives.*—None.
4. *Technique of evaluation.*—Council employs a general review of all title I programs.
5. *Organization.*—One research secretary and a staff director involved with research projects "of a superficial nature."
6. *State-local evaluation.*—None.
7. *OMB role.*—OMB not involved.
8. *GAO role.*—None.
9. *In-house versus contracts.*—None at present.
10. *Funding.*—Funded from title I program funds.
11. *Availability to Congress.*—Available at any time upon request.
12. *Innovations.*—Plan to make greater use of the Office of Education research arm.
13. *Date of reply.*—August 10, 1971.

National Aeronautics and Space Administration

1. *Number of domestic programs.*—Two listed by OMB.
2. *General description.*—NASA states that their activities, primarily pioneering research and development, are not conducive to quantitative analysis.
3. *Definition of goals and objectives.*—Goals of NASA are not defined by measurable objectives and outputs to gage effectiveness.
4. *Technique of evaluation.*—"All major work efforts are evaluated periodically in varying detail in terms of cost-effectiveness, alternative

approaches, et cetera." NASA requests cost-benefit studies on such major investment projects as space shuttle program from out-of-house contracts.

5. *Organization.*—The Office of Administration is the "focal point" for NASA program evaluation. Generally the agency does not maintain a separate evaluation capability. Participating program staff "* * * perform the bulk of day-to-day and periodic evaluation."

6. *State-local evaluation.*—Nothing mentioned.

7. *OMB role.*—"OMB has evaluated programs both in cooperation with NASA staff and independently * * *."

8. *GAO role.*—GAO is required by law to make cost-benefit studies. Other reports have been made on efficiency.

9. *In-house versus contracts.*—Though there are at present several contracts, "* * * the predominant practice is in-house evaluation."

10. *Funding.*—Except for one program, all funding for evaluation is by program or management designation.

11. *Availability to Congress.*—Information is made available to the authorization and appropriation committees, though information contained in the President's budget estimate is "administratively confidential."

12. *Innovations.*—None.

13. *Date of reply.*—September 15, 1971.

National Capital Housing Authority

1. *Number of domestic programs.*—Four listed by OMB.

2. *General description.*—Operations limited to the District of Columbia. HUD controls all development and management programs.

3. *Definition of goals and objectives.*—None.

4. *Technique of evaluation.*—Agency does employ alternative approaches and experiments, but only as the result of arguments with HUD.

5. *Organization.*—No separate office; several staffs involved.

6. *State-local evaluation.*—Not applicable.

7. *OMB role.*—OMB not involved directly, but rather through HUD evaluation.

8. *GAO role.*—There has been no recent activity.

9. *In-house versus contracts.*—HUD task force was engaged under contract during the past 2 years.

10. *Funding.*—All evaluation funded through HUD by subsidy.

11. *Availability to Congress.*—"The release of such information would probably require approval of HUD or OMB or both* * *."

12. *Innovations.*—Currently attempting to develop a procedure for continuing evaluation of the Housing Authority.

13. *Date of reply.*—August 12, 1971.

National Science Foundation

1. *Number of domestic programs.*—Listed by OMB, 35.

2. *General description.*—The Foundation does not feel that objectives such as improving the educational system's scientific training capability can be measured in terms of quantification.

3. *Definition of goals and objectives.*—"Objectives generally are long term and qualitative in nature." Quantitative output measures are not well defined.

4. *Technique of evaluation.*—Formal program evaluation in terms of output and expenditure data "has not as yet been done* * *."

5. *Organization.*—What evaluation is done is performed on a decentralized basis principally by program staffs; however, the Foundation has established a central evaluation staff, independent of the operating units.

6. *State-local evaluation.*—Nothing mentioned.

7. *OMB role.*—No regularly scheduled activity, though special studies are occasionally requested.

8. *GAO role.*—Similar to that of OMB, limited to occasional evaluation study requests.

9. *In-house versus contracts.*—Contracting done only in specific instances, not as a general practice.

10. *Funding.*—The evaluation staff (three professionals) is funded through the administration directorate budget appropriations.

11. *Availability to Congress.*—Information made available is limited.

12. *Innovations.*—Study of evaluation staff activities.

13. *Date of reply.*—August 24, 1971.

Office of Economic Opportunity

1. *Number of domestic programs listed by OMB.*— 11.

2. *General description.*—Economic Opportunity Act requires that all programs of OEO be evaluated. Also, OEO has done or will do overall impact studies of all its programs.

3. *Definition of goals and objectives.*—Cites difficulty in developing output measures for social programs. Apparently some programs are defined in terms of objectives and short-term output measurement, however. Also, some programs have multiple and overlapping objectives.

4. *Technique of Evaluation.*—Little mention is made of the employment of PPBS, of cost-effectiveness studies, of efficiency gages, et cetera. Though often cited as a model, OEO's reply specifies no particular evaluation techniques.

5. *Organization.*—Office of Planning, Research, and Evaluation, 18 professionals evaluating poverty programs of OEO and other agencies; Office of Program Development, nine professionals evaluating demonstration programs of Office of Planning and Development; Office of Health Affairs, Division of Program Planning and Evaluation, five professionals; Office of Legal Services; Planning, Technical Assistance, and Evaluative Division, three professionals; headquarters level, Office of Operation, three professionals: one for general, one for migrant programs, and one for State and local grants; 10 regional offices each employ one professional.

6. *State-local evaluation.*—No funds apportioned to State or local governments. However, project grants are given to States to support State Economic Opportunity Offices, whose role is advisory: some State offices maintain full-time professional staff for evaluation; others maintain part time.

7. *OMB role.*—Role limited to synthesizing OEO evaluations.

8. *GAO role.*—Numerous reviews of OEO's operations—Economic Opportunity Act amended 1967 directing GAO to review programs under act to determine efficiency as well as extent of achievement of objectives; issued 60 reports to Congress in 1969, and 1971 had 28 audits in progress by June.

9. *In-house versus contracts.*—Contracting out-of-house primary vehicle for evaluation—$4 to $6 million per annum on contracts. Most of 1 percent of budget set aside for evaluation goes to contracting.

10. *Funding.*—Staff funded from budget activity lines of programs to which they belong. No specific legislative evaluation authorization, though OEO maintains 1 percent policy.

11. *Availability to Congress.*—Final reports of contract evaluations are made public 60 days after OEO acceptance. Raw data and draft reports are not made available.

12. *Innovations.*—Policy experiments, before and after studies, new data bases.

13. *Date of reply.*—September 9, 1971.

Overseas Private Investment Corporation

1. *Number of domestic programs.*—Five listed by OMB.

2. *General description.*—The OPIC was formally organized on January 19, 1971, and no later than March 1, 1974, will submit an analysis to Congress concerning the possibility of transferring all or part of its activities to the private sector.

3. *Definition of goals and objectives.*—There is little definition of either long-term or short-term productivity goals. Crude output measures (for example, an input of $11 billion investment insurance is considered to have produced $4 billion in private investment) are employed.

4. *Technique of evaluation.*—Long lead time and difficulty in projecting eventual outcome are considered to be the two factors which make OPIC activities not conducive to evaluation in terms of cost-effectiveness, efficiency and cost-benefit analysis. OPIC does consider experimental variations.

5. *Organization.*—The Office of the Vice President for Corporate Planning, composed of five professionals, with the support of the Treasurer's Office, undertakes the bulk of OPIC evaluation. Program staffs participate in reporting data.

6. *State-local evaluation.*—None.

7. *OMB role.*—Undertake an independent evaluation.

8. *GAO role.*—Several aspects of the OPIC activities have been evaluated by the GAO.

9. *In-house versus contracts.*—Response indicates that several consultant firms have been contracted to study OPIC specific activity area benefit.

10. *Funding.*—Evaluation is funded through personnel appropriations.

11. *Availability to Congress.*—Most will be available upon request.

12. *Innovations.*—Output indicators are being developed.

13. *Date of reply.*—August 3, 1971.

Postal Service

1. *Number of domestic programs.*—One (six postal academies) OMB program.
2. *General description.*—At time of reply, were reorganizing and developing evaluative methods, consequently nature of practices unclear.
3. *Definition of goals and objectives.*—In 1965, instituted a PPB system and have defined "functions" for some programs. More emphasis on immediate output goals, which is sensible in light of the Service's task.
4. *Technique of evaluation.*—In 1965, a PPB system was instituted which allowed comparison of planned outputs with actual accomplishments. Uncertain whether this apparatus still exists. Output seem to be measured in terms of number of pieces, deliveries, cases, families served, et cetera. Many operations are judged to not have quantifiable output.
5. *Organization.*—Due to reorganization, unable to describe organization and size of evaluation staffs. In the past, evaluation staffs were frequently composed of part-time operating officials. Carried out at all levels with overall evaluation at headquarters.
6. *State-local evaluation.*—No mention.
7. *OMB role.*—Vague answer—OMB will review budget from an "informational viewpoint," to make sure it fits the President's program.
8. *GAO role.*—Twenty-four studies in 1970, dealing with "financial controls, revenue collection, and improvement of agency programs."
9. *In-house versus contracts.*—March 1971, 154 active contracts dealing mainly with postal hardware and mailing systems design.
10. *Funding.*—No specific designation. In-house from postal revenue and operating receipts, contractual from "Research, development, and engineering" appropriation.
11. *Availability to Congress.*—"In general" available, on "case-by-case basis."
12. *Innovations.*—Whole evaluation apparatus being reorganized.
13. *Date of reply.*—August 27, 1971.

President's Council on Physical Fitness and Sports

1. *Number of domestic programs.*—Eight programs listed by OMB.
2. *General description.*—Extent of evaluation varies on a program-to-program basis.
3. *Definition of goals and objectives.*—As mentioned above, extent varies by program, from nonexistent in the Governor's Council on Physical Fitness to very good in the national summer youth sports program.
4. *Technique of evaluation.*—Cost-effectiveness and alternative approaches, as well as output measurement, used in the national summer youth sports program (NSYSP). Physical fitness and sports information program employs output and effectiveness measures. Generally output used where deemed applicable, and ultimate effectiveness used frequently.

5. *Organization.*—Decentralized, with no separate staff. Evaluations are performed extensively by other agencies and organizations, such as the National Collegiate Athletic Association, OEO, et cetera, and by participating program personnel.
6. *State-local evaluation.*—No information provided.
7. *OMB role.*—None.
8. *GAO role.*—None.
9. *In-house versus contracts.*—No contracts to profit organizations; OEO has evaluated NSYSP, and has contracted with the Auerback Corp. for a study on NSYSP.
10. *Funding.*—No specific authorization.
11. *Availability to Congress.*—No information provided.
12. *Innovations.*—No information provided.
13. *Date of reply.*—November 15, 1971.

Securities and Exchange Commission

1. *Number of domestic programs.*—One listed by OMB.
2. *General description.*—The Commission maintained that measurement of ultimate effectiveness and productivity is difficult.
3. *Definition of goals and objectives.*—There is no definition of productivity goals, neither short nor long range.
4. *Technique of evaluation.*—Expenditure and work data are evaluated in terms of alternative approaches and improved program strategies.
5. *Organization.*—Highly decentralized, with the responsibility for program evaluation borne by the division or office concerned with the program.
6. *State-local evaluation.*—None.
7. *OMB role.*—Primarily involved in the budgetary process, though one study of Commission activities was completed.
8. *GAO role.*—None, except periodic audits.
9. *In-house versus contracts.*—No contracting by the Commission, though OMB has retained a consultant firm to review Commission organization and operations.
10. *Funding.*—Staff funded through general appropriation.
11. *Availability to Congress.*—Information is made available through the budgetary process or upon request.
12. *Innovations.*—A new, small program evaluation staff is planned for the recently reestablished Office of Executive Director.
13. *Date of reply.*—August 30, 1971.

Small Business Administration

1. *Number of domestic programs.*—Fourteen listed by OMB.
2. *General description.*—Most areas which are shown to be lacking have planned innovations either currently under implementation or in the developmental phase. With these, SBA evaluation should be good.
3. *Definition of goals and objectives.*—". . . we have no full-blown, ongoing system, readily defined in terms of objectives and outputs conducive to measurement and effectiveness."
4. *Technique of evaluation.*—PPBS, focusing on costs to the taxpayer and benefits to the small business community. Emphasis has thus been given to cost-effectiveness measurement.

5. *Organization.*—Centralized under the Assistant Administrator for Planning, Research, and Analysis—six professionals and one secretary. Field offices, participating program staff relatively uninvolved.

6. *State-local evaluation.*—No information provided.

7. *OMB role.*—According to reply, role has been extensive. OMB has been "cast in the leadership role for the establishment and implementation of PPB systems." SBA and OMB work closely in this regard.

8. *GAO role.*—No past involvement, though currently evaluating one program as part of its regular general audit.

9. *In-house versus contracts.*—"Studies contracted out on a very limited basis," paid for by funds for research.

10. *Funding.*—Evaluation staff funded by the administration's administrative staff appropriations. No specific authorization for evaluation in SBA budget allocation.

11. *Availability to Congress.*—"* * * could be made available." "This would require processing by the Office of Management and Budget, in accordance with procedures for the clearance of legislation and legislative materials."

12. *Innovations.*—Statement of mission, objectives, and priorities to be developed; first planning and evaluation capability in the Chicago—Region V—area.

13. *Date of reply.*—October 7, 1971.

Tennessee Valley Authority

1. *Number of domestic programs.*—Three listed by OMB.

2. *General description.*—Generally seems rather poor, with no staff, little out-of-house, no objective definition, and with no overall program goals or outputs established.

3. *Definition of goals and objectives.*—In response to question asking number of programs operated and monitored in terms of definite output measures and goals, TVA stated "none."

4. *Technique of evaluation.*—Program elements are defined in terms of specific outputs, but programs themselves are defined by goals so general that program evaluation is impossible. Evaluation, however, is "commonly used in expenditure and output evaluation of individual program elements."

5. *Organization.*—General manager bears overall responsibility, while operating officers share this responsibility. No State or local offices. No independent evaluation staff.

6. *State-local evaluation.*—None.

7. *OMB role.*—"* * * has requested specific evalutions, but has not directed or participated in any evaluation effort at the agency level."

8. *GAO role.*—"* * * has audited and evaluated technical procedures, but has not made program evaluations."

9. *In-house versus contracts.*—"Consultants may occasionally be used in evaluation studies * * *."

10. *Funding.*—Program evaluation funded through program operating budget.

11. *Availability to Congress.*—"* * * will be provided to the appropriate committees on request."
12. *Innovations.*—A permanent planning and evaluation staff, initially consisting of several professionals, is to be established under the Office of the General Manager.
13. *Date of reply.*—August 9, 1971.

U.S. Commission on Civil Rights

1. *Number of domestic programs.*—One listed by OMB.
2. *General description.*—Commission is primarily a factfinding and fact disseminating agency, with output primarily publications based on hearings et cetera.
3. *Definition of goals and objectives.*—"We judge our effectiveness on how far the Nation evolves on the road to equal opportunity."
4. *Technique of evaluation.*—An annual program planning process; each month progress reports submitted by operating offices, to determine how well program objectives are being met.
5. *Organization.*—Office of Management; evaluation done only on an agencywide basis; no staff person assigned to evaluation, but simply one of duties of Director of the Office of Management.
6. *State-local evaluation.*—None.
7. *OMB role.*—"* * * evaluation in cooperation with agency people."
8. *GAO role.*—"* * * has had no part in evaluation studies of the agency."
9. *In-house versus contracts.*—Only one time, a study of State advisory committees.
10. *Funding.*—Office of Management funded through staff appropriations.
11. *Availability to Congress.*—"* * * could be made available upon request."
12. *Innovations.*—None.
13. *Date of reply.*—August 9, 1971.

United States Information Agency

1. *Number of domestic programs.*—No programs listed by OMB.
2. *General description.*—Major activities are informational services and opinion shaping and sampling.
3. *Definition of goals and definitions.*—The USIA does not define, except in a very limited sense, productivity goals and objectives. Agency does employ a PPBS.
4. *Technique of evaluation.*—Though no specific cost-effectiveness measurement system, general references were made in the agency response to concern for optimum resource allocation, alternative approaches, and improved program strategies.
5. *Organization.*—Both organized on a centralized and decentralized basis. Office of Research and Assessment, composed of three sublevel staffs, major evaluative mechanism, with 86 positions. The Office of the Director also maintains a resource analysis staff—15 positions.
6. *State-local evaluation.*—None.

7. *OMB role.*—Essentially a budgetary role. Generally USIA works in conjunction with OMB staff.

8. *GAO role.*—Role "relatively limited", though GAO reports usually contain findings concerning USIA support of U.S. objectives.

9. *In-house versus contracts.*—None.

10. *Funding.*—No specific authorization for either personnel or program evaluative effort.

11. *Availability to Congress.*—Agency "* * * makes every effort to share its evaluative information upon request * * *" to Congress.

12. *Innovations.*—None.

13. *Date of reply.*—August 13, 1971.

United States Tariff Commission

1. *Number of domestic programs.*—Three listed by OMB.

2. *General description.*—Tariff Commission involved in initial phase, factfinding investigations. Also, there are time limitations.

3. *Definition of goals and objectives.*—These "investigations are not of a type which may be readily defined in terms of objectives and outputs conducive to measurement."

4. *Technique of evaluation.*—Data collected "regarding costs" used by staff for planning and budgeting.

5. *Organization.*—No separate evaluation staff. Commissioners and senior staff perform an "evaluative function."

6. *State-local evaluation.*—Not applicable.

7. *OMB role.*—Regular consultation with OMB by staff regarding budget and management.

8. *GAO role.*—"GAO has not, to our knowledge, conducted any evaluation studies of our programs."

9. *In-house versus contracts.*—None.

10. *Funding.*—No separate evaluation funds, regular personnel channels.

11. *Availability to Congress.*—Information used in support of budget requests; use of executive privilege unlikely.

12. *Innovations.*—Pondering the use of automatic data processing equipment.

13. *Date of reply.*—August 6, 1971.

Veterans' Administration

1. *Number of domestic programs.*—Thirty-eight listed by OMB.

2. *General description.*—VA is wary of input/output measurement, as it feels that the number of hospital beds provided, for example is not the real output of a program. However, such output measures are used extensively.

3. *Definition of goals and objectives.*—"All of our programs are operated and monitored in terms of quantitative outputs * * *." The reply lists each program and the types of outputs specifically measured. Definition of goals is not mentioned in the reply.

4. *Technique of evaluation.*—VA emphasized output and expenditure evaluation in relation to the efficiency and effectiveness (cost-

effectiveness) of program execution. This emphasis entails experimental variation and input/output analysis.

5. *Organization.*—Assistant Administrator for Management and Evaluation—central element reporting to Administrator; "at the bureau level, independent elements are also involved in the evaluation of program execution."

6. *State-local evaluation.*—"* * * no information about State or local evaluation staff. No Federal funds are authorized for this purpose."

7. *OMB role.*—"* * * routinely involved," through budgetary process with VA staff and independently; and through "general management improvement programs."

8. *GAO role.*—"* * * continuously active," turning out several reports annually. Their interest, however, is more restricted to administrative issues, rather than with program substance.

9. *In-house versus contracts.*—"We do not contract for program evaluation as such." However, occasionally program execution studies are contracted; for example, currently a study of automatic data processing is underway.

10. *Funding.*—No appropriations are specifically earmarked for evaluation. Generally, funds authorized through operating expenses.

11. *Availability to Congress.*—Readily available in all congressional budgetary submissions; and unless approved by the President, executive privilege will not be used.

12. *Innovations.*—Plans to improve general evaluation staff, as well as the development of additional measurement criteria for "weak-spot" programs.

13. *Date of reply.*—September 15, 1971.

Washington Metropolitan Area Transit Authority

1. *Number of domestic programs.*—No programs listed by OMB.

2. *General description.*—Not a Federal agency in the normal scope.

3. *Definition of goals and objectives.*—Not defined.

4. *Technique of evaluation.*—No PPB, or building-block format. Review annually of operations to stay within budgetary constraints. Also, a benefit-cost study contracted for—benefits exceeding costs 3 to 1 ratio.

5. *Organization.*—Office of Program Control—10 full-time staff—responsible for monitoring funds. District of Columbia and suburban jurisdictions have full-time staff to evaluate programs.

6. *State-local evaluation.*—See No. 5.

7. *OMB role.*—Evaluates both independently and in cooperation.

8. *GAO role.*—Agency subject to GAO audit.

9. *In-house versus contracts.*—One major cost-benefit study thus far out-of-house.

10. *Funding.*—Program evaluation expenses are included in the administrative budget.

11. *Availability to Congress.*—Information made available to the appropriate committees; any information deemed necessary will be available by request.

12. *Innovations.*—None.

13. *Date of reply.*—September 2, 1971.

Water Resources Council

1. *Number of domestic programs.*—One listed by OMB.
2. *General description.*—A task force reviewed agency practices in 1965. Proposals were tested, but have yet to be implemented.
3. *Definition of goals and objectives.*—There are long-range goals formulated in a general way. No short-range productivity goals conducive to measurement are formulated.
4. *Technique of evaluation.*—The only quantitative evaluation performed is a cost-benefit analysis, described as a ratio of costs to proposed contributions to long-term objectives.
5. *Organization.*—Grant requests are evaluated by Council staff and an interagency state grants committee. Data reporting is carried out by the requesting State gency.
6. *State-local evaluation.*—None.
7. *OMB role.*—OMB reviews budgetary proposals, independently of Council staff.
8. *GAO role.*—GAO has undertaken an independent evaluation of the States planning grants program administration.
9. *In-house versus contracts.*—None.
10. *Funding.*—Staff is funded under administration and coordination appropriations.
11. *Availability to Congress.*—Available upon request.
12. *Innovations.*—Following completion of the task force's recommendations review, final recommendations will be made to the President.
13. *Date of reply.*—August 16, 1971.

Federal Home Loan Bank Board

1. *Number of domestic programs.*—One listed by OMB.
2. *General description.*—Board is composed of three members; response answers questions only with regard to their one domestic program, housing opportunity allowance program.
3. *Definition of goals and objectives.*—"Evaluation of expenditure and output data in the aspects noted in your question (2) has not been feasible due both to the newness of the program and the limited period of operating experience."
4. *Technique of evaluation.*—As the program is administered by individual member institutions, the Board does not feel that agency activities and the evaluation of effectiveness are very related.
5. *Organization.*—Office of Bank Management (two persons) in coordination with the 12 housing coordinators at each district bank is responsible for evaluation.
6. *State-local evaluation.*—None.
7. *OMB role.*—"OMB's role in evaluation is essential to review program effectiveness * * *."
8. *GAO role.*—"* * * has not as yet been involved in the evaluation process * * * ."
9. *In-house versus contracts.*—"Only the storage and processing of statistical data is done through outside sources * * * ."
10. *Funding.*—"No funding of the evaluation staff has been provided."

11. *Availability to Congress.*—"* * * is always available * * * ." "No executive privilege has been claimed for any evaluative information."

12. *Innovations.*—"* * * no innovations are contemplated."

13. *Date of reply.*—February 25, 1972.

PROFILES OF ANALYTICAL STUDIES

This compendium is the latest in a series of committee documents dealing with the effectiveness of public expenditures. Because of the size and variety of public spending programs, they have a vast effect on the economy. The committee has stressed the need for much better capability for evaluating public programs as a primary requirement for improving the competence of the Federal Government to formulate public economy policy.

The need for more extensive and higher quality analysis of Federal programs is made abundantly clear in the survey made under the supervision of Senator William V. Roth, Jr., Republican of Delaware, which appears as the first study in this volume.

Using an easily understandable, common sense approach, he reaches some striking conclusions:

> Executive departments and independent agencies do a rather poor job of defining the goals or objectives of the programs they administer.
>
> Use of a formal planning-programing-budgeting system is almost nonexistent among independent agencies.
>
> There are almost no programs to help State and local grant recipients improve their own evaluation and analysis. In fact very few programs permit money to be used for such purposes.
>
> The Office of Management and Budget's inovlvement in substantive evaluation at the agency level is very limited.
>
> There are only a few instances where program money may be used for evaluation.

One paragraph in Senator Roth's summary is especially noteworthy for both policymakers and economists:

> *The use of analytical techniques is subject to a number of dangerous distortions.* These include over-objectification, over-systematization, and use for advocacy by program managers and political executives. We must keep in mind that it is especially difficult to guage whether social programs are successful. These programs necessarily have *multiple goals* which in their ultimate form are very hard to measure. *Further, I think we need to guard against the erection of complicated formal structures of analysis which have no impact on decisionmakers.* (Emphasis added.)

It is especially unfortunate that analysis has not been used more fully since all of the advantages originally discussed still exist and substantial advances have been made in quantifying many of the costs and benefits. But if benefit-cost analysis is to be implemented and used to its fullest potential, renewed efforts must be made by policymakers in both the executive and legislative branches of government. The economics profession has made significant advances in the level of sophistication of their analysis which should aid this task, but one thing is clear—benefit-cost analysis does not make decisions.

Analysis can provide an important and helpful tool for making decisions, but it is no more than a tool. Problems involving social policy and value judgments must be considered and weighed in conjunction with the results of benefit-cost analysis and the final decision made by the human policymaker.

The following papers will illustrate the need for better analysis, they will help bring policymakers up to date on some advances made by economists, and they will provide some examples of the ways benefit-cost analysis is applied to different types of programs. The data and analysis contained in individual papers is quite helpful and informative for the programs discussed, but the real value of the volume is in its illustrative nature.

The problem of price changes has been largely ignored in most benefit-cost analysis. The reason has been that even though price inflation may cause some distortion in the allocation of resources, it is a pecuniary change and does not reflect future gains in the value of real output. This problem, however, becomes significant when the price of project inputs and the price of project outputs change relative to each other. When this occurs, a real change in the value of outputs has taken place and should be explicitly considered in the analysis. The first paper, "Benefit-Cost Analysis and Technologically Induced Relative Price Changes: The Case of Environmental Irreversibilities" by Krutilla and Cicchetti, examines these relative price changes for a specific case, Hell's Canyon.

There are two basic causes of these relative price changes. The first is simply growth in technology. As technology advances new plants can be built to operate more cheaply and efficiently than the existing plants, thus making the old ones obsolete before they are worn out. This, in turn, lowers the price of inputs relative to outputs—especially when those outputs include limited natural resources. The second cause of relative price changes lies in the nature of the irreproducible environmental resources used. As population continues to grow with a corresponding growth in the use of environmental resources, the value placed on these nonproducible resources will rise relative to producible goods.

In order to explicitly take account of these causes of price changes, the authors develop two models; the technological change development model to estimate the present value of the benefits of building a hydroelectric facility, and the preservation model to estimate the benefits of preserving Hell's Canyon in its natural state which would be necessary to make society indifferent between the two alternatives. Once they know what the preservation benefits would need to be, the authors can compare them with a benefit estimate derived from the technological change model. They find that the actual preservation benefits are an order of magnitude greater than would be necessary for society to be indifferent between preservation and development.

While the authors point out that their analysis is not conceptually complete—there are other benefits which might be included—the paper nevertheless goes a long way toward improving the way economic analysis is applied to projects involving environmental irreversibilities. This analysis can provide a useful base for developing the general methodology necessary to evaluate proposed environmental projects in an unbiased manner.

The second paper, by Davis, Ingle, and Gillen, also examines an environmental program but using a slightly different approach. They look at the small watersheds program and the evaluation methods currently used by the Soil Conservation Service. As is too often the case when a Federal agency undertakes benefit-cost analysis, the Soil Conservation Service methods are seriously inadequate.

Using two case studies as specific examples, the authors calculate the maximum value of environmental costs which might be incurred before the project would be rejected. In some respects this is a subjective figure but it offers an easily obtainable number to use as a first approximation. It is also helpful to use this number in conjunction with the benefit-cost ratio for those projects that may be marginal. The authors do not discuss any induced relative price changes which would tend to lower the maximum they have calculated. They also revise the Soil Conservation Service estimates of benefits and costs to arrive at a more accurate ratio. The sensitivity of the ratio to relatively small changes is readily seen.

The paper by Robert Haveman points out one of the more serious shortcomings of benefit-cost literature as it has developed to date. Researchers and analysts have concerned themselves almost exclusively with examining the prospective benefits and cost of a proposed program: This, of course, must be done in order to make the investment decision. However, once the decision is made, the analysts have tended to go on to the next proposal and never look back. Ex-postanalysis—looking back—can be extremely helpful in discovering the shortcomings of the previous analysis. This is Haveman's topic.

Reexamining a water resource facility, for example, 10 years after it has been put in place is not quite as simple as it might first appear. Improvements will have been made in evaluation technology and statistical techniques. This will necessitate reestimating the ex-ante appraisal using original data but new methodology. The actual performance of the project must then be evaluated and this evaluation compared with the newly reestimated ex-ante appraisal.

Even the straightforward reasoning above contains certain problems. Evaluating the performance of a project is one of the most difficult. If, for example, the flood losses actually prevented by a flood control project are used as an estimate of the project's benefits, then the project's worth will be greatly overstated. This is because part of the undamaged property located on the flood plain would have located elsewhere if the project had not been constructed and therefore would have been undamaged in any event. While this property may contribute to the economy of one particular locale, it does so at the expense of another part of the country; the net benefit to the Nation's income is zero.

This last point is particularly important for policymakers to understand, because it has been included in the Corps of Engineer's computations of the benefits of projects presented to Congress. A complete discussion of the Corp's methodology used on a particular project is contained in a recent GAO report.[1] Clearly when a benefit-cost analysis presents the policymaker with incomplete or misinformatio it is a disservice rather than a useful tool.

[1] "Comptroller General's Report to Hon. Bob Packwood, U.S. Senate," *Congressional Record*, Sept. 21, 1972, S15543.

Having discussed these and other problems likely to be encountered in any ex-post analysis, Haveman continues to a conceptual discussion of the benefits to be derived from a waterway improvement in the context of the U.S. transportation industry. Once the conceptually correct method of determining ex-ante benefits is determined, he compares it with the current practice of the Corps of Engineers. A case in point illustrates the inadequancies of the analytical framework applied by the Corps. In part, the Corps is following methods of analysis dictated by legislation. From a policy standpoint, Congress would be better served by legislation which would allow the use of improved evaluation techniques. Once again the need for congressional understanding is illustrated if benefit-cost analysis is to be used to its fullest potential.

In the final section of his paper, Haveman provides an example of how a conceptually correct ex-post analysis would be undertaken for a specific case. This illustrates the problems typically encountered and possible ways to solve them. More importantly, it points out the shortfalls in the performance of ex-ante estimation when it is not refined and improved by the feedback from ex-post analysis.

The welfare mess is one that has received increasing attention in recent years, but since the 92d Congress did not deal completely with the problem, it will continue to haunt us. This makes studies of welfare proposals such as "Family Assistance Plan: An Analysis and Evaluation" by Bowden, Cain, and Hausman, particularly useful.

While the study is concentrated or an evaluation of the FAP proposal, its usefulness is not limited to a single plan. Any form of an income maintenance program is going to encounter essentially the same problems; this primarily involves integrating the various forms of financial assistance with one another and developing a Federal program that is compatible with the many different State and local assistance programs. This paper analyzes these problems and provides a helpful methodology to examine other welfare proposals that may be put forth. Additional problems such as work incentives, and incentives to family stability can be examined within an economic context, but the ultimate social decision must be made giving appropriate weight to the political considerations as well as the economic.

The fifth paper in this volume by Smolensky and Gomery gives an overview of the benefits, costs, and equity consequences of providing low-income families with decent housing through public ownership and subsidy programs. Although it does not include overall cost estimates—taxes are not considered—the study does illustrate the usefulness of benefit-cost analysis in examining benefit-in-kind transfer programs.

Benefit-in-kind transfer programs provoke a basic question: why is the transfer made in kind rather than in cash? Clearly there are indirect benefits to the total society which might not accrue if the direct beneficiary could choose cash. These and the more obvious direct benefits and the various ways they might be measured are discussed in the first section of the paper. The authors conclude that if the goal of public housing is to maximize the number of people who choose to move from substandard into standard housing at a given level of expenditures, our current programs will not achieve that goal. However, that this is the true or overriding objective of public housing is not obvious.

The second section of the paper is devoted to equity considerations which are presumably implicit in our housing goals. Based on the authors results, it would appear that other considerations have outweighed tenant equity. As the authors point out, the distribution of non-tenant benefits is beyond the scope of this analysis.

The final part of the paper discusses the implications of benefit-cost analysis for decisionmaking. The two most important conclusions are: (1) All of the objectives of our housing program should be spelled out in reasonable detail and (2) sufficient information must be available to adequately evaluate the program. Once again we see the importance of the ex-postanalysis discussed by Haveman.

The paper by Martin Feldstein on the medicare program is basically a look at a Federal program through an econometric model. This can be a very useful way of examining the benefits of a program, particularly when the impact on the private market is of concern. An econometric model provokes a whole set of questions about the interaction of Federal programs with the rest of the market; it also can provide some surprising insights into the answers.

By the end of its second year of operation, the medicare program has paid out over $8 billion in benefits and had had a substantial impact on the health care segment of our economy. Has this program lived up to the expectations of its authors? Whatever the answer, any program of this magnitude certainly deserves some careful scrutiny.

One of Feldstein's findings which policymakers may not have expected is that in spite of uniform national coverage, the benefits actually received vary widely among the different States. Again this relates to the problem of integrating Federal and State income transfer programs that was discussed earlier in the context of FAP by Bowden, Cain, and Hausman. Other findings relate to the impact medicare has had on the cost of health care in general—younger age groups are forced to pay higher prices; the impact of medicare on the use of health facilities by different age groups; the impact of medicare in different areas of the country with varying population density; the impact of medicare on different health facilities such as nursing homes, and so forth.

Although Feldstein does not make normative judgments about medicare, his analysis provides the basis for policymakers to make these decisions. Concurrently this type analysis should be very helpful in refining the program to reach its objective more efficiently and with minimal undesired side effects.

The last papers in this volume are devoted to programs that involve some kind of training or education. The most difficult problem in evaluating any program of this sort is to measure benefits in terms of how close they approach the program's objectives. Too often in the past, measures of these programs have focused on the visible inputs such as the number of participants or the physical facilities used. While this latter measure is more easily obtainable, it is virtually useless for evaluating the program.

The first of these papers is an evaluation of the Neighborhood Youth Corps by Somers and Stromsdorfer.[2] Since this program has the objective of encouraging potential high school dropouts to remain in school, it is extremely difficult to arrive at a single number to call the benefit-cost ratio. The benefits which can be quantified and used for program evaluation include the difference in earnings of two persons of comparable background—one of whom participated and one who did not, and changes in the probability of attaining a given level of education. Based on their findings, the authors conclude that the Neighborhood Youth Corps has had a significant impact on the enrollees' participation in the labor force and therefore on total earnings. The inschool program may be an effective social program but the value of the summer program, although it may serve noneconomic purposes is doubtful. They also conclude that income is not a dominant factor in the decision to drop out of school. For the policymaker, this implies that programs to succeed in encouraging potential dropouts to remain in school.

The next paper is an evaluation of the economic efficiency of remedial elementary education for disadvantaged adults by Myron Roomkin. Once again, there are many noneconomic consequences of basic education which must be considered in policymakers' decisions to grant or deny support for such programs.

Roomkin is more optimistic about the prospects for quantifying noneconomic benefits than many of his fellow researchers, but as he notes in the paper, if basic education programs are to be justified on economic grounds, then at a minimum the economic benefits such as increased individual earnings and improved productivity must be measured. He attempts this measurement using multiple linear regression analysis with such variables as average hourly earnings before training, amount of vocational training in addition to basic education, age, level of educational attainment, etc.

While the results may be disappointingly small and inconclusive for those who expected basic education to be the best approach to helping the disadvantaged, there are some positive and useful things to be learned from the study. One of the most interesting which is hinted but not thoroughly explored, is the relationship between basic and vocational education. This study suggested that with an increased level of basic educational attainment, subsequent vocational training may have much greater benefits.

Another paper in this final group is Bruce Davie's analysis of a vocational training program conducted by the Bureau of Indian Affairs. The method of analysis is necessarily and admittedly very simple and open to legitimate challenge, the assumptions underlying the analysis are highly questionable. The value of the paper, therefore, does not lie in the ratios calculated, but in illustrating the potential improvements that become obvious as program managers go through the exercise of calculating those ratios. These program improvements are the human resource corrollary to the analytical improvements discussed in the earlier paper by Robert Haveman.

The next paper is also concerned with vocational education but it looks at a different aspect. The study by Hu, Lee, and Stromsdorfer compares earnings and employment by vocational high school graduates with those of comprehensive high school graduates. By con-

[2] The authors use the term "cost-effectiveness" to describe their analysis. This term originally came from military analyses where the objective was specified and the problem was to find the least cost method of achieving it. The term has been broadened so that now it is used generically or interchangeably with "benefit-cost."

trolling for certain sociodemographic characteristics such as sex, IQ, race, and so forth, the authors are able to obtain good comparable estimates for earnings and employment differentials over a 6-year period.

Although some of the statistical estimates have large standard errors the general conclusion is clear: noncollege vocational school graduates on the average do better in terms of earnings and employment than noncollege comprehensive school graduates. When costs and benefits are compared, vocational education—although more expensive—appears to be the better investment. One should note, however, that as the comprehensive school graduates gain experience in the labor force, the earnings gap between the two groups tends to narrow.

The final paper in this group examines several older benefit-cost analyses and compares the results. As it points out, there is such variation in the assumptions and data underlying the analysis that the ratios measured in one study are not necessarily comparable to those measured in another. The authors attempt to adjust for these differences and arrive at a comparable set of numbers. They point out, however, that "the numbers alone, without regard to the peculiar viewpoints and definitions behind each of the numbers used, are almost certain to be misleading."

In response to the problem of inadequate and inconsistent data, the study includes a list of recommendations addressed to the Congress. Even if no substantive changes were made in manpower programs, collecting this basic data and providing the recommended followup information could certainly contribute better informed decisionmaking.

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BENEFIT-COST ANALYSIS AND TECHNOLOGICALLY INDUCED RELATIVE PRICE CHANGES: THE CASE OF ENVIRONMENTAL IRREVERSIBILITIES

By JOHN V. KRUTILLA *and* CHARLES J. CICCHETTI *

The application of economic analysis in public (and private) expenditure evaluation involves many simplifications. Since in a general equilibrium sense everything depends on everything else, the inclusion of all the interdependent variables of possible theoretical significance in analysis would overwhelm the analyst as well as the decision under consideration.[1] Accordingly, at best only the variables expected to have the preponderant quantitative significance are treated. It is assumed implicitly that the excluded variables would provide information insufficiently significant in a quantitative sense to warrant the added costs of more detailed treatment. Typically a consensus is developed by the practitioners in any field of application regarding the variables of greatest significance for the purpose being considered which will generally have its roots in a self-conscious examination of the warranted level of detail.

Thus, in the course of the development of benefit-cost analysis for public resource development programs in the United States, the question of the significance of expected future increases in the general price level came under serious examination by members of the coordinating group recommending benefit-cost procedures for Federal resource development agencies. It was recognized that while price inflation will result in some distortion in the allocation of resources, it nonetheless was a pecuniary phenomenon which should not be mistaken for future gains in the value of real output from the investment under consideration. Accordingly, the Subcommittee on Benefits and Costs of the Federal Inter-Agency River Basin Committee recommended in 1951 that the general price level, for purposes of project evaluation, be assumed to remain constant over the life of the project under consideration.

Following the Federal Reserve-Treasury Accord of 1951, interest rates and bond yields began to rise, accompanying the earlier and persistent rise in the general price level. The opportunity cost of capital, in public investments, soon began to exceed the interest rates used in public investment planning.[2] In response to the vigorous

* The authors are respectively director, natural environments program at Resources for the Future, Inc. and visiting associate professor of economics and environmental studies at the University of Wisconsin, Madison. They wish to thank the *Natural Resources Journal* for permission to use parts of a paper published in another form previously by that Journal and to the Joint Economic Committee where this paper appeared originally.

[1] See Roland McKean on the meaning and inevitability of sub-optimization, or partial equilibrium analysis, in *Efficiency in Government Through Systems Analysis* (New York: John Wiley & Sons, 1958), pp. 26-34.

[2] See John V. Krutilla, "Efficiency Goals, Market Failure, and the Substitution of Public for Private Action" in *The Analysis and Evaluation of Public Expenditures: The PPB System*, a Compendium of papers submitted to the Subcommittee on Economy in Government of the Joint Economic Committee of the Congress (Washington: GPO, 1969), Vol. I, p. 281.

effort to bring the two into greater conformity,[3] a counter argument was advanced. Since a stable price level for resource development projects' outputs was assumed, it was argued that it would be necessary to have interest rates for planning purposes continue below the market rate of interest (or yields on government long term bonds) in order to avoid introducing a spurious change in relative prices of project inputs and outputs. That is, a large part of the increase in the market rates of interest, it was implied, could be attributed to a premium required in yields of fixed-principal assets to compensate for the persistent erosion of their real value due to expectations of continued price inflation.[4] The distinction drawn between changes in the general prices' level and changes in relative prices has merit. Nonetheless there were many good reasons to introduce a consideration of changes in prices of project outputs relative to prices, or opportunity costs, of project inputs. That this was the case followed from the results of extensive research on the behavior of prices of extractive industry production relative to the prices of goods and services generally. The costs of extracting natural resource commodities and their market prices historically were shown to have remained either stable (for some) or actually declined (for others) relative to the price of goods and services in general.[5] Accordingly, since these were the commodities which were being produced, in part, as outputs of the public resource development programs, there was in fact an authentic change in the price of outputs of such programs relative to the general price level. But the changes were in a direction contrary to that which the proponents of a differential (lower) interest rate for planning purposes assumed to be required.

With authentic changes in relative prices of program inputs and outputs established, such changes, if demonstrated to be quantitatively significant, should be included among the items explicitly considered in benefit-cost analysis.

A related issue of a somewhat different character is also potentially relevant for consideration of changes in relative values. Many resource development programs result in the "reclamation" of lands representing natural environments or the development of arable land by the transformation of natural areas which themselves have a potential to yield services of value in their natural state. Similarly the development of hydro-electric power, and related water resource developments, in the process not infrequently convert free flowing streams and other bodies of water from their natural state to "working rivers." The conventional practice in benefit-cost analysis has been either to ignore, or to treat such services as "extra-economic." [6] As common property resources are often being used for such purposes, but only private

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[3] During 1968 and 1969 hearings were held by the Joint Economic Committee coinciding with an effort by the Bureau of the Budget to move the rate used for discounting into greater conformity with yields on long term government bonds. See for example, *Economic Analysis of Public Investment Decisions; Interest Rate Policy and Discounting Analysis.* Hearings before the Subcommittee on Economy in Government of the Joint Economic Committee (90th Congress, 2nd Session), July 30, 31; August 1, 1968 (Washington: Government Printing Office, 1968).

[4] See testimony of Henry P. Caulfield, Jr., *ibid.*, p. 14.

[5] Neal Potter and Francis Christy, *Trends in Natural Resource Commodities: Statistics on Price, Output, Consumption, Foreign Trade, and Employment in the United States, 1870-1957* (Baltimore: The Johns Hopkins Press, 1962).

[6] See for example, *Proposed Practices for Economic Analysis of River Basin Projects.* Report to the Inter-Agency Committee on Water Resources, prepared by the Subcommittee on Evaluation Standards, Washington, 1958, p. 44; McKean, *op. cit.*, p. 61; John V. Krutilla and Otto Eckstein, *Multiple Purpose River Development* (Baltimore: The Johns Hopkins Press, 1958), p. 265; and Maynard M. Huffschmidt, John V. Krutilla and Julius Margolis, *Standards and Criteria for Formulating and Evaluating Water Resource Developments.* Report to the Bureau of the Budget, Washington, 1961, pp. 52-3.

property resources used in public (and some private)[7] development programs are counted as costs, the opportunity benefits foregone by the preemption of common property resources are conventionally overlooked. More significant than the exclusion of these opportunity costs as reflected in current demand, is the fact that the preempted resources are frequently irreproducible environmental resources. Accordingly, while the flow of extractive industrial commodities has been augmented at falling supply price historically due to gains in productive efficiency, an increase in demand for irreplaceable assets will result in growing relative scarcity and increase in relative value. There then appears to be an asymmetry in the implications of technological advance for the value of the different purposes to which such environmental resources will be devoted which will be reflected in changes in relative values.[8]

It will be the purpose of this paper to investigate the quantitative significance of taking these previously neglected considerations into account. We shall do so in the context of a currently controversial environmental case involving the Hells Canyon of the Snake River occurring between the Wallowa Mountains of Oregon and the Seven Devils Peaks of Idaho.[9]

A Multiperiod Model for a Hydroelectric Power Facility: The Developmental Case

The Hells Canyon represents the deepest gorge on the North American Continent. Due to the elevation differential from Canyon floor to its rim, most of the ecological life zones found in North America are represented in a horizontal distance of roughly half a mile. Because of its great depth, narrowness of its course in some reaches and the steepness of its walls, it represents both a unique geomorphological occurrence and perhaps the best remaining hydroelectric site in coterminous United States. Development of the site for hydroelectric power, of course, will represent an action with an irreversible environmental impact, thus foreclose one of the options presently available. Preservation of the natural environment of the remaining portion of the Canyon [10] will require forebearing the benefits from hydroelectric development. In short, the net benefits lost by the preclusion of one alternative course of action by adoption of its mutually exclusive alternative represents the opportunity cost of the selected course. In this section we shall evaluate the benefits of development considering all costs except for the opportunity benefits available from the area if retained in its present state.

As long as the price consumers are willing to pay exceeds the project's cost, the accepted method of estimating the net benefit of a hydroelectric development is to compare its costs with that of the most economical alternative designed to provide identical services. Since the services provided are the same, the gross benefits of the two alternatives being compared must be equal. The only net benefit

[7] Private developments on publicly-owned lands and water under license or permits such as private hydroelectric developments on navigable streams, mining on lands in public ownership, etc.

[8] John V. Krutilla, "Conservation Reconsidered," *American Economic Review*, September 1967, Vol. 57, No. 3, pp. 777–86.

[9] See, *In the Matter of Pacific Northwest Power Company and Washington Public Power Supply System* Projects Nos. 2243/2273, before the Federal Power Commission.

[10] It should be mentioned that approximately a half of the Canyon's two-hundred mile length has already been developed by the Idaho Power Company.

that one can claim will be the savings in cost that it can show rs compared with its alternative.[11]

This traditional measure of benefit is calculated at the time the hydroelectric power project is constructed and therefore implicitly assumes that the technology of alternative sources of energy is fixed over the entire life of the hydroelectric project. However, in a growing, technologically innovating economy, new thermal plants with new technology replace older less-efficient plants within the period typically taken as the life of a hydro plant. The improved technology and shorter life of alternative energy sources should be reflected in both changing energy and capacity costs and suggest an adjustment to the conventionally measured net benefits of a hydro facility.

The traditional unadjusted present value of the cost of the alternative source of electric power can be represented as follows:

$$PVC_a = \sum_{n=1}^{50} \frac{[C_I + E(8760F)]}{(1+i)^{n-1}}$$

where: n = the assumed life of the hydro facility (50 years)
C_I = constant annual capacity costs/KW of the alternative energy source
E = energy cost/KWH
F = the plant factor (assume to be 0.90)
i = the discount rate

The F term represents the plant factor, which is defined as the average power load over the relevant time period divided by the peak load. By operating under a rule of minimizing unit costs the system uses its most efficient plants first. The system will be managed in such a manner that those plants with the highest efficiency are utilized most fully; this policy will mean the newest plants will have the highest plant factor.

As any one plant in the system ages and new plants enter the system with improved operating efficiency and reduced unit cost, the older plant will be used a smaller proportion of the time. To take account of the impact of technological change, we recognize that as the alternative for the hydro facility begins to age, its plant factor will decline. The Federal Power Commission studies suggest that a thermal alternative enters with a high plant factor but declines to 0.20 by the 20th year.[12] We assume for computational simplicity that the plant factor declines from 0.90 in the initial year to 0.30 in the 20th year and replacement in the 30th year, that is, by an arithmetic factor of 0.03 per year.

This energy will be replaced each year by an equal amount of energy but at reduced costs from new, more technologically advanced additions as more efficient plants enter the system over time. In any given year the alternative cost of an equivalent source of energy to the hydro will be made up of the weighted average of today's and tomorrow's technology. Such an adjustment of the conventional formulation of the costs of the alternative is derived in appendix A.

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[11] See, Peter O. Steiner, "The Role of Alternative Cost in Project Design and Selection," *Quarterly Journal of Economics*, Vol. LXXIX, No. 3, pp. 421-22 (August 1965). Proof of this statement is found in Appendix A.

[12] "Hydro-Electric Power Evaluation," F.P.C. No. P-35 (1968) and "In the Matter of . . . ," testimony of Dr. John V. Krutilla.

Furthermore, when the original thermal plant reaches 30 years of age it will be replaced by a new plant, therefore the effect of technological change on capacity costs will also be important. We can expect that a new capacity cost after 30 years will be equal to the present capacity costs reduced by the rate of technological advance.

We can express the present value of alternative costs adjusted for both capacity and energy cost changes with technological progress for the 50-year expected life of the hydro facility as: [13]

$$PVC'_a=[C_I+(8760)EF]\frac{(1-a^{30})}{(1-a)}-\frac{8760EK}{i}\left[\frac{1-a^{29}}{1-a}-29a^{29}\right]+$$

$$\frac{8760EK}{(1+r)(1+i)-1}\left[\frac{1-b^{29}}{1-b}-29b^{29}\right]+\left(\frac{1}{(1+i)}\right)^{30}\left([C_{II}+8760'E'F]\frac{(1-a^{20})}{(1-a)}-\right.$$

$$\left.\frac{8760E'K}{i}\left[\frac{1-a^{19}}{1-a}-19a^{19}\right]+\frac{8760E'K}{(1+r)(1+i)-1}\left[\frac{1-b^{19}}{1-b}-19b^{19}\right]\right)$$

where:

K = a constant representing the time decay of plant factor (assume .03)

r = the annual rate of technological change

$C_{II}=C_I/(1+r)^{30}$

$E'=\dfrac{E}{(1+r)^{30}}$

$a=\dfrac{1}{1+i}$

$b=\dfrac{1}{(1+r)}(1+i).$

Using similar notation for the traditional measure of the present value cost of the alternative:

$$PVC_a=\sum_{n=1}^{50}\frac{[C_I+E(8760F)]}{(1+i)^{n-1}}$$

becomes:

$$PVC_a=[C_I+(8760)EF]\frac{(1-a^{50})}{1-a}.$$

Now we can determine the adjustment factor necessary to calculate the net benefits of a particular river as an input for the production of electric power, by adjusting the conventional measure of net benefits:

$$b_a=PVC_a-PVC_H,$$

where: PVC_H is the present value of hydro power costs

to show the impact of technological change on both energy and capacity costs of the alternative by dividing PVC'_a (adjusted) by

[13] See appendix A for this derivation.

PVC_a and recalculate net benefits using this adjustment factor as b'_a, by:

$$b'_a = \frac{PVC'_a}{PVC_a} \cdot PVC_a - PVC_H$$

$$b'_a = PVC'_a - PVC_H.$$

In table I the calculation of the percentage of unadjusted to adjusted costs

$$\frac{PVC_a}{PVC'_a}$$

is shown. The results of this adjustment are rather insensitive to various assumptions about i, r, and the three different mills per kilowatt-hour values, as used in the Hells Canyon case. However, when alternative costs (PVC_a and PVC_H) are close, the change in net differences may be significant.

TABLE I.—OVERSTATEMENT OF HYDROELECTRIC CAPACITY AND ENERGY VALUES BY NEGLECTING INFLUENCE OF TECHNOLOGICAL ADVANCES

Discount rate per year (i=)	Technological advance rate per year rt=	Conventionally estimated costs of the alternative as a percentage of the costs of the alternative when adjusted for influence of technological advance, for various capacity and energy costs			
		Dollars per kilowatt capacity	Mills per kilowatt-hour		
			Percent at 0.98	Percent at 1.22	Percent at 1.28
0.08	0.03	27.43	107.4	107.9	108.0
	.04		109.0	109.6	109.7
	.05		110.2	110.9	111.1
0.09	.03	30.08	105.9	106.4	106.5
	.04		107.2	107.7	107.8
	.05		108.2	108.8	108.9
0.10	.03	32.89	104.8	105.1	105.2
	.04		105.8	106.2	106.3
	.05		106.5	107.1	107.2

Source: "In the matter of . . . ." Op. cit., exhibit 670, table 1, p. 3, testimony of John V. Krutilla.

A Multiperiod Model for the Preserved Canyon

Consider next the preservation alternative. When the facility providing the service is a reusable, nondepreciating asset, such as a natural environment protected against destruction or degradation, the gross value of benefits is the area under the demand curve for each time period the natural area is used. If time is given the customary value of 1 year, the gross benefit of the natural area would be approximated by the sum of discounted annual benefits. This present value can then be compared with the capital investment (if any) plus the present value of annual operating costs (if any) and also the opportunity cost, or net present value of the most economical alternative use (b'_d) precluded by retention of the area for uses compatible with existing environmental conditions in the Canyon.

To establish the consistency in the treatment of the net developmental and net preservation benefits, we must also consider the net value of substitute environmental resources which might also provide experiences similar to those possible in the present canyon.

Since the canyon in an undeveloped state is a gift of nature, the costs, other than opportunity costs accounted for in b'_a, are zero. Additionally, Hells Canyon is in many respects unique,[14] thus the benefits to society from preserving attributes of uniqueness cannot be diminished by close substitutes, since none exist. However, some present uses of the Canyon, such as big game hunting, white water boating and fishing may occur with alternative environmental resources. If the present availability of these alternatives exceeds the present and expected future demand, the value of preserving the canyon for these uses, which is but one component of this excess supply, would be negligible.

At the present time wilderness areas comparable to Hells Canyon may be generally characterized in one of two ways. In some cases or for some uses they are managed so as to control and restrict use, i.e., ration the available supply. When certain areas are regulated in this manner, they will not be feasible alternative sources of supply for prospective users of Hells Canyon since they are already being used at or near capacity. In other cases environmental resources may be open to use without rationing. In such cases use will continue up to the point where congestion costs grow large and reduce net average benefits per user to zero. From the testimony in the case and the work of George Stankey [15] we may conclude that for activities which use the services of both the canyon and other environmental resources, reducing the supply by altering the canyon will prevent present and potential users from finding available like substitutes. Under the circumstances there would be no positive net alternative benefit, and preservation benefit is reduced to an evaluation of gross benefits for the activities provided at the preserved Canyon.

If the demand for the services of the area grows, congestion externalities eventually will arise. That is, a point will be reached beyond which the use of the area by one more individual per unit time will result in a lessening of the utility obtained by others using the area. We have taken this point to be the carrying capacity of Hells Canyon for the purpose of our analysis. If the marginal benefits of additional users exceed the marginal congestion costs they inflict on others, total benefits could be increased by relaxing this constraint. But, we seek to define a quantity of constant quality services the value of which represent a lower bound estimate of the preservation alternative. Implicit in this position, of course, is the assumption that pricing will be employed in practice to ration use to the constraint level.

Growth in the demand for services of the preserved area and a capacity constraint introduce some complications in the analysis. First, as income, relative prices, population and tastes change through time, the usual *ceteris paribus* assumptions must be relaxed. Accordingly, the shape and area under the demand curve may be expected to change with temporal shifts in the demand curve. Such shifts must be incorporated into the benefit estimating procedure and treated separately. Secondly, capacity constraint, since its value sets the

[14] See, Luna B. Leopold, "Quantitative Comparison of Some Aesthetic Factors Among Rivers," Geological Survey Curcular 620 1969) also his testimony, "In Matter of: Pacific Northwest Power Company and Washington Public Power Supply System," Projects Nos. 2243/2273, before the Federal Power Commission.

[15] George Stankey, *The Perception of Wilderness Recreation Carrying Capacity: A Geographic Study in Natural Resources Management*, Michigan State University, Department of Geography, Ph. D. Thesis, 1971.

limit on the range over which the quantity demanded can be assumed without further adjustment, must be defined.

Taking the effect of population change first, a plausible hypothesis is that, given similar individual demand schedules for successive population, an increase in population will cause a constant percentage increase in quantity demanded for any given price. That is, if we expect relatively constant preferences and income distributions as the population grows, this would mean that the ratio of the percentage change in quantity demanded to the percentage change in population would be invariant with price, or that there would be a constant elasticity of quantity demanded to population size.

Two other components of the shift in the demand schedule result from changing consumer incomes and relative prices. With advances in technology it is expected that the stocks of producible goods per capita will increase and a concomitant drop in the price of these producible goods will occur. The price per unit or value of nonproduced goods in fixed supply would be expected to change relative to price of producible goods.

Hicks and Allen [16] by using a system of simultaneous partial differential equations have explained the necessary and sufficient conditions for relative price variation in a two-good world. These will be functions of the relative income elasticities, price elasticities, cross elasticities, percent of initial year's budget spent on each commodity and the elasticity of substitution. From their analysis we conclude that if (*a*) the present uses of Hells Canyon as a preserved environmental resource have poor substitutes among manufactured goods, (*b*) the income and initial price elasticities of demand for present uses of the Canyon are numerically larger than for manufactured goods in general, and (*c*) the percent of the budget spent on the good in fixed supply is smaller than on producible or manufactured goods in general, we would expect the relative price and therefore value of the good in fixed supply to grow over time relative to the price of manufactured goods. In short, we are assuming that the environmental services of an unaltered Hells Canyon are relative luxury goods in a two-good world.

To utilize the above criteria in a computational model, as economic expansion occurs, two conventional economic parameters are important. First, the income elasticity of manufactured goods and second, the cross-elasticity of demand of the price of Hells Canyon relative to the quantity of manufactured goods. For computational simplicity these two effects are combined to form a vertical shifter for the demand schedule.

It then follows that if a visit to Hells Canyon is considered a relative luxury good with no close substitute by a portion of the population (which considers manufactured goods as normal goods) the price

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[16] Hicks, J. R. and R. G. D. Allen, "A Reconsideration of the Theory of Value," *Economica*, New Series Vol. I, 1934. In their analysis they provide a framework that can be used to determine the conditions sufficient for the price of a good in fixed supply to grow relative to the price of manufactured goods. These are that the elasticity of income for the good in fixed supply must exceed the elasticity of substitution which in turn must exceed the income elasticity of manufactured goods. If it is also expected that the price elasticity of manufactured goods is inelastic, then all three shifters for the demand curve of the good in fixed supply will be positive for quantity and price. These three shifters are the income elasticity, and the two cross-elasticities multiplied by their corresponding percentage price decrease and percentage quantity increase for the manufactured goods. See "Preservation vs. Development: Some Economic Issues," C. J. Cicchetti and J. V. Krutilla. Paper presented at the Econometric Society, New York, 1970.

or value that this group will be willing to pay for a visit to Hells Canyon would grow over time. Finally, we assume for computational simplicity a constant percentage increase in willingness to pay per percentage increase in income for a given quantity.

A third component of shift in demand indicated above was taste. The tastes or preferences of individuals may be thought of as affecting the numerical values or signs, the explicit elasticities of population to quantity (horizontal) and income to price (vertical) over time. For example, in the initial time period population might grow at, say, 1.5 percent per year but the quantity demanded at zero price might be growing at 10 percent per year. However, the rate of change of tastes for the population at large favoring this kind of recreational activity would begin to decline as a "saturation level" is approached so that eventually demand will reflect only additions to population and incomes rather than an increasing proportion of the population participating.

To this point we have avoided being specific about the nature of the "preservation values," and this has been deliberate. The services which a natural area of this sort can provide are several, the value of some of which have become measurable by advances in economic analysis, for example the value of some outdoor recreation resources, while the value of others are as yet intractable to economic measurement, for example, option value of preserving rare scientific research materials. For this reason we adopt an alternative strategem. We do not seek, directly, to learn the present value of services yielded from the Canyon if preserved in its present condition since we do not know how to measure it *en toto*. We ask rather what would the present value need to be to equal or to exceed the present value of the developmental alternative. And to get better insight, we ask additionally, what would the base year's annual benefit need to be, changing in response to real income and population growth, to have a present value equal to or greater than the developmental alternative. This latter step is of considerable analytical assistance by virtue of the difference in the relation between the initial year's benefit and total present value for the two competing choices of the area in question—preservation or development. This follows because of the asymmetry in the behavior of the value of the output streams from the two incompatible uses of the site as technology changes and the economy grows. We show this in exaggerated form for illustrative purposes in the present value computational models for the two below.

The development alternative:

$$b'_d = \sum_{t=1}^{T} \frac{b_o(1+r)^t}{(1+i)^t}$$

Where b'_d is the present value of developmental benefits
b_o is the initial, or base year's, benefits
T is the relevant terminal year for the development alternative
i is the discount rate
r is the simplified representation of the technological change adjustment for development benefits presented earlier.

The preservation alternative:

$$b_p = \sum_{t=1}^{T'} \frac{b_o(1+\alpha)^t}{(1+i)^t}$$

Where b_p is the present value of the benefits from preserving the area in its natural condition

b_o is the initial, or base year's, benefit

T' is the relevant terminal year for the preservation alternative

i is the discount rate

α is the rate of growth in annual benefits as qualitatively described above and quantitatively explained in detail in appendix B.

We assume that T and T', the terminal year for each choice, are determined by the year in which the discounted annual benefit falls to zero.[17] These values need not and probably would not be the same. For convenience in computation, we will select T and T' as the years in which the increment to the present value of net benefits of each choice falls to \$0.01 per \$1 of initial year's benefits.

Although the initial year's benefit of the developmental alternative may be quite large, and in fact the net present value as computed [18] is impressive, the initial year's preservation benefits may need to be only very modest, given the relation between α and i in the present computational model for preservation benefits. What we wish to do, then, is to compute present value of 1 dollar's worth of initial year's "composite" preservation benefits as explained in appendix B for use in determining what the total initial year's preservation benefits would need to be, to equal or exceed the present value of developmental benefits. We achieve our objective by dividing the present value of \$1 of initial year's benefits growing at a variable rate α into the present value of developmental benefits falling at a variable rate r. This calculation is the required initial year's preservation benefits which makes the two alternatives a matter of social indifference.

Quantitative Results and Sensitivity Analysis

In the case of the technological change development model, the quantitative results will depend on investment per unit capacity of the alternative thermal source, itself partly depending on the interest rate. In addition, the results will depend on the cost per kilowatt hour of thermal energy. Finally, the rate of advance in technical efficiency itself enters into the calculation of the difference between the results obtained when technological advance is, and when it is not, introduced explicitly into the analysis. For our purposes, we have relied on construction cost data provided by Federal Power Commission staff witness;[19] have used opportunity cost of capital of 9 percent, but with estimates provided alternatively using 8 percent

[17] For demonstration of the correctness of this criterion, see Anthony C. Fisher, John V. Krutilla and Charles J. Cicchetti, "The Economics of Environmental Preservation," *American Economic Review*, September 1972.

[18] The "net" present value, of course, does not reflect the opportunity costs of converting an existing recreational area into a hydroelectric storage reservoir, which is a principal task of this exercise.

[19] Testimony of FPC staff witness Jessell, "In the Matter of . . . ." Op. cit., and exhibit No. R-54-B.

and 10 percent for purposes of sensitivity analyses [20]; have used rates of technological progress of between 3 percent and 5 percent per year, to bracket what is believed to be the relevant range [21]; and have used energy costs, again supplied by FPC staff witnesses, of 0.98 mills per kilowatt hour in the early stage, ranging to 1.28 mills per kilowatt hour in the later period of analysis.[22] The adjustment factors for introducing the influence of technological change into the analysis were shown in table I.

The present value of a dollar's worth of initial year's preservation benefit (table II) is a function of both the rate of growth in annual benefits, α, and the discount rate, i. But from the discussion above, which is more specifically defined in appendix B, it is apparent that annual benefits do not grow at a uniform rate (α) over time but depend upon certain parameters. These are:

Parameters Affecting Preservation Benefits	*Symbol*
Annual Change in Use	γ
Annual Increase in Willingness to Pay	r_y
Recreational Carrying Capacity	k
Rate of Deterioration in Demand When Congestion Point is Reached	d
Year at Which Increase in Demand Equals Only Population Increase	m

Since k represents the time period when "recreational carrying capacity" is reached and is given by the capacity of the area to accommodate recreation seekers without eroding the quality of the recreational experience, k and γ are related.[23] The selection of the value of m of 50 years, with alternative assumptions of 40 and 60, was governed by both the rate of growth of general demand for wilderness or primitive area recreation, and the estimated "saturation level" for such recreational participation for the population as a whole. Finally, the range of values for r_y was taken from what we know about the conventional income elasticity of demand (as reinterpreted in the light of the expected lack of substitutes both in the present and over time), for this kind of recreation activity [24] and growth in per capita income over the past two or three decades.

Now, what do these models tell us which the traditional analysis of comparable situations requiring the allocation of "gifts of nature" between two incompatible alternatives does not?

Let us take for illustration, subject later to sensitivity analysis, the computed initial year's preservation benefit (table III) corresponding to i of 9 percent, r_t of 0.04, γ of 10 percent and k of 20 years, m of 50 years and r_y of 0.05; namely $80,122. Is this a preservation benefit we might expect to be equaled or exceeded by the first year the hydroelectric project would otherwise go into operation? In many cases we would have only the sketchiest information and would have to make such a comparison on the basis of judgment. In the case of Hells Canyon, we obtained rather better information and shall return

[20] A discount rate of 9 percent, with alternatives of 8 and 10 percent was the result of independent study. *See* Otto Eckstein and Arnold Harberger, "Economic Analysis of Public Investment Decisions: Interest Rate Policy and Discounting Analysis." Hearings before the Subcommittee on Economy in Government of the Joint Economic Committee, 90th Cong., 2d sess. (Washington: U.S.G.P.O., 1968). See also Seagraves, J. A., "More on the Social Rate of Discount," *Quarterly Journal of Economics*, Vol. LXXIV, No. 3 (August 1970).

[21] Data on technological change computed from Electrical World's biannual *Steam Station Cost Surveys*, 1950–68.

[22] Testimony of FPC staff witness Chavez, "In the Matter of . . . ." *Op. cit.*, and exhibit No. R-107-B.

[23] The particular values taken, that is, γ of 10 percent and k of 20 years, with alternative assumptions for purposes of sensitivity analyses, were chosen for reasons given in Krutilla testimony, *op. cit.*, transcript pp. R-5864–66 and R-5872.

[24] Cicchetti, Seneca, and Davidson, *The Demand and Supply of Outdoor Recreation* (Washington: Department of Interior, 1969).

TABLE II.—PRESENT VALUE OF $1's WORTH OF INITIAL YEAR'S PRESERVATION BENEFITS (GROWING AT α)

i=8%; m=50 years

r_y	γ=7.5% k=25 years	γ=10% k=20 years	γ=12.5% k=15 years
0.04	$134.08	$169.86	$173.90
0.05	211.72	263.49	262.12
0.06	385.10	467.30	449.00

i=9%: m=50 years

r_y	γ=7.5% k=25 years	γ=10% k=20 years	γ=12.5% k=15 years
0.04	$93.67	$120.07	$125.89
0.05	136.12	172.35	176.25
0.06	214.76	267.10	264.49

i=10%, m=50 years

r_y	γ=7.5% k=25 years	γ=10% k=20 years	γ=12.5% k=15 years
0.04	$69.28	$89.45	$95.71
0.05	95.15	121.91	127.68
0.06	138.17	174.85	178.66

Where:
i=discount rate.
r_y=Annual rate of growth of price for a given quantity.
γ=Annual rate of growth of quantity demanded at given price.
k=Number of years after initial year in which carrying capacity constraint becomes effective.
m=Number of years after initial year in which gamma falls to rate of growth of population.

TABLE III.—INITIAL YEAR'S PRESERVATION BENEFITS (GROWING AT THE RATE α) REQUIRED IN ORDER TO HAVE PRESENT VALUE EQUAL TO DEVELOPMENT

i=8%, m=50 years, r_t=0.04, b'_d=$18,540,000

r_y	γ=7.5% k=25 years	γ=10% k=20 years	γ=12.5% k=15 years
0.04	$138,276	$109,149	$106,613
0.05	87,568	70,363	70,731
0.06	48,143	39,674	41,292

i=9%, m=50 years, r_t=0.04, b'_d=$13,809,000

r_y	γ=7.5% k=25 years	γ=10% k=20 years	γ=12.5% k=15 years
0.04	$147,422	$115,008	$109,691
0.05	101,447	80,122	78,336
0.06	64,300	51,700	52,210

i =10%, m=50 years, r_t=0.04, b'_d=$9,861,000

r_y	γ=7.5% k=25 years	γ=10% k=20 years	γ=12.5% k=15 years
0.04	$142,335	$110,240	$103,030
0.05	103,626	80,888	77,232
0.06	71,369	56,397	55,194

Source: Exhibit No. R-671, "In the Matter of . . ."
Where: i=Discount rate.
r_y=Annual rate of growth in price for a given quantity.
γ=Annual rate of growth of quantity demanded at given price.
k=Number of years following initial year upon which carrying capacity constraint becomes effective.
m=Number of years after initial year upon which gamma falls to rate of growth of population.
b'_d=Present value of development (adjusted).
r_t=Annual rate of technological progress in the development case.

to the matter subsequently. But for now, we have the sum of $80,000 as the benchmark figure which we feel is necessary to justify, on economic grounds, allocation of the resource to uses compatible with retention of the area in its present condition. This sum of $80,000 compares with the sum of $2.9 million, which represents the "levelized" annual benefit from the hydroelectric development, when neither adjustments for technological progress have been made in hydroelectric power value computations, nor any site value (i.e., present value of opportunity returns foreclosed by altering the present use of the canyon) is imputed to costs. Typically then, the question would be raised whether or not the preservation value is equal to or greater than the $2.9 million annual benefits from development.

Let us now consider the readily quantifiable benefits from the existing uses of the Canyon. These are based on studies conducted by the Oregon and Idaho State's Fish and Game Departments, in collaboration with the U.S. Forest Service, and are displayed along with our imputation of values per user day in table IV below. From table IV one could argue, for example, that the preservation benefits shown are roughly only a third ($0.9 million to $2.9 million) as large as would be required in comparisons based on traditional analysis of similar cases. By introducing the differential incidence of technological progress on the mutually exclusive alternatives for the Hells Canyon, we have quite a different conclusion. The initial year's preservation benefit,

TABLE IV.—ILLUSTRATIVE OPPORTUNITY COSTS OF ALTERING FREE-FLOWING RIVER AND RELATED CANYON ENVIRONMENT BY DEVELOPMENT OF HIGH MOUNTAIN SHEEP

Quantified losses	Recreation days, 1969 [1]	Visitor days, 1969 [2]	Visitor days, 1976
Stream-based recreation: [3]			
Total of boat counter survey	18,755	28,132	51,000.
Upstream of Salmon-Snake confluence	9,622	14,439	26,000.
Nonboat access:			
Imnaha-Dug Bar	9,678	14,517	26,000.
Pittsburgh Landing	9,643	14,464	26,000.
Hells Canyon downstream:			
Boat anglers	2,472	1,000	1,800.
Bank anglers	9,559	2,333	4,000.
Total stream use above Salmon River	40,974	[4] 46,753	84,000 at $5.00/day=$420,000.
Hunting, Canyon area: [5]			
Big game	7,050	7,050	7,000 at $25.00/day=$175,000.
Upland birds	1,110	1,110	1,000 at $10.00/day=$10,000.
Diminished value of hunting experience [6]	18,000	18,000	29,000 at $10.00/day=$290,000.
Total quantified losses			$895,000±25 percent

[1] "Recreation days" corresponds to definition as per supplement No. 1, S. Doc No. 97; namely, an individual engaging in recreation for any "reasonable portion of a day." In this particular study, time involved must be minimum of 1 hour, as per letter, from Monte Richards, Coordinator, Basin Investigations, Idaho Fish and Game Department.

[2] "Visitor day" corresponds to the President's Recreational Advisory Council (now, Environmental Quality Council) Coordination Bulletin No. 6 definition of a visitor-day as a 12-hr. day. Operationally, the total number of hours, divided by 12, will give the appropriate "visitor-day" estimate.

[3] Source: "An Evaluation of Recreational Use on the Snake River in the High Mountain Sheep Impact Area," survey by Oregon State Game Commission and Idaho State Fish and Game Department in cooperation with U.S. Forest Service, report dated January 1970 and memorandum, W. B. Hall, Liaison Officer, Wallowa-Whitman National Forest, dated Jan. 20, 1970.

[4] Not included in the survey were scenic flights, nor trail use via Saddle Creek and Battle Creek trails. Thus, estimates given represent an underreporting of an unevaluated amount.

[5] "Middle Snake River Study, Idaho, Oregon, and Washington" Joint Report of the Bureau of Commercial Fisheries and Bureau of Sports Fisheries and Wildlife in Department of the Interior Resource Study of the Middle Snake, tables 10 and 11.

[6] The figure 18,000 hunter-days is based on Witness Pitney's estimate of 15,000 big-game hunter-days on the Oregon side, and estimated 10,000 hunter-days on the Idaho side (provided in letter from Monte Richards, coordinator, Idaho Basin investigations, Idaho Fish and Game Department, dated Feb 13, 1970) for a total of 25,000 hunter-days (excluding small game; i.e, principally upland birds) in the canyon area, less estimated losses of 7,000 hunter-days. This provides the estimated 18,000 hunter-days, 1969 total, which growing at estimated 5 percent per year for deer hunting and 9 percent per year for elk hunting would total 29,000 hunter-days by 1976.

Note: Unevaluated losses: (A) Unmitigated anadromous fish losses outside impact area; (B) unmitigated resident fish losses: (1) Stream fishing downstream from High Mountain Sheep; (C) option value of rare geomorphological-biological-ecological phenomena; and (D) Others.

subject to reevaluation on the basis of sensitivity tests, appears to be an order of magnitude ($900,000 to $80,000) larger than it needs to be to have a present value equaling or exceeding the present value of the development alternative. Thus we get results significantly different from traditional analysis.

