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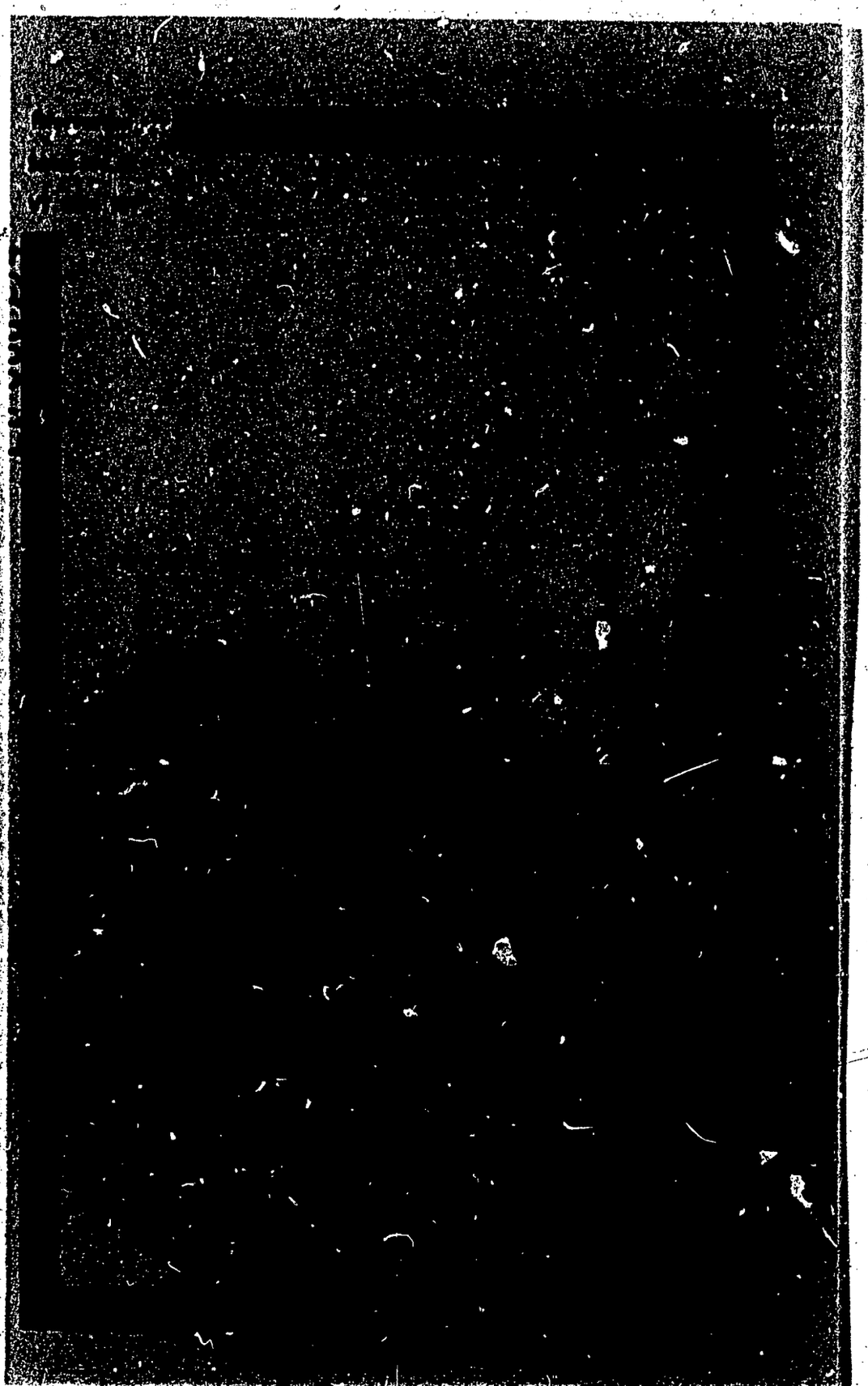
ABSTRACT

The methodology to perform benefit-cost studies exists, but there is much ambiguity concerning the implications of such studies as a result of using faulty methodology. For example, control groups are a necessity, as are adequate sampling procedures and adjustment for non-response bias and self-selection bias, and all studies do not employ this methodology. Another limitation is that currently a benefit-cost study will only show whether or not a program appears to pay. Further judgments must be made on whether to expand or cut back the program, and what to give up or take on. In spite of these and other limitations, benefit-cost analysis interjects a systematic analysis into a previously judgmental area. The cost and methodological limitations of such studies will inhibit their immediate widespread adoption. This study, written for non-economists, surveys the various approaches to improving the analysis of vocational education and related manpower training programs. (CD)



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REVIEW AND SYNTHESIS OF COST-EFFECTIVENESS STUDIES OF VOCATIONAL AND TECHNICAL EDUCATION

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PREFACE

The economics of vocational-technical education programs versus the effects of a lack of such programs is considered extensively in this work. *Cost-Effectiveness Studies of Vocational and Technical Education* is designed to alert researchers and directors of education-related programs alike to the issues surrounding this area.

The author questions the validity of academic study as opposed to vocational-technical study in terms of future earning power for whites and nonwhites. He further relates problems in this area to the length of vocational-technical education programs.

The bibliography is subdivided into four sections to allow the specialist to peruse those readings pertinent to his field.

The profession is indebted to Ernst W. Stromsdorfer, Indiana University, for his scholarship in the preparation of this review and synthesis report. Recognition is also due Michael E. Borus, Michigan State University, J. Robert Warmbrod, The Ohio State University, and Robert C. Young, The Center, for their critical review of the manuscript prior to final revision and publication. J. David McCracken, information specialist at The Center, coordinated the publication's development.

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INTRODUCTION

This study seeks a synthesis of the various approaches to improving the analysis of vocational education and related manpower training programs. This will be an economic analysis since the programs in question are designed to improve the efficiency of the United States labor force and increase the overall level of welfare or well-being in the most general sense of this term. However, this study will also discuss the implications of noneconomic benefits to these programs as they relate to cost-benefit analysis. This study will achieve this synthesis by investigating the current state of the art of economic evaluation of these educational programs.

Both cost-benefit and cost-effectiveness studies of vocational education and related manpower programs will be summarized to determine the current "state of the art" and to draw policy conclusions concerning the optimal level of investment in such programs. Likewise, the methodological literature will be summarized to serve as a reference point for judging the extant cost-benefit studies as well as to serve as a general guide to the conduct of such future analyses.

While this study is intended for noneconomists, economic analysis and theory will be used. However, much of the methodology of cost-benefit analysis is relevant to any rigorous social science so that, with appropriate development of ideas and economic concepts, the materials covered should be of use to the interested noneconomist.

As in any survey of the literature, this study draws very heavily on the works of others, and the present author has only a marginal claim to originality. In this regard, therefore, I would like to express my appreciation to those numerous people on whose works I have relied.

Specifically, I would like to thank the editors of *Socio-Economic Planning Sciences* for permission to use sections of my jointly authored article, "Special Problems in the Economic Analysis of Human Resources," in Chapter I. Thanks are due to Einar Hardin and Michael E. Borus for permission to reproduce data from their study, *Economic Benefits and Costs of Retraining (Lexington, Mass.: Lexington Books, D.C. Heath and Co., 1971).* Laure M. Sharp likewise gave permission to duplicate data from her study, *Graduates of Vocational-Technical Programs in Junior Colleges.* Also, I would like to thank Gerald G. Somers for his permission to use part of my jointly authored article in his book, *Vocational Education: Today and Tomorrow.*

Thanks are especially due to my former colleagues, Jerome Moss of the University of Minnesota, Teh-wei Hu of the Pennsylvania State University and Maw Lin Lee of the University of Missouri, who graciously consented to allow me to reprint or adapt from portions of our previously published articles.