We must still consider the sensitivity of these conclusions to the particular values the variables used in the simulation model. Sensitivity tests can be performed with the data contained in tables I and II, along with additional information available from computer runs performed. Some of these checks are displayed in table V.

TABLE V.—SENSITIVITY OF ESTIMATED INITIAL YEAR'S REQUIRED PRESERVATION BENEFITS TO CHANGES IN VALUE OF VARIABLES AND PARAMETERS (AT i=9 PERCENT)

Variable	Variation in Variable		Percent change	Percent change in preservation benefit
	From—	To—		
r_y	0.04	0.05	25	39 to 49
r_t	0.04	0.05	25	25
k [1]	20 years	25 years	25	30 to 40
γ	10 percent	12.5 percent	25	−4 to +7
m	40 years	50 years	25	3

[1] The 25-percent change in years before capacity is reached translates into a 40-percent change in carrying capacity at the growth rate of 10 percent used here.

Given the estimated user days and imputed value per user day, it follows that the conclusions regarding the relative economic values of the two alternatives are not sensitive within a reasonable range, to the particular values chosen for the variables and parameters used in the computational models.

There is need, however, for another set of tests when exponential growth rates are being used. We might regard these as "plausibility analyses." For example, the plausibility of the ratio of the implicit price to the projected per capita income in the terminal year was examined and found to equal 2.5×10^{-3}. At today's prices and per capita income level this is comparable to a user fee of approximately $10. Similarly, the ratio of the terminal year's preservation benefit to the GNP in the terminal year can be examined for plausibility and is found to be 4.0×10^{-7} in the present example. This value compares with a ratio of the total revenue of the applicants' in 1968 to GNP of 5.0×10^{-4}. The year at which the growth rate in quantity of wilderness-type outdoor recreation services demanded falls to the rate of growth of population must also be checked to insure that the implicit population participation rate is something one would regard as reasonable. Such tests were performed in connection with the *Hells Canyon* case in order to avoid problems which otherwise would stem from use of unbounded estimates, and we found our assumed initial rates of 10 and 12.5 percent were conservative values.

Summary and Conclusions

Since the readily observed initial year's benefits were greater than the minimum value which was required to make the present value of the two alternatives equal, the analysis was concluded at that point. On the other hand, since the analysis relied implicitly on the price compensating measure of consumer surplus and does not include a

consideration of option value, that is, the economic value gained from preserving the option to visit the canyon in its present state for those members of society, who are not certain users of the canyon, the resulting estimate would therefore be a lower bound estimate of the preservation value. For circumstances in which the present value of the output stream from the developmental alternative would exceed that of the preservation alternative, as calculated above, a question might arise as to whether the comparative values are sufficient to justify the allocation to irreversible developmental purposes on economic grounds.

The analysis presented in this paper is important for a specific class of public works projects, which involve environmental irreversibilities. However, the general methodology is probably equally useful for all projects, which involve environmental irreversibilities. Presently, the National Environmental Protection Act of 1970 requires that all environmental irreversibilities must be outlined in an environmental impact statement. The methodology included in this current paper extends conventional benefit-cost analysis in such cases. While we have not developed a general methodology for all such cases, it is hoped that analysis of the type described above will be further extended and that the Congress will require the joint evaluation of the environmental impact statements (102 (C)) and benefit-cost analysis for such projects.

Appendix A

THE ALTERNATIVE COST ADJUSTMENT EQUATION

$$1<n\leq 30$$

$$C'_a{}^n = C_I + E8760\left[F-(n-1)K+\frac{(n-1)K}{(1+r)^{n-1}}\right]$$

and

$$C'_a{}^1 = C_I + E8760F$$

$$= C_I + E8760(F-(n-1)K) + \frac{E8760}{(1+r)^{n-1}}(n-1)K$$

$$= C_I + E8760F - E8760K(n-1) + \frac{E8760K(n-1)}{(1+r)^{n-1}}$$

$$PVC'_a(30) = \sum_{n=1}^{30} \frac{C'_a{}^n}{(1+i)^{n-1}}$$

therefore

$$PVC'_a(30) = \sum_{n=1}^{30}\left[\frac{C_I}{(1+i)^{n-1}} + \frac{EF8760}{(1+i)^{n-1}} - \frac{EK8760(n-1)}{(1+i)^{n-1}} + \frac{EK8760(n-1)}{(1+r)^{n-1}(1+i)^{n-1}}\right]$$

Each of these terms is a separate geometrical progression whose sum is given by the standard formula

$$s = f\frac{(1-c^n)}{1-c}$$

where

f = first term
c = common ratio
n = number of years this value is summed over.

The first two terms in $PVC'_a(30)$ have the same common ratio

$$\frac{1}{1+i}$$

which we will denote by "a", therefore if s_1 equals sum of first progression and s_2 equals the sum of the second progression, then

$$s^1 = C_I \frac{(1-a^{30})}{(1-a)}$$

and $s^2 = EF8760 \frac{(1-a^{30})}{(1-a)}$

The third term has a common ratio of $\frac{1}{(1+i)}$ (or a) but is also multiplied by $n-1$

and can therefore be thought of as $(n-1)$ separate geometric progressions with this common ratio, a. The effect of this can be seen if we let the number of periods equal m, then:

$\sum_{i=1}^{m} ma^m$ becomes

$$a + a^2 + \quad \ldots \quad a^m = a\frac{(a^m-1)}{a-1}$$

$$a^2 + \quad \ldots \quad a^m = a^2\frac{(a^{m-1}-1)}{a-1}$$

$$a^3 \quad \ldots \quad a^m = a^3\frac{(a^{m-2}-1)}{a-1}$$

$$\vdots$$

$$a^{m-1} + \quad a^m = a^{m-1}\frac{(a^2-1)}{a-1}$$

$$a^m = a^n \frac{(a-1)}{a-1}.$$

By factoring out a common term $\frac{a}{a-1}$ we are left with

$$\frac{a}{a-1}\left[(a^m-1) + a(a^{m-1}-1) + \ldots a^{m-2}(a^2-1) + a^{m-1}(a-1)\right]$$

which becomes after summing and multiplying

$$\frac{a}{a-1}\left[ma^m - a^{m-1} - a^{m-2} \ldots - a - 1\right].$$

Multiplying by $\frac{-1}{-1}$ we can reduce this to

$$\frac{a}{1-a}\left[a^{m-1} + \ldots a + 1 - ma^m\right].$$

Since the first m terms are also a geometric series they can be summed to form

$$\frac{(1-a^m)}{(1-a)}$$

and therefore

$$\sum_{i=1}^{m} ma^m = \frac{a}{1-a}\left[\frac{1-a^m}{1-a} - ma^m\right]$$

is a general result we can use to determine the sum of the third and fourth terms, s_3 and s_4 respectively.

In the case of s_3 the common term is "a" and the number of periods $m=29$, therefore

$$s_3=-\frac{a}{1-a}\,8760EK\left[\frac{1-a^{29}}{1-a}-29a^{29}\right].$$

but note

$$\frac{a}{1-a}=\frac{1}{i}$$

since

$$a=\frac{1}{1+i}$$

therefore

$$\frac{1}{i}=\frac{a}{1-a}$$

$$s_3=-\frac{1}{i}\,8760EK\left[\frac{1-a^{29}}{1-a}-29a^{29}\right].$$

In the case of the fourth term the common ratio is

$$\frac{1}{(1+i)(1+r)},$$

which we will call b. By using the same procedure as for the third term

$$s_4=\frac{b}{1-b}\,8760EK\left[\frac{1-b^{29}}{1-b}-29b^{29}\right]$$

and

$$\frac{b}{1-b}$$

is similarly reducible to

$$\frac{1}{(1+r)(1+i)-1}.$$

Therefore

$$s_4=\frac{1}{(1+r)(1+i)-1}\,8760EK\left[\frac{1-b^{29}}{1-b}-29b^{29}\right].$$

In a similar manner the PVC_a' (31,50) can be determined if we define

$$C_{II}=\frac{C_I}{(1+r)^{30}}$$

$$E'=\frac{E}{(1+r)^{30}}$$

and start the series off with a discount factor of

$$\left(\frac{1}{1+i}\right)^{30},$$

which we factor out of each term, then

$$PVC_a'(31,50)=\frac{1}{(1+i)^{30}}\left[[C_{II}+8760E'F]\left[\frac{1-a^{20}}{1-a}\right]-\right.$$

$$\left.\frac{8760E'K}{i}\left[\frac{1-a^{19}}{1-a}-19a^{19}\right]+\frac{8760E'K}{(1+r)(1+i)-1}\left[\frac{1-b^{19}}{1-b}-19b^{19}\right]\right]$$

PVC_a' becomes the sum of $PVC_a'(30)$ and $PVC_a'(31,50)$ thus completing the derivation of the equation shown in the text.

$$PVC_a' = [C_I + (8760)EF]\frac{(1-a^{30})}{(1-a)} - \frac{8760EK}{i}\left[\frac{1-a^{29}}{1-a} - 29a^{29}\right] +$$

$$\frac{8760EK}{(1+r)(1+i)-1}\left[\frac{1-b^{29}}{1-b} - 29b^{29}\right] + \left(\frac{1}{(1+i)}\right)^{30}\left([C_{II} + 8760E'F]\frac{(1-a^{20})}{(1-a)} - \right.$$

$$\left. \frac{8760E'K}{i}\left[\frac{1-a^{19}}{1-a} - 19a^{19}\right] + \frac{8760E'K}{(1+r)(1+i)-1}\left[\frac{1-b^{19}}{1-b} - 19b^{19}\right]\right)$$

where:

K = a constant representing the time decay of plant factor (assume .03)
r = the annual rate of technological change.

Appendix B

THE BENEFIT ESTIMATION MODEL FOR THE PRESERVATION CASE

Let:

b_o = \$1.00 of initial year's benefits.
P_o = initial vertical axis intercepts (see Figure I below).
Q_o = initial horizontal axis intercept.
D_oD_o' = initial year's composite computational demand schedule.
r_y = rate of growth in vertical component of shift, related to the increase in per capita income, assuming a constant (income-price) elasticity

$$\frac{\Delta P_H}{P_H} \cdot \frac{Y}{\Delta Y}\Big|Q = Q_o$$

γ = the historical rate of growth in the quantity demanded for $P = O$; i.e., horizontal component of demand shift at zero price. γ is constant up until capacity (year k).
k = the year the area reaches recreational carrying capacity.
d = the rate of decay of γ after year k which brings the rate of change in horizontal component of demand shift to rate of growth of population.
m = the year in which the rate of the horizontal component of demand shift equals the rate of growth of population.
i = rate of discount.

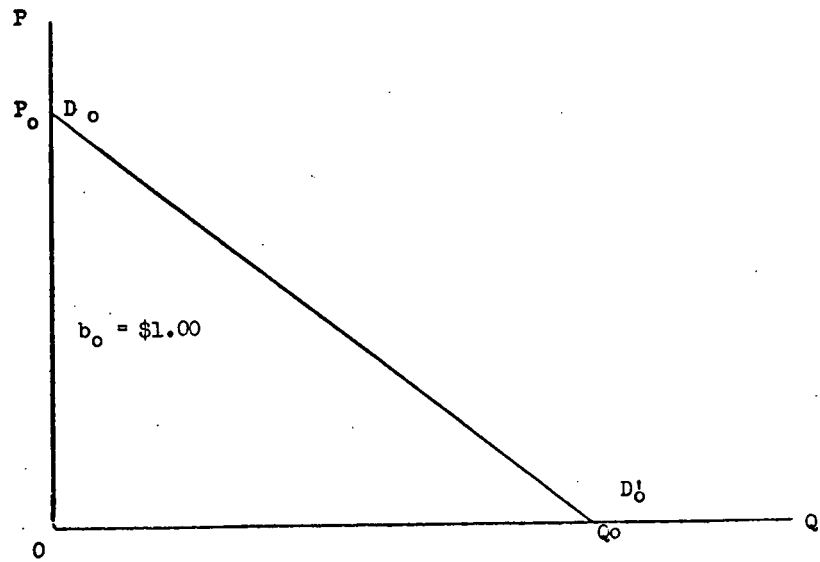

FIGURE I.—Demand curve in the initial year

$$P_t=(1+r_v)^t P_o$$

$$Q_t=(1+\gamma)^t Q_o \text{ for } t\leq k$$

$$Q_t=Q_{t-1}(1+\gamma_t) \text{ for } t>k$$

where

$$\gamma_t=\gamma(1+d)^{t-k}$$

and

$$d=\left[\frac{\gamma \text{ population}}{\gamma}\right]^{\frac{1}{m-k}}-1.$$

$$PV_{b^o}=\sum_{t=1}^{\infty}\frac{b_t}{(1+i)^t}$$

$$b_t=\frac{1}{2}P_tQ_t \text{ for } t\leq k$$

i.e., the area under the composite computational demand schedule D_tD_t'

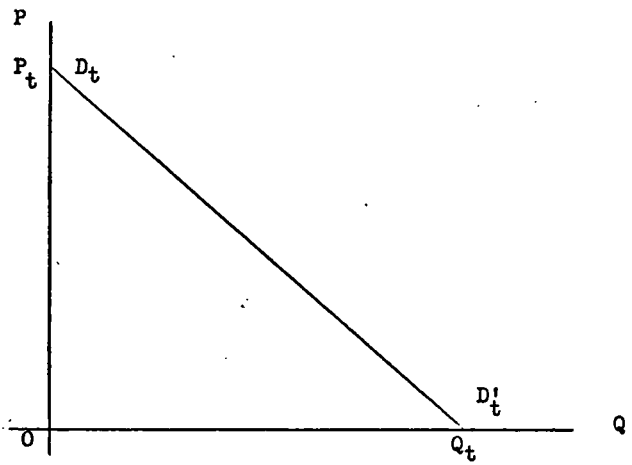

FIGURE II. Demand curve in year $t\leq k$

$b_t=\frac{1}{2}P_tQ_t-\frac{1}{2}P^*{}_tQ^*{}_t$ for $t>k$

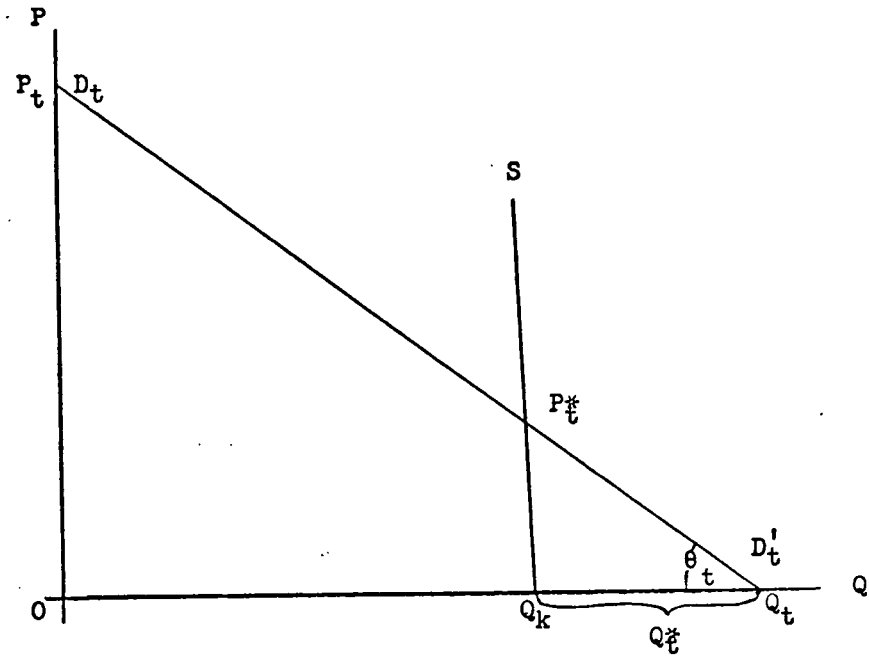

FIGURE III.—Demand curve in year $t>k$

where

$$\frac{P_t^*}{Q_t^*}=\tan\theta_t=\frac{P_t}{Q_t}$$

$\therefore$

$$P^*{}_t=Q_t^*\cdot\frac{P_t}{Q_t}$$

and

$$Q^*{}_t=Q_t-Q_k$$

and

$$b_t=\frac{1}{2}P_tQ_t-\frac{1}{2}(Q_t-Q_k)^2\frac{P_t}{Q_t}\text{ for }t>k$$

$\therefore$

$PV_{b^o}=b_t(t\leq k)+b_t(t>k)$, appropriately discounted.

An important parameter of the system is the annual percent increase in benefits. This is derived as follows:

$$b_t=\frac{1}{2}P_tQ_t \text{ for } t\leq k$$

$$=\frac{1}{2}(P_o(1+r_v)^t)(Q_o(1+\gamma)^t)$$

$$=\frac{1}{2}P_oQ_o((1+r_v)(1+\gamma))^t$$

but

$$1=\frac{1}{2}P_oQ_o$$

$$\therefore \quad b_t=(1+r_v\gamma+r_v+\gamma)^t$$

$$\frac{db_t}{dt}=(1+r_v\gamma+r_v+\gamma)^t\ Ln(1+r_v\gamma+r_v+\gamma)$$

$$\text{annual percent change in benefits}=\frac{\frac{db_t}{dt}}{b_t}$$

$$\therefore \quad \frac{\frac{db_t}{dt}}{b_t}=\frac{(1+r_v\gamma+r_v+\gamma)^t Ln(1+r_v\gamma+r_v+\gamma)}{(1+r_v\gamma+r_v+\gamma)^t}$$

$$=Ln(1+r_v\gamma+r_v+\gamma)$$

$$\text{for } t\leq k$$

The rate of change in preservation benefits referred to in section 3, α, is identical to this value

$$\frac{\frac{db_t}{dt}}{b_t}$$

when t is less than capacity, but since tastes are expected to change when the Canyon becomes saturated, the rate of change in benefits begins to decline at capacity (k). Accordingly,

$$\frac{\frac{db_t}{dt}}{b_t}$$

is an upper bound and would exceed the α discussed in section 3 for the life of the Canyon.

Finally, the slope of the initial composite computational demand schedule (the area under which is equal to unity) may be varied and the effect measured, since:

$$P=a+sQ$$

$$\frac{P_o \cdot Q_o}{2}=1$$

and

$$P_o=P \text{ when } Q=0$$

$$Q_o=Q \text{ when } P=0$$

$$\therefore \quad P=P_o+sQ$$

$$s=\frac{P_o}{Q_o}$$

$$sQ_o=P_o$$

and

$$P_o Q_o = 2$$
$$sQ_o^2 = 2$$
$$\therefore \quad Q_o = \sqrt{2/s} \text{ and } P_o = sQ_o$$

This last result allows for the calculation of benefits for various initial slopes as well as varying demand shifts and supply constraints, thus completing the general derivation for the computation of benefits through time for linear demand schedules.

By use of this model to calculate the present value of a dollar's worth of initial year's benefits, we can obtain, of course, the initial year's benefits required to justify retaining the canyon area in its present uses. The latter can be further decomposed by putting the initial year's benefits on an expected value per user basis. That is, if:

U_o = expected number of users in the initial year

B_o = the required initial year's benefits to justify preserving the canyon in its present condition

B_o/U_o = the expected average user value required to justify preserving the canyon area in its present type of uses.

Then this further decomposition permits us to observe the number of recreational (and/or other) users, estimate the average price or value per recreation day required, and compare this value or price with what is known about prices paid for similar types of recreational experiences.

AN ECONOMIC PERSPECTIVE ON THE SMALL WATERSHEDS PROGRAM

By ROBERT K. DAVIS, BARBARA J. INGLE, *and* WILLIAM J. GILLEN

I. THE SMALL WATERSHEDS PROGRAM

In 1954, Congress passed the Watershed Protection and Flood Prevention Act, subsequently amended, which provided for flood control, drainage, irrigation, water supply, and other water development within watersheds not greater than 250,000 acres. The act was an outgrowth of earlier Soil Conservation Service (SCS) demonstration projects and the Flood Control Act of 1936, both of which demonstrated a need for runoff and waterflow retardation and prevention of soil erosion in watersheds. More than 1,000 watershed projects have been approved, with as many as 2,000 additional applications as a backlog, indicating substantial success for the program.[1]

The program is composed of both structural and nonstructural measures, as demonstrated in the distribution of costs of the 100 projects which had been approved through June 1970. (Table 1 shows the percentage distribution of costs.) Structural measures comprised 72 percent of the costs; land treatment measures, including related technical assistance, amounted to 28 percent of the costs. Floodwater retarding structures and channel improvements are engineering measures designed to reduce flood damages either by storing or by speeding the drainage of floodwaters. The land treatment measures are the part of the program which carries out the original mission of soil conservation and flood retardation through conservation farming.

Flood plains protected by the structural measures become available for new or more intensive crop production; the farmer is thereby enabled to drain marshes and wetlands. The overall result has been an increase in the available cropland acreage. Anticipating this result, Arthur Maass, writing at the inception of the program, quoted USDA economic watershed surveys which stated that 80 to 90 percent of the benefits of the program would accrue directly to farmers as increased agricultural production.[2]

Since World War I the United States has achieved an expansion in the productivity of agriculture which has exceeded the growth of demand for farm products. The index of farm production per manhour has tripled since World War II, from 49 in 1946 to 153 in 1965.[3] The Government has implemented many costly programs intended to maintain farm incomes and to keep production under control. In

[1] Statement by George R. Bagley, national vice president, National Association of Conservation Districts, before the House Subcommittee on Government Operations, June 10, 1971.

[2] Arthur Maass, *Public Policy*, Graduate School of Public Administration, Harvard University, Cambridge, 1954.

[3] *Food and Fiber for the Future*, Report of the National Advisory Commission on Food and Fiber, U.S. Government Printing Office, July 1967.

view of these efforts it is apparent that the social value of measures which result in additions to crop acreage and output is quite low, perhaps negative.

TABLE I.—*Installation costs by type of measure in watershed workplans approved through June 30, 1970*

	Cost in percent
Structural measures:	
Floodwater-retarding (FWRS)	30. 1
Grade stabilizing	1. 1
FWR & GS combined	. 3
Multiple-purpose reservoirs (MP)	10. 3
Other single-purpose reservoirs (SP)	. 4
Channel improvement (CI)	23. 2
Dikes and levees (D&L)	. 5
Floodways and diversions (F&D)	. 9
Debris basins (DB)	. 4
Basic recreation facilities (BRF)	2. 6
Critical area treatment (CAT)	. 1
Miscellaneous structures (miscellaneous)	1. 6
Total structural measures	72. 3
Land treatment measures:	
Application of measures (Public Law 566)	. 5
Application of measures (other funds)	23. 5
Technical assistance (Public Law 566)	2. 5
Technical assistance (going program)	1. 2
Total land treatment	27. 7
Total installation costs	100. 0

Source: "Inventory of Benefits, Costs and Other Data for Public Law 566 Watershed Work Plans," Soil Conservation Service, USDA. April 1971.

Channelization and Agricultural Drainage

Channelization and wetland drainage are chiefly responsible for the increase in available cropland acreage. Channelization is the process of dredging, deepening, and straightening a natural stream to increase its capacity to hold runoff in times of excess precipitation. It is necessary at the same time to remove trees and brush for a distance of 20–100 feet from the stream banks. Farmers abutting the channels may then dig ditches or lay tile to conduct water into the channel and lower the water table on their land to the point where crops can be successfully grown. Swamps, marshes, and intermittent wetlands may be drained in this manner.

The policy of the Department of Agriculture in 1967 was that drainage of wetlands not presently in agricultural use could not be the primary purpose of assistance provided under the Small Watersheds Act.[4] Recently, Kenneth Grant, Director of the Soil Conservation Service, issued a memorandum in response to criticism of channelization. The memorandum disallowed any channelization for which the primary purpose was drainage.[5] However, drainage may still be a secondary objective, and drainage remains a large factor in the small watersheds program. The allocation of total installation costs for 1,001 watershed work plans approved for operations through June 30, 1970,

[4] J. T. Saunders and N. A. Back, "Wanted: Partnership to Manage Water," *Land*, The 1958 Yearbook of Agriculture, 85th Cong., 2d sess., H. Doc. 280, p. 354.
[5] Kenneth E. Grant, Watersheds Memorandum-108, USDA-SCS. Feb. 4, 1971.

show nearly one-third of the total, or $33,139,000, was allocated to agricultural drainage.[6] The difference between flood protection and measures which allow drainage may often be semantic and additional benefits may definitely be allocated from flood protection to drainage.

Environmental Costs

Those who favor drainage consider channelization an environmental improvement; yet it does result in identifiable environmental costs. Channelization creates a raw ditch cleared of overhanging boughs, thickets, and rushes along the shore. Habitat losses for fish and wildlife are severe. Stream bank habitat is a critical link in the ecology of most wildlife forms in the countryside. A recent study documented a 90 percent reduction in poundage of fish in channelized streams with negligible recovery 40 years later.[7]

Streams and marshes in the natural state provide recreation to a growing number of hikers, campers, canoeists, and others. Krutilla (1968) has argued that since the supply of natural environments is fixed in the United States, and since the demand for outdoor recreation is growing, then the value of such environments is increasing.[8] It follows that the environmental and recreational costs of channelization or drainage are also growing greater.

In conjunction with the subject of environmental costs it should be noted that the primary justification of channelization as a flood reduction measure itself remains a disputable point. John W. Emerson has made a case study of the channelization of the Blackwater River in Johnson County, Mo. He found that the doubled gradient caused by straightening the normally meandering stream increased the rate of erosion. "Since the present channel is much wider and deeper than it was when newly dredged, there have been bridge repairs and loss of farmland. Downstream reduction in channel capacity due to termination of dredging has cuased sedimentation and increased flooding."[9] Other conservationists observe that channelization and drainage have reduced local damage while transferring the problem to downstream areas, where increased drainage and flood problems have been noted.[10]

Consideration of Alternatives

There have undoubtedly been occasions when channelization or drainage has been the only alternative, and where the benefits of flood protection would justify the costs just described. However, alternatives are usually not considered, and the use of channelization has been incautious and indiscriminate.[11]

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[6] "Inventory of Benefits, Costs, and Other Data for Public Law 566 Watershed Work Plans," compiled by the Natural Resource Economics Division, Economic Research Service, for the Soil Conservation Service, USDA, April 1971.

[7] Jack Bayless and William B. Smith, "The Effects of Channelization Upon the Fish Populations of Lotic Waters in Eastern North Carolina," North Carolina Wildlife Resources Commission, Division of Inland Fisheries.

[8] John V. Krutilla, "Balancing Extractive Industries with Wildlife Habitat," from *Transaction of the 33d North American Wildlife and Natural Resources Conference*, Mar. 11, 12, 13, 1968 (Wildlife Management Institute: Washington, D.C.).

[9] John W. Emerson, "Channelization: A Case Study," *Science*, vol. 173, No. 3994, July 23, 1971, p. 325.

[10] See *Stream Channelization* (part I), Hearings before a Subcommittee of the Committee on Government Operations, House of Representatives, 92d Cong., 1st sess., May 3 and 4, 1971. (See especially the pp. 83–89 articles by Flavil H. Griggs published in the Dyersburg (Tenn.) Mirror, Aug. 27, 1970.)

[11] *Ibid.* (See hearings for numerous examples). See also USDA Watershed Memorandum 108, in which SCS Director Kenneth Grant cautioned against indiscriminate use of channelization.

In its manuals and guides, the Soil Conservation Service indicates that its analysis of flood control measures is limited to considering structural and engineering devices. This effectively excludes consideration of the nonstructural alternatives which have come into use in the programs of some other construction agencies. By assuming that the structural measures are the only remedies for flood damage reduction, the Soil Conservation Service may produce more expensive and costly projects than if it were to incorporate nonstructural measures such as flood plain zoning, crop insurance, and land use adjustment. Since agricultural damage rather than structural damages and loss of human life typify the flood losses of many of these watershed projects, the possibilities for nonstructural alternatives would seem to be particularly great.

Consideration of these alternatives may effectively nullify the need for many flood reduction projects.

Conclusion

Around 1941, the Department of Agriculture reached the conclusion that land treatment had little effect on reducing major floods. Moreover, according to Maass, "officials of the Soil Conservation Service and of the Secretary's Office have tried to make it clear to committees of Congress ever since 1942 that upstream works cannot give adequate protection to a river basin and are not a substitute for downstream dams and channel work needed to protect urban centers." [12] Accepting this assessment, we are left with the conclusion that the program as presently designed does not function as a flood reduction measure below the controlled stream. Instead its implicit purpose has been to increase available cropland acreage and crop production on lands abutting and just below the floodwater-retarding structures and channelized streams. The practice of agricultural drainage in conjunction with channelization contributes to this increase. When the questionable social benefits of this practice are balanced against the certain social and environmental costs, the validity of many projects of the small watershed program is left in doubt.

These costs may or may not exceed the net benefits of a specified project. The proper procedure should be to evaluate the quantifiable benefits and costs before assessing the qualitative social and environmental costs. Up to this point the paper has examined some of the qualitative aspects of the watershed program. With this background, the remainder will analyze in specific monetary terms the benefit-cost ratios used by the Soil Conservation Service.

II. The Benefit-Cost Problem

A careful examination of SCS benefit-cost procedures reveals several ways in which the analysis may be improved and better made to serve its function of indicating the social worth of a project.

[12] Maass, *op. cit.*

Benefits

The benefits of the small watershed program are in large part inferred from increased agricultural production. Increased production results from reduced flood losses, diminished risk of flooding, improved drainage, and related land use changes. While reduced flood losses are readily seen to increase output, diminished risk of flooding also contributes to output by permitting a shift to more intensive land use and to higher value crops, or to restoration or reclamation of unproductive flood plains.

Attribution of increased output to particular features of a given project is a difficult and sometimes arbitrary distinction.[13] Table 2 shows the percentage distribution of benefits for 1,001 Public Law 566 projects.

What is important for this discussion is evaluation of the increased output. We referred earlier to the low social value of increased agricultural output.[14] ". . . The general principle that project services or products have value only to the extent that they are needed is inherent in any economic evaluation." [15] Thus, surplus and price supported crops have a value less than market price. Until 1966 the SCS evaluated net increases in output on the basis of Department of Agriculture projected long term prices (PLT). Since 1966, the SCS has used Department of Agriculture adjusted-normalized prices (AN).[16] AN prices are intended to reduce the influence of government programs in maintaining artificially high price levels. Since they do not eliminate the influence of government programs, AN prices exceed the actual social value of the commodity.

TABLE 2.—*Benefits from structural measures in watershed work plans approved through June 30, 1970*

[1,001 projects proportion of total annual benefits]

Type of benefit:	*Percent*
Flood damage reduction	46. 8
Changed land use: agriculture	2. 6
Changed land use: urban	1. 7
Intensified land use	7. 0
Other flood prevention	3. 6
Drainage	8. 4
Irrigation	4. 2
Other water management:	
Agriculture	. 5
Fish and wildlife	(1)
Other nonagriculture	. 5
Municipal and industrial water	1. 9
Recreation	12. 7
Incidental recreation	1. 1
Off-project benefits	1. 1
Redevelopment benefits	1. 6
Local secondary benefits	6. 3
Total	100. 0

[1] Not shown separately in early plans, included in other nonagricultural water management.

Source: "Inventory of Benefits, Costs and Other Data for Public Law 566 Watershed Work Plans," Soil Conservation Service, Washington, D.C., April 1971, table 4.

[13] *Economics Guide for Watershed Protection and Flood Prevention*, Soil Conservation Service, Washington D.C., 1964 with amendments, p. 6-4.

[14] The question concerns not only allotment crops, but non-allotment crops as well since these are often substitutes.

[15] *Economics Guide, op. cit.*, p. 1-3.

[16] John Vondruska, "An Economic Evaluation of Small Watershed Project Evaluation Procedures", University Microfilms, Ann Arbor, Mich., 1971, p. 197.

It follows that benefits which are inferred from AN output prices are still exaggerated. Table 3 indicates that supported prices are as much as 50 percent higher than competitive prices. Whatever may be said about the agricultural price support system, the effect of the price support system should be netted out in order to express the value to the society of an increase in the commodities in question.

To continue to avoid the appropriate evaluation of increased production is certainly inconsistent with desirable public policy as expressed by such bodies as the National Advisory Commission on Food and Fiber which recommended that

> . . . public funds for agricultural reclamation, irrigation, drainage and development projects should be justified on the basis of whether they represent the cheapest means of getting additional farm production if needed.[17]

The obvious response is to use some value substantially less than market price or AN price for evaluating the benefits of increased agricultural output. The direct benefits of crops that end up in storage is zero, the resources being used up contributing nothing to real national income, as Eckstein points out.[18] It is now SCS policy to omit benefits from new lands in their benefit analysis [19] but, of course, many projects have already been justified partially on the basis of returns from new lands.

Recreation benefits provide 13 percent of all project benefits. These benefits come from use of the impoundments created by Public Law 566 programs. The evaluations of the benefits appear to follow standard Federal procedures which have been adequately discussed elsewhere.[20] These essentially arbitrary evaluations may be varied within limits. Two deficiencies in the SCS analysis are: (1) Failure to deduct from its recreation benefits the value of recreation displaced from the site of the impoundment, and (2) failure to assess the marginal value of the recreation site; the latter would account for the reduction in recreation benefits arising from the availability of similar alternative recreation opportunities.

Secondary benefits are a large item in the total benefit distribution shown. However, the SCS does not include secondary benefits in its reported benefit-cost ratios. Nonetheless, in its tabular presentations accompanying projects it often fails to exclude secondary benefits and thereby implies a larger benefit-cost ratio than reported in the text of its project writeups. Since the *Economics Guide* states emphatically that "secondary benefits from a national viewpoint are not considered pertinent to the economic evaluation of Public Law 566 projects" [21] it is inconsistent that this ambiguous treatment of secondary benefits in project analysis is followed.

A minor source of benefits from watershed development is called "redevelopment" benefits. These refer to the benefits of using unemployed local labor or other unemployed local resources. Although

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[17] S. O. Berg, Chairman, *Food and Fiber for the Future*, Report of the National Advisory Commission on Food and Fiber, U.S. Government Printing Office, July 1967, p. 21.

[18] Otto Eckstein, *Water Resource Development*, (Cambridge: Harvard University Press), 1958, p. 200.

[19] Statement of Kenneth E. Grant, Administrator, SCS, USDA, in *Stream Channelization*, Hearings before a subcommittee of the Committee on Government Operations, House of Representatives, vol. 1, p. 538–9.

[20] Marion Clawson and Jack Knetsch, *The Economics of Outdoor Recreation*, (Baltimore: Johns Hopkins), 1966.

[21] *Economics Guide, op. cit.*, p. 11–12.

TABLE 3

Crop and unit	PLT Michigan	1960–64 U.S. average	Normalized prices: Current United States	Normalized prices: Adjusted AN, United States	Brandow projection 1965 United States
Wheat (bushel)	$1.60	$1.77	$1.82	$1.30	$0.87
Corn (bushel)	1.40	1.08	1.09	1.05	.77
Oats (bushel)	.76	.62	.62	.60	.41
Barley (bushel)	1.12	.92	.91	.85	.62
Sorghums (56-pound bushel)		.98	1.03	.95	.68
Hay, all (ton)	18.20	22.40	22.00	22.00	
Dry beans, edible (hundredweight)	6.00	7.14	6.97	7.00	
Sugar beets (ton)	15.30	11.90	11.70	11.70	
Soybeans (bushel)	2.28	2.38	2.45	2.45	1.35
Cotton (pound)		.314	.315	.250	.21
Tobacco (pound)		.60	.60	.60	
Cabbage, fresh market (hundredweight)	1.95	2.28	2.29	2.29	
Carrots, fresh market (hundredweight)	1.81	3.32	3.34	3.34	
Celery, fresh market (hundredweight)	3.30	3.85	3.87	3.87	
Potatoes (hundredweight)	1.75	2.01	1.70	1.70	
Farm price indexes, USDA, 1910–14 base of 100:					
Prices received, all	235	240	243	233	[1] 190
Prices received, crops		231	236	217	[1] 175
Prices paid, all	265				
Prices paid, production items only		269	272	272	

[1] 21 percent less than 1959.

Sources: For PLT: USDA, ARS and AMS, "Agricultural Price and Cost Projections" (Washington, D.C.: USDA, 1957). For AN and related: U.S. Water Resources Council, "Interim Price Standards" (Washington, D.C.: The Council, April 1966); supplemented by (for vegetable crops) USDA, SCS, "Economics Guide" Notice 7 (Washington, D.C.: SCS, Mar. 26, 1968). Brandow's projections: Walter Wilcox, "Agriculture's Income and Adjustment Problems," U.S. Congress, Joint Economics Committee, "Economic Policies for Agriculture in the 1960's" (Washington, D.C.: U.S. Government Printing Office, 1960), pp. 14–17.

the advantages of using unemployed resources are real, it makes little sense to add the total payments made to these resources to "benefits." Instead the costs of the project could be reduced by an appropriate percentage based on the project's resource requirements and the degree of unemployment in the region.[22]

Costs

ASSOCIATED COSTS

The problems of cost analysis are several and difficult. SCS policy guides on the question of associated costs do not simplify the problem. Consider:

> Associated costs [are] the value of goods and services needed over and above project costs to make the immediate products of the project available for use or sale. They are usually considered as deductions from benefits. (*Economics Guide*, p. 3–39; Watershed Handbook, p. 103.016).[23]

Examples of associated costs are:

> . . . provision of streets and utilities, conversion from pasture to cropland, clearing woods, farm drainage and the like on agricultural land, additional barns, granaries, and equipment needed to handle the additional production (from *Economics Guide*, p. 3–39).

Another form of associated cost is land treatment measures, as land-leveling and on-farm drainage or irrigation systems.

When land treatment measures are required to realize the benefits from structural measures, the cost of the necessary land treatment becomes an associated cost (*Economics Guide*, p. 3–39.)

[22] Robert H. Haveman and John V. Krutilla, *Unemployment, Idle Capacity, and the Evaluation of Public Expenditures*, (Baltimore: Johns Hopkins Press), 1968.

[23] "Watershed Protection Handbook," Soil Conservation Service, Washington, D.C., August 1967, with amendments.

Since land treatment measures account for more than a quarter of all project costs, they warrant careful consideration. However,

> [a]lthough their costs and physical effects must be estimated, no specific determination of monetary benefits from such measures is required for economic justification.[24]

As a reason for this exception, the Watershed Handbook does state:

> Experience has fully demonstrated that the combined private and public benefits from installation of land treatment measures will exceed their cost. [p. 102.02].[25]

The soundness of this proposition is not obvious, and in any case deserves more careful analysis.

The *Economics Guide* states that, "associated costs do not appear in the benefit-cost ratio"; but, "they are deducted from the gross benefit."[26] The apparent explanation of these contradictions is that SCS practice prescribed by the Watershed Handbook does not follow the principles established in the *Economics Guide* in the matter of associated land-treatment costs. The benefits of land treatment are also ignored, thus removing from the benefit-cost analysis a major part of project costs.

ENVIRONMENTAL COSTS

Earlier we referred to the substantial environmental costs that may result from small watershed projects. To be sure, environmental costs are elusive and not readily reducible to economic standards of measure and comparison. The National Environmental Policy Act of 1969[27] requires that environmental amenities and values be given appropriate consideration along with economic and technical considerations, and directs officials to develop methods and procedures for doing so.

We suggest that although there will always be much subjectivity in assessing environmental costs, the comparison of monetary benefits and costs with environmental costs can be made less incompatible.

One way of dealing with environmental costs would be as

$$C+X$$

where C is the accountable project costs and X represents the environmental costs of the project. The benefit-cost criterion with these costs included would be

$$B \geq C+X$$

Then we can calculate a break-even value for "X" as

$$B-C=X.$$

For the Lost River project in the example following, the first approximation of $B-C$ is $28,640. Thus, if the aggregated environmental losses are worth that much or more, the project is undesirable. That decision, of course, is still largely subjective, but it does give the analyst a figure with which to work, and is in contrast to current procedures which do not provide for concurrent economic and environ-

[24] *Ibid.*
[25] *Ibid.*
[26] *Economics Guide, op. cit.*, p. 3-40.
[27] 42 USC 4321 et. seq.

mental assessments. Further, it will highlight the ambiguous economic rationale for those projects where the benefit-cost ratio is close to one, as in Chicod, the second example following.

LAND ACQUISITION COSTS

Acquisition of land rights accounted for 16 percent of the total cost of 64 small watershed projects in fiscal year 1970. The weakness in the SCS treatment of these costs is in the choice of an appropriate discount rate. The SCS procedure is to discount these costs at the same rate as any other costs. As Eckstein notes, there is a certain attractiveness in so doing. However, these costs are not conceptually or practically the same as structural costs.

The problem is to determine the value of land as an annual amount in order to fit it to other annualized amounts in the benefit-cost analysis. The market value of land, which is the amount to be discounted, is derived from a private, locally determined rate of interest which includes not only the rate of return from the land, but also a factor for capital appreciation netted of the effects of inflation. It can readily be seen that the private rate of return will be greater than the usual discount rate applied to SCS projects.

When SCS applies the usual discount rate to market price, it substitutes that rate for the market rate. Invariably, the rate used is too low, and considerably understates the annual costs of the land. The Chicod example shows how the true rate is determined for a project.

The Discount Rate

The Soil Conservation Service conforms to Government policy in its use of the discount rate. Projects planned prior to December 24, 1969, used a discount rate equal to the rate of interest payable by the Treasury on securities outstanding which at original issue had terms to maturity of 15 years or more. Since that date the discount rate has been pegged at the yield rate of securities having 15 years or more until maturity which are sold during the year. When this formula was imposed, the discount rate for water projects immediately rose from 3.25 percent to 4.625 percent. The current rate (1972) is 5⅜ percent.

There are some persuasive arguments being made that this rate understates the real opportunity cost of capital in the economy today. A study for the Joint Economic Committee concluded that a discount rate of 10 percent would be appropriate for Government projects.[28] The Office of Management and Budget has adopted that rate for evaluating all Government investments outside the water resources field. The Water Resources Council has proposed 7 percent as an interim discount rate for water resources while at the same time adopting the OMB view that the opportunity cost of capital is the appropriate concept for arriving at the correct rate.

Without attempting to resolve either the theoretical or political issues involved, we conclude that both the current SCS rate and the historically lower rates of discount understate the opportunity costs

[28] Joint Economic Committee, U.S. Congress, *Economic Analysis of Public Investment Decisions: Interest Rate Policy and Discounting Analysis*, Report of the Subcommittee on Economy in Government, Washington, 1968.

of funds employed in water resources investment. In examples to follow we employ higher discount rates to illustrate the magnitude of this understatement.

III. Two Case Studies

In the two examples that follow we illustrate the application of the principles discussed earlier. The Lost River case emphasizes corrections in benefits to account for the inflated value of agricultural benefits and corrections in costs to account for the omission of certain associated costs. Without touching the interest rate we illustrate that the economic justification for the Lost River project is highly dubious.

In the Chicod case we go directly to the interest rate adjustment and illustrate that this correction alone is enough to undo the economic justification of this project. Further adjustment for understating the annual costs of the land taken for the project completes the dissection of the Chicod.

Two points are worth noting in these examples. The first is that it has not been necessary to directly estimate the environmental costs of these projects. Our strategy has been to first define as accurately as possible the net benefits of the project which would then be compared with the environmental costs in determining whether the project were justifiable. Having found negative net benefits in both cases, there was no further need to quantify the environmental costs.

Second, a caveat is in order regarding the treatment of inflated agricultural benefits and a related quantity, understated land costs. It has been amply demonstrated that SCS projects are sensitive in their evaluation to the prices assumed for agricultural outputs.[29] In order to make use of this knowledge we have conservatively adjusted the benefits in the Lost River case. No such adjustment was made in the Chicod case but instead the understated land costs were corrected. The point to be emphasized is that to make both adjustments in the same project would be inconsistent because supported agricultural prices also inflate private land values. Making a correction for inflated agricultural benefits would require that agricultural land values also be reduced. Since these values are already understated vis-a-vis the private land market in the project analysis, and since we do not possess the tools for tracing commodity prices through to land values, we can make one or the other correction but not both.

An Analysis of the Lost River Project

The sensitivity of the benefit-cost analysis of a public law 566 project may be illustrated by an example. The case chosen is the Lost River project in southern Indiana. The data used are based upon the Work Plan for Watershed Protection and Flood Prevention, Lost River Watershed, February 1969.

The annual benefits claimed for the Lost River project are attributed to flood damage reduction, recreation, municipal water supply, use of unemployed resources and secondary effects. Total benefits claimed are $629,473 (table 4).

[29] Vondruska, *op. cit.*, ch. 6, p. 196. He found that removing the effects of price support programs reduced benefits to 37 percent of the base level.

TABLE 4.—*Benefits in Lost River project*

1. Flood damage reduction:	
a. Agricultural production	$150, 100
b. Nonagricultural	23, 120
c. Erosion scour	15, 310
d. Indirect	20, 970
Total	[1] 209, 500
2. Flood and drainage related:	
a. New crop land	35, 030
b. Higher production	34, 740
3. Recreation	252, 523
4. Water supply	21, 940
5. Use of unemployed resources	21, 110
6. Secondary	54, 630
Total	629, 473

[1] Total includes $8,380 annual flood reduction benefits attributed to land treatment measures.

Following the preceding analysis all secondary and indirect benefits and all benefits for new land or more intensive use of flood plain land, items 1d, 2a, 2b, and 6 would be subtracted from total benefits leaving a net of $484,103. This benefit figure may be further questioned because it contains increases in crop production due to less frequent and severe flooding. If half of the remaining agricultural benefits are disallowed, benefits reduce to $409,053. Benefits of $484,103 are therefore generous.

Annual costs as accounted in the work plan and shown in table 5, infra, are estimated to be $455,643. With minimum defensible adjustments in benefits alone the project becomes marginal at best.

The "break even" value of environmental costs is $28,460. If the annual environmental costs of this project exceed $28,460, the project would be rejected without further questioning of the other underestimated costs. This is not a large number and considering the loss of present tourist attractions in the Rise of Lost River, the Rise at Orangeville and Wesley Chapel Gulf (which have been proposed as national landmarks), and the threatened destruction of rare species of blind fish and other cave life, it would appear that the Soil Conserva-

TABLE 5.—*Original and adjusted cost analysis*

Construction	$4, 411, 035
Engineering	380, 130
Administration	717, 722
Land rights	2, 203, 550
Total	7, 712, 437
Annual equivalent at 4⅝ percent	398, 193
Annual O, M, and R	57, 450
Total	[1] 455, 643
Addition for land treatment costs (Federal portion only) $436,100.	
Annual equivalent at 4⅝ percent	22, 500
First corrected costs	478, 143
Addition for land treatment costs (private portion) $1,777,300.	
Annual equivalent at 4⅝ percent	91, 180
Total	569, 323

[1] Source: "Lost River Watershed Work Plan."

tion Service could have arrived at the conclusion that the project is undesirable on the basis of its correctly derived benefits and environmental losses.

If costs are corrected for obvious underestimations, the project becomes clearly uneconomic. The first correction made in table 5 consists of adding the costs of land treatment associated with the project. If only Federal outlays are included on the assumption that the benefits of these outlays are already accounted for in the analysis, costs rise to $478,143. If the full costs of land treatment are charged against the project, costs rise to $569,643 and the benefit-cost ratio drops to 0.85. Ignoring the benefits of the private outlays for land treatment measures can be justified on the grounds that they are output increasing in effect, but this of course ignores the possible conservation values of these measures.

An Analysis of the Chicod Project

The Chicod Creek project in the Coastal Plain of North Carolina [30] represents another example of how benefit-cost ratios may be recomputed with substantially different results than presented by the SCS. The project consists of land treatment measures and channel improvement. Nine thousand, nine hundred acres of cropland and 435 acres of grasslands will benefit from vegetative measures such as conservation cropping systems cover crops, crop residue use, and grasses and legumes in rotation. Tile and drainage mains and laterals will be installed. Three hundred and nineteen thousand and sixty-six feet of streams will be channelized.

In 1971, the SCS reevaluated the project "to include additional measures for fish and wildlife mitigation (sic), modification and the addition of laterals, inclusion of sediment control features and the updating of installation costs." [31] Although the interest rate used for discounting costs in the original analysis (1965) was 3⅛ percent and the current interest rate reported by the Water Resources Council is 5⅜ percent,[32] the SCS did not compute its costs on the basis of the new interest rate.

Taking account of the increased mitigation costs lowers the benefit-cost ratio from the original 2.1:1 to the revised value of 1.3:1. The obvious question is what would happen to the economic justification of the project if the new interest rate were applied to the costs.

Project benefits consist of:

Flood damage reduction	$46, 666
More intensive use	7, 044
Improved efficiency	21, 100
Total	74, 810

Project costs evaluated at two rates of interest are:

Interest rate	Structural	O. & M.	Total	B–C
3⅛ percent	38, 655	19, 100	57, 765	1.30
5⅜ percent	55, 040	19, 100	74, 140	1.01

[30] *Watershed Work Plan.* Chicod Creek, Soil Conservation Service, 1965, with supplement, Aug. 9, 1971

[31] *Supplemental Watershed Work Plan.* Chicod Creek Project, Soil Conservation Service, Washington D.C., August 1971.

[32] 36 Fed. Reg. 13306 (July 17, 1971).

While the project does not fail the benefit-cost test, at the revised interest rate it clearly becomes marginal. Any consideration of the considerable environmental costs of 300,000 feet of channelization or of the real cost (see argument above) of the project land acquired would make the project uneconomic.

As to the adjustment of land costs, the data for determining the appropriate rate of interest are:

	Percent
Ratio of annual income to market value	[1] 5. 6
Plus rate of capital appreciation	[2] 5. 0
Less rate of inflation	[3] 1. 6
Thus, the correct rate to apply to the cost of land is 9 percent:	
Structural costs (less land) at 5¾ percent	$45, 152
Land cost at 9 percent	15, 559
O. & M	19, 100
Total costs	79, 100

B:C 0.95

[1] "Farm Real Estate Market Developments," Economic Research Service USDA, December 1968, p. 31.
[2] From Mr. Lewis Clark, president of the board of realtors, Greenville, Pitt County, N.C. 27834.
[3] "Economic Report of the President," 1971, table C3.

NOTE.—The *Supplemental Watershed Work Plan* includes under the heading "Land Rights" $70,450 in road and bridge modifications and farm crossings. This amount has to be excluded to determine the value of the land itself.

The project fails the benefit-cost analysis even before environmental costs and excessive agricultural benefits are deducted.

This project analysis assumes that none of the wooded swamps along the river will be cleared and farmed after channelization. This assumption is probably not correct but since this would be new land coming into production it would not count as a net benefit (re Watersheds Memorandum—108). However, if some of this land does come into crop production it will then be subject to damage from the remaining floods, a point which must be anticipated and used to adjust the costs of the project to an even higher figure.

IV. SUMMARY

Analysis of the qualitative and quantitative benefits and costs of some aspects of the small watershed program has revealed inadequacies in the economic analysis of the program, and the existence of substantial social costs. The Soil Conservation Service counted until recently the benefits of increased production at full supported market prices rather than at competitive prices, a practice which inflates benefits of increased production by as much as 50 percent. Current practice makes a partial adjustment for support effects. Recreation benefits are computed without qualifications for displaced recreation and the substitution effect, either or both of which may substantially reduce these benefits.

On the other hand, project costs are systematically underestimated. Associated costs are not considered in the final benefit-cost equation, and environmental costs are ignored. By evaluating land aquisition costs at the same discount rate as other costs, the SCS understates the value of the land, thereby understating the costs.

Although we believe that there is basic merit in the small watershed program, it is apparent that uncritical evaluation of projects and inappropriate planning procedures have led the program into increasing conflict with emerging social values. Improving the sensitivity and accuracy of the benefit-cost practices employed by the SCS would, in our opinion, go a long way toward correcting these errors and toward bringing the program back into harmony with society's economic and environmental aims.

EX POST BENEFIT-COST ANALYSIS: THE CASE OF PUBLIC INVESTMENTS IN NAVIGATION FACILITIES

By ROBERT H. HAVEMAN*

In the literature of welfare economics, contributions to the theory and application of public expenditure analysis have grown rapidly in recent years. The economic efficiency, or national income maximization, criterion has become defined with precision, and the decision criteria pertinent to it have become specified, both with and without constraints. Similarly, there has been substantial progress in defining national income benefits and costs and in developing procedures for measuring them. And, even though there may not be unanimity among analysts, the range of approaches to the handling of uncertainty, time, and unemployment in the analysis of public expenditures has been substantially narrowed.[1]

In nearly all of this benefit-cost literature, emphasis has been placed on the ex ante evaluation of public expenditures. Attention has been focused on the decisionmaker, who, confronted with a set of alternatives, is required to choose a limited number from among them. Presuming that the decisionmaker desires to maximize the net economic benefits flowing from his decision, benefit-cost analysis has provided him with the conceptual tools required to discover the optimum set of alternatives on the basis of information known prior to the decision.

Only very recently has it been possible to find any significant research at all that focuses on the economic results of public undertakings after they have had time to develop a performance record. Neither the criteria for ex post evaluation nor approaches for measuring economic results are at all well developed. The development of consistent techniques for evaluating the effectiveness of public program performance on an ex post basis should be a high priority item on the research agenda of economists and other social scientists concerned with public policy. Indeed, it is now clear that further extension of the application of ex ante economic analysis to public expenditure programs requires the demonstration that such analysis offers some prospect of isolating those programs and investments that would maximize the net social return. Neither in the literature of public expenditure analysis nor in government practice should the efficacy of ex ante benefit-cost analysis continue to be accepted as a matter of a priori logic and faith.

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*Professor of economics, University of Wisconsin. This study was supported by a grant from Resources for the Future, Inc., and uses material developed in Robert H. Haveman, *The Economic Performance of Public Investment* (Resources for the Future, 1972). The conclusions of the paper are the sole responsibility of the author.

[1] See U.S. Congress, Joint Economic Committee, *The Analysis and Evaluation of Public Expenditures: The PPB System*. A compendium of papers prepared for the Subcommittee on Economy in Government of the Joint Economic Committee, 91st Cong., 1st sess. (1969), 3 vols. Many of these papers have been revised and expanded in Robert H. Haveman and Julius Margolis, *Public Expenditures and Policy Analysis* (Markham Publishing Co., 1970).

Objectives of and Obstacles to Ex Post Benefit-Cost Analysis

The research effort reported in this paper was stimulated by the failure of planning agencies in the public works area to gather and use feedback information from ex post analysis to refine and develop the ex ante evaluation model. The objective of the research is to explore some of the impediments to the application of ex post evaluation techniques, to suggest an operational approach to the problem, and to apply this approach in a case study. In the water resource field, ex ante planning is in an advanced stage, but scarcely any attempt has been made to utilize feedback information. Therefore, the waterway improvement program was chosen for this study in order to illustrate the problems, approaches, and techniques of ex post performance appraisal.

In this study, a widely held presumption is accepted—that the primary objective of public navigation investment is the provision of services that market failures prohibit the private sector from supplying adequately.[2] Public sector responsibility, then, is to plan these developments so as to maximize net economic gain—the difference between social benefits and costs. This economic efficiency objective provides the analytical framework for this study.[3]

Clearly, alternative objectives might have been chosen. The choice might have been to evaluate the entire range of impacts of project construction and operation—income redistribution, demographic change, regional development, and so on. However, given that the basic purpose of public works investment is to correct for market failure, it is judged that improvement in the methodology of estimating primary economic impacts should precede the ascertaining of a number of various and sundry nonmarket impacts. In addition, estimation of these nonefficiency impacts, even if possible, would require an enormous research effort. While outputs from water resource investment do influence the distribution of income, demographic patterns, and regional development, these changes are complex functions of an enormous number of variables, and not all the variables are project related. Current knowledge and available statistical techniques are inadequate for filtering out the changes attributable to the particular public investment from the myriad other economic changes.[4]

Even though the program impacts evaluated in this paper are restricted to economic efficiency, several obstacles to meaningful ex post appraisal remain. Most of these empirical or measurement problems are encountered directly in this empirical effort and other ex post evaluations of long-lived public investment undertakings.

First, if the primary purpose of evaluating the performance of existing public investments is to provide a feedback to the planner on the efficacy of his current procedures for ex ante project analysis, severe problems are caused by the evolution of agency evaluation practices. It does little good to tell the planner that his evaluation

[2] For elaboration of the basis for the assertion that public water resource activities are undertaken for resource allocation or economic efficiency reasons, see John V. Krutilla, "Efficiency Goals, Market Failure, and the Substitution of Public for Private Action," U.S. Congress, Joint Economic Committee, *ibid.*, pp. 277–89.

[3] The criterion adopted in this study is an economic, or resource allocation, criterion. It is not concerned with the financial feasibility of undertakings, nor is it concerned with whether or not the revenues actually generated by these undertakings cover their costs.

[4] On this point, see A. Myrick Freeman and Robert H. Haveman, "Benefit-Cost Analysis and Multiple Objectives: Current Issues in Water Resources Planning," *Water Resources Research*, vol. 6, No. 6 (December 1970), pp. 1533–39.

procedures of a decade ago were inaccurate if, in fact, significant changes in the process of project appraisal have been adopted during the intervening years. Given the evolution of evaluation methodology, it is necessary (1) to reevaluate the ex ante expected efficiency benefits of a project by using current evaluation methodology but data from the time of project construction, (2) to appraise the performance of the project from the date of project completion to the present, and (3) to compare the realized performance with the revaluated prediction. Through this counsel of perfection, the analyst would have a description of the state of the world both at the time of the original ex ante analysis and at the time of the ex post evaluation.

If this procedure is to be used to develop an ex ante standard to which the ex post evaluation can relate, serious data and measurement problems are likely to be encountered. Appropriate data describing conditions at the time of project construction are not likely to be available in sufficient detail at a later date unless a deliberate effort has been made to preserve this information. For investments of the U.S. Army Corps of Engineers, for example, this effort has not been made for projects constructed prior to 1958 and only irregularly for projects constructed after 1958. To ascertain the values of the appropriate variables at the time of project construction requires an analysis equivalent in scope to that of an adequate project survey report. Consequently, accurate appraisal of existing ex ante evaluation techniques through ex post appraisal entails both the cost of reconstructing the conditions that prevailed prior to the undertaking and the cost of ascertaining current conditions for every investment to be studied.

A second obstacle is the with-without versus before-after problem. The basic economic efficiency criterion requires that the observed values of relevant output-related variables be compared with the values that would have existed if the project had not been undertaken. This criterion, it should be emphasized, is not the same as comparing the observed values of these variables with their value before the investment project was put in place. An ex post evaluation of this before-after sort is of no use to the planner in his efforts to improve evaluation procedures. If, for example, the flood losses actually prevented by a flood control project were estimated and used as a basis for judging its benefits, the appraisal of the project's worth would be greatly overstated. Implicitly, the appraisal would indicate that the prevention of damage to property induced into the flood plain by the project constituted a benefit attributable to the project. Such a claim has no economic rationale, because the additional capital placed on the flood plain would have been located on comparable land, which probably would have been flood free, if the project had not been constructed.[5] If ex post evaluation is to contribute helpful feedback to the planning process, it must avoid the simpler, more manageable before-after comparison and seek a benefit measure which reflects the difference between the present value of the national income stream with the project and the present value of the income stream if the project had not been constructed. It is not difficult to envision the added difficulties of a with-without appraisal.

[5] In fact, flood damages to property that is uneconomically induced into the flood plain by the project are appropriately treated in an ex post analysis as disbenefits, or costs attributable to the project.

A third difficulty encountered in developing a meaningful appraisal of project performance relates to the stochastic nature of some anticipated project outputs. For example, if a stream whose flood plain has been protected by a flood control installation demonstrates no flood-level discharge (under natural streamflow conditions) for 10 years following the construction of the project, it is clearly not accurate to state that the value of the output of the project is zero. Rather, it must be recognized that the investment has afforded protection against the occurrence of a probabilistic event. It has, in effect, a value that is analogous to insurance. Consequently, evaluation of the real worth of the investment must account for the probabilistic nature of the hydrology of the stream. Substantial conceptual and empirical problems are involved in appraising the performance of investment projects whose output depends upon such a stochastic process.

A fourth problem encountered in performing meaningful ex post analysis has to do with the nonmarket external impacts that accrue from nearly all public investments. If these impacts do not pass through an organized market, if they are not registered close to the site of project construction, if they involve nonmeasurable benefits or costs (or benefits and costs not commonly evaluated in monetary units), it is difficult for the analyst to discern the real from the pecuniary impacts and to appropriately account for the former of these values.

A final obstacle to meaningful empirical evaluation of project performance is the time pattern of the outputs of long-lived investments. For some investments, an analysis performed a decade following project completion may capture a significant portion of the total lifetime outputs of the project. For other projects, however, the time stream of expected outputs may display a very slow start, with the bulk of expected project benefits occurring in the later years of the project's life. In the latter case, the analyst would find it most difficult to judge the efficiency of the investment on the basis of its output stream during the first decade. The appraisal of performance in this case is meaningful only after the lapse of a significant period of time after the construction of the project.

The Nature of Economic Benefits From Waterway Improvement: the Concept of National Resource Savings

Improvements in inland waterways, ports, and harbors, like other public investments, yield physical outputs of social value. And, as with other public investments, the real dollar values of the outputs and inputs determines the net worth of the investment. Navigation improvements are of value of society because they reduce the costs required to satisfy the demand for transportation services. The cost savings generated by navigation improvements are represented by the reduction in the value of resources that the Nation devotes to the transportation of commodities and people.

As with the output of many other public investments, a demand curve for the output of public navigation improvements can be envisioned. Possessing economic worth, the outputs of navigation improvements can be exchanged for dollars to income or for wealth possessed by some spending unit. That is, there exists a willingness to

pay for these outputs. However, because of the peculiar set of institutions surrounding the transportation industry in the United States, the values to be attached to navigation improvement outputs fail to conform to any observed prices.

For example, although shippers utilizing the waterway would be willing to pay an amount equal to the savings in transportation expense they experience by using the waterway, this value, because of the institutional characteristics of this industry, will not represent the social value of the gain. To be sure, the savings experienced by the shippers utilizing the waterway would represent the real value of the waterway if the rate differentials that shippers experience equalled the real cost savings involved. However, while barge rates are presumed to accurately reflect the costs of the direct users of the waterways (bargelines), rail rates are generally conceded to be substantially above real rail costs. Hence, part of the saving experienced by shippers is simply an income transfer from the owners of railroads and/or the purchasers of their service. This portion of the savings to shippers, then, is a "pecuniary externality" and does not represent real savings of costs.

To estimate the value of the net social benefits of a waterway improvement, then, we must seek to isolate the reductions in real cost and increases in transportation services due to the existence of the improved navigation facility. Figure 1 will be helpful in visualizing the meaning of efficiency benefits in this context. Assume that in a given region a volume of traffic (measured in ton-miles) is to be moved in a given period of time and that the real cost per unit of moving traffic is given by the curve labeled AC in figure 1. The height of the average cost function (AC) is determined by the technology of existing facilities in the year in question and the dollar value of national resource inputs necessary to move the traffic.[6] This vertical distance is a weighted average of the unit costs of moving a given volume of traffic allocated by shippers among the various modes on the basis of effective rate and time-in-transit differentials. In computing the average, the unit cost of each mode is weighted by the volume of traffic moving on that mode.[7] For the movement signified by OX_1, the total value of resource (including congestion) cost is given by $OX_1\,BA$.

Assuming that the volume of ton-miles to be moved is fixed at OX_1 (i.e., a completely inelastic demand function), the efficiency impact of any improvement in transportation facilities will be reflected in the height of the average cost function. Thus, if the incremental cost of movement by water is less than the unit cost of an alternative mode, and if this differential is reflected in lower charges (adjusted for delay-time) to shippers on water relative to the alternative, the creation of a waterway capable of transporting barge traffic will

[6] The resource costs included in the AC function include both the "straight-through operating" costs of transportation provision plus the "delay-time" (or congestion) costs. If for no other reason, it is this latter component of costs that causes the average cost function to rise. See Charles W. Howe and others, "Optimum Traffic Flow, Congestion, and Design in a Waterway System: Determination by Simulation," in *Inland Waterway Transportation: Studies in Public and Private Management and Investment Decisions* (Resources for the Future, 1969).

[7] Hence, the average cost function displays unit costs after each shipper has chosen the least expensive mode of transportation as reflected in the rates he faces. It should be noted that the AC function is not the least-cost function for moving OX_1 units of traffic. Because of the disparity in the extent to which rates exceed costs among modes, some shipments may be moving on a high-cost alternative when average costs are estimated. Indeed, because of this disparity, the public improvement of a waterway may cause some traffic to shift to the higher-cost improved waterway from a lower-cost alternative.

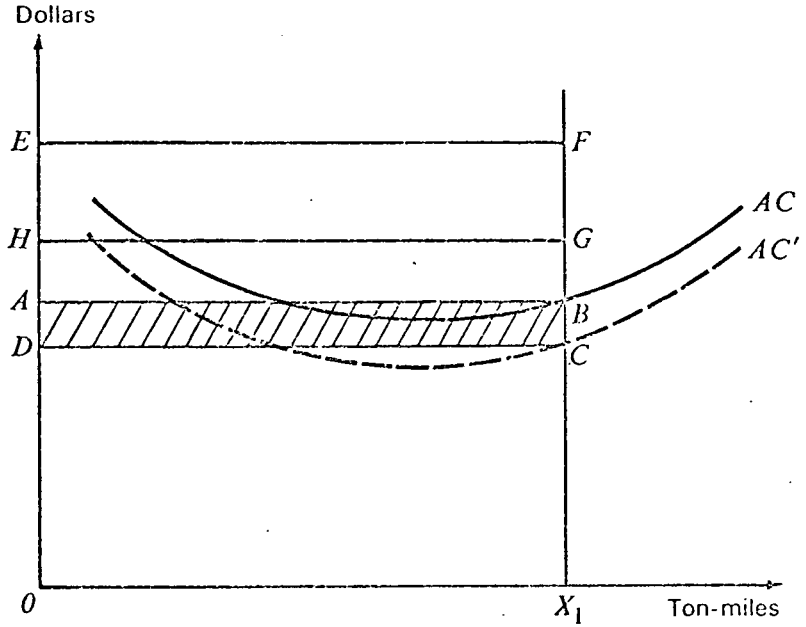

FIGURE 1

reduce the observed level of the average cost function.[8] The construction and use of the new facility will result in a downward shift in AC function to, say, AC' with the size of the shift being a function of the decrease in the unit costs of transportation on the waterway and the amount of traffic that shifts to the waterway from an alternative mode. Given that OX_1 units of traffic must be carried, the shift in AC shown in figure 1 implies that the total value of annual resource cost decreases from OX_1AB to OX_1CD, resulting in a total annual resource cost saving of $DCBA$.[9]

By assuming that the demand curve for ton-miles of highly substitutable transportation services is completely inelastic, a major com-

[8] The new average cost function will again reflect real costs after shippers have allocated their commodities among the alternative modes. Thus, if no shipper decides to use the newly created facilities (because of, say, monopolistic pricing practices or other market imperfections), the observed average cost curve will not shift down at all because of the improvement. Or, if the reduced barge rates on the improved facility cause some traffic to shift from a lower-cost alternative to the higher cost waterway, the observed average cost curve may rise because of the improvement. Consequently, the national resource savings depend on both the volume of traffic using the new facility and the resource cost that would have been incurred in moving that traffic without the improved facility.

Moreover, the effect on the average cost of the alternative modes due to the diversion of traffic to the waterway must be entered in the calculation of the new AC curve. For example, one could conceive of the opening of a new waterway diverting traffic from a railroad that already had excess capacity, thus raising the incremental costs of railroad transportation. The net impact of reduced costs on the traffic using the new facility and increased costs on the traffic remaining on the old facility might conceivably balance in such a case, leaving no *net* gain.

[9] It should be emphasized again that the savings to shippers may substantially exceed the national resource saving resulting from the provision of a new lower-cost facility. For example, in the realistic case in which railroad rates are administratively set significantly above incremental rail costs, while barge rates more closely approximate barge costs, the savings to shippers who shift from rail to water transportation would substantially exceed the savings in costs. In terms of figure 1, a hypothesized decrease in the weighted average effective rate from OE to OH would exceed the decrease in unit costs. Thus, while the value of annual resource saving was $DCBA$, the annual saving to shippers would be the larger rectangle $EFGH$. Similarly, this estimated saving in resource costs attributable to the waterway will likely exceed the cost savings that would be realized if the OX_1 units of traffic moved on the least-cost mode both before and after the waterway improvement.

ponent of the real value of investments in waterway facilities has been neglected. In reality, if the provision of waterway services results in a lower-priced alternative transport mode, the number of units of transportation service demanded will likely increase.[10] This effect, which is attributable to the waterway, must also be included in the benefit estimate. The analysis of this component of benefits attributable to the public investment is shown in figure 2.

Assume that, before the waterway improvement, the average effective rate [11] was OE and that OX_1 units of transportation services were being purchased. Assume also that the impact of the improved waterway was to generate a reduction in the average effective rate rate from OE to OH and that this lower rate yielded an increase in traffic from OX_1 to OX_2. The shaded area X_1FIX_2 then represents a gross value generated by the existence of the waterway. This value less the incremental cost of moving the traffic increment $[OX_2 - OX_1]$ measures the net value of the additional transportation services and

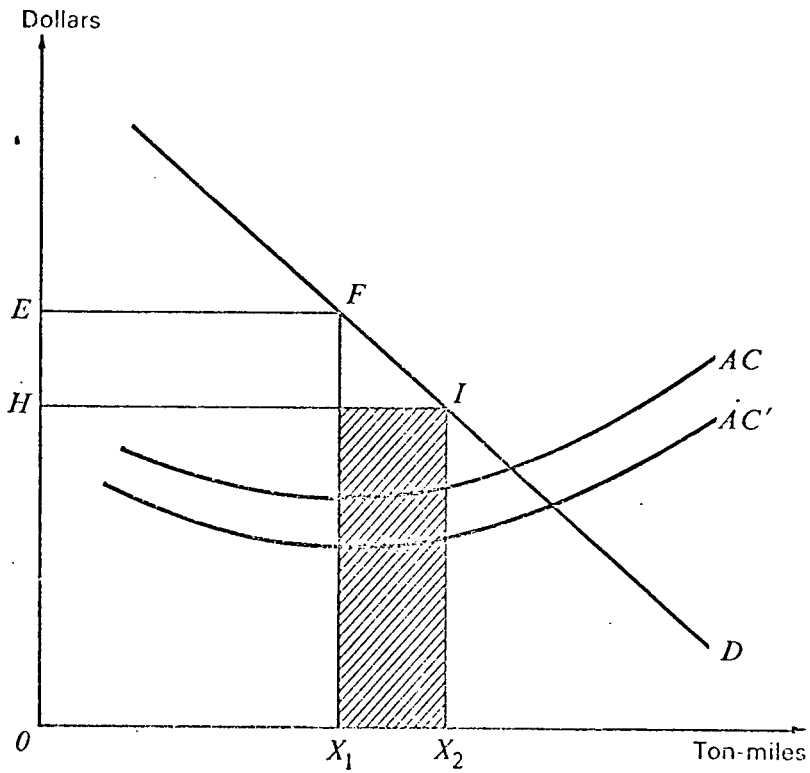

FIGURE 2

[10] This increase in the quantity demanded from a lower-price mode is the sum of a direct and an indirect effect. The direct effect is the increment to traffic from lower barge rates, which are a direct result of the investment. The indirect effect is the traffic increase from railroad rates which are reduced toward costs by the presence of waterway competition. Given that regulatory agencies would fail to reduce railroad rates toward costs in the absence of the waterway, it is reasonable to attribute both of the impacts to the waterway.

[11] The average effective rate is a weighted average of prevailing rates for transportation services, using the volume (ton-miles) of traffic using each mode as weights. The reduction of the average effective rate, then, is due to both the direct and indirect impacts as discussed in the previous footnote.

must be included in the benefit estimate.[12] The increment to cost, it should be noted, is the sum of the incremental costs of the newly generated traffic, whether the traffic is carried by water or an alternative mode.

The total willingness to pay for the navigation improvement is equal to the sum of the reduction in costs of moving existing traffic (*DCBA*, in figure 1) and the net willingness to pay for the additional traffic generated by the improvement (X_1FIX_2 less the sum of incremental costs of moving $[OX_2 - OX_1]$ in figure 2). This sum represents the total value of economic efficiency benefits attributable to the waterway investment.

The Components of Waterway Improvement Benefits and Their Ex Ante Measurement

In the conceptual discussion of the preceding section, it was concluded that the benefits of investments in navigational improvements equal the unit reduction in cost for moving existing traffic plus the excess of the willingness of transportation service demanders to pay for additional units of transportation over the marginal cost of supplying them. Although this conceptual framework can be applied to transportation improvements in general, it is of particular use in discussing the procedures for performing ex ante empirical evaluation of individual navigation projects.

In terms of the preceding discussion, the components of the real value of benefits from an investment in navigation facilities are as follows:

1. Reduction in real transportation costs on those units of existing traffic that already use the waterway.
2. Reduction in real transportation costs on those units of existing traffic that shift from alternative transportation modes to the waterway.[13]
3. The net change in real transportation costs on those units of existing traffic that remain on alternative transportation modes.[14]
4. The willingness to pay (relevant area under the demand curve of figure 2) for additional transportation services by purchasers entering any transport market (i.e., rail, highway, waterway) because of the reduced average effective rate resulting from the waterway improvement less the marginal cost of supplying these additional services.[15]

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[12] See Howe and others, "Optimum Traffic Flow," for a discussion of the economic benefits from newly generated traffic. As they point out, the cost saving on existing traffic may understate or overstate the true benefits, depending on the institutional conditions determining use of the waterway. In the analysis presented in the text, total traffic and its allocation among modes is taken to be a function of observed rates only. Depending on the level of observed rate structures, then, the total volume of traffic may or may not be the social optimum.