Finally, parts of Chapter III are based on analysis previously shown in *Report of the Analysis Group, HEW Vocational Education Review Task Force.*

I would like to reaffirm that I alone am responsible for any remaining errors in this study, including any possible misinterpretations of authors' works or ideas.

Ernst W. Stromsdorfer

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REVIEW AND SYNTHESIS OF COST-EFFECTIVENESS STUDIES OF VOCATIONAL AND TECHNICAL EDUCATION

THE RATIONALE OF ECONOMIC ANALYSIS OF EDUCATION AS AN INVESTMENT

Benefit-cost analysis or cost-effectiveness analysis is simply a popular term for economic analysis of any program or action. This analysis can be part of a larger decision-making strategy, such as systems analysis or of program budgeting, or it may be performed within its own narrower framework. In either case, it is quantitative analysis whose intent is to provide a criterion or standard for decision-making so as to allocate in a rational and optimal way a given set of scarce resources among numerous competing needs.

Thus, benefit-cost analysis is a technique which concerns itself with the optimum allocation of resources. It is a tool of analysis which assesses the alternative courses of action in order to help decision makers maximize the net benefit to society. The essence of this analysis lies in its ability to evaluate the total value of benefits against the total costs.

Optimum Allocation of Public Expenditures for Vocational Education

A basic assumption in economics is that goods are scarce and that persons prefer to have more goods rather than less. Therefore, it is generally desirable to employ resources in those uses which have the highest productivity. Given the total amount of resources available for public and private education of all types, it is relevant to determine the optimum allocation of expenditures on these different programs.

Theoretical Criterion. Assuming that the goal of society is, given its values and objectives, to maximize its social welfare, which includes both economic and noneconomic components, it is possible to demonstrate the rule by which this welfare may be maximized. Society has a variety of goals and objectives, some of which are complementary to each other and some of which are competitive. For educational programs alone, there are several goals. These are the goals of (1) economic efficiency—achieving the maximum output for a given set of inputs, (2) immediate consumption and future consumption—the enjoyment of the process of education and the ability to achieve greater or more varied enjoyment in the future due to one's education, (3) equity—the realization of a more socially desirable distribution of wealth, and (4) socialization—the inculcation of socially desirable values and behavior.

These goals can be measured by appropriate indices of output. These outputs can be combined to represent an overall measure of welfare or satisfaction. Thus, we can specify a social welfare function either with respect to the outputs of all social programs, including education, or we can specify a more restricted social welfare function which expresses only that part of social welfare affected by a particular set of programs.

Thus, the social welfare function can be written in the form:

1) $W = w(g_1, g_2, \ldots, g_n)$

Where W represents social welfare (or can be denoted as social benefits) and the g's represent the output of different social programs. The maximization of function (1) is subject to the constraint of the social budget, namely

$$2) \quad B = \sum_{i=1}^{n} (a_i + c_i g_i)$$

Where a_i is the fixed cost of the ith social program c_i is the marginal cost of the ith social program, and B is the total resources available to society.

The Lagrangian multiplier is used to solve the maximization problem, that is:

$$3) \quad w(g_1, g_2, \ldots, g_n) - \lambda \left[\sum_{i=1}^{n} (a_i + c_i g_i) - B \right] = 0$$

where, λ is the Lagrangian multiplier. Differentiating this expression with respect to g_i, then:

$$4) \quad w_i - \lambda c_i = 0$$

where $w_i = \frac{\partial W}{\partial g_i}$ is the marginal benefit of the ith program. From this it follows that:

$$5) \quad \frac{w_i}{w_j} = \frac{c_i}{c_j} \qquad (i, j = 1, 2, \ldots, n)$$

and also that:

$$6) \quad \frac{w_i}{c_i} = \lambda$$

Thus, in equilibrium, as shown in equation (5), the maximization of social benefits is achieved if the ratio of marginal benefit in this example of two government programs is equal to the ratio of the marginal cost of these programs; that is, the marginal benefit is proportional to the marginal cost. (Marginal means the incremental increase in total cost or benefit due to adding one more unit of output to a program.)

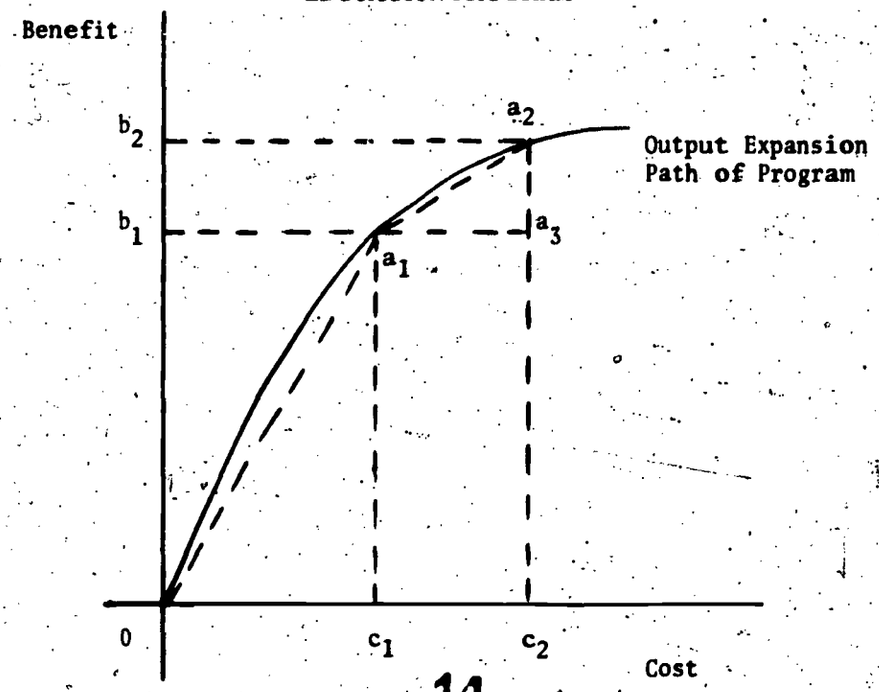
An application of this principle to the optimum allocation of public expenditures on vocational education versus say manpower development training is to spend resources on each program to the point where the marginal benefit-marginal cost ratio of vocational education is equal to the marginal benefit-marginal cost ratio of manpower development training. In other words, other conditions being equal, such as the population of persons being served, if the ratio of marginal benefits to marginal costs of vocational education is higher than that of manpower development training, then the government should increase its expenditures on vocational education up to the point where the two ratios are equal. This can be done within a fixed budget by shifting funds from manpower training to vocational education or by expending any extra public funds on vocational education as additional funds become available. More

explicity, the optimum amount of public expenditures for vocational education and manpower development training is at the point where the additional benefits from an additional dollar spent on these two educational programs would be equal.

This analysis points out the necessity of contrasting the marginal benefits with the marginal costs of competing educational programs in order to discover which among a set of alternatives is *relatively* more desirable. That is, the additional benefits of adding one more unit of output (a student) must be contrasted with the marginal or extra cost of that unit of output (a student).