[13] There is a basic analytic problem involved in estimating the real cost savings on units of traffic shifting to the improved waterway because of the institutions surrounding the setting of rates for regulated transportation. Because regulated rail rates may remain above incremental rail costs after construction of the waterway, units of traffic may be induced to shift from lower real cost movement by rail to higher real cost movement by water. The cost saving on such shifts is negative. This problem is discussed further later in this paper.

[14] This saving may reflect a reduction in congestion costs associated with use of the alternative modes prior to waterway improvement and the concomitant traffic shift.

[15] Estimation of this value for individual projects is empirically difficult. For example, how does one separate the additional traffic generated by the waterway improvement from traffic shifts from other regional transportation markets attributable to the intrusion of a new source of supply?

In undertaking the empirical estimation of the total expected benefits of a proposed navigation improvement, each of these components must be specifically evaluated. The following procedure is derived from the above analysis; its application would yield a close approximation to the real social value of project-generated benefits.

1. The traffic that will use the waterway after its improvement will be of three kinds:

(*a*) Traffic that shifts to the waterway from alternative modes because of rate differentials (adjusted for time-in-transit differentials). To estimate the traffic in this category, the analyst has to estimate the response of traffic to rate and time-in-transit differentials.[16] Assuming that units of transportation service are homogeneous, this estimate for any given year can be based on the following functional statement:

$$T_n^w = F\,(R_n^a - R_n^w)$$

where

T_n^w = the traffic on the waterway in year n from the shift phenomenon,

R_n^a = the rate charged on the alternative mode in year n,

R_n^w = the rate on the waterway in year n.

Total traffic over the life of the project generated by this shift is ΣT_n^w over the x years of the project. The important thing to note about this procedure is that the estimate of traffic in future years must be related to the *rate differentials* [17] projected for future years.

(*b*) Traffic that will move on the waterway even with no improvement. For traffic of this type, the analyst must project the growth of both sources of traffic that now utilize the waterway and new sources of traffic that will be water oriented by nature of their product.

(*c*) New traffic generated by the improvement. For this traffic the analyst must estimate the elasticity of demand for new waterway transportation, forecast future barge rates, and, on the basis of these estimates, calculate the volume of new traffic on the waterway that will be generated by the reduced barge rates.[18]

2. Presuming that the waterway improvement is undertaken, the national cost savings on traffic of type (*a*) and that part of (*b*) that would have moved without the navigation improvement will equal the sum of the incremental costs on alternative modes of transportation less the sum of the incremental costs of transportation on the waterway (including differentials in handling costs). In the case of traffic of type (*b*), the alternative mode of transportation is the undeveloped river. For the remainder of traffic (*b*)—new sources of water-oriented traffic—and traffic of type (*c*), the benefit equals the willingness of the demanders of the service of the waterway to pay for it (i.e., the area under the demand curve for the generated waterway traffic) less the marginal cost of supplying the service.

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[16] This, in turn, implies the estimation of the relationship between rate changes and cost changes on alternative transport modes.

[17] It should be noted that any differences in shippers' costs associated with alternative modes, such as handling charges, are included in the "rate differentials" concept used here.

[18] The analyst must take care to distinguish the elasticity of demand for newly generated traffic from the elasticity of demand for traffic shifting from alternative modes. The latter is treated under traffic type (*a*) above.

3. The willingness to pay for the additional nonwaterway traffic generated by the reduced rates on alternative modes, less the sum of marginal cost of moving this traffic, must also be credited as benefits to the waterway improvement if it is assumed that rates on alternative modes that prevail before the waterway improvement are artificially maintained at an arbitrarily high level; that the public sector is constrained from affecting the height of the rates through direct regulation; and that the competition generated by the waterway will effect a reduction in the rates on alternative modes.[19]

The Current Practice of Ex Ante Navigation Benefit Estimation

Current agency practice in the ex ante estimation of navigation benefits has been determined by direct congressional action in the Department of Transportation Act of 1966. This is the only category of water resource investment benefits for which Congress has explicitly dictated the definition of benefits and the concepts to be used by agencies in evaluation efforts. Largely because of this intervention, current navigation evaulation procedures deviate more from ideal procedures than in any other project purpose. Indeed, most professional economists familiar with this area judge that existing congressionally imposed standards foster overinvestment in navigation facilities and inefficiency in the choice among alternatives. In this section, the recent evaluation of corps benefit estimation practice will be described, and the serious inefficiencies fostered by the legislative directive will be pointed out.[20]

The waterway benefit evaluation procedures utilized by the Corps of Engineers prior to 1960 have been described by Otto Eckstein.[21] Pre-1960 corps practice was to evaluate the unit benefits of a navigation improvement by comparing the current rates that shippers would pay to transport commodities on the improved waterway with the rates they would pay for the next best alternative mode. Eckstein demonstrates that, because of the complex nature of the railroad ratemaking process and the setting of railroad rates to cover full costs, it is the unit savings to shippers that are being estimated and not national resource cost savings per unit of traffic moved. He states:

> The benefits of navigation, as measured currently by the Corps of Engineers, therefore, substantially overstate the saving of cost realized by the nation as a whole.[22]

In estimating the volume of traffic that would utilize a proposed waterway, the corps employed a survey of the commerce flowing into and out of the region.[23] On the basis of the surveys, an estimate was made of the volume of future traffic that would move by water. In practice, a sizable share of expected traffic growth in the region was often credited to the construction of the waterway and projected as waterway traffic. For commodities that already moved (at least partially) on the waterway, the volume of traffic expected to shift from

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[19] These assumptions were made in the analysis of figure 2.

[20] See James R. Nelson, "Policy Analysis in Transportation Programs," in *The Analysis and Evaluation of Public Expenditures; The PPB System*, op. cit., pp. 1102–27.

[21] Otto Eckstein, *Water Resource Development: The Economics of Project Evaluation* (Harvard University Press, 1958).

[22] *Ibid.*, p. 174.

[23] See the testimony of James R. Nelson concerning this survey technique, in *Economic Analysis and the Efficiency of Government*, hearings before the Subcommittee on Economy in Government of the Joint Economic Committee, 91st Cong., 1st sess. (1969), pp. 489-90.

alternative modes to the waterway was judgmentally projected on the basis of a comparison of the freight charges on and off the waterway, using current alternative-mode rates and barge rates expected to prevail upon completion of the waterway.[24]

In this procedure, it was implicitly assumed that the difference between rail rates and barge rates would not change during the life of the project. However, primarily because of the competition of the waterway, postwaterway railroad rates are likely to decrease below their preproject counterparts by more than barge rates. For this reason, there is sound a priori reason to expect that the traffic projected on the waterway by this technique is overstated. Prior to 1960, then, the procedures used to estimate both traffic on the waterway and unit savings on this traffic led to bloated estimates of the benefits from navigation improvements.

In 1960, a significant change in procedure was adopted by the corps. The use of transportation *rates* was dropped, at least in concept, in favor of a comparison of the resource costs of shipping commodities by water with the costs of transporting them by an alternative mode in the absence of the project. The change, however, still permitted rates to be used as an estimate of railroad costs when estimates of railroad costs were unavailable. In practice, the use of rates became the rule.[25]

However, even after the 1960 change, estimates of traffic expected to move on the waterway remained based on a comparison of current rail rates [26] and barge rates expected to prevail when the waterway is completed.[27] This is so even though the possibility of dramatic decreases in railroad rates—compelled by the competition of the improved waterway—was noted in a corps engineering manual.[28]

Consequently, while the new cost-based procedures were superior in concept to pre-1960 procedures, in practice the reported estimates were similar under both methods. Because of insufficient comparative cost data or insufficient understanding of patterns of rail rates after waterway construction, the use of current rates to estimate both traffic and unit savings remained the standard procedure for analysts in the field.

In October 1964, however, a second revision in evaluation procedures was announced. This alteration—which took the form of an interim procedure to replace the post-1960 cost-basis-with-loopholes—was a substantive one in both form and practice.

In this revision, the corps defined water-compelled rates as those nonwaterway transportation charges that are likely to prevail in the future if the waterway is improved; nonwater-compelled rates are those likely to prevail in the future if the waterway is not improved. Given these definitions, the process of estimating future traffic required a comparison of expected barge rates after completion of the waterway and water-compelled rates on alternative modes. However, the basis of estimating unit cost savings moved back from the cost basis adopted (in principle) in 1960 to a position intermediate to it and the pre-1960

[24] These rates were calculated on the assumption that barge lines would establish rates that would cover full costs.

[25] In some cases, however, this revision enabled the lowest observed rail rates to be used in project evaluation.

[26] In some cases, the lowest observed rail rates were used.

[27] This 1960 changes incorporates the suggested procedures outlined in "The Green Book." See Federal Inter-Agency River Basin Committee, Subcommittee on Benefits and Costs, *Proposed Practices for Economic Analysis of River Basin Projects* (1950).

[28] U.S. Army, Corps of Engineers, "Engineering Manual for Civil Works" (mimeo.).

practice of using current rate differentials. The estimation of unit cost savings in this revision required the comparison of projected postproject barge rates and future, though nonwater-compelled, rates on alternative modes. That is, the projected rates on transportation modes alternative to the waterway would reflect technological improvements in the alternative modes but not the competition of the waterway.[29]

The effect of implementing this procedure was that estimates of traffic expected to move on the improved waterway were lower than estimates generated by earlier procedures. Because of the changes, fewer projects were able to demonstrate a benefit-cost ratio above unity. The response to these improved procedures by the Public Works Committees of Congress was one of strong objection. In particular, Congressman and Senators from States with strong waterway interests found this interim procedure to be a severe obstacle to project approval.[30]

Through section 7 of the Transportation Act of 1966, Congress, led by the waterway interests, eliminated the interim procedure. The essence of this legislation was to force the Corps of Engineers to revert to the pre-1960 practice of estimating both waterway traffic and unit savings on the current rate basis. The provisions of section 7 of the act are as follows:

> The standards and criteria for economic evaluation of water resource projects shall be developed by the Water Resources Council established by Public Law 89–80. For the purpose of such standards and criteria, the primary direct navigation benefits of a water resource project are defined as the product of the savings to shippers using the waterway and the estimated traffic that would use the waterway; where the savings to shippers shall be construed to mean the difference between (*a*) the freight rates or charges prevailing at the time of the study for the movement by the alternative means and (*b*) those which would be charged on the proposed waterway; and where the estimate of traffic that would use the waterway will be based on such freight rates, taking into account projections of the economic growth of the area.

As a result of this legislation, navigation benefits are based on an estimate of future waterway traffic, which on a priori grounds, is seriously overstated, and on an estimate of unit benefits for this traffic, which represents savings to shippers rather than the appropriate (and smaller) savings in national resources devoted to transporting commodities.[31]

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[29] The following paragraphs, taken from the corps engineering manual, explain this interim procedure

> "(1) The traffic that would be expected to move over a considered improved waterway will be estimated on the basis of projected "water-compelled" rates with consideration of all data and factors that are likely to modify current rates to take account of the competitive situation anticipated with the waterway in being, and foreseeable technological developments applicable to the several transport media.
>
> "(2) Estimates of unit transportation savings attributable to the waterway improvement will be determined on the basis of the projected "non-water-compelled" rates, with consideration of all pertinent data and factors, including the competitive situation anticipated in the absence of the waterway improvement, current rates, and foreseeable technological developments applicable to the several transport media.
>
> "(3) The transportation benefits of a considered waterway improvement, for the movement of traffic that would move by other means in the absence of the waterway, will be derived by applying to the traffic movements estimated in (1) above, the unit savings estimated as in (2) above. These benefits will be used in project justification and in computing the benefit-cost ratio."

[30] The objections of the "public works" interests in Congress to the interim procedure and the results of their objections are described in Robert Haveman and Paula Stephan, "The Budget Congress Won't Cut," *The Reporter*, February 22, 1968.

[31] It should be noted that savings to shippers as "construed" in the act is even an overstatement of the real unit savings that shippers are likely to experience. The real savings to shippers will equal water-compelled rail rates minus barge rates for future traffic moving by barge on the improved waterway and current rail rates minus water-compelled rail rates for future traffic moving by rail.

Current Waterway Evaluation Practice—A Case in Point

In order to contrast existing corps evaluation practice (as required by section 7 of the Transportation Act of 1966) with the correct a priori evaluation framework, the recent corps analysis of the proposed Yazoo River navigation project is presented here.[32]

The Yazoo River flows for 169 miles in a southwesterly direction through the State of Mississippi. In its unimproved state it has a 9-foot navigation channel for about 46 percent of the year. The purpose of the proposed project is to provide a year-round 9-foot channel. Of the alternative plans studied, the "one-lock plan" was judged optimal. This plan would provide a 9-foot navigation channel for the 169 miles of the Yazoo River during the year.

The procedures employed by the corps in estimating the navigation benefits attributable to this investment are as follows:

1. Base-year potential waterway traffic was estimated by means of a detailed study of the traffic flows in the area. This study was based largely on interviews with shippers in the Yazoo River basin area.
2. Savings in transportation expense to shippers, taken to be the difference between base-year freight charges experienced on alternative modes and current estimated rates applicable to movements on an improved waterway, were estimated on the basis of observed rail rates and projected barge rates.
3. Projection of the traffic that would use the waterway from 1975 to 2025 was based on index factors developed by estimating the growth of population, agricultural production, and manufacturing output in the pertinent region.
4. Estimation of future savings to shippers was obtained by multiplying the future traffic estimates, by commodity (obtained in point 3) with current (or base-year) rate differentials (obtained in point 4).

The empirical estimates obtained by applying these procedures are outlined in the following paragraphs.

THE ESTIMATION OF BASE-YEAR POTENTIAL WATERWAY TRAFFIC

The District Office of the Corps of Engineers accepted as potential traffic for the waterway the entire volume of "water-adaptable"[33] traffic that moved by all modes in the relevant region[34] in 1966—the base year. In addition, because the project was not expected to be operational until 1975, all additional water-adaptable traffic expected to develop from 1966 to 1975 was included in the estimate of potential 1975 barge traffic.[35]

For the base year, the corps estimated annual potential traffic to be 806,200 tons,[36] of which 465,000 tons moved in a downstream

[32] The data and procedures discussed in this section are taken from U.S. Army Corps of Engineers, "Review Report on Yazoo River Navigation Project" (December 1966).

[33] A commodity is treated as "water adaptable" if it is known to be moving on other waterways in the Nation.

[34] The 14-county region surrounding the waterway was used for the study. This region is one of the least productive in the United States. In 1965, the per capita income of this region was only 46 percent of the national per capita income.

[35] It is interesting to note that the Corps of Engineers, in conducting interviews on which to base this estimate, relied on "lists of potential shippers submitted by the Yazoo River Development Committee of the Rivers and Harbors Association of Mississippi."

[36] This estimate of potential traffic should be compared with the average annual traffic flow of the Yazoo River from 1935 to 1958 of 22,000 tons and about 150,000 tons per year in recent years. According to the corps report on the Yazoo River, the latter number was bloated by "movements by shipping interests in good faith to demonstrate their interest in a year-round navigation channel." As noted above, the Yazoo River is currently navigable at 9-foot depths for nearly 50 percent of the year.

direction, and 341,000 tons moved upstream. About 70 percent of this traffic was composed of agricultural products, fertilizers, or oyster shells.

Using this estimate of 806,200 tons of potential 1966 waterway traffic, the corps calculated the traffic that would be likely to move on an improved waterway. In performing this calculation, the corps analyzed each of the component commodities in the total potential traffic estimate to determine if the expected barge rates on an improved Yazoo River would be sufficiently below current railroad (or alternative mode) rates, to cause a shift to the waterway. If the expected waterway rates were sufficiently below [37] current nonbarge rates for a particular commodity, it was assumed that 100 percent of that commodity would shift to the waterway. On this basis, the corps estimated that of the 806,200 tons of water-adaptable traffic currently moving in the region, 768,400 tons (over 95 percent of the total) would travel on the waterway if it were constructed.

THE ESTIMATION OF SAVINGS TO SHIPPERS

Having an estimate of traffic that would move on the river if it were improved, the corps estimated current nonbarge transportation rates [38] and expected barge transportation rates if the waterway had currently been in operation.[39] The difference between these two rates is defined as the estimate of savings to shippers per unit of traffic in the base year (1966). Aggregate savings to shippers were calculated as the product of this unit savings and the number of tons of traffic that would move on the waterway if it were improved (discussed in the preceding paragraph). For the traffic moving upstream, the savings to shippers average 85 cents per ton, and for traffic moving downstream, per ton savings averaged $1.48. Thus, the total annual transportation expense that would have been saved by shippers if the waterway had been in operation in 1966 was estimated at $943,100.

To project this annual savings to 1975 (when the improved waterway would be in operation), the corps added $49,000 of additional savings from the traffic that was expected to develop between 1966 and 1975. For 1975, the total annual benefit estimate was $992,000.

PROJECTION OF FUTURE TRAFFIC

The future traffic expected to move on the improved Yazoo River was projected by the corps by the application of factors of increase. The base-year estimate of 768,400 tons of waterway traffic was scaled upward on the basis of projected changes in population, agricultural and industrial growth. The pertinent growth indexes developed by the Corps of Engineers for population, agricultural output, and manufacturing output in the relevant trade area are (1966=100):

[37] The determination of "sufficiently below" is apparently subjective and judgmental.

[38] The land transportation charges were obtained either from tariff records on file with the interstate Commerce Commission or from rate scales applicable to similar movements under like conditions.

[39] This estimate was synthesized largely from barge-rate experience on other improved waterways, e.g., the Mississippi River or the Gulf Intracoastal Waterway. For example, while grain movements by barge on the Yazoo River are now charged $2.02 per ton, the Corps estimated that the barge rate for the same commodity and distance, *were the Yazoo River improved*, would be only 79 cents, or only 39 percent of the preimprovement rate.

	1975	2025
Population	108.	202
Agricultural output	120	253
Manufacturing output (value added)	132	1,040

For both population and agricultural output, the rate of growth implied by these indexes is about that estimated for the entire United States by the Bureau of the Census and the Department of Agriculture. The rates of growth implied by the index for value added is about 6–7 percent, or about 150 percent of the rate of growth of projected value added for the United States.

To obtain the traffic projection for movement on the improved Yazoo River, the agricultural output indexes were applied to the agricultural components of the 1966 expected traffic estimate. The manufacturing output indexes were applied to the industrial components of expected 1966 traffic on the improved waterway. The population indexes were used to project the tonnage growth for commodities related to personal consumption.

The corps projection of future traffic in 1975 and 2025 on the improved Yazoo River was as follows:

TONNAGE

	1966	1975	2025
Agricultural commodities	294,000	348,400	796,300
Industrial commodities	417,500	581,100	4,578,400
Commodities related to personal consumption	56,900	61,500	115,000
Total	768,400	991,000	5,489,700

FUTURE SAVINGS TO SHIPPERS

In projecting the stream of navigation benefits (aggregate savings to shippers), the corps multiplied the projected tonnage figures, by commodity, by the unit savings to shippers. The life of the project was stipulated as 50 years, extending from 1975 to 2025. The expected annual benefits from an improved waterway are as follows:

	1966	1975	2025
Agricultural commodities	$463,000	$579,500	$1,221,500
Industrial commodities	442,000	609,200	4,799,800
Commodities related to personal consumption	37,600	40,600	75,900
Total	942,600	1,229,300	6,097,200

Using an interest rate of 3⅞ percent, the estimate of annual navigation benefits totaled $3,169,500. The benefit-cost ratio for the entire project was calculated to be 1.6.

As is clear from this example, the analytical framework applied by the corps, and dictated by legislation, deviates substantially from the appropriate framework presented in the first section of this paper. The corps estimates of both expected traffic and unit benefits include substantial values beyond those economically justifiable. From this a priori analysis, there is a sound basis for claiming that the Corps of

Engineers estimates of waterway benefits seriously overstate real national economic benefits in the form of reduced transportation costs.

A Case Study in Ex Post Benefit-Cost Analysis: The Illinois Waterway

In this section, the results of an effort to evaluate the benefits and cost of a public investment designed to produce navigation services are reported. The investment evaluated is that undertaken by the Corps of Engineers on the Illinois Waterway. This evaluation of the realized benefits of a navigation improvement is designed to demonstrate the procedures required to develop an estimate of economic benefits and the difficulties in applying them.[40] It should also illuminate the serious weaknesses in the bloated estimates of ex post navigation benefits developed by waterway interests.[41] Because virtually no traffic would move on an unimproved Illinois river and because substantial survey data on the waterway have recently been developed by the Corps of Engineers and the Board of Engineers for Rivers and Harbors, the Illinois Waterway project forms an ideal basis for an ex post benefit-cost study.

The Illinois River flows from Chicago to about 40 miles above St. Louis, where it meets the Mississippi River—a distance of 327 miles. Over the past 35 years, Federal funds have been used to transform the river into a navigable waterway. Currently, the river is navigable throughout its length and, with few exceptions, possesses a depth of 9 feet and a width of 300 feet. The geographic location of the waterway is shown in figure 3.

[40] The only other systematic analysis of the realized benefits of a waterway improvement not performed or supported by a vested interest group is that presented by Frank H. Dalia. This analysis was a part of Dalia's Ph. D. dissertation submitted to the Department of Economics of Tulane University in 1964 ("An Economic Examination of Federal Water Resources Developments in the Ouachita-Black River Basin"). The Ouachita-Black navigation project was undertaken by the Corps of Engineers in 1922.

In this study, Dalia estimated that the realized benefits of the Ouachita-Black project equaled $2.6 million and the realized costs equaled $30,722,000. The resulting ex post benefit-cost ration was calculated to be a minute 0.085. Dalia estimated that from 1922 to 1962 the sum of all undiscounted benefits (in 1962 dollars) was approximately one-third the sum of all undiscounted costs.

[41] See, for example, the data and conclusions in *Waterway Economics*, vol. 1, no. 3 (January 1967), published by the American Waterway Operators, Inc., Washington, D.C.

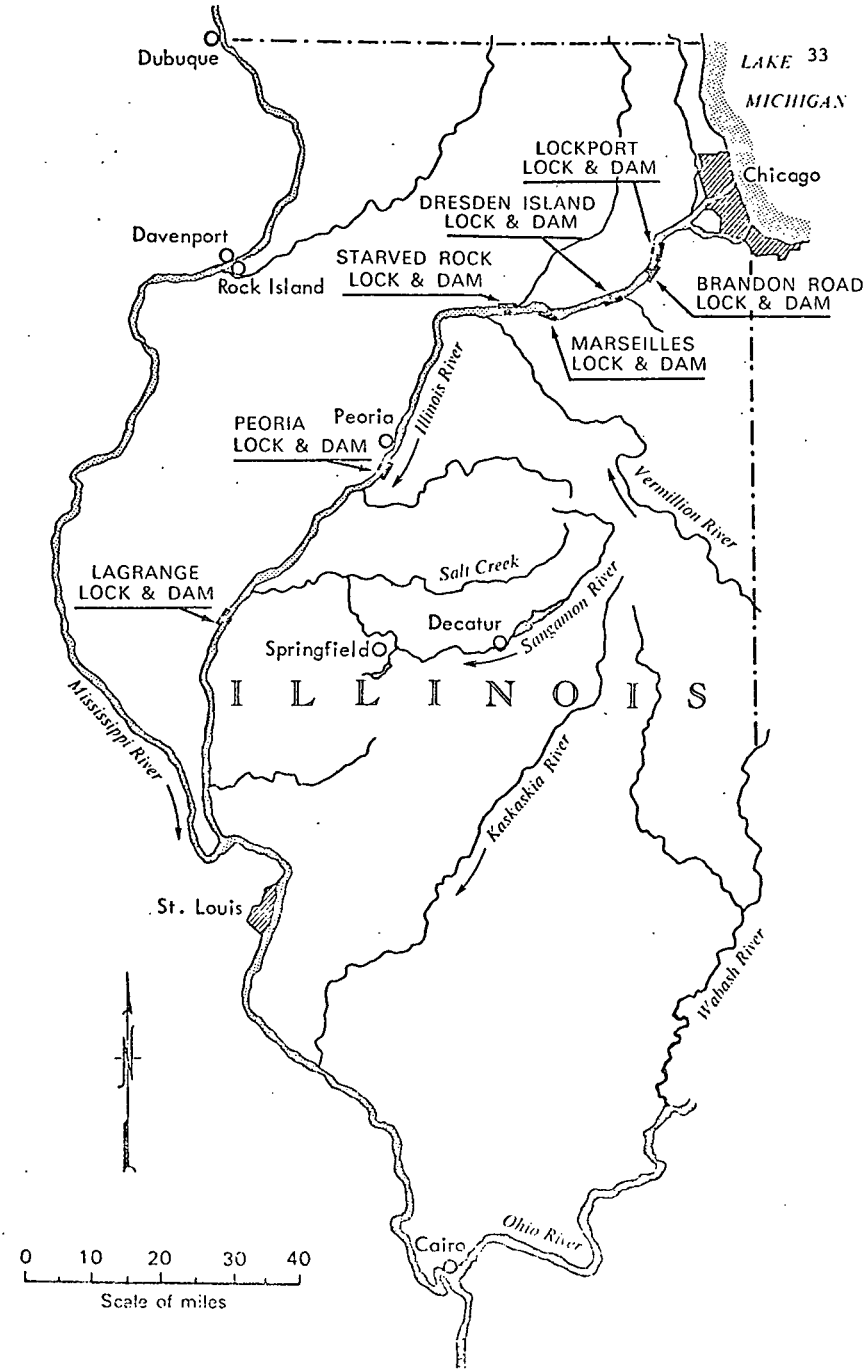
Dubuque
LAKE MICHIGAN
33
LOCKPORT LOCK & DAM
Chicago
DRESDEN ISLAND LOCK & DAM
Davenport
Rock Island
STARVED ROCK LOCK & DAM
BRANDON ROAD LOCK & DAM
MARSEILLES LOCK & DAM
Illinois River
PEORIA LOCK & DAM
Peoria
Vermillion River
Salt Creek
LAGRANGE LOCK & DAM
Decatur
Sangamon River
Springfield
ILLINOIS
Mississippi River
Kaskaskia River
St. Louis
Wabash River
Ohio River
Cairo
0 10 20 30 40
Scale of miles

FIGURE 3

The portion of the waterway analyzed in this study extends from the river mouth, at Grafton, Ill., to Lockport, Ill., a distance of 291 miles. The two remaining segments of the waterway, the Cal-Sag project and the Chicago Sanitary and Ship Canal, are excluded since the former is not yet complete and the latter was constructed by the State of Illinois for nonnavigation purposes.

The portion of the Illinois Waterway below Lockport has seven locks, each 110 feet wide and 600 feet long. Five of these locks were completed in 1933, and the remainder went into operation in 1939. For the purpose of this analysis, then, the project will be assumed to begin in 1939 and to last for 50 years.

In terms of 1962 prices, the estimated cost of the project over its life is $196 million. Of this amount, $185 million will be borne by the Federal Government and $11 million by State and local interests.[42] The vast majority of these costs have already been incurred.

In this study, an attempt is made to provide empirical answers to the following questions:

1. Given both the traffic that has actually moved on the Illinois Waterway and an estimare of future traffic, with projected future rates until 1988 (the end of its 50-year life), how much have shippers using the waterway actually saved in shipping charges?

2. Given an estimate of the traffic that would have moved on the waterway if the rate differential between barge and the least-cost alternative mode were equal to the cost differential of these modes, what is the national resource cost savings attributable to the Illinois Waterway?

The answer to the first question yields a benefit estimate close to that of the 1964 corps revision of benefit estimation procedures. The only difference is that actual nonbarge rates along the Illinois Waterway would reflect both technological improvements and the competition of the waterway. In the 1964 procedure, only the former of these effects would be reflected in the benefit estimate.[43] However, because the unit savings implicit in the question are based on rate differentials rather than on cost differentials, the benefit estimate will exceed that based on a conceptually correct definition of navigation benefits.

The answer to the second question yields an estimate of navigation benefits under circumstances that permit no units of traffic to move by barge if an alternative mode with a lower real cost exists, the point being that, under actual circumstances, an improved waterway attracts some traffic for which it is not the lowest (social) cost mode. This problem of a divergence in private and social costs is due both to the absence of user charges on the waterway and to the practices in rail pricing of the Interstate Commerce Commission. The data available do not permit the ex post isolation of this component of waterway traffic, so, in effect, it is assumed that this traffic yields zero (rather than negative) net benefits.

Consequently, while neither of these estimates correspond directly to the appropriate concept of economic benefits defined in the first section of this paper, the second calculation based on cost differentials is judged to be a close, although somewhat overstated, estimate of the

[42] This information and the raw data on which this analysis is based were obtained from the Evaluation Division of the Board of Engineers for Rivers and Harbors in Washington, D.C. The data were gathered by the board for a study of the Illinois Waterway in 1966.

[43] It will be recalled that the 1964 corps revision was substantially more sound than the evaluation procedure now used by the corps, as required by the Transportation Act of 1966.

real economic benefits produced (and expected to be produced) by the waterway. The traffic that is not counted yields no resource cost saving by moving on the waterway. In fact, the movement of this traffic on the waterway entails costs in excess of those required for movement on alternative nonwater modes. Were units of this traffic counted in the benefit estimate, they would be valued at a negative cost saving, hence reducing the benefit estimate still further.

In answering each of these questions, an empirical estimate of two time series is required. The first of these series is the estimated annual traffic utilizing the waterway together with its commodity composition and origin-destination distribution. The second is the estimated per unit cost or rate differential applicable to each unit of traffic.

In developing the series necessary to answer the first question, the following assumptions were made and procedures adopted:

1. All the waterways connecting with the Illinois Waterway were assumed to be operational so that the navigation savings estimated were incremental to the Mississippi River system.
2. All traffic moving on the Illinois Waterway was analyzed from actual origin to actual destination. Alternative sources of supply of the various commodities were not considered.
3. The rate differential observed on each of 20 commodity categories in 1962 was assumed to prevail for each commodity for the period from 1939 to 1970.[44]
4. The rate differential calculated by projecting barge and alternative modes rates, by commodity, were used for the 1971–88 period. These projected rates were based on the assumption that a once-for-all technological change relating to trainload and high volume barge movements of coal and grain takes effect in 1971.[45]
5. In estimating the traffic level, by detailed commodity, the following assumptions were made:
   (*a*) For the years 1939 to 1962, actual traffic volumes recorded on the Illinois Waterway, by commodity, were used.
   (*b*) For the years 1963 to 1970, individual commodity traffic projections, assuming no structural rate change, were used.[46]
   (*c*) For the years 1971 to 1988, individual commodity traffic volumes expected to move on the waterway, assuming projected rates prevail (see point 4) were used.[47]
6. It is assumed that the origin-destination distribution of traffic in each commodity category does not change from the observed 1962 pattern.

[44] These observed 1962 rate differentials were obtained from a detailed study by the Board of Engineers for Rivers and Harbors. In this study, and 1962 commodity movements in excess of 10,000 tons, amounting to 76 percent of the traffic that moved in 1962, were analyzed. Some 400 individual commodities were analyzed from origin to destination. The average unit saving developed in this analysis was applied, by commodity, to the remaining 24 percent of the traffic. These differentials also include an allowance for handling and transfer if more than one mode is used in a shipment.

[45] These rate projections were proposed by analysts of the Board of Engineers for Rivers and Harbors. While the projections are limited to coal and grain movements, these commodities compose a sizable share of Illinois Waterway traffic.

[46] These traffic projections with no structural rate change were done by analysts at the Board of Engineers for Rivers and Harbors. They are based on assumptions of the rate of growth of demand for each of the detailed commodity categories in the region of the Illinois Waterway, adjusted for stipulated expected economic changes, such as the increasing use of nuclear power in the Chicago area.

[47] The traffic expected to use the waterway if projected rate differentials prevail was estimated by means of a detailed analysis of 1962 traffic in which those movements displaying actual rate differentials smaller than projected rate differentials were excluded. In this analysis, the ratios of traffic remaining to actual traffic, by commodity, were applied to the traffic projections expected to prevail with no structural rate change, by commodity.

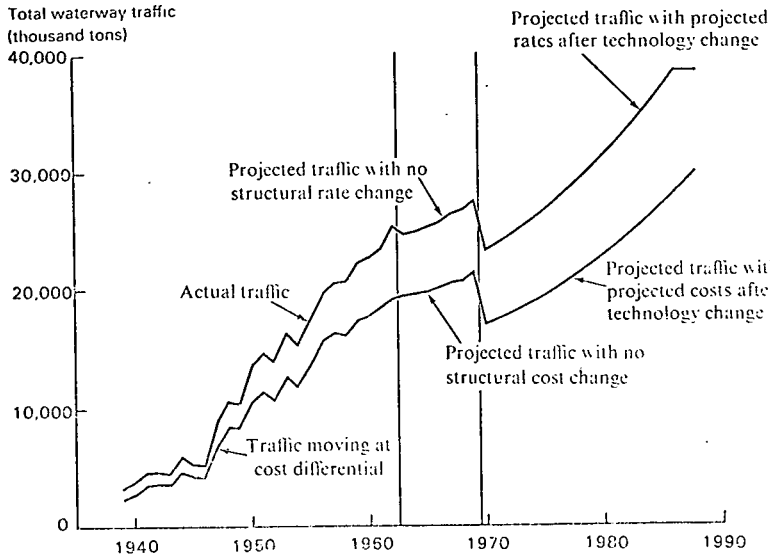

FIGURE 4

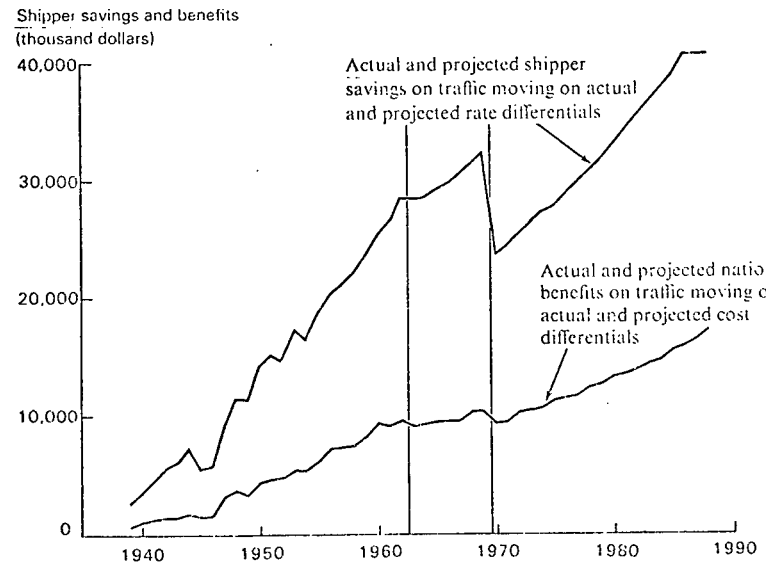

FIGURE 5

On the basis of these procedures, an estimate of the volume of traffic in each of 20 commodity categories using the waterway is obtained for each of the 50 years of project life. These detailed traffic estimates are shown in table 1 for selected years. The aggregate volume of traffic is plotted as the upper curve in figure 4. On the same basis, a rate differential for each commodity category for each year of project life is secured. The estimated total saving to shippers in

any given year equals the product of traffic moving and unit rate differential for each commodity summed over all commodity categories in that year. This series of total annual savings is plotted as the upper curve in figure 5.

TABLE 1.—ILLINOIS WATERWAY TRAFFIC IN SELECTED YEARS UNDER ALTERNATIVE ASSUMED RATE DIFFERENTIALS

[In thousands of tons]

Commodity group	Traffic on actual and projected rate basis					Traffic on actual and projected cost basis				
	1939	1952	1962	1972	1982	1939	1952	1962	1972	1982
Upbound:										
Coal	1,720	4,201	7,808	5,764	8,033	1,410	3,445	6,403	2,542	3,842
Grain:										
Corn	371	1,039	330	392	467	235	659	209	249	295
Wheat	57	48	189	242	310	57	48	189	242	310
Soybeans	25	201	131	225	274	16	131	86	147	178
Other	8	45	51	61	72	5	29	32	38	45
Petroleum and petroleum products	168	3,446	4,309	5,533	7,882	136	2,791	3,490	4,482	5,898
Sand and gravel	222	1,001	2,070	1,500	1,500	222	1,001	2,070	1,500	1,500
Iron ore			555	200	200			555	200	200
Chemicals		146	870	1,288	1,906		146	870	1,288	1,906
Phosphate rock		171	468	619	820		171	468	619	820
Other	240	889	1,651	2,443	3,617	171	634	1,177	1,742	2,580
Total upbound	2,811	11,187	18,432	18,267	24,481	2,522	9,055	15,549	13,049	17,574
Downbound:										
Coal		752	5				552			
Grain:										
Corn	80	433	3,258	1,799	2,700	32	173	1,209	1,646	2,510
Wheat	18	146	388	497	636	18	146	388	497	636
Soybeans		25	616	311	379		9	181	311	379
Other		89	74	25	37		36	18	22	26
Petroleum and petroleum products	32	704	1,050	1,348	1,774	16	357	532	683	899
Sand and gravel		134	25				75			
Chemicals		78	267	395	585		78	267	395	585
Other	174	492	1,248	1,886	2,791	136	448	994	1,471	2,177
Total downbound	304	2,853	6,927	6,261	8,902	202	1,874	3,589	5,025	7,212
Total, all traffic	3,115	14,040	25,359	24,528	36,315	2,454	10,929	19,138	18,074	24,786

In developing the series necessary to answer the second question, the following points 3′, 4′, and 5′ are substituted for points, 3, 4, and 5 in the above list:

3′. The unit cost differentials estimated for each of twenty commodity categories in 1962 are assumed to prevail for each commodity for the period from 1939 to 1970.[48]

4′. Unit cost differentials calculated by projecting barge and alternative mode costs, by commodity, are used for the 1971–88 period. These projected costs are based on the assumption that the once-for-all technological changes discussed in point 4 above reduce costs by the same percentage as projected rates were reduced.

5′. In estimating the traffic level, by detailed commodity, the following assumptions were made:

(*a*) For the years 1939 to 1962, actual traffic volume, by commodity, excluding those movements that demonstrated no savings with rate differentials equal to the cost differentials estimated in point 3 above, were used.[49]

(*b*) For the years 1963 to 1970, individual commodity traffic projections, assuming no structural rate change and adjusted to exclude those movements that demonstrated no savings with rate differentials equal to the cost differentials estimated in point 3 above, were used.

(*c*) For the years 1971 to 1988, individual commodity traffic volumes expected to move on the waterway if projected rates prevail, adjusted to exclude movements that demonstrated no savings with rate differentials equal to projected cost differentials estimated in point 4 above, were used.

Use of these procedures generates an estimate of the volume of traffic that would have used the waterway for each of 20 commodity categories if rate differentials equaled cost differentials in each of the 50 years of the life of the waterway. These detailed traffic estimates are shown for a sample of years in table 1, and aggregate traffic volume is plotted as the lower curve in figure 4. Application of these procedures also yields an estimate of the rate differential equivalent to the cost differentials for each commodity category for each year of project life. The estimated total national cost saving in any given year equals the product of total traffic and unit cost differentials for each commodity, summed over all commodity categories in that year. This series is shown as the lower curve in figure 5.

In table 2, the benefit and cost results of this ex-post analysis of the Illinois Waterway are summarized. The calculation presented there shows two separate estimates of the economic worth of the Illinois Waterway in 1939, using 1962 prices. Column 1 summarizes the results when observed rate differentials served as the basis for both traffic and unit saving estimates. These estimates are similar to,

[48] These estimates of carrier cost differentials are based on out-of-pocket costs of 1962 barge and alternative mode operations. These cost estimates were obtained from (1) a special study by the Board of Engineers for Rivers and Harbors of the Chicago and Illinois Midland Railway Co. and the Illinois Central Railroad for railway costs, (2) an analysis by the Office of the Chief of Engineers, for barge costs, and (3) studies of motor carrier costs by the Interstate Commerce Commission, for truck costs.

[49] The traffic excluded from the actual (projected) traffic estimates was based on a detailed analysis of the 1962 traffic movements. The question asked about each commodity movement was: "If the rate differential was equal to the 1962 cost differential would this unit of traffic have moved on the Illinois Waterway?" If the answer was negative, the transportation mode with the least real cost for that shipment was non-barge and that shipment was excluded from the traffic estimate for the Illinois Waterway. Movement of this traffic on the Illinois Waterway entails real costs above the minimum and, hence, resource misallocation.

although more conservative than, those which would be produced by applying the current corps procedures dictated by the Transportation Act of 1966, discussed above.

TABLE 2.—PERTINENT SUMMARY DATA FOR THE ILLINOIS WATERWAY PROJECT

	Project evaluation using traffic on actual and projected rate basis and savings on actual and projected rate differential basis (1)	Project evaluation using traffic on actual and projected cost basis and benefits on actual and projected cost differential basis (2)
Present value in 1939 of benefits using 5-percent interest rate (million)	$294.2	$102.0
Present value in 1939 of benefits using 3-percent interest rate (million)	$428.6	$178.5
Present value in 1939 of costs using 5-percent interest rate (million)	$233.2	$233.2
Present value in 1939 of costs using 3-percent interest rate (million)	$238.5	$248.5
Benefit-cost ratio at 5 percent	1.26	.44
Benefit-cost ratio at 3 percent	1.72	.72
Range of savings (dollars per ton)	.89–1.18	.37–0.57
Median savings (dollars per ton)	1.06	.48

Column 2 presents the results when observed cost differentials served as the basis for both traffic and unit savings estimates. These results closely correspond to the economic efficiency concepts which form the basis of an appropriate estimate. In developing these estimates, the observed record of project performance during one-half of the 50 year life if the project provided the basis for both benefit and cost estimation. In addition, projected changes expected to occur during the remaining life if the project, as observed from the perspective of the mid-1960s, were incorporated into the estimation model.

For each of the two traffic and unit savings assumptions, the present value of benefits was calculated, using both a 3 percent and a 5 percent rate of interest. When current rate differentials are used for estimating both traffic unit sayings, the project demonstrates a benefit-cost ratio above unity in both the 3 percent and the 5 percent interest rate calculations. When the benefit estimates are based on the more appropriate cost differentials, the resulting benefit-cost ratios are substantially lower. In neither the calculation using the 3 percent rate nor that employing 5 percent does the benefit-cost ratio exceed unity. Using an interest rate of 5 percent, the present value of project benefits viewed from the year 1939 is less than one-half the present value of costs; on the 3 percent basis, the present value of benefits viewed from the year 1939 is approximately 65 percent of the present value of project costs.[50]

Table 2 also shows that, when existing rate differentials are used to estimate unit savings, the Illinois Waterway had reduced transportation expenses borne by shippers by more than $1 per ton in well over one-half of the years of project life. When the more appropriate cost differential basis is used to estimate per unit real resource savings, a median per ton value of less than 50 cents is found.

These ex post results are important as estimates of the performance of the Illinois Waterway investment under various estimation assump-

[50] A discount rate of between 3 and 5 percent was judged appropriate in evaluating benefits and costs from the perspective of the late 1930s—a low interest rate period. A calculation of the benefit-cost ratio using an interest rate of 10 percent—appropriate for the later 1960's—was also performed. Using the 10 percent discount rate, the ratio based on rate differentials was slightly above 0.5; the ratio based on cost differentials was below 0.2.

tions and procedures. They are even more significant as hard evidence of the extent of benefit overstatement that is generated by existing ex ante benefit estimation procedures. While the bloated benefit estimates in the first column of table 2 substantially exceed the more appropriate present value of real national resource savings in the second column—$294 million to $102 million at a 5-percent interest rate—it should be emphasized that the estimates of savings to shippers in the first column are more conservative than the definition of savings to shippers in the Transportation Act of 1966.[51] It should be recognized that additional data development and analysis could yield still stronger conclusions and provide more meaningful guidance to the development of improved ex ante procedures by public agencies.[52]

The Economic Efficiency Criterion and the Evaluation of Public Investments: Some Concluding Comments

This study was undertaken to establish a conceptual framework for the ex post appraisal of the economic performance of public sector investments in the navigation area and to make a first cut empirical evaluation of a particular project. The framework adopted n this study was based on a national accounting stance and emphasized the primary, or efficiency, benefits, and costs of public undertakings.

The purpose for adopting this economic efficiency framework in appraising water resources investments was twofold. First, the basic nonpolitical reason why Government undertakes such public works activities is an economic efficiency reason. Were it not for the public good and the decreasing cost aspects of these investments, they would be part and parcel of the private sector and subject to the maximum net benefits criterion that guides private decisions. Because these activities do not typically serve social functions other than the correction of market failure, and because of the desire to avoid transferring resources from more productive activities in the private sector to less productive activities in the public sector, this criterion is also an appropriate one for these public works undertakings.

Second, the parameters of the production function implicit in the economic efficiency model are relatively well know. While there are still some unsettled conceptual and empirical issues, there is wide agreement on the definitions and measurement of inputs and outputs—of benefits and costs—within the efficiency model. The same cannot be claimed for other nonefficiency evaluation models; for example, models with multidimensional objective functions, including income redistribution, regional aid or development, or "social well-being."

The conclusions of this study are not encouraging. Serious inconsistencies were found between the ex ante evaluation procedures of the Corps of Engineers and those that would be derived from the basic efficiency model. Evaluation procedures for measuring navigation

[51] It will be recalled that both traffic and unit savings in the savings to shippers framework employed here are based on observed and projected rate differentials as they exist throughout the life of the project. These differentials, therefore, are narrowed by both the post-project competition of the waterway and technological change in the nonwaterway modes. The Transportation Act concept of savings to shippers requires both traffic and unit savings estimates to be based on rate differentials observed prior to the project.

[52] These ex post estimates of project performance cannot be compared with ex ante estimates prepared by the agency prior to project construction. In the corps report on this project, prepared in 1933, no benefit-cost ratio was calculated. In that report, "prospective" annual benefits were estimated to be $5.2 million, using the current rate basis. This "benefit" was achieved in the 4th year of project operation. Similarly, cost estimates were sketchy. For the Illinois Waterway, below Lockport, investment costs were estimated to be $15.5 million with $0.5 million annually for operation and channel maintenance.

benefits applied by the agency (as required by law) have little, if any, relationship to an efficiency concept of benefits or any other benefit concept that has economic meaning. In the empirical case study presented, estimates of benefits derived from an appropriate efficiency framework shows little relationship to benefit estimates as they would be calculated by the corps. The bias incorporated into agency ex ante evaluation procedures results in the persistent overstatement of expected benefits.

At a minimum, then, this study has demonstrated a need to seriously reappraise the procedures of benefit-cost analysis as practiced by the Corps of Engineers. Unless procedures are based on an appropriate benefit-cost framework and constantly revised on the basis of performance feedback from existing undertakings, the credibility of ex ante analysis will, and should, be challenged. The serious discrepancies between the costs and benefits derived from the efficiency model and those calculated by the Corps of Engineers do little to instill confidence in current ex ante analysis as conducted by the corps.

Further, these results generate serious questions concerning the direction of current efforts to revise planning and evaluation procedures in the water resource area.[53] These efforts have largely neglected the need to improve the evaluation of primary benefits and costs and have concentrated on including several nonefficiency impacts, such as income distribution, regional growth, and secondary effects, in the basic evaluation model. Surely, knowledge of these nonefficiency effects is relevant to project appraisal and choice, and information on them should be developed and presented to decisionmakers. However, given the serious shortfalls in the performance of ex ante benefit and costs estimation—an area where production functions are fairly well understood—the first order of business would seem to be improvement of these estimates before more esoteric impacts generated by linkages that are little understood are pushed full-blown into the basic ex ante evaluation model. Indeed, before more confidence can be placed in the benefit and cost estimates based on primary impacts, it seems almost ludicrous to develop complex procedures for building ex ante estimates of these elusive nonefficiency effects into formal criteria.[54]

Finally, it would appear that a more substantial monitoring and ex post evaluation effort by agencies could lead to important improvements in benefit-cost procedures. Through such an effort, a basis for correcting persistent biases in existing ex ante estimation procedures would be obtained. Moreover, through regular and ongoing project monitoring and evaluation, much could be discovered about the little-known and vaguely understood relationships between public investments and changes in income distribution, regional growth, and environmental quality. At this time, obtaining increased knowledge of these relationships clearly must precede the development of ex ante project evaluation procedures that incorporate these nonefficiency variables.[55]

[53] U.S. Water Resources Council, *Principles for Planning Water and Land Resources* (Washington, D.C., 1970).

[54] See A. Myrick Freeman III and Robert H. Haveman, *op. cit.*, pp. 1533–39, for a further critique of the efforts to formalized multiple objective criteria in the planning process.

[55] Gilbert White has also recently emphasized the need to undertake appraisal of the performance of completed works in order to better understand both the efficiency and nonefficiency impacts of water developments. He states: ". . . the analytical methods to determine effects, as in the case of income redistribution from building an irrigation scheme or impacts upon ecosystems from a new reservoir, are still imperfect. It is partly because few attempts have been made to apply what methods are available to the appraisal of completed works. The shelves are bursting with plans and with normative studies of optimal solutions. A few inches will suffice to record what is known, in fact, to have happened." Gilbert F. White, *Strategies of American Water Management* (University of Michigan Press, 1969), p. 14.

THE FAMILY ASSISTANCE PLAN: AN ANALYSIS AND EVALUATION

By D. Lee Bawden, Glen G. Cain, *and* Leonard J. Hausman*

Abstract

The family assistance plan (FAP) is analyzed as a prototype of welfare reform providing a federally financed income guarantee, an extension of cash transfers to the working poor, and a movement toward Federal administration of public assistance. To fulfill the objectives set for FAP by the administration, however, a number of changes should be made in the legislation which has been proposed. The recommended changes are directed toward making a firm and explicit commitment to Federal administration; eliminating extraneous provisions like the work test and child care services, and treating income from various sources more uniformly when computing benefit levels. The problem of work disincentives that result when benefits are reduced as the recipient's earnings increase is given special attention. The conversion of the food stamp program into additional cash transfers is another recommended improvement. This change would raise the basic cash guarantee to $2,440 and has other advantages.

I. Introduction

President Nixon's family assistance plan (FAP) advances major welfare reforms. It provides for a federally financed income guarantee, extends cash transfers to the working poor, and appears to take major steps toward Federal administration of public assistance. Although it is not possible to discuss a final version of the bill, we believe it is useful to analyze the issues that must be dealt with in any legislation providing income supplements, and we use the October 1970, version of the bill to illustrate in a concrete way the problems encountered. (This is a "revised revision" of H.R. 16311, which the House passed earlier in the year.)[1] In 1971 FAP was represented by a new bill, H.R. 1, which incorporated several changes, some of which are mentioned below. The Senate Committee on Finance made

*D. Lee Bawden is an associate professor of economics and agricultural economics at the University of Wisconsin; Glen G. Cain is professor of economics at the University of Wisconsin. Leonard J. Hausman is assistant professor of economics and social policy at Brandeis University. The research reported here was supported by funds granted to the Institute for Research on Poverty at the University of Wisconsin by the Office of Economic Opportunity and to Brandeis University by the Office of Child Development in the Department of Health, Education, and Welfare. The authors wish to express their gratitude for an unusually large amount of advice and criticism from a number of their colleagues at the Institute for Research on Poverty and The National Manpower Policy Task Force Associates. Special thanks are due Robinson Hollister, William Klein, Robert Lampman, Larry Orr, and Harold Watts. An earlier version of this paper was issued as a policy statement of the National Manpower Policy Task Force Associates. On a subject as complicated as income maintenance and regarding a bill like FAP, no two people are likely to agree on all the points discussed in this paper. We wish, therefore, to absolve all those mentioned, explicitly or implicitly, from responsibility for our conclusions, recommendations, and errors.

[1] The current version of the bill at this date (January 1971), along with explanatory material, is available in: Senate Finance Committee, H.R. 16311, June revision revised and resubmitted with staff analysis, November 5, 1970. Our reference to the bill and to various supplementary facts about it will be from this source unless otherwise noted.

further changes in H.R. 1, redirecting the bill away from income supplements for the working poor and toward providing job opportunities. This last version of the bill is sufficiently different from FAP that the analysis of this paper has limited relevance.

Among students of the field there is widespread acceptance of the following general objectives of FAP:

1. The alleviation of poverty among all poor persons;
2. The reduction of financial disincentives to work;
3. The provision of financial incentives to maintain stable families;
4. The equal treatment of equally poor persons, regardless of residence or source of income; and
5. The development of a single and efficient administrative mechanism that promotes the dignity and self-reliance of FAP recipients.

In the words of Robert Finch, former Secretary of HEW, the administration aims at "revolutionary structural reform in the (welfare) system." [2] The most important obstacle to this aim and to attaining the objectives listed above is a limited budget, but there are opportunities to improve the bill within the 1970 budgetary allocation of $4.3 billion. Our suggestions for revisions that raise the financial costs will be made clear, as will those that reduce them. The recommendations made, however, do not necessarily consider political pressures that impinge on the Congress; gaging such pressures and devising appropriate responses to them is not within our competence.[3]

The analysis and suggested changes in the bill proceed in a framework provided by the list of objectives, though it should be noted that the objectives are interrelated and that many provisions of the bill affect several objectives.

II. Alleviation of Poverty

The major purpose of FAP is to put money, and thus goods and services, into the hands of the poor. The degree to which the program achieves this purpose depends on the extent of its coverage, income and asset eligibility criteria, and level of benefits.

Coverage.—The plan is basically designed to aid poor families with children who are either under 18 years of age or who are 18 to 21 years of age and in school.[4] For the first time, therefore, all poor families in which the head is working will be given federally financed assistance in all 50 States. It is noteworthy that almost half the poor people in the United States are members of families with an able-bodied male head, less than 65 years of age; that over 60 percent of the latter group is poor despite the fact that the breadwinner holds a full-time, year-round job; and that, among most of the remainder, the head works part time the entire year or full time for part of the year. FAP embodies the principle that the working poor are as deserving of help as are those

[2] Robert H. Finch, "Statement of Secretary of Health, Education, and Welfare," in House Ways and Means Committee, 91st Congress, 1st Session, *The Subject of Social Security and Welfare Proposals*, part 1 of 7, p. 50, October 15-15, 1969.

[3] Indeed we are skeptical of the usefulness of assessing congressional opinions prior to a thorough explanation and debate of the general issues in welfare reform and of the particular issues of specific legislative proposals like FAP. How many would have predicted the passage of FAP by the House, after reading the results of the survey of congressional opinion by Cavala and Wildavsky? (See their article "The Political Feasibility of Income by Right," *Public Policy*, XVII (Spring 1970), pp. 321-354.)

[4] Separate provisions of the bill to assist financially all aged, blind, and disabled adults and to provide social services to all poor persons will not be discussed in this paper.

who are unable to work; it moves us closer to a standard whereby families receive assistance because they *are* poor, and not because of *why* they are poor. A large step is thereby taken toward removing incentives for an individual or family to engage in behavior to fit into such categories of eligibility as "the fatherless family" or "the family with an unemployed head."

The inclusion of families without children and of unrelated individuals would, of course, enhance the goal of reducing poverty. The costs of such an extension of coverage is estimated to be about $1.5 billion. A large portion of these benefits would supplement incomes of deserted, divorced, and single women, and much of the remainder would go to young couples, most of whom will eventually become parents. Such expanded coverage would reduce or eliminate the "child bonus" now offered in the bill, since childless couples would not have a special incentive to have a child. Moreover, this extension reduces the probability that children would be transferred from their natural home to that of a childless relative to qualify the latter unit for FAP benefits.

Eligibility criteria: income and assets.—A family's income and size principally determine its FAP benefits. The income guarantee is $500 per year for each of the first two family members plus $300 per year for each additional member. This is the amount that would be paid to a family, perhaps in monthly or biweekly installments, if it had less than $720 in annual earnings. For example, a family of four earning $720 or less would receive Federal payments of $1,600 per year. Each dollar earned in excess of $720 would result in a 50 cents reduction in FAP benefits. (Each dollar of some types of income that are declared as "unearned" would result in a $1 reduction in FAP benefits.) If the family of four has $3,920 or more in earned income, FAP payments are reduced to zero. The amount of FAP payments for a family of four is given by the formula: FAP payments=$1,600—½ (nonexcludable family income—$720). (The initial revision of H.R. 1 provided $800 for each adult and $400 for each additional child, with lesser amounts allowed to fourth and higher parity children. The rate at which payments are reduced as income increases was raised to two-thirds.)

In computing family income to determine the size of FAP payments, income from the following sources is excluded: earnings of children in school up to a limit that is unspecified in the bill, the tuition part of scholarships and fellowships, training allowances, the value of food stamps, other public or private charities, and inconsequential or infrequently received income, if the latter income is less than $30 per quarter. Moreover, families are allowed to deduct from their reported income the expenses of child care for a working parent up to some limit of expenses to be decided by the Secretary of HEW.

There are two categories of nonexcludable income—earned and unearned. Wages, salaries, and income from self-employment are considered earned, and this income is "taxed" at 50 percent: i.e., the FAP benefit is reduced by 50 cents for each dollar of earned income. Unearned income consists of rents, dividends, interest payments, veterans' pensions, unemployment compensation, farm subsidies, and the like—anything that is not the direct product of labor. Income from these sources results in a 100 percent offset in FAP benefits—FAP benefits are reduced on a dollar-for-dollar basis as unearned income is received.[4]

[4] Throughout the paper the terms, "offset," "offset rate," "implicit tax rate," and for brevity, "tax rate," will be used interchangeably.

One motive for offsetting unearned income at a 100 percent rate is to save FAP funds, but it is not clear that this will be the result. If a FAP beneficiary knows, for example, that his receipt of unemployment compensation is completely negated by a reduction in his FAP benefit, he is unlikely to bother applying for the unemployment payments. In response to this type of situation a provision was added to H.R. 16311 requiring that "no assistance will be payable for any family member who *refuses* to apply for unemployment, social security, or *other such benefits* for which he is *apparently* eligible" (emphasis added). The italicized words signal troublesome points of policing the provision. These difficulties are unnecessary and could be avoided if the offset rate on unearned income were below 100 percent, since it would then pay the recipient to apply. At a 50-percent rate, for example, one less FAP dollar would be paid out for every two unemployment compensation dollars received, and the beneficiary would be better off. This same argument applies to other sources of income which are offset at 100 percent—pensions (which can be delayed), farm subsidies (which require an outlay of cost on the part of the recipient and raise the effective total "tax" on the subsidy above 100 percent), and so on.

It should be emphasized, however, that these interagency savings and costs are of less consequence to national output than would be the substantial incentive for FAP families who earn rental income (which involves, let us note, some costs to the renter) to abandon such income-producing efforts altogether. Similarly, the 100-percent offset provides an incentive to convert income-earning assets to alternatives which substitute rising valuation or deferred income for current income.[5]

The treatment of infrequently earned, small amounts of income may be a necessary simplification for administrative reasons. However, the deduction of large amounts of earnings of children who attend school seems excessively generous, considering the amounts that can be earned during summers. Some nonpoor families will receive scarce FAP dollars that could otherwise he used to increase benefits for more needy families. Moreover, an incentive is created to substitute children's labor (which is not offset) for that of an adult, whose earnings are offset at 50 percent; or, as is common among farmers under the positive income tax, to transfer some of the adult's earnings to the children in the guise of wages. Greater equity could be achieved with an explicit ceiling of perhaps $600 per working child per year, with amounts over this treated as regular income and thus offset at the applicable rate.

Aid from public programs and private charities is not counted in family income for purposes of determining FAP benefits. One disadvantage is that the principle of horizontal equity is violated: A family receiving aid or charity of a given amount will get more FAP payments than a family which has earnings of the same amount. Another disadvantage is that incentives are created for people to "categorize" themselves to become eligible for such aid. Thus it is more consistent with the objective of equity and of a desired in-

[5] It is not clear what principle of equity is served by the distinction between earned and unearned income. If two families have the same income, it seems more equitable to provide them with the same assistance without regard to the source of their income. One might argue that a recipient of unemployment compensation or a landlord has more leisure than one who is receiving wage income, but the argument appears strained to us.

centive system to count as income all of this aid in excess of some nominal amount but not including nominal gifts for special occasions. This procedure is not without some difficulties, however. One is the problem of placing a dollar value on in-kind income such as housing or clothing. Another is that the charitable agency may already be reducing its payments when the recipient's income rises, and thus the added FAP offset will increase the effective tax rate facing the FAP recipient. Finally, some charitable agencies may object to handing out "50-cent dollars" and may withdraw their aid to FAP recipients.

The benefits of medicaid are also not counted in family income when FAP payments are determined. Although it is reasonable to view medicaid less as income than as payments to cover unforeseen expenses of ill health or injury, some categories of the poor are not eligible to receive medicaid. The restricted coverage creates an inequity and, as will be discussed below, an undesirable incentive for the recipient to stay "on welfare" to maintain his medicaid benefits. A useful reform is the proposed family health insurance plan (FHIP), which replaces medicaid with a national health insurance plan for all poor families with children. Premiums to pay for the insurance are to be scaled according to the income of the family. Although some poor families will pay slightly more for medical care under FHIP than under medicaid, and despite the fact that the proposed method of paying premiums creates, in effect, a small tax on income that is added on to the tax implicit in the reduction of FAP payments as income rises, FHIP promises to be a preferable way of providing health services. The problems involved in the accumulation of tax rates are discussed below.

An asset limit also exists for determining eligibility: A family with nonexcludable assets in excess of $1,500 cannot receive FAP payments. Since the value of an owner-occupied home, all household goods and personal effects, and business assets of the self-employed are excluded, it would not be too difficult for a family to exchange its includable assets—like personal savings or the cash value of an insurance policy—for excludable ones, to meet the $1,500 limit. We doubt that this conversion of assets should be encouraged. The problem of keeping "nonpoor" families from receiving scarce funds can be much more equitably handled by including as income some fraction, say 10 percent, of estimated net worth above some specified exclusion levels. An equity of $10,000 in a home and $20,000 in business assets might be excluded for imputation purposes. The income from a business, however, would be included and offset at the applicable rate.

Benefit levels.—The maximum FAP benefit of $1,600 for a family of four is only 45 percent of the 1970 poverty threshold of $3,720. By the time FAP is implemented, the threshold will exceed $4,000. In 1970 forty-two States guaranteed more than $1,600 per year to four-person families which qualify for Aid to Families with Dependent Children (AFDC). The adequacy of FAP must be measured, however, after taking into account supplementary payments which States are required to offer and the food stamp program.

The bill requires that a State must supplement FAP benefits for all female-headed FAP recipients, if the benefit levels of the State's program of AFDC exceed the FAP guarantee level. There are 42 States which will be required, under this provision, to add cash payments to raise FAP benefits up to the levels of AFDC benefits prevailing in October 1970. (Twenty-three States now have an AFDC–UF pro-

gram—UF stands for unemployed father. Federal aid to this program is scheduled to end under FAP after a period of 2 years, during which time States will be required to maintain their existing coverage for families who were receiving payments at the time the law goes into effect.)

A food stamp program will also provide a sizable supplement to FAP. The food program is very similar to the FAP program, except that recipients are constrained to use their supplements to purchase food. A family of four, with zero earnings and no other income, is eligible for a $1,272 "food stamp bonus." If this family is eligible for a $1,600 annual FAP payment, its food stamp bonus will be reduced, since FAP payments will be counted as income for purposes of determining the food stamp allowance. The amount of food stamps going to a zero-earnings family of four covered by FAP would be about $840. Taken together, these two programs will guarantee a family of four a minimum income of approximately $2,440 per year, about two-thirds of the 1970 poverty level. (H.R. 1 dropped the food stamp program, so its basic cash guarantee of $2,400 for a family of four with no other income is about the same guarantee level as H.R. 16311 offered when FAP was combined with the food stamp bonus.) Families of four with earnings of around $3,000 or more and with payments from both programs (not including medical insurance), will be raised above the 1970 poverty-line of $3,720. If FAP becomes law, the estimated cost of the food stamp program, which covers all poor persons, is $1.6 billion per year. This compares with the additional costs of $2.2 billion in FAP payments, which cover a somewhat smaller population, after allowance is made for the replacement of $2.8 billion of current welfare payments.

The question remains whether such a sizable sum could not be better spent by expanding the coverage of FAP, increasing the cash guarantee, lowering the implicit tax rate on earned income, or some conbination of the three. Prof. Harold Watts, director of the Institute for Research on Poverty at the University of Wisconsin, has argued against the use of food stamps:

> The first issue here is whether, aside from the public passion for feeding the poor, there is any lasting reason for dealing with food separately from the general and varied needs of people with low incomes. There is ample empirical evidence that people spend a substantial part of any increase in income on food. This is particularly true for the poor. If by a combination of food stamps and cash benefits we do not coerce people into spending more on food than they would have with an all-cash benefit of equal value, we shall simply have gone needlessly to substantial nuisance and expense. If on the other hand, we try to make people spend substantially more on food (and correspondingly less on clothing, housing, transportation, education, etc.) than they would with an all-cash benefit, we shall be facing a serious enforcement problem in preventing families from reselling the stamps or food. Such an enforcement nightmare could largely nullify (by its cost) the rather dubious advantage of altering their expenditure patterns. In either case food stamps seem to be a bad bargain in comparison to general cash benefits.[6]

Another issue, the effect the food stamp program has on raising offset rates on earned income, is taken up in the next section.

III. Incentives To Work

An issue in the reform of welfare which has received much attention is the need to alter the features of existing legislation which dis-

[6] Harold Watts, testimony before the House Ways and Means Committee, 91st Congress, 1st sess., *The Subject of Social Security and Welfare Proposals*, pt. 7 of 7, pp. 2456-2467, Nov. 13, 1969.

courage work. This is not only because of the importance attached to work in its own right, but because the costs of the program are directly related to the amount of work and earnings of the eligible population. The provisions of the bill that affect work behavior are principally those involving the level of the guarantee, the offset rates on earnings, the ease or difficulty in shifting on and off FAP rolls, the treatment of expenses of work and child care, and the use of a "work test." A discussion of these provisions follows.

The guarantee level.—Higher guarantee levels and the associated higher amounts of income supplements are expected to create greater disincentives to work. There is widespread agreement with this proposition on the basis of "common sense" and "intuition" or economic theory,[7] depending on one's approach to the issue, but there is little hard evidence from any source on the extent of disincentives. We would add no more to this qualitative judgment except to mention that "informed opinion" also holds that the extent of disincentive is probably minor, and that the guarantee level is much less important a factor than the implicit tax rates on earned income.

The tax rate on earned income.—The FAP proposal follows the 1967 public assistance amendments in attempting to keep the implicit tax rate on earnings below 100 percent. The implicit tax rate on earnings of 50 percent specified in FAP should lessen the disincentive to work among the more than 2 million families receiving AFDC assistance payments, but a 50-percent rate is likely to create some disincentive to work for the many families not previously on welfare. Under FAP a family will be allowed to earn up to $720 annually with no loss of FAP benefits, or more than $720 if the income is excludable or if there are deductible expenses for child care.

There are, however, additional implicit tax rates from other segments of the welfare package that will affect low-income families. In the 42 States where AFDC payments are higher than the basic FAP levels, an increase of $1 in a family's income will bring about a reduction in total FAP and state payments of 66⅔ cents for those families eligible to receive both types of payments.[8] Moreover, in all 50 States the food stamp program will provide another type of benefit that will be reduced as family income is increased—another addition to the accumulative offset rate. There are social security taxes to be added and, above a certain level of income, positive income taxes. FHIP adds another implicit tax because the premiums increase as income rise. (H.R. 1 does not have the food stamp offset, but the overall offset rate is as high or higher because the FAP offset is 66⅔ percent instead of 50 percent.)

The compounding of tax rates that results from direct taxes on earnings and losses in program benefits is illustrated in tables 1–3 in the appendix. Separate examples are given for those States in which the basic FAP benefit overrides the current level of AFDC payments and for those in which supplementary benefits will be required in order to maintain current payment levels. A detailed discussion of the

[7] See, "Income Redistribution and the Labor Supply: A Symposium," with an introduction by H. Watts and articles by C. Green, R. Perlman, P. Albin and B. Stein, J. Leuthold, and J. Conlisk, *Journal of Human Resources*, III, (Summer 1968).

[8] In 22 of the 50 States there are some welfare recipients who receive outside income and are allowed special (and varying) tax rates on this income if their welfare budget is below the "standard of need" budget of the State. The bill provides separate treatment of these cases for a 2-year period, but we will not discuss this issue.

tables is provided in the appendix. Only the major points are noted here.

Consider the combined effect of the benefit reduction rates in the FAP, food stamp, and medical insurance programs, along with social security and income taxes which apply to FAP recipients in States that will not offer supplemental benefits. Recipients in these low-benefit States will be facing offset rates of between 74 and 90 percent on earnings between $720 and $3,920 per year. In high-benefit States, the problem would be more serious since the State supplements may be offset at a 66⅔ percent rate, which means that the basic FAP rate of 50 percent is increased by 16⅔ percent. Recipients who would be eligible for State supplements would face tax rates of between 76 and 94 percent on earnings between $720 and $6,300. For households receiving income-conditioned housing or day care subsidies, the tax rate problem becomes more serious. It is not unusual to find cases in which the total benefit reduction exceeds the amount of income increase, so that the family is worse off for having (and reporting!) the income gain.

Since these exceedingly high tax rates are inconsistent with a major objective of FAP, the minimizing of financial disincentives to work, a proposal is put forth in table 3 to reduce the combined tax rate. By replacing the food stamp program with an addition of $840 to the basic cash allowance and creating a special device to absorb social security and income tax payments, the combined tax rate is always kept at or below 60 percent. Even this rate is high, since our preference is to keep the total tax rate close to the 50-percent level.

If the reduced tax rate would result in less work disincentive and more earnings than the presently proposed bundle of programs, the costs of the proposed change may be minimal. Furthermore, State supplements would be overridden in many States, thus eliminating their exceedingly high tax rates. A problem would remain of course, in those States that at present guarantee recipients more than $2,440 per year in cash payments. One possible solution could be a freezing of the rolls of the high benefit State programs of AFDC and AFDC–UF—adding no new families and allowing attrition of existing families—and placing a ceiling on future increases in these plans, except for cost-of-living adjustments. In exchange for such a severe curtailment of the current welfare programs, a commitment could be written into the bill to raise FAP benefit levels in real terms at a rate of 5 or 6 percent per year—that is, at twice the rate of increase in the U.S. median family income.

Getting on and off FAP rolls.—One disincentive to employment faced by public assistance recipients is the fear that their return to welfare would be difficult in the event that their jobs failed to provide permanent selfsufficiency. FAP should remove this fear; under it the working poor receive benefits, so there can be a smooth transition off and on the FAP rolls as recipients gain and lose employment in jobs paying above poverty levels. (Precisely what accounting period is used in determining the amount of a family's benefit is a closely related and complicated question that will be discussed shortly.)

Under the AFDC–UF program, States discontinue aid to a family if the male head works 30 or more hours per week (or more than three-fourths of the number of hours considered by the man's industry to be full time for the job, whichever is reached first). The 30th hour

of work in a week renders the family ineligible for any AFDC–UF and, in many instances, medicaid benefits. These eligibility stipulations created special incentives for male heads to reduce their work effort. Under FAP, a male head will be allowed to work any number of hours and will receive some FAP benefits until his earnings exceed $3,920 per year and some FHIP benefits until his earnings exceed $5,620 per year.

Work expenses and child care costs of working parents.—One rationale for the deduction of $720 from annual family earnings before calculating FAP payments is that this amount, equal to $60 a month, corresponds roughly with the expenses incurred in earning income. This objective can be met more directly by allowing deductions of up to $50 a month from earnings of the first adult earner and up to $25 a month for each additional adult earner. Deductions of these amounts would remain within the budget limits implied by the annual deduction of $720 per family, and they would provide more horizontal equity among families with different numbers of adult earners and among families where the earners work different numbers of months per year. Further, the added incentive to work for secondary earners might eventually result in reduced FAP payments.

FAP allows a deduction from income for costs of child care for an employed mother, widowed father, or other guardian. If the implicit tax rate on income is 50 percent, then deducting the full costs of child care lessens these costs to the family by 50 percent (if the offset rate is 80 percent, the cost to the family is only 20 percent), with the Federal and State governments absorbing the other 50(80) percent in the form of higher FAP and State supplemental benefits. A complete subsidy could be affected by allowing a deduction of the cost divided by the offset rate (e.g., a double deduction with a 50 percent offset rate), with a specified maximum deduction, but this scheme would offer no incentives to spend less on day care than the maximum allowable.

For some parents, the FAP legislation goes further in subsidizing child care. At substantial cost, the bill provides for the funding of 450,000 day-care slots, at a minimum of $900 each, which offer educational, health, nutritional, and other services in addition to custodial services. The rationing device by which this sizable subsidy is to be extended to some mothers but not to others is not clear, but it seems likely that those mothers who have not been working and who are referred to training and employment by local agencies administering FAP will be given the highest priority. It is hard to justify this rationing criterion: The children of these mothers are not necessarily those who would most benefit from an enriched day-care program; nor are these the mothers, necessarily, who should be especially enticed to substitute market work for homework.

HEW has recently recommended offering day care costing $1,220 a year per child to poor mothers who work. Bills in Congress are appearing which envision spending up to $10 billion on child-care programs. All the problems previously discussed in trying to provide high benefits and to keep implicit taxes and breakeven levels low are met again. If a work test is used to ration the child-care services, criteria and policing must be provided to determine how much and how frequently a mother must be working to be eligible. If implicit taxes are kept low, say, by HEW's recommendations not to charge fees until after FAP or State supplement breakeven levels are reached

($3,920 to roughly $6,500), then subsidized day care will be available to families making up to $10,000 or more a year. Another HEW recommendation, aimed at avoiding having middle-income families receive subsidies, is to institute an income notch such that a family must fall below it to become eligible, but can rise above it without losing eligibility. This will create glaring inequities since some families who have gotten "on the rolls" may be receiving a subsidy and yet have higher incomes than other families who are not receiving subsidies because they never got on the rolls. This device also creates perverse incentives for families to drop temporarily just below the notch in order to become eligible to receive the subsidy.