Marginal cost-benefit calculations are not sufficient, however, to make a complete decision with respect to investing in social programs such as vocational education. In addition to the relative effectiveness of a program as measured by marginal benefits and costs, it is often important to know what the absolute level of effectiveness of a program is; that is, in the long run does the program operate in the black. To make this determination of absolute effectiveness, a measure of average costs and benefits must be performed, for a program could be relatively more effective than some set of alternatives, yet it may not be covering its long run average costs. Such a condition will be reason for rejecting the educational program if other non-efficiency goals do not intervene. Thus, average costs, that is, total cost divided by the total units of output, must be compared with average benefits, total benefits divided by the total units of

FIGURE 1
HYPOTHETICAL BENEFIT-COST CURVE FOR THE VOCATIONAL EDUCATION PROGRAM



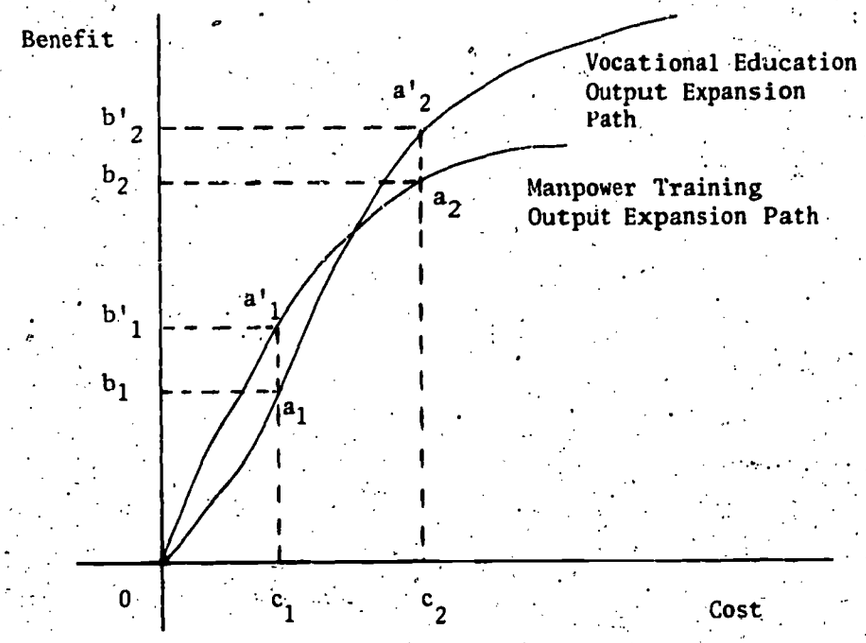
output. And, the present value of net average benefits (benefits minus costs) should be zero or positive.

A Diagrammatic Exposition. These principles can, perhaps, be best illustrated by means of graphs. (See Glennan, 1969, I.) Given that a decision is to be made on whether to spend an additional sum of social resources on either vocational education or manpower development training, the problem is to choose between the two. That is, which will yield the greater addition to benefits for the alloted additional resources? Figure 1 shows the difference between average costs and benefits and marginal costs and benefits. Figure 2 contrasts the marginal and average costs and benefits of the two programs. The diagrams are hypothetical.

In Figure 1, assume the vocational education program is operating at a level where total costs are equal to oc_1 and total benefits are equal to ob_1. The average benefit-cost ratio is given by $\frac{ob_1}{oc_1}$. This ratio is also equal to the slope of the line segment oa_1.

Suppose the program is expanded out to point a_2 by adding resources equal to c_1c_2. Then c_1c_2 represents marginal costs, the addition to total costs, and b_1b_2 represents marginal benefits, the increase in total benefits, due to the increase in costs. The marginal benefit-cost ratio is equal to $\frac{b_1b_2}{c_1c_2}$ and slope of the arc a_1a_2.

FIGURE 2
HYPOTHETICAL BENEFIT-COST CURVES FOR VOCATIONAL EDUCATION AND MANPOWER DEVELOPMENT TRAINING PROGRAM



Thus, it can clearly be seen that marginal and average costs and benefits and hence, their ratios, usually differ, the difference depending on the level of output.

In Figure 1, given that costs and benefits are measured in the same units, average benefits are greater than average costs, as depicted in the graph. The next question is to compare two programs–vocational education and manpower development training.

In Figure 2 at the current funding level of oc_1, manpower training has a higher average benefit-cost ratio, $\frac{ob'_1}{oc_1}$, than does vocational education with an average benefit-cost ratio of $\frac{ob_1}{oc_1}$. However, if we expand both programs by the same amount of increased resources, c_1c_2, the incremental or marginal benefit-cost ratio of vocational education, $\frac{b_1b'_2}{c_1c_2}$, is greater than the marginal benefit-cost ratio of manpower training, $\frac{b'_1b_2}{c_1c_2}$. Thus, since both programs are covering their average costs, i.e., each is operating in the black, the extra resources should be applied to the vocational education program and not to the manpower development training program in this hypothetical example. To apply the extra resources, c_1c_2, to manpower training rather than to vocational education would result in a smaller addition to total output.

A Model for Cost-Benefit Evaluation of a Program. An evaluative model is needed to achieve the estimates of costs and benefits to perform the analysis above. This evaluative model should have several components. First, it should examine the nature of the output processes of competing programs which are designed to fulfill a given set of objectives for a target population. Second, the model should determine which program and its output process is most efficient. As suggested above, this type of evaluation has several major characteristics. First, it is quantitative. There must be some estimate of costs and benefits. Usually, but not necessarily, these costs and benefits are expressed in monetary terms. Second, the evaluation must be directly related to the specific purposes being served by the program. The appropriate specification of the objective or set of objectives of the program is crucial to the evaluation. An improper specification of objectives as well as an ill-conceived choice and construction of indices to measure the attainment of objectives will result in an invalid evaluation of the program. Third, the benefit-cost evaluation must link benefits with costs. Treatment of either benefits or costs in isolation cannot provide valid information in making choices among social programs. Vocational education is not less efficient or less desirable simply because it costs more, both on the average and in marginal terms, to educate a student in a vocational program than it does to educate him in an academic program in a comprehensive high school.

In summary, an appropriate model to evaluate any program within vocational education or a similar social program in education should have the following steps:

1) The program objectives or desired program outcomes must be specified.

2) The processes or activities used to implement the program must be specified. In economic terms, this means that the production function or production process must be specified whereby the output of any given activity is related to a relevant set of inputs to that activity.
3) A cost function or cost relationship based on the production functions given for each activity must be specified.
4) A benefit function (s) must be specified based on an appropriate index or set of indices designed to measure program outputs.
5) Costs and benefits must be compared.

Program Objectives and Output. The objectives of a social program such as vocational education must be made explicit. If objectives are stated in terms of all-encompassing goods such as "the improvement of happiness," the program cannot be evaluated since there is no way to measure such a broad outcome as "happiness," let alone define it with clarity.

Vocational and technical education are, however, more efficiency oriented and lend themselves to a benefit-cost framework more readily than other types of education except manpower training. However, the objectives of vocational education are still multi-dimensional and the specification of a single functional relationship which uniquely encompasses all of these simultaneous objectives is extremely difficult and remains, as yet, to be done. It is for this reason that the estimation of program benefits is generally so much more difficult than the estimation of program costs, although, as we shall see below, some of the relative simplicity in the estimation of costs is more apparent than real, since costs and benefits are simply two sides of the same coin. Costs are negative benefits and benefits are negative costs. The same general economic principle of foregone alternatives or opportunities governs the conceptual identification of each.

Nevertheless, without a single index of benefits (and costs) to measure the multiple dimension of objectives (and both economic and non-economic costs), the practice has been to estimate a single dimension, such as earnings or wage rate per hour, and treat it as an index of the objective of "efficiency." Thus, wage rates or a similar unique measure implicitly ignores other dimensions of the efficiency concept such as the reduction of unemployment or the potential increase in output due to increased labor mobility or job satisfaction.

To continue, the output of vocational, technical or manpower training is the acquisition of certain behavioral capabilities. The objectives of these types of education, whose fulfillment depends in a functionally related way on the acquisition of these capabilities, have been enumerated above but bear repeating. These objectives are:

1) Economic efficiency (h_1)
2) Consumption (h_3)
3) Equity (h_2)
4) Socialization (h_4)

The program objectives (W for welfare or well-being) can be expressed as:

$$W = w(h_1, h_2, h_3, h_4)$$

A specification of the relative weights of each component of welfare, their general functional form, that is, whether they are linearly or non-linearly related to welfare, as well as knowledge of the interactions, complementarities and conflicts among them would complete the specification of this "objective function." The next step would be to maximize the total value of this function, given one's limited resources.

However, to repeat, the problem is that we do not have a unique index to measure W and, in fact, we do not even have a unique index to measure the components of W, such as h_1 or h_2. Also since certain aspects of these objective components are almost surely jointly created, that is, a given input simultaneously creates more than one type of output, the choice of an index to represent a component which is jointly determined with another component will likely result in an error in ascribing costs.

Production and Cost Functions. Cost functions can be estimated directly from cost and output data without performing the intermediate step of specifying the production function, the process whereby the program produces the desired output. However, without an understanding of the production process, that is, the way in which program inputs are related to program outputs and any interactions among the inputs, it is very difficult to estimate the impact of a program. This is a critical stage in the evaluation process since as yet there is no widely accepted theory as to how vocational capabilities are imparted and what variables are critical to the efficiency and effectiveness of the learning process.

Therefore, the production process is usually one which in practice is specified through trial and error by attempting to statistically "fit" various empirical relationships. This is unsatisfactory, however, since the available independent variables which can serve as candidates to explain a given learning process are limited only by the researcher's ingenuity at generating additional variables, as is demonstrated by more than one study discussed below.

However, leaving these problems aside, if educational administrators act so that they try to maximize a set of objectives of vocational education, then the production process can be specified as:

$$Y_i = f(X_{i1}, X_{i2}, \ldots, X_{in})$$

where Y_i is a complex index of output performance of vocational education for the ith student, and the X_i's are the inputs used to produce the output of vocational education for the ith student.

If inputs can be expressed in money terms, costs can then be expressed as a function of the production process, as follows: $Z_i = f(V_i)$ where Z is total costs, V is program enrollment, i stands for the ith program of a given type. This cost function could be expressed in linear or non-linear form, and variables other than enrollment could be added to the function to account for cost-influencing factors whose effects one may wish to hold constant. The result of estimating a total cost function will be an estimate of marginal cost—the extra cost of training one additional student.

The Linkage of Costs and Benefits. If benefits are nonmonetary, then for a particular program the achievement of a target level of program performance at

the lowest cost (both monetary and nonmonetary) identifies the desirable program. Or, a given cost can be set and that program which achieves the greatest increment of improvement in output performance is the desirable program. For situations where costs and benefits are in monetary terms, the general economic rule is to maximize the present value of net benefits. However, several investment criteria exist to achieve this, such as the internal rate of return, the benefit-cost ratio, or net present value. In the real world, constraints usually exist which invalidate each of these criteria to a degree. These problems will be discussed below.

The Generality of the Model. This simple model outlines the general approach one would take to evaluate the efficiency of vocational and technical education programs. Given that objectives are clearly specified and that performance indices to measure the achievement of the objectives can be devised, then alternative projects to achieve the objectives can be investigated. Input combinations between alternative projects will likely vary. Also, input combinations can be varied within a given project. The effects of both types of variation can be noted on both output and input costs. Ideally, the combination of inputs for a given cost which will maximize a given type of output can be discovered and overall educational efficiency can be improved.

The Specification and Measurement of Inputs. The specification and measurement of inputs into the process by which vocational capabilities are imparted to students suffer from the lack of a widely accepted theory of learning. In the absence of an unambiguously acceptable theory, the problem of specifying the input variables becomes more complex. There are, however, three broad classes of variables to consider, and, of course, there are unknown interactions among them. These three sets of variables can be classified as *student inputs, educational process inputs,* and *socioeconomic influences.*

The educational process starts with students, each of whom differs with respect to characteristics which affect his ability to learn at the time he enters the particular vocational program. Students differ in relevant aptitudes, achievement, motivation, and health which create variation in their ability to learn. One must adjust for the effects of these factors on anticipated program outputs.

The educational process in which the students are engaged has characteristics which provide the learning experience. Students are encouraged to respond in particular ways, all under the guidance of an instructor with certain characteristics. Finally, the activity takes place in particular physical and psycho-social learning environments.

In addition to the student characteristics and the specific educational process which is to be evaluated, the act of learning is affected by other experiences and conditions in the students' environment which could influence the proper identification and measurement of net educational outcomes. These experiences can take place at any time after the educational process begins and before the outcome is measured. For example, students might take a variety of other courses which differentially alter their ability to learn the content of the given educational process which is to be evaluated. Or, for instance, economic conditions could alter the availability of particular kinds of jobs after

graduation. Of course, if one is able to structure an experimental model with a properly formed control group, the last set of influences may not be too serious an obstacle.

In summary, dozens of variables can be used to account for the three types of influences noted above, and thus far, little conceptual guidance exists to dictate their choice or their functional form.

Specification and Measurement of Educational Outputs. The general difficulties involved in constructing a properly specified index of output have already been discussed. However, additional practical problems exist.

A benefit can be defined as any result of the vocational education process that increases individual or social well-being or welfare. This increase in welfare can be either economic or non-economic. With respect to economic welfare, benefits occur either directly by increasing productivity or indirectly by freeing resources for alternative uses. With respect to non-economic welfare, the educational process results in an increased level of satisfaction for those participating in the educational process.

The problem of selecting and weighting relevant output indices becomes even more complex when programs with varied mixes of "general" and "vocational" components are compared. Typically the output indices chosen are appropriate to vocational objectives but slight the intended outputs of the general education component; this raises serious questions about the validity of the resultant program comparison. In a more generalized sense, it epitomizes the type of bias that can result from judging any program on the basis of a narrowly conceived set of outputs, without regard for the program's concomitant effect (positive or negative) upon other desirable outputs.

Conceptual difficulties also arise when the amount of education is considered as a relevant variable. When holding power or amount of further education, for example, is utilized as a dependent variable, education is being treated as an end in itself. In other instances, the education variable (like holding power) might be considered an independent variable, and its ultimate and actual effect upon other outputs measured. The choice of treating the amount of education as a dependent or independent variable changes with the evaluation context and rationale, but making the choice cannot be ignored.

Finally, greater attention must be paid to the specification and measurement of developmental outputs. The effect of educational processes upon career patterns, as one illustration, should be determined. Longitudinal data are therefore required.

Benefit-Cost Analysis and the Investment Criterion

Given that costs and benefits have been successfully estimated, there are two additional elements to benefit-cost analysis: time and the interest rate used to discount costs and benefits to their present value. Both the costs and benefits of investment in vocational and other forms of education occur through time. Different investment alternatives are likely to have different time profiles. The purpose of discounting is to attach relative weights to these cost and benefit time profiles in order to account for the productivity of investment and social or

private time preference. (For further discussion, see Prest and Turvey, 1965, I; Eckstein, 1961, I; Hirshleifer, 1960, I: Solomon, 1959, I.)