Although there are reasons for subsidizing day-care programs, the system should not be tied to FAP. The target populations of the two programs, while not mutually exclusive, are not the same. Day-care programs are aimed at preschool children, whereas mothers of preschool children are not required to work under FAP.

The work and training test.—The bill requires certain family members to register with the State employment service (SES) for manpower services, training, and employment. At the discretion of local administrators of the program, FAP benefits may be denied those family members who do not register or who refuse to participate without good cause in suitable manpower services, training, or employment. The registration requirement itself can be useful as a means of bringing a variety of manpower services to the attention of low-income people. What is questionable, however, is the provision which allows for the denial of payments to individuals who refuse to participate in a training program or take a job.

We find the work test objectionable on several grounds. The first is that it conflicts with the principle—admittedly not universally held—that the receipt of income supplements should be a right and not a privilege. The second objection is the danger that the work test will be subverted by low-wage employers who will view FAP recipients as a source of labor for whom they can pay below-market wages because the work requirement has pushed them into the labor market. The SES may be willing to cooperate in this endeavor in an effort to reduce FAP expenditures—an understandable objective of a governmental agency. The costs of compelling a mother of school-age children to forego "home production" are easy to ignore under these pressures. Indeed, the lack of an explicit recognition of such home production is another reason we object to the work test as specified in FAP. The fourth objection is the danger that the work test may be administered in a racially or otherwise discriminatory manner. Finally, the administrative complexity of enforcing a work test may be excessive. For example, should a carwasher who is laid off during a rainy spell be required to take a different job? Should a factory worker who is reduced from 40 to 25 hours work per week be required to train for another occupation? What should be done about an ice cream vendor in the winter? What kind of work will be defined as "suitable" for a mother with no previous work experience, and what kind of job will she be required to accept to maintain her portion of FAP benefits? These questions are intended to suggest the difficulty of administering a work test, especially for a population of marginal workers whose work patterns are typically unstable.

We should recognize that the work test, as a practical matter, will be difficult if not impossible to direct at the underemployed, while those who are not working at all will be easy targets. However, we see little evidence for the proposition that workers will quit working, as long as they are able to retain a reasonable fraction of their earnings. A current OEO experiment in New Jersey and Pennsylvania with the negative income tax has not revealed any such departures from the labor force in the face of experimental tax rates of 30, 50, and 70 percent.[9] Indeed, little or no reduction in effort or earnings have been detected in this experiment, although it is certainly premature and imprudent to conclude that there will be no reduction in the amount of time or effort in work after the families fully adjust to the income maintenance plans. But this sort of partial reduction in work effort is not likely to be prevented by a work test, unless the test is applied with an army of investigators.

Although our overall judgment is that the potential savings in FAP funds that would result from applying the work test do not offset its shortcomings, we recognize the political pressures for its retention. Many legislators and much of the public demand a work test. We also are aware, first of all, that the work test built into AFDC by the 1967 public assistance amendments has been, in general, not harshly enforced.[10] Secondly, the FAP work test, unlike that in the 1967 law, will not apply to women with children under 6. Thirdly, a revision in H.R. 16311 affords an individual a measure of protection by allowing him to refuse work that is not "suitable," that is, that does not accord with his previous wages and experience, his ability to travel to the job, and similar factors. Fourthly, priorities have been added to the bill which specify that unemployed fathers and volunteer mothers should be assigned to work and training opportunities before other persons are. Since the suitable work clause that appears in State unemployment insurance (UI) laws has been included in the bill, we would recommend for protective and administrative reasons the general adoption of rules used to administer the UI work test for FAP work test purposes. Since some FAP recipients will have no previous wage experience, we would add that no recipient could be assigned to a job that pays less than 90 percent of the Federal minimum wage. If wages below this level are the highest available, the maximum obligation of the recipient shall be to attend training courses to raise his (or her) earnings capacity above the level of the Federal minimum wage. Such safeguards should be acceptable to all sides on this issue, but their detail illustrates the problems in relying upon local officials to determine when and in what manner they will interfere with the work decisions of individuals.

IV. Incentives to Family Stability

No charge has been leveled more frequently at the AFDC program than that it promotes family breakups. To date, families headed by destitute males have been able to receive public assistance in less than half the States. This incentive for male heads to desert in order to

[9] See Harold W. Watts, "Adjusted and Extended Preliminary Results from the Urban Graduated Work Incentive Experiment" (Discussion Paper Series 69-70; Madison: Institute for Research on Poverty, University of Wisconsin, 1970).

[10] Of course, it was in one respect more liberally worded than the FAP work test. Welfare departments had the option of not sending recipients to the employment service under the 1967 test. Under the FAP test, only those explicitly excluded by the law need not register for work.

qualify their families for AFDC is sharply reduced in most States under FAP. Aid will be provided to all families with children whose incomes fall below FAP breakeven levels. In some States, however, sizable gaps remain in the benefits available from AFDC compared to FAP. The financial incentive to desertion for a father will be intensified by the elimination, after 2 years of FAP as law, of the AFDC–UF program in the States in which it has operated. On this point, compare the figures in table 1 (column I) and table 2 (column J) of the appendix. If the tables are thought of as applying, respectively, to 4-person male-headed and female-headed families within the same State, the tables illustrate that, at the same level of the head's earnings, the female-headed family has a higher total income than the male-headed family. Even when the male head departs, and thus reduces the eligible family to three persons, the total income of the three-person, female-headed family is higher than that of the four-person male-headed family, at the same level of earnings. At zero earned income, for example, the differences in total benefits between 4-person male-headed and female-headed families in the same State is $1,304. If the male head of the household were to leave his family, the payments would drop by his share of the benefits from FAP, food stamps, and FHIP, but the remaining family members could receive increased payments because they would then become eligible for the State supplements. In a State such as that illustrated in table 2, the total benefits at zero-earned income for a female-headed family of three persons would be $3,460,[11] which is $520 more than the $2,940 available to the male-headed family of four.

We are not suggesting that AFDC–UF-type State supplements, with the old work regulations, be reinstituted. The best way to avoid the problems of equity and work incentives posed by the AFDC–UF regulations, and the incentives to desertion created by the elimination of AFDC–UF, is to raise the FAP guarantee and breakeven level with no increase in implicit tax rates. By doing this, the goals of work incentives, horizontal equity, and family stability incentives can be achieved simultaneously. But the costs of the FAP program would be higher.

V. Equity in Benefits for Poor Families Within and Across States

The accounting period.—The motivation behind many of the foregoing suggested changes in the bill has been the desire to attain "horizontal equity"—equal benefits to equally poor families. We cannot overemphasize the idea that horizontal equity means more benefits for poor people, since, for given program allotments, all instances of benefits to the nonpoor (or even not-so-poor) are matched by less benefits to the poor (or poorest). The definition of "equally poor" was shown to involve family size, net worth, and sources of income, among other considerations. We have yet to discuss the question of the time period over which the income status of the family is to be measured.

A reasonable length of time is the 1-year period used by the Internal Revenue Service for income tax payers; it implies that two families

[11] A family of three in a State that guaranteed a poverty level income of $3,120 would be able to receive $1,300 in FAP benefits, $1,820 in State supplements, and $68 in food stamps. In addition, we have estimated that the FHIP subsidy would be worth $272. The total income of the family of three would be $3,460.

with the same yearly income should receive the same amount of FAP payments for that year. To adopt a shorter period would waste scarce FAP funds by making payments to people whose incomes fluctuate seasonally, but whose annual incomes are above the FAP breakeven point. Moreover, if eligibility for FAP benefits were defined over a shorter time period, some families (particularly the self-employed) would be encouraged to concentrate their income in one part of the year.

How best to adjust FAP payments, which probably ought to be made as frequently as every 2 weeks or at least once a month, to respond to within-year fluctuations in family incomes is a difficult problem, one that has not been satisfactorily addressed in the proposed FAP legislation. The issues that arise may be brought out by some examples. Consider a system in which the FAP payment for the current month is based on last month's income. If a family has no income in the first month, it would be entitled to a FAP payment (say one-twelfth of its annual entitlement) at the beginning of the second month. But then, if, during the second through the 12th month, the family's income exceeds the break-even point, it would owe the Government the amount it received at the beginning of that second month. Such yearend reconciliations could cause some minor hardships to families that do not plan ahead wisely, and there would be administrative problems in recovering such overpayments.

The need for yearend reconciliations should be avoided, and one way to do so is to use a lagged period of 1 year for calculating payments. One alternative is to make all FAP payments in the current year contingent upon the income received in the previous year. The problem with this system is clearly that the payments made in the current year may bear no relation to the needs of the family that year. Zero income in the current year, for example, would not produce any FAP payments if last year's income was at or above the break-even point, and the FAP payments forthcoming in the next year might coincide with another year of high earnings. This accounting procedure is undesirable because it makes the system so unresponsive to need.

An accounting system that would be slightly more responsive to needs would be one in which the payments for the current month are based on an average of the previous 12 months' income. A family that was right at the break-even point for the previous 11 months would begin to get some payments after a month of zero income. Even here, however, the amount of FAP payments would only be $\frac{1}{12}$ of the monthly guarantee. Not until the family had experienced 12 months of zero income would it receive the full monthly guarantee.

An accounting system which both avoids the yearend reconciliation and is relatively responsive to current needs is one in which a 1-month accounting period is combined with an income carry-forward feature. Under this system, a family would "carry forward" the amount of income which exceeded the break-even amount over the previous 12 months, and this carry-forward amount would be assigned to the current month's income if it fell below the break-even point. Since the accounting period is basically the previous 12 months, there is no yearend reconciliation. That this method is more responsive to current need can be illustrated with some examples. If a family was right at the break-even level for 12 months, it would get a full-sized monthly FAP payment if its income fell to zero during the 13th month because it would have had no income to carry forward. If, by contrast, the

family's income for the previous 12 months had exceeded the break-even amount by $200 and it earned $50 in the 13th month, then the FAP payment would be based on a 1 month's income of $250 ($200 carry-forward+$50 current income). Assume the family had four persons; it then would be eligible for FAP benefits, since $250 per month for 12 months is $3,000, which is below the break-even amount of $3,940. A FAP payment of slightly more than $38 would be made for that month, since $38 is 1/12 of $460, which is the yearly FAP benefit if the previous 12-month income is $3,000 (based on the formula: FAP payment=$1600−½[$3,000−$720]). If the family's earnings continue to be $50 the next month, the FAP payment rises to the full amount (1/12 of $1,600, or $133, since the $50 is counted in the set-aside that on a yearly basis amounts to $720).

More details could be added to this brief discussion of the problem of the accounting period, but enough has been said to indicate how its resolution is an important determinant of who gets FAP payments, how much they get, and how responsive to current needs such payments will be. Such an important issue should not be left, as it is now, to the discretion of "a Cabinet secretary." The principle of horizontal equity is not effectively upheld in the current FAP bill, which emphasizes quarterly periods and makes no mention of an annual adjustment. Although the bill provides for "the secretary" to consider income received in other periods, such discretionary power and administrative intervention would be unnecessary if sufficient detail were specified explicitly in the bill.

The bill deals with the problem of making the payments responsive to current needs by providing funds for emergency payments. While such an emergency fund is probably necessary, it should not and need not be the sole vehicle to insure responsiveness. The more reliance placed on an emergency fund, the more room for indiscriminate determination of an "emergency" by a caseworker, and the larger the administrative expense. These reversions to the "old" welfare system can be minimized if the carry-forward is adopted. It would achieve equity in benefits over a year's accounting period, while maintaining a reasonable balance between being responsive to current needs of FAP families and requiring greater self-reliance of these families to plan their receipts and expenditures throughout the year. Finally, the suggested system avoids the need to recover overpayments at the end of a year.

Uniformity across States.—In a statement describing the current welfare system, ex-Secretary Finch spoke of its "unjustifiable discrepancies as between regions of the country * * * with no national standards for benefit levels and eligibility practices." [12] FAP goes a long way towards achieving national standards, but sources of interstate discrepancies remain. The principal source is the varying levels of State supplemental benefits. There remains a need to mandate complete Federal control of FAP, provide especially strong incentives to the States for Federal administration of the supplements,[13] and reduce the amount of discretionary authority to administer the bill.

At the outset of the program, the bill allows for any one of three administrative setups: A State can distribute the basic benefit and its

[12] Finch, *op. cit.*, p. 50.
[13] If the basic FAP payments were high enough to override all state supplements, then Federal administration of the whole program would be assured.

own supplement; it can allow the Federal Government to do both; or it can share responsibility with the Federal Government with each distributing its own benefits. After January 1, 1974, only the Federal Government can distribute the basic FAP payment to male-headed families. Whatever the administrative arrangement is, the coverage, eligibility rules, and payments procedures are supposed to be the same for all States for the basic payment and the State supplement. Experience under AFDC has demonstrated, however, that uniform Federal rules administered by different State and local agencies become quite un-uniform in application. Although financial incentives are provided to the States to relinquish administrative control of welfare, what is needed is a sharp break with past practices; and this can be facilitated by mandating Federal administration of the federally financed part of the new welfare system.

Even with a Federal administrative structure, the adoption of explicit regulations as substitutes for current discretionary authority on such matters as work tests and accounting periods is also necessary to insure uniformity in treatment across geographic boundaries. Suggestions relevant to these areas were made in previous sections of the paper.

VI. Conclusion

The provisions of the family assistance bill have been discussed in terms of achieving the objectives that the Nixon Administration has set for the plan: The alleviation of proverty, the redirection of incentives, the reduction in the gross disparities among States and among families on welfare, and the establishment of efficient and humane administration. The last-mentioned objective was not discussed separately, since this issue arose frequently in discussing various provisions under the headings of the other objectives of the bill. It was particularly in evidence in discussing the work test and Federal State administration.

The family assistance plan promises major improvements in the Nation's welfare system, but the bill can be strengthened in several places. Recommended changes have been suggested throughout the paper. Briefly, they involve: (1) Establishing a more explicitly uniform administrative structure within the Federal Government, which will limit discretionary authority at the local level; (2) eliminating or curtailing a number of related programs and provisions, like the food stamp program, child care, and other social services, and the work test; and (3) treating income from various sources more uniformly in terms of how they affect benefit reductions.

A basic concern in the formulation of our recommendations is the elimination of disparities across States and, equally important, disparities within States among poor families who do not qualify for the current categorical aid programs. These disparities not only constitute inequities, but they foster behavior by which these very forms of categorical aid are increased. The disparities are reduced by FAP and would be further reduced by adopting many of our recommendations. Nevertheless, their complete elimination can best be achieved by increasing FAP payment levels—which would take the form of a higher breakeven point and lower implicit tax rates on earned income. As more funds become available, increases in FAP payments will permit the replacement of all categorical programs.

The longrun outlook for welfare reform is bright, despite the difficulties and problems we have discussed in this paper—problems which are attributable to current political and budgetary constraints. If our sights are pointed in the right direction, the future availability of funds from sheer economic growth or from reductions in other governmental expenditures will permit the financing of a system of universal income guarantees which can achieve all of the five objectives initially specified.

Appendix

The compounding of implicit tax rates that results from direct taxes on earnings and losses in program benefits associated with earnings is illustrated in tables 1–3. All families of four receiving FAP benefits in the eight low-payment States and families with male heads in all 50 States will face the offset schedule shown in table 1. These families are not eligible for any State supplemental benefits. Different offset rates take effect at different levels of earnings, and each row in the tables marks an earnings level at which a different marginal offset rate takes effect. Between 0 and $720 of earnings, the social security, food stamp, and medical insurance taxes apply and sum to 42 percent. Thus, for example, a man earning $720 loses 5.2 percent of that (or $37) in social security taxes; then his food stamp bonus is reduced by 31.8 percent of $720 (or $299);[14] and then he must pay an amount equal to 5 percent of $720 (or $36) of his family's $500 FHIP premium, because the family's money income has increased from $1,600 to $2,320. At $720 of annual earnings, the 50 percent FAP offset rate takes effect and the total effective marginal tax rate (column L) on earnings between $720 and $2,080 rises to 74 percent, which exceeds the highest rate in the positive income tax system (65 percent).[15] The average tax rate (column M) of 63 percent is almost as high. When the 14 percent positive income tax rate and the higher medical insurance offset rates take effect, the aggregate marginal rate climbs to 90 percent:[16] Note that these rates, ranging from 74 percent to 90 percent, apply over the broad range of earnings ($720 to $3,920) in which most working recipients will find themselves. Thus the actual implicit tax rates on earnings, for male-headed families (and for female-headed families in the eight low-payment States) are considerably higher than the frequently mentioned 50 percent.

[14] In this and subsequent tables, the food stamp program is assumed to have a uniform tax rate of 31.8 percent and an earnings set-aside of $240 per family. While there is no fixed set-aside in the current program, work-related expenses are deductible. The figure of $240 is used to approximate the allowable earnings set-aside.

[15] Because the food stamp and the FHIP authorities will offset the net money income change of $680, which is one-half of the change in earnings between $720 and $2,080, rather than that gross change, the effective marginal tax rate on the $1,360 of increased earnings is less than 92 percent (=5.2+50.0+31.8+5.0); it is 74 percent.

[16] We have assumed that a family of four begins paying positive income taxes after its income reaches $3,800, according to the Tax Reform Act of 1969 and our interpretation of how the new law would apply in 1972. No State taxes are included.

TABLE 1.—RELATIONSHIPS AMONG EARNINGS, TAXES, TRANSFER PAYMENTS, AND IMPLICIT TAX RATES: MALE-HEADED FAMILIES IN ALL STATES AND FEMALE-HEADED FAMILIES IN LOW-BENEFIT STATES (4-PERSON FAMILY)

(A) Gross earnings	(B) Social security tax (5.2 percent of A)	(C) Postive Federal income tax [1]	(D) Take-home pay	(E) FAP payment [$1,600−½ (A−$720)] [2]	(F) Gross money income (A+E)	(G) Food stamps [$1,272 −0.318 (F−$240)]	(H) Medical insurance [3]	(I) Total income (D+E+G+H)	(J) Change in earnings (change in A)	(K) Change in total income (change in I)	(L) Marginal implicit tax rate [4] (percent)	(M) Average implicit tax rate [5] (percent)
[6] 0	0	0	0	$1,600	$1,600	$840	$500	$2,940				
									$720	$418	42	42
$720	$37	0	$683	1,600	2,320	611	464	3,358				
									1,360	358	74	63
2,080	108	0	1,972	920	3,000	394	430	3,716				
									1,720	411	76	69
3,800	198	0	3,602	60	3,860	121	344	4,127				
									120	12	90	69
3,920	204	$17	3,699	0	3,920	102	338	4,139				
									320	125	61	69
4,240	220	62	3,958	0	4,240	0	306	4,264				
									260	184	29	66
4,500	234	98	4,168	0	4,500	0	280	4,448				
									300	167	44	65
4,800	250	140	4,410	0	4,800	0	205	4,615				
									820	450	45	62
5,620	292	263	5,065	0	5,620	0	0	5,065				
									180	143	21	61
[7] 5,800	302	290	5,208	0	5,800	0	0	5,208				

[1] At an earnings level of $3,000, the head of a family of 4 will begin to pay positive income taxes assuming that a family head may claim a $700 exemption for each family member, and a $1,000 standard deduction. (These assumptions approximate how the new tax law amendments will affect low-income families.) The tax amounts are 14 percent on the 1st $1,000 in excess of $3,800; $140 plus 15 percent of the 1st $1,000 in excess of $4,800; and $290 plus 16 percent of the 1st $1,000 in excess of $5,800.

[2] FAP payments are based on gross earnings in the October 1970 version of the bill. Thus, the break-even point is $3,920 of gross earnings, since at this level of earnings FAP payments are zero.

[3] Medical insurance has a basic premium value of $500. The contribution schedule of the FAP recipient is: 0 percent of gross income (column F) to $1,600; 5 percent of F from $1,600 to $3,000; 10 percent of F from $3,000 to $4,500; and 25 percent of F from $4,500 to $5,620.

$0 \leq F \leq \$1,600$ I=$500−0
$\$1,600 \leq F \leq \$3,000$ I=$500−5 percent (F−$1,600)
$\$3,000 \leq F \leq \$4,500$ I=$500−70−10 percent (F−$3,000)
$\$4,500 \leq F \leq \$5,620$ I=$500−220−25 percent (F−$4,500)

[4] The aggregate implicit marginal tax rate on gross earnings (A) is, in general, not equal to the simple sum of the various offset rates which apply to earnings. Over the interval 0 to $720, the rate happens to be equal to the simple sum because the changes in the tax bases used by the social security, food stamp, and health insurance authorities are the same, $720. The offset formulas become more complicated as the various actual and implicit taxes begin to take effect; and the aggregate marginal tax rate is always less than the simple sum of the applicable tax rates. The tax rates that apply over the bracketed intervals are listed in column L and are derived from the following formulas:

Implicit tax rates on

[0–$720]=5.2%+31.8%+5%=42%
[$720–$2,080]=5.2%+50%+31.8%−15.9%+5%−2.5%=73.6%
[$2,080–$3,800]=5.2%+50%+31.8%−15.9%+10%−5%=76.1%
[$3,800–$3,920]=5.2%+14%+50%+31.8%−15.9%+10%−5%=90.1%
[$3,920–$4,239]=5.2%+14%+31.8%+10%=61%
[$4,239–$4,500]=5.2%+14%+10%=29.2%
[$4,500–$4,800]=5.2%+14%+25%=44.2%
[$4,800–$5,620]=5.2%+15%+25%=45.2%
[$5,620–$5,800]=5.2%+15%=20.2%

The amount of the tax (that is, the sum of benefits lost and standard taxes paid on earnings between $720 and $2,080) is computed as follows:

$$\text{tax}=0.052A+0.500(A-\$720)+0.318[A-0.500(A-\$720)]+0.100[A-0.500(A-\$720)]$$

The other tax amounts are similarly computed.

[5] The average implicit tax rate equals

$$1-\left(\frac{(I_2)-(I_1)}{(A)}\right)=1-\left(\frac{\text{total income}-\$2{,}940}{\text{gross earnings}}\right)$$

[6] Underlined amounts indicate earnings levels which are repeated in the other tables.

[7] Row included solely to offer a comparison with the same earnings amount in other tables.

While these tax rates are high, even steeper ones confront female heads of households in the 42 States where AFDC benefits are higher than FAP benefits. The point is illustrated in table 2, which shows the effect of adding State cash supplements to the FAP benefits in order to raise the total cash guarantee to levels as high as those now provided by AFDC payments. In table 2 the money guarantee for female-headed families of four with no earnings is assumed to be $3,720—a high level but still less than the $3,960 that New York State provided in 1971. The State supplement of $2,120 per year to the family with no earnings permits the total income guarantee, including food stamps and medical insurance, to amount to $4,244, as compared to $2,940 for the male-headed family of four. As earnings rise, the State supplement is reduced or taxed away at 16⅔ percent up to $3,920, which makes the aggregate implicit tax rate on cash payments 66⅔ percent; beyond $3,920 the implicit tax rate on the supplements alone remains 66⅔ percent.

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TABLE 2.—RELATIONSHIPS AMONG EARNINGS, TAXES, TRANSFER PAYMENTS, AND IMPLICIT TAX RATES: HIGH-BENEFIT STATES FOR FEMALE-HEADED FAMILIES WITH FOUR PERSONS[1]

(A) Gross earnings	(B) Social security tax (5.2 percent of A)	(C) Positive Federal income tax[2]	(D) Take-home pay [A−B +C)]	(E) FAP payment [$1,600-½ (A−$720)][3]	(F) State supplement payment[4]	(G) Gross money income (A+E+F)	(H) Food stamps [$1,272−0.318 (A+E+F)]	(I) Medical insurance[5]	(J) Total income (D+E+F +H+I)	(K) Change in earnings (change in column A)	(L) Change in total income (change in column J)	(M) Marginal implicit tax over the interval of earnings[6] (percent)	(N) Average[7] implicit tax (percent)
[8] 0	0	0	0	$1,600	$2,120	$3,720	$166	$358	$4,244				
										$520	$275	47	47
$520	$27	0	$493	1,600	2,120	4,240	0	306	4,519				
										200	170	15	38
720	37	0	683	1,600	2,120	4,440	0	286	4,689				
										180	44	76	46
900	47	0	853	1,510	2,090	4,500	0	280	4,733				
										2,900	574	80	72
3,800	198	0	3,602	60	1,607	5,467	0	38	5,307				
										120	7	94	73
3,920	204	$17	3,699	0	1,587	5,507	0	28	5,314				
										340	20	94	74
4,260	222	64	3,974	0	1,360	5,620	0	0	5,334				
										540	76	6	76
4,800	250	140	4,410	0	1,000	5,800	0	0	5,410				
										1,000	131	87	77
5,800	302	290	5,208	0	333	6,133	0	0	5,541				
										500	62	88	78
6,300	327	370	5,603	0	0	6,300	0	0	5,603				

[1] The example below applies to a State guaranteeing $3,720 for a family of 4, not including health benefits or food stamp benefits.

[2] See footnote 1, table 1.

[3] See footnote 2, table 1.

[4] State supplement, F, is assumed to be $2,120 at zero earnings, an amount selected to provide a total cash supplement of $3,720 for a family of 4, not including the medical insurance or the food stamp benefit. The formulas for comupting the State supplement are as follows. "A" is gross earnings.

$$\$720<A<\$3,920\ F=\$2,120-\tfrac{1}{2}[\tfrac{1}{3}(A-720)]=2240-\tfrac{1}{6}A$$
$$\$3,920<A<\$6,300\ F=\$1,587-\tfrac{2}{3}(A-3920)=4200-\tfrac{2}{3}A$$

[5] See footnote 3, table 1, but not that gross income is column G in this table.

[6] Implicit Tax rates on:

$0–$520] =5.2%+31.8%+10%=47%
[$520–$720] =5.2%+10%=15.2%
[$720–$900] =5.2%+50%+16.67%+10%−5%−1.67%=75.20%
[$900–$3,800] =5.2%+50.0−16.67+25.00−12.5−4.17=80.20%
[$3,800–$3,920] =5.2%+14.0+50.0+16.67+25.00−12.25%−4.17%=94.4%
[$3,920–$4,260] =5.2%+14.0+66.67+25.00−16.67=94.2%
[$4,260–$4,800] =5.2%+14.0+66.67=85.9%
[$4,800–$5,800] =5.2%+15.0+66.67=86.9%
[$5,800–$6,300] =5.2%+16.0+66.67=87.9%

[7] The average implicit tax equals

$$1-\left(\frac{\text{total income}-I_1}{\text{gross earnings}}\right)=1-\left(\frac{(J)-4244}{(A)}\right)$$

[8] See footnote 6, table 1.

In table 2, we see that over the very large range of earnings, $720 to $6,300, the aggregate implicit tax rate on earnings varies between 76 and 94 percent. The latter rate applies when earnings reach $3,800, because the positive income tax begins to take effect, and the social security, State supplement, the FHIP tax rates continue in effect. The food stamp bonus, however, and its associated offset ends when earnings are $520 (and gross money income is $4,240). The 94 percent tax rate means that a worker earning $2.50 per hour will increase his total income at a rate of 15 cents per hour worked over this particular range. For female heads of households receiving income-conditioned rent supplements or public housing subsidies, paying income-conditioned day care fees, or paying State and local income taxes, the combined implicit tax rates will be higher than those in table 2.[17] Whether they exceed 100 percent depends on whether the offsets are computed on gross earnings or on the net or post-tax earnings.

These high tax rates are inconsistent with a major objective of FAP, the minimizing of financial disincentives to work. A small improvement would be effected by a return to the computation of FAP and State supplement benefits on earnings after Federal and State income taxes were deducted. This reform, which was embodied in an earlier version of the bill, lowers the highest implicit tax rate in table 2 to 87 percent (instead of 94) and raises the breakeven point to $6,741 (instead of $6,300).[18] But rates of over 80 percent remain staggering. The problem illustrates the consequences of the failure to institute an income maintenance plan with wider coverage, higher benefits, and a single offset rate. Table 3 embodies proposals which attempt to deal with these issues. The food stamp program which provides $840 worth of stamps to a family of four with no earnings and a $1,600 FAP payment, is replaced with cash allowances of that amount, permitting a total FAP payment of $2,440. The FHIP benefit is retained, but the offset rates on it are lowered to 7.5 percent (except for a 10 percent rate on the first $600 of personal income). Most importantly, the offset rate on FAP benefits is 50 percent, which, in combination with the offset on FHIP benefits, results in accumulated rates that are about 10 percentage points less than the marginal and average rates in table 1 for corresponding earnings levels.

[17] The administration proposes to make rent payments income-conditioned for families living in public housing. Like the reform proposed in converting Medicaid to a health insurance plan paid in part by graduated fees, an income-conditioned rent payment avoids the sharp break at the amount of family income when the family becomes ineligible to receive the subsidy. As these programs are run now, the implicit tax rate at that income amount is likely to be astronomically high. For example, some nominal amount of additional earnings (theoretically, one more dollar), which lifts the family's income over the cut-off point for receiving aid, might entail the loss of, say, $1,600 worth of housing (or health) subsidies. We do not include the treatment of housing subsidies in our paper, since only about 6 percent of all FAP families will be receiving these subsidies, nor do we include, in the interest of avoiding excessive complexity, day care fees and State and local income taxes.

[18] Readers who would like to see tables similar to 1 and 2, but using a post-tax basis for computing FAP and State supplement benefits, may write the authors.

TABLE 3.—RELATIONSHIPS AMONG EARNINGS, TAXES, TRANSFER PAYMENTS, AND IMPLICIT TAX RATES IN A RECOMMENDED SYSTEM TO COVER ALL POOR FAMILIES OF 4 PERSONS[1]

(A) Earnings	(B) Social security tax (5.2 percent of A)	(C) Positive Federal income tax[2]	(D) Take-home pay (A—B—C)	(E) FAP payment (regular)[3]	(F) FAP payment (double reduction)[4]	(G) Medical insurance[5]	(H) Total income (regular)	(I) Total income (double)	(J) Marginal implicit tax (regular) (percent)	(K) Average implicit tax (regular) (percent)	(L) Marginal implicit tax (double) (percent)	(M) Average implicit tax (double) (percent)
[6] 0	0	0	0	$2,440	$2,440	$500	$2,940	$2,940				
									15	15	15	
$600	$31	0	$569	2,440	2,471	440	3,449	3,480				15
									62	23	57.5	
[7] 720	37	0	683	2,380	2,417	431	3,494	3,531				18
									63	55	57.5	
3,800	198	0	3,602	840	1,038	200	4,642	4,840				50
									70	58	57.5	
4,800	250	$140	4,410	410	730	125	4,945	5,265				52
									70	60	57.5	
5,764	300	285	5,179	0	442	53	5,232	5,674				53
									28	60	57.5	
5,800	302	290	5,208	0	432	50	5,258	5,690				53
									29	57	57.5	
6,466	336	397	5,733	0	240	0	5,733	5,973				53
									29	55	50	
6,800	354	450	5,996	0	144	0	5,996	6,140				53
									30	53	50	
7,316	380	538	6,398	0	0	0	6,398	6,398				53

[1] The recommended system replaces food stamps with an $840 cash allowance at zero earnings for a family of 4; it thus has a basic FAP cash payment of $2,440, contains a $600 set-aside for work-related expenses for each earner, and allows a double-deduction for social security and income taxes. (FAP payments and implicit tax rates with single deductions for the Federal income tax are shown in columns E, H, J and K.

[2] See footnote 1, table 1.

[3] FAP = $2,440 —0.5(A—$600) for earnings up to $5,764.

[4] FAP = $2,440—0.5 [A-2(B+C)—$600] for earnings up to $7,316.

[5] The recommended schedule for computing medical insurance benefits (G) is
G=$500 — 10% A for $0 \leq A \leq \$600$
=$440 — 7.5% (A—$600) for $\$600 \leq A \leq \$6,466$
At an earnings amount of $6,466 the medical insurance subsidy declines to zero.

[6] See footnote 6, table 1.

[7] See footnote 7, table 1.

Table 3 also shows the effects of allowing a double deduction from earnings of social security and income taxes. Allowing a deduction of twice the sum of social security and income tax payments from earnings before the earnings are "taxed" by FAP, along with converting food stamps to cash and modifying the medical insurance plan, prevents the marginal implicit tax rates from rising above 57.5 percent (see column L) and the average rates are kept in the 50 to 53-percent range over the relevant levels of earnings. These reforms would, of course, raise budgetary costs, since FAP payments would not be reduced to zero until a family receives $7,316 in earnings. When earnings reach $5,480, however, FAP payments, although positive, amount to less than the positive taxes on earnings.

EFFICIENCY AND EQUITY EFFECTS IN THE BENEFITS FROM THE FEDERAL HOUSING PROGRAM IN 1965

By EUGENE SMOLENSKY *and* J. DOUGLAS GOMERY*

INTRODUCTION

The Programs

For all practical purposes the Federal program being discussed here consists of dwelling units in projects operated under the provisions of the U.S. Housing Act of 1937 (the Wagner-Steagall Act) as subsequently amended, particularly in the Housing Act of 1949.[1] As of December 31, 1969, 822,561 units were under management. More than 100,000 of these units were added in the last year, thus the program is very small but has accelerated its growth in recent years.[2]

Low-rent public housing is provided through the interaction of two agencies of two different branches of government. The Federal Government acting through a public corporation pays most of the capital costs and also furnishes technical help and supervision of the management of the dwelling units. However, it is the local authority, established by a local branch of government, that actually develops and administers the low-cost housing units, and it is the local authorities which directly provide the housing to qualified tenants at below-market rents. (More specific regulations and provisions of the housing acts directly concerned with public housing will be discussed in the body of the paper as they are needed.)

One specific objective of public housing was to create a source of demand in slack construction periods, but the potential for using public housing as an economic stabilizer is not the concern of our analysis and therefore will not be discussed further. Rather the other specified objective, that of providing decent, safe, and sanitary dwellings for the poor (though both construction and demolition) is what is central to this paper. Thus we will be dealing with the benefits, costs, and equity consequences of providing low-income families with standard housing through public ownership and public subsidy of earmarked dwelling units.

In part I of this paper the substantial body of economic analysis which has accumulated on the economic efficiency of federally assisted Government owned and operated low-income housing programs will be summarized. In part II new data will be presented on one aspect of the

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[1] The three major acts in public housing's early years were: (a) Public Law 412, the Wagner-Steagall Act, 1937, (b) Public Law 671, 1940, under which housing was built for World War II defense workers and later converted to low-rent use, (c) Public Law 171, the Taft-Ellender-Wagner Act, 1949. Three major amendments were passed in 1961, 1964, and 1968.

[2] "HUD Statistical Yearbook, 1969," table 1, p. 193.

equity consequences of the same programs. In part III the implications for policy decisionmaking will be drawn not to suggest legislation but rather to illustrate the strengths and weaknesses of using benefit-cost analysis to evaluate in-kind transfer programs. The benchmark year for this study is 1965 because of the rich data base available for that year alone.[3]

I. The Economic Efficiency of Public Housing

Benefits and Beneficiaries

Beneficiaries.—There are two classes of beneficiaries of public housing programs. One group, of course, is the tenants. Potentially, the tenants may benefit in two ways. First, they may acquire housing preferable in quality, price or both to that which they would occupy in the absence of the programs. Secondly, the tenants may acquire more of goods other than housing as a consequence of a fall in their expenditures on rent.[4]

The second set of potential beneficiaries is all taxpayers who do not live in public housing. Since the Federal public housing program is old and its existence has been reconsidered and reaffirmed often, and its tenants are only a tiny proportion of the electorate, it seems reasonable to conclude that nontenants also derive benefits, either real, pecuniary or both, from the program. The potential sources of benefits to the nontenants are of the several kinds which accrue to both consumers and to factors of production whenever a new commodity is introduced. Enumerating the beneficiaries on both sides of the transaction serves to highlight the political supporters of the program. For that reason, pecuniary as well as real benefits are taken into account. The magnitudes of these benefits depend, of course, on what use the resources involved would have been put to in the absence of public housing. All benefits are net of what they would have been in the absence of the program. Further, where benefits are pecuniary, there are equal and offsetting losses, but the whole cost side of public housing has been omitted in this paper, since this is a part of a larger study in which the tax side is treated as a single package.

First, to the extent that the public housing program increases the output of housing, it provides direct income (or capital gains) to architects, builders, construction workers, lawyers, administrators, and the like in the short run. That is, over the short run, and conceivably in the long run, the program may increase producers' surplus for some factors (while lowering the after-tax income of other factors).[5] Second,

[3] On Dec. 31, 1965, there were 604,044 low-rent public housing dwelling units under management. U.S. Department of Housing and Urban Development, "Annual Report," 1965, p. 164.

[4] It does not follow from the fact that tenants opt for public housing voluntarily that they are necessarily better off as a consequence of the program. If the public housing program adversely alters the price of housing in the private sector then it may be that tenants are made worse off by the program. That is, if public housing removed large quantities of private housing in a market, the tenants might have preferred the preprogram state of the world and choose to occupy public housing only because the prior options no longer exist. While this is possible in some markets, it is probably not a general phenomenon and will not be further considered. That is, it will be assumed that tenants are not made worse off by the public housing system.

[5] The original counter-cyclical objective of the Wagner-Steagall Act has already been referred to. As put here, the objective is consistent with but broader than simply counter-cyclical assistance to the housing industry broadly defined, rather it is assistance regardless of the stage of the cycle. It has been implicitly assumed that tenants do not supply inputs to construction. It is also assumed that total housing does not in fact increase as a consequence of public housing.

it provides benefits to owners of land used for public housing. It has been widely noted that public housing is often placed on relatively high priced, already occupied land when relatively low priced vacant land is available.[6] The land is often in deteriorated, blighted or slum neighborhoods. Owners of that land may have been deterred from improving that land or the structures upon it because of negative externalities, i.e., the value of the parcel of land depends upon the uses of the land around it, therefore an improved house next to a deteriorated one has a lower market value than it otherwise would. Acquiring many parcels of land and improving them simultaneously eliminates this negative externality. The price paid for the land when acquired is a major factor affecting who will benefit from the elimination of these negative externalities depending upon whether the owner is paid the post-renewal or the prerenewal value of the land. It may be that the Government purchase price compensates the prior owners for the capital losses they experienced by paying them the post-renewal value. Furthermore, the external effects may extend beyond the grounds of the public housing project, by an extension of the same argument. The placing of public housing is one factor which governs the distribution of the benefits and costs of those externalities.

Third, public housing may serve as a vehicle by which politicians dispense benefits for their own gain and taxpayers may see this as a satisfactory way to support the party system. The key factor here is that public housing is not provided to all the eligible.[7] Three kinds of rationing are thereby introduced. First, only a tiny percentage of eligible families receive this subsidy. Second, public housing is restricted to only some communities which means that only some politicians can dispense the service. Third, the distribution of public housing may represent a political decision on where the poor are to live, since fixing the distribution of low income housing must affect the spatial distribution of low-income persons. Since only some of the eligible in each community are granted public housing, occupying public housing is a valuable privilege and those who control access to it may be expected to receive some political advantages from its dispensation.

Public housing may also serve an insurance role. Some taxpayers may want public housing to exist because there is some finite probability, albeit small, that they will some day require the service. Finally, the taxpayer may suffer a loss in satisfaction from the existence of slums even if they do not live in or adjacent to them. Public housing as an alternative to substandard housing may be a pure public good of the merit variety.

It must be apparent from this list of potential nontenant benefits and beneficiaries, that public housing constitutes, among other things, a multipronged assault on the negative externalities which emanate from the proximity of lower to higher income persons. To the extent that public housing is associated with the destruction of slum dwellings one source of negative externalities is eliminated directly. Furthermore, as already mentioned, slum properties may be acquired at a price which compensates the owners for capital losses due to negative externalities which they may have experienced in the past. Restricting the geographical dispersion of public housing and hence the spatial

[6] Olsen estimates that this adds ten percent to the cost of public housing. Edgar O. Olsen, "A Welfare Economic Evaluation of Public Housing" (Unpublished Ph.D. thesis, Rice University, 1968).

[7] Our estimate to be presented in Part III is that 3 percent of the eligible population actually lived in public housing in 1965.

dispersion of the poor will reduce the costs of other negative externalities which flow from income differentials. Thus if low-income children constitute a behavior problem in the classroom, public housing may provide a way to isolate low-income children.

We must also note that by giving the poor an in-kind transfer, the givers guarantee that the difference in housing quality consumed, hence the negative externalities, will be less than would be in the case if either no transfers or cash transfers were given. If only cash transfers were made, then the recipients would be able to consume more of all goods and services, and would be free to choose a new combination of goods and services that included only a small increase in housing if that was what they wanted. An in-kind transfer restricts the receiver's consumption to a particular set of goods and services. In this case it fixes the quality of housing the poor will consume. One way to rationalize putting such a restriction on the poor is to note that the housing quality consumed by the poor enters into the utility function of the givers as well as the receivers. It may be therefore that the goal of public housing as an in-kind transfer is to maximize the welfare of the givers that is, the taxpayers, under the constraint the tenants are not harmed. The givers welfare in this case can be defined as the removal of the negative externalities due to substandard housing. This type of transfer may be Pareto optimal since both the tenants and the taxpayers benefit.

The dollar value of benefits to tenants.—The benefit to tenants of living in public housing is the value of the subsidy which they receive, and hence the terms benefits and subsidy may be used interchangeably. Measurement of the subsidy is complicated by the fact that there are at least two different ways to view it and conceptually the two viewpoints yield somewhat different magnitudes. The first viewpoint, which we shall call the "value approach," seeks to measure the money value, in the aggregate, that the tenants place on the utility they receive from occupying their dwellings over and above the rent they actually pay. An alternative equivalent definition is the sum over all tenants of the amount of cash which if offered each of them would be sufficient to make each of them indifferent between receiving the cash, or the use of the dwelling at the given rent. If the subsidy is to be interpreted as the real income equivalent of the contribution to the welfare summed over all the tenants, this approach seems to be the correct one.

A quite different approach to measuring the subsidy is the "resource cost approach," which is the value the market places on the resources used to provide the low-cost public housing dwellings, minus the rent actually paid by the tenants. Another way to define this approach is as the amount of money, were it annually paid to the tenants of public housing instead of providing the units themselves for as long as the units were occupied, which would leave the net total resource cost of the program to society unchanged. If the purpose of the benefit-cost analysis is to seek the least cost way of housing low-income families in safe, decent and sanitary housing, this second approach to defining the subsidy is the more appropriate one.

The two views of the subsidy can be usefully contrasted in the following way. The value approach views the subsidy from the tenant's side with benefits valued by the tenant's tastes and income. The resource cost approach takes the taxpayer's perspective and the market's appraisal of the product. Needless to say these two vantage

points put different dollar values on allocating resources to public housing.

The resource cost approach estimates the average benefit per tenant to be $62 per unit month.[8] The procedure for making the estimate was as follows. In a fully employed economy, a decision on the part of the Government to undertake public housing construction implies that some other activity cannot be undertaken. Given the specific set of resources used in private housing it seems reasonable to assume that the foregone activity in the private sector is the construction of a similar dwelling because that provides a standard for comparison. (One consequence of this assumption is that it leads to using a relatively low discount rate in the calculations which follow. Since the resource cost calculated is very sensitive to the discount rate, the resource cost must be considered a minimum estimate.) In the private sector, a profit-maximizing entrepreneur will expect that over its lifetime the dwelling he has invested in will earn at least as much for him as he could earn on any other investment of similar risk. When the Government institutes a public housing project, it must expect to generate at least the same amount of total utility as the private entrepreneur could have generated, for if the public housing project yields less satisfaction to its tenants than a similar project in the private market, the social welfare of the Nation would be greater if the private market undertook the project. Thus, if one public investment is to be socially justified, the combined rent plus subsidy must, discounted by the compound interest that could have been earned in alternative investments, equal the total cost of the project. Thus for the Government, the test a public housing unit must pass before it is undertaken can be expressed mathematically as:

$$(1) \qquad V \leq \sum_{t=1}^{n} \frac{(R_t + S_t)}{(1+I)^t}$$

where the right hand term represents the stream of rents minus the maintenance and other related expenses (R_t) plus the implicit subsidy (S_t), over the life of the building (n), discounted at the appropriate rate of interest (I); the left hand term is the initial resource cost of the dwelling (V).

If every public housing unit that has been built passes the benefit-cost test set down in (1), then the inequality can be used to provide a minimum estimate of the subsidy. All that this requires is to set the right hand side of (1) equal to the left hand side, and then to solve for S_t, since V, R_t and I can be calculated from published data.

For housing units build under Public Law 171, the Housing Act of 1949, V=$13,400 per unit, at original cost in 1965 prices (including the

[8] Others who have used this approach were Gillespie, Fisher, and Weiner. Gillespie uses the "expenditures on behalf of the tenants." As corrected by Bish and calculated by Smolensky, Gillespie's approach yields an average tenant subsidy based on cost, including capital costs, to the taxpayers of $26/unit/month. Fisher calculates a subsidy value from the "annual contribution" made by the Public Housing Authority to each local housing authority sufficient to insure payment of the principal and interest of each project's permanently financed debt. From table 12, p. 160 for 1958, his latest year, we calculate a $21/month/unit subsidy value. Weiner uses a very crude approach by taking average cost data across the program. He calculates an average monthly subsidy per tenant of $106. This is a very high figure due to a high estimate of the opportunity cost of the Government's resources. See: Gillespie, W. Irwin, "Effect of Public Expenditures on the Distribution of Income," in Richard A. Musgrave, ed., *Essays in Fiscal Federalism* (Washington. D.C.: The Brookings Institution, 1965). Fisher, Robert Moore, *Twenty Years of Public Housing—Economic Aspects of the Federal Program* (New York: Harper and Row, Publishers, 1959). Weiner, Neil S., *The Distribution of the Gross Benefits of Present Federal Welfare and Income Maintenance Programs* (Washington, D.C.: Institute for Defense Analysis, Economic and Political Studies Division, 1966); Bish, Robert L., "Public Housing: The Magnitude and Distribution of Direct Benefits and Effects on Housing Consumption," *Journal of Regional Science*, Vol. 9, No. 3 (December, 1969), pp. 425–38; Smolensky, Eugene, "Public Housing or Income Supplements—The Economics of Housing the Poor," *Journal of the American Institute of Planners*, 34 (1968), pp. 94–101.

costs of land acquisition). R_t=$2.54 per unit per month. Assuming a 40-year-life, as is conventional for apartment house units, and a rate of interest of 5 percent, which is a good approximation of the average mortgage rate over the period, S_t was derived. The average monthly subsidy per unit for Public Law 171 units over the period from 1952 to 1964 is $62 in 1965 prices. The monthly amount which could have been made available in cash to the tenants over the 40 years from the date the unit was first occupied without affecting the distribution of the Nation's resources between tenants and nontenants, then was $62.

The value approach to measuring benefits seeks to determine the minimum amount of cash a tenant would voluntarily accept to forgo the right to live in public housing. This amount summed over all tenants would be the aggregate measure of total benefits as perceived by the tenants. The best way to obtain the data relevant for this measure would be to give some tenants the right to sublet and then to observe the resulting rental price, but there have been no such experiments. The value to the tenants has therefore been estimated by use of a reasonable, though biased, approximation due to Prescott.[9] The standard technique for valuing benefits, from the tenants point of view, is to calculate the difference between the private market rental of a public housing unit and the rent actually paid. The theory underlying the procedure is as follows.

To determine each unit's private market value two specific public housing regulations are employed. The Public Housing Authority requires that maximum rents at admission be no more than 80 percent of private market rents for comparable units. Second, the tenants of public housing must pay no more than 20 percent of their incomes (adjusted for family size) as rent. Thus, if the upper income limits for tenant eligibility are known, and if these limits were originally set at levels such that the maximum *theoretical* rents (that is, 20 percent of the income limits) would be both 20 percent of the income limit and 80 percent of rents for comparable private units, then these private rental values can be reconstructed from the income limits alone. None of the *actual* rents charged, either as absolute amounts or as percentages of actual income, affect the estimate of comparable private rents at all. Using the single unvarying private rental value applicable to each tenant size-location category, the varied *individual* subsidy for each family in that category can be found by subtracting the family's actual rent paid from the market value estimate.

Applying this approach to the data used in the second part of this paper yields an average subsidy of $31 per unit per month.

This measure of benefits is crucially dependent upon the assumption that rents in public housing are in fact 80 percent of their market value. The usefulness of the assumption depends on the local authority's valuation of comparable units, but there seem to be no apparent incentives tempting them to bias their estimates. Neither does there seem to be any incentive for them to set income limits at levels other than those which would allow 20 percent of the income limit to just equal the maximum rent allowable by the 80-percent rule. The determination of what is a comparable dwelling unit, however, is a complex problem. In many respects, public housing is a unique commodity. It represents a joint product of different social services, and by law often appears in special neighborhoods, e.g., urban renewal areas, where the neigh-

[9] Prescott, James R., "The Economic of Public Housing: A Normative Analysis," (unpublished Ph.D. dissertation, Harvard University, 1964).

borhood has usually certain characteristics. Furthermore, there is no new private housing for low income families with which the local housing authority can compare its product.

A more formal analytical apparatus with which to summarize the various concepts of tenant benefits and their magnitudes has been offered by Olsen and Prescott and is pictured on figure 1.[10] For analytical convenience it is useful to conceive of apartments of different size and quality as embodying different amounts of an unobservable quantity of homogeneous units of housing service. It is in these units that the absissca of figure 1 is calibrated. The ordinate is the price per standardized unit of housing service, and it too is unobservable. What is observable is price times quantity, which is the market rent of the apartment when the housing market is perfectly competitive. The demand function which appears in figure 1 is the quantity of units of housing service related to the price of those units and is assumed to be unit elastic. Dimensions are indexed so that $PQ=1$ at all points on the demand function.

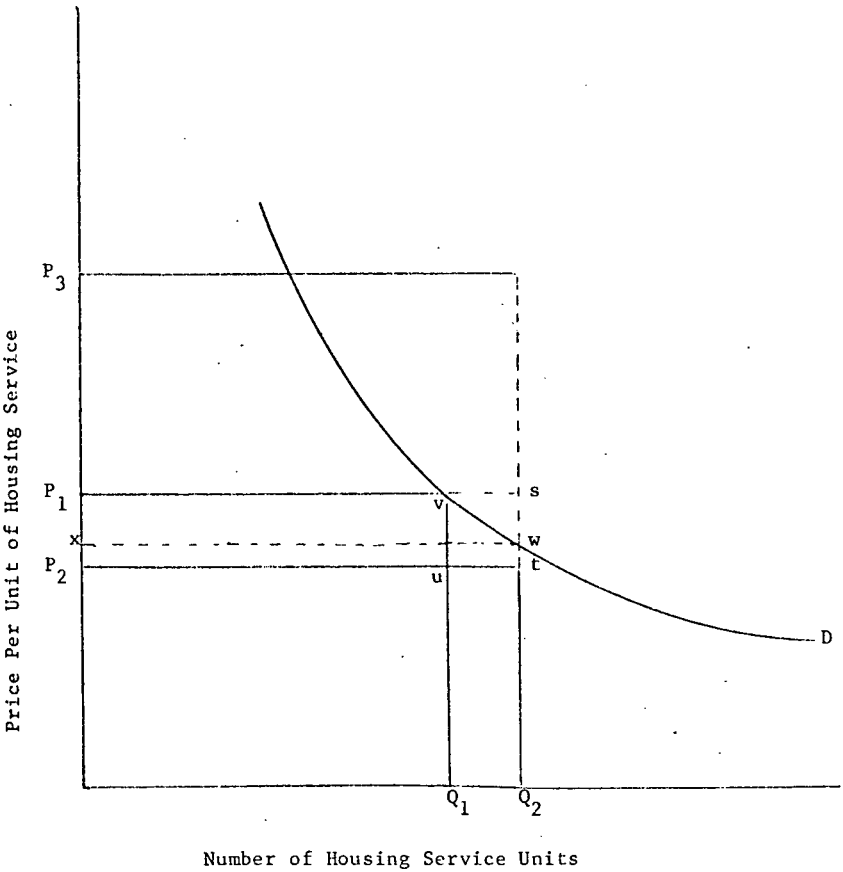


FIGURE 1

[10] The following discussion follows closely that of Olsen and Prescott. Edgar O. Olsen and James R. Prescott, "An Analysis of Alternative Measures of Tenant Benefits of Government Housing Programs with Illustrative Calculations from Public Housing," mimeo.

P_1Q_1 is the rent paid by a typical family for its substandard unit before moving into public housing. A reasonable estimate would be \$60/mo. P_2Q_2 is the rent paid by the typical family for its standard quality public housing unit. Q_2 is positioned to the right of Q_1 because public housing units are of standard quality while Q_1 generally was substandard housing. Since the Public Housing Authority sets both the quantity of housing service units and the price per unit, the intersection of price and quantity for the public housing unit would lie on the demand curve only if the PHA knew the demand function or by accident, and hence P_2Q_2 is assumed to lie below the demand curve. In fact the average rent per unit is set by PHA at \$44 (P_2Q_2). Since the rent paid before moving into public housing (P_1Q_1) is \$60, and the demand function is unit elastic, P_2Q_2 lies below the demand function in the representative case.

The conceptual measure of the value approach to the subsidy is the area P_1vwtP_2, which is the increment in tenant consumer surplus which results from moving from private to public housing.[11] The increment in consumer surplus is the maximum amount the tenants would be willing to pay (and which could be collected by a perfectly discriminating monopolist) for his public housing unit. Hence it is a measure of tenant benefits and is referred to as the value of the unit to the tenant throughout the paper. Olsen and Prescott estimate P_1vwtP_2 to be \$26 per unit per month. Of this amount P_2twx is the reduction in rental payments per unit per month and is equivalent to a cash grant of \$16.

To precisely measure the value of the unit to the tenant requires that the demand functions of the tenants be known or assumed. Most investigators have been unwilling to assume that they know the elasticity of demand and hence they have contended themselves with the already mentioned approximation due to Prescott.[12] Graphically then, the usual measure of tenant benefits is taken to be $P_1Q_2 - P_2Q_2$. (It is the measure used in part II of this paper.) P_2Q_2 is the rental paid by the tenant in public housing, but P_1Q_2 requires interpretation.

If the supply functions of homogeneous units of housing service were produced under constant returns to scale and sold in competition markets then P_1s would be the supply curve of housing units and P_1Q_2 would be the market value of a public housing unit if placed on the private market and rented to the highest bidder. P_1Q_2 less P_2Q_2 is the difference between the rent the public housing unit could obtain in the open market and what it actually earns when rented by the local housing authority. P_1Q_2 is not observable, but it is the market rent of the unit and can be obtained via Prescott's approximation.

[11] On the assumption that demand does not shift due to the income effect associated with the move. The increment in consumer surplus (B) is consumer surplus in public housing less consumer surplus in private housing.

$$B=\left[\int_0^{Q_2} f(Q)dQ-P_2Q_2\right]-\left[\int_0^{Q_1} f(Q)dQ-P_1Q_1\right]$$

Rearranging terms:

$$B=P_1Q_1-P_2Q_2+\int_0^{Q_2} f(Q)dQ-\int_0^{Q_1} f(Q)dQ$$

$$=P_1Q_1-P_2Q_2+\int_{Q_1}^{Q_2} f(Q)dQ$$

[12] Aaron and Von Furstenberg have shown that the value of the units to the tenants is sensitive to the presumed marginal rate of substitution between housing and other goods. Aaron and Von Furstenberg, "How Inefficient are Transfers in Kind: The Case of Housing Assistance," *Western Economic Journal*, Vol. 9, *No.* 2 (June 1971), pp. 184–191.

Olsen and Prescott estimate P_1Q_2 to be \$71. Thus the difference between the market rent and the rent paid by the tenants is \$27. (New estimates of market rent are reported in part II.)

The usual measure of tenant benefits ($P_1Q_2 - P_2Q_2$) is biased because it exceeds the tenant's perceived value (P_1vwtP_2) by the triangle *vsw*. As the estimates of Olsen and Prescott already presented indicate, however, the bias is very small (\$27 versus \$26), if the elasticity of demand for housing is indeed close to unity.

The resource cost in the public sector of providing a typical public housing per unit per month was previously indicated to be \$109, and has been entered in figure 1 as P_3Q_2.

The various magnitudes embodied in the figure can be summarized as follows:

Resource cost (P_3Q_2)	\$109
Market value (P_1Q_2)	71
Resource cost less market value ($P_3Q_2 - P_1Q_2$)	38
Rent paid for public housing (P_2Q_2)	44
Expenditures on behalf of tenants or resource cost less rent paid ($P_3Q_2 - P_2Q_2$)	65
Usual measure of tenant benefits or market value less rent paid ($P_1Q_2 - P_2Q_2$)	27
Value of the unit to the tenant or cash value of subsidy (P_1vwtP_2)	26
Bias in usual measure of tenant benefits (*vsw*)	1
Reduction in rent (P_2twx)	16

Thus we can see that taxpayers are spending \$65 per unit per month to provide a subsidy which the tenants value at \$27 per unit per month. (This despite the fact that a substantial portion of the subsidy is equivalent to a cash grant which the tenants presumably value at a dollar per dollar of subsidy received.)

The Benefits to Non-Tenants

If we can assume that in a program as old as this one decisionmakers roughly understand the magnitudes involved, then a minimum estimate of benefits to nontenants is feasible.[13] Presumably the difference between the resource subsidy and the value to tenants constitutes the benefits to nontenants (\$38). Our numbers indicate that the benefits to nontenants exceed the benefits to the tenants by \$11 per unit per month. We do not know, however, how to allocate these benefits among the various categories of nontenant beneficiaries. It can be said, however, that allocating tenant benefits alone by income class, as shall be done in part II, yields a biased measure of the distributive effects of this program. The reason for this is that tenant benefits accrue, by and large, to low income families. Whoever the nontenant beneficiaries are, it seems certain that they are not poor.

Concluding Comments on Benefit-Cost Analysis and Economic Efficiency in Public Housing

Conducting a benefit-cost analysis of an in-kind transfer program such as public housing takes a form different from the normal project evaluation. In fact, the resource cost approach to measuring the subsidy assumes the benefit-cost ratio to be unity and uses that assump-

[13] It is a minimum estimate, because it does not evaluate the pecuniary benefits of reallocating resources toward the residential housing sector, and does not take account of the possibility that the same dollar of benefits enters into the utility functions of more than one individual which would be the case if public housing is a merit good.

tion to calculate the implicit subsidy which is in turn then called benefits. The value approach yields a tenant benefit which is very small when compared to costs (roughly .3). No significance attaches to this number, however, because it is apparent from the form the subsidy to the tenants takes, that benefiting tenants is not the sole objective of the program. If the sole objective was to maximize tenant welfare, then it is a well-known theorem of economics that the optimal form of the subsidy is a direct cash transfer. In-kind transfers are efficient only if some people other than the direct recipients of the commodity being transferred also benefit from that transfer. These *a priori* deductions, and even identifying those who might benefit indirectly does not provide a sufficient basis for evaluating the efficiency of in-kind programs in general and public housing in particular. It is conceivable that a measure of benefits to everyone who might benefit is feasible, but that is unlikely. An alternative is to specify a goal of the program which is consistent with its administration and then to ask if that goal could be more cheaply achieved. Among the dangers of utilizing this approach is that the goal chosen as the basis for the evaluation may not generally be accepted as the true objective by equally knowledgeable persons. Despite that danger, the results of one such study will be briefly reported upon here.[14]

Assume that the goal of the public housing program is to maximize the number of families who voluntarily choose to move from substandard to standard housing given the total level of expenditures to be made. The problem is then transformed from a benefit-cost calculation to an output maximization problem.

The minimum cost way of achieving this objective appears not to be the housing program of the 1937 and 1949 acts. Rather it would appear that the tenants should be sold vouchers on the condition that the recipients then locate themselves in standard housing (i.e., it should roughly take the form of the food stamp program.) The face value of the voucher should be the minimum rent at which standard housing is available to the tenant. The price paid for the voucher by the tenant should be the price the tenant would willingly pay for that quality of housing. It has been estimated that such a procedure would have increased the proportion of families living in standard housing by 50 percent without increasing total expenditures. This finding is not conclusive. It depends on an admittedly poor estimate of the costs of upgrading the substandard housing stock to standard quality. The new period of experimentation now underway in the low-income housing field may yield firm evidence on the matter.

The literature then generates a general impression that public housing is inefficient if it is intended solely to benefit tenants and it is probably inefficient if the objective is to house the maximum number of tenants in public housing given the expenditure level. Perhaps though public housing is inefficient it may greatly promote equity. It is to that issue to which we now turn.

II. Equity

Introduction

In this section the distribution of benefits among various classes of beneficiaries is examined. The great bulk of the inquiry is devoted to

[14] Smolensky, *op. cit.*

examining the distribution of tenant benefits, with the discussion of nontenant benefits restricted to an appraisal of the bias introduced by their omission. (Nontenant benefits are omitted because no way has been derived, conceptually, to allocate the benefits to nontenants though in the aggregate they appear to be as large as the tenant benefits.) No attempt to distribute the costs of the public housing program has been essayed and hence the equity discussion is, of course, incomplete.

The concept of benefits which will be employed has been referred to earlier as the value approach to measuring the subsidy and is calculated as the difference between the rent paid by the tenant and the estimated market rent of the units the family occupies. The primary data source is the Survey of Economic Opportunity (SEO) covering the year 1965. An extensive discussion of the survey and the computation techniques utilized is contained in the appendix.

Income is the primary classification upon which the equity discussion is based, where income is defined as total family income less government transfers. The consequences of including government cash transfers in income will be touched upon briefly. One comparison will also be made with a distribution in which families are classified by welfare ratio, where the welfare ratio is defined as income divided by the poverty level of income for families of that size. In addition, attention will also be given to distributions classified by such characteristics as race, family size, age, region, and city size, all of which are correlates of horizontal and vertical equity for which data is available.

For most distributions two sets of data will be provided. One is the ratio of the number of actual tenant families to the number of eligible households. Conceptually, the eligible population consists of all households which meet the eligibility requirements as set separately by each of the local housing authorities. Thus eligibility varies from place to place as indicated in the appendix. The relevance of the ratio of tenants to the eligible population (T/E), is that it embodies one concept of equity. If the T/E ratio is the same in all categories, then the tenants constitute a random draw from the eligible population. Of course this is just one of several potential equity concepts which could be applied and is especially relevant for evaluating horizontal equity. It answers a question such as: "Do families with the same income have equal access to public housing no matter what region of the country they happen to live in?"

The second set of data shows the mean subsidy per socioeconomic category, such as age of the household head. Horizontal equity also requires equal treatment of equals with regard to the mean subsidy. These tables thus answer a question such as: "Do families with the same income receive the same subsidy, once they are in public housing, no matter what region of the country they happen to live in?" The mean subsidy value is also relevant to vertical equity. Thus we use the mean subsidy value to answer a question such as: "Is the subsidy progressively, proportionally or regressively distributed?" The T/E ratio is also useful for evaluating vertical equity. Most observers would find it offensive to learn that, ceteris paribus, a higher income (but still eligible) family has a better chance of getting into public housing than a lower income family. Some might believe that vertical equity requires that the lowest income families have the best chance of gaining admission.

Empirical Results

This section analyzes the relevant data collected in the 1965 Survey of Economic Opportunity (SEO). First the results of cross-tabulations between tenant income, the ratio of tenants to the eligible population when classified according to selected socioeconomic characteristics, and the mean subsidy to the tenant when similarly classified are presented. Some generalizations are then drawn. Finally biases in the data and the procedures are discussed and the generalizations modified in light of those biases.

Results

Results are presented in tables I through V. The set of five "A" tables deals with the ratio of tenants to the eligible population. The set of five "B" tables presents the distributions of the mean subsidy by age, sex, race, and location. The eligible and tenant population distributions and the tenant eligibility ratios are also displayed on a series of charts.

The overall ratio of tenants to eligible population in the Nation as a whole is 2.9 percent. Table I–A and charts I–A and I–B indicate households with incomes under $2,000 are grossly underrepresented and the higher income classes are grossly overrepresented.[15] The probability of being admitted to public housing rises persistently with income, which violates vertical equity. As shall be shortly seen, no matter how the data are classified, the T/E ratio always rises with income. Vertical equity will be violated in every T/E table to be subsequently presented.

[15] The T/E ratio reaches infinity in the $7,500 and over class because there are tenants who receive more than $7,500 in income, but tenants of that income are not eligible for public housing. The presence of such tenants may be due to reporting errors. However, tenants whose incomes exceed the income limits may be in public housing for short periods while searching for alternative housing.

CHART I A

TOTAL ELIGIBLE AND TOTAL TENANT POPULATIONS

(Percentage Distributions)

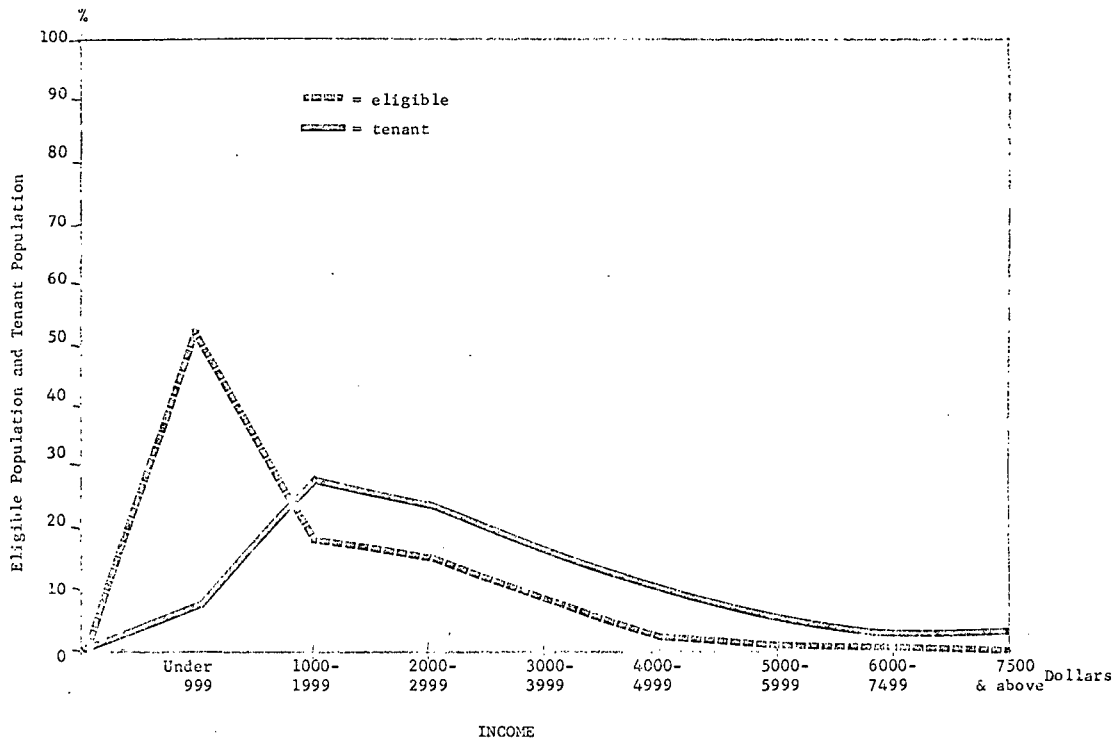


CHART I B

T/E PERCENTAGE - TOTAL

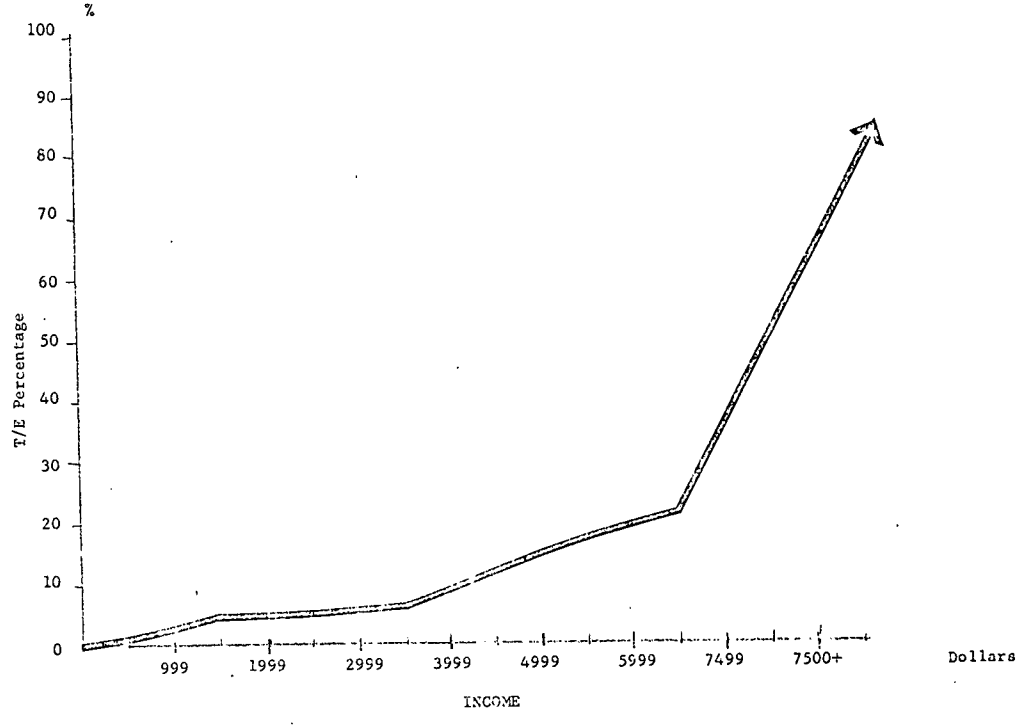


TABLE I–A.—*Ratio of tenants to eligible total population*

Income class:	*Percent*
Under $1,000	0. 4
$1,000 to 2,000	4. 5
$2,000 to $3,000	4. 6
$3,000 to $4,000	5. 7
$4,000 to $5,000	11. 7
$5,000 to $6,000	17. 1
$6,000 to $7,500	30. 8
$7,500+	[1] ∞
Total population	2. 9

[1] Some tenants reported incomes greater then $7,500 despite the fact that such tenants were not eligible for public housing except in very special circumstances which could not be taken account of in the tabulations.

TABLE I–B.—MEAN SUBSIDY VALUE

Income class	Mean subsidy value	Arc elasticity
$0 to $1,000	$452	
$1,000 to $2,000	409	−0. 10
$2,000 to $3,000	378	−. 15
$3,000 to $4,000	365	−. 11
$4,000 to $5,000	363	−. 02
$5,000 to $6,000	396	+. 43
$6,000 to $7,500	323	−1. 35
$7,500 and over	146	[1] −5. 81
Total population	381	

[1] Assumes the upper income of families in this open-ended class to be $9,500.

The mean subsidy (table I–B) will be presumed to satisfy vertical equity if it is progressively distributed throughout the income range. Since a subsidy is the negative of a tax, progressivity requires that as income rises, the percentage fall in the subsidy is greater than the percentage rise in income. Computationally that will mean that the percentage change in subsidy divided by the percentage change in income be a number less than −1.0, e.g., −2.0. More formally, when the arc elasticity of the subsidy-income function is less than −1.0 in all neighboring income classes, the subsidy is progressively distributed. Conversely, when the arc elasticity of the subsidy-income function is greater than −1.0, e.g., −.50, the subsidy will be called regressive, and regessivity violates vertical equity.

The arc elasticity of the actual subsidy-income function is recorded in column 2 of table I–B. The subsidy function is regressive at the outset and does not become progressive until income reaches about $5,500, and hence violates vertical equity. Vertical equity will be violated in a great many of the subsequent subsidy-income tables.

In part, the vertical inequity observable in the subsidy-income relation is due to the Public Housing Administration (PHA) rules. To illustrate this, table I–C was constructed in the following way. The value approach, when calculated, assigns an annual subsidy (S_j) to each tenant, which is defined as the difference between what the public housing unit would command as rent if placed on the open market (M_j) and the rent actually paid by the public housing tenant (R_j):

$$S_j \equiv M_j - R_j$$

The market rent for each apartment was estimated by making use of the operating rules of the Public Housing Administration.

Two rules are relevant. First the PHA requires that the maximum rent which can be charged for any unit be no more than 80 percent of the market rent:

$$R_j \leq .8M_j$$

Furthermore the rent paid for a unit was intended to be no more than 20 percent of the income of the family residing in that unit. All local housing authorities have assigned an upper income limit (L_j) for tenant eligibility which varies with family size. These size specific limits are different for different local housing authorities, as already indicated. Assuming that families of the same size occupy similar housing units in different localities makes it possible to assign a market rent to each unit and hence to each family. If income limits were set by the local housing authorities at levels making it at least theoretically possible for the authorities to meet both Public Housing Authority guidelines, then it is possible to assign a market rent to each unit and hence to each family. The maximum guideline rent for a tenant at the income limit for his family size is R_j^*:$R_j^*=.20L_j$ and we assume that $R_j^*=.8M_j$, where L_j is the applicable income limit. Then $.8M_j=.2L_j$ and

$$M_j=R_j^*\tfrac{.2}{.8}L_j=.25L_j.$$

R_j is the actual as opposed to the maximum guideline rent paid by each family; if $R_j=R_j^*$ for a tenant at the income limit, then that tenant's subsidy (S_j) would be

$$M_j-R_j^*=.25L_j-.20L_j=.05L_j$$

For tenants whose rent does not equal the theoretical maximum, the subsidy is $M_j-R_j=.25L_j-R_j$. R_j may or may not equal 20 percent of family income, whatever that income.[16]

TABLE I-C.—THE IMPLICIT REGRESSIVITY OF PUBLIC HOUSING RULES ILLUSTRATED AND COMPARED TO THE ACTUAL MEAN SUBSIDY

Income (Y)	Subsidy implicit in PHA rules (S_1)	Proportional subsidy	Arc elasticity of S_1	Actual mean subsidy (S)	Arc elasticity of S
(1)	(2)	(3)	(4)	(5)	(6)
Under $1,000	$1,275	$3,038		$452	
			−0.17		−0.10
$1,000 to $1,999	1,075	1,013		409	
			−.40		−.15
$2,000 to $2,999	875	604		378	
			−.79		−.11
$3,000 to $3,999	675	432		365	
			−1.40		−.02
$4,000 to $4,999	475	336		363	
			−2.65		+.43
$5,000 to $5,999	275	275		396	

[16] Tenant subsidy will differ from $.05L$ under any of several conditions: (1) if the family's income is less than the income limit for his family size-location category, the estimate of market rent will not change, but the actual rent charged will be less (assuming that the 20 percent guideline is adhered to), making the size of the subsidy greater. (2) If the 20 percent guideline is not followed, and rent is a higher (lower) proportion of income, the subsidy will be less (more) than it would be under the guidelines. Again, failure to follow the 20 percent guideline does not affect the estimate of comparable private rent. (3) If in fact the authority did *not* coordinate its original income limits schedule with the comparable private rents actually prevailing in the area in such a way as to make the $.80M=R_j^*=.20L_j$ equality hold, then the estimate of private rents are inaccurate, and the subsidies will be biased. If M_j is overestimated, subsidies will be as well, if M_j is too small, so will be the estimate of the subsidies.