Discounting is theoretically justified for a number of reasons. The first is that the interest rate used in discounting represents the opportunity cost of investment funds; that is, invested wealth usually earns a positive rate of return. Thus, "Y" dollars invested today will yield "Y + X" dollars at some time in the future due to the productivity of the investment. Therefore, reversing the process, to relate this *future* income to its *present* value, one must discount the future income stream to the present time when the investment decision is being contemplated. Second, future income is valued less than present income. People have a positive time preference, that is, they dislike postponing consumption. (See Baumol, 1961, I, pp. 410-413, for a brief theoretical rationale of time preference.)

Investment Criteria. A variety of investment criteria is available to the education decision-maker. At the simplest level of analysis benefit differentials and cost differentials can be estimated. The pay-back period can also be estimated. The net expected present value, the benefit-cost ratio, and the expected internal rate of return can be calculated. Under certain conditions, these last three measures are equivalent and provide the same guidance to decision-making. The conditions are noted below and exceptions to these conditions comprise the bulk of this discussion.

The Correct Criterion. There is considerable confusion over what constitutes a "correct" investment criterion. This is due to the fact that there is confusion between specification of the appropriate investment rule as distinct from the criterion to achieve the goal of the rule. The appropriate investment rule in benefit-cost analysis is to maximize the net present value of benefits. Depending on the nature of constraints, any of the last three criteria above may achieve this rule. However, there are both practical and theoretical conditions which either commonly exist or can be devised which demonstrate that no single investment decision criterion is theoretically correct for all investment situations. (See Hirshleifer, 1958, I, pp. 329-352, and Bailey, 1959, I, pp. 476-488.) This discussion concentrates on only three of the above criteria: the expected internal rate of return, the expected net present value, and the benefit-cost ratio.

Cost and Benefit Differentials. Cost and benefit differentials represent a necessary but incomplete stage of analysis. These differentials show the configuration of the data and provide the inputs to the proper (for a given set of constraints) investment criterion. Alone they are not a useful guide to decision-making, yet, one commonly perceives misunderstanding of this fact. For instance, a given education program A, costing X dollars more than an alternative education program B, is averred (by its advocates) to be of "higher quality" or (by its detractors) to be "too costly." But "higher quality" or "too costly" in what sense? Both these statements, taken by themselves, are nonsense in terms of the efficiency and effectiveness of the program. Costs and benefits must always be related to each other.

The Pay-Back Period. The pay-back period is a simple ratio of total costs, C, to constant marginal benefit, b, with the constant benefit measured over a given time unit such as a month or year. Thus, b/C equals the pay-back period.

This simple index relates costs and benefits to each other and different programs can be crudely judged as to their relative effectiveness. The criterion is to select the investment with the shortest pay-back period.

The pay-back criterion suffers from a variety of conceptual flaws. First, it ignores the fact that costs and benefits of competing investments are distributed through time and have different time profiles. Education yields its benefits over an entire lifetime. Discounting is necessary to make the different benefit-cost profiles commensurable. Second, the absolute size of net benefits between alternatives may differ but the use of the ratio will obscure this. Third, as with the internal rate of return, the pay-back criterion breaks down completely in those cases where investment alternatives are mutually exclusive. Thus, the pay-back period criterion has serious conceptual limitations as a decision-making tool, and is not highly recommended.

A Consideration of Three Criteria. The net expected present value criterion can be stated as follows: Given the appropriate interest rate by which to discount, one should adopt any program for which the present value of the discounted stream of net benefits is greater than zero. Or if more than one program has net discounted benefits greater than zero at the given rate of interest, adopt the program with the highest present value of net benefits.

The benefit-cost ratio tells the decision-maker to invest in those programs for which the ratio of the present value of benefits to the present value of costs is unity or greater.

The result of calculating a rate of return is a simple percentage which can be compared against that interest rate which represents an acceptable rate of social or private investment return. Briefly defined, the internal rate of return is that interest rate which makes the discounted value of costs equal to the discounted value of benefits. (See Blaug, 1965, I, p. 155.)

A Critique of the Three Criteria. Much controversy exists over what constitutes the proper investment criterion. The discussion in the literature centers around a critique of the present value and the internal rate of return criteria. The benefit-cost ratio is not widely considered. This latter fact is especially significant in light of federal government practice to employ the benefit-cost ratio as an investment criterion.

Many writers argue that the present value rule is most correct since it automatically assures that the present value of benefits is at a maximum. As noted previously, this position is taken because of a confusion between what identifies the correct maximand as against the appropriate criterion to achieve that maximand. However, to repeat, both the present value and internal rate of return criterion will result in the proper and identical investment decision given that: capital markets are perfectly competitive, investment alternatives are not interdependent, all relevant investment choices are completely divisible so that marginal adjustments can be made, and all net returns are reinvested at the original rate of return or higher up to the end of the project with the longest benefit stream. (Blaug, 1965, I, p. 168.)

In this context both are correct and neither is to be preferred over the other. However, it is unlikely that these conditions will ever be met

simultaneously. The real world imposes constraints such that each of these rules can, at times, give advice which will result in the decision-maker's not maximizing the present value of net benefits. The following sections consider these constraints in turn.

Constraints Which Invalidate the Rate of Return Criterion

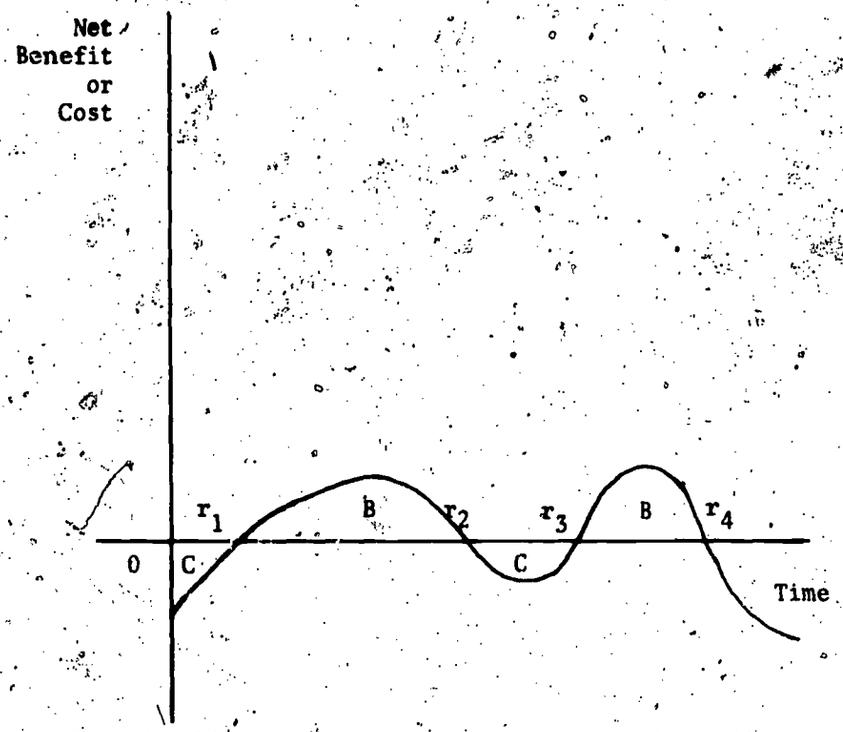
Interdependency. Where two programs are mutually exclusive, the use of the rate of return criterion breaks down. It is possible under this condition of interdependency to invest in an activity which has a higher internal rate of return but lower present value than an alternative project. This criticism is quite relevant from the view of an individual contemplating an educational investment in himself. When an individual makes a decision that commits him to an educational process for a specified period of time, he eliminates all other educational actions he may have taken for the period which is subsequently committed. In addition, once he has undergone training during that time period, that expanse of time is irretrievably lost. Thus, if he decides to take training as a carpenter, he usually cannot simultaneously take training as a psychiatrist. The two investments are mutually exclusive and thus, interdependent–taking one course of action affects the ability to take the other course of action. In short, in this context one can think of the human as a site or locus upon which, in general, only one type of training or education can occur at a given point in time. Thus, educational or occupational investments in specific human beings have the general characteristic of being mutually exclusive.