Now assume $5,500 to be the average upper income limit. In that case the maximum annual subsidy would be $275, and the annual rental value of the dwelling unit would be $1,375. A family with an income of $4,500 occupying that unit and paying 20 percent of its income in rent would receive a subsidy of $475 per year. The subsidy rises because the market value of the unit is now fixed but the rent paid falls proportionately with income. Column (2) repeats this calculation for each income class. In each cell but the highest, the subsidy is a minimum, but in the highest income class the subsidy is a maximum (S_1). Column (3) presents what the subsidy would have to be, if the subsidy were a proportionate negative tax on income, (i.e., the elasticity of the subsidy with respect to income is -1) also taking the $275 subsidy in the uppermost income as the base (S_2). Cloumn (5) repeats some of the mean value subsidies from table I–B.

Several conclusions can be drawn from table I–C. Comparing columns (2) and (5) shows that subsidies could be larger than they are, even if tenants paid 20 percent of their income as rent, which in general they do not. Comparison of columns (2) and (4) provide one basis for judging the proportionality, regressivity or progressivity of the PHA rules strictly interpreted. With a $275 base (the subsidy earned in the income class $5,000–$5,999), strict proportionality is not arithmetically feasible over the whole income range. Individuals in the highest class earn 11 times the income of the lowest on average, but if the poorest families received a subsidy 11 times higher the subsidy would exceed the market value of the units. Strict proportionality could only be obtained, therefore, if the PHA provided the lowest income families with free housing and then added an even larger cash payment. Proportionality and even progressivity is arithmetically possible over the rest of the income range however. If tenants in the income class $1,000–$1,999 occupied the most valued units and paid about $30 per month in rent, the subsidy would be proportional over the income interval from $1,000 to $6,000.

The arc elasticity of the subsidy-income function constructed according to a strict interpretation of the PHA rules is entered in column (4). The subsidy would be progressive at incomes above $3,500 and regressive at the lower end under a strict interpretation of prevailing rules. That is, column (4) exhibits progressivity in the income range above $3,500 and regressivity below that income. The administrative rules call for a larger percentage decrease in the subsidy when going from an income of $3,500 to an income of $4,500 than the percentage increase in income. The same is true in the next higher income class. At the lower end, the percentage rise in subsidy is smaller than the percentage fall in income as we proceed from higher to lower income classes. Vertical equity therefore would not result from the public housing rules unless the administrators seek consciously to achieve it by having the ratio of rent to income rise rapidly as income increases. Hence it is not surprising that the actual distribution of the subsidy is highly regressive. Comparing column (6) with column (4) of table I–C indicates, moreover, that the actual subsidy-income function is even more regressive than would be the case under a strict interpretation of the rules. Finally, the range of the actual mean subsidy is miniscule when compared with the variation in income. Instead of seeing even a threefold increase in the subsidy between the income class centered

on $5,500 to the income class centered on $1,500 in column (3), the rise is a mere 10 percent.

The actual mean subsidy is produced by the complex interaction of many variables and hence judgment should perhaps be suspended at this point. Subsequent tables will show, however, that this pattern is repeated over nearly all subgroups. That is, the variance in the subsidy is very small across income classes, and what differences there are tend to produce a larger percentage increase in subsidy than the percentage decrease in income at the upper end of the income scale and the reverse at the lower end. The results tend to violate vertical equity for each subgroup of the population examined.

While the T/E ratio favors the upper income groups and the percentage change in the mean subsidy also favors the same group, the bulk of the public housing subsidy (which totaled $234 million in 1965) accrued to the middle income groups where the national population is concentrated. Nearly 70 percent of the subsidy accrued to households earning more than $1,000 but less than $4,000. Families with income under $1,000 received about 9 percent of the total subsidy, while families with income over $5,000 were granted 12 percent. Noting that the poor and near poor receive nearly 80 percent of the subsidy, Bish has expressed satisfaction with the way the subsidy is distributed by income class.[17] Our criteria leave us far less satisfied.

We turn now to the distribution of tenant benefits across various socioeconomic groupings.

(1) *Family Size*

The tenant to eligible percentage rises as the family size grows. For small families (e.g., one or two members) the T/E is less than 2 percent while for large families (e.g., seven or eight members or more) the T/E is 9.7 percent. (See table II–A, panel A.) The T/E ratio by income class and family size is not reported in the table but, by and large, in just about every family size group the bulk of the eligible families lie below that of the tenant distribution; that is, the tenants tend to center around higher income values than the eligibles. For small, low-income families the T/E is relatively low while larger families in higher income brackets are greatly overrepresented (have a relatively high tenant/eligible ratio).

The mean subsidy values tend to rise as family size increases. (See table II–B, panel A.) The range of variation remains small. Within each family size category the mean subsidy tends to fall, though by modest amounts, as income increases. Thus, for example, the mean subsidy falls by a third over the range of incomes from $1,000 to $6,000 while, of course, average income rose by 500 percent.

The interrelationship among income, family size, and public housing can also be examined using the welfare ratio. Since a family's welfare ratio is its income divided by the poverty line for families of that size, the distribution of public housing tenants according to welfare ratio takes income and family size into account simultaneously. If low-income families were generally small while high-income tenant families were generally large that would temper the conclusion that public housing favors high-income families. In fact there is some evidence to support this speculation. Nearly 60 percent of tenant families have a welfare ratio of 1 or less, indicating that 60 percent of

[17] R. L. Bish, "Public Housing: The Magnitude and Distribution of Direct Benefits and Effects on Housing Consumption," *Journal of Regional Science*, vol. 9, No. 3, December 1969.

tenant families are officially poor. An additional 13 percent of families have welfare ratios between 1 and 1.25, that is, they are very nearly poor. On the other hand, only 6 percent of tenant families have welfare ratios less than 0.25, while 32 percent of tenants have welfare ratios between 0.75 and 1.25. Assuming that anyone with a welfare ratio under 0.25 is eligible for public housing, the T/E ratio for this group is less than 1 percent. Thus while the implication that public housing violates vertical equity is somewhat tempered when the welfare ratio is substituted for income, it hardly disappears.

TABLE II–A.—PERCENTAGE OF TENANTS TO THE ELIGIBLE POPULATION BY SELECTED SOCIAL CHARACTERISTICS

A		B		C	
Family size	Percent	Age	Percent	Highest school grade completed	Percent
1	0.8	Under 20	1.2	Less than 8th grade	2.3
2	1.9	20 to 24	5.4	8	1.8
3	4.9	25 to 34	8.8	9 to 11	4.6
4	7.1	35 to 44	5.8	12	3.8
5	6.9	45 to 54	4.4	13 to 15	2.8
6	8.0	55 to 59	3.1	16	2.0
7	10.2	60 to 64	1.1	More than 16	1.6
8 or more	9.7	65 or older	10.4		
Total population	2.9	Total	2.9	Total	2.9

Source: Tabulated from the Survey of Economic Opportunity, 1966. See appendix A.

TABLE II–B.—MEAN SUBSIDY VALUE BY SELECTED SOCIAL CHARACTERISTICS

A		B		C	
Family size	Dollars	Age	Dollars	Highest school grade completed	Dollars
1	288	Under 20	419	Less than 8th grade	443
2	324	20 to 24	313	8	444
3	328	25 to 34	404	9 to 11	374
4	388	35 to 44	368	12	314
5	532	45 to 54	436	13 to 15	271
6	418	55 to 59	314	16	438
7	498	60 to 64	323	More than 16	206
8 or more	407	65 or older	383		
Total	381	Total	381	Total	381

Source: Tabulated from the Survey of Economic Opportunity, 1966. See appendix A.

(2) *Age*

The population has been formed into eight categories based upon the age of the household head. The middle age groups are substantially overrepresented, while the extreme upper and lower age groups are underrepresented (table II–A, panel B). The variation over the 72 age-income categories is difficult to summarize, but the same generalization appears to hold: low T/E ratios for lower incomes and higher T/E ratios for higher income families in each age category.

The mean subsidy values (table II–B, panel B) present no clear-cut generalizations: nearly all the values in the different age-income categories are within 20 percent of their class mean values. The tendency for there to be slightly higher values in lower income brackets and slightly lower subsidies in higher income brackets persists.

(3) Grade Completed by Household Head

The T/E percentages reveal little. (Table II–A, panel C.) Having completed some or all of high school yields a somewhat higher probability of living in public housing than for elementary graduates but the difference is not large. The breakdowns by income class, like age, result in too few tenants in some cells to be meaningful, but it appears to remain roughly true that the T/E persists in rising with income at each level of education attained by the household head.

The mean subsidy level falls with education level in general (table II–B, panel C) because even within the tenant population, median income rises with education.

(4) Race

The SEO reports much too high a percentage of tenants as blacks, 69 percent, when the actual percentage was roughly 56 percent. Nevertheless it seems safe to conclude that the nonwhite population is clearly overrepresented in public housing The survey yields a T/E ratio of 12 percent for blacks and only 1 percent for whites.

CHART II A

WHITE ELIGIBLE AND WHITE TENANT POPULATIONS

(Percentage Distributions)

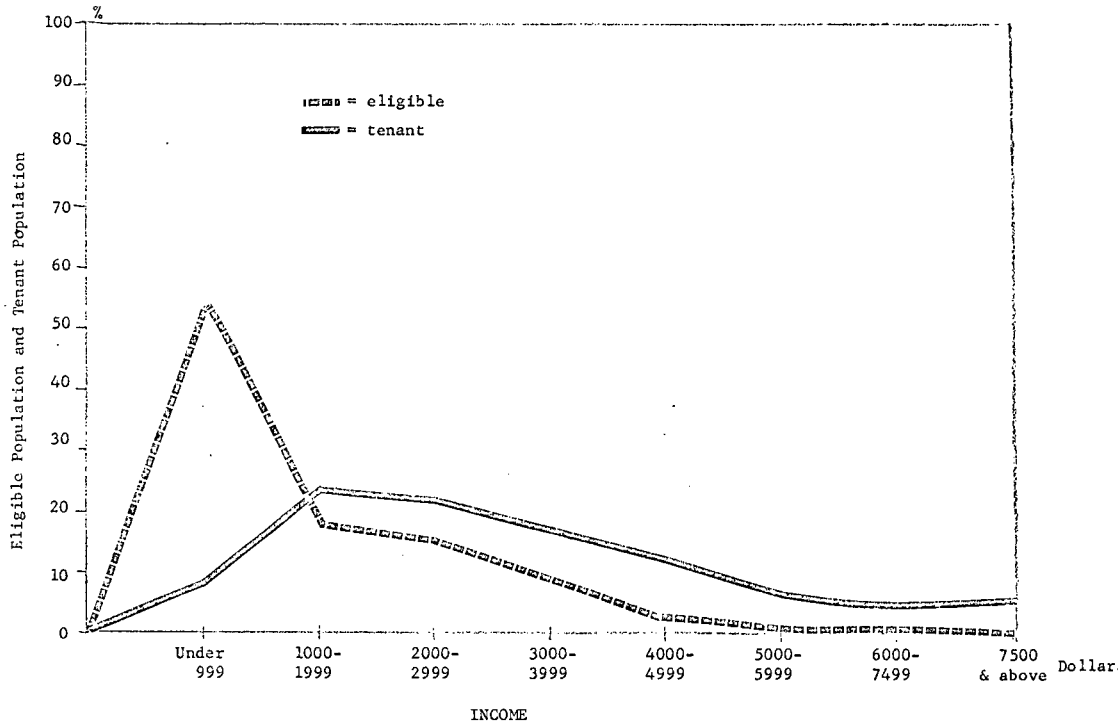


CHART III A

NON-WHITE ELIGIBLE AND NON-WHITE TENANT POPULATIONS

(Percentage Distributions)

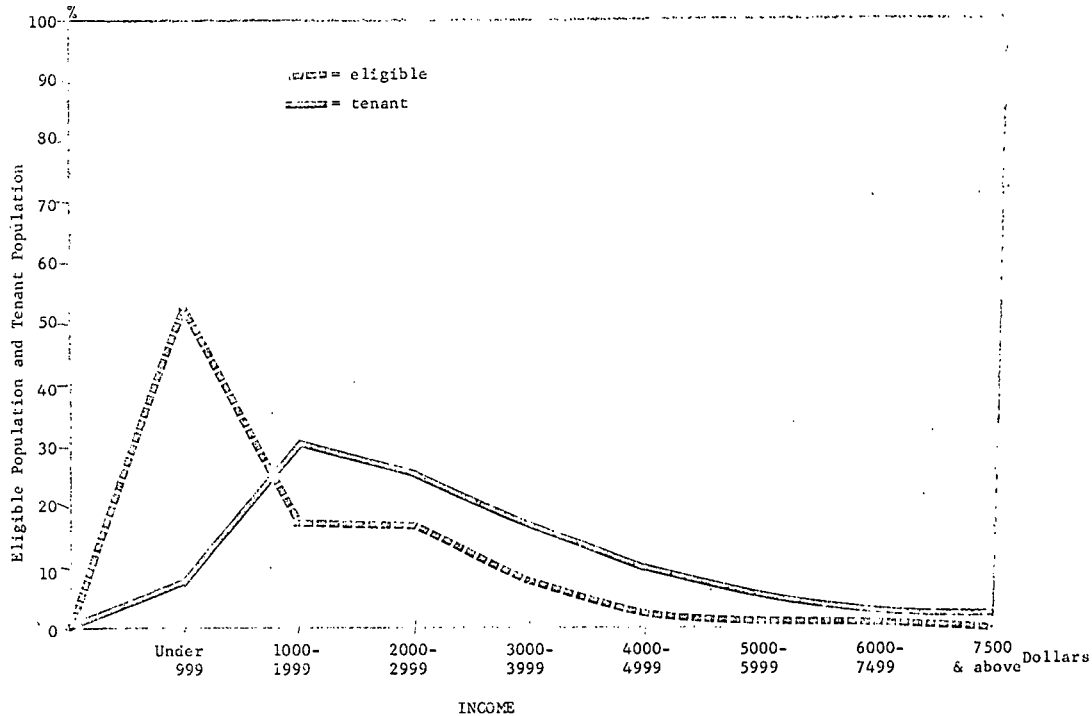


CHART II B

T/E PERCENTAGE - WHITE

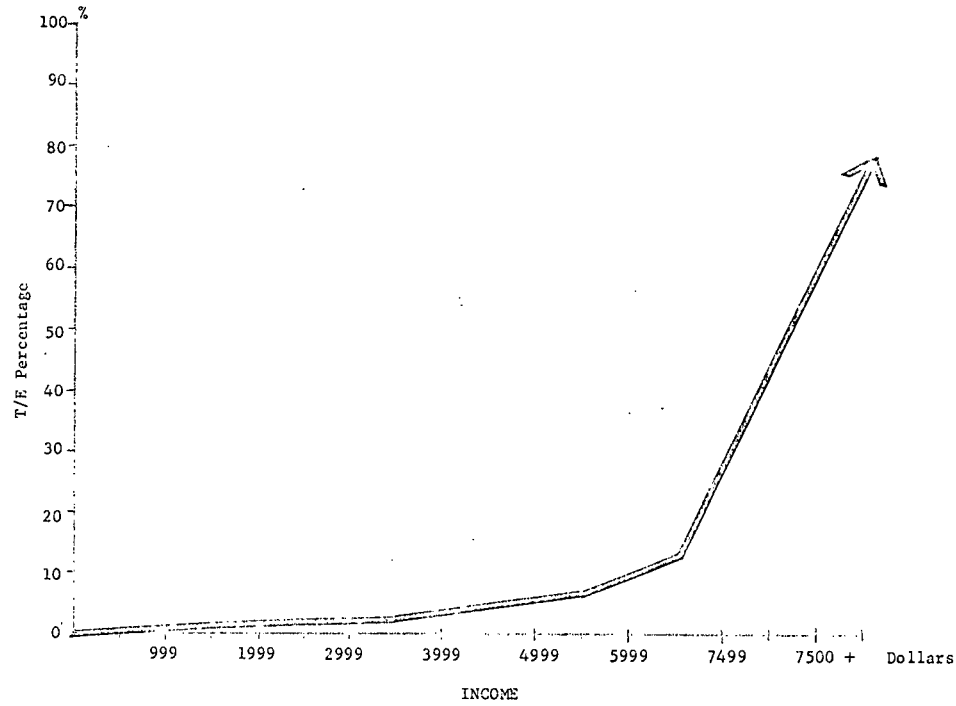
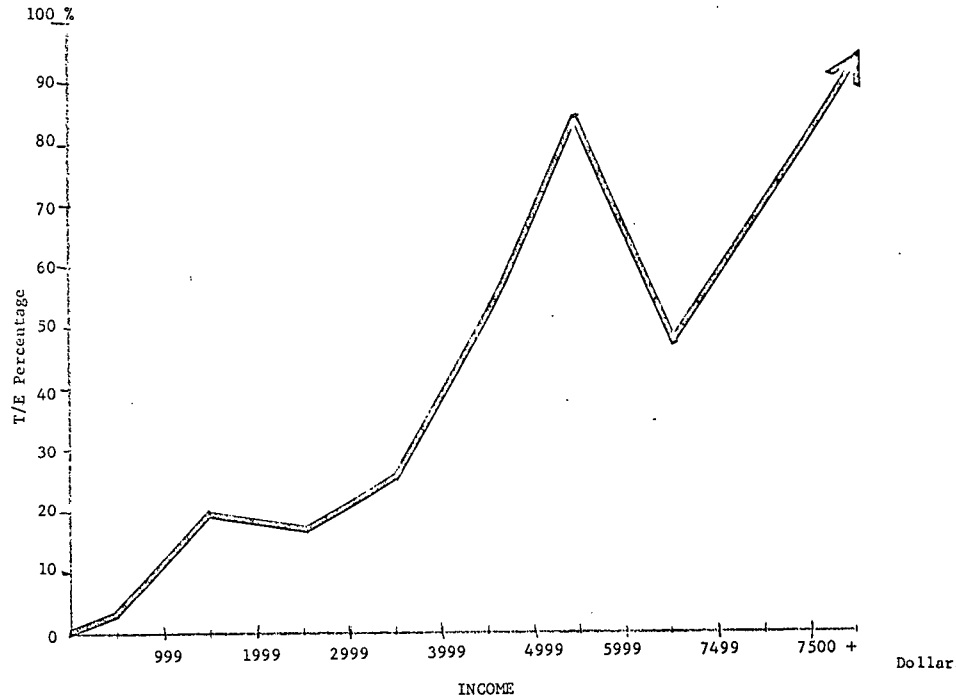


CHART III B

T/E PERCENTAGE - NON-WHITE



As shown in charts II–A and III–A the mode of the distribution of the eligible population again is reached in a lower income class than the mode of the tenant distribution. For each separate income class, the T/E's are much smaller for whites than nonwhites. For nonwhites in an income class over $1,000 the T/E is especially large relative to that of whites. Also to be noticed is the ris ng T/E by income class for either group. In other words, the 'ower income classes are greatly underrepresented, while the upper income classes are greatly overrepresented for either group. (See table III–A.)

The mean subsidy, on the other hand, is higher for whites than nonwhites On the ave rage the subsidy is $440 for whites, and only $354 for nonwhites. (Table III–B.) In some upper income categories, however, nonwhites receive higher subsidies that is, fo: categories $5,000 to $6 000 and $6,000 to $7,500. Nevertheless while whites are 31 percent of the tenants they receive 36 percent o the subsidy. This is despite the fact that white tenants tend to have higher incomes than nonwhite tenants. For both whites and nonwhites the subsidy is progressive at the upper end of the income scale and regressive elsewhere except or the very bottom end of the nonwhite distribution which is also progressive.

In summary, there is a smaller proportion of eligible whites in public housing but they receive higher average subsidies per family.

(5) *Sex*

This variable indicates the sex of the family (interview unit) head. The T/E ratio favors neither sex. By income class, as is the case for most socioeconomic variables, the T/E rises as income increases. The lower income classes are greatly underrepresented, while the upper income classes are greatly overrepresented. (See table III–A). As in previous cases the mode of the eligibles by income class is to the left of the tenants.

By mean subsidy value, the pattern is the same as for the population as a whole.

(6) *Sex and Race*

This category breaks down the distributions into white male, white female, nonwhite male, and nonwhite female. The T/E are very different when compared by race as above. The difference between sexes in either category is very small, but slightly favors the males—but not by enough to be meaningful.

Comparing the four categories in tables III–A and III–B yields two basic generalizations. First, the T/E rises with income class in all categories. Second, nonwhites in every category possible, and by large amounts in many categories, have a higher T/E percentage.

The mean subsidy is higher for whites than nonwhites, however. It is higher for males in most cases—although very slightly for nonwhites, and more for whites. On the whole, subsidies decline in value as the income class rises, although over $5,000, the pattern is hard to discern, most likely because the sample sizes get very small and the averages get sensitive to unusual cases. For all whites the subsidy turns progressive at about $4,500, but for nonwhites it does not become progressive until the highest income class.

TABLE III-A.—PERCENTAGE OF TENANTS TO THE ELIGIBLE POPULATION, BY RACE, SEX, AND INCOME CLASS OF THE HOUSEHOLD HEAD

Income class	Total		Male			Female		
	White	Nonwhite	Total	White	Nonwhite	Total	White	Nonwhite
0	0.1	1.4	0.3	0.1	1.2	0.5	0.2	1.6
0 to $999	.1	1.8	.2	0	.8	.7	.2	2.6
$1,000 to $1,999	1.3	19.7	3.1	1.5	11.7	6.6	1.0	29.8
$2,000 to $2,999	1.5	17.2	4.0	1.7	13.5	6.0	1.1	23.5
$3,000 to $3,999	2.1	25.6	5.7	2.1	25.9	5.6	2.1	24.5
$4,000 to $4,999	5.0	52.1	10.3	3.8	57.1	21.6	16.4	35.4
$5,000 to $5,999	6.9	84.6	18.6	7.7	109.2	7.6	0	26.4
$6,000 to $7,500	13.2	47.4	19.0	12.9	42.5	160.3	56.4	297.6
$7,500 plus								
Total	1.1	11.7	3.1	1.3	12.4	2.8	.6	10.9

Source: Tabulated from the Survey of Economic Opportunity, 1966. (See app. A.)

TABLE III-B.—MEAN SUBSIDY VALUE OF TENANTS, BY SELECTED SOCIAL CHARACTERISTICS

Income class	Total		Male			Female		
	White	Nonwhite	Total	White	Nonwhite	Total	White	Nonwhite
0	$463	$447	$425	$381	$453	$467	$511	$444
0 to $999	383	482	428	303	499	458	409	478
$1,000 to 1,999	521	372	463	534	412	387	487	352
$2,000 to 2,999	475	341	435	549	368	302	239	313
$3,000 to 3,999	420	340	374	426	351	332	398	302
$4,000 to 4,999	477	295	373	579	274	330	265	409
$5,000 to 5,999	383	403	399	383	409	342	0	342
$6,000 to 7,500	272	372	329	258	404	249	717	132
$7,500 plus	189	96	140	178	92	233	384	132
Total	439	354	395	460	357	357	381	351

Source: Tabulated from the Survey of Economic Opportunity, 1966. (See app. A.)

(7) *Size of SMSA*

We now consider the location of public housing (tables IV–A and IV–B). The T/E ratio is higher in SMSA's than elsewhere (4.4 percent compared to 2.9 percent). The bulk of the tenants and eligible persons live in SMSA's with populations over 750,000. More than one-half of the public housing units are located in SMSA's of this size and the T/E ratio is 5.0 percent. Small SMSA's (less than 250,000) and SMSA's with 500,000 to 750,000 persons are also overrepresented (4.1 percent and 4.3 percent respectively), while SMSA's of 250,000 to 500,000 have a T/E ratio exactly equal to the national norm: 2.9 percent. Thus it is in the small towns and rural areas where T/E ratios are below 2.9 percent.

The T/E ratio by income class compared to the full sample T/E ratio is shown in Table IV–A. The T/E percentage rises with income class whatever the size of place. The higher T/E for persons living in SMSA's is due to the greater proportion of eligibles who live in non-SMSA areas (the denominator of the ratio) rather than an unusually small number of tenants (the numerator of the ratio). In fact, 89 percent of all tenants but on 58 percent of the eligible households live in SMSA's.

TABLE IV-A.—PERCENTAGE OF TENANTS TO THE ELIGIBLE POPULATION BY CITY CHARACTERISTICS AND INCOME CLASS

Income class	All places	In SMSA's			Outside SMSA
		All SMSA's	Central city	Urban fringe	
0	0.4	0.6	0.9	0.1	0
0 to $999	.4	.6	.8	.2	.1
$1,000 to $1,999	4.5	7.2	10.5	2.0	1.3
$2,000 to $2,999	4.6	7.2	10.2	1.7	1.3
$3,000 to $3,999	5.7	8.1	11.3	3.1	1.2
$4,000 to $4,999	11.7	14.5	19.1	4.3	2.7
$5,000 to $5,999	17.1	15.0	19.9	7.1	
$6,000 to $7,500	20.8	18.9	31.6	7.8	
$7,500 plus					
Total	2.9	4.4	6.1	1.4	.7

Source: Tabulated from the Survey of Economic Opportunity, 1966, see app. A.

TABLE IV-B.—MEAN SUBSIDY VALUE BY CITY CHARACTERISTICS AND INCOME CLASS

Income class	All places	In SMSA's			Outside SMSA
		All SMSA's	Central city	Urban fringe	
0	$453	$449	$452	$416	$486
0 to $999	452	432	426	476	537
$1,000 to $1,999	409	392	386	447	520
$2,000 to $2,999	387	368	363	426	443
$3,000 to $3,999	365	365	372	331	363
$4,000 to $4,999	363	364	375	257	341
$5,000 to $5,999	396	402	444	129	434
$6,000 to $7,500	323	342	362	276	124
$7,500 plus	146	130	113	178	276
Total	381	373	376	347	448

Source: Tabulated from the Survey of Economic Opportunity, 1966, see app. A.

The SMSA grand mean subsidy is $373 as compared to $381 for all the tenants. The values break into two groups. Small SMSA's (less than 250,000) and large SMSA's (over 750,000) have mean subsidy values near $373. The two middle sized SMSA's (250,000 to 500,000 and 500,000 to 750,000) have much lower values, $235 and $286 respectively. This implies that the differences in income limits is larger than the difference in private rental values across cities. It is perhaps interesting to note that the subsidy-income function shows an exceptional degree of progressivity in the urban fringes, with progressivity setting in at about $3,500 (though there is an exception).

(8) *Within the SMSA's*

We now consider the location of public housing within SMSA's (tables IV–A and IV–B). Central city locations are so favored that the T/E ratio in the inner cities is 6.1 percent. Public housing has a much smaller relative impact outside of SMSA's: 0.4 percent and in the urban fringe, 1.4 percent.

However the mean subsidy values indicate that subsidies are highest in the non-SMSA's and are the lowest in the urban fringe. With nearly 90 percent of all tenants, subsidies in the central city are, of course, quite close to the grand mean.

(9) *Census Region*

The T/E ratios reveal that the Northeast (NE) and the South are slightly overrepresented, while the North Central (NC) and the West are slightly underrepresented (table V–A). The differences from the national average are not great in any case. By income class the T/E percentages rise in each region, except in the South where the rate accelerates more quickly.

TABLE V-A.—PERCENTAGE OF TENANTS TO THE ELIGIBLE POPULATION, BY REGION

Income class	Northeast	North central	South	West
0	0.7	0.4	0.4	0.5
0 to $999	.6	.2	.4	.6
$1,000 to $1,999	4.2	1.9	6.5	4.3
$2,000 to $2,999	5.3	3.0	6.2	2.5
$3,000 to $3,999	5.1	1.7	23.7	3.4
$4,000 to $4,999	7.4	5.0	461.0	29.1
$5,000 to $5,999	8.5	1787.0		
$6,000 to $7,500	10.9			
$7,500 and over				
Total	3.4	1.5	4.1	2.3

Source: Tabulated from the Survey of Economic Opportunity, 1966. See app. A.

TABLE V–B.—MEAN SUBSIDY VALUE, BY CENSUS REGION

Income class	Northeast	North central	South	West
0	$572	$540	$576	$466
0 to $999	604	487	435	513
$1,000 to $1,999	715	612	322	216
$2,000 to $2,999	442	374	363	391
$3,000 to $3,999	614	434	260	399
$4,000 to $4,999	564	346	181	173
$5,000 to $5,999	464	245	267	474
$6,000 to $7,500	445	340	61	151
$7,500 and over	418	129	−149	94
Total	525	405	289	335

Source: Tabulated from the Survey of Economic Opportunity, 1966. See app. A.

Presumably, it is the intent of the Public Housing Administration that all families be eligible for admission to their units who cannot buy standard housing in the private market without spending an undesirably large proportion of their income on shelter. The cost of standard housing varies substantially from place to place, however. Hence, since tenants may be charged no more than 20 percent of their income as rent, income limits must be higher where the cost of living is higher. For example, if a standard unit for a family of four is reasonably readily available for $100 per month in Atlanta and $150 per month in New York City, then the income limit in Atlanta should be $6,000 per year, while it should be $7,000 per year in New York City. (It would be useful to compare the rental for standard housing implied by the local income limits with other estimates of the rental cost of standard housing in each local housing market, but such a comparison is outside the scope of this paper.)

Income limits do vary substantially across the United States as is indicated in the appendix, and this affects the distribution of tenants by income class. Thus 30 percent of all public housing tenants live

in the Northeast, but they represent nearly 50 percent of tenants with incomes over $5,000. Alternatively, while 44 percent of all public housing tenants live in the South, southerners provide nearly 50 percent of the tenants in the income range from $1,000 to $4,000. The West with 12 percent of all tenants, provides 20 percent of the tenants with incomes under $1,000. The regional allocation of public housing units is, therefore, a major determinant of the distribution of tenants by income class. Altering the size distribution of income of tenants is going to require altering the regional distribution of housing units.

There is no necessary reason for the mean subsidy to vary across regions within each income class simply because income limits vary since rents paid could also be expected to vary proportionately. This is not the case, however. Mean subsidy values are highest in the Northeast in nearly all income classes followed by the North Central region, the West and the South in that order. Perhaps as income limits rise, the proportion of tenants at those limits decline.

Given the regional distribution of mean subsidies it is somewhat less surprising that their distribution is generally regressive. Subsidies are highest in the Northeast, and the Northeast has a disproportionate number of tenants at the uppermost end of the income scale. Furthermore, the subsidy-income function in the Northeast is markedly regressive. It does not even turn progressive at the upper end. The subsidy-income function is regressive only at the bottom end in the other regions. The subsidy-income function is especially progressive in the South, generally turning progressive at an income of about $2,500.

Some Generalizations

One critical variable examined in the preceding section was the ratio of the tenant to the eligible population. The first generalization that stands out from the detailed analysis is that in every case the mode of the distribution of the eligible population is to the left of that for the tenant population. (See charts I–A, II–A, and III–A presented earlier.) In other words, the bulk of the tenants tend to be from a higher income class than the bulk of the eligible persons and thus the T/E ratios tend to rise with income (See charts I–B, II–B, and III–B presented earlier.)

As the income of the eligible persons increases, therefore, the greater becomes his chance of being a tenant in public housing. This tendency is so pronounced that the same rising probability occurs in all socio-economic classifications that are meaningful, i.e., do not have such a small sample size that computation of a T/E is dominated by random error. For the white population, T/E rises very slowly (chart II–A) until the highest income class is approached. The T/E for the nonwhite group rises very quickly to the highest levels reached by whites but then continues upward.

The public housing program clearly favors eligible persons with greater incomes. There are "poor" persons being helped, but there are many (at least 5 percent) who are receiving a subsidy and are not "poor," even by the more lenient HUD cut-off level. (The HUD cut-off levels are usually somewhat higher than the Orshansky-Social Security-OEO cut-off levels.) The main point being made, however, is that since the poorest persons are not being helped first, other criteria

determine who become tenants in the program. Some speculations on just what those other criteria might be will be presented in part III.

The second major generalization which emerges is that the decline of the mean subsidy values by income class is too modest to be called progressive. Table I–B, which examined the MSV for the whole population, demonstrates that from $0 to $5,000–$6,000 there is a gradual decline in the MSV and above that income level the decline is more rapid. This tendency is not as dominant as the rise in the T/E ratio in the income. The MSV's in the income range $0 to $5,000 fluctuate greatly as the total population is further classified by various socioeconomic characteristics.

In summary, to receive a subsidy one must be a tenant and upper income groups have a higher probability of being in the program; once a tenant, the subsidy will be higher the lower the income class. In other words, the very poorest are not favored for entry into the program—and clearly entry is the only way to receive any direct benefits—but once in the program, the poor receive a greater average subsidy.

The tenant with those characteristics which maximize the probability of being in public housing would be part of a large family, and would be nonwhite. He would live either in the South or Northeast. The household head might be of either sex and would have had some high school education. He would be middle aged (20–59), neither very young nor very old. He chooses to live in an SMSA—most likely a large (over 750,000) one. He is willing to live in the central city.

Once in the program the following characteristics would yield a relatively large subsidy. Again the household head would be a member of a large family, but he would be white. He would live in the Northeast, not in the South. He would have little education and live in a small or large SMSA—not one with a population between 250,000 and 750,000. He chooses not to live in the urban fringe.

The eligible person with the lowest probability of being in public housing would be very poor. He would be white from the North Central or Western Census regions. He would be very young or very old and living alone or in a small family unit. He would have either a little or a lot of education. He would not live in an SMSA—especially not a large SMSA.

A person in the program who would receive small subsidy amounts could be described like this: He lives alone or in a small family. He is nonwhite and lives in the South. He lives in a middle-sized SMSA (250,000 to 750,000) or in the urban fringe, but he doesn't live on a farm or in a rural county.

In 1965 the public housing program violated both horizontal and vertical equity. That horizontal equity was not achieved is more dramatically evidenced by the fact that only 3 percent of the eligible were helped at all. Furthermore, those who lived in the South or Northeast, or were black, or who lived in the central city or a large SMSA had a higher probability of being in public housing than did others with the same pretransfer income. Horizontal equity was also violated because tenants who lived in the Northeast, or in very small or very large cities or who were white received higher subsidies than other tenants with the same pretransfer incomes.

Violations of vertical equity are also serious. The proportion of the very poorest eligible for public housing and obtaining it is not higher

than the proportion of higher income families who are eligible and who are housed. Indeed quite the opposite is true. In addition though lower income families receive larger subsidies, the percentage increase in their subsidies tends to be small relative to their income disadvantage.

Post-Transfer Income

Many public housing recipients are also the recipients of cash transfers, such as payments under public assistance; social security, veteran's benefits, railroad retirement and government employee pensions; workmen's compensation and unemployment compensation. Adding these payments to earned income shifts the distribution of tenants by income class substantially to the right. Thus the proportion of tenants in the under $2,000 income classes falls from 36 percent to 21 percent and the proportion in the income classes from $3,000 to $6,000 rises from 36 percent to 45 percent.

Classifying tenants by their posttransfer incomes leaves the average subsidies per income class virtually unaffected.

Since mean subsidies per class are barely affected by the shift to posttransfer income the overall regressivity of the subsidy schedule for tenants as a whole is also unaffected. The regressivity of the schedule is somewhat reduced for the nonwhite tenant population, however, because the mean subsidy in the lowest income class is raised substantially while the subsidy in the highest income class falls sharply. This is somewhat offset by the fall in the mean subsidy of whites in the lowest income class. No ready explanation for this result is evident.

Statistical Bias

The SEO sample of tenants appears to have several substantial biases. First, it is biased with respect to income since it drastically overestimates the proportion of tenants at the extremes of the distribution. As indicated in the appendix, this bias was eliminated by using the percentage distribution of tenants as published by HUD as the weights when blowing up the sample distribution to national estimates.

Two other biases remain in the data. First, the survey substantially overestimates the proportion of nonwhite tenants. Nonwhites are 69 percent of the sample, but only 56 percent of tenants.[18] Despite the size of the bias, correcting for it would leave the general impression only slightly altered. After correcting for the bias the white T/E rises from 1.1 to 1.5 percent while the nonwhite T/E falls from 11.7 to 9.5 percent.

The SEO substantially underrepresents the over 65 population in public housing since the sample puts 7 percent of tenants in the aged category while HUD puts about 23 percent in that category.[19] It remains true, however, that the aged were underrepresented in public housing in 1965.

The sample also overrepresents the proportion of low-income tenants in the West.[20]

As best we can tell, the sample gives us a reasonably good representation of tenants on other socioeconomic characteristics and also

[18] The distributions with respect to which the sample biased are of "families recommended for continued occupancy" by PHA an reported in: U.S. Department of Housing and Urban Development, *Statistical Yearbook*, 1966, p. 288

[19] *Ibid.*, p. 289.

[20] *Ibid.*, p. 288.

on the eligible population. The major conclusions of this part are unaffected by the biases in the data.

Non-Tenant Benefits

It is crucial at this point to reassert the consequences of confining the distribution to tenant benefits and tenant beneficiaries. In the aggregate nontenant benefits appear to be as large as tenant benefits. While nontenant benefits have not been assigned by income class it is difficult to imagine circumstances in which they accrue to the poor. Since the distribution of tenant benefits is regressive, the distribution of the total benefits of the public housing program must be highly regressive indeed.

III. Implications for Decisionmaking

The burden of this paper thus far has been to demonstrate that the Federal public housing program is woefully inadequate, scandalously inefficient and wickedly inequitable. It is now time to soften the criticism and to admit that the program is not what it is because wicked, lazy, venal men have distorted a noble act. Rather what has happened is the product of reasonable men making reasonable choices in the face of insufficient information and conflicting objectives.

The program is, of course, grossly inefficient if its sole purpose is to improve tenant welfare, but the program must have a more complicated objective. The program is probably inefficient, however, even if the goal is to get the tenants into decent, safe, and sanitary housing. The case is not proven, however. A priori it would seem that conditional cash grants would be the cheapest route to that objective, but no one can be certain of that until it is tried in rigorously controlled, adequately funded experiments. Selling housing vouchers at discount to tenants on the condition that the recipients live in standard housing needs to be tried soon.

The second apparently unsatisfactory aspect of public housing is the relatively small number of very low-income families housed. The fact is, however, well known and documented each year in HUD's Statistical Yearbook. Its cause is also well known. Until the Housing and Urban Development Act of 1969 each local housing authority was compelled to cover its operating costs, primarily with rental income and several analysts have noted the close relationship between increases in operating costs and increases in rents. As long as rent had to cover operating costs the proportion of very low-income families admitted had to be small, since rental income is tied to tenant income but operating costs are not. The conflict between the need to cover costs and the desire to house the very poorest was recognized at the outset as evidenced by the following dialog which took place in the Senate during the debate on the Wagner-Steagall Act of 1937.

Mr. Walsh. There is no longer any question as to the local authority having discretionary power to choose between a large number of persons of low income, but they must choose those with the lowest incomes.

Mr. Wagner. Those with the lowest incomes . . .

Mr. Copeland. I take it this carries out the same thought that was suggested to me, that at all times the families with low income shall have the preference.

Mr. Wagner. My amendment is even more mandatory, because it requires the selection of the lowest-income families . . . .

It appears to be the sentiment of this body, and it is my own sentiment, that those having the lowest income are those for whom we are legislating. We are not justified in spending public money for the construction of projects for the benefit of people with incomes enabling them to afford to live in buildings erected by private industry. In order that we may take care of the poorest first, we provide that those with the lowest incomes shall have preference, and when they are disposed of, we may take care of those with the next highest incomes, and so on. Questions of character, of course, will always have consideration . . . .

There are some people whom we cannot possibly reach: I mean those who have no means to pay the rent minus the subsidy. This, after all, is a renting proposition not a complete gift . . . .

Mr. PEPPER. The Senator means then . . . the lowest-income group which is able to pay the rentals which will be required by the authorities who administer this act.

Mr. WAGNER. Yes.[21]

As things now stand the primary way a local housing authority can house an increased number of the very poorest is to grow rapidly. New units have the lowest operating costs and the larger the proportion of new units operated by a single authority the lower can be aggregate rents. If the aim is to have a larger proportion of very poor people in public housing the program can be permitted to rapidly expand.

The Sparkman Amendment to the Housing and Urban Development Act of 1969 explicitly permitted Federal annual contributions to be used to cover operating expenses. The Brooke Amendment to the same act authorized $75 million for operating subsidies to forestall insolvency, raise maintenance levels and to hold down rents for low income tenants. The authorization for operating subsidies has now been raised to $150 million. The elderly, large families, families displaced by government programs and very low-income families can now receive a special subsidy of up to $10 per month funded outside of rental income. Given the financial crises facing many local housing authorities, how much of the $150 million authorization will go to raising the proportion of low income families or even lowering the rent of those in public housing is problematical.

One further possibility is to permit receivers of housing vouchers to spend them on public housing. What is really required, however, is an explicit investigation of alternative ways of providing operating subsidies to the local housing authorities conditional on an increase in the proportion of very low-income families housed. Such a study was called for in the 1969 Housing Act.

No doubt the need to cover operating expenses also explains why subsidies vary so little from income class to income class. The rules under which the local housing authorities set rents are such that the subsidies could dramatically differ by income class. However rents net of operating costs were averaging a mere $30 per unit per year around 1965. Increasing the subsidy by even a small amount at the low income end would soon mean bankruptcy.

To some extent the violations of horizontal equity may also be reasonable. The rural poor may be barred from participation because of the relatively high administrative costs that would be involved in drawing them into the program. A supplementary program of providing mobile homes may warrant study, however.

The relatively low percentage of tenants to eligibles in the West may reflect the fact that the housing stock is newer there. It may be that at the same income level, residents of the West occupy better housing

[21] Fisher, Robert M., *Twenty Years of Public Housing—Economic Aspects of the Federal Program.* (Harper and Brothers, New York) 1959, pp. 222-223.

than do residents of the East and the Old South. The need may therefore be relatively greater at each income level outside of the West. A similar argument may explain the higher proportion of blacks in public housing. Here the argument would be that blacks have a greater need because they are more likely to occupy substandard housing at each income level than do whites as a consequence of racial discrimination. Larger families may be overrepresented for a similar reason—need may be greater at each income level. Alternatively, since income limits and hence rents can rise as family size increases, the local authorities may prefer large families as a way to meet operating costs—though operating costs must also rise as family size increases.

Finally, demand factors may be determining, with the local authorities taking tenants strictly on a first come, first served basis. The overrepresentation of blacks and large families at least, may be explainable in this way. HUD's inability to racially integrate public housing projects has been one of its longstanding concerns.

Still another potential hypothesis is that blacks, large families, and city-dwellers are overrepresented and the aged underrepresented because the former generate substantial negative externalities while the latter generate little. Public housing may be a way to isolate those families which cause the greatest discomfort to nonpoor taxpayers. What the local public housing authorities may be trying to do is to minimize negative externalities subject to the constraint that rents cover operating costs. The location of public housing sites, and the conflict that breaks out over this location from time to time supports this latter hypothesis. On the other hand, given the small scale of the program in the aggregate the large number of local housing authorities is contrary evidence for unless public housing leads to a drastic reduction in the number and size of slums it is hard to see how negative externalities are reduced. If the aim is to reduce the discomforts of the nonpoor from living near slums, either a significant increase in the number of units or a drastic reduction in their spatial distribution is called for.

What Needs To Be Done

First, because the SEO is not an ideal data source, and because it is 5 years old, the empirical results of this study should be validated by HUD. Second, assuming that the findings are substantiated, scientifically conducted experiments with housing vouchers should be undertaken. Third, further consideration should be given to ways to subsidize the operating costs of local housing authorities which will add to the number of very low income families housed and which will permit greater variation in subsidy size by income class in existing public housing. An ideal arrangement might involve legislating that rent be an increasing percentage of income, with the taxpayer absorbing the difference between rent paid and 25 per cent of income up to some maximum aggregate supplement per local housing authority. Finally, perhaps some consideration should be given to determining whether the overrepresentation of blacks, large families, and city-dwellers and the underrepresentation of the aged is desirable. A supplementary program to aid the nonurban poor to occupy standard housing is probably the most pressing requirement if horizontal equity is to be achieved.

APPENDIX

ESTIMATING THE BENEFITS TO TENANTS OF PUBLIC HOUSING

I. INTRODUCTION

The distributions of benefits to families in public housing were calculated from the Survey of Economic Opportunity (SEO) conducted in 1966 by the Bureau of the Census at the request of the Office of Economic Opportunity. The 1966 SEO sample consisted of about 30,000 households and was made up of two parts: (1) a national sample (of about 18,000) drawn in the same way as the Current Population Survey (CPS) sample; and (2) a supplementary sample (of about 12,000) of areas with large concentrations of non-whites. The 1966 (but not the 1967) SEO noted if a respondent lived in public housing, and also contains much other demographic information on each family such as their income, assets, ages, family status, etc. The tabulations were made from the SEO file of the Social Systems Research Institute (SSRI) and The Institute for Research on Poverty, both at the University of Wisconsin, as received (and then re-formatted) from the Brookings Institute. Below the calculations to determine the benefits and their distribution will be described, but prior to that (in Part II), definitions of the variables used, from the SEO files and elsewhere, will be presented.

II. DEFINITIONS

These definitions are confined to the important variables used in the benefit calculations and the cross tabulations.

1. Interview unit.—Either a family or an unrelated individual 14 years old or older. A family consists of all household members related by blood, marriage or adoption. An unrelated individual is a person who either lives alone or with persons not related to him.

2. Pretransfer income.—Total family income excluding transfer payments for all adults in each interview unit. Included are (i) wages and salaries, (ii) incomes from ownership of a business, professional practice or partnership, (iii) income from farm ownership, (iv) interest and dividends from savings, stocks, bonds or other investments, and (v) rent from property, real estate or roomers. Excluded are (a) social security payments, (b) government retirement program payments, (c) veteran's pensions, (d) pensions from private employers, (e) unemployment insurance benefits, (f) public assistance, relief, welfare, and federal programs: aid to dependent children, aid to the blind or totally disabled, and (g) other incomes such as annuities or royalties. This definition is based on concepts used in the CPS income series published in the Current Populations Report Series, P–60.[22]

3. Economy poverty cutoff levels.—Sometimes known as the Orshansky poverty lines, these are the Social Security Administration's economy income poverty cutoff levels priced as of December 1965. These cutoffs have been modified in the SEO file to reflect a change in the price index used and also a different method of computing the farm cutoffs. The cutoff levels are broken down by the sex of the household head, family size (1 to 7 or more) and the age of the household head (only for one or two member families, and then only depending upon whether the head is over or under age 65).

4. Family weights.—Weighting factors established by the Census Bureau to expand the SEO estimates to national figures.[23] These weights were used to compute all estimates of national totals and distributions except for the public housing population.

5. Public housing.—As part of a question on housing, it was determined if an interview unit (family) was a renter of public housing. A public housing development was defined in the SEO file as a development owned and managed by a Federal, State, or local agency. No differentiation is made among these three categories.

6. Approved income limits for admission to low rent public housing.—The maximum income a family may earn and still continue to reside in a Federal public housing unit. This maximum is required by the Public Housing Authority to meet two requirements. Each unit may rent for no more than 80 percent of its estimated

[22] For further detail see Series P–60, No. 51 and No. 53. For definitions of the exact definitions of items (i–v) and (a–g) see "Guide to Documentation and Data Files of the 1966 and 1967 Survey of Economic Opportunity" (Institute for Research on Poverty, University of Wisconsin), 1970, mimeo.

[23] See for a complete explanation: "Guide to the Documentation and Data Files of the 1966 and 1967 Survey of Economic Opportunity" (Institute for Research on Poverty, University of Wisconsin, Madison), 1970, mimeo.

market value and no tenant may pay more than 20 percent of his family income as rent. Tables A–I and A–II list the limits used in the benefit calculation by census region and the 12 largest cities in the United States as listed in the SEO file.[24] The source of each table is listed below the table.

7. Rent.—the rent per month each interview unit pays to live in a public housing unit.

8. Military.—A household head on active duty in the United States armed services.

9. Subsidy.—Estimated market rent of the public housing unit less the actual rent paid. The two requirements described in definition 6 which the rental charged must meet imply that the market rent is 0.25 the approved income limit.

III. Actual Calculations

The calculations proceeded in three steps. First, the implicit subsidy which accrued to each family in public housing during 1965 was calculated. Step 2 formed cross tabulations of the subsidy by welfare ratio (defined below) and pretransfer income class, and different demographic variables. Step 3 displayed the final results, the distribution of the implicit subsidy of public housing by income class, raised population totals by an appropriate matrix of weights.

Step 1.—A subsidy to each interview unit (family) was calculated for all non-military families in public housing. An approved income limit for admission to low rent public housing was assigned to each interview unit living in public housing based upon family size and location. If the unit was located in one of the 12 largest SMSA's, the limits were from table A–I, otherwise the limits were drawn from table A–II. This upper income limit was then multiplied by 0.25 to obtain the annual private market rental value. The subsidy was then taken to be the private market rental value minus the annual rent paid.

Thus, each interview unit (family) in public housing was assigned a subsidy value calculated for it.

Step 2.—As part of the classification system a new variable created: The welfare ratio. It was calculated by dividing pretransfer income by the economy-poverty cutoff level for each interview unit (family) in public housing.

Cross tabulations were then formed relating the estimated subsidies to welfare ratio categories and pretransfer income class, and by different demographic variables.[25]

Each set of classifications included three sets of tables: Simple frequency counts expanded to national figures by the family weights, total sums of the subsidy in dollars, and mean subsidies in dollars. The sets of tables also included column and row percentage breakdowns. For some breakdowns a sample size classification was also obtained. Below will be listed the different demographic variables used.[26] Demographic variables used:

1. Age, sex, and race of the Interview Unit Head.
2. Interview unit size.
3. Census region
4. Living in one of 12 largest SMSA's.
5. Weeks worked by the Interview Unit Head.
6. Size of SMSA in 1960
7. Farm residence.
8. Poor area in large city or not.
9. In SMSA or not
10. Poor southern county or not.

Step 3.—The final step was to display the distribution of the subsidy by income class and welfare ratio category. Before displaying the results calculated in step 2, a simple check revealed that the weights used to expand the public housing sample to national estimates were grossly incorrect. As described in the introduction to this appendix, the SEO sample was divided into two different parts. The family weights used to expand figures differed greatly for each part (by a factor of 10) and since the part with the larger weight, the sample conducted like the CPS sample, has a high degree of variability, the expanded figure is far from the true value due to the larger expansion factor. The SEO weighting tech-

[24] The SEC files lists the 12 largest SMSA's while the limits are just for cities. The two are assumed to be the same for purposes of use on the SEO file.

[25] The program used is described in the manual: "XTAB-XTABRUN-A Cross Tabulation Package, User's-Programmer's Manual," No. 11, Data and Computation Center, Social Systems Research Institute, University of Wisconsin, August 1969. The calculations were performed on the Univac 1108 at the University of Wisconsin (Madison) Computing Center with help from the Social Systems Research Institute and the Institute for Research on Poverty.

[26] Detailed definitions and their breakdowns of the cross-tabulations used can be supplied on request.

nique corrected itself for the sampling variability by ratioing up the estimates to the census values in various categories and this has been done for public housing.[27]

Specifically, the SEO sample expanded by its own weights puts the number of families in public housing at 1,163,503 when an upper bound to the number actually living in all types of Federal, State or local public housing is approximately 800,000. We also know from data published by HUD that in Federal public housing (the vast majority of the units) only 6 percent of the families have incomes less than $1,000, while the SEO estimates over 11 percent of the families fall into this category. At the other end of the distribution, HUD puts less than 7 percent of tenants earning more than $6,000, while the self-weighted SEO puts more than 21 percent of families at that income. Thus, since we know the true distribution of families living in Federal public housing units by income class in 1966, the SEO total was ratioed up for the distribution by income class (see columns 1–6 on table A–I).[28] These new weights were assigned to each public housing family in the sample.

Thus, table A–I displays the ratioing up calculations and the new adjusted total subsidy and percentage distribution by income class. The ratioing up technique is done in columns 1 through 6 with the new weights shown in column 6. The mean subsidy by income class is then displayed in column 7 and was drawn from SEO's calculations described above. The actual adjusted distribution is then displayed in column 9. Other distributions of the public housing population were calculated with the same weights.

IV. Conclusion

This appendix has detailed the steps taken to calculate the tables presented in the main text of the paper. General procedures were outlined, but inevitably some details were omitted. Further information will be provided by the authors on request.

TABLE A–I.—APPROVED INCOME LIMITS FOR ADMISSION TO LOW-RENT HOUSING IN 12 LARGEST CITIES BY NUMBER OF PERSONS IN FAMILY

[In dollars]

City	Number of persons in family—											
	1	2	3	4	5	6	7	8	9	10	11	12
Baltimore, Md	3,000	3,400	3,650	3,650	4,000	4,000	4,200	4,200	4,200	4,200	4,200	4,200
Chicago, Ill	3,000	4,200	4,400	4,600	4,800	5,000	5,200	5,200	5,200	5,200	5,200	5,200
Cleveland, Ohio	2,900	4,000	4,200	4,400	4,600	4,800	5,000	5,200	5,400	5,500	5,500	5,500
Detroit, Mich	4,200	4,200	4,300	4,300	4,700	4,700	4,700	4,700	4,700	4,700	4,700	4,700
Houston, Tex	2,640	2,640	3,040	3,040	3,780	3,780	3,780	3,780	3,780	3,780	3,780	3,780
Los Angeles, Calif	3,900	3,900	4,300	4,300	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600
New York, N.Y	3,888	5,256	5,760	5,760	7,476	7,476	7,896	7,896	7,896	7,896	7,896	7,896
Philadelphia, Pa	3,200	3,600	3,800	3,800	4,000	4,000	4,200	4,200	4,200	4,400	4,400	4,400
Pittsburgh, Pa	3,400	4,000	4,400	4,400	4,600	4,600	4,800	4,800	4,800	4,800	4,800	4,800
St. Louis, Mo	3,700	3,700	4,400	4,400	4,900	4,900	4,900	4,900	4,900	4,900	4,900	4,900
San Francisco, Calif	2,880	4,000	4,200	4,200	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500
Washington, D.C	3,200	3,500	3,700	3,900	4,100	4,300	4,500	4,700	4,900	5,100	5,100	5,100

Source: Report of the National Commission on Urban Housing, Appendix: Admission and Retention Standards for Public Housing, table A–3, 1968.

[27] For an explanation of the weighting and sampling variability see "1966 and 1967 Survey of Economic Opportunity Sample Design and Weighting," p. 13, in "The Guide to Documentation and Data Files of the 1966 and 1967 Survey of Economic Opportunity," *Ibid.*

[28] We have used 1966 data due to its availability and the fact that it is a very close approximation to the 1965 figures. For the sources see table A–III*, footnotes.

TABLE A–II.—APPROVED INCOME LIMITS FOR ADMISSION TO LOW-RENT HOUSING BY CENSUS REGION BY NUMBER OF PERSONS IN FAMILY

[In dollars]

Region	Number of persons in family—											
	1	2	3	4	5	6	7	8	9	10	11	12
Northeast	3,600	3,900	4,150	4,250	4,500	4,550	4,750	4,800	4,800	4,800	4,000	4,800
North Central	2,750	3,600	4,025	4,350	4,550	4,750	4,900	4,950	4,950	4,950	4,950	4,950
South	2,850	2,950	3,150	3,150	3,450	3,450	3,450	3,450	3,450	3,450	3,450	3,450
West	3,300	3,300	3,500	3,500	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800

Note: These are the median limits of the largest cities of each region as a proxy of a regional income limit. The 45 largest cities were divided by region and in each region the median income limit values were recorded. This was used when a unit was not located in 1 of the 12 largest SMSA in table A–I.

Source: See table A–I.

ECONOMETRIC ANALYSIS OF THE MEDICARE PROGRAM

By MARTIN S. FELDSTEIN*

The $60 billion health care industry has become one of the largest public sector activities. More than a third of this expenditure is financed by the Federal, State, and local governments. Hospital care, which accounts for $22.5 billion, is provided almost exclusively by government and nonprofit institutions. Approximately half of the $11.7 billion of voluntary insurance is issued by nonprofit organizations.[1]

An appropriate allocation of resources in this highly decentralized and mixed public-private sector of our economy cannot be assumed to occur automatically. Prerequisites for appropriate public policy are both a general understanding and specific estimates of the basic behavioral relations of the health care sector. The current paper contributes to the development of such an overall model of the health sector by presenting a system of equations focusing on the allocation of health care resources to the 20 million aged persons under the medicare program.[2]

The medicare amendment to the Social Security Act was a fundamental departure in the financing of American health care. To its opponents, medicare was the opening wedge that would destroy American medicine through national health insurance and socialized medicine. To its supporters, medicare would remove the financial barriers that prevented the aged from receiving all the medical care they needed.[3] More specifically, the legislation included both comprehensive hospital insurance financed by the social security payroll tax and voluntary supplementary medical insurance financed jointly by individual premiums and an equal subsidy from general Federal revenue.[4] By July 1968, the end of the second fiscal year of operation,

*Professor of Economics, Harvard University. This paper draws heavily on my "An Econometric Model of the Medicare System," *Quarterly Journal of Economics*, February 1971 and my "The Use of an Econometric Model for Health Sector Planning," *Federal Programs for the Development of Human Resources*, a compendium of papers submitted to the Subcommittee on Economic Progress of the Joint Economic Committee. The study of the medicare program was supported by a grant from the National Center for Health Services Research and Development. I am grateful to Eva Reissner Ewing for research assistance and helpful suggestions.

[1] These amounts refer to fiscal year 1968–69.

[2] For a more general discussion of the uses of an econometric model of the health care sector, see M. S. Feldstein, Economic Analysis for Health Service Efficiency: Econometric Studies of the British National Health Service, vol. 51 of *Contributions to Economic Analysis* (Amsterdam: North-Holland Publishing Co., 1967), ch. 9.

[3] For a discussion of these controversies, see P. A. Corning, *The Evolution of Medicare*, U.S. Department of Health, Education, and Welfare, Social Security Administration, Office of Research and Statistics, Research Report No. 29 (Washington, D.C.: U.S. Government Printing Office, 1969); T. R. Marmor, "Doctors, Politics, and Health Insurance for the Aged: The Enactment of Medicare," in A. Sindler (ed.), *Cases in Contemporary American Government* (Boston: Little, Brown & Co., 1969); and H. M. Somers and A. R. Somers, *Medicare and the Hospitals: Issues and Prospects* (Washington: The Brookings Institution, 1967).

[4] The hospital insurance program ("part A" of medicare) currently provides that for each spell of illness (defined to end when the insured is in neither a hopsital nor a nursing home for 60 continuous days) the insured is entitled to (1) 90 days of semiprivate hospital care (with a $40 deductible on admission and $10 copayment during days beyond the 60th), (2) 100 days of skilled nursing home care in an "extended care facility" (with a $5 copayment after the first 20 days), and (3) part-time nursing and other home health care after hospital discharge. The supplementary medical insurance ("part B" of medicare) covers doctors' services regardless of where they are rendered, hospital outpatient care, and certain other medical services and supplies. There is a $50 annual deductible and a 20 percent coinsurance provision but no limit to the quantity of services used. The individual premiums for the supplementary medical insurance may also be paid by State governments; this accounted for nearly 12 percent of all premiums in fiscal year 1968. These State government expenditures can be partly reimbursed by the Federal Government under the medicare program.

medicare has paid more than $6.2 billion in hospital insurance benefits and nearly $2.1 billion in medical insurance benefits.[5] This is approximately 45 percent of the total amount of benefits paid in the same period by all other health insurers in the Nation. Nearly one-third of the acute hospital care rendered to persons of all ages is paid for by medicare. The aggregate effect appears to have been a substantial increase in the use of hospital and physicians' services by the aged population, with approximately half of the health care costs of the aged paid by medicare. In short, medicare has been a massive financial program aimed at providing the aged with full access to health services.

There is still substantial interstate variation in the amount of medical services used by people over 65 years old. This continues even though the Medicare program provides national uniformity in insurance coverage and an almost complete removal of price rationing for hospital and physician services. It is clear that insulating health care for the aged from the normal health services market mechanism is not sufficient to achieve or even to approach a uniform standard of care. For example, during the first 2 fiscal years there were 549 hospital admissions per 1,000 enrollees in the Nation as a whole, but the State admission rates [6] had a standard deviation of 93, reflecting a range between 418 and 843. Similarly, extended care facility admissions during those years averaged 61 per 1,000 hospital admissions, with a range between 15 and 138. Benefits per enrollee also varied substantially. Hospital insurance benefits averaged $588 per hospital episode with an interstate standard deviation of $149; for supplementary medical insurance the average per insured person was $115 with a standard deviation of $27.

This paper explores the reasons for and the implications of this variation with the aid of the strictural equations and reduced form of a simple econometric model of the medicare subsystem of the health care sector. In addition, the model and related equations are used to test the effectiveness of various specific features of the medicare program that were designed to promote efficiency in the use of health care resources. The most obvious of these is the insuring of nursing home care (that is, extended care facilities) to reduce the use of the more expensive hospital care. Similarly, the supplementary medical insurance was in part a response to previous studies that had shown that persons with only hospital insurance would obtain inpatient care for conditions that could be treated at lower cost on an outpatient basis.[7] These tests generally indicate that several features of the medicare system have not served their original purposes.

The basic conclusions of this research can be summarized briefly:

(1) *Although the amount of hospital care received by the aged is sensitive to the local availability of hospital beds, this sensitivity is less for the aged than for the rest of the population.* As a result, a higher proportion of the hospital care goes to the aged in those States in which facilities are relatively more scarce. The misallocation may occur because medicare has insulated the aged from the hospital price mechanism that

[5] Information about expenditure, utilization, and availability is published in 1st Annual Report on Medicare, 90th Congress, 2d session, House Doc. No. 381 (Washington: U.S. Government Printing Office, 1968); 2d Annual Report—Operation of Medicare Program, 91st Congress, 1st session, House Doc. No. 91-57 (Washington: U.S. Government Printing Office, 1969); Health Insurance Benefits Advisory Council Annual Report on Medicare, July 1, 1966–Dec. 31, 1967 (Washington: U.S. Government Printing Office, 1969).

[6] Excluding Alaska and Hawaii, and combining Washington, D.C., Maryland, and Virginia.

[7] See, for example, Somers and Somers, *Doctors, Patients and Health Insurance* (Washington: The Brookings Institution, 1961), and B. A. Weisbrod and R. J. Fiesler, "Hospitalization Insurance and Hospital Utilization," *American Economic Review*, vol. 51 (March 1961).

rations admissions, and particularly average stay per admission, for the rest of the population.

(2) *The purchase by state governments of supplementary insurance for the "medically indigent" aged is primarily an income supplement program with little effect on reducing the number of persons without supplementary insurance.*

(3) *A greater local availability of physicians substantially reduces hospital admissions and the cost of care per episode, but has an almost offsetting effect on the cost of out-of-hospital medical care.*

(4) *The net effect of the extended care facilities is to raise cost per hospital episode.*

(5) *Nonwhites receive substantially less from medicare than whites (a smaller proportion has supplementary insurance; extended care admissions are fewer; and the benefits per hospital admission are substantially lower).*

Section I discusses the general uses of an econometric model of the health sector. Section II summarizes some of the basic concepts and terminology of econometric models in general. The third section presents a brief overview of the medicare model. The individual estimated equations are discussed in sections IV through VIII. Section IX presents and discusses the reduced form parameters for the medicare system as a whole. A brief final section considers some overall conclusions. Although the paper includes a number of technical comments about the method of estimation, the reader who is interested in the conclusions and the general method of analysis can skip these with no loss of overall understanding.

I. The Uses of a Health Sector Model

A fully developed econometric model of the health care sector would provide a complete quantitative picture of the Nation's health care system. It would show how hospitals and other institutions, doctors and paramedical personnel, governments at all levels, insurance agencies, and patients interact to determine, the pattern of services that are provided; the resources used in their production; the patients who consume these services; the payments received by institutions and individuals; and the prices paid by consumers. It would moreover be dynamic, indicating the reaction lags and time paths along which variables respond to each other.

The estimation of a full-scale dynamic model of the health care sector presents a number of difficult economic and statistical questions. Moreover, the currently available data are not adequate to provide all the information necessary for policy purposes. These problems are not insuperable: Substantial progress should be possible during the next few years. The current section describes some of the potential uses of a health sector model.

Conditional Prediction Planning

Federal Government policy in the health care field currently concentrates on subsidizing the construction of hospital facilities and, through the medicare and medicaid programs, providing health insurance for the aged and those in low-income groups. Future developments may involve the Government more directly in the supply of

nursing home facilities, the training of medical personnel, and the provision and financing of the care of individual patients. Through each of these activities, the Government influences, both directly and indirectly, all aspects of the provision and use of health care services. For example, providing additional support for hospital building in one State would not only influence its pattern of hospital admissions but would also affect the building of private nursing homes, the attraction of doctors to the State, the wages of nurses and paramedical personnel, et cetera. All of these effects are relevant to determining the optimal level of such support for hospital construction.

More generally, associated with each possible Government health sector policy are: (1) A set of available facilities—both those directly influenced by the Government (for example, hospital beds) and those indirectly influenced (for example, private nursing homes); (2) the costs incurred by the Government and by others; (3) the pattern of utilization of facilities (for example, hospital admission and duration of stay by diagnosis); and (4) the ultimate effect of this care on the health of the Nation. In principle, the Government should select that policy which maximizes a welfare function (in which the variables are measures of the Nation's health, the costs incurred by the Government, and other costs) subject to the constraints imposed by the behavioral and technological relations between Government policy variables, total availabilities, costs, utilization, and health. In practice, this approach to health sector policymaking is far from attainable. The behavioral relations linking Government policy to the overall availability and use of services are almost completely unexplored. Technological relations between the use of health services and the resulting improvements in community health are known only for a quite limited range of activities. Because of the extreme difficulties in estimating these technological relations, a less demanding approach to health sector policy must be sought.

It is nevertheless important to preserve, as much as possible, the idea of choosing among policies in terms of their effects. If the ultimate impact which a Government action will have on the Nation's health cannot be assessed, it is at least possible to use estimated behavioral relations to predict its overall effects on the pattern of availability and use of health care services. The making of such conditional predictions would be the primary use of an econometric model of the health care sector. The importance of using a multiequation model is that this method can capture the complicated interactions and feedbacks of the health care system. In this way, the model permits calculating the indirect as well as the direct effects of Government policy. This will be elaborated below.

Monitoring and Explanatory Information

Although such conditional prediction planning requires using the entire model, each individual equation can by itself provide information which could aid policymakers. It is helpful to distinguish two types of information, which may be called monitoring information and explanatory information.[8]

Monitoring information permits assessing individual aspects of the current operation of the health care system. More specifically, it

[8] Both structural and reduced form equations are relevant here. The distinctions between these two forms of equations and between the types of information they contain will be made in sec. 2.

answers the question: How do differences in variable x affect some other variable(s) in the health care system? An example will clarify this. It is known that areas differ in the number of hospital beds available per thousand population. Anyone responsible for health sector policy should know what effects this has on the types of cases treated, the mean duration of stay per case, et cetera. Because clinicians serve in a single area, they will not be aware of these differences between areas in the patterns of admission and treatment. Similarly, a crude statistical comparison of admission rates or mean durations of stay in different areas would not distinguish the effects of bed availability differences from other factors which vary among areas. In contrast, the equations of an econometric model can conveniently indicate how the health care system responds to differences in bed availability, demographic characteristics, income, et cetera. The current model indicates that interstate differences in the number of short-term beds per capita have substantial effects on the number of cases admitted to hospital and the average duration of stay per case.

Explanatory information relates to specific suspected problems and to the casual relations which must be understood as a prerequisite of a general appraisal of health sector operations? It answers questions of the form: What are the reasons for the differences between areas and through time in variable y? Do these imply any malfunctioning of the health care sector? For example, officials might start with the observation that hospital admission rates differed substantially between States and then ask whether this was due to differences in population age-sex structure and medical characteristics or whether it also reflected differences in income, insurance coverage, hospital availability, et cetera.[9]

II. The Nature of Structural and Reduced Form Equations

Before looking at the specification and estimates of the current model, it will be useful to review the general concepts and terminology of complete-system econometric models. An econometric model is a set of interdependent statistically estimated equations. The model *as a whole* explains the values taken by one set of variables (the *endogenous* variables) in terms of the values taken by the remaining variables (the *predetermined* variables). The number of equations in the model is equal to the number of endogenous variables. Some equations may be merely definitional: that is, true as an identity, and therefore need not be statistically estimated. Each nondefinitional equation describes some behavioral or technological relationship. The dependent ("left-hand side") variable of such an equation is one of the endogenous variables; some of the explanatory ("right-hand side") variables may also be endogenous. The estimated coefficients of the explanatory variables in a particular equation indicate the *direct effects* of each such variable on the dependent variable of that equation. The set of behavioral, technological, and definitional equations together constitute the *structural form* of the model.

If the equations are all linear, it is easy to solve the set of equations for the endogenous variables; that is, to express each endogenous variable as a linear function of all of the predetermined variables.

[9] For a detailed econometric analysis of this problem, see my "Hospital Cost Inflation," *American Economic Review*, December 1971.

This new set of equations is known as the *reduced form* of the model. Each coefficient in a reduced form equation indicates the total effect that predetermined variable has on an endogenous variable. An example will clarify this very important distinction between the direct effect coefficients of the structural form equations and the total effect coefficients of the reduced form equation. Assume that the structural equation with the number of private nursing home admissions as dependent variable has among its explanatory variables the number of beds in Federal Government hospitals (a predetermined variable) and the number of beds in private hospitals (an endogenous variable). Both variables should have negative coefficients, indicating that an increase in the availability of either type of hospital bed would decrease the number of persons admitted to nursing homes. Now, consider the effects of an increase in the number of Federal hospital beds. The direct effect is to decrease the number of nursing home admissions by the amount indicated by the structural equation coefficient. But the increased number of Federal hospital beds would decrease the building of private hospitals; fewer private hospital beds would increase the demand for nursing home admissions. The *total* effect on nursing home admissions of the change in the number of Federal hospital beds, reflecting both its direct effect and its indirect effects such as that through the availability of private hospital beds, would be indicated by the coefficient of the Federal hospital bed variable in the reduced form equation for nursing home admissions.

Because policy depends on *total* effects and not just direct effects, the reduced form equations are of great importance. The virtue of a multiequation model of the health care system is that it can capture the interdependencies and feedbacks in the system's behavior and transmit this information to the reduced form equations.

III. An Overview of the Medicare Model

The model presented below explains the interstate variations in five key variables: the proportion of enrollees with supplementary medical insurance, the hospital and extended care admission rates per thousand enrollees, and the average levels of hospital and medical insurance benefits. The predetermined variables in the model are of five types: demographic characteristics of the enrollees (color, sex, percent over 75 years old); population density and the proportion of persons living in cities of more than 100,000; average income in the State; State health policy variables directly affecting the aged (State purchase of supplementary medical insurance, participation in medicaid, previous public welfare expenditure on medical and hospital care for the aged); and characteristics of the local health care system (availability of hospital beds, physicians, and nursing home beds; extent of insurance coverage among the nonaged population; general hospital cost and duration of stay patterns).[10]

All of the equations of the model were specified to be linear in the logarithms of the original variables. This permits the use of multiplicative identities (e.g., hospital insurance benefits per enrollee equals hospital admissions per enrollee times hospital insurance benefits per hospital episode) without losing the simplicity of calculating a general

[10] Some of these variables would of course be endogenous in a more general model of the health care sector. A simple prototype of such a model is presented in Feldstein, "An Aggregate Planning Model," loc. cit., and "The Use of an Econometric Model," loc. cit. As noted below, some of the variables describing the local health care system are treated as endogenous for estimation.

reduced form from linear structural equations. It also implies that all of the structural and reduced form coefficients are estimates of constant elasticities.[11]

The model was estimated by instrumental variables. With a sample of 47 observations,[12] considerations of consistency outweigh the increased variance of the instrumental variable estimators. The choice of instruments was governed by the logic of the two-stage least squares procedure. All of the exogenous variables within the medicare model were included in the instrument list, plus a selection of other variables that would be exogenous in a more complete model of the health care sector.[13] The daily hospital cost and average duration of stay variables were treated as endogenous and excluded from the list of instrumental variables.

Estimates relate to the 2-year period from July 1, 1966, to June 30, 1968. Pooling the 2 years in this way at least partly overcomes the problem that States may have differed in the period required to achieve equilibrium levels. The data on medicare is published in the annual reports of the medicare program. Most of the explanatory variables relate to 1967, i.e., the middle 12 months of the 2-year period. When possible, stock variables relate to the middle of 1967. The variables are defined as they are introduced below; more detailed definitions and data sources are available on request.

IV. Supplementary Medical Insurance

By the end of the second fiscal year, 84 percent of all medicare enrollees had purchased supplementary medical insurance, and an additional 11 percent had been "bought in" by their State governments. Despite this high percentage, nearly 1 million aged persons were without medical insurance. This situation raises two questions that might be answered with the available data. First, what types of persons are more likely than average not to be insured on either a voluntary basis or through their State's buy-in program? Second, do State buy-in programs substantially increase the number with medical insurance, or do they merely replace private money by public money? The answers to both questions are relevant to the proposal of the Department of Health, Education, and Welfare that the supplementary medical insurance no longer be voluntary but be financed through the social security payroll tax in the same way as the hospital insurance.

The proportion of enrollees with supplementary insurance [14] (PESI) is likely to be influenced by their demographic characteristics, income, previous use of medical and surgical insurance, and by the State's policy of buying in lower income persons. The statistical analysis showed that supplementary insurance is more common in States where a higher proportion of enrollees are white (WHITE) and where a higher proportion live in cities of over 100,000 persons (CITY) and is less common where the proportion of the population over 75 years old

[11] Dummy variables and constant terms are, of course, an exception. The constant terms also reflect arbitrary scaling factors but are not of interest as such.

[12] Maryland, Virginia, and Washington, D.C., were combined into one observation and Alaska and Hawaii were excluded.

[13] The method was thus similar in spirit to the technique suggested by F. M. Fisher, "Dynamic Structure and Estimation in Economy-Wide Econometric Models," in J. S. Duesenberry et al. (eds.) *The Brookings Quarterly Econometric Model of the United States* (Chicago: Rand McNally and Co., 1965), but without the formal ordering and test procedure, which would, in any case, be impossible since the full health sector model was not specified.

[14] This relates to the number at the end of the second fiscal year.

is high relative to those over 65 (AGE).[15] The results are presented in equation (1) below.

Because there is no data on previous insurance purchases by current medicare enrollees, the proportion of the current population under 65 with medical and surgical insurance (INSMS) was used to allow for habit persistence in the purchase of insurance. The expected positive sign was obtained.

No measure of the permanent income or wealth of the population over 65 is available, and actual money income for this group is a very poor measure of potential spending power. The median per capita income for the State population as a whole (INC) is used on the assumption that interstate variation of the wealth of the retired is likely to be highly correlated with the income levels of the employed population. This income variable does have a positive effect.

The percentage of medicare enrollees for whom the State government purchased medical insurance in fiscal year 1968 varied from zero to 28.4 percent; the mean of the State percentages was 8.3 percent and the standard deviation, 7.8. No satisfactory explanation of this variation could be developed in terms of the economic and demographic variables used in this study. A regression of the proportion "bought in" in fiscal 1968 on AGE, WHITE, MALES (the proportion of males among those over 65), INC, INSMS, CITY, and a dummy variable that equaled one for Southern States had a coefficient of determination (R^2) of only 0.24. It seems reasonable to assume that buying in is a local political decision that could only be explained in terms of political variables and characteristics of State government finance. It is therefore taken to be exogenous in this study. Because the bought-in proportion is zero in several States, the variable cannot be used in an equation that is linear in logarithms. The variable actually used is the proportion of medicare enrollees not bought in by the government (PENB). As explained below, the evidence indicates that the current buy-in program has a statistically significant but relatively small positive effect.

Equation (1) presents the individual elasticity estimates (the symbols now stand for the logarithms of the corresponding variables):

$$
\begin{aligned}
(1)\ PESI = &-\underset{(0.243)}{0.112} + \underset{(0.021)}{0.071}\ WHITE - \underset{(0.029)}{0.044}\ AGE \\
&+ \underset{(0.005)}{0.012}\ CITY + \underset{(0.016)}{0.018}\ INC + \underset{(0.013)}{0.039}\ INSMS \\
&- \underset{(0.025)}{0.081}\ PENB \\
&\qquad\qquad R^2 = 0.62.
\end{aligned}
$$

The income elasticity is the only coefficient less than 1.5 times its standard error. Because of the imperfect correspondence between INC and the theoretically appropriate income variable, the elasticity is probably biased downward. It is better therefore to retain the current estimate than to omit the variable as statistically insignificant.[16]

Although the positive elasticity with respect to the proportion of whites is small, the implied numerical effect is quite large. For

[15] The proportion of males and the population density were insignificant.

[16] Dropping INC has little effect on the remaining coefficients. In the order in which the variables appear in equation (1), the coefficients become 0.022, 0.84, −0.051, 0.009, 0.046, −0.074.

the Nation as a whole, 92.9 percent of medicare enrollees are white and 95.4 percent of all enrollees have supplementary insurance. Using the estimated elasticity implies that approximately 95.9 percent of whites have supplementary insurance;[17] correspondingly, only 88.9 percent of nonwhites have supplementary insurance (i.e., 95.4=0.929 [95.9]+0.071[88.9]).[18] If these inferences are correct, this important feature of the medicare program has not reached significant numbers of nonwhites despite the relatively low cost and the possibility of being bought in under State medicaid and welfare programs.

The elasticity with respect to PENB permits estimating the number of persons bought in by the Government who would otherwise not have bought their own supplementary insurance. Linearizing the elasticity at the mean values of 89 percent not bought in and 95 percent with supplementary insurance implies that, on average, buying in an additional 1,000 enrollees raises the number with supplementary insurance by only 87.[19] States probably could have directed their buy-in programs to be much more effective at raising the number of persons with supplementary insurance. Instead, they chose to use the buy-in program primarily as a means of reducing the cost of insurance to the low-income aged.

Equation (1) implies that some additional policy is needed if supplementary insurance is to reach nearly all medicare enrollees. The HEW recommendation to give medical insurance the same compulsory status as hospital insurance is one possibility. An alternative solution would be to replace the current system of proportional Federal reimbursement of State expenditure on buy-in with a system that rewards States for achieving a high percentage of enrollees with medical insurance. That would encourage States to use the buy-in program to increase coverage rather than merely to offset costs.

V. Hospital Admissions

Uniform comprehensive insurance did not produce equal effective access to hospital care in all states. Hospital admissions per enrollee (HAPE) during the first 2 years varied between 0.418 and 0.844. It is important to discover why, despite the absence of effective price rationing, so much variation remains.

The per capita availability of short-term general hospital beds (STGBPC) has a substantial impact. Where beds are more abundant, doctors are more permissive in their admissions decisions. The partial elasticity of HAPE with respect to STGBPC, as indicated by equation (2), is 0.377; the impact of this elasticity is indicated by the the range of short-term bed availability—from a low of 3.1 per 1,000 population to a high of 6.1.

Although the sensitivity of medicare admissions to local bed availability is a weakness of the medicare program as such, it is an important protection for the nonaged population. If medicare admissions were not sensitive to bed availability, patients in younger age groups would receive substantially less care in States where

[17] I.e., $\left(\frac{100.0}{92.9}\right)^{0.07}(95.4)=95.9$.

[18] The elasticity is the partial effect of color. If income and previous insurance were not held constant, our estimates would imply even less insurance for nonwhites. However, the effect of AGE and CITY probably influences the estimate in the opposite direction.

[19] I.e., $\frac{d\,\mathrm{PESI}}{d\,\mathrm{PENB}}=-0.081\left(\frac{\mathrm{PESI}}{\mathrm{PENB}}\right)=-0.081\left(\frac{95}{89}\right)=-0.087$.

beds are relatively scarce. Indeed, the medicare admission elasticity of 0.377 is markedly lower than a previous estimate of the corresponding elasticity for the entire population of 0.641.[20]

This result suggests that the younger age groups are more affected by bed scarcity than the medicare population, a situation that is probably contrary to the public interest. A possible explanation, although one that remains to be verified by more research, is that hospital prices are raised where medicare patients exert additional pressure on demand. This reduces the amount of care demanded by nonmedicare patients, while medicare patients, facing the same "price" everywhere (that is, the deductible and copayment), are not deterred. The explanation is supported by the results for hospital insurance benefits presented in section VII below.

The cost of out-of-hospital care, as measured by the proportion of the enrollees with supplementary medical insurance, had no significant effect on HAPE. This may reflect two offsetting effects of supplementary insurance; it lowers the cost of private physicians' services in the hospital as well as out of hospital. Alternatively, it may be due to the generally high level and relatively small variation in PESI.

In contrast, the availability of out-of-hospital care, as measured by the number of private practice physicians per capita (PPMDPC), did have an important effect. The partial elasticity of HAPE with respect to PPMDPC was −0.202. This implies that better organization of physicians' services for medicare patients could generally reduce costly hospital admission. It also indicates that because the aged now have better hospital insurance than the rest of the population, in areas of physician shortage the aged are able to shift their form of care to an inpatient hospital basis. More hospital care for the aged in turn implies less care for the rest of the population.

Hospital admission rates are generally lower in more densely populated States. In rural areas, physicians admit patients to hospital for care that would be provided at home or in the doctor's office if distances were not so great. The comprehensive hospital insurance of medicare enrollees would encourage such behavior. The estimated elasticity of −0.066 implies approximately 17 percent more admissions per thousand enrollees in a sparsely populated State like Iowa (density equals 49.1 persons per square mile) than in a densely populated State like Connecticut (density equals 600.6).[21] The cost implications of this emphasize the potential value of a more detailed study of ways to provide better alternatives to hospital admissions in rural area.

The substantial interarea variation in admission rates underscores the arbitrariness of the hospital admission decision. A very high proportion of admissions are not medically necessary in any technologically defined sense. The hospitalization of medicare enrollees can therefore be substantially influenced by doctors' attitudes and patients' expectations about the amount of care that should be provided to patients who are not self-paying. Such attitudes change slowly. Today's practice is still influenced by the standards prevailing for welfare patients in the premedicare period. One measure of the attitude toward

[20] Feldstein, "An Aggregate Planning Model," *loc cit.*, and "The Use of an Econometric Model," *loc cit.*,

[21] This estimate of the partial effect of density is based on linearizing around the average admission rates and density.

nonprivate aged patients is the per capita State and local welfare expenditure on health care for the aged in the premedicare period (PCWEHA). This enters the equation with a highly significant although small elasticity of 0.062. A probable and important implication of this habit persistence variable is that medicare admissions will be increased through time merely by the growing acceptability of care for patients who are not self-paying.

The medicaid program, initiated in 1966, provided for Federal, State, and local sharing of reimbursement for hospital and physician services for that part of the population deemed to be medically indigent. By the end of fiscal 1968, 36 States had opted to participate in medicaid. A medicare enrollee who was classified as medically indigent by his State could avoid the deductible and coinsurance features of medicare. Because that reduces the cost of both in-hospital and out-of-hospital care, it is not clear a priori what its effect is on the demand for medicare admissions. In addition, a State's participation in medicaid reduces potential medicare admission by increasing the demand for bed days by nonaged patients. The potential effect of medicaid was measured by the number of months during the period that the State participated in medicaid (MCAID). The estimated coefficient of −0.0017 implies that the provision of completely free outpatient and inpatient care (that is, without deductibles and coinsurance) may reduce hospital admissions.[22]

Equation (2) presents the basic equation for hospital admissions per enrollee:

$$
\begin{aligned}
(2)\quad \mathrm{HAPE} = &-0.672 + 0.377\ \mathrm{STGBPC} - 0.202\ \mathrm{PPMDPC} \\
&\quad (0.170)\quad (0.081)\qquad\quad (0.073) \\
&-0.066\ \mathrm{DENS} + 0.062\ \mathrm{PCWEHA} \\
&\quad (0.010)\qquad\quad (0.022) \\
&-0.0017\ \mathrm{MCAID} - 0.036\ \mathrm{MALES} \\
&\quad (0.0015)\qquad\quad (0.012) \\
&\qquad\qquad\qquad\qquad\qquad R^2 = 0.78.
\end{aligned}
$$

A variety of other variables that might be thought to influence HAPE have been considered: the percentage of the population under 65 who have insurance (INSMS), the percentage of whites among enrollees (WHITE), income (INC), and the relative number of enrollees over 75 (AGE). Equation (2*a*) shows that none of these is significantly different from zero; the overall explanatory power of the equation is hardly raised at all by introducing these four explanatory variables:

$$
\begin{aligned}
(2a)\quad \mathrm{HAPE} = &-1.26 + 0.372\ \mathrm{STGBPC} - 0.163\ \mathrm{PPMDPC} \\
&\quad (2.07)\quad (0.094)\qquad\quad (0.121) \\
&-0.058\ \mathrm{DENS} + 0.059\ \mathrm{PCWEHA} \\
&\quad (0.018)\qquad\quad (0.023) \\
&-0.0019\ \mathrm{MCAID} - 0.033\ \mathrm{MALES} \\
&\quad (0.0016)\qquad\quad (0.013) \\
&-0.038\ \mathrm{INSMS} + 0.126\ \mathrm{WHITE} \\
&\quad (0.144)\qquad\quad (0.216) \\
&+0.073\ \mathrm{AGE} - 0.095\ \mathrm{INC} \\
&\quad (0.215)\qquad\quad (0.136) \\
&\qquad\qquad\qquad\qquad\qquad R^2 = 0.79.
\end{aligned}
$$

[22] The negative coefficient may, however, merely reflect the above-noted competition for beds from nonaged medicaid patients.

VI. Extended Care Unit Admissions

Extended care units can best by described as sophisticated nursing homes that have the facilities and personnel to provide skilled post-hospital care for patients who no longer need the full services of a hospital but who are not, in principle, capable of being cared for at home. As already noted, the rate of extended care admissions per hospital admission (ECAPHA) varies widely; for the 2 fiscal years, the low was 0.015 and the high was 0.138.

Equation (3) shows that a high proportion of this variation can be explained by the number of extended care beds per enrollee (ECBPE), the per capita availability of short-term general hospital beds (STGBPC), the number of private practice physicians per capita (PPMDPC), and the proportion of whites among the enrollees (WHITE). None of the other demographic variables or income was significant.

$$(3) \quad \begin{aligned} \text{ECAPHA} = {} & -7.172 + 0.458\ \text{ECBPE} \\ & (3.070) \quad (0.081) \\ & -1.481\ \text{STGBPC} + 0.853\ \text{PPMDPC} \\ & (0.247) \quad (0.260) \\ & +1.225\ \text{WHITE} \\ & (0.470) \end{aligned}$$

$$R^2 = 0.81.$$

The effect of available extended care beds [23] on admissions is similar to the effect of hospital bed availability on hospital admissions. The negative elasticity with respect to short-term general beds per capita shows that in areas of greater than average bed scarcity physicians economize on hospital beds by transferring relatively more patients to extended care facilities. The substantial positive elasticity with respect to PPMDPC supports the result of the HAPE equation that the presence of more physicians reduces the use of expensive hospital inpatient care.[24] Finally, the elasticity with respect to WHITE shows that, despite provisions of the medicare legislation that make discrimination illegal and despite the presumably greater need of nonwhites for extended care admissions because of poor home conditions, nonwhites are substantially discriminated against in obtaining admissions to these facilities.

VII. Hospital Insurance Benefits Per Hospital Episode (HIBPHE)

HIBPHE varied in the 2 fiscal years from a low in Mississippi of $337 to a high in Connecticut of $998. That nearly threefold range underlines how varied actual benefits can be despite nominally uniform insurance coverage. Moreover, the extreme variation is not explicable in terms of differences in input costs alone: in Mississippi the average

[23] ECBPE is treated as endogenous for estimation but is not explained in the model presented in this paper. Preliminary analysis failed to establish an appropriate equation for the variable. In particular, the number of nursing home beds per enrollee is almost uncorrelated with ECBPE ($r=0.1665$). In more general equations, the nursing home bed variable remains insignificant. This is quite surprising, and further research on the question is planned.

[24] The mechanism for this is uncertain. It may reflect relatively shorter stays in extended care facilities, permitting more admissions per available extended care bed; alternatively, it may reflect more pressure to admit patients in general to hospitals and, therefore, to transfer medicare patients to extended care facilities.

cost per patient day for all patients in short-term general hospitals (ACPPD) was $43.10 in 1967, and in Connecticut it was $68.28.

Unfortunately, the currently published medicare data on hospital insurance (part A) benefits does not separate costs for hospitals and extended care facilities. Neither is there information about average duration of stay, one of the key determinants of cost per episode. Nevertheless, the variation in HIBPHE can be well explained in terms of currently available data. Equation (4) contains three types of variables: cost per patient day (ACPPD), factors affecting duration of stay (HAPE, STGBPC, ECAPHA, AGE, WHITE), and costs due to stays in extended-care facilities (ECAPHA).

The cost of a hospital spell is the product of the duration of stay and the average cost per patient day. This suggests imposing a unit elasticity of HIBPHE with respect to average cost per patient day in short-term general hospitals (ACPPD). It was not done for several reasons: (1) average daily costs for medicare patients are not necessarily proportional to costs for all patients; (2) although variables determining average stay are included in the equation, the average hospital and extended care stays of medicare patients are not actually in the equation; (3) daily costs in extended care facilities are likely to be only approximately proportional to short-term hospital costs; and (4) benefits are subject to deductibles and coinsurance. Nevertheless, the elasticity of HIBPHE with respect to ACPPD is 1.107, which, with a standard error of 0.272, is not significantly different from one.

A higher rate of hospital admissions (HAPE) lowers costs per hospital episode in two ways. More admissions implies less severe cases: average stay per case is therefore likely to be shorter and average cost per day lower. Because of the method of hospital reimbursement, the estimated elasticity of −0.772 probably reflects an understatement of the second of these effects.

The positive elasticity with respect to hospital bed supply (STGBPC) appears to indicate that medicare patients do have substantially shorter stays in areas of relative bed scarcity. However, 0.639 is a partial elasticity that does not allow for the effect of availability on stay that acts through HAPE and ECAPHA. The total elasticity of HIBPHE with respect to STGBPC (that is, the reduced form coefficient), obtained by substituting equations (2) and (3) for HAPE and ECAPHA, is very much lower: 0.173. This is also slightly lower than a previous estimate of the corresponding elasticity for the entire population of 0.186.[25] It supports the conclusion of section V that because medicare patients are not subject to price rationing they receive relatively more of the medical services in the areas where those services are particularly scarce.

The elasticity of HIBPHE with respect to extended care admissions per hospital admission (ECAPHA) is a crucial test of whether the extension of medicare insurance to these facilities does lower costs. The positive and significant elasticity, 0.118 with a standard error of 0.060, shows that extended care admissions raise rather than lower the cost per hospital episode. If durations of hospital stay are decreased by transferring patients to extended care units, the extra stay in those

[25] See Feldstein, "An Aggregate Planning Model," loc. cit., and "The Use of an Econometric Model," loc. cit. This estimate refers to the elasticity of mean stay with respect to short-term bed availability.

units more than outweighs the saving in hospital costs.[26] The rapid growth of extended care facilities and the current substantial interstate differences in ECAPHA suggest that this may be an important source of future increase in medicare costs.

The finding in equation (2) that a greater availability of physicians (PPMDPC) reduces admissions suggests that there may be a similar effect on duration of stay. More inputs of physicians' services in hospital are likely to complete any treatment sooner,[27] and having more physicians in an area permits patients to be discharged sooner for care to be completed at home or in the doctor's office. The negative elasticity of −0.376 supports this view and emphasizes again the potential saving in institutional care costs that may be achieved by a greater supply of physicians' services.

The elasticity of benefits per episode with respect to the proportion of whites among medicare enrollees (WHITE) is high: 0.658. This implies that the average benefit per episode is very much higher for whites than for nonwhites even when allowance is made for average cost per patient day in the State. Further research in the issue should be done when data disaggregated by color become available.

The negative elasticity of HIBPHE with respect to the proportion of persons over 65 who are also over 75 (AGE) contrasts with the almost identical mean stays for the two age groups found by the National Health Survey in the immediate premedicare period.[28] The survey data showed, however, that for high-income individuals the stay was greater for those aged 65 to 74; medicare may have the effect of making everyone act in his hospital behavior as if he had a high income. There are a variety of other possible explanations that can only be tested when more detailed data are available.[29]

$$
\begin{aligned}
(4)\ \text{HIBPHE} = {} & -5.74 + 1.107\ \underset{(3.08)}{\text{ACPPD}} - \underset{(0.272)}{0.772\ \text{HAPE}} \\
& + \underset{(0.167)}{0.639\ \text{STGBPC}} + \underset{(0.145)}{0.118\ \text{ECAPHA}} \\
& - \underset{(0.201)}{0.376\ \text{PPMDPC}} + \underset{(0.060)}{0.658\ \text{WHITE}} \\
& - \underset{(0.218)}{0.502\ \text{AGE}} \qquad \underset{(0.189)}{}
\end{aligned}
$$

$R^2 = 0.90.$

VIII. Supplementary Insurance Benefits

Supplementary insurance benefits (part B) are primarily payments for physicians' services. The wide variations—from $47 per enrollee with supplementary insurance to $122—reflect differences in the quantity of medical services rendered and in the prices charged.[30] Equation (5) relates supplementary benefits per enrollee with supplementary insurance (SBPESI) to the number of physicians, the rates of hospital

[26] There is, of course, the possibility that transferring patients to extended care facilities lowers total patient cost by reducing the number of hospital readmissions.

[27] For rather strong evidence on this production relation, see Feldstein, "Economic Analysis for Health Service Efficiency," op. cit., chs. 4 and 5.

[28] "Current Estimates from the Health Interview Survey," National Center for Health Statistics, series 10, No. 37 (Washington: U.S. Government Printing Office, 1967), p. 26.

[29] The proportion of males among medicare patients, the population density, and the proportion of the population living in large cities were all insignificant.

[30] Because of the $50 deductible, benefit payments magnify the variation in actual spending.

and extended care admissions, the age variables, and the proportion of males among the population over age 65:

$$
\begin{aligned}
(5)\quad \text{SBPESI} = {} & 12.02 + \underset{(1.86)}{} + \underset{(0.145)}{0.555\ \text{PPMDPC}} + \underset{(0.150)}{0.401\ \text{HAPE}} \\
& + 0.180\ \text{ECAPHA} - \underset{(0.059)}{} \qquad \underset{(0.318)}{1.067\ \text{AGE}} \\
& - 0.059\ \text{MALES} \\
& \underset{(0.020)}{}
\end{aligned}
$$

$R^2 = 0.71$.

The high positive elasticity with respect to PPMDPC emphasizes the importance of availability as a determinant of care in a system in which an effective price mechanism has been removed. The method by which this behavior is established remains to be investigated. Both physicians' preferences for certain types of cases and the self-regulating deterrent effect of queues (in hospital out-patient departments, and in doctors' offices and appointment books) are likely to be important ingredients.

The positive elasticity with respect to HAPE is as expected, since supplementary insurance covers physicians' services in hospital. Similarly, the coefficient of ECAPHA is consistent with the implication of equation (5) that extended care admissions increase the total number of days of institutional care per hospital episode. It is further evidence that the extended care coverage increases the total cost of the medicare program.

The negative elasticity with respect to the percentage of males is consistent with previous survey results.[31] The lower utilization by those over 75 conflicts with the earlier survey findings. This may be only a "statistical" artifact due to the aggregate cross-section analysis and the distribution of deductibles. It may, however, reflect a new pattern of care that emerged when the price mechanism of allocating physicians' services was replaced by medicare. The proportion of whites and the population concentration (DENS and CITY) were not significant.

IX. The Reduced Form of the Medicare System

The explanatory variables in the first three equations are all exogenous to the medicare subsystem.[32] The two benefit equations, however, contain hospital admissions and extended care admissions among the explanatory variables. Reduced form benefit equations can be obtained by substituting the HAPE and ECAPHA equations for these variables. The results are:

$$
\begin{aligned}
(6)\quad \text{HIBPHE} = {} & 0.173\ \text{STGBPC} - 0.120\ \text{PPMDPC} \\
& + 1.107\ \text{ACPPD} + 0.051\ \text{DENS} + 0.803\ \text{WHITE} \\
& - 0.502\ \text{AGE} - 0.048\ \text{PCWEHA} \\
& + 0.0013\ \text{MCAID} - 0.028\ \text{MALES} \\
& + 0.054\ \text{ECBPE} - 6.068; \\
(7)\quad \text{SBPESI} = {} & 0.628\ \text{PPMDPC} - 1.067\ \text{AGE} - 0.073\ \text{MALES} \\
& - 0.001\ \text{MCAID} + 0.025\ \text{PCWEHA} \\
& - 0.115\ \text{STGBPC} + 0.082\ \text{ECBPE} + 0.220\ \text{WHITE} \\
& - 0.026\ \text{DENS} + 10.460.
\end{aligned}
$$

[31] *Current Estimates from the Health Interview Survey*, op. cit.

[32] This is equivalent to treating the health care sector as a block recursive system with no immediate feedback from the medicare block to the other health sector variables that appear as explanatory variables in the current equations.

It is difficult to summarize the difference between the structural and reduced form coefficients briefly. For HIBPHE the primary differences are that (1) the total effect of physician availability in reducing hospital costs is less than the partial effect; (2) the total effect of the proportion of whites in the population is even larger than in the structural equation; (3) the availability of beds raises cost per episode much less than in the structural equation; and (4) the availability of extended care beds raises total costs per episode. For SBPESI the major changes are that (1) hospital bed availability enters with a negative effect; (2) extended care bed availability substantially raises supplementary benefits; and (3) benefits are higher in States with a higher proportion of white enrollees.

From these two reduced form equations and the structural equations for hospital admissions per enrollee (HAPE) and percentage of enrollees with supplementary insurance (PESI), it is possible to derive reduced form equations for hospital insurance benefits per enrollee (HIBPE) and supplementary insurance benefits per enrollee (SBPE)

The reduced form equation for hospital insurance benefits is:

(8) HIBPE=0.550 STGBPC− 0.322 PPMDPC
+1.107 ACPPD+0.803 WHITE−0.502 AGE
+0.014 PCWEHA−0.0004 MCAID
+0.054 ECBPE+0.008 MALES−0.015 DENS
−6.740.

The coefficients of STGBPC, PPMDPC, and WHITE are of greatest interest. The elasticity of only 0.550 with respect to the supply of hospital beds shows that the quantity of care received by medicare patients is relatively insensitive to the availability of beds. In short, the effect of medicare appears to be that the nonaged receive a lower proportion of the hospital care in states where beds are relatively scarce because they are price sensitive while medicare patients are not.

The substantial coefficient of PPMDPC reflects the combined effect of reducing admissions and cost per admission. The high positive elasticity with respect to the proportion of whites has been discussed already. It is also interesting to note that substantially less hospital and extended care facility treatment seems to go to medicare enrollees over 75 years old.

For supplementary insurance benefits per enrollee, the reduced form equation is:

(9) SBPE=0.628 PPMDPC−1.111 AGE−0.073 MALES
−0.001 MCAID+0.025 PCWEHA−0.115 STGBPC
+0.082 ECBPE+0.291 WHITE−0.026 DENS
−0.081 PENB+0.039 INSMS+0.018 INC
+0.012 CITY+10.348.

These coefficients are, of course, very similar to those for supplementary benefits per enrollee with supplementary insurance. The differences are the addition of the last four variables and the increased effect of the proportion of whites.

Because the equations have been specified to be nonlinear (i.e., linear in logarithms), it is not possible simply to add equations (8) and (9) to obtain elasticities of total medicare expenditure per enrollee

with respect to each of the explanatory variables. These total expenditure elasticities depend on the actual values of all the explanatory variables. However, the total expenditure elasticity with respect to any variable is simply the weighted average of the two separate expenditure elasticities (for HIBPE and SBPE) with the relative expenditures as weights.[33] For the nation as a whole, 73 percent of total medicare in the second fiscal year was for hospital insurance benefits and 27 percent for supplementary insurance benefits. Using these weights, we obtain the following elasticities for total medicare expenditures.

(10)

STGBPC:	0.370	PPMDPC:	−0.666
ACPPD:	0.808	ECBPE:	0.062
INSMS:	0.010	INC:	0.005
DENS:	−0.018	AGE:	−0.666
MCAID:	−0.0006	PENB:	−0.022
WHITE:	0.726	CITY:	0.003
MALES:	−0.014	PCWEHA:	0.017

The most interesting of these elasticities are the two for which the HIBPE and SBPE coefficients had opposite signs: STGBPC and PPMDPC. It is clear that the positive effect of bed availability on HIBPE substantially outweighs the saving on supplementary benefits. Although the net effect of physician availability is to decrease total cost per enrollee, the substantial effect of availability on SBPE erodes most of the saving on the cost of institutional care. A more detailed understanding of how physician availability affects inpatient care and the use of supplementary benefits may permit a redesign of the medicare system to take advantage of ways to reduce hospital costs without corresponding increases in supplementary benefits.

X. Concluding Remarks

Despite uniform and quite comprehensive health insurance of the aged population, very great variation remains in the use and benefits under the medicare program. This paper has presented an econometric model of the medicare subsystem that explains substantial portions of this variation in terms of demographic and economic characteristics of the population, State health policy variables, and characteristics of the local health care system.

The analysis also uncovered a second serious weakness of the medicare program. The amount of hospital care received by medicare patients is substantially less sensitive than the nonaged population to interstate differences in the availability of hospital beds. As a result, a higher proportion of the hospital care goes to the aged in those States in which facilities are relatively more scarce. The misallocation may occur because medicare has insulated the aged from the hospital price mechanism that rations admissions, and particularly average stay per admission, for the rest of the population.

[33] This important proposition is proven simply. Let $Y_1=AX_1^{\alpha_1}X_2^{\alpha_2}$ and $Y_2=BX_1^{\beta_1}X_2^{\beta_2}$. Then the elasticity of Y_1+Y_2 with respect to X_1 is:

$$\frac{\partial(Y_1+Y_2)}{\partial X_1}\cdot\frac{X_1}{Y_1+Y_2}=[\alpha_1 Y_1 X_1^{-1}+\beta_1 Y_2 X_1^{-1}]\cdot\frac{X_1}{Y_1+Y_2}$$

$$=\frac{\alpha_1 Y_1+\beta_1 Y_2}{Y_1+Y_2}$$

Several more specific results of particular importance may be summarized briefly: (1) State government purchasing of supplementary insurance for the "medically indigent" aged is primarily an income supplement program with little effect on reducing the number of persons without supplementary insurance; (2) greater availability of physicians substantially reduces hospital admissions and the cost of care per episode, but has an almost offsetting effect on the cost of out-of-hospital medical care; (3) the net effect of the extended care facilities is to raise cost per hospital episode; (4) nonwhites receive substantially less from medicare than whites (a smaller proportion has supplementary insurance; extended care admissions are fewer; and the benefits per hospital admission are substantially lower).

The analysis of this paper should be pursued at a less aggregate level. Two questions are of particular importance. First, what disease categories or, more generally, patient types receive less care when the admission rates of medicare and nonaged patients are reduced?

Second, in the absence of effective price rationing, what is the mechanism by which medicare patients currently receive less care in States of greater bed scarcity? The results of such research should help the government to deal with both the inevitable interstate variation in care received and the direct competition between medicare and nonaged patients.

One general point should be emphasized in conclusion: uniform comprehensive insurance for the aged is not an appropriate policy when States differ in the availability of resources and the pattern of competing demands. The overall performance of the medicare system could be improved if the current uniform provisions were replaced by a system that tailored incentives to local conditions. More specifically, a variety of methods could be used to economize on hospital beds in States where they are relatively scarce. In short, the econometric model of the medicare system shows the importance of a more spatially disaggregated approach to health care policy. This lesson no doubt extends beyond medicare to other public programs of health insurance and health care. As our understanding of the behavioral relationships of the health care sector develops, it will be possible to design such programs more effectively.

THE IN-SCHOOL AND SUMMER NEIGHBORHOOD YOUTH CORPS: A NATIONWIDE EVALUATION OF AN INVESTMENT IN DISADVANTAGED HIGH SCHOOL YOUTH*

By GERALD G. SOMERS *and* ERNST W. STROMSDORFER

I. INTRODUCTION AND BACKGROUND

The in-school and summer Neighborhood Youth Corps was created by the Economic Opportunity Act of 1964 (Public Law 88–452) with the intent to further the educational attainment and improve the performance of new entrants to the labor force. While not spelled out in detail in the act, the primary operational objective of the Neighborhood Youth Corps is to increase the high school graduation rate of students who are potential dropouts due to economic reasons. The program attempts to achieve this objective through providing paid work experience for students in their high schools or in other governmental or private employment. The underlying premise is that increased earnings and family income will lead to increased school attendance by covering the opportunity costs, that is, foregone earnings, of staying in high school. The work experience is also intended to impart labor market discipline and other skills associated with successful performance in the world of work once the students leaves high school, and thereby, to enhance the primary benefit of increased schooling. Finally, society is seen to derive benefits from the work being performed while participants are in the program

From its initial year in 1965 through 1970, first-time enrollments in the in-school and summer components of the NYC have increased more than fourfold, from 102,300 to 435,090 (table 1). The in-school component has only increased about 50 percent while the summer component has increased by a factor greater than seven. This is of marked interest since, to anticipate the presentation of our results, the summer component has had no statistically significant effect in increasing the graduation rate or post-high-school earnings. In fact, the objectives of the summer NYC appear to have changed over time, with a recent emphasis on helping to "cool off the long hot summer." This change in emphasis to meet problems in the central cities, may also have reflected an awareness that the summer NYC component was having little or no effect in achieving its original objectives.

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TABLE 1.—FEDERAL OBLIGATIONS FOR 1ST-TIME ENROLLMENTS AND IN-SCHOOL AND SUMMER NEIGHBORHOOD YOUTH CORPS

[In thousands]

	1970	1969	1968	1967	1966	1965
1st-time enrollments	435.9	429.6	373.5	394.7	256.0	102.3
In-school	74.4	84.3	118.3	166.8	160.8	54.7
Summer	361.5	345.3	255.2	227.9	95.2	47.6
Federal obligations	$210,127	$197,075	$185,585	$200,754	$263,237	$127,742
In-school	59,242	49,048	58,908	67,448	(1)	(1)
Summer	150,885	147,927	126,677	133,306	(1)	(1)

[1] Data not available for NYC components prior to fiscal 1967.

Source: Manpower Report of the President. April 1971, table F-1, p. 299.

Reflecting the relative growth of the summer component, total obligations (not funds actually spent) of the in-school and summer Neighborhood Youth Corps components have risen in 6 years from $127,742,000 to $210,127,000—an increase of about 64 percent. This increase was characterized by an absolute reduction in the allotted funds to the in-school component along with a modest rise in summer component funds of $17.5 millions over 6 years. Yet, the in-school component has achieved some of its originally legislated objectives as the following analysis will show.

The data in table 2 show an increase in Negro enrollments by a factor of more than four. Since Negroes, especially Negro females, benefit most from the Neighborhood Youth Corps, this trend is consistent with our findings.

TABLE 2.—CHARACTERISTICS OF YOUTH ENROLLED IN NEIGHBORHOOD YOUTH CORPS IN-SCHOOL AND SUMMER PROJECTS

	September 1969 to August 1970	September 1968 to August 1969	September 1967 to August 1968	September 1966 to August 1967	September 1965 to August 1966	January 1965 to August 1965
Total (thousands) [1]	517.0	474.6	483.7	446.0	357.8	157.5
Sex (percent):						
Male	50.0	53.4	54.2	54.8	54.8	63.4
Female	50.0	46.6	45.8	45.2	45.2	36.6
Race (percent):						
White	53.7	46.3	47.3	52.4	55.8	67.3
Negro	42.5	47.4	48.0	43.3	39.0	28.7
American Indian	2.5	2.9	2.6	2.5	3.5	2.0
Oriental	.4	.7	.6	.6	1.0	.7
Other	1.0	2.6	1.5	1.2	.7	1.3
Sex (thousands):						
Male	258.5	253.4	262.2	244.0	196.1	99.8
Female	258.5	221.2	221.5	201.6	161.7	57.6
Race (thousands):						
White	277.6	219.7	228.8	233.7	199.6	106.0
Negro	219.7	225.0	232.2	193.1	139.5	45.2
American Indian	12.9	13.8	12.6	11.2	12.5	3.2
Oriental	2.1	3.3	2.9	2.7	3.6	1.1
Other	5.2	12.3	7.3	5.4	2.5	2.0

[1] Includes 1,493,000 youth enrolled in summer projects since the beginning of the program in January 1965.

Source: Manpower Report of the President, April 1971. Galele F-10, p. 308.

In light of these enrollment and financial trends, this study seeks to evaluate the extent to which the in-school and summer NYC has succeeded in achieving the objectives originally legislated for it by Congress. This evaluation utilizes multiple regression techniques and

cost-effectiveness analysis to investigate the costs and benefits of the program. Costs and benefits are estimated in private terms, for society and for the Federal Government. The data for measurement of costs and benefits are gained from Government records, a field questionnaire and a school record data sheet.

II. Study Design

This cost-effectiveness analysis is based on a sample of 60 in-school and summer NYC projects randomly chosen from the nationwide population of 1,120 projects which operated in fiscal years 1965–66 and 1966–67 inclusively. These were selected equally among three geographic strata—20 each from the North, South and West.[1] The projects were chosen with probability of selection proportional to size of project. However, the unit of analysis is the NYC participant and not the NYC project; its focus is the experience of the young persons who were enrolled in the NYC 1 day or longer during this time. The intent of the sampling procedure was to randomly select 10 NYC participants and 10 comparison persons from each of the 60 projects. Thus, the total sample size would be 1,200 observations. In fact, due to nonresponse as well as incomplete field interviews, the analysis of schooling benefits is based on 780 observations (442 NYC's and 338 comparison persons) while the analysis of labor market benefits is based on 676 observations (338 NYC's and 288 comparison persons).

The comparison group was randomly selected from the same high school as the NYC group. The comparison group conformed to the age and family income restrictions established for entry into the program. The NYC group and the comparison group conform closely on a number of sociodemographic characteristics as shown in table 3. However, as in most retrospective evaluations which do not use a pure experimental-control group design, program effects are measured by contrast with a comparison group rather than a control group as this term is understood in a strict experimental model.

TABLE 3.—CHARACTERISTICS OF NYC AND CONTROL SAMPLES, UNWEIGHTED, HIGH SCHOOL SAMPLE, GRADUATES AND DROPOUTS

Variable	NYC n=436	Control n=344	Total n=780
Probability of graduation	86.47%	82.30%	84.62%
Total school grades completed	11.8	11.7	11.7
	(6.0)	(6.9)	(6.4)
Age in years	19.94	19.99	19.96
	(.98)	(1.23)	(1.09)
Income per capita per family	659	661	660
	(355)	(249)	(312)
Farm residence	6.65%	9.59%	7.95%
Father's education	8.63	9.01	8.80
	(3.44)	(5.06)	(4.24)
Number of times respondent dropped out of high school	.165	.212	.186
	(.372)	(.409)	(.389)
Sex:			
Male	43.35%	44.77%	43.97%
Female	56.65%	55.23%	56.03%
Ethnic origin:			
White	56.42%	59.01%	58.56%
Negro	24.77%	25.87%	25.26%
American Indian	8.03%	4.94%	6.67%
Mexican-American	9.40%	9.59%	9.49%
Puerto Rican	.688%	0%	.385%

Note: Values in parentheses are the standard deviations of the respective means.

[1] The definitions of North, South and West conform to those in the "County and City Data Book" (Washington, D.C.: U.S. Gov. Printing Office, 1967), p. viii.

In an effort to increase the comparability between the NYC and the comparison groups, a discriminant function was estimated and incorporated in the regression equations used to measure program benefits. The discriminant function is a probability function which estimates the likelihood that a person would be in the NYC based on sociodemographic, psychological, and motivational characteristics. While it does not completely control for bias due to the selection process, it is a partial adjustment for the bias in benefit estimations which results from selection into the program.[2]

III. Analysis Results

Costs.—Private, social and governmental costs to the program were measured. Both average and marginal costs were estimated.[3]

Cost data from Government records break total financial costs into a sponsor share and a Federal share. Due to problems of price imputation and the existence of excess capacity and joint cost problems at the sponsor site, Federal financial costs are considered to be a better measure of social economic costs (actual resources devoted to the program by society) than is the sum of the sponsor plus the Federal share. However, Federal costs overestimate social economic costs due to the element of subsidy paid to the participants. In addition, the Federal share is also a measure of Federal Government cost. Finally, from a private cost standpoint, the wages to the Neighborhood Youth Corps participant represent both a benefit and an opportunity cost of foregone leisure, study time, and home production. Table 4 presents the estimates of cost. The data in this table are largely self-explanatory. Marginal costs are generally higher than average costs, though the difference is sometimes very small and not statistically significant. Private average costs are about twice as high as social average costs, due to the fact that the typical NYC participant who was interviewed stayed in the program for a longer period of time than the average NYC participant in the population as a whole. Since private benefits are based on the same sample as that from which private costs are estimated, there is no necessary bias within this cost-benefit comparison. But if greater benefits are associated with a longer stay in the program, which appears to be the case, then there is likely to be an upward bias in the estimate of social benefits.

[2] The discriminant function was estimated in the following way:

(*a*) First, variables which directly determine eligibility into the NYC program were forced into the model estimating the function regardless of their level of statistical significance. These were age and income per capita per family. In addition, the following variables were also forced into the model: farm residence; the number of times a respondent has dropped out of high school; the proportion of subjects the respondent found interesting in high school; sex and ethnic origin.

(*b*) Second, 15 additional psychological, educational, and sociodemographic variables were allowed to enter the model explaining the discriminant function if they had a level of statistical significance of 0.25 or higher. On this basis, four of the 15 entered the model. These were:

(1) "When you were in high school, did you ever hear of the NYC program?" Yes—1; No—0.

(2) Average number of hours worked per week while the respondent was in high school, exclusive of any NYC work.

(3) Father's education, in years of school completed.

(4) "Is there any particular line of work that you would really like to get into?" Yes—1; No—0.

[3] Average costs represent total costs divided by total enrollment. Marginal costs represent the increase or addition to total costs due to adding one more enrollee to the program. Average costs and benefits are needed to see if the program is profitable in absolute terms, that is, whether the program is operating in the black. Marginal costs and benefits are needed to determine the relative profitability of the program vis-a-vis other programs. For example, given two programs, A and B, each of which adds an additional enrollee at an additional cost of $1 each, A is preferred to B, in economic terms, if its increase in benefit due to the additional enrollee is greater than that of program B.

TABLE 4.—COST ANALYSIS OF THE IN-SCHOOL AND SUMMER NEIGHBORHOOD YOUTH CORPS

Cost concept[1]	Average cost	Marginal[2] cost
Social:[3]		
In-school and summer enrollment combined	$402	$475
In-school enrollment only	492	495
Summer enrollment only	184	189
Federal Government:		
In-school and summer enrollment combined	313	409
In-school enrollment only	368	422
Summer enrollment only	102	184
Private:[4]		
In-school and summer enrollment combined	834	----------
In-school enrollment only	741	----------
Summer enrollment only	701	----------

[1] These are marginal and average costs per participant for those participants who stayed in the program 1 day or longer.

[2] Marginal costs are estimated from a cubic total cost function which has the following general form:

$$Y_{1_i}X_{1_i}^{1/2}=a_1X_{1_i}^{1/2}+a_2X_{2_i}X_{1_i}^{1/2}+a_3X_{3_i}X_{1_i}^{1/2}+a_4X_{3_i}^{2}+a_5X_{3_i}^{3}X_4+a_6X_{4_i}X_{1_i}^{1/2}+a_7X_{4_i}^{2}X_{1_i}^{1/2}+U_{1_i}$$

where

Y_{1_i}=total costs for the time period of the project, in hundreds of dollars by project;

X_{1_i}=weight factor, the normalized value of the inverse of the probability of project selection, by project;

X_{2_i}=length of project, in months;

X_{3_i}=total in-school and/or summer enrollment, by project;

X_{4_i}=total out-of-school enrollment, by project; and

U_{1_i}=a random disturbance.

[3] Social costs are here defined as sponsor share plus Federal share. As indicated in the text, however, Federal share alone is undoubtedly a more accurate measure of the commitment of social resources to the program. The direct transportation and meal costs incurred as a result of program participation are omitted in the social and Federal Government estimates.

[4] These costs include foregone earnings and the direct costs of holding the Neighborhood Youth Corps job. The foregone earnings are expressed in terms of after-tax earnings. Direct costs of holding the NYC job are estimated from Leonard H. Goodman and Thelma D. Myint, *The Economic Needs of Neighborhood Youth Corps* Enrollees (Washington, D.C.; Bureau of Social Science Research, August 1969). Private marginal costs were assumed to equal average costs in the study. Private costs are higher than social costs because those NYC participants who were interviewed stayed in the program a longer average period of time than the population of participants as a whole.

Labor market benefits.—This brings us to a consideration of labor market benefits. As with costs, private, social, and governmental labor market benefits are estimated by means of multivariate regression analysis. Marginal and average benefits are estimated. In addition to accounting for participation in the Neighborhood Youth Corps program, the benefit equations adjust for the intervening influence of age, year and quarter when a respondent ultimately left high school, employment experience during high school, marital status, father's education, labor market area, sex, ethnic origin, and the discriminant function.

The indexes of benefit are average monthly earnings, months of unemployment, and months of voluntary labor force withdrawal. Before-tax earnings are an explicit measure of social monetary benefits. After-tax earnings are private monetary benefits. Months unemployed are a measure of the employment effect of the program. The labor force participation variable, in this case, the months of voluntary labor force withdrawal, is a measure of the degree to which NYC participation encourages entry into the labor force. Finally, the increase in Federal income taxes and social security taxes is considered a benefit to the Federal Government. Table 5 presents the estimated labor market benefits.

TABLE 5.—ANALYSIS OF LABOR MARKET BENEFITS OF NYC PARTICIPANTS COMPARED WITH NONPARTICIPANTS IN THE PERIOD SINCE FINAL DEPARTURE FROM HIGH SCHOOL

Sample groups	Average months available to be in civilian labor force	Total before tax earnings	Total after tax earnings	Total Federal income and social security taxes	Months unemployed	Months voluntarily out of labor force
Total (n=676)	18.56	[1] [2] $831	[2] $702	$109	0.42	−2.30
	(21.04)	(346)	(283)	(71)	(.61)	(.98)
Male (n=311)	14.51	[3] 1,171	876	−129	[3] .79	−1.02
	(15.02)	(633)	(509)	(104)	(.44)	(1.21)
Female (n=365)	22.01	466	423	53	[4] 3.11	[4] −5.12
	(24.55)	(368)	(313)	(91)	(1.04)	(1.37)
White (n=398)	20.36	[2] 1,013	[2] 794	124	−.10	[2] −3.06
	(19.93)	(477)	(387)	(100)	(.58)	(1.20)
Negro (n=166)	13.22	[4] 1,579	[4] 1,186	[4] 286	[4] −3.09	−2.23
	(13.73)	(542)	(447)	(102)	(.72)	(1.50)
White male (n=202)	16.28	1,078	445	231	−.44	−1.12
	(14.79)	(805)	(190)	(152)	(.50)	(1.44)
Negro male (n=57)	11.39	[3] 1,182	[3] 1,094	[5] 271	[4] −6.89	−.18
	(12.84)	(686)	(630)	(165)	(1.47)	(2.58)
White female (n=196)	24.56	382	422	59	1.29	[2] −4.56
	(23.41)	(517)	(438)	(141)	(1.08)	(1.78)
Negro female (n=109)	14.17	[3] 1,217	760	[2] 255	[2] −2.00	−3.11
	(14.13)	(681)	(557)	(127)	(.81)	(1.93)

[1] These statistics are the partial regression coefficient and the standard error (in parentheses) of the partial regression coefficient. They are interpreted as follows: For the total sample, the NYC participants earned $831 more in the 18.56 months since they left the NYC than did their counterparts in the comparison group. The difference is significant at the 0.05 level. That is, the chances are only 1 in 20 that the actual difference between the 2 groups is zero. The NYC group paid $109 more in Federal income and social security taxes in the 18.56 months after they left the NYC than did their comparison group counterparts, but the difference is actually not statistically significant from zero due to the large relative size (109/71) of the standard error.

[2] Significant at the 0.05 level.

[3] Significant at the 0.10 level.

[4] Significant at the 0.01 level.

[5] Significant at the 0.109 level.

Note: All significance tests are 2-tailed tests.

The average NYC participant earned a total of $831 more than his comparison group counterpart in the year and a half average period since the NYC participant left the program. This amounts to about $46 more per month over this 18.56-month period.

Total private aftertax earnings amount to $702 for the total sample in this 18.56-month period. There is no net increase in Federal Government tax benefits due to the NYC program. There is no net difference in the number of months unemployed between the NYC and the comparison group; however, the NYC group has 2.3 months less voluntary labor force withdrawal. Thus, while the NYC program has not reduced the unemployment rate among its participants it has increased the labor force participation rate which, in turn, has resulted in a statistically significant increase in total earnings.[4] Table 5 shows that males benefit more than females in terms of earnings and Negroes benefit more than whites. Since the male-female proportion in the study is approximately the reverse of that in the population enrollment, this means that the measured benefits have a downward bias in the study. Next Negro females benefit more than Negro males. Negroes, as contrasted with whites, contribute significantly to Federal Government benefits, and, in fact, within the Negro group it is only

[4] Since there was no statistically significant difference in average hourly wage rate between the two samples, the increase in earnings is due mainly to an increase in the labor force participation rate. There is then the possibility that NYC participants have simply displaced other youths in the labor market. The result then may be that the observed increase in earnings is due to income redistribution alone and does not represent an increase in national income. However, an inspection of the unemployment rates and numbers of employed persons aged 16 to 19 from the third quarter, 1965 to the third quarter, 1969 shows, in general, that unemployment rates are dropping steadily while the number of persons in the labor force steadily increased. Thus, no necessary displacement effect need be assumed. See *Employment and Earnings*, vol. 16, No. 10, April 1970, pp. 128–129 and vol. 13, No. 7, January 1967, p. 115.

Negro females who make a statistically significant contribution. Insufficient data exist for an analysis of the American Indian and Mexican American groups.

Table 6 shows the labor market benefits of the NYC by program component. As can be seen, the participant who enrolled only as an in-school participant gained the largest social and Federal Government benefits. Those who enrolled in both an in-school and summer program component gained the largest private benefits. The summer program yielded no direct monetary benefits. However, continued support of the summer component may well be justified on other economic, social and or political grounds.

TABLE 6.—ANALYSIS OF LABOR MARKET BENEFITS OF NYC PARTICIPANTS BY PROGRAM COMPONENT IN THE PERIOD SINCE DEPARTURE FROM HIGH SCHOOL

Program component[1]	Total before tax earnings	Total after tax earnings	Total Federa income and social security taxes
In-school only (n=437)	[2][3] $968	[4] $609	$164
	(422)	(348)	(96)
Summer only (n=308)	547	448	71
	(492)	(403)	(85)
In-school and summer combined (n=354)	[4] 784	[4] 650	64
	(475)	(391)	(86)

[1] In-school only equal those participants who enrolled only as in-school NYC participant; summer only equal those participants who enrolled only as a summer only NYC participant; in-school and summer combined equal those participants who enrolled both as an in-school and a summer participant.
[2] These statistics are the partial regression coefficient and its standard error in parentheses. See table 5.
[3] Significant at the 0.05 level.
[4] Significant at the 0.10 level.

Note: See table 37 in the final report for a more elaborate analysis of the effects of program components.

Educational benefits.—Although the post-high school labor market benefits to the program are large for the average NYC participant, the major legislated purpose of the NYC program is to increase school attendance and cut the dropout rate. There are four measures of educational benefit: (1) the probability of high school graduation, (2) number of years of high school completed, (3) probability of college attendance, and (4) probability of postsecondary education other than college. Multiple regression models are used to measure the net impact of the NYC program on these indexes of benefit. In addition to NYC participation, the regression models control for the effect of age, income per capita per family, urban-rural place of residence during school, number of times the respondent dropped out of high school, father's education, ethnic origin, sex and the discriminant function.

As table 7 shows, the NYC program taken as a whole has no effect on the probability of high school graduation and years of high school completed. When subgroups are studied separately, only Negroes, Negro females and American Indians experience a positive effect on their probability of graduation from high school. These results apply to regression models which express NYC participation in dummy variable form; that is, a dichotomous classification for participation or nonparticipation in NYC. If a study respondent is an NYC participant, we designate the value of 1. A value of zero is assigned to the nonenrollees or comparison group respondents.

TABLE 7.—ANALYSIS OF EDUCATION BENEFITS OF NEW YORK CITY PARTICIPANTS BY SAMPLE GROUPS

Sample group[1] (separate regression models)	Probability of high school graduation	Years of high school completed	Probability of attending college[2]	Probability of attending post-secondary education
Total (n=780)	[3] −0.0046	−0.04	[4] 0.1255	[5] 0.0650
	(.0152)	(.05)	(.0418)	(.0351)
Male (n=343)	[6] −.0586	−.08	[5] .1134	[4] .1529
	(.0245)	(.05)	(.0644	(.0562)
Female (n=437)	−.0120	−.07	.0830	−.0143
	(.0177)	(.07)	(.5471)	(.0445)
White male (n=217)	−.0064	−.01	.0404	[6] .1501
	(.0238)	(.07)	(.0736)	(.0669)
Negro male (n=63)	−.0045	.08	.0348	.1138
	(.0162)	(.15)	(.1458)	(.0996)
White female (n=232)	−.0132	[6] .18	.1057	−.0075
	(.0425)	(.09)	(.0694)	(.0569)
Negro female (n=134)	[4] .1251	.07	.1230	−.0611
	(.0414)	(.09)	(.1058)	(.0911)
White (n=449)	−.0120	.10	[6] .1036	.0699
	(.0167)	(.06)	(.0504)	(.0431)
Negro (n=197)	[4] .0820	.02	.0822	−.0302
	(.0293)	(.08)	(.0844)	(.685)
American Indian (n=52)	[6] .1464	[4] −.76	−.6169	−.2043
	(.0713)	(.23)	(.8689)	(.8576)
Mexican-American (n=52)	[4] −.2121	−.11	[4] .4937	.1469
	(.0626)	(.17)	(.1732)	(.1330)

[1] The sample sizes in this column apply to the first two columns of estimates only. The numbers are slightly smaller for the last 2 columns.

[2] These regressions apply to high school graduates only.

[3] The statistics are the partial regression coefficient and its standard error. The regression coefficient is interpreted as a probability for the 3 dependent variables labeled "probability * * *" The coefficient for years of high school completed is interpreted as a decimal fraction of a year. Multiplication of the probability by 100 converts it to a percent. Thus, for the total sample, the probability of high school graduation for the average New York City participant is .0046 less than that of his comparison group counterpart. However, the difference is not statistically significant from 0. The New York City participant attends, on the average, .04 of one school year less than his comparison group counterpart. This is about 8 days less (200×.04). However, this difference is not statistically different from 0. Finally, the NYC participant is 12.55 percent more likely to attend some type of college, given that he graduates from high school, compared to his comparison group counterpart.

[4] Significant at the 0.01 level.

[5] Significant at the 0.10 level.

[6] Significant at the 0.05 level.

When NYC participation is expressed as a continuous variable in terms of number of months in the program, the NYC program is seen to have a small positive effect. Namely, 1 additional month stay in the NYC tends to add 1 extra day in school attendance.

However, the NYC program has a positive and relatively large effect on the probability of college attendance or other postsecondary education for those NYC participants who graduate from high school. The evidence suggests that the higher earnings due to participation in the NYC may have been partly responsible for enrollment in further education.

In summary, it appears that the premise upon which the NYC program is based may be an incorrect one. There is a gross positive relationship between income per capita per family and graduation from high school. However, when income per capita per family is considered in conjunction with other sociodemographic variables, in the case of the total sample and almost every subgroup the effect of the income variable on high school graduation is zero or negative. Thus, for those persons still in high school, the family income variable may not be the most important variable affecting dropout behavior. It may be that approaches in addition to raising family income, such as counseling and educational guidance, are needed to change the propensity of students to drop out.

However, once a person has graduated from high school, earnings per NYC participant do appear to be an influence on one's likelihood of acquiring some type of college or other postsecondary education.

Investment analysis.—The cost and labor market benefit data on earnings can be combined to evaluate the NYC program as a social and private investment. Based on the Federal concept of social cost and a benefit period equal to the average length of time the NYC participant had available to participate in the civilian labor force, the social average rate of return is 69.6 percent and the social marginal rate of return is 22.8 percent.[5] Total social average benefits at a 10-percent discount rate amount to about $171,700,000 for the operation of the NYC program during fiscal years 1965–66 and 1966–67. Total social marginal benefits amount to about $35,700,000.[6] These estimates are sufficiently large so that even if the analysis contained considerable upward bias in benefits or downward bias in costs it is unlikely that the net benefits would be reduced to unacceptably low levels from a social standpoint.[7] It appears, therefore, that in monetary-economic terms, the in-school and summer NYC taken as a composite has been an efficient social investment. As noted above, however, the summer program, taken alone, yields no net monetary benefit.

Evaluation by the participants.[8]—Regardless of the objective facts of their Neighborhood Youth Corps work and their post-high school employment, the participants in the Neighborhood Youth Corps programs evaluated their experience in the most enthusiastic terms. They were highly satisfied with the kind of work assigned to them in the Neighborhood Youth Corps program; they were satisfied with their hourly wage rates; and they praised their supervisors.

Overwhelming majorities of the participants felt that their Neighborhood Youth Corps participation would result in a better job in the future, and they were convinced that the program had improved their attitude toward education, toward work, and toward themselves.

Although there were interesting differences in some of these responses by region, type of program, sex, and ethnic origin, the similarities in the patterns of response were notable; and they added up to a very enthusiastic endorsement of the Neighborhood Youth Corps program by those who had participated in it. This result is also a type of program benefit for it suggests that the program was well received by the target population. This may imply that the target population has experienced an improvement in morale and a greater identification with society as a whole and may, as a result, contribute to their own and society's well-being in other positive noneconomic ways.

IV. Implications of the Findings

Methodological considerations.—Two basic methodological problems are found in this study. The first deals with possible bias caused by

[5] The rate of return can be intepreted as an interest or profit rate. It is the interest rate which makes the present capital value of costs equal to the present capital value of benefits.

[6] Source: Tables 4, 5 and Gerald G. Somers and Ernst W. Stromsdorfer, *A Cost-Effectiveness Analysis of the In-School Summer Neighborhood Youth Corps* (University of Wisconsin, Center for Studies in Vocational and Technical Education, July 1970). Costs are based on Federal share only and include the costs of participating in the NYC program such as extra transportation and meals. On a monthly basis these amounts to approximately $17. These costs are based on Goodman and Myint, *op. cit.*

[7] In fact, as shown in Tables 2 and 3 above, the ratio of males to females in the nationwide program is the reverse of that in the study sample, where there is a higher proportion of females. Since table 5 shows that females do considerably less well than males, the net earnings benefits estimated in the study are probably strongly biased downward.

[8] Discussed in detail in ch. VIII, Gerald G. Somers and Ernst W. Stromsdorfer, *op. cit.*

selection into the program. The second deals with nonresponse bias.

The discriminant function, a measure of the probability of selection into the Neighborhood Youth Corps program, given certain socio-demographic and psychological characteristics, is used to adjust for self-selection. Ideally, this variable should not be statistically significant in the benefit equations. This would imply that an increase or decrease in the probability of selection as a Neighborhood Youth Corps participant has no effect on labor market performance or educational experience. However, it turns out that the partial regression coefficient is zero in 11 of 27 labor market benefit equations, positive for seven models, and negative for nine. Thus, in 16 cases the probability of selection in Neighborhood Youth Corps did have an effect on the outcome. So while self-selection bias has been reduced for some models, its effect has not been eliminated in this study. Our judgment is that this bias is mixed in effect but may yield slightly higher benefits to the Neighborhood Youth Corps. However, the negative sign in nine of the 27 equations indicates some downward bias as well.

Nonresponse may contribute to an upward bias in the benefit estimations. The Neighborhood Youth Corps participants who were located in the survey stayed in the program a longer period of time on the average than the population of Neighborhood Youth Corps participants as a whole. Since there is a positive relation between benefits and length of stay in the Neighborhood Youth Corps program, an upward bias seems apparent.

However, one must remember that monetary economic benefits were quite large. A considerable reduction could occur before these benefits would become unacceptably low. If an accurate measure of bias from these sources were available, benefits would probably remain positive even after an adjustment for bias were made.

In summary, net monetary economic benefits of Neighborhood Youth Corps are considered to be positive and large; but, contrary to participants' assertions, there is no evidence in the regression analysis of a net benefit in high school retention and graduation rates. From a morale and psychological standpoint, the program appears to have been a success.

Policy conclusions.—The composite of in-school and summer NYC programs included in this survey yields significant monetary benefits, due mainly to an effect on increasing labor force participation. On this basis, the in-school component of the program in particular warrants continued and prehaps increased funding as an effective social program. The summer NYC program, taken alone, does not warrant funding on grounds of economic efficiency based on the original program objectives. However, noneconomic considerations may be especially important in this regard.

Zero or negative program effects on the high school graduation rate, together with a zero or negative relation between high school graduation and income per capita per family, suggest that a principal operational premise of the NYC program may not be correct. Variables other than family income may be more important in reducing the dropout rate in the short run. The legislation deserves reexamination on this basis, therefore.

Negroes, particularly Negro females, generally benefit more than whites. However, continuance of the program for whites may be justified on grounds of equity or income distribution, rather than on

grounds of economic efficiency. As long as the program as a whole pays off, its services should not necessarily be denied to any one disadvantaged subgroup unless it has been clearly demonstrated that a more effective program is available to supplant it.

Although small sample size makes generalization hazardous, it appears that American Indians benefit only minimally from the NYC program. Our visits to projects in the field, however, as well as the comments of project directors, support this conclusion. It follows that the program should be reworked to increase its effectiveness in meeting the needs of American Indians.

THE BENEFITS AND COSTS OF BASIC EDUCATION FOR ADULTS: A CASE STUDY

By MYRON ROOMKIN*

This study is a case study evaluation of the economic efficiency of basic education, i.e., remedial elementary education, for disadvantaged adults, using the analytical tools of cost-benefit analysis. The subject of the study is the adult basic education program, financed under the Manpower Development and Training Act (MDTA-ABE), as operated in Milwaukee, Wis. Due to the limited scope of a case study, the results of this investigation have direct application at the city and State level. Nevertheless, this study offers some evidence on which Federal policymakers can base future decisions. In addition, it presents the methodological procedures of cost-benefit analysis, which can be extended to evaluate other basic education programs under other legislative authorizations.

BACKGROUND

Federal efforts to fight poverty during the previous decade to a large extent emphasized remedial education programs for the educationally disadvantaged adult. Between 1960 and 1968, Congress authorized 28 different remedial education programs for adults—often called basic education programs—under the auspices of 10 Federal departments.[1] As a measure of the magnitude of Federal efforts in this area, the largest of these programs, the adult basic education program of the Adult Education Act, has received about $260 million in Federal funds since fiscal year 1965; and nearly 455,730 persons participated in this program during fiscal year 1968.[2] Other programs with distinguishable basic education components have been authorized under the Elementary and Secondary Education Act, the Vocational Education Act, the Manpower Development and Training Act, the Social Security Act, and the Migration and Refugee Act. Unfortunately, current funding and enrollment statistics for each of these programs are, for many reasons, difficult to acquire, but available estimates for fiscal year 1967 show that over 1.1 million educationally deficient adults participated in one or more federally sponsored adult basic education programs. The general impression is clear: when viewed together, these 28 programs represent a major Federal commitment to basic education as an antipoverty policy.

Given the Federal Government's involvement in basic education programs—in initiating, financing, and monitoring programs—it is

*The author is Assistant Professor of Industrial Relations, Graduate School of Business, The University of Chicago. Financial support for this research was granted by the Manpower Administration, U.S. Department of Labor, The Ford Foundation dissertation fellowship program, and the University of Wisconsin. The author, however, accepts full responsibility for the content of this article.

[1] For a complete listing of Federal basic education programs, see Greenleigh Associates, Inc., *Inventory of Federally Funded Adult Basic Education Programs: Report to the President's National Advisory Committee* (New York: Greenleigh Associates, Inc., 1968).

[2] Office of Education, U.S. Department of Health, Education, and Welfare, *Adult Basic Education Program Statistics: Students and Staff Data July 1, 1968–June 30, 1969* (Washington, D.C.: U.S. Government Printing Office, 1970).

appropriate for the Government to determine the economic efficiency of these programs. It is an economic fact of life that Federal funds for antipoverty programs are limited, while at the same time, programs such as institutional occupational training, on-the-job instruction and even income maintenance schemes are offered as alternatives to basic educational instruction. An efficient allocation of resources requires that the Federal Government invest resources in those programs which accomplish desired consequences for the poor and which achieve these benefits for the least costs.

Understandably some have argued that the true goal of basic education programs is to improve the educational achievement level of the educationally deficient. As such, these proponents continue, one cannot assess the social or psychological importance of literacy in dollars and cents. Of course, there are many noneconomic benefits resulting from basic education. (Their nature and magnitude, I suggest, are also subjects for empirical investigation.[3]) But, improved educational attainment can theoretically result in economic benefits such as increased individual earnings and improved productivity. Rational decisionmaking requires that these economic benefits be measured, if basic education programs are to be justified on economic grounds.

To date, a great deal of research has been conducted on the benefits and costs of manpower programs, but most of this research has concentrated on vocational training and related programs. Only a paucity of research on the economic consequences of basic education has been conducted.

Existing Evidence

In general, basic education research has concentrated on documenting the ability of basic education programs to improve the educational achievement level of trainees but has stopped short of exploring the economic consequences stemming from these improvements.[4] The overall opinion has been that if the gain in educational achievement was large enough, the labor market would adjust accordingly. Where economic consequences have been examined, the evidence to support this position is inconclusive.[5]

Simple follow-up procedures of program participants show varying results. In a study of fathers of AFDC families in Detroit, conducted 6 months after training, only 6, of 35 participants had found employment.[6] Somewhat different results were obtained in a study conducted in California. One year after training 54 percent of the trainees were employed; but during the year, as many as 85 percent of the sample had found employment.[7]

[3] An evaluation of select noneconomic consequences of basic education is presented in M. Roomkin, "An Evaluation of Adult Basic Education Under the Manpower Development and Training Act in Milwaukee, Wisconsin" (unpublished Ph. D. dissertation, The University of Wisconsin, 1971).

[4] See, for example, Darrell Anderson and John A. Niemi, *Adult Education and the Disadvantaged Adult* (Syracuse: ERIC Clearinghouse on Adult Education, 1969), and Edmund des Brunner, David S. Wilder, Corinne Dirchner and John S. Newbery, *An Overview of Adult Education Research* (Chicago: Adult Education Association, 1959), p. 272.

[5] It is worthwhile noting that it is often difficult to evaluate basic education programs, because they are usually strongly associated with other complementary treatments. Very often, basic education is offered in combination with skill training, job searching, counseling and/or attitudinal education. When combined with other treatments the net contribution of basic education to trainee performance is difficult to assess. To date no research has adequately isolated a basic education component to such programs, but William Brazziel, "Effects of General Education in Manpower Programs," *Journal of Human Resources*, Vol. 1, No. 1, 1966, pp. 39–44, has demonstrated the importance of compensatory education in skills training programs.

[6] Thomas Patten, Jr., and Gerald E. Clark, Jr., "Literacy Training and Job Placement of Hard-core Unemployed in Detroit," *Journal of Human Resources, Vol. 3, No. 1, 1968*, pp. 25–46.

[7] Frank C. Pearce, "Adult Basic Education: Evaluation Through Research," June, 1966 (mimeographed).

Using a more rigorous follow-up design with a control group, Greenleigh Associates [8] found 85 percent of program completers employed after graduating from select programs in New Jersey, New York, and California. Unfortunately the matched control group—individuals who qualified for enrollment in basic education but who did not attend—had higher employment rates. Finally, employing a paired-comparison technique for generating a control group from welfare rolls in Milwaukee, Cain and Somers [9] found that trainees requiring instruction at grades zero through four increased their individual earnings $7.00 per week after completing a compensatory educational program. At a higher level of academic attainment, i.e., five to eight grades for formal schooling, instruction augmented weekly earnings $24.

In none of the studies described above have the researchers attempted to compute the efficiency of basic education—that is to compare program benefits to the costs of the program. As a consequence of this omission, even those studies identifying increased individual earnings resulting from basic education have not justified the continuance of their program as an efficient allocation of public revenue or individual time.

A Case Study Evaluation

To examine the economic outcomes of basic education for the disadvantaged and to compare them to program costs, this paper adopts a narrow and intensive focus on basic education under the Manpower Development and Training Act (MDTA-ABE) [10]—one of the larger Federal efforts to use basic education as a separate remedial treatment.[11] As indicated earlier, the study focuses on the MDTA-ABE program as it exists in Milwaukee, Wis.

MDTA–ABE in Milwaukee

Wisconsin has operated basic education courses under MDTA since 1966—the first year such programs were authorized.[12] In Milwaukee, these programs have instructed over 1,000 persons who were functioning at less than the eighth grade level of educational achievement.

As in the case of most institutional MDTA programs, applicants for admission are screened by the local office of the State Employment Service. All training and instruction is provided by contractors. Upon completion of the instruction, trainees are referred back to the employment service for job counseling and placement.

While enrolled in the basic education courses, trainees are entitled to a maximum of 26 weeks of instruction and stipend, but many pupils do reenroll in these courses, according to individual need and motivation. Mean enrollment duration was 3 months or 307 hours of instruction.

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[8] Greenleigh Associates, Inc., *Participants in the Field Test of Four Adult Basic Education Systems: A Follow-up Study* (New York: Greenleigh Associates, Inc., 1968), pp. 80-91.

[9] Glen C. Cain and Gerald G. Somers, "Retraining in the Disadvantaged," edited by Cathleen Quirk and Carol Sheehan, *Research in Vocational and Technical Education* (Madison: Center for Studies in Vocational and Technical Education, 1967), pp. 27-44.

[10] 42 U.S.C. 2571 *et seq.* P.L. 87-415, March 15, 1962, as amended.

[11] Separate figures on MDTA-ABE enrollments are not available, but during FY 1970, 14.6 percent or 18,980 participants in MDTA institutional programs had completed less than 8 years of school. This figure is undoubtedly supplemented by an unknown number of participants who were functioning at less than the eighth grade level in spite of their higher level of formal educational attainment.

[12] MDTA institutional programs were expanded in 1964 to incorporate basic educational instruction as supplementary to specific, occupationally oriented courses. Subsequently, MDTA was further amended to permit independent basic education programs without reference to any specific vocational training course.

Classes are organized in a conventional teacher-classroom format, but as one would expect, special efforts are made to ensure at least a modicum of individualized attention and instruction. Standardized educational achievement tests are administered to trainees after the fifth day of instruction and upon their termination from the program. Although primarily used as a teaching aid, these tests do show that basic education pupils from October 1968 to March 1969 (the last instructional period for which data are currently available) improved their average mathematical and reading performance, but not markedly so. Mean mathematical proficiency rose from 5.5 to 6.5 grades, while reading scores moved from 5.0 to 6.1 grades.

Table 1 presents a description of the trainees enrolled in Milwaukee MDTA–ABE courses during the October 1968–March 1969 instructional period. It is notable in table 1 that almost 75 percent of the trainees are classified as disadvantaged according to the Department of Labor definition. Looking beneath this classification, the correlates of poverty are quite evident: Nonwhite comprised the bulk of the group; 47 percent of the trainees were below 25 years of age; approximately 22 percent were on public welfare; and an additional 22 percent were receiving unemployment compensation before enrolling in the program. While one-half of the trainees were female, over four-fifths of the group were primary wage earners, which suggests that many of the women were heads of families. Based upon these data, it appears that the Milwaukee MDTA–ABE programs were servicing the hard-core disadvantaged.

TABLE 1.—*The percentage distribution of select socio-demographic characteristics for Milwaukee MDTA–ABE trainees during the October 1968–March 1969 instructional period*

Select socio-demographic characteristics	*Percent of all trainees (N=256)*
Race:	
White	12.1
Negro	64.8
Spanish surname	23.1
Total	100.0
Sex:	
Male	48.0
Female	52.0
Total	100.0
Age:	
Under 20	20.6
21–24	26.6
25–34	28.8
35–44	16.0
45–54	5.8
Over 55	2.2
Total	100.0
Labor force status just prior to training:	
Employed	25.1
Unemployed	75.9
Total	100.0

TABLE 1.—*The percentage distribution of select socio-demographic characteristics for Milwaukee MDTA–ABE trainees during the October 1968–March 1969 instructional period*—Continued

Select socio-demographic characteristics	*Percent of all trainees (N=256)*
Marital status:	
Married	51.4
Unmarried	49.6
Total	100.0
Prime wage earner status:	
Prime wage earner	82.8
Secondary wage earner	17.2
Total	100.0
Socioeconomic level [1] [2]:	
Poverty level	63.9
Disadvantaged	74.2
Physically handicapped	10.7
Welfare recipients just prior to training	22.1
Unemployment compensation recipients just prior to training	21.4

[1] Based upon U.S. Department of Labor suggested definitions.
[2] Categories are not mutually exclusive.

Research Design

A sample of 173 trainees—hereafter called the treatment group—was randomly selected from the 256 who were enrolled in the Milwaukee MDTA–ABE during the October 1968 to March 1969 instructional period. The sample was drawn from a stratified population to insure the proportional representation of race, sex, and age characteristics.

To assess the level of earnings and employment performance in the absence of a basic education program, a control group was selected from the files of the Wisconsin State Employment Service, Milwaukee Office. In all, 150 control group members were selected so as to match treatment group members according to age, sex, race, educational attainment, and labor market status as of the time of enrollment.