This criticism of the internal rate of return is just as binding from the social standpoint but the relative magnitude of the consequences stemming from it are probably not as serious. For example, if the construction of a comprehensive high school on one end of town proves to be an economic mistake, one can always construct an area vocational-technical school on a different site in another part of town. Or, an incorrect investment in Individual A does not preclude a correct investment decision to be made with respect to Individual B, since while one individual is not divisible, a group of individuals from society's standpoint is divisible.

Successive Cost Outlays. More than one cost outlay occurring over time can result in more than one rate of return being estimated for the same benefit-cost stream. The same number of rates can exist as there are inflection points where the cost stream switches to a benefit stream and vice versa. No one of these rates is necessarily correct.

From the private or individual standpoint the occurrence of multiple cost outlays is a theoretical possibility due to the risk of unemployment. The individual can perceive at least part of the expenditure necessary to maintain him during periods of long-term cyclical unemployment as costs incurred to maintain his productive capacity in a given skill. Thus, he may have a time stream of benefits and costs as appears in Figure 3. Here, as many as four internal rates of return could exist. However, it is not likely that short-term cyclical or seasonal unemployment would result in any measurable skill deterioration. Long-term structural unemployment could, however.

FIGURE 3
TIME INCOME STREAM OF AN INDIVIDUAL WITH MULTIPLE COST OUTLAYS



The unemployment example is similar from the standpoint of society. Although one could argue that society in any case is committed to keeping its members alive, or at least a certain number of them, in order to assure its own continuity, society may still incur differential costs which are uniquely associated with maintaining a given skill structure and level of ability. These costs should be counted as necessary costs to assure the viability of the original skill level.

Finally, from both society's and the private or individual viewpoint, if the person had to reinvest in himself due to the fact that technological change had destroyed the economic relevance of his previous skill, this new investment cost and the benefits flowing from it should be treated as an entirely new benefit-cost sequence.

Changing Rate of Interest. Investment in vocational education over time will likely change the distribution of income and hence, other things equal, will also change the social opportunity cost of investment funds which depends, in part, on the distribution of income. In this case, a uniquely calculated rate of return becomes conceptually irrelevant since it does not reflect the changing social opportunity cost rate of investment funds.

Constraints Which Invalidate the Present Value Criterion

Multiple Interest Rates. An individual may invest in himself by using personal savings, borrowed funds, or by reducing his current consumption. A different private interest rate may be relevant to each of these sources of funds. Assuming the individual did not use some weighted rate of interest to represent the interest rates which apply to personal savings and borrowed funds plus the rate of time preference he attaches to foregone consumption but instead chose to discount the stream of costs and benefits of different alternatives by each rate, the ranking of alternatives at one rate may differ from the ranking of alternatives at the others. It is then unclear as to which relative ranking is the correct one.

TABLE I

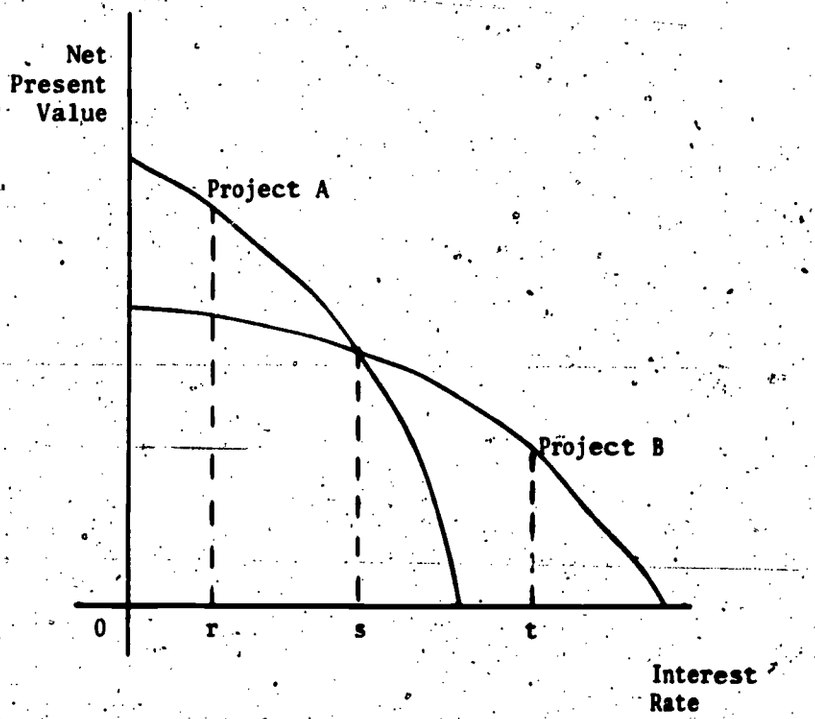
CONSTRAINTS ON DECISION RULES

Difficulties Occur With	
Present Value When	**Internal Rate of Return When**
1. Different discount rates are used to evaluate a set of projects with dissimilar time-benefit streams. *Result:* Different rankings may occur for each discount rate.	1. Projects are mutually exclusive. *Result:* A high rate of return project may be adopted which precludes the possibility of maximizing net present value.
2. Discontinuities occur such that project costs become large relevant to current resources. *Result:* Adoption of a given project on the basis of its higher present value may preclude the adoption of two or more smaller projects whose summed present value is larger than the original project.	2. The market interest rate varies over the life of the project. *Result:* The single computed rate of return becomes conceptually irrelevant since all time periods are treated on a par. This is the most fundamental conceptual failure of the rate of return rule.
3. Budget constraints occur. *Result:* This is a variant of the discontinuities constraint and, again, the likelihood may be that failure to maximize present value will occur.	3. More than one cost outlay occurs over time. *Result:* a) Mutliple rates of return are computed no one of which is conceptually correct; b) Problems of mathematical estimation become extremely difficult.

In addition, in many practical situations when a single unambiguous rate cannot be chosen, advice is often given that more than one rate of interest should be used in order to provide a range of estimates of discounted costs and benefits. This again may result in a switch in the differential rankings of alternatives vis-a-vis the different rates. The result will be that choice between investment alternatives will become indeterminate if one attempts to employ both rankings.

A suggested solution to this switching problem involves the selection of that interest rate which makes the net present value of the set of alternatives all equal. This rate then serves as the cut-off point in selecting the appropriate ranking, and hence, the appropriate investment. In Figure 4, the present values of education programs A and B are equal at an interest rate of s. If the social time preference rate is always less than s, perhaps rate r, then the present value of program A is always greater than program B and program A should be chosen in preference to B. But, if disagreement exists as to what is the proper social time preference rate, (for instance, "is its value to the left or right of s?"), then one is no better off than before. The dilemma remains.