Follow-up interviews were sought with each member of the control and treatment groups in the late spring, 1970. After extensive search efforts, 87 of the 173 treatment group members and 82 of the 150 control group members were located and interviewed. A comparison of the interviewed control and treatment group individuals with those who were not interviewed, using a limited amount of available data (e.g., race, sex, and age), showed that response selectivity was not a major problem with the acquired interviews.[13]

[13] Of equal concern to the validity of the study was the problem of control-treatment group comparability. Even though matching and sampling procedures were carefully designed to produce comparable distributions of key variables among both groups, added methods were utilized to account for the joint distribution or covariance of variables. For each dependent variable specified below, a test for the equality of regression coefficients across treatment and control samples revealed the successfully interviewed members of both groups to be from the same overall population, at the .05 level of statistical significance. Using the dependent variables, average hourly earnings and individual employment rates, the hypothesized model described below is tested for three samples (1) the treatment group; (2) the control group; (3) a combined sample of treatment and control observations. The resulting sets of regression coefficients are then compared for statistical equality. For detailed results of this statistical test see, Roomkin, *op. cit.*, pp. 37–42. A general description of the test can be found in J. Johnston, *Econometric Methods*, (New York: McGraw-Hill Book Co., 1963), p. 136.

This is not to say that the individuals in each group were identical—and, in fact, they were not. It was found that treatment group members—even after receiving compensatory instruction—read and utilized their literacy skills less frequently than those never receiving remedial instruction.[14] At the very least, this suggests a motivational difference between the groups. However, since trainees and nontrainees could not be selected for study on the basis of their reading habits, the control group in this study represents the only available and usable comparison to the treatment group.

Economic Benefits

The economic outcomes of basic education programs are intended to operate through labor market mechanisms. Theoretically, improved educational proficiency results in greater levels of individual productivity, reflected by higher earnings. Increases in hours worked, independent of wages earned, i.e., an employment effect, constitutes the second major economic benefit of basic education. By combining the wage improvement with the increase in hours worked, an estimate of the net before-tax earnings contribution of basic education can be calculated as well.

Earning Effects

To isolate the contribution of basic education to participant earnings, treatment group members are compared to control group members, using the statistical procedures of multiple linear regression analysis. The posttraining period average hourly earnings of all subjects in the study is suggested to be a linear function of the following variables: (1) whether the individual participated in basic education; (2) whether the individual had completed a vocational training program other than basic education after October 1968 (the date basic educational instruction began); (3) the number of weeks the individual was eligible for work after October 1968, as a measure of trend; (4) his average hourly earning in the 2-year period before October 1968; (5) the number of years of formal schooling completed; (6) his age; (7) a measure of his motivation level to achieve economically; (8) his marital status; (9) his race; and (10) whether he is the prime wage earner in his family. It is hypothesized that participation in basic education results in a positive and significant increase in average hourly earnings, holding the other factors constant.

To achieve a refined estimate of the basic education earnings effect, the anticipated positive relationship between earnings and vocational training should be held constant. By and large research on the effectiveness of vocational training has dealt with nondisadvantaged workers, but recently evidence has appeared documenting the positive impact of vocational training upon disadvantaged trainees as well.[15]

[14] The extent of book, magazine and newspaper reading habits in the post-training period was significantly greater (at the .05 level) for control group members than for treatment group members.

[15] Thomas I. Ribich, *Education and Poverty* (Washington, D.C.: Brookings Institution, 1968), pp. 34–60, and W. L. Hansen, B. A. Weisbrod, and W. J. Scanlon, "Schooling and Earnings of Low Achievers," *American Economic Review*, Vol. LX, No. 3, June, 1970, pp. 409–418.

Unexpectedly, many of the persons in the sample had participated in vocational instruction programs. About 55 percent of the female and 45 percent of the male graduates of basic education in Milwaukee continued their instruction in postbasic education, vocational courses. Among the control group, 30 percent of the female members and 20 percent of the males participated in such programs during a comparable period—from October 1968 to the time of their interview. In spite of this substantial incidence of vocational instruction, however, a comparison between the effectiveness of basic education with that of vocational education should be guarded. The identified vocational programs were found to display a wide variety of occupational aims, sponsorship and duration. In addition, the sample was not selected to represent recent vocational program graduates.

The variable, number of weeks eligible for work, is included to quantify the effect of trend upon earnings. Treatment group members are judged to be eligible for employment as of the date training—either basic education or an additional, postbasic education training program—terminated. Labor market exposure time on the average is 36 weeks for male and 31 weeks for female treatment group members. In the absence of the program, control group observations reflect twice as much time exposed to the labor market. Mean labor force exposure time for males is 75 weeks, while females average slightly less exposure at 73 weeks.

As suggested previously, significant motivational differences between control and treatment samples are likely. Therefore a measure of individual motivation originally developed by Rosen is included in the explanatory model.[16] A summary score ranging from 6 to 30 is calculated from interviewer-administered questionnaires for each observation which records the extent of economic motivation.

The remaining variables in the equation—educational attainment, age, racial identity, and previous earnings—are self-explanatory. They are entered as control variables, and a discussion of their performance will not be extensive.

Table 2 reports the results of regressing posttraining average hourly earnings on the 11 specified regressors for 69 male and 100 female observations separately. The model is found to explain 33 percent of the variation in average posttraining hourly earnings for male participants in the study, and approximately 20 percent of the variability for females. These results are statistically significant at the .10 and .05 levels for the male and female equations respectively.

[16] Bernard C. Rosen, "Race, Ethnicity, and the Achievement Syndrome," *American Sociological Review*, February 1959. Achievement values should not be confused with the notion of achievement motivation which is a personality trait. See David C. McClelland, John W. Atkinson, Russel S. Clark, and Edgar L. Lowell, *The Achievement Motive* (New York: Appleton-Century-Crofts, Inc., 1963). Achievement values scores have been used in previous labor market research. See, for example, Harold L. Sheppard and A. Harvey Belitsky, *The Job Hunt* (Baltimore: The Johns Hopkins Press, 1966), p. 123; James Morgan and Martin David, "Education and Income," *Quarterly Journal of Economics*, vol. 77, No. 4, 1963, pp. 423-437; and Myron Roomkin, "High School Dropouts and Vocational Education in Wisconsin" (Madison: Center for Studies in Vocational and Technical Education, The University of Wisconsin, 1970), (Mimeographed), pp. 74-81.

TABLE 2.—DETERMINANTS OF POSTTRAINING AVERAGE HOURLY EARNINGS (CENTS) BY SEX

Variable	Male		Female	
	Regression coefficient [1]	Standard error of regression	Regression coefficient [1]	Standard error of regression
1. Participation in basic education	52.0	[2] 38.0	4.9	36.3
2. Vocational training	−29.2	27.3	27.8	[3] 16.7
3. Total time eligible for civilian labor force	2.3	[4] .8	1.5	[2] .7
4. Average hourly earnings for 2 years before October 1968	.3	[2] .1	.3	[2] .1
5. Number of years of school completed	−5.3	6.0	−7.4	6.2
6. Age	−2.8	[2] 1.7	−.9	1.1
7. Achievement value scores	0	2.8	−.8	2.1
8. Marital status	−15.6	36.6	−17.1	21.9
9. Race:[5]				
(a) White	26.0	40.2	55.1	43.6
(b) Negro	2.2	39.6	24.4	34.7
10. Prime wage earner status	9.7	30.1	−5.0	20.4
11. Constant	141.9	125.0	126.2	100.2
R^2	[4] .33		[2] .20	
S.E.E.	94.7		84.1	
N	69.0		100.0	

[1] Can be viewed as the relative contribution to posttraining period average hourly earnings.
[2] Significant at the .05 level.
[3] Significant at the .10 level.
[4] Significant at the .01 level.
[5] Referenced to Mexican-American racial identity.

Concentrating on the earnings effect of basic education, that is, the relative contribution of basic education to posttraining average hourly earnings, regression computational procedures produce a male effect of 52 cents per hour and a female effect of 5 cents per hour. These coefficients, however, are not significantly different from zero at the .05 level based upon their corresponding standard errors of regression. Although for statistical and policymaking purposes, highly significant results are usually desirable, the absence of such significance does not necessarily mean that the benefits of the program are zero per se. Rather, the sample regression coefficient (b) is still the best-guess and unbiased estimate of the true population parameter (β), assuming of course that the model is correct in both form and content.[17]

The contribution of vocational training to average hourly earnings, while not the primary focus of this research, is worthy of discussion. Interestingly, the vocational training effect for females is approximately 28 cents per hour—greater than the female basic education effect by a factor larger than 5. This result is also significant at the .10 level. Women, in terms of average hourly earnings, benefit more from specific institutional vocational training than from the general compensatory education approach.

On the other hand, males display a surprising negative relationship between vocational training and average hourly earnings. While this result is statistically insignificant at a usually minimum level of acceptance (.10), males who take vocational training programs earn about 29 cents an hour less than those who do not. Looking further into the relationship between group membership and the payoff from vocational training, it is found that vocational training enhanced the average hourly earnings of male control group members 23 cents but detracted 51 cents from the hourly earnings of the male treatment cohort. These estimates are clear of the effects of other variables in the analysis.[18]

[17] H. B. Draper and H. Smith, *Applied Regression Analysis* (New York: John Wiley and Sons, Inc., 1966), p. 81.
[18] The model described above is executed for male control and treatment samples separately. The variable signifying basic education is excluded from the equation.

Table 3 provides a possible answer to this paradox. Listed in this table are partial correlations between select variables in the analysis for male treatment group members. A reading achievement test score (measured in tenths of full-time grade equivalents) has been added to the model to represent the level of male reading achievement upon graduation from Milwaukee MDTA–ABE. The test score has been squared to allow for a curvilinear relationship between itself and other variables in the analysis.

TABLE 3.—PARTIAL CORRELATIONS BETWEEN SELECT VARIABLES IN THE ANALYSIS OF MALE TREATMENT GROUP MEMBERS

Select independent variables	Dependent variables: Posttraining average hourly earnings	Dependent variables: Probability of taking vocational training [1]
Achievement values score (motivation)	[3] −0.130	[3 5] 0.375
Reading achievement score (squared)	[2 4] .477	[3 5] −.206

[1] The dichotomous variable representing the presence or absence of vocational instruction is interpreted as the probability of participating in such a program.
[2] Computation based upon the following variables: (1) total time eligible for civilian labor force; (2) average hourly earnings for 2 years before training; (3) number of years of school completed; (4) age; (5) achievement values score; (6) marital status; (7) prime wage earner status; (8) race; (9) reading achievement test score (squared); and (10) vocational training incidence.
[3] Computation is based upon all variables listed in footnote 2 but excludes posttraining average hourly earnings.
[4] Significant at the .01 level.
[5] Significant at the .05 level.

It can be seen in table 3 that the partial correlation between individual motivation and vocational training is not exceptionally large but is significant at the .05 level. Thus it appears that motivation plays a part in determining the likelihood of postbasic education vocational instruction. Moreover reading achievement preformance—one measure of trainee quality—is found to be a significant independent predictor of vocational instruction and posttraining average hourly earnings.[19] By inference, male graduates of basic education who enter vocational courses, although highly motivated to succeed, are the poorer students, based upon reading achievement tests. The interesting question remains: what would be the contribution of vocational instruction to hourly earnings if students with higher reading achievement levels were to enter into vocational programs? The analysis of male control group members and all female observations suggest that the contribution would be positive and substantial.

Employment Effects

A significant increase in individual employment rates is a benefit of basic education. Other things being equal, a decrease in the unemployment rate signifies greater area or national prosperity, as well as representing a major individual benefit both economically and psychologically. Of course, a positive employment effect of basic education will interact with the hourly earnings benefit to produce an even greater level of total individual earnings.

[19] Comparable results are found when mathematical achievement scores are substituted for reading achievement scores. For a more intensive examination of trainee educational achievement patterns, see Roomkin, "Evaluation of Adult Education," *op. cit.*, pp. 154–162.

The contribution of basic education to individual employment can be assessed by examining individual employment rates in the posttraining period; that is, the amount of posttraining time employed divided by the total amount of time the individual has worked or sought work.

As in the analysis of hourly earnings, regression equations are generated separately for male and female groups. For obvious reasons, the variable, preprogram average hourly earnings, is replaced by the preprogram individual employment rate. The major hypothesis of this section is that the basic education effect on percentage time employed will be significantly positive.

Table 4 reports the results of regressing the individual posttraining employment rate upon the specified independent variables for male and female groups. The hypothesized model performs poorly for males; the coefficient of determination (R^2) for men is approximately 0.20 and not significant at the minimum level of .10. The equation for females, on the other hand, is highly significant at the 0.01 level and displays a coefficient of determination of .24.

TABLE 4.—DETERMINANTS OF POSTTRAINING INDIVIDUAL EMPLOYMENT RATES BY SEX

Variable	Male		Female	
	Regression coefficient [1]	Standard error of regression	Regression coefficient [1]	Standard error of regression
1. Participation in basic education	−10.2	14.3	−0.4	2.0
2. Vocational training	−22.1	[2] 10.1	−.8	.9
3. Total time eligible for civilian labor force	−.6	[2] .3	−0	0
4. Percent time employed 2 years before October 1968	22.2	[3] 12.2	3.4	[4] 1.2
5. Number of school years completed	−1.5	2.2	−.2	.3
6. Age	−.4	.6	.1	.1
7. Achievement value scores	−.4	1.0	−.1	.1
8. Marital status	−14.8	13.4	−1.7	1.2
9. Race: [5]				
a. White	7.9	15.2	8.3	[4] 2.4
b. Negro	15.2	14.7	3.3	[3] 1.9
10. Prime wage earner status	−2.7	11.1	−1.2	1.1
11. Constant	70.8	45.1	4.1	5.5
R^2	.20		[4] .24	
SEE	34.9		4.6	
N	69.0		100.0	

[1] Can be viewed as the relative contribution to porttraining employment rates.
[2] Significant at the .05 level.
[3] Significant at the .10 level.
[4] Significant at the .01 level.
[5] Referenced to Mexican-American racial identity.

The effect of basic education upon the proportion of posttraining time employed is found to be negative for both men and women.[20] Disadvantaged men participating in Milwaukee MDTA–ABE reduce by 10 percent the amount of time they are employed. Females are not affected as greatly, but a reduction in working time of approximately 0.5 percent is traceable to basic education. Once again the results are not statistically significant but still represent unbiased estimates of population parameters. The question of statistical significance aside, the failure of basic education to produce positive employment effects is disturbingly clear.

[20] Recently, D. O. Sewell, *Training the Poor: A Benefit Cost Analysis of Manpower Programs in the U.S. Anti-Poverty Program* (Kingston, Ontario: Hansen and Edgar, Ltd., 1971), p. 82, also found an insignificant employment effect from manpower programs for the disadvantaged.

It is notable in the male equation that individual employment rates decreased with exposure to the labor market, suggesting a general decrease in the demand for labor. A larger overall demand for labor, say through stimulation of aggregate demand, could conceivably lessen the negative impact of basic education upon individual employment rates—and possibly even result in a positive effect.[21] But judged within the time period of this study, no positive effect upon individual rates is discernible.

Increased Average Annual Earnings Before Taxes

The estimated employment and earnings effects can be used to calculate the average annual money benefit of basic education before taxes. Essentially, the pretax benefit is the difference between the interaction of wages and hours resulting after basic educat on and the level of total earnings which occurred prior to training, inflated to represent 1 year's earnings.[22] The derived average male annual benefit before taxes is $317.82, and the equivalent statistic for females is $11.60. A weighted average benefit for the entire trainee sample, i.e., a value reflecting the sex composition of the sample, is $158.58.

Benefit-Cost Estimates of Basic Education

Based upon the above analysis the Milwaukee MDTA–ABE has produced only marginal changes in individual earnings before taxes. Although meager and unimpressive, the benefits are still positive—and hence, the final determination of program effectiveness rests upon the comparison of benefits to costs. In general terms, program efficiency can be approached from the perspective of the Federal Government—the social efficiency estimate—and from the viewpoint of the individual trainee—the private estimate.

Looking first at the public efficiency of basic education, expenditures for basic education consist of the following component costs: (1) Operating expenditures—both fixed and variable—adjusted for previous investments in physical resources; and (2) opportunity costs or foregone earnings while in training adjusted to reflect the probability of employment.

During 1969, the total operating cost of the program was $265,448. Expenditures on fixed cost items constituted approximately one-fourth of this total, after adjusting fixed costs to represent previous investments in physical equipment. The added refinement of adjusting fixed costs to reflect the pattern of resource utilization is omitted, because data on program utilization rates are unavailable.

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[21] Unemployment data for the Milwaukee SMSA confirm this conclusion. Although 1968 and 1969 displayed yearly unemployment rates of 2.7 percent, between October 1968 and March 1970, the general time frame of this research, monthly unemployment rates rose slowly from 2.5 percent of the work force to 3.2 percent

[22] The mean earnings benefit before taxes (B) for sex group i can be expressed as:

$$B_i = \{[(e_i + \Delta e_i) \cdot (w_i + \Delta w_i)] - ew\}\phi$$

where:

e = the average hourly earnings of trainees;

Δe = the average hourly earnings differential of trainees above nontrainees (i.e., partial regression coefficient for the basic education variable in the analysis of posttraining average hourly earnings);

w = the average total number of hours employed in the posttraining period by trainees;

Δw = the average differential number of hours employed by trainees above nontrainees (i.e., the translation of the partial regression coefficient for the participation status variable in the analysis of posttraining individual employment rates into its equivalent number of absolute hours of employment);

ew = the interaction of average wages and hours—the total income without allowance for earnings and hours differentials; and

ϕ = a weighting factor to adjust for the less than 52-week mean followup period.

Opportunity costs are calculated on an hourly basis. The average hourly earnings for male and female control group members is used as the estimate of opportunity costs, since it is weighted by the probability an individual trainee would be employed if not in training. During the training period male control group members earned on the average $1.78 an hour, while mean female hourly earnings was $1.15.

By computing variable and opportunity costs on a per-hour-of-instruction basis and adding an allowance for fixed costs, an average per-student expenditure is obtained. A typical student in Milwaukee MDTA–ABE received 307 hours of instruction which translates into an average total public cost of $1,274 per student. The mean enrollment for male and female trainees was 323 and 293 hours of instruction respectively, producing corresponding average social costs of $1,414 for male trainees and $1,120 for females.

If we discount the net before-tax earnings gain of basic education at 10 percent for 10 years, the present value of training is $1,069 for all trainees, $2,142 for male trainees and $78 for female trainees.[23] The ratio of summed public benefits to public average per-student costs—one measure of program efficiency—is discouraging: benefits over cost equals 0.84 for all trainees, 1.5 for males, and 0.07 for females. Slightly more favorable ratios are apparent at lower levels of discounting, but even at a more liberal discount rate of 5 percent, the ratio for all trainees is 1.06—a rate slightly greater than unity, but not convincingly so.

The computation of private benefit-cost ratios requires slight modification in the composition of both costs and benefits. On the costs side, each trainee bears only his opportunity costs of training. Benefits are the sum of earnings differentials over a specified time horizon plus the money received during training for student support. Treating total support expenditures as being related to instructional time, the stipend is calculated at the rate of $1.16 per hour of enrollment. The opportunity costs of instruction, once again, reflect the probability of employment in the absence of the program.

Private benefit-cost ratios show explosive returns to basic education instruction in Milwaukee. At a 10-percent discount rate and a 10-year benefit duration, the ratio for a combined male and female group equals 3.2, while males exhibit a 4.3 ratio, and the female ratio equals 1.2. Quite noticeably, the ratio for females barely exceeds unity, but even this is a remarkable performance given the almost negligible annual before-tax earnings gain for females. In sum, while society appears to be inefficiently investing in Milwaukee basic education programs, a relatively small number of trainees find these programs to be economically rewarding.

Summary and Policy Implication

The major findings of this research are as follows:

(1) Participants in MDTA–ABE in Milwaukee exhibited a statistically insignificant but positive earnings effect measured in terms of augmented average hourly earnings. Males increased their average hourly earnings 52 cents, while females earned approximately 5 cents an hour more.

[23] Future earnings are adjusted to reflect growth due to nonquality improvements in labor. One-third of the 3 percent growth in output per manhour since 1947 is assumed to be due to quality increases in labor productivity. The remaining two-thirds or 2 percent are used as a weighting factor on future annual earnings.

(2) Specific vocational instruction for females was shown to have a substantial positive effect (28 cents) upon hourly earnings and a negative effect (29 cents) for males. The negative performance of this variable for males was traced to the actions of basic education's less able male graduates, who were highly motivated to succeed, in spite of their poor achievement abilities.

(3) The employment effect of basic education, i.e., increased percentage time employed, was negative for both males and females. Participation in basic education reduced their proportion of time employed by approximately 10 percent below the level of employment displayed by the control group. A much less severe reduction in employment time, less than 1 percent, was exhibited by females.

(4) Comparing a calculated before-tax annual increase in individual earnings to the public costs of the program in ratio form as a summary measure of program efficiency, basic education was found to be a relatively inefficient allocation of Government resources. It is worthwhile noting that this conclusion is still valid, even though benefits were compared to costs under a set of very liberal assumptions.

(5) From the viewpoint of the individual trainee basic education was a very rational and rewarding undertaking. The benefits to the individual far exceeded the personal costs of the instruction, primarily because opportunity wages were below the level of stipend payments.

These findings are tentative and should be viewed with caution. Indeed there are many alternative hypotheses which explain the poor performance of the basic education students relative to the control group used in this study. It is possible that response selectivity between treatment and control groups make a sound evaluation impossible. There is no way of knowing whether the nonrespondents in both samples bias the results.

But, if sample selectivity were no longer a problem, other factors could still produce positive earnings differentials in favor of those who participate in basic education programs. Higher earnings can result from better and more extensive job search efforts. Trainees have access to professional counselors to direct their initial search efforts, and hopefully, because of their training seek more labor market information during the job search.

The queue theory of labor market operation tells us that employers rank prospective workers in terms of individual characteristics believed to predict on-the-job success. Where predictors of success cannot be easily measured, employers rank workers according to proxy attributes. For example, individual productivity can not be directly measured for each worker, but employers use the formal educational attainment level as a proxy for productivity.

In a similar fashion, employers may use the fact that an individual worker participated in training programs as a measure of future job success, irrespective of the trainee's actual abilities. Thus, trainees displace nontrainees from jobs even though both trainee and nontrainee are equally competent workers. This phenomenon has been called the displacement effect of training programs, but it is suggested that it really represents a credential effect whereby employers respond to the credentials of workers (a certificate of program completion or a high school diploma) rather than the worker's true abilities.

At the same time, the voluntary withdrawal of workers from the labor force to participate in training reduces the supply of labor at a

given quality level. The vacuum created by the removal of workers is filled as nontrainees now obtain employment. If the training program is large enough to enroll major portions of the illiterate and semi-literate population, then not only will nontrainees obtain jobs, but wages will rise to adjust to the shortened supply.

Both the displacement and the vacuum effects become more likely when both trainees and nontrainees utilize the local office of the Employment Service. The Employment Service, it is recalled, provided the names of persons for the control group, while at the same time it served as the referral agency for basic education. It is possible that the Service refers the poorer workers to training and gives the better workers the limited amount of available employment. Equally possible, however, is the tendency for the Employment Service to give their limited number of job referrals to trainees, since these workers are the products of Employment Service sponsored training programs. No doubt both tendencies could exist, and further research should attempt to isolate the stronger or net effect upon posttraining performance.

These caveats aside and in the absence of literature documenting the effectiveness of basic education programs, the results of this study provide some guidance for the future design of manpower programs for the disadvantaged. In general there is reasonable cause to doubt the absolute impact of remedial educational instruction upon the earnings and employment of the disadvantaged. There are some indications that at the same time basic education may be less effective than the specific vocational programs which were represented in the sample. If further research replicate this finding, it would appear logical to design compensatory education programs so that they are closely tied to specific vocational programs, even though there was substantial participation in vocational programs by individuals who supposedly were educationally unprepared for such programs.

One alternative solution is to provide formal basic educational programs in preparation for skills instruction. Educationally disadvantaged adults could receive formal remedial education in a specific classroom setting. The program could operate almost as it does now, except the transition to vocational instruction would not be left to chance. Occupational skills or specific slots in existing institutional MDTA programs would be maintained to guarantee each successful completer of the basic education program access to vocational training. Under this approach, the costs of providing compensatory educational instruction—both instructional and opportunity costs—would be sizeable. The combined cost of remedial preparation and vocational instruction may even diminish the overall return on vocational programs, which has been shown to be favorable. Moreover, based upon the Milwaukee experience, a large number of basic education participants would require a substantial amount of instruction (perhaps one to two years) before reaching an adequate level of academic achievement; and many participants, it is feared, would never reach a desired level of performance. Each failure of the basic education program—i.e., each student who is incapable of promotion—would represent a zero benefit when calculating average program performance, thereby creating strong pressures to cream off more capable trainees in the selection of basic education participants.

A more efficient alternative, it is suggested, is to directly accommodate disadvantaged input into institutional and on-the-job training programs. These programs could be modified to incorporate specially designed educational components without prohibitively adding to instructional costs or the length of the program. While on the surface this alternative appears to be a formidable task, it could be achieved by fully implementing modern learning and teaching techniques, possibly even teaching machines.

Although this author favors the latter alternative, we still need more research before policy can be cemented. Additional evaluations of basic education programs, particularly those using data on many programs, are greatly needed. But we still stand to gain insight from further case studies.

USING BENEFIT-COST ANALYSIS TO ASSESS A HUMAN RESOURCE INVESTMENT PROGRAM

By BRUCE F. DAVIE*

The plight of the American Indian, especially with regard to such measures of well-being as income, housing, and education, has been well documented in a compendium of papers presented to this committee.[1] Several Federal agencies, including the Bureau of Indian Affairs, Department of Labor, and Office of Economic Opportunity have developed programs attempting to deal with the problem of unemployment and low earnings among Indians. Many approaches have been tried, including subsidized on-the-job training, job placement services, and adult vocational education. This paper focuses on one approach and one program. The approach is residential training centers for Indian families and single adults. The particular program is at the Roswell Employment Training Center, Roswell, N. Mex., where the Thiokol Chemical Corp., under contract with the Bureau of Indian Affairs, conducts a program having the capacity to house and provide training, counseling, and placement services for 325 trainees and their children.

The application of benefit-cost analysis, as an evaluative technique, to human resource investment programs has been widespread and the theoretical issues fully explored, if not completely resolved.[2] The results of applying the technique to data on the post-training employment of ex-students from the Roswell Training Center are discussed here. More importantly by conducting a benefit-cost analysis program managers developed the capacity to study the relationships between elements of their program and outcomes—the subsequent employment experience of trainees. This development is explored more fully in the paper's concluding section. The first section briefly describes the Roswell program, the second section discusses the application of benefit-cost analysis to the program, and the third presents the results of the analysis.

I. PROGRAM DESCRIPTION

The Roswell Employment Training Center was established in September 1967 under contract with the Bureau of Indian Affairs. The first student arrived in March 1968. Using the facilities of a former Air Force base, the Center was designed as a residential employment training program for Indian families, solo parents, and single adults.

*Associate professor of economics, Georgetown University, Washington, D.C. The author became acquainted with the program discussed herein in the capacity of a consultant retained by the Bureau of Indian Affairs and the Thiokol Chemical Corp. to advise on the implementation of benefit-cost analysis. The opinions expressed are those of the author and do not necessarily represent those of the Bureau of Indian Affairs or the Thiokol Chemical Corp.

[1] Joint Economic Committee, 91st Cong., 1st sess., *Toward Economic Development for Native American Communities*, vols. 1 and 2 (Washington, D.C.: Government Printing Office, 1969.)

[2] See B. G. Somers and W. D. Wood, eds., *Cost-Benefit Analysis of Manpower Policies* (Kingston, Ontario: Queen's University, 1969)

Skill areas in which training is conducted include: automotive repair, baking, body and fender, building maintenance, cooking, cosmetology, electronic assembly, meatcutting, meatpacking, nursing assistant, office-clerical, retail sales, small engines, surveyor aide, telephone lineman, and welding.

Opportunities are provided for trainees who have not completed high school to work toward a high school equivalency degree (GED). Training programs are designed to extend for 9–12 months. A child care center is provided for young children; older children attend public schools in Roswell.

Emphasis is placed on training and counseling designed to aid trainees in adjusting to typical work situations and to living off reservations. Indian culture is respected and students are encouraged to maintain and develop appreciation of their heritage. The managers of the program have expressed their philosophy in these words:

The Roswell Employment Training Center has been established to provide training and developmental experiences that will enable Indian adults to enter productive employment, make satisfactory adjustments to modern community and job situations, and to develop adequate personal characteristics for the enjoyment of responsible citizenship and continuous employment. This statement of philosophy will describe some of the concepts and attitudes that will guide the operations of this Center.

The vocational courses presented will be for those employment fields which offer full-time, year-round work opportunities with adequate income, and for which favorable employment opportunities exist.

Life skills are as important as vocational skills in determining the adjustment and success of a person on a job. A great deal of our training activities will be toward the development of acceptable attitudes, adequate English language ability, proper work habits, knowledge and use of acceptable behavior patterns and other such skills which will raise both the dignity and the effectiveness of the person.

We recognize that each student is an individual, not just a member of the class or the student body. We accept each person as an independent personality. We know that differences in people are good, and we will not impose practices which would destroy the individuality of any student. At the same time, we know that each individual must meet his responsibilities to his group and his community.

We endeavor to analyze the needs of each student, and then plan and present training activities that will help that student meet his particular needs. Each student is allowed to progress at his own rate. Efforts are made to assure that each educational or training activity will enable the student to enjoy success. The best educational progress is made as a student moves from one success to higher and more technical levels of successful experiences.

A democratic atmosphere will prevail with students being encouraged to participate in the development of activities, the formulation of rules, and the solving of problems relating to their community life. The importance of the individual and of his opinions is emphasized. Each student is assisted to live as a cooperating member of the community and as a contributing citizen.

Students are given encouragement and positive direction in establishing rules and standards by which they intend to live while at this Center. We believe that a person develops most when he is helping himself. Student self-direction is one of our main educational goals.

Students are encouraged to develop both price and knowledge in their Indian heritage. This is done for many reasons, some of the main reasons being that adequate feelings of self-worth and self-respect are prime factors in emotional stability and satisfactory relationships with other people.

We encourage staff members to involve themselves personally with the students of the Center. We believe that a truly sincere interest of one concerned adult with another will bring about the most effective relationship between teacher and learner.

To help the staff be effective there will be many training and developmental activities. Many of the same attitudes and philosophies that apply to students apply to staff members. We will recognize the individuality of each. We know

that a person can work most effectively when his feelings and his actions are compatible with a truly integrated personality.[3]

Trainees come to Roswell from all parts of the country, mostly from reservations; about one-third of the students have been Navajos. Attendance at the Center is, of course, voluntary. Recruitment was the responsibility of the Bureau of Indian Affairs during the first years of the program; the contractor subsequently assumed responsibility for recruitment. Emphasis has been placed on recruiting among the "hard core" unemployed and underemployed. The need for employment training and the expectation that many of the unemployed, underemployed, and new entrants to the labor force from among Indian groups will find employment opportunities outside reservations was documented by the Bureau of Indian Affairs in a presentation to this committee.[4] Economic development on reservations, desirable as that objective is, cannot reasonably be expected to provide enough new jobs. Many Indians will be seeking employment off reservations if they are to earn incomes above poverty levels.[5]

After a period of initial operation the managers of the Roswell Center were requested by the Bureau of Indian Affairs to conduct a benefit-cost analysis of the program. The request originated in the Office of Management and Budget. The next section describes the analysis undertaken.

II. Method of Analysis

The first step in the evaluation of any human resource program is to specify the nature of the intended outcome. Indeed this is often the most difficult step in the entire process of program analysis. Consider again the stated objective of the Roswell program, ". . . to provide training and developmental experiences that will enable Indian adults to enter productive employment, make satisfactory adjustments to modern community and job situations, and to develop adequate personal characteristics for the employment of responsible citizenship and continuous employment." Can the success or failure of the program be judged in terms of stated objectives? Can program outcomes be related to costs?

An analysis that relates program inputs to outcomes should be distinguished from descriptions which often pass under the guise of evaluations. One mode of program description focuses on inputs: the number of trainees and their characteristics, the quantity and quality of the staff, and the nature of the physical facilities used. Although it is useful to ask if appropriate numbers from target population groups are enrolled and to inquire about the adequacy of the staff and facilities, this does not provide evaluative results useful for decisionmaking. A second mode of program description concentrates on process: curriculums used, counseling procedures followed, and the organization of the extracurricular activities. Neither mode of description is adequate because the crucial measurement of outcomes is missing.

[3] Roswell Employment Training Center, "Proposal for Follow-on Contract, Fiscal Year, 1972," Exhibit No. 1, Program Descripton (submitted to: Bureau of Indian Affairs, May 3, 1971) pp. 2–4.

[4] See "Comparison of Fiscal Year 1967 and Fiscal Year 1970 Congressional Budget Submissions for One Program" in Subcommitee on Economy in Government, Joint Economic Committee, 91st Cong., 1st Sess. *The Analysis and Evaluation of Public Expenditures: The PPB System*, vol. 2 (Washington, D.C. Government Printing Office, 1969), pp. 786–98.

[5] There is a basic policy question here of profound significance. Should programs be maintained that encourage the migration of Indians from reservations to urban areas when to do so would seem to weaken traditional Indian culture? This question is obviously beyond the bounds of economic analysis.

The semiannual reports prepared by the managers of the Roswell Center have been chiefly descriptive of inputs and processes. The only included data related to outcomes has been numbers of placements and annual salaries of those placed, by training area. These data are obviously significant but they do not adequately measure outcomes in economic terms. Average salaries in the jobs in which trainees are initially placed are not a reliable measure of earnings because ex-trainees may not stay in their initial job. A more inclusive measure estimates the change in earnings attributable to the program. This requires followup data on the employment status of trainees, say 6 months or a year after leaving the center so as to estimate actual annual earnings after training. Ideally, these estimates of earnings should be compared with the earnings of a control group—similar individuals who did not undergo training—to calculate the differences in earnings attributable to the training experience.

Using earnings differentials to measure benefits from human resource investment programs has become a standard method of evaluation. It assumes that added earnings reflect the increased productivity of labor, that new goods and services are being produced that society would not have enjoyed in the absence of the training program. Any change in welfare or other transfer payments are properly neglected by this measure of outcomes. If welfare payments are reduced the disposable income of recipients goes down and that of taxpayers increases—there is no change in the value of goods and services produced. Unless one is willing to argue that the amount involved is valued more highly by taxpayers rather than recipients, reductions in welfare payments should not be counted as an economic benefit of the program.

There are certainly other benefits to be expected from an employment training program such as "developmental experiences," "satisfactory adjustments to modern community situations," and development of "personal characteristics for the enjoyment of responsible citizenship"; future opportunities may open for trainees that would otherwise be closed and children may develop more fully because of the child care and schooling available. These benefits are hard to measure; their neglect can be rationalized by noting that they are likely to be enjoyed only if earnings increase. For this reason the only measure of benefits used in the analysis of the Roswell program was earnings differentials. Post-training earnings were compared to pre-training earnings to estimate differentials because no adequate control group could be established. The annual amount of the differential was projected forward for the number of years trainees could be expected to stay in the labor force. The present value of that time stream of earnings differentials was then compared to program costs.

Ideally, costs should be measured by the highest value of the program's resources if used in an alternative manner. Transfer payments, such as trainee stipends, are excluded for the same reason that they are excluded from the calculation of benefits. The major resources costs are staff services, where salaries are taken as the measure of their value in an alternative use; other direct costs such as supplies; and the opportunity costs of trainees—the earnings foregone as a result of undertaking training. In the case of the Roswell Center it is assumed that the physical facilities had no alternative use.

III. Results of the Analysis [6]

In June of 1970, a followup study was conducted by mail of all trainees who had entered the Roswell Center between its inception in March 1968 and February 28, 1970. In all 576 questionnaires were issued and 338 were returned. The 59-percent response rate, which is very high for mail questionnaires, is in part attributable to the offer of $5 for each return. (See the attachments for copies of the survey instruments.) Of the 338 returns, 310 were usable; those from trainees who were continuing their education or were in the armed services were excluded and a few had incomplete data. Returns were grouped according to the length of time since trainees had left the Roswell Center: those who had been gone for more than 1 year, for 6 months to 1 year, and for 3 to 6 months.

The calculation of benefit-cost ratios using the data from this survey is illustrated in Table 1, where the 170 trainees who had been gone from Roswell for 1 year or more are considered. Of this group 70 were employed at the time of the survey at an average hourly wage of $2.25. This was actually a lower percentage of the group employed than was the case prior to coming to Roswell for training when 82 of the 170 were employed. Because the average wage rate after training was significantly higher than the average wage rate before training, there was still a positive earnings differential associated with training equal to $573 per year. The present value of this amount over a period of 41 41 years is $8,674, using a 6-percent discount rate. The average length of training for this group was 8 months and the direct training costs per month equaled $658. This amount excludes any transfer payments to trainees. The other element of resource cost associated with training was foregone earnings estimated at $113 per month per trainee. The total costs for 8 months of training was $6,166. The ratio of benefits to costs is 1.41.

Table 1.—*Illustrative Calculation of Benefit-Cost Ratio*

Trainee Category.—The 170 trainees who had been gone from the Roswell Employment Training Center (RETC) for more than one year.

Benefits Per Trainee.—Prior to RETC, 82 of the 170 trainees were employed at an average hourly wage rate of $1.35 or an annual income of $2,808. After RETC, 70 trainees were employed at an average hourly wage rate of $2.25, or an annual income of $4,680. (Annual salary was computed by multiplying the hourly wage rate times 2,080 hours per year.)

Additional annual earnings per trainee. . .

$$\frac{(\$4,680\times 70)-(2,808\times 82)}{170}=\$573$$

The present value of this annual amount for 41 years (the number of remaining years in the labor force for trainees whose average age was 24) at a six percent rate of discount is $8,674

[6] This section draws heavily from "Roswell Employment Training Center Trainee Follow-up Report" (July 29, 1970) and other unpublished raports.

Cost per trainee

Adjusted contracted costs per trainee:	
Average length of training of 8 months times contracted cost (less transfer payments) per month per trainee of $658	5, 264
Foregone earnings per trainee:	
Number of trainees working prior to RETC, times their monthly income, times the average length of training divided by the total sample group: $82 \times \frac{\$2,808}{12} \times 8 \div 170$	902
Total costs	$6, 166
Benefit/Cost Ratio: $\frac{\$8,674}{\$6,166} =$	1.41

Source: "Roswell Employment Training Center Trainee Follow-Up Study," July 29, 1970.

Table 2 indicates benefit-cost ratios, also calculated using a 6-percent discount rate, for trainees covered in the June 1970 survey for a variety of different trainee categories. For example, it is interesting to note that the ratio is less than unity for the group that had been away from Roswell for 6 months to 1 year and more than unity for both the group that had been away for a year or more and the group that had been away for 3 to 6 months. This may indicate a period of transition between the jobs in which trainees were intially placed and a later period of more stable employment. The results for single men show benefit-cost ratios greater than one for all three groups. This is also the case for married men though note the significant decline in the ratio as the length of time since leaving Roswell increases. The results for single women show high benefit-cost ratios for the 3- to 6-month group and ratios less than unity and even negative for the other two groups. This suggests that single women may return to reservations and again experience high levels of unemployment after an initial employment experience. For married women the ratios are negative for the first two groups but greater than one for the group that had been away from Roswell for 1 year or more. For some categories more than the usual amount of doubt is cast on the validity of the benefit-cost ratios because of the small numbers in the group.

TABLE 2.—BENEFIT-COST RATIOS BY CATEGORY OF TRAINEE

[Ratios calculated using a 6-percent discount rate]

	Length of time since leaving Roswell					
	3 to 6 months		6 to 12 months		More than 12 months	
	Ratio	Trainees	Ratio	Trainees	Ratio	Trainees
Total group	1.97	44	0.72	96	1.41	170
Single men	1.64	9	2.52	24	1.71	22
Married men	5.41	8	1.71	23	2.55	52
Single women	3.05	12	.54	21	−.48	45
Married women	−.61	15	−1.55	28	1.49	51

Source: "Roswell Employment Training Center Trainee Follow-Up Study," July 29, 1970.

In addition to providing data necessary for the calculation of benefit-cost ratios the survey of ex-trainees from the Roswell Center gave program managers much other information helpful in assessing results

and suggestive of possible modifications in the program. For example, the data showed that 66 percent of the 310 former trainees to be living on reservations and that of these 31 percent were employed. Of the 13 percent living in rural areas outside reservations 44 percent were employed and of the 21 percent living in urban areas 62 percent were employed. In each type of residence area married men had the highest employment rate. The 34 percent of the trainees who had achieved GED's at Roswell had significantly better post-training employment experiences than the others. Only 7 percent of the trainees had come to Roswell as high school graduates. The followup study showed better results for those experiencing about 6 months of training than for either those whose stay at the Center was relatively short or those who stayed 9 to 12 months to complete their training. One possible explanation of this phenomenon is that some trainees retained patterns of dependency and stay at the Center as long as they could. Upon leaving the Center many of these trainees returned to reservations where they continued to experience the high levels of unemployment and low levels of earnings that, unfortunately, characterize the typical labor market experience of American Indians. Those who stayed at the Center for about 6 months, seem to have left, in large part, in response to employment opportunities even though they may not have fully completed their program of training. This could be interpreted as recognition on their part of the opportunity costs which they bore as long as they remained in training. An alternative explanation of this phenomenon would be that many of the trainees needed longer periods of training, not so much to acquire additional occupational skills, but, rather to develop their ability to adjust to the world of work.

A second followup survey was conducted in the fall of 1970, at the request of the Bureau of Indian Affairs, covering all former trainees who had been away from Roswell for a year or more. A total of 439 individuals were surveyed, 11 were excluded from the analysis because of indefinite illness, death, or continued schooling. There were 353 responses. The rather high percentage of response, 82 percent, was occasioned by considerable additional effort in contacting persons surveyed to determine what effect the additional responses would have. The results were very favorable and surprising to the extent that generally more individuals were employed in the group constituting the additional respondents (those most difficult to obtain an initial response from) than reported employment in the initial group. Of the 353 responses, 151 were currently employed at an average hourly wage rate of $2.07. A benefit-cost ratio of 3.92 was calculated following the same procedure outlined above. The ratio for single individuals was 1.64 and 4.84 for married individuals. The data showed better employment records for trainees who had completed their programs compared with trainees who left before completion. A larger fraction (40 percent) of the trainees who completed training were living off reservations than was the case for those who did not complete. These data also permitted comparisons of employment experiences by area of training, showing that employment and earning were highest for those who had trained in automotive skills. Program managers assessed the impact of some of the results of the followup study in these terms:

> The most difficult aspects of assessing feedback data of this nature is attaching the proper degree of significance to the results. The tendency is perhaps to react too strongly to the most obvious results (most of which are economic) and not strongly enough to the more subtle results of the data. Generally, it has been

determined from questions of a social nature that housing and transportation problems must be resolved with assistance at the outset of employment and a certain degree of continued assistance provided, decreasing with time, to establish any measure of job retention. This appears true particularly in urban areas where jobs are more plentiful and wages are higher. Consequently, we have and are continuing to sophisticate our placement function, which now includes a job development phase in advance of employment whereby many of the social related problems are resolved prior to employment. It also includes a more adequate method of contact for those requesting reemployment and other assistance.

Additional examples of program development and modification which have resulted at least in part from our follow-up system, include a full-time driver education course, more detailed program phaseout courses dealing realistically with job interviews, communicating with fellow employees, and case studies of experiences of prior students in actual job and social environments. Also, additional vocational courses have been instituted and some eliminated to lend more flexibility to student desires and needs and to maintain attunement with changing market conditions.

In acquiring new students, we have endeavored to obtain people who are as free as possible from serious personal problems (primarily medical) which might cause them to leave the program before completion of training; in an effort to increase our number of completing trainees, since, of course, based on evaluation they do far better in all areas of comparison.[7]

A third followup survey was conducted in the summer of 1971 of 283 trainees who left Roswell between November 1, 1970, and April 30, 1971. About 60 percent of the questionnaires were returned; of these about 30 percent were employed. The benefit-cost ratio was 2.03.

IV. Conclusions

The benefit-cost analysis described above is about the simplest possible for a human resource investment program. Earnings before and after training are compared, differentials projected, at a constant amount, over the years ex-trainees can be expected to remain in the labor force. The present value of these amounts are then compared to direct program costs plus the opportunity costs of trainees to estimate benefit-cost ratios. Every step of the analysis can be challenged on theoretical and empirical grounds. Pretraining earnings may be understated; perhaps earnings differentials should be projected at growing, rather than constant, amounts in future years; the lack of complete followup data may bias the estimated earnings differentials; a control group should really be established; maybe 6 percent is not the "right" discount rate to use; an estimate of the value of the physical facilities in an alternative use should really be included as a cost—all this and probably more could be charged. To focus on these niceties of analysis would be to miss an important aspect of program analysis. Analysis should not only ask the question, "Is this a good program?" or "Has the benefit-cost ratio been appropriately and accurately estimated and is it greater than unity?" but should provide program managers with the information they need to change particular aspects of their program in an effort to improve performance.

A human resource investment program is not a single entity to be evaluated at budget review time but a complex affair with many subtle relationships among inputs, processes, and outcomes. Analysis should go well beyond answering the good/bad question and encourage program managers to focus on measurable outcomes and on the relationships between elements of their program and those desired outcomes. It is, in a sense, just as much a waste of resources to continue a program that has a 3 to 1 benefit-cost ratio when with changes

[7] Roswell Employment Training Center, unpublished report.

in the program the ratio could become 5 to 1 as it is to continue a program where the ratio is less than unity.

The managers of the Roswell Employment Training Center were shocked to learn from their first followup study that only 39 percent of their former trainees were employed after spending an average of 8 months in training at an average direct cost per trainee per month of $658. The fact that a benefit-cost ratio of more than one could be estimated—basically because prior employment and wage rates were so abysmally low—was of little comfort. Their thinking broadened beyond program completions and placements as measures of success to sustained employment at decent wage rates. As a result of their own continuing evaluation using followup surveys the program has been altered. More staff resources are used to locate suitable job opportunities and in counseling after placement. The relationship between length of training and outcomes has been reviewed and a case made for longer periods of training for particularly disadvantaged trainees.[8] Responsibility for recruitment was assumed by the contractor in part to keep the population of trainees at capacity in order to minimize costs per trainee. Some skill areas have been added and others dropped from the array of offerings. Other program modifications have also occurred. The program managers will be using benefit-cost analysis to determine the effectiveness of these changes and to discover new problems and opportunities for improvement.

ATTACHMENT A.—COVERING LETTER FOR JUNE 1970, FOLLOWUP SURVEY

THIOKOL CHEMICAL CORP.,
ROSWELL DIVISION,
Roswell, N. Mex.

DEAR FORMER STUDENT: Even though some time may have passed since you last heard from any of us at the center, we would like you to know that we are still very interested in you and what you are doing.

In order to make the center a better place for students to train, and to do a better job for those of you who have left the center, we are asking you to help us by answering the questions below and filling out the questionnaire attached. If you send back both the letter and questionnaire to us with the questions answered by June 30, 1970, we will send each family or unmarried person $5. For each family we have to get back the letters and questionnaires for both, the man and wife. Please answer these questions:

Question.—In the month before you came to RETC were you receiving welfare?
Answer.—Yes____ No____.
Question.—In the month before you came to RETC were you working on a job?
Answer.—Yes____ No____.
Question.—If you were working on a job how much money were you making each payday?
Answer.—$____.
Question.—How often were you paid?
Answer.—____.
Question.—What is your address now?
Answer.—_____.
No. Street
_____.
City State

Now, please answer the questions on the questionnaire form. After you have finished that, put both the letter and the questionnaire in the envelope addressed to Thiokol, seal it, and mail it. It does not need a stamp. We will mail your $5 when we receive it.

Thank you,

ROY HADLEY.

[8] Roswell Employment Training Center, "Proposal for Follow-on Contract," fiscal year 1972, exhibit 2: Program Improvements (submitted to: Bureau of Indian Affairs, May 3, 1971), pp. 10–11.

ATTACHMENT B.—FOLLOWUP QUESTIONNAIRE

ROSWELL EMPLOYMENT TRAINING CENTER QUESTIONNAIRE

SECTION I.—GENERAL

1. Name:
2. Social security No.:
3. Are you now:
   ____Single
   ____Married
   ____Solo parent
   ____Divorced
   ____Separated
   ____Other_____ (please explain)
4. Where do you live now? (Check the one that fits.)
   ____On the reservation.
   ____Off the reservation in a place or town with less than 2,500 people.
   ____Off the reservation in a place or town with more than 2,500 people.
5. Would you move away from the reservation if you could not find work?
   Yes____ No____.
6. How many jobs have you had since leaving RETC_____. (Write in number of jobs.)
7. How many months have you worked since leaving RETC_____. (Write in number of months.)
8. Are you working now?
   Yes____ No____.

Special instructions.—Read carefully before going on.
If you are working now fill out section II (questions 9–15).
If you are not working fill out section III (questions 16–14).

SECTION II.—PRESENTLY EMPLOYED (WORKING)

9. Are you working for an employer? Yes—— No——. Please give employer name and address. ————.
10. Do you have your own business or farm? Yes—— No——.
11. Do you work for a member of your family? (Father, mother, uncle, etc.)
    Yes—— No——.
12. When do you get paid?
    ——Once a week
    ——Once every 2 weeks
    ——Once a month
    ——Other—explain————.
13. How much money are you paid each payday (before deductions are taken out)? $——. If the amount of money is not the same every payday, put down the amount you usually make.
14. If you are working for a family member (father, mother, uncle, etc.) do you get your food free? Yes—— No——. Do you get your room free? Yes—— No——.
15. Are you using your RETC training in your job? Yes—— No——.

SECTION III.—PRESENTLY UNEMPLOYED (NOT WORKING)

16. Have you worked since leaving the training center?
    Yes—— No——.
17. What was your hourly rate on your last job? $————.
18. Did you use your RETC training in your last job?
    Yes—— No——.
19. Why did you leave your last job?
    ——Didn't like the area.
    ——Didn't like the work.
    ——Didn't like the people.
    ——Laid off.
    ——Other—explain————.
20. Are you looking for a job now?
    Yes—— No——.
21. Are you now getting welfare?
    Yes—— No——.

22. Are you in school or full-time training instead of working (like nurses school, adult education, college, etc.)?
Yes—— No——. If yes—where?————.
The next two questions are for women with children!
23. Are you staying home to take care of your family? Yes—— No——.
24. Are you staying home because you can't get a job? Yes—— No——.

Attachment C.—Form for Capturing Pretraining Employment Data During Entry Interview

TRAINING ENTRY INTERVIEW

(Per manpower statistical definition—Bureau of Census)

To be used by interviewor who will ask the questions and discuss for clarification:
Student Name———————— Social Security Number————
1. During the month prior to acceptance for training at Roswell Employment Training Center, were you performing work for which you were paid, or did you work any time in your own business or on your own farm?
a. Yes——. If yes, go to question 2.
b. No——. If no, go to question 3.
2. If you were working according to question 1 above:
a. What was your rate of pay (or how much did you allow yourself if you own a business or farm?)

	hourly	( )	
$————	weekly	( )	Check one (√)
	monthly	( )	

b. How many hours did you work each:
Week————, or (Complete one)
Month————
3. If you answered "no" to question 1, did you work during that month (prior to training acceptance) for at least 15 hours each week without pay in a business or on a farm owned by a member of your family (your parents, brother, uncle, etc.).
a. Yes——. If yes, go to question 4.
b. No——. If no, go to question 5.
4. If you worked for a family member without pay, did you get your room and food free?
a. Yes——.
b. No——.
5. Were you receiving welfare payments at the time of acceptance for training at Roswell Employment Training Center?
a. Yes——.
b. No——.
Note: If student met the "yes" category for either question 1 or 3 above, but was absent that week because of illness, vacation, personal reasons, et cetera, he will be considered as employed and we are to obtain his normal weekly hours and pay.

THE EFFECTIVENESS OF SECONDARY VOCATIONAL EDUCATION*

By TEH-WEI HU, MAW LIN LEE, *and* ERNST W. STROMSDORFER**

INTRODUCTION

Secondary education in the United States can be classified into two broad types: vocational and comprehensive. Vocational secondary education is oriented toward immediate job opportunities after graduation, while one of the major orientations of the curriculum of the comprehensive high school is toward preparing students for a college education.

There has been marked growth in vocational enrollments and expenditures in the 1960's, especially since the passage of the Vocational Education Act of 1963. The total enrollment of vocational education in 1960 was 3.8 million, while in 1969 it was almost 8 million, an increase of more than 100 percent. The total federal, state, and local expenditures for vocational education was $239 million in 1960, while in 1969 it was $1,369 million, an increase of about 5.8 times.[1] It is obvious that the rate of increase in expenditures on vocational education is much higher than the rate of increase in vocational student enrollment, even taking account the inflation of 21 percent during the 1960's decade.

Since the passage of the Vocational Education Act by the Congress in 1963, school administrators, public officials, and economists have shown increasing interest in the evaluation of the relative economic and social merits of vocational education. The 1968 Amendments to the Vocational Education Act are a practical expression of this interest.

One aspect of this concern relates to the student who considers high school as his terminal education. Undoubtedly many students, upon entering high school, do plan to attend college, but for a variety of reasons they change their minds upon graduation. However, there are others who view the probability of their attaining a post-high school education as being near zero. Should this type of student be encouraged to attend vocational high school or comprehensive high school? Which of these two types of schooling will yield him the highest net economic

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**The authors are, respectively, Associate Professor at the Pennsylvania State University, Professor at the University of Missouri, and Associate Professor at the Indiana University.

[1] *Digest of Educational Statistics* (Washington U.S. Government Printing Office, 1970), pp. 35-36 and p. 58.

advantage? Is vocational education better in strict monetary terms than comprehensive education for this type of student? How much better? How should school administrators allocate their extra resources to vocational or comprehensive high schools in view of the costs and returns to these two types of schools? This study will provide certain answers to the above questions by comparing costs of these two types of schools and the labor market performances among vocational and comprehensive high school graduates who did not attend college.

The comparison of comprehensive and vocational high school graduates should be qualified by the realization that the objectives of the two types of schools are different. The comprehensive high school offers courses that are more likely to be college preparatory. If benefits from these courses are partly noneconomic and amount to more than the noneconomic benefits from the curriculum of vocational schools, then the use of simple money measures of benefits will bias the estimated benefits in favor of vocational education.

Methodology and the Model

Educational services produced by schools are both a consumption good and an investment good. If one pursues education because knowledge is desired for its own sake, then educational services can be treated as a consumption good. However, educational services also have an impact upon future occupational choices and earnings and for this reason they can be treated as an investment good.

During the past decade, economists have testified to the importance of the investment nature of education. They have found that education affects the structure of wages in the labor market and thereby the structure of relative earnings [1]. Education is also considered an important factor affecting the amount of savings and capital formation and, in turn, the longrun economic growth of the economy [3, 4]. This paper is concerned with investment aspects of vocational and comprehensive education. Although the importance of the consumption aspect of education is recognized, we have no data available to analyze this aspect of the problem.

The measurement of economic returns for high school graduates who do not attend college will be considered in terms of their labor market performance after their graduation. Of course, this measurement does not include all economic returns or other nonmonetary returns. Since the general goals of the students in the two types of high schools may differ—for instance, the vocational student may put more weight on earnings than on "status"—the comparison between the purely economic returns for the two types of students is only a partial evaluation of the returns to secondary schooling. Remember that the analysis is limited to students who do not go to college.

Finally, the differences in labor market performance among the two types of high school graduates who do not attend college are not due solely to their different training. Factors such as sex, IQ, race, and family background are also very important. Therefore, it is necessary to control for these sociodemographic characteristics in

order to estimate the net effect of curriculum for the two types of graduates with respect to their labor market performance. Having obtained the net monetary benefit of these two types of education, a comparison between costs and benefits can be made.

The Dependent Variables

As stated previously, the purpose of this study is to compare the economic performance of high school graduates in the labor market. The data permit us to evaluate a six-year period following graduation. The measurements of performance are: (1) average monthly before-tax earnings for the six-year period following graduation, and (2) the percent of time employed in the six-year period following graduation. In order to measure the changes in performance, the statistical model includes: (1) average monthly earnings before taxes in the first year after graduation, (2) average monthly earnings before taxes in the sixth year after graduation, (3) the percent of time employed in the first year following graduation, and (4) the percent of time employed in the sixth year following graduation. Time spent in the military, a significant factor in the post-graduation experience of males, was excluded when earnings and employment measures were calculated.

Earnings before taxes are considered as social economic benefits, since the incremental increase in before-tax earnings which are due to the investment in vocational or comprehensive education represent an explicit measurement of the monetary returns of education to society. The use of the time employed as a dependent variable gives an explicit measurement of employment as a policy goal of education.

The Independent Variables

There are seven independent variables which are conceptually relevant in the model: city of graduation, type of school, sex, IQ, race, marital status, and father's education. Except for IQ and father's education, each of these variables is expressed in terms of dummy variables; that is, a dichotomous classification for each condition of response to the variable. For instance, if a graduate is a male, we designate the value of 1. A value of zero is assigned to female graduates.

The variable for city of graduation represents the different industrial structure, labor market structure, price levels, and other economic and demographic factors of a given city which prevailed when the student graduated. Such factors will have an impact on earnings and employment of high school graduates. The variable for type of school of a graduate is used to measure the difference, if any, in labor market performance between these two types of graduates.

The variables of sex, IQ, race, marital status, and father's education represent a graduate's personality, motivation, intelligence, and socioeconomic background. These variables are included in the equation to permit a measure of the net effect due to different types of education.

These high school graduates have four different times of graduation, January and June of 1959 and January and June of 1960. Two sets of

dummy variables to control for time of graduation were introduced in the equation, but their effects were insignificant, and they had only a negligible influence. Therefore, they were not included in the final equation. There are additional relevant independent variables which may affect a graduate's labor market performance, such as military experience, voluntary non-labor force participation, and post-high school training. These variables will be examined later in the analysis.

Data

The basic data for the study were obtained from the responses to a mail questionnaire sent in 1966 and 1967 to some 8,300 persons who had graduated in January and June 1959 and January and June 1960 from senior high schools of three major cities, one of which is located in the upper Midwest and the other two on the East Coast. The principal focus of the questionnaire was on the six-year post-graduation labor market experience of the graduates.

There were 2,767 usable questionnaires returned, a response rate of one-third. The nonresponse group was almost equally divided between persons for whom valid addresses existed—that is, questionnaires were delivered to them—and persons with dead letter addresses. It is possible to examine nonresponse bias only among those nonrespondents whose addresses were current. From this group a random sample of 450 graduates was selected and interviewed in person. Of these, 226 did not attend college. For this group we fit the same regression function, using earnings and employment as dependent variables, as we used for the mail response sample. Given the appropriate calculations, this is interpreted as a test of whether the respondents to the mail questionnaire differed from the personally-interviewed nonrespondents. The test of the regression results indicated that two samples came from the same population.[2]

Before we present the findings of regression analysis, it would be helpful to display the sample's sociodemographic characteristics with respect to earnings and employment. Table 1 shows the gross differences of earnings and employment between the groups. Multiple regression analysis will be used to control for the effects on earnings and employment of a number of such variables simultaneously.

Statistical Results

This section will first present the regression equations for the sample of 2,767 observations. Then, to overcome the interaction factors among the independent variables in the model, we will separate the sample on the basis of sex and ethnic origin (white and nonwhite) and estimate separate regression equations for each of the four sample subsets.

[2] The differences between the two samples can be tested in terms of regression coefficients in two regression equations (J. Johnston, *Econometric Methods* [New York: McGraw-Hill, 1963], pp. 136–138). We use the same basic independent variables as in Table 2 to estimate average six-year period before-tax monthly earnings. The error sums of square are obtained for the mail questionnaire sample, the personal interview sample, and the combined two samples, respectively. We can formulate an F-ratio to test the hypothesis that the two samples are from the same population. The computed F-ratio is 1.598; therefore we do not reject the hypothesis.

TABLE 1.—THE RELATIONSHIPS BETWEEN SELECTED SOCIODEMOGRAPHIC VARIABLES AND EARNINGS AND EMPLOYMENT DURING THE 6-YEAR POSTGRADUATION PERIOD

Variables	1st year after graduation		6th year after graduation		Average in 6 years	
	E[1]	N[1]	E	N	E	N
Total sample (2,767)[2]	184	59.2	339	70.9	264	66.6
	[3] (163)	(42.1)	(250)	(42.1)	(170)	(31.4)
Curriculum:						
Comprehensive (1,687)	171	50.2	336	70.8	250	62.7
	(123)	(21.2)	(210)	(41.6)	(167)	(24.8)
Vocational (1,080)	232	73.3	343	71.1	285	72.7
	(143)	(27.9)	(236)	(43.3)	(165)	(25.4)
Labor market:						
City A (1,237)	189	60.9	329	71.3	260	67.1
	(163)	(42.4)	(240)	(42.3)	(162)	(31.4)
City B (483)	235	70.9	318	74.0	293	72.5
	(159)	(43.2)	(233)	(28.3)	(175)	(35.9)
City C (1,047)	154	50.9	362	70.5	255	62.5
	(159)	(42.7)	(266)	(41.3)	(174)	(31.9)
IQ:						
Low 89 or less (325)	167	56.1	303	64.5	255	63.7
	(141)	(32.4)	(241)	(34.4)	(178)	(27.3)
Average 90–100 (1,818)	179	57.2	329	68.8	261	65.4
	(152)	(40.3)	(252)	(38.2)	(182)	(29.4)
High 111 or above (624)	196	60.3	354	74.6	272	68.9
	(162)	(43.6)	(254)	(39.2)	(192)	(26.2)
Sex:						
Male (952)	204	56.9	509	90.0	355	74.3
	(199)	(43.0)	(228)	(25.8)	(195)	(30.3)
Female (1,815)	174	60.4	251	60.9	216	62.5
	(140)	(41.6)	(212)	(45.3)	(131)	(31.2)
Race:						
White (2,376)	197	61.9	346	70.0	275	67.7
	(167)	(41.7)	(257)	(42.7)	(173)	(31.2)
Nonwhite (391)	105	42.4	299	76.7	195	59.9
	(116)	(41.0)	(191)	(37.3)	(124)	(31.7)

[1] E denotes average before-tax monthly earnings in dollars. N denotes percent of time employed.
[2] The numbers beside each sociodemographic characteristic are the sample size of the characteristic in question.
[3] The values in parentheses below the group means are the standard deviations of the group means.

Effects of Vocational Education on Earnings

Table 2 presents the regression analysis of average before-tax monthly earnings and percent of time employed of the total sample of non-college high school graduates in the six-year period following graduation. There are several phenomena to be observed from the results of this earnings analysis.

1. During the first year after graduation, the vocational graduates earned, on net, an average of $54 more per month (or $54×12=$648 more in the first year) than did the comprehensive graduates. The value of $54 is shown as the coefficient of vocational curriculum variable under the column of "1st year after graduation." During the sixth year after graduation, the vocational graduates earned $16 more per month on the average (or $16×12=$192 more for the year) than did the comprehensive graduates. However, this difference is not statistically significant. Thus the earnings streams of the two types of graduates appear to be converging over time.

This potential convergence could be due to several factors, such as changes in the productivity of the two types of graduates or changes in the structure of occupational demand. Changes in productivity may be occurring for several reasons. First, motivational and intellectual characteristics could be exerting an increasing impact on labor market performance. The average IQ of the vocational graduates is 103.0 with a standard deviation of 11.4; for the comprehensive graduates it is 106.8 with a standard deviation of 12.9.

TABLE 2.—AVERAGE BEFORE-TAX MONTHLY EARNINGS (IN DOLLARS) AND PERCENT OF TIME EMPLOYED FOR HIGH SCHOOL GRADUATES

Variables	1st year after graduation		6th year after graduation		Average in 6 years	
	E [1]	N [1]	E	N	E	N
Curriculum:						
Comprehensive [2]						
Vocational	54	14.4	16	3.7	43	9.6
	[3] (6)	(1.6)	(9)	(1.6)	(6)	(1.2)
Labor market:						
City A [2]						
City B	19	4.8	−14	−.5	12	2.7
	(8)	(2.1)	(12)	(2.1)	(8)	(1.6)
City C	−53	−14.1	30	−.9	−20	−7.3
	(7)	(1.7)	(9)	(2.7)	(7)	(1.3)
Male	26	−4.5	259	29.0	137	11.1
	(6)	(1.6)	(9)	(1.6)	(6)	(1.2)
IQ	−1.5	−.43	1.6	.13	−.5	−.24
	(.3)	(.06)	(.4)	(.06)	(.3)	(.05)
White	112	26.6	10	−7.5	76	11.4
	(9)	(2.3)	(12)	(2.2)	(9)	(1.7)
Marital status:						
Married [2]						
Single	−20	−5.6	57	20.7	−1	4.7
	(7)	(1.7)	(9)	(1.7)	(7)	(1.3)
Separated, widowed, divorced	−5	−5.2	15	9.7	−4	−.6
	(14)	(3.7)	(20)	(3.6)	(14)	(2.8)
Father's education	−5.7	−1.91	−.1	−.03	−4.0	−3.13
	(.9)	(.23)	(1.3)	(.23)	(.9)	(.18)
Intercept	296	103.0	39	47.3	229	86.5
Adjusted coefficient of determination [4]	.14	.15	.26	.16	.20	.11
Number of observations	2,767	2,767	2,767	2,767	2,767	2,767

[1] Both E and N are dependent variables; E denotes average before-tax monthly earnings, and N denotes percent of time employed.

[2] This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor. Thus, for example, in the 1st year after graduation, vocational graduates earned $54 more per month than did comprehensive graduates.

[3] Values in parentheses are the standard errors of the coefficients.

[4] This statistic indicates the proportion of total variation in the value of the dependent variable which is accounted for by all the independent explanatory variables in the regression equation. Thus, 14 percent of the variation in earnings in the first year after graduation is accounted for by the combined effect of curriculum, labor market, sex, IQ, race, marital status and father's education.

A second possibility is that the two types of graduates have had differential amounts of post-high school training (other than on-the-job training). The effect of post-high school training on the earnings of each sample was estimated with separate equations. For the first year after graduation, the size of the partial regression coefficient of earnings with respect to post-high school training is larger (and negative in sign) for the comprehensive sample than it is for the vocational sample. Thus, the comprehensive sample experienced larger opportunity costs (direct costs were not measured) for post-high school training than did the vocational sample. However, in the sixth year after graduation, vocational students who took post-high school training experienced a larger amount of earnings as a result of this training than did their comprehensive counterparts. Therefore, post-high school training gives mixed effects regarding the apparent convergence in earnings of the two types of graduates.

2. The results indicate that over the entire six-year period after graduation, the average vocational graduate earned $43 more per month (or $3,096 more in six years) than the average comprehensive graduate, after controlling for all other variables in the model.

3. It is worthwhile to make a brief comparison between the results of this study and the results obtained by Corazzini [2] and Taussig [5]. Corazzini estimated the difference in earnings between vocational and comprehensive high school graduates based on differences in the

average starting wage for machine operators in Worcester, Massachusetts. He estimated the difference in earnings to range from $80 to $560 per year. Taussig estimated that the wage differentials of males employed in training-related occupations in New York City increased by $0.12 per hour over the time period of his study. This difference would result in a differential of $240 per year (assuming a 2,000 hour work year).

The results of the present study indicate that vocational graduates gained an average of $516 per year over the six-year period after graduation. The difference in the results between this study and the studies of Corazzini and Taussig may be attributable to one or more of the following reasons: First, both Corazzini and Taussig did not control for a number of sociodemographic factors, so their estimated earnings are gross rather than net. Second, both of them used wage rates instead of earnings to calculate the benefits of graduates. Earnings are, of course, a product of the wage rate and the amount of time worked. Third, the samples for each study were obtained for different cities in different time periods.

4. An examination of the effects of sociodemographic variables reveals that during the first year the male graduate in general earned $312 more than the female graduate. He earned $3,108 more than the female graduate during the sixth year after graduation. Males generally earn higher wages than females and tend to work more, since females generally marry soon after graduation and tend to leave the labor market.

5. Race is a significant factor in explaining the differences in earnings among graduates. During the first year after graduation the white graduate gained $112 more in average before-tax monthly earnings than the nonwhite graduate. However, the differences in earnings between white and nonwhite graduates become small during the sixth year and are not statistically significant. Part of the explanation for this lies in the sex factor. In an examination of separate regression equations for white and nonwhite males and females, we find that the nonwhite female earned more than the white female during the sixth year because more nonwhite than white females are likely to be in the labor force at that time. These results will be discussed when we analyze male and female graduates separately in the latter part of this article.

6. The confusing signs of the marital status variable are due to interaction effects with sex. When separate regressions are fit for each sex, we find that both single males earn less and single females earn more than their married counterparts.

Effects of Vocational Education on Employment

The analysis of the employment experience of the two types of graduates gives results which are consistent with those of the earnings equation shown in Table 2. During the first year after graduation, the vocational graduates were employed, on net, 14.4 percent (or about 7.5 weeks) more than the comprehensive graduates. During the sixth year the vocational graduates were employed 3.7 percent (or about 1.9 weeks) more than the comprehensive graduates. On the average, vocational graduates were employed 9.6 percent (or about 30 weeks) more

than the comprehensive graduates during the six-year period following graduation.

The effect on employment of the graduates' sex, IQ, race, labor market location, marital status, and father's education is similar to the effect of these variables on earnings.

Information was obtained on the length of time it took the graduates to find their first jobs during the first year after graduation. This variable is also considered to be a function of location of labor market at time of graduation. type of school, sex, IQ, race, marital status, and father's education. The results support the findings on employment during the first year after graduation. (Regression results will not be presented here.) Given the same sociodemographic conditions in general vocational graduates took 11 weeks less than comprehensive graduates to find their first jobs after graduation. If we impute the graduates' first-year average weekly earnings as their weekly opportunity cost for job search, then the vocational graduates on the average had earned \$737 ($\$67 \times 11$) before comprehensive graduates started their first jobs.

It is also of interest to note that nonwhite graduates took 12 weeks more than white graduates to get their first jobs. There was no statistically significant difference between males and females in the time it took them to get their first jobs.

Effects of Post-High School Training on Earnings and Employment

We introduced a dummy variable into the regression equation to indicate whether or not a graduate completed a post-high school training program after graduation. This variable is not statistically significant in the equation for earnings and employment for the six-year period, but during the first year after graduation, for those who had post-high school training, both earnings and employment are less than otherwise, by \$44 per month (\$528 for the year) and 6 weeks, respectively. This is expected since such training would reduce an individual's ability to be a full-time member of the labor force. On the other hand, during the sixth year, those who had post-high school training earned \$33 more per month (\$396 for the year) and were employed 2 more weeks than those who had no such training. These values are statistically significant at the .01 level. However, without more complete cost information, we cannot assess the net economic advantage of this post-high school training.

Effects of Interactions

The discussion in the preceding sections suggests that interactions exist between sex and other sociodemographic variables and between race and other sociodemographic variables that determine the levels of earnings and employment among graduates. Therefore it is necessary to estimate earnings and employment equations separately on the basis of sex and race. In fact, male and female graduates have different labor force experiences, such as military experience which is usually specific to males and voluntary non-labor force participation which is largely specific to females.

TABLE 3.—AVERAGE BEFORE-TAX MONTHLY EARNINGS (IN DOLLARS) AND PERCENT OF TIME EMPLOYED FOR MALE AND FEMALE, WHITE AND NONWHITE HIGH SCHOOL GRADUATES

Sample groups	1st year after graduation		6th year after graduation		Average in 6 years	
	E[1]	N[1]	E	N	E	N
Male:						
Comprehensive[2]						
Vocational	41	9.1	33	2.5	44	6.2
	[3] (13)	(2.8)	(15)	(1.8)	(13)	(2.0)
Female:						
Comprehensive[2]						
Vocational	62	18.5	14	4.6	47	12.3
	(17)	(1.9)	(10)	(2.1)	(16)	(1.5)
White:						
Comprehensive[2]						
Vocational	56	14.9	14	3.3	43	9.5
	(7)	(1.7)	(10)	(1.7)	(7)	(1.3)
Nonwhite:						
Comprehensive[2]						
Vocational	34	9.6	43	7.1	43	9.4
	(12)	(4.1)	(19)	(3.8)	(12)	(3.2)

[1] Both E and N are dependent variables; E denotes average monthly earnings, and N denotes percent of time employed.
[2] This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor. Thus, in the 1st year after graduation, male vocational graduates earned, on the average, $41 more per month than their comprehensive counterparts. The variables of labor market, IQ, marital status, and father's education are included in the equation, but their coefficients are deleted from this table.
[3] Values in parentheses are the standard errors of the coefficients.

The regression analysis is presented by separating sex and race into four sample groups—male, female, white, and nonwhite. We use the same variables as in Table 2 to analyze the graduates' labor market performance, except for the deletion of the sex or race variables in the regression equations, respectively. Table 3 summarizes the regression coefficients for vocational graduates among these four sample groups. The coefficients of other variables are omitted for space considerations. Each coefficient in Table 3 represents the result of one regression equation.

Male and Female Graduates.—In Table 3 we see that male vocational graduates earned $41 per month more than male comprehensive school graduates during the first year after graduation and $33 more in the sixth year. Female vocational graduates earned $62 per month more than female comprehensive school graduates during the first year, but this difference dropped to only $14 by the sixth year. It is interesting to note that although the white male vocational graduate earned more on the average than the nonwhite male vocational graduate during the sixth year, there is no significant difference between white and nonwhite female vocational graduates during the sixth year.

Table 3 also presents the employment experiences of male and female graduates. Again, the sign and statistical significance of both the male and female employment equations are consistent with the respective male and female earnings equations. The positive effects on the percent of time employed attributable to vocational schooling apply to both males and females, and these effects diminish by the sixth year. The coefficients of the marital status regressors indicate that single females have more time employed, while there is no difference in time employed between single and married males.

Two important activities which affect the employment and earnings of males and females in special ways are military experience for males and marriage for females. A military experience variable in the male equation was found to have no statistically significant effect on either earnings or employment.

In another test, separate regressions were fit for only those female graduates who remained in the labor force. With this restricted sample, the earnings of female vocational graduates were found to be higher by $28 per month and employment greater by two weeks compared to female comprehensive graduates during the sixth year after graduation. The results are consistent.

White and Nonwhite Graduates.—Table 3 also presents estimates of earnings and employment differentials for white and nonwhite graduates. These results indicate that both white and nonwhite vocational graduates are relatively better off than their respective comprehensive counterparts. (Recall, however, that only those graduates of the two schools who did not go to college are being compared.) Earnings and employment differences between white and nonwhite male graduates are twice the differences between white and nonwhite female graduates.

The adjusted coefficients of determination (R^2) for equations of nonwhite graduates are less than those for the equations of white graduates. The implication is either that there are more random factors or error-in-measurements for the nonwhite groups or that the variables omitted from these equations are more important for nonwhites.

TABLE 4.—NET EFFECTS ON EARNINGS (IN DOLLARS) AND EMPLOYMENT, VOCATIONAL VERSUS COMPREHENSIVE GRADUATES FOR SEPARATE REGRESSIONS BY RACE AND SEX

Sample groups	1st year after graduation		6th year after graduation		Average in 6 years	
	E [1]	N [1]	E	N	E	N
White male:						
Comprehensive [2]						
Vocational	43 [3] (14)	9.0 (3.0)	30 (16)	2.0 (1.8)	44 (14)	5.7 (2.1)
Nonwhite male:						
Comprehensive [2]						
Vocational	21 (27)	9.0 (8.7)	61 (38)	7.1 (5.5)	49 (29)	9.7 (6.1)
White female:						
Comprehensive [2]						
Vocational	65 (7)	19.5 (2.1)	9 (11)	4.4 (2.4)	46 (7)	12.7 (1.6)
Nonwhite female:						
Comprehensive [2]						
Vocational	42 (13)	10.8 (4.7)	32 (21)	5.4 (4.5)	43 (13)	9.3 (3.6)

[1] Both E and N are dependent variables; E denotes average monthly earnings, and N denotes percent of time deployed.
[2] This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor. Thus, for instance, for the 1st year after graduation white male vocational graduates earned $43 more per month, on the average, than their comprehensive graduate counterparts. The variables of labor market, IQ, marital status, and father's education are included in the equation, but coefficients are deleted in this table.
[3] Values in parentheses are the standard errors of the coefficients.

Finally, a refined regression analysis is presented by separating sex and race into four sample groups—white male, nonwhite male, white female, and nonwhite female. Table 4 summarizes the regression coefficients for vocational graduates. We have used the same method of presentation as discussed in Table 3.

Although the nonwhite male vocational graduates earn more than the graduates of comprehensive schools, the differences are not statistically significant, as were the better performances of white male and female vocational graduates, compared to their respective white counterparts among comprehensive graduates. Whether these results imply that nonwhite males should be indifferent between

choosing vocational and comprehensive education depends, hypothetically speaking, on whether they are focusing on the relatively high expected values of the earnings differentials (an average of $49 in favor of vocational schooling) or on the risk revealed by the high variance of these differentials.

The Costs and Returns

The above analysis indicates that on the average over the six-year period noncollege vocational graduates did much better than noncollege comprehensive graduates in terms of earnings and employment. However, it is also widely known that the costs of vocational education are higher than those of the comprehensive school. The question is, then, does vocational education still pay off if we compare costs and returns of the two types of high school education?

The length of training for high school students for all curricula is three years in this study. Cost analysis is performed by pooling cross-section cost data for the fiscal years 1956 through 1960. Only City A has both capital cost and current cost information. Therefore we will restrict our comparison between types of schooling to City A.

We imputed annual capital costs for City A by employing the capital recovery factor. In our use of this technique we assumed an average building life of 60 years and a social opportunity cost rate of capital of 10 percent. The total (capital and current) costs are related to average daily attendance (ADA). The estimated marginal costs at ADA for vocational education are $525. That is, total costs increase by $525 for each additional vocational student in ADA who is added to the program. Marginal costs at ADA for comprehensive education are $321.[3] The difference in opportunity costs among vocational and comprehensive graduates while they are attending high school is assumed to be negligible.

Monetary returns for high school graduates in City A are obtained by estimating the regression coefficients based on City A samples by following the model presented in Table 2. The estimated earnings for vocational graduates are higher than for comprehensive graduates by $52 per month, or $624 more on the average per year over the six-year post-graduation period.

Given the method of estimating costs and returns for high school education in City A, several investment measures can be considered: net present value, the benefit-cost ratio, and the internal rate of return. However, the measured earnings in this study are in terms of differences between two types of graduates. Therefore, the three estimated investment criteria used in this study are in terms of the difference in net present value between vocational and comprehensive education, the ratio of difference in benefits to difference in costs between the two types of education, and the rate of return for costs and benefits differences between the two types of education.

If we discount at a 6 percent interest rate, the difference in net present value between vocational and comprehensive education is $2,031 for the six-year period following graduation. Vocational education yields a net present value of $1,534 more than comprehensive education

[3] Incidentally, the average total current expenditures per ADA are $632 for vocational high schools and $440 for comprehensive high schools during 1957–60 in City A. The difference in average total current expenditures between these two types of schools is very close to the difference in marginal costs between the two types of schools. For detailed discussions of the estimated cost function, see E. W. Stromsdorfer, T. W. Hu, and M. L. Lee, "Theoretical and Empirical Problems in the Analysis of the Economic Costs of Vocational Education," 1968 *Proceedings of the American Statistical Association*, pp. 144–52.

at the 10 percent interest rate. The ratio of difference in benefits to difference in costs between the two types of education is 4.7 if we discount at 6 percent. At 10 percent interest, the ratio is about 4.0.

Based on the estimated differences in costs and benefits, a rate of return can be estimated. This rate will equate costs and benefits differences between two different cost-benefit streams. The estimated rate of return is 56.8 percent. Given the study sample, this implies that at any discount rate less than 56.8 percent, the net present value of the cost-benefit stream for vocational education is greater than the net present value of the cost-benefit stream for comprehensive education.

Thus, when one is attempting to choose between two investment alternatives on the basis of net present value, benefit/cost ratio, and internal rate of return, vocational education is preferred over comprehensive education for those students who will not go to college.

The above implication, however, is strictly true under some fairly severe constraints. The benefit-cost comparison speaks only for the City A sample of high school graduates who do not attend college and assumes that the past experience adequately represents the future. Also it assumes that vocational and comprehensive high schools are not substantially different in the nonmonetary benefits conferred.

Concluding Remarks

Educational services can be considered not only as a consumption good but also as an investment good. This study limits itself to the investment aspect of vocational versus comprehensive high school education. Based on six-year labor market experiences of high school graduates who did not attend college, the analysis of this study suggests that the monetary returns of vocational graduates are higher than those of comprehensive high school graduates—for those graduates who do not go to college. The earnings differential between these two broad curricula may be disappearing as these graduates move along their lifetime earnings profiles. However, based on averages over the six-year period for the sample of City A graduates not attending college, investment in vocational education is economically efficient, if money costs and benefits are relatively complete indexes of total economic costs and benefits. Finally, this study ignores all noneconomic costs and benefits of the two types of secondary education, although it is recognized that these noneconomic factors are important in any analysis of the total impact of education.

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BENEFITS AND COSTS OF MANPOWER TRAINING PROGRAMS: A SYNTHESIS OF PREVIOUS STUDIES WITH RESERVATIONS AND RECOMMENDATIONS

By JOE N. NAY, JOHN W. SCANLON, *and* JOSEPH S. WHOLEY*

INTRODUCTION

Over the past decade, Federal manpower training programs have been the object of a number of benefit/cost analyses. What can be inferred from this body of information to guide policymaking and program management? To answer this, the major published manpower program benefit/cost analyses, plus several unpublished data sources, have been reviewed and synthesized.[1]

A wide and bewildering range of benefit/cost ratios are found in this literature. The wide range of ratio values seems to stem largely from two problems:

- Uncertainty over what constitutes cost and benefit. Definitions vary so much that separate studies relying on identical data produce different results.
- Inadequate data. In many cases, the data collected may not fairly reflect the average or typical impact of the program under study.

The first problem is dealt with in this report by extracting some basic cost and benefit elements from each of the studies. A set of benefit/cost ratios is then synthesized from these elements with all of the calculations performed in as nearly the same manner as possible. This normalization of existing data produces a range of values for the benefit/cost ratios from each program that is at least compatible in definition.

Exploration of the second problem—dealing with data that are not truly representative of the program or its impact—leads to doubts about the usefulness of the past results. It is concluded that unfortuitous combination of differences in research design and wide natural variations within programs have led to unreliable cost and effectiveness findings for manpower training programs.[2] The numbers imply a comparability that does not appear to be justified because of the way apples and oranges—and some lemons—are mixed together.

This study has four main sections. Section I presents the synthesis of past studies adjusted to a common basis. Section II highlights some

*Members of the Urban Institute staff carried out this analysis between April and June 1971, supported by a contract with the Joint Economic Committee. It draws on Federal manpower training program evaluations and data available at the Institute and the U.S. Department of Labor.

[1] The Institute staff has just completed a review of much of this material in the course of producing the design of a new system for evaluation for use by the Department of Labor. This design is reported in: John W. Scanlon, *et. al., An Evaluation System to Support Planning, Allocation and Control in a Decentralized, Comprehensive Manpower Program*, Final Report, The Urban Institute, March 1971.

[2] The word "program" is used throughout this paper to indicate one of the various well-defined manpower training programs of the Federal Government considered in its entirety. Thus, the Concentrated Employment Program (CEP) is characterized as a national program, while an individual CEP center operating in the field is a "project" within that program.

of the sources of potential error found in the earlier studies and discusses the significance for decisionmakers of the wide variation found within manpower training programs. Section III outlines the problems involved in relating benefit/cost findings for manpower training programs to national economic measures. Section IV discusses manpower training information that Congress should require to enhance its ability to fulfill an overview role. These sections are preceded by a short summary of findings and conclusions. Material amplifying many of the points is contained in the appendices.

Findings and Conclusions

- The manpower training benefit/cost studies reviewed have methodological limitations which make it impossible to be sure that the true average results of the programs were measured.
- Average benefit/cost ratios for entire manpower training programs hide the quite large variations in benefits and costs that occur within the programs from project to project. Several studies reviewed dramatically illustrate this within program variation.
- Because of the first two points, it is risky to try to use the findings about average benefit/cost ratios of the various programs as a basis for deciding which programs should be expanded and which given less priority.
- A more productive approach appears to be the use of detailed cost and effectiveness data to identify successful projects within the programs—and to attempt to use the experience of those projects to help improve the less successful ones.
- To perform its overview of manpower training programs, the Congress should request a more useful set of information from the Department of Labor on a continuous and systematic basis. Even the best of this benefit and cost information, however, will be more appropriate for detecting trends and much less reliable for measuring the absolute value of a certain program or project at any given time.
- Congress should include in manpower legislation the requirement for full, accurate data collection that follows consistent definitions across all programs. Once these data gathering processes are followed, project and program improvement can be pinpointed and followed from year to year.
- Calling attention to weaknesses in the benefit/cost information currently available for judging manpower training programs should not be taken as an indictment of the programs. It simply means that at the present time, no one knows exactly how effective the manpower programs are. In addition, successfully moving people from the ranks of the unemployed into jobs, or from marginal jobs to more productive ones, generates benefits that go beyond pure economic measures.
- At present, most benefit/cost analyses and evaluations deal only with the impact of training on the trainees themselves. To realize the potential of manpower training programs as economic tools requires more understanding of the impact of successful training on the general labor market. Congress should request that the various theories about this impact be validated through field measurement in a major research effort by the Department of Labor.

• In summary, all contradictions and inconsistencies have not been eliminated in this synthesis of previous manpower training cost/benefit studies. Interpretations and comparisons of benefit/cost ratios based on the numbers alone, without regard to the peculiar viewpoints and definitions behind each of the numbers used, are almost certain to be misleading.

I. Synthesis of Results of Past Analyses and Evaluations of Manpower Training Programs

The approximately two dozen studies and reports from which this synthesis is drawn give ratios of benefits to costs that range from values as low as 0.2 to far over 100.[3] The wide range of results is due to different viewpoints, different definitions,[4] technical deficiencies, and problems with sampling data—all compounded by the actual wide variations in effectiveness within each program sampled.

We have attempted to eliminate many of the definitional problems by adopting a single basis for the calculation, then extracting the relevant elements of costs and benefits from each of the studies. We cannot retrospectively put the methods of the studies on a common basis. However, it is possible to put some of the basic results obtained by the studies into a common framework, and that has been done here.

Definitions of Costs and Benefits

Definitions were selected that would encompass as many of the past results as possible. Program costs were taken to be simply the administrative and training costs of government. Benefits were based upon the increase in before-tax earned income from the year before training to the year after training. Neither foregone earnings, value of the work performed, nor contributions of private employers were used in calculating costs or benefits. Only for MDTA on-the-job training (OJT) and job opportunities in the business sector (JOBS) were enrollee stipends included in the costs.

Incremental income gains were adjusted to represent the gain in the year following training, projected as a fixed gain for a 10-year period and discounted to present value at an interest rate of 10 percent.[5]

Explanation of Synthesis

The results of the synthesis are shown in figure 1. The range within which the benefit/cost ratios fell when all were calculated on a common basis is indicated. Points shown are predominantly averages for an entire study or major portion of a study.

The time period of the training represented by the points in figure 1 are as follows:[6] Neighborhood Youth Corps, out-of-school (NYC O/S)—primarily 1965–66; job opportunities in the business sector

[3] Some of these disparate values come from selecting different data from the same program, while others come from different interpretations of the same data. For discussion of an example of the latter, see Ribich, 1968.

[4] An example of the variations that can be produced by varying the viewpoint and the definition for creating the benefit/cost ratio (even when the same data are in use) is included in appendix A. The synthesis in this section is an attempt to remove most of this type of variation from the results.

[5] This convention is one suggested by the Office of Management and Budget for projecting benefits of social programs and is used here simply to provide a common basis for calculation. Further discussion of the methods used in this paper are given in appendixes A and B. For a sophisticated discussion of the actual flows out of and into poverty, see Terence F. Kelly, "Factors Affecting Poverty: A Gross Flow Analysis," in *The President's Commission on Income Maintenance Programs—Technical Studies*, pp. 1–81.

[6] More detail is given in appendixes C and D concerning the source material and data used in calculating the ratios.

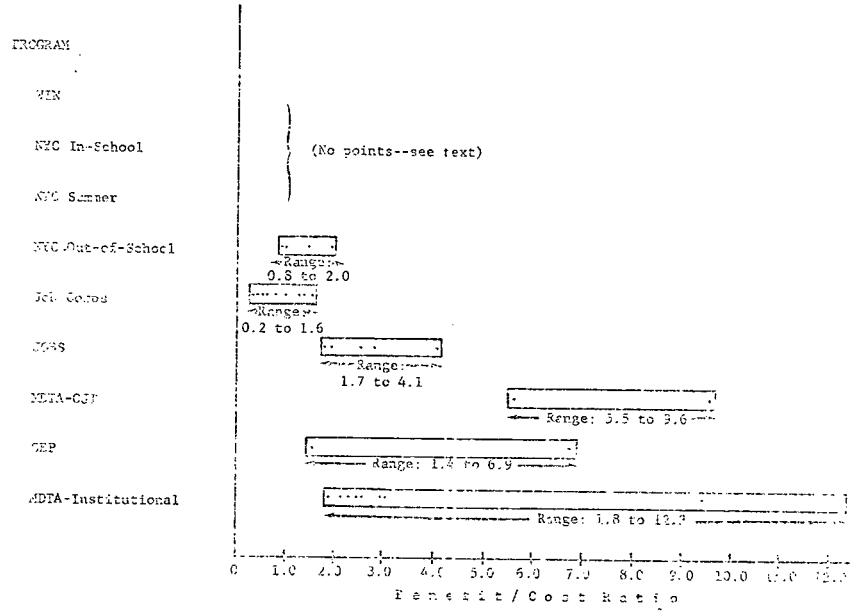

FIGURE 1.—Range of average benefit/cost ratios for major manpower training programs.*

*Points are drawn from data in 22 reports and studies—see appendixes C and D.

(JOBS)—1968 and 1969–70; MDTA on-the-job training—1963–65 and 1969–70; MDTA institutional[7]—1962–64, 1964–65, 1967, and 1969–70; Job Corps—1966, 1967, and 1968; and concentrated employment program (CEP)—principally 1968. The available data were examined to see if there was any evidence of systematic variation over time or with economic conditions, but little evidence was found. This does not mean that there are not trends over time in the cost and effectiveness of manpower programs. These studies do not seem to indicate such trends, possibly because of some of the methodological problems recounted below.

After the time and effort required to digest and consolidate the findings of past manpower training research, it is disappointing to have to conclude that sweeping generalizations cannot fairly be drawn from this synthesis. It would be tempting to say that the results indicate, as they appear to do, that JOBS is generally better than Job Corps and NYC O/S; that OJT is generally superior to all three, that institutional training and CEP fall somewhere in between. After a thorough review of the material from which the results come, however, we concluded that such observations would be superficial and misleading. The information available cannot be offered as a basis for informed national decisions by the Congress on programs or funding.[8] There is little assurance that these past results reflect either absolute or

[7] One study, Stromsdorfer (1968), covers ARA institutional training, a predecessor of MDTA institutional

[8] Many of the studies themselves caution on the limitations of their data and tenuousness of their results. Several studies are presented more as exercises in development of method than as reliable benefit/cost analyses of the program. (For example, Muir, *et al.*, on MDTA and Leasco Systems and Research Corp. on CEP.)

relative effectiveness; they are neither accurate nor systematic, so comparisons cannot properly be derived from them. We would be derelict in our responsibility to the committee to indicate otherwise. Some of the reasons for this judgment are given below.

The studies do indicate that, on average, most manpower training programs did achieve at least moderate benefits for many trainees. Whether these wage gains were worth the economic cost incurred is not clearly documented by existing studies.

Programs not Providing Benefit/Cost Data

Note that figure 1 does not include benefit/cost ranges or points for two major programs: Work incentive program (WIN) and NYC in-school and summer program. These have not had sufficient contract or in-house efforts directed an analysis of their benefit/cost ratios to include them in the synthesis. Therefore, these programs are discussed here separately in terms not comparable with the other programs.

Major benefit/cost studies based upon field data have not been accomplished for the WIN program, but two earlier projections provide some guidance.[9] The referenced program memorandum indicates that, if its assumptions are met, a benefit/cost ratio calculated simply from total Government savings and costs would be slightly over one for the entire group entering in any one year. Costs would, of course, be much higher if the proportion of mothers requiring preschool day care increased. That analysis does not include any increases in income due to training, so that any gains of this type would be added to the benefit side of the equation.

A recent analysis [10] of the results of MDTA training on AFDC recipients is relevant here, since such training is one of the services that WIN provides. A sample of 4,024 AFDC recipients who entered training during fiscal year 1969 and who became employed completers showed average wage rate gains of better than $0.50 per hour. Our best estimate based on enrollment and completion figures would be that this represents a present discounted value per enrollee of about $1,300. Since this benefit is also of the same order of magnitude as cost per participant, we would estimate the benefit/cost ratio of WIN to be somewhere around 1 on an economic basis and perhaps as high as 2 when the savings in welfare costs are included. Any attempts to include more mothers with preschool children would tend to lower these ratios, of course.

The NYC in-school and summer programs have had only one major benefit/cost study.[11] The primary purpose of NYC is to encourage students to return to stay in school. Little evidence that it served this purpose was found. Economic considerations from this program are only a secondary goal and the conclusions that should be drawn from this study are not clear, depending heavily upon interpretation of data of high variability.

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[9] Two early analyses which considered project costs and benefits are: (a) Worth Bateman, "An Application of Cost-Benefit Analysis to the Work-Experience Program," *American Economic Review*, vol. 57, No. 2, pp. 80–90, May 1967, and (b) Department of Health, Education, and Welfare, "Program Memorandum on Income Maintenance and Social and Rehabilitation Services Programs of DHEW, Fiscal Years 1970–1974," PM–2, pp. II.3–20, November 1968.

The paper by Bateman contains a detailed break-even analysis for work experience and training. The HEW program memorandum provides projected levels of costs and benefits for the WIN program. Data are becoming available that allow the break-even point for WIN to be assessed in at least a gross way.

[10] Prescott, Tash, and Usdane, "Training and Employability: The Effects of MDTA on AFDC Recipients," *Welfare in Review*, January–February 1971.

[11] Somers and Stromsdorfer, 1970.

II. Some Cautions in Interpreting the Synthesis

The review of many benefit/cost studies of manpower training programs and the attempt to synthesize them according to a common basis led to serious reservations about both the original studies and the synthesis of their findings. These reservations stem from two primary problems—one with the methodology of the studies, the other with the nature of the manpower programs:

- Measurement techniques vary among studies and introduce biases into the benefit/cost ratios, the extent of which cannot be estimated. Since the programs are not homogeneous, these one-time studies using small samples most likely have not captured the true average benefits and costs of each program.
- There is great variability in cost and effectiveness within each Federal manpower training program which makes the overall average benefit/cost ratio, even when accurately obtained, not a particularly useful tool.

These points are discussed next in greater detail. It is important to remember during this discussion that manpower programs are not homogeneous—they are arrayed over time, geography, program concept, target group, and local economic conditions. This makes comparability difficult to achieve. If the true national average were known for each program in figure 1, outright comparison of programs would not be appropriate since many of them serve markedly different target groups. In other words, their distributional objectives differ. Comparability could be achieved by weighting the value of serving the different groups or by considering only those parts of the programs serving similar populations.

Measurement Techniques Differ

The dimensionless benefit/cost ratio offered the possibility of comparing these various programs or parts of programs by adjusting for the effects of all attendant variables. Statistical regression techniques are usually used to handle the various explanatory variables. The studies reviewed do not use a common set of independent variables and the statistical analysis differs among studies. Moreover, the same data have frequently produced different answers because different regression equations were used to extract the elements of benefit and cost from the data.

Every study involved some sampling plan to obtain data. Measures of cost and benefit were then extracted from these data and the ratios of benefits were calculated to costs. One or more of these steps were carried out differently from study to study, so that biases, whose direction and magnitude usually cannot be estimated, were introduced. Consequently, a great deal of what appears as variations in program benefit/cost ratios from study to study is attributable to biases introduced in the measuring process.

One type of inconsistency among studies centers on the sampling plans: they differ from study to study, they are usually not realized in practice, and they are often not for the degree of variation found. For instance, a sample may be designed to produce follow-up data on 1,000 out of 100,000 trainees, but only 500 of those selected produce usable data, or are found at all. Little can be known about how the information about benefits would have differed if the other half of

the responses had been obtained. The size of the realized sample is especially important since the wage and income difference to be detected is not large. It is not unusual to find among a sample of training applicants an average wage rate of $1.50 per hour but with a sample standard deviation of as much as $1.[12] Since an increase in wages after the training program of only 7½ cents per hour produces $1,000 in future benefits discounted to the present,[13] accuracy in pretraining and posttraining measurement and the obtaining of a representative sample can have important impacts on the final benefit/cost ratio. This implies a need for fairly large, well administered, and highly accurate samples, yet none of the studies reviewed met all of these conditions.

Another type of inconsistency arises in the techniques used in measurement of program benefits. Two approaches were used most frequently in the studies reviewed: comparisons of the before-and-after program income for the trainees, and comparisons of the before-and-after income of trainees compared to a control group. Ideally, control groups should be introduced to determine what part of the trainee gain is attributable to training.

Figure 2 reproduces the data of figure 1 and indicates those points drawn from studies where benefits were based on comparison with some type of control group. Most of the other ratios are based on adjusted calculations of income before and after training. A range of answers would have been expected to be shifted downward by the use of control groups, since they generally tend to reduce the benefit estimate. However, many of the control groups that were used are

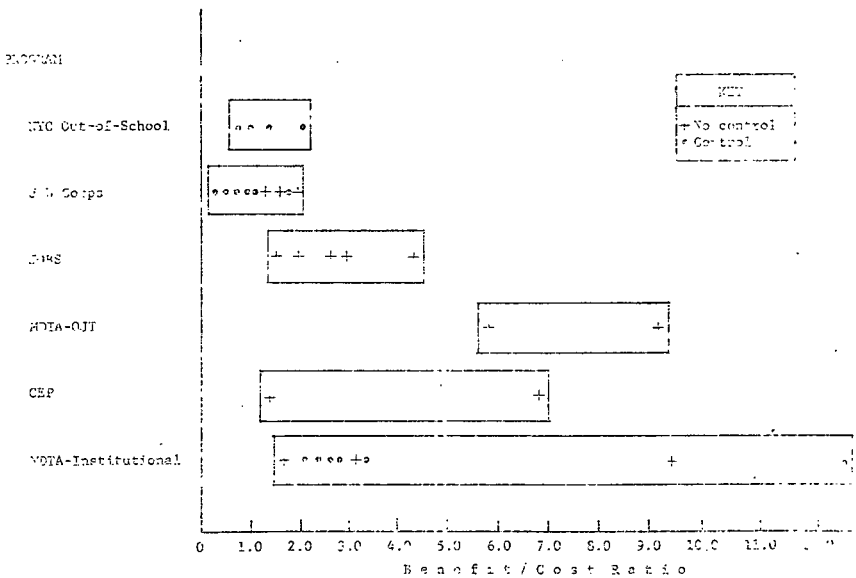

FIGURE 2.—Range of benefit/cost ratios showing findings based on control groups.

[12] This much variation means that only two times out of three would the wage of an applicant fall between $0.50 and $2.50 per hour.

[13] Present value of benefits over a 10-year period, using a 10 percent per year discount rate.

open to challenge on a variety of grounds. Selecting a suitable control or comparison group of persons not receiving training has proven quite difficult in practice.[14] Their use usually introduces another bias into the calculations whose magnitude and direction are difficult to estimate.

In some studies, after-training annual incomes were calculated from the hourly wage rate at job placement upon completion of training or at the time of interview. This, of course, requires certain assumptions about job stability and the extension of hourly rates to annual rates which are not at all well validated. Other studies have tried to capture the actual changes in annual income over time by relying upon longitudinal surveys. The sources of benefit data also vary from the sole use of project files to the use of Social Security files, introducing still another reason to doubt clear comparability among studies.

Up to this point, we have considered what are essentially potential sources of error in the measurement of the average benefit/cost ratio for a program, i.e., all participants in CEP or OJT. An error in sampling or reduction of data inevitably means that the average value has been incorrectly determined. Further, the use of a ratio can magnify mathematically the biases introduced in determinations of costs and benefits.[15] A failure to comply with the sampling plan is especially troublesome, since this produces unanswerable questions about the amount or direction of bias this caused in the findings.

Variation Within the Programs

We turn now to consideration of the extensive variations in benefits and costs within Federal manpower training programs and the information that is lost by working with gross averages. Within a program, variations in effectiveness occur because of differences in backgrounds and characteristics of applicants, services provided, local economic conditions, project management, and the like.

Part of the variation shown in figure 1 results from the fact that some studies focused on only a portion of a program or on a specific group within a program. Whether participants in separate projects were male or female; black, brown or white; youths or adults; illiterates or literates; short term or long term trainees; and whether studies measured the impact on a selected type of participant were bound to affect the findings.

Several of the analyses considered dramatically demonstrate the variation in cost and effectiveness among projects within a program.

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[14] For a recent treatment of this problem, see the papers given at the session on control groups at the recent "Conference on the Evaluation of the Impact of Manpower Programs," June 15–17, 1971, Ohio State University, Columbus, Ohio (to be published in book form).

[15] Consider a ratio, B/C, which has a percentage error of b in a benefit, B, and a percentage error c in the costs, C. Then the value of the ratio including the two errors is:

$$\frac{B+bB}{C+cC}=\frac{(1+b)B}{(1+c)C}.$$

The error in the numerator propagates into the ratio as a direct percentage; the error in the denominator as

$$\frac{1}{1+c}.$$

Therefore, a 50 percent underestimate of cost would multiply the ratio by

$$\frac{1}{1-0.5}=2.0.$$

Consider the concentrated employment program data shown on figure 3.[16] The benefit/cost ratio, as a weighted average of all projects in the program, was found to be 6.8. The adjoining column, however, presenting benefit/cost ratios on a project-by-project basis, shows a very wide range from 2.3 to 15.8. The data from which these ratios were drawn have project costs per enrollee ranging from $544 to $1,793 and project benefits per enrollee from $256 to $1,577.

A good study [17] of institutional training found wide variation in effectiveness among types of training courses. While the average for the sample was +2.1, the ratios for the courses ranged from −0.6 to +21 (see figure 3).

Similar, if not always such dramatic, illustrations can be drawn by examining details of most of the other average benefit/cost ratios shown in figure 1. The point that cannot be stressed too much is that

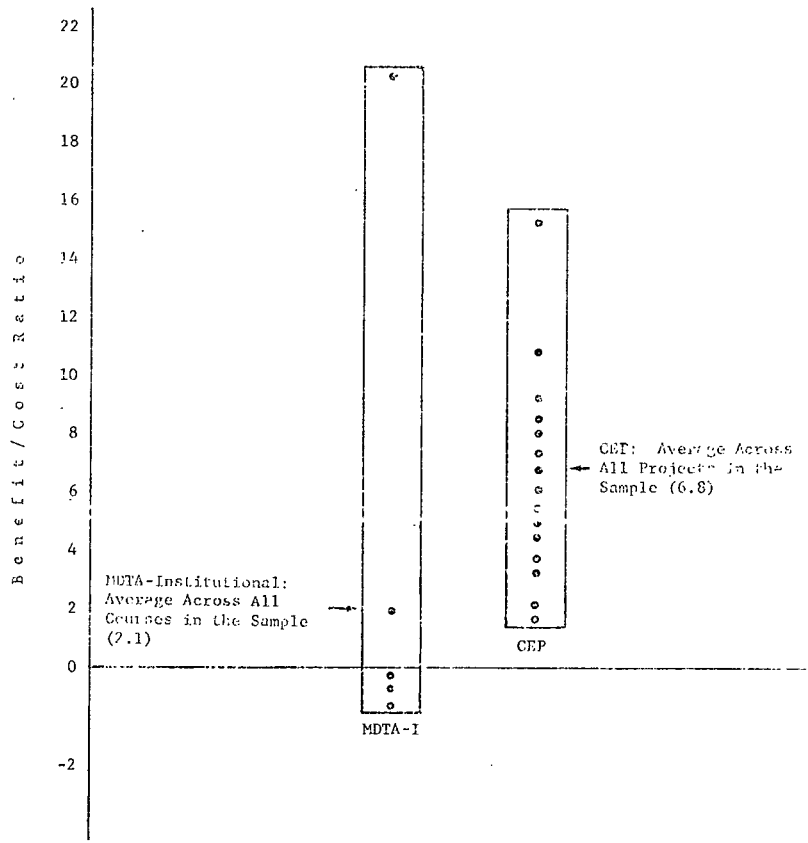

FIGURE 3.—Examples of Benefit/Cost Ratios From Project to Project Within Two National Programs.

[16] Leasco Systems and Research Corp., 1969. This study contains an excellent methodological approach for determining cost and performance on a project-by-project basis.

[17] Borus and Hardin, 1969. This study is exceptional in its handling of various viewpoints and elements of benefit and cost. The presentations in Cain, 1967, and Woltman and Walton, 1969, are also clear and detailed. Borus and Tash, 1970, contains a very good exposition of some of the newer thinking on cost-effectiveness.

manpower training programs are not homogeneous and have wide within-program variations in performance.

Use of the Study Findings

From a practical standpoint, the variations within programs create an even stronger objection to making policy decisions on the basis of the average ratios than does concern about their accuracy. As already stated and for all the reasons given, there is a strong likelihood that the average benefit/cost ratio presented for a specific manpower training program may not represent the true average performance. And even if the true averages were obtained, variations *within* each program appear to be so large as to reduce the significance of the averages.

Emphasis on the cautions against misuse of the findings here is not intended to suggest that studies of cost and effectiveness have no value. While the averages can be misleading about entire programs, the project-to-project variations just described appear to lend themselves to practical applications in program management and improvement. The high benefit/cost ratios point toward projects that appear to have been successful, while those at the other end of the range point toward possible failures or serious problems.

The identification of successes and failures can be made only tentatively from the ratios. Significant variation can be expected to remain unexplained even after the data are adjusted for differences in labor markets and people served. More detailed understanding of the intent and nature and operational setting of the specific projects is needed to interpret variations in performance among projects or parts of a program. To the extent that the reasons for variations are identified, these findings then provide a basis for bringing all projects within a program closer to the effectiveness level of the best ones.

Using average benefit/cost ratios to compare programs or as a basis for allocating resources to them would appear risky and unfounded. Improving the programs through careful attention to the different performance ratings indicated from project to project, on the other hand, seems to hold a high potential.

III. Understanding the National Economic Impact of Manpower Training Programs

The ratios calculated for figure 1 followed the common practice of measuring benefit according to the economic impact upon enrollees. Costs were limited to those incurred in training. Program impact on the Government budget, the economy, and other labor force populations were not accounted for.

The impacts upon trainees and upon the Nation can be quite different. It is conceivable that an applicant group could benefit from a program but that the net effect on the labor market or economy could be zero. For example, there is the often discussed but seldom measured displacement effect—trainees displacing workers who otherwise would have filled the jobs in which the trainee was placed, thereby resulting in no change in unemployment rates or in GNP.

On the other hand, the net effect could be much greater than the impact on trainees alone. One way that a program may have a beneficial impact far beyond its immediate impact on applicants is through the

so-called "vacuum" effects—the trainees could take skill-shortage jobs that otherwise would not be filled and at the same time vacate unskilled jobs into which the unemployed are easily drawn. Multiplier effects may also occur when the filling of certain jobs creates the need for more supporting workers with the same employer.

Unfortunately, these positive or negative national impacts of existing manpower training programs cannot be calculated at this time. Their magnitudes and directions have not yet been determined. The effects on the local labor market and economy of the reentry of a number of workers with additional new skills into the labor market remain unknown because scarcely any validation of these impact theories have been performed through actual measurement in the labor market. Any attempt to extrapolate information about the impact of training on applicants (which can be and have been measured) to the impact on the economy must be based on unsupportable assumptions at this point in time.[18]

This deficiency in understanding can and should be overcome. The gains made by trainees must be related to the behavior of local labor markets by carrying out tests of various proposed models of "secondary" effects against data from actual labor market operation. While there has been a significant amount of theoretical work done on the local labor market, there has been very little empirical work—that is, actual measurement and testing of theories. This latter research should have a high priority within the Department of Labor if manpower training programs are to be designed and used to obtain gross economic effects.

IV. Manpower Training Information Congress Needs and Should Require

The information about the cost-effectiveness of training programs presently available has been found wanting in consistency and usefulness. What steps can Congress take to assure improvement in the future? To answer this, it is first necessary to consider the several facets of manpower training programs over which Congress may exercise its review powers. These include:

- The distribution of training services and benefits among target groups to insure that national distributional goals are met.
- The administration of the national programs to determine whether the programs are improving over time.
- The questions of costs versus benefits to determine whether the programs are worthwhile investments from various viewpoints.
- The use of manpower training programs as economic tools in dealing with unemployment and inflation.

The most valuable information for the purposes of the Congress may well be data that permit comparisons to be made from year to year to detect trends in identically calculated measures of the programs. To improve the accuracy and consistency of such data, the Congress should require that information be gathered in a format

[18] See discussion at "Conference on the Evaluation of the Impact of Manpower Programs," op. cit., especially the session on secondary effects chaired by James Hefner with presentations by McDonnell, Mangum, and Robson.

similar to that shown in a recent Joint Economic Committee publication.[19] The format for distributional data shown there should be adequate and could be provided currently by the Department of Labor. We would modify the cost and benefit data to include for each program: [20]

- Average cost per enrollee.
- Number of enrollees.
- Number of completers (by categories in those programs that have multiple categories of completers).
- Number of employed completers.
- Average workweek of an employed completer.
- Increase in income of employed completer.

All benefit data should be accompanied by an explanation of the method of determination and a specification of the groups of participants (completer, employed completer, dropout, etc.) to which it is applicable.

We recommend that the Congress select one or two of the simplest of viewpoints and sets of elements from those illustrated in appendix B. Congress should then request from the Department of Labor the benefit/cost ratios on a consistent basis from year to year. These ratios should be useful not because of their absolute value but because they will highlight trends over time, serving as indicators of average performance for each program.

We recommend that unsupportable assumptions on the value of work performed, social costs, private costs, or projected benefits not be used in the benefit/cost calculations. However, we do recommend that attempts be made to measure these various elements.

Each year, the Congress should also request the Department of Labor to examine raw cost and effectiveness data accumulated at the appropriate administrative level for all projects within the programs and use these for determining the causes of variations.[21] These data could then serve as the basis for annual discussions between Congress and the executive branch on the improvement of performance within each program.

If the information provided is to be continuous and to grow in accuracy and consistency, several features must be mandated through legislation. All manpower legislation should include provision for:

- One standard, comprehensive system of required reporting from the local level.
- One-year follow up on the wage rate, income, and job stability of participants.
- Systematic processing at several administrative levels to provide plan vs. performance information and relative effectiveness information on local projects.[22]
- Reduction of this information to the formats desired by the Congress.

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[19] *Economic Analysis and the Efficiency of Government.* Report of the Subcommittee on Economy in Government of the Joint Economic Committee, Congress of the United States, February 9, 1970, Washington, D.C., appendix 3: Illustrative Manpower Overview Data.

[20] For the NYC program, measures of its goals of keeping participants in school would also be needed.

[21] For programs like CEP and WIN, the appropriate administrative unit would be the individual CEP or WIN project. In the case of MDTA, data might be more properly accumulated at the State level. As decentralization proceeds, the relevant administrative unit might become the local prime sponsor of each comprehensive manpower program. This should improve the capability for review both in DOL and in the Congress.

[22] Our design of this type of evaluation is presented in Scanlon, *et al.*, *op. cit.*

Continuous longitudinal data are required to determine the success of trainees following training. One proposed approach is to put primary dependency on large field surveys supplemented by the reporting system. Or one may put primary dependence upon the reporting system supplemented by field surveys to discover biases and fill gaps in data. Because of the extensive need for program management information and evaluation on a project basis and for research leading to improvement within programs, we favor the latter course.

To enable more knowledgeable use of manpower training programs as economic tools, there is great need for validated quantitative models that describe the impact of trainees from manpower programs on local labor markets. It is time to stop talking about what effects trainees might have on local markets and measure what these effects are in practice, at least on a small scale. Out of such testing could come more definitive advice for both the Department of Labor and the Congress about the economic effects of training programs. We recommend that Congress direct and earmark resources for data collection projects focusing on measurement and analysis of the effects of training programs on local labor markets under different conditions.

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APPENDIX A

VARIATION IN BENEFIT/COST RATIOS DUE TO DEFINITIONS USED IN THE CALCULATION OF THE BENEFIT/COST RATIO

BENEFIT/COST RATIOS

A hypothetical example is provided here to illustrate benefit/cost ratio variations of the type which we have attempted to eliminate from our synthesis by using a single viewpoint and definition.

It is important at the outset to realize that, while the data *elements* necessary for calculation of benefit/cost ratio can be factually determined (given sufficient time and effort), the procedures for calculating ratios from these elements are determined by the analyst. Since each particular B/C ratio involves a set of definitions, one can construct nearly any imaginable form from any set of data. Furthermore, some of the data elements necessary for any particular definition chosen have nearly always turned out not to be available in practice, generally requiring some heroic assumptions to produce the final numbers used.

The procedures chosen for calculating these ratios represent in each case the application of a set of decision rules to the values of the data elements. B/C ratios are not the only set of decision criteria that might be used nor have they been, in practice, necessarily a consistent set of decision rules.

Manpower programs are arrayed over time, geography, program concept, need groups, and varying economic conditions. The dimensionless benefit/cost ratio, produced by consistent procedures, if it could ever have been created, offered the possibility of comparing these various programs without the attendant discussion of all of the parameters. That is, an institutional training project from Arizona in 1967 with a benefit/cost ratio of 4.5 should somehow have been better than an OJT project in Pittsburgh in 1965 with a benefit/cost ratio of 2.3. The consistent use of procedure should have discounted the effects of all attendant variables. In practice, however, different viewpoints, procedures, and definitions of the benefit/cost ratio have often altered the final value considerably, even with the same basic data. The purpose of this appendix is to demonstrate with a concrete example how this can happen and what it means. Throughout the example, a single set of basic data shown in Figure A1–1 is used.

SOCIAL ECONOMIC VIEWPOINT

Consider the case of an enrollee in a manpower training program who becomes an employed completer. Let us assume that his actual training program had a cost (including administration and placement but not including transfer payments) of $900. His other income statistics, including tax and transfers, are shown in Figure A1–1. In the one-year period preceding enrollment he earned $2,400. In the one-year period following training he earned $3,600. Thus, the trainee had an earned income gain of $1,200 following the training program costing $900. This is the first chance to calculate and use a B/C ratio. We ask whether the resources withdrawn from the society for training have been matched by the addition made by his increased income.[23] The answer is $1200/900 = 1.33$, which is greater than 1. The increase in wages was more than the cost of training.

Let us now imagine, however, that this trainee has an identical twin (shown on Figure A1–1), identical to him in every way *except* that he did not enroll in the training group. This makes the twin a perfect control for determining the amount of gain actually attributable to training. In the year following the completion of training, the twin earned $3,200 without taking a training program. We might now reason that, of the $3,600 earned income received after training, a gain of only $400 is attributable directly to the training program and therefore the actual benefit/cost ratio was only $400/900 = 0.44$, far less than one.

[23] We shall not include the income that he has foregone during training in the economic calculations. While this is a cost to the *applicant*, the fact that (especially for disadvantaged populations) the job he vacates to take training will probably be filled from the pool of unemployed means that the productivity of that job is probably not lost to the *economy* while he is in training.

TRAINEE

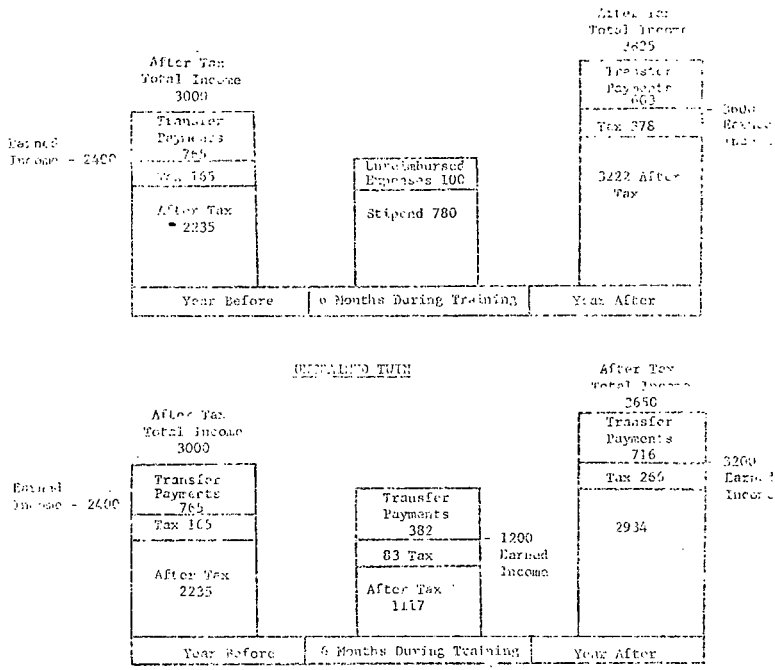


FIGURE A1–1.—Basic Data Elements for Benefit/Cost Ratio Calculations.

Once the twin enters the discussion, however, we must consider that the trainee is presently earning at a higher rate and that this is likely to continue. There are three possibilities: the trainee's differential advantage over his twin may continue to climb over the years, presenting an ever increasing gain from the training; the effects of the training course may wear off after a few months or years and the wages of the trainee may drop back to the same wage rate as his twin; or he may just continue to maintain the $400/year advantage over his identical twin as the result of training. In the absence of definitive data on this question, there is no basis for choosing among the assumptions of increasing, constant, or decreasing gain. If we take a middle path, as is common practice, we would assume that the trainee will continue to make exactly $400 more than his untrained twin each year for some extended time into the future. We might still be perplexed by the problem of how to value this projected gain at the time of training.

The Office of Management and Budget has dealt with such questions in Circular A–94 and advises a 10 percent per year discount rate applied over a period of 10 years for projected benefits of social programs. The general mathematics involved appear complex. If an identical fixed gain is considered in each succeeding year, however, the present value of a fixed gain in earnings projected 10 years ahead and discounted at 10 percent per year over the 10-year period can be determined simply by multiplying the fixed gain for one year by 6.44. For example, our $400 per year gain in wages has a present discounted value (at 10 years and 10 percent) of $2,576. Using this value, our benefit/cost ratio becomes 2576/900=2.86. Thus, if our assumptions are right, over time the increase in wages exceeds the cost of training.

So far, we have only considered social economic benefit/cost ratios with gains in earned income used to represent gains in national income. Consider now the question of whether the program was a good personal investment for the applicant.

THE APPLICANT VIEWPOINT

In the year before the training program, suppose the combined income of the applicant from welfare, unemployment, and after-tax income was $3,000, identical to that of his twin (see Figure A1–1 again). Assuming that the applicant could have

done equally well during the six-month training course period (had he not been involved in training), he has foregone about $1,500 during this period. In addition, he had out-of-pocket transportation expenses of $100. However, he was unemployed when he entered the training program and he received a stipend of $30 per week for the 26 weeks of training, a total of $780. So we now figure that his net cost was his foregone payments and earnings of $1,500 plus $100 for transportation, minus $780 of stipends—a net cost to the applicant of $820. In the year following training, his combined after-tax earnings and transfer payments totaled $3,825 (higher income, reduced transfer payments). His twin also had reduced unemployment payments that year and collected after-tax earnings plus unemployment of $3,650. So the net cash gain over his twin appears to be $175 that year. Without projecting into the future, the return is disappointly small, since the applicant's personal benefit/cost ratio would be 175/820=0.21. He has actually lost money on his training (since the ratio is less than 1). If we follow the OMB guidance, however, and project that the yearly gain will persist for 10 years, its discounted present value is found to be 6.44×$175=$1,127. Now the applicant's personal B/C ratio is 1127/820=1.37. The investment of time and effort will pay off after all—if the assumptions underlying the OMB guidance are valid.

Government Budget Viewpoint

Finally, we look at the program from the point of view of the government budget. While the applicant was in the program, the government lost taxes of $83 and paid $780 in stipends during the course. Analysts vary in treating the stipend in figuring the government's ratios. If it is included as a cost, the government loses money on the course. We must consider, however, that the applicant might have gone on to exhaust his unemployment and gone on welfare, if he had not entered training. The answer in determining how to attribute costs and benefits, of course, is to use the twin as a control. The proper comparison is between the government's balance of payments with the trainee and with the twin. The calculations are shown in Figure A1–2.

The net cost to the government over that of the twin was $1,381 during the training program. The government's gain (again over the control) was $225 the first year from a combination of reduced transfer payments and increased taxes. This has a present discounted value of 6.44×$225=$1,449. The government's B/C ratio is 1449/1381=1.05. The program was profitable for the government.

Summary of the Examples

The basic elements used in the calculations of the examples were shown in Figure A1–1. The cost of actual training and administration (now shown in Figure A1–1) was $900. These elements gave rise to the eight benefit/cost ratios which are summarized in Figure A1–3.

We notice that the benefit/cost ratios vary over a considerable range (0.17 to 8.57) for this example, dependent on the viewpoints and definitions used. Remember that this is simply due to definitional changes, since the example assumes perfect data and perfect control. The first benefit/cost ratio (1.33) came from comparing the actual cost of training with a simple before and after change in wages for the enrollee. When this gain in wages was offset by earnings from a "perfect" control over the one-year follow-up period, the benefit/cost ratio dropped to 0.44. Projecting the fixed gain ahead in accordance with the OMB instructions produced an overall benefit/cost ratio of 2.86. Since these were social economic rations, the effect of transfer payments was ignored.

We next examined costs and benefits from the viewpoint of an applicant. Using the control and one year's difference in earnings, the ratio appeared to be 0.21. However, if the gain was projected for 10 years and discounted to the present time at 10 percent per year, the ratio became 1.37. Comparison to determine government budget effects (including transfer payments and a control) gave a benefit/cost ratio for government of 1.05.

What does all this mean? It means that, even in simple cases with perfect data, it is important when looking at B/C ratios to know which viewpoint is being taken and what elements have been used in the calculation.

Controls or Comparison Groups

In our example, the use of a perfect control (the twin) gave us a firmer basis for drawing absolute conclusions and deciding what portion of apparent gains

	Pre-Project		Training		Post-Training	
Government Debits for Trainee	Transfer Tax Paid	$765 -165 $500	Stipend Training	$ 780 900 $1680	Transfer Tax Paid	$603 -378 $225
Government Debits for Twin	Transfer Tax Paid	$765 -165 $500	Transfer Tax Paid	$382 - 82 $299	Transfer Tax Paid	$716 -266 $450
Net Debit Over Control		$ 0		$1381		-$225
	1 Year		6 months		1 Year	

Net Cost = $1381

Present Discounted Value of Decrease in Government Debits over that of Control = $225 x 6.44 = $1449

$$B/C = \frac{1449}{1381} = 1.05$$

FIGURE A1-2.—Calculation of the Government B/C ratio with the use of a control (The Untrained Twin).

	1 Year	10 Years
Social Economic (before & after comparison)	1.33	8.57
Social Economic (with control)	0.44	2.86
Applicant (with control)	0.21	1.37
Government Budget (with control, transfer, etc.)	0.17	1.05

FIGURE A1-3.—Summary of benefit/cost ratios from the single set of data in Fig. A1-1.

should be attributed to the training program. It is often quite difficult to determine the amount of benefit attributable to training without a control group. Choice of the control group may thus be expected to affect the final value of the B/C ratio. In the field, unfortunately, no one has found a reliable method of retrospectively creating a control group. Since randomizing the selection of enrollees for training has seldom been done, most present control group data are suspect to some degree.

This example has dealt with the direct effects of training on the applicant, both for simplicity of illustration and because this method is in common use. Suppose an analysis is desired of the economic or budget effects of a program across a target population, a local economy, or the national economy. It now becomes necessary to examine the assumption that the net impact on enrollees represents

the impact of the program. Several so-called "secondary" effects must be considered. Some of these are:

Multiplier effects.—Do the positive results of the program get multiplied either through direct or economic multiplier effects?

Vacuum effects.—Do the trainees take up skill-shortage jobs that would otherwise not be filled and thus vacate unskilled jobs into which the unemployed are drawn?

Displacement effects.—Do the trainees simply displace workers who would otherwise have filled the jobs in which the trainee was placed, thereby causing no change in unemployment or in GNP?

These are important questions in considering the government budget and social economic viewpoint because the answers to them determine what multipliers or deflators are to be included in the benefit elements and the ratios can be quite sensitive to these choices. While many postulated forms of these effects exist at the present time, not enough—in fact scarcely any—validation through actual measurements in the labor market have been performed to justify using either the magnitudes or direction of these effects in computation. We have recommended in the body of the report that emphasis in research be redirected from the theoretical nature of these effects to attempts to measure them in several actual labor markets under various economic conditions. This is a necessary prerequisite to further quantitative discussions of the use of training programs as economic tools.

A successful training program enters a number of trained workers into the local labor market. To determine the impact, or even the direction of the impact, of this on the local economy requires a quantitative assessment of these postulated (and perhaps other unpostulated) secondary effects.

Appendix B

ELEMENTS NECESSARY FOR CALCULATIONS OF VARIOUS BENEFIT/COST RATIOS

In this appendix an illustration is presented of the various elements of cost and benefit that are necessary for three different viewpoints from which benefit/cost ratios might be calculated. The actual definitions for using these elements to obtain a benefit/cost ratio vary among analysts and each definition can usually be supported with a good argument.[24] The elements of data themselves, however, can be determined (with sufficient time and money) for any program. Because of this, they are described here unencumbered by benefit/cost ratio definitions. Once an analyst has collected this raw material, any desired benefit/cost ratio that can be defined can usually be calculated. Hence, our emphasis in the main paper on obtaining the data elements for the calculations, rather than simply the results.

Elements of Cost and Benefit From Three Viewpoints

Social economic viewpoint.—It is difficult to give a simple description of social economic benefit/cost ratios. The comparisons made from this viewpoint should, in theory, represent the marginal increases in national income compared with the marginal societal losses. In practice, most analysts often allow the gain in enrollee's income to be used to represent the gain in national income. Since even the average values of cost and benefit are difficult to determine accurately, we shall forgo consideration of the marginal values. Transfer payments are usually excluded from the calculations using this viewpoint as representing simply a problem in allocative efficiency rather than any marginal change in national productivity.

In practice, these arguments simplify considerably the basic elements considered (see Figure B2–1) while complicating their use in constructing benefit/cost ratios because of questions of multiplier, vacuum, and displacement effects. A true economic benefit/cost ratio must include these effects. Since these effects become part of the more complicated definitions of the method for calculations, they are discussed following the example in Appendix A. At this point, we are simply discussing what basic elements of data are needed.

Applicant viewpoint.—From this viewpoint, we wish to describe the elements necessary to determine the cash value at a point in time of all benefits accruing

[24] See Borus and Hardin, *op. cit.*, 1969, and Hardin, 1967.

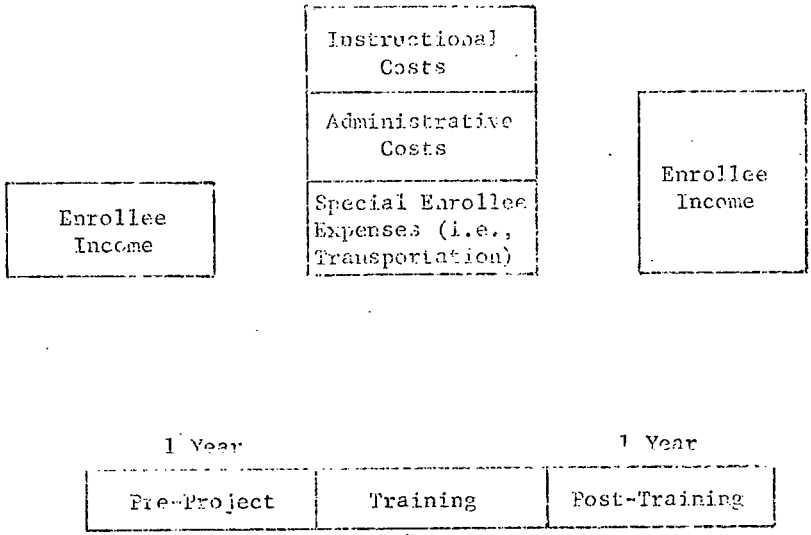


FIGURE B2–1.—Basic Elements of Benefit and Cost from the Social Economic Viewpoint.

to the enrollee and of his personal cost of participating in the program. The time base for an enrollee appears as shown in Figure B2–2. We recommend that a one-year period before and after training be used as a basis for determining the value of elements of cost and benefit calculation.

The elements necessary for accomplishing a benefit/cost analysis from an applicant point of view are shown in Figure B2–2 for the three time periods. In the year before training the applicant may have welfare payments and services, unemployment benefits, and income from working. While in training, an enrollee may have unreimbursed expenses connected with the program, may draw a stipend and other payments from the program, may forego income that he might have earned, and may receive supportive services from the program. In the year following the program the enrollee is expected to have a larger income than before. There may very well be unemployment or welfare payments during this year, however.

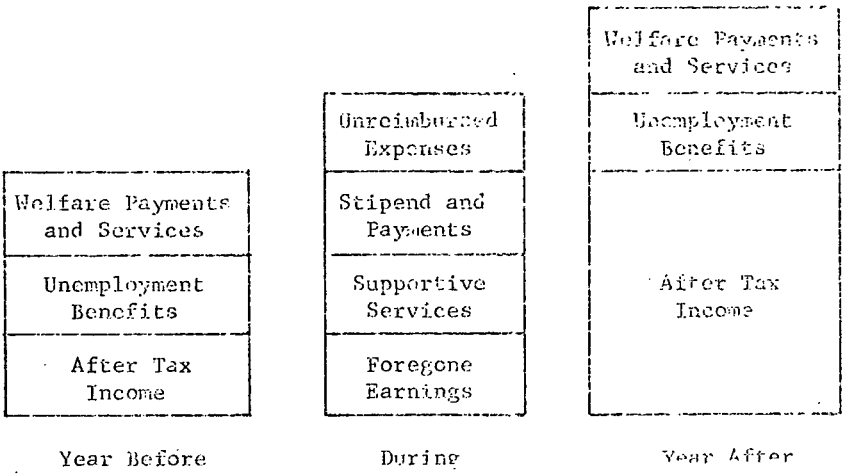
Without a control, a simple before and after comparison of income (deflated for economic activity) may be the basis for judging income gains. With a control sample, we are interested in the gain of the trainee over the control. In this case the same elements are required for the control, except that the foregone income of the applicant during training is equivalent to the income of the control over the same period.

Foregone income has been included in the applicant viewpoint and omitted from the economic viewpoint in agreement with that body of economists who hold that, while the income is foregone by the applicant during training, the productivity represented by it is generally not lost to the economy for the applicant and jobs that constitute the bulk of the population under consideration.

Government budget viewpoint.—When we attempt to view the benefits and costs from the viewpoint of the government budget, we find the elements with which we are concerned become those of Figure B2–3. Preprogram costs lie in welfare and unemployment payments; preprogram benefits in tax payments. In-program costs are the payments directly to the enrollee and the other project costs, including training and overhead. After training, any welfare and unemployment costs represent continued costs to the government, while tax payments represent continuing benefits.

The dominant basic elements.—A review of the elements of data considered with the three alternate viewpoints—social economic, applicant, government budget—shows that two core elements are necessary to all viewpoints. These are:

- Preprogram income per enrollee.
- Post-program income per enrollee.



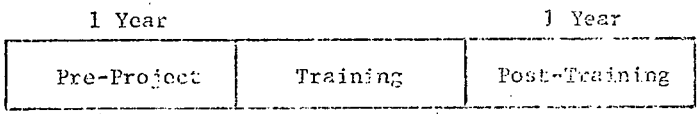


FIGURE B2-2.—Elements of Costs and Benefits from An Applicant Viewpoint.

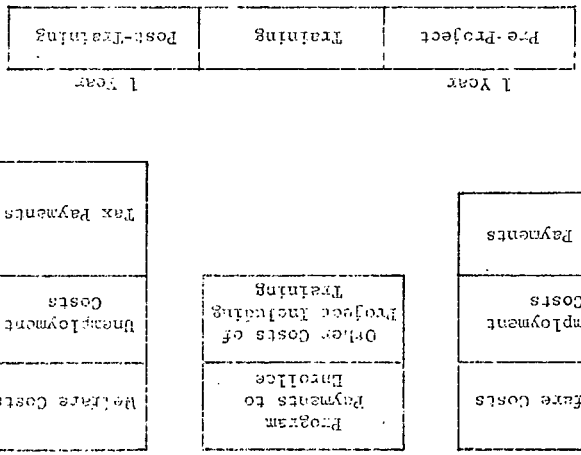


FIGURE B2-3.—Elements from a Government Budget Viewpoint.

In addition, these elements tend to be important in calculations from two of the viewpoints:

- Stipends and transfer payments per enrollee before, after, and during training.
- Cost of administering and operating the training program per enrollee.

In addition, information from a control or comparison group is often used.

Keeping the Calculations on a Common Basis

One of the keys to understanding and making commensurable the many different costs and effectiveness measures used by various analysts of manpower training programs is to relate them to some simple, yet consistent, description of the participants in a training program. The description used throughout this paper is outlined below. Figure B2–4 indicates that every training project generally operates with some target group or population from which the applicants are to be drawn. These applicants are screened at intake to determine eligibility and match people to training. At this point, some applicants are screened out for a variety of reasons and some may be accepted but do not enroll in the project. This constitutes the fraction of people who have had some formal contact with the project, but have never enrolled.

Prior to the intervention of a training program, some target population exists from which the project will draw applicants. From these applicants, a group of enrollees will be actually admitted to the project. All those who formally enter the program will be called in this paper *enrollees*. As shown in Figure B2–4, an enrollee must either become a *completer* or a *dropout*. In practice, it will be found that many programs have several levels of completion. Continuing this definition process, however, completers will be further divided into completers who obtain employment (*employed completers*) and those who do not (*unemployed completers*). In practice, these distinctions will not be so clear because many projects define various levels and types of completion and because employment for many of the graduates is sporadic, rather than a simple yes or no situation. It will be useful to preserve this distinction in some form, however, in order to avoid being misled on the derivation of costs and benefits and the scope of the samples taken.

If various levels of benefits are to be attributed to dropouts (or alternately if they are to be used as controls), it is generally desirable to distinguish employed dropouts from unemployed dropouts.

National figures of cost and performance for the entire program within which a project is operated are aggregate representations of cost and benefits for all projects within the program. In the case of participation figures, these aggregations are actually more or less accurately created from accumulated project data. Costs can rarely be determined to the enrollee level, however, and generally represent the gross expenditures prorated in some manner over the number of enrollees.

One important consideration in estimating the ratio of benefits to costs from any viewpoint is to produce an estimate of both across the same base. The benefit/cost ratio for a program, taken from any viewpoint, is

$$\frac{(\text{Benefit/Completer}) \times (\text{No. of Completer}) + (\text{Benefit/Dropout}) \times (\text{No. of Dropouts})}{\text{Total Program Cost}}$$

or

$$\frac{B_c N_c + B_d N_d}{\$}$$

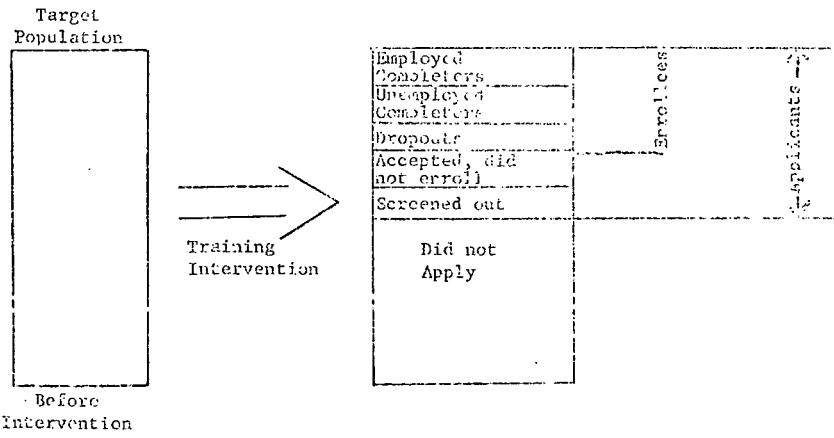


Figure B2–4

Some past work has, on the contrary, estimated the cost by dividing gross expenditure by total enrollment ($N_e = N_c + N_d$) and then compared this with returns found by studying enrolled completers. More specifically, assuming $B_d = 0$, those authors use

$$\frac{B_c}{\$/N_e}$$

rather than

$$\frac{B_c \frac{N_c}{N_e}}{\$/N_e},$$

this clearly overstates the program benefit/cost ratio.

In summary then, each project represents an intervention involving cost and some intended result for some population of enrollees. In performing calculations to place costs and benefits on a common basis for a program or project, it is necessary to know:

- The total number of enrollees.
- The number of dropouts.
- The number of completers.
- The number of employed completers.

These numbers might not be necessary if the four main enrollee elements of cost and benefit above were actually available over the pre-training, training, and past-training time periods for all enrollees. In practice, the enrollee data elements have not all been available as pointed out in the body of this report. These enrollee population fractions are then necessary to put the benefits and costs on a common basis.

Appendix C

SOURCES OF ELEMENTS OF BENEFIT AND COST

A Tabulation of the Elements Used in Calculation and Their Sources

BENEFITS, COSTS, AND RATIOS AS EXTRACTED FROM SELECTED SOURCES[1]

Study	Annual benefit[2]	Cost[2]	Benefit/cost
NEW YORK CITY, OUT OF SCHOOL			
Borus (1970): Indiana	$170	$560	2.0
Woltman & Walton (1969):			
Males	150	980	1.0
Females:			
Method A	229	980	1.5
Method B	115	980	.8
JOB CORPS			
Cain (1967):			
From educational gains:			
Low range	[110]	3,500	.2
High range	[338]	3,500	.7
From survey	[203]	3,500	.4
Louis Harris & Associates (1969)—Training period:			
Fall 1968 (wage rate data)	[541]	[3] 3,613	1.0
Fall 1968 (income data)	[922]		1.6
Early 1967 (wage rate data)	[790]		1.4
Job Corps research and evaluation: New enrollees as control	[807]	3,613	1.4
Woltman & Waltman (1969):			
Male	97	3,840	.2
Female	135	3,840	.2
JOBS			
Estimated from OFMS/OMMDS data		[1,700]	
1968 participants, Senate; JOBS (1970)	1,093		4.1
SDC (1969): 1969–70 completers		[4] 3,000	
Senate, JOBS (1970)	[4] [811]	([5])	1.7
Senate, MDTL (1970)	[4] [811]	([5])	1.7
Greenleigh, 1970	[4] [1,216]	([5])	2.6
Estimated from OFMS/OMMDS data	([6])	[4] [2,800]	1.9
			2.8

See footnotes at end of table.

BENEFITS, COSTS, AND RATIOS AS EXTRACTED FROM SELECTED SOURCES[1]—Continued

Study	Annual benefit[2]	Cost[2]	Benefit/cost
MDTA			
Hardin & Borus (1969): Whole sample	251	772	2.1
MDTA-institutional, by classroom-hours/trainee:			
60–200	976	299	21
201–600	5	656	−.1
601–1,200	−121	1,367	−.6
1,201–1,920	−136	1,455, 1,455	−.6
Michigan	316	780	2.6
HEW, Doorway to the Seventies (1970)	[498]	[1,055]	3.0
Institutional on-the-job training	[632]	[738]	5.5
Muir (1967):			
Institutional	1,338	923	9.3
On-the-job training	1,208	809	9.6
Smith (1970), MDTA-institutional	[302]	1,055	1.8
Main (1966), MDTA-institutional, completers and dropouts	[409], [499]		2.5, 3.0
Completers (estimates from three different regression equations)	[376]		2.3
Estimated from OFMS and OMMDS data		[1,051]	
ARA (A PREDECESSOR OF MDTA-INSTITUTIONAL)			
Stromsdorfer (1968), State institutional	736	[385]	12.3
CPP			
System Development Corp	[218]		
Estimated per enrollee (without stipends)		[1,000]	1.4
Leasco Systems and Research Corp:			
Urban CEP projects	954	792	7.8
	430	589	4.7
	1,006	774	8.4
	593	1,206	3.2
	615	829	4.8
	1,131	627	11.6
	786	544	9.3
	1,577	642	15.8
	1,445	1,015	9.2
	831	858	6.2
	961	586	10.6
	646	719	5.8
	1,447	1,773	5.3
	256	714	2.3
Overall weighted average			[6.9]

[1] More detailed descriptions of the source documents are given in App. D.
[2] Numbers without brackets are taken directly from the referenced study; numbers with brackets were calculated on an adjusted basis from the data available in the referenced study. All data are on a per enrollee basis unless otherwise noted.
[3] Cost from Job Corps research and evaluation.
[4] Per completer.
[5] Cost from SDC.
[6] See above benefits.

Appendix D

SOURCES OF BENEFIT AND COST DATA SYNTHESIZED IN THIS REPORT

NYC Out of School

Woltman & Walton; *Evaluations of the War on Poverty—The Feasibility of Benefit-Cost Analysis for Manpower Programs;* Report UR–054; Resource Management Corporation; Bethesda, Maryland; March 1969. Training Period: 1965–66. Coverage: National. Control: Short term participants. Uses Dunlap survey data.

Borus, Michael E. and others; "A Benefit-Cost Analysis of the Neighborhood Youth Corps: The Out-of-School Program in Indiana;" (in *Journal Of Human Resources,* Spring 1970, v. 5, pp. 139–159).

Job Corps

Louis Harris and Associates; *A Survey of Ex-job Corpsmen;* Report 1899, April 1969. Training Period: 1967 and 1968. Coverage: National. Sample: 4309 corpsmen 6–8 months after training, 5154 corpsmen 12–15 months after training. Average comparisons of income before and after without control group.

Gain, Glenn G.: *Benefit/Cost Estimates for Job Corps,* Discussion Paper, Institute for Research on Poverty, University of Wisconsin, Madison, Wisconsin, September 1967. Training Period: 65–66. Coverage: National. Control: No shows and late no-shows. Uses Harris Survey data and a projection of educational improvement for benefit determination.

Job Corps Research and Evaluation; *Job Corps Benefit/Cost Study;* A&R Report #11; OEO; Washington, D.C. Training Period: 1966. Coverage: National. Control: Entrants of equivalent age. Sample: 668 former enrollees 18 months after participation, 200 used in calculations. Excludes females, conservation centers, and incomplete records.

Woltman & Walton; *op. cit.,* March 1969. Training Period: 1965–66. Coverage: National. Control: No shows. Benefits from Harris survey data.

See also the application to Job Corps of a relative cost/benefit technique developed by Benn & Wheeler in *A Job Corps Study of Relative Cost Benefits, Volume I & II;* Software Systems, Inc.; Washington, D.C.; April 1969. See especially their examination of cost per terminee.

Jobs

Partial data from summaries published by Office of Financial and Management Systems and Office of Manpower Management Data Systems.

U.S. Senate; *The JOBS Program* (Job Opportunities in the Business Sector), Background Information; Subcommittee on Employment, Manpower, and Poverty; April 1970. See both the report and Department of Labor comments.

U.S. Senate; Manpower Development and Training Legislation, 1970, Hearings before the Subcommittee on Labor and Public Welfare, Part 4; May 5, 6, 11, 14, 18, and 21, 1970.

Systems Development Corporation; Final Report, *Evaluation of the JOBS Program in Nine Cities;* Technical Memorandum TM-WD-(L)-313/001/000; SDC; Falls Church, Va.; September 1969. Cost data.

Greenleigh Associates, Inc.; *The Job Opportunities in the Business Sector Program:* Greenleigh; Washington, D.C.; June 1970. Brief estimate of benefits (10 SMSA's).

MDTA—On-the-Job Training

Muir *et al.*; *Cost/Effectiveness Analysis of On-the-Job and Institutional Training Courses;* Report PRC D–1297, Planning Research Corporation, Washington, D.C.; June 1967. Training Period. FY 1968, 1964 1965. Coverage: National. No control group. Data source: Department of Labor's applicant file. Final sample size was 652 completers.

Department of Health, Education, and Welfare, *Education and Training, Doorway to the Seventies,* 1970 Report of the Secretary to the Congress on the Manpower Development and Training Act; Washington, D.C., April 1970. Training period: FY 1968. Coverage: National. Contains the results of a Department of Labor earnings mobility study on MDTA completors. Data source is the DOL applicant file.

MDTA—Institutional

Main, Earl, *A Nationwide Evaluation of MDTA Institutional Job Training Programs,* National Opinion Research Center/University of Chicago, October 1966. Training period: 1964 through February 1965. Coverage: National. Control. 1060 friends, neighbors and relatives of the experimental group. A national probability sample of 1200 trainees was interviewed (along with controls) at least one year after training. Data were collected on a total of 2,258 people.

Stromsdorfer, Ernst, "Determinants of Economics Success In Retraining the Unemployed: The West Virginia Experience." *The Journal of Human Resources,* Vol. III, No. 2, Spring 1968. Coverage: ARA institutional training program (a predecessor of MDTA) in West Virginia and the State training program. Training period: 1961–1962. Control group used. Data source: follow-up interviews one year after training (1964).

Muir, *et al.*; *Cost/Effectiveness Analysis of On-the-Job and Institutional Training Courses,* Report PRC D–1297, Planning Research Corporation, Washington, D.C., June 1967. Training Period: FY 1963, 1964, 1965. Coverage: National. No control group. Data source: Department of Labor's applicant file. Final sample size was 2010 completors.

Smith, Ralph; *An Analysis of the Efficiency and Equity of Manpower Programs,* Dissertation, Georgetown University, Washington, D.C., 1970. Training Period: FY 1967. Coverage: National. No control group. Data source is the earnings mobility studies based on the Department of Labor's applicant file.

Borus, M. and Hardin, E.; *Economic Benefits and Costs of Retraining Courses in Michigan,* School of Labor and Industrial Relations, Michigan State Univeristy, December 1969. Training period: 1962, 1963 and 1964. Coverage: ARA and MDTA courses in Michigan. Control group of 281 noshows used. Stratified sample of training classes yielded 503 trainees.

Department of Health, Education and Welfare, *Education and Training, Doorway to the Seventies,* 1970 Report of the Secretary to the Congress on the Manpower Development and Training Act, Washington, D.C., April 1970. Training period: FY 1968. Coverage: National. Contains the results of a Department of Labor earnings mobility study on MDTA—Institutional completers. Data source is the program's applicant file.

Concentrated Employment Program

Leasco Systems and Research Corporation, *Quantitative Analysis of the Concentrated Employment Program,* Technical Report MSG—101/69, Bethesda, Maryland, August 1969. Coverage: 19 CEP I cities. Training period: FY 68. Sample: 300 enrollees sampled for each city. No control group used. Data source: project files. No interviews were made.

System Development Corporation, *Evaluation of the Impact of Selected Urban Concentrated Employment Programs,* TM-WD-(L)-359/000/02, Falls Church, Virginia, November 1970. Coverage: non-random selection of 14 urban projects. Training period: 1968–1969. No control group used. Follow-up interviews were made with terminees out of the program for 3 to 15 months. Random sample of project files yielded about 1450 respondents.

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