FIGURE 4
THE SWITCHING OF INVESTMENT ALTERNATIVES



Budget Constraint. The present value rule will sometimes prove to be invalid when a budget constraint or investment discontinuities face the decision-maker. If one follows the advice to invest first in that activity which has the highest present value, it may still be that some alternative combination of investments will prove possible, each of which requires a smaller investment outlay but which, when taken together, yield a summed present value greater than the single larger investment. The proper strategy when budget constraints or discontinuities occur, then, as long as the alternatives are not mutually exclusive, is to exhaust the budget by choosing the *set* of alternatives with the highest internal rates of return. This will actually maximize present value for the *set* of investments.

Such a constraint is a major problem from the standpoint of the individual seeking to educate or otherwise invest in himself. As investors, students have limited access to investment sources. Also, students are relatively unproven in the labor market so that there is a great deal of risk and uncertainty concerning the benefit stream of an investment in them. Capital markets are relatively imperfect in the area of human resource investment due, in part, to the unwillingness of creditors to accept a person's own self as loan collateral as well as the quasi-illegality of indenturing oneself. The capital created by the investment in education is real, but it is embodied in and cannot be separated from the human agent. It cannot be used as collateral in the same way that physical capital can. It cannot be sold. High risk and liquidity premiums would have to be charged in addition to the opportunity cost rate of capital if the capital market were to make funds generally available to investors in this area. (Becker, 1964, I, p. 35.) Institutional constraints are such that these very high interest rates are not charged. Instead, lower rates are set and the pool of investment funds is rationed among those projects which qualify at the lower interest rates. As a result, investment funds are not generally available to finance one's self-investment in education and similar human capital investment.

Personal loans *are* made strictly on a person's representation that his actual or expected income stream and, hence, his expected capital value, is of sufficient size and certainty of being realized that he can pay back the loan. Thus, in such cases the loan is made on the basis of accepting the person's expected capital value as collateral, but this practice occurs normally *after* and *not before* the person seeking the loan has created the capital value which is embodied in him. In line with this, most student loans made by banks are offered mainly as a public service and are made on the basis of the parents' expected income stream and not on the basis of the great expectations of the student seeking the loan.

Hence, the individual is generally faced with investment budget constraints which do not allow him perfect choice among all possible investment alternatives. He may have access to sufficient funds to contemplate training as a carpenter but not as an electronics technician or as a medical doctor.

Investment budgets are also constrained from the standpoint of government, such as a school district, though disagreement exists as to the exact nature and seriousness of this constraint. Legislative limits are set for specified periods upon amounts to be spent by school districts and other governmental units. Even though new funds are voted for new budget periods and the budget

periods continue through time, a short-run constraint exists which can be repeated indefinitely.

Only in the broadest sense does a constraint exist for the economy as a whole in this area of education for it is difficult to conceive of a given investment which would be so large as to absorb a significant proportion of the gross national product.

Constraints Which Invalidate the Benefit-Cost Ratio Criterion

The benefit-cost ratio has some of the operational shortcomings of both the expected net present value rule and the expected internal rate of return. Like the expected net present value rule, its use will cause problems if more than one interest rate is used to discount. That is, the choice of the most efficient investment alternative may switch. However, if budget constraints or discontinuities, or both, occur, then the benefit-cost ratio, like the internal rate of return, is preferred over the present value criterion. Given the interest rate used to discount, choice of those investments with the highest ratios will maximize net present benefits. But, if investments are mutually exclusive, the use of the benefit-cost ratio, as with the expected internal rate of return, may give an incorrect result unless the returns from the investment are reinvested at an interest rate at least as high as that yielded by the next best alternative and at least through that time period represented by the investment alternative having the longest time profile of costs and benefits.

The resolution to the above switching problem under condition of budget constraint is to discount at only one interest rate. Note that this single rate is not necessarily the social or private interest rate representing the opportunity cost of capital. The proper rate is the highest marginal rate of return on that set of investment projects which just exhausts the investment budget. Then those projects in the chosen set which are discounted at this rate must have a present value of zero or greater. Any project with a present value of less than zero when discounted at this marginal rate should be excluded. The method for finding the investment set with the highest marginal rate of return is to discount the array of investment alternatives at different interest rates until that set of investment alternatives is found which just exhausts the investment budget. (See Hirshleifer, 1960, I, Appendix to Chapter VII; also McKean, 1958, I, Chapters 5 and 7.) One then chooses the set with the highest rate. However, this technique can be cumbersome and impractical if there are a large number of alternatives and interdependency exists among them. With interdependency, an extremely large number of possible combinations of these alternatives can exist, all of which must be tested. Such a situation is likely to occur in investments in human beings.

It is important to note that the budget could conceivably be so constrained that the number of investment projects would be insufficient to include those which would lower the marginal rate of return down to the social or private opportunity cost rate of capital. If the social rate is used in a situation where it is less than the marginal internal rate of the contemplated set of investments, then the projects will likely be adopted which will not result in maximizing net present value.

However, Hirshleifer points out that even this rule, while a useful and plausible one under conditions of capital rationing or budget constraint, is not strictly correct. First of all, the marginal project may not have an unambiguous rate of return. Second, even if there is an unambiguous internal rate of return, one may choose the wrong course of action, unless consideration is made of the earning value of resources yielded by each project as well as the market rate of interest by which intertemporal shift of benefits of a given benefit stream can be undertaken. (Hirshleifer, 1960, I, p. 171.)

In summary, given the qualifications above, when there is capital rationing (and this is a common situation for an individual contemplating investment in himself), the benefit-cost ratio is the proper criterion for investment decision-making, since by choosing the set of investments with the highest ratios he will thereby maximize net present value. When there is no budget constraint, and for society (not a governmental unit, including the federal government as a whole) this is usually the case, adopting those projects with the maximum net present value is the proper course of action.

Summary

Both marginal and average costs and benefits must be estimated. The average benefit-cost ratio indicates the absolute level of performance of a social program. The marginal benefit-cost ratio indicates the relative level of performance of a social program.

Given that the average benefit-cost ratios of two competing programs are both greater than unity, welfare will be maximized by shifting funds to that program with the higher marginal benefit-cost ratio, until the ratios of the two competing programs are equal.

An accurate evaluation of a social program requires an accurate specification of objectives, a specification of desired outputs, appropriate indices to measure these outputs, and an appropriate model which specifies the manner in which program inputs create the desired program outputs.

A program cannot be evaluated in any efficiency sense by comparing costs or benefits separately. High costs imply neither a "high quality" nor an "expensive" program. High benefits do not necessarily imply a worthwhile program.

The appropriate investment decision rule is to invest in that social program with the highest net present capital value. Three different investment criteria exist to achieve this efficiency rule: the net present value rule, the internal rate of return, and the benefit-cost ratio. Under appropriate conditions, all three rules yield the same result. However, the real world imposes constraints, which in any given case, can invalidate any one of these criteria.

METHODOLOGICAL ISSUES IN THE ESTIMATION OF COSTS AND BENEFITS

Definition of Cost and Benefit

Costs are defined in their most general sense as opportunity costs. That is, the cost of doing anything is the value of the next best opportunity or alternative which has to be foregone because of the particular course of action one has taken. Thus, in the most general terms, the cost for an individual to invest in vocational or technical education is the cost of (1) not being able to work simultaneously in the labor market or (2) the cost of foregone leisure or (3) the inability to engage in production at home.

There is often a confusion in the literature since costs are sometimes treated as being conceptually different when, in fact, what differs are the problems involved in measuring them. Thus, some writers will categorize educational costs into direct outlays, indirect outlays, opportunity costs–meaning wages foregone–and capital costs. Yet, it has to be remembered that all costs are opportunity costs and one should not consider cost elements as conceptually different simply because they may occur at different points in time, accrue to different individuals or groups, or take different institutional forms such as wages or tuition.

Benefits are just the reverse of costs. They are opportunities gained as a result of engaging in some activity. Thus, they can represent (1) increases in the value of labor market production or activity or (2) increases in the value of consumption or leisure or (3) increases in the value of non-market or home production. In short, they represent increases in the productivity of market and non-market production and consumption.

To avoid errors in underestimating or overestimating costs and benefits, they should ideally be measured in terms of utility lost and gained. Then, there would be no confusion that the complex multiproduct nature of educational investments were being crassly subsumed under money returns and costs alone. Measurement of utility, however, is a council of perfection. It cannot be done, given the state of the art. And, in an imperfect world, it is improper to consider money costs and benefits as measures of utility or even as good indices or proxies for it. Given the complex nature of educational investment, both in terms of its costs or benefits, it is best to simply indicate the components of costs or benefits being measured and not claim wider validity for them as proxies of utility. This discussion brings us to a general consideration of the methodological issues in the measurement of costs and benefits. In short, the measurement of costs is just as difficult as the measurement of benefits, and previous statements by some investigators concerning the greater ease of cost estimation are based on a simplistic concept of cost. (See Judy, 1969, I.)

General Considerations

A foray into the methodoligical issues surrounding the distinction of costs and benefits of investment in social programs designed to improve human welfare brings a variety of basic conceptual problems to the fore. The best summary discussion of these problems to date has been performed by Lester Thurow in his book *Investment in Human Capital.* (See Thurow, 1970, I, especially Chapter 8.) The basic issues he discusses can be outlined as follows:

1) Earnings maximization versus utility maximization;
2) Complementarity in production and consumption;
3) Joint costs of production, consumption and investment;
4) Non-market production and consumption;
5) Change in perferences due to the act of educating or training;
6) Risk due to lumpiness of investments; and
7) Complementarity, substitutability, and inseparability of human skills and abilities.

Thurow lists several other points, but these above are of most interest with respect to investment in vocational and technical education or other training programs since they impinge directly on the measurement of costs and benefits.

In addition to these points, one should consider:

8) Externality;
9) Income redistribution effects as they influence the determination of costs and benefits;
10) The influence of unemployment on the determination of costs and benefits; and
11) The problem of the control group.

Each point will be considered below with specific reference to vocational and technical education. And, where applicable, each point will be considered with respect to social, individual or governmental estimation of costs and benefits.

Earnings versus utility maximization. Even though vocational and technical education as well as manpower training have a more immediate labor market orientation than do other forms of education, such as a liberal arts college education or the pursuit of a general curriculum in high school, it is dangerous to evaluate the former types of education only in terms of earnings maximization. Earnings are only one of the elements which comprise one's utility. One of the elements of utility one gains besides earnings are direct consumption benefits during the educational process itself as well as improved possibility for the enhancement of consumption after education. If persons are rational in their pursuit of utility or welfare maximization, they will gravitate to those kinds of education and occupations which give them direct consumption benefits along with increased earnings. This is the crux of the matter when educators, economists and others seek to evaluate the degree of "job satisfaction" involved in career choice.

Of course, if all persons are rational, including those who pursue the college preparatory or general curriculum in high school, there is no necessary reason after the fact to assume *a priori* that vocational or technical students will have greater job satisfaction than other types of students. Presumably, each

group gravitates to that type of training which will maximize its expected future job satisfaction. Thus, job satisfaction and other characteristics of a person's post-training situation which are measures of psychic well-being and the degree of consumption benefits being received on the job must be directly measured. However, if different kinds of persons gravitate to different programs, there remains the difficult task of establishing unambiguous scales to measure these direct consumption and psychic benefits. Different elements may comprise the consumption and receipt of psychic benefits by different groups. Thus, even if you ask the same kind of question of these different groups, seemingly uniform and consistent responses may have entirely different meanings and be incommensurable.

Complementarity in Production and Consumption. Since one's human capital is inseparable from oneself, in the act of producing one also consumes. This occurs simultaneously and failure to account for this phenomenon can lead to an incorrect measure of benefit. Other things equal, if a person dislikes his job, one may tend to overestimate the benefit to the individual person. However, if he likes his job a great deal, other things equal, one may tend to underestimate the total benefit received. There is no reason, however, to assume that one type of curriculum automatically has a greater over (or under) estimate of measured benefits due to this phenomenon.

Joint Costs of Production, Consumption, and Investment. Thus, production and consumption on the job are joint due to the fact that any economic activity based on human capital can't be separated from the human agent. Likewise, the investment itself is joint, producing both production and consumption capabilities. This fact complicates the estimation of costs considerably. An excellent example of this is the Job Corps. Here, participants engage in training at residence centers. They simultaneously produce, consume and invest in themselves. Their maintenance costs support all three of these activities simultaneously since the activities are joint. Even though society or the participants' families won't have to maintain these participants, they would in many cases be maintained at lower levels were they not presently in the Job Corps. Thus, the question becomes, why isn't any measured increase in consumption treated as a social benefit of the program? Or, should it be treated as a transfer—a benefit received for which no reciprocal service or benefit is rendered—and hence not counted as a social gain?

But even if one agrees from the consumption standpoint to treat the increased level of maintenance as a transfer, the higher level of nutrition, medical services, clothing, and the like, should contribute simultaneously to increased production in the Job Corps Center as well as improve learning while in the Center. How can one sort out the immediate consumption component from the investment component of the higher level of maintenance? Assuredly, the higher level of maintenance is not all transfer payment. But, since the three activities are a joint output of maintenance, they cannot be separated out.

Similar kinds of problems exist with cooperative vocational education. The work component of a coop program is jointly production, consumption and investment. Is the wage rate the student receives a measure of the student's productivity *net* of his on-the-job training or investment? Economic theory

would argue that it is not likely to be completely net of the on-the-job training costs—that is, the student will not pay for all of his on-the-job training costs via a reduction in his wage rate. To the extent that a coop student will have a job with components that are peculiar to the firm's own operations, we could expect the firm to pay this cost to cover this firm's specific component of the job. However, to cut down turnover and loss of his investment in the student, the employer is likely to share both the costs and the returns to the firm-specific training component of this job with the coop student. Conceptually, these cost and benefit components should be separated out; but this is often difficult to do. No one, to date, has attempted an empirical resolution of this issue. The jointness of these activities renders a separation most difficult from an empirical standpoint. (Problems of prorating joint costs will be discussed further below.)

Non-Market Production and Consumption. Non-market production and consumption is a major consideration in any complete evaluation of the effectiveness of vocational and technical education or manpower training. Obviously, persons trained in vocational and technical skills, such as electricians, auto mechanics, engineers and the like, are in the position to provide considerable non-market production for themselves since the skills themselves are in the high areas of demand: craftsmen and semi-technical, and professional. This production should be imputed as a return to the education, but as yet, no effort to do so has been made in benefit-cost or cost-effectiveness studies. Likewise, women who have learned vocational skills may be in a position to provide higher valued services as housewives than those with no such training. With respect to the ghettoized, poor, and other disadvantaged groups, courses in home economics and consumer education may yield very high non-market returns if the assertions concerning the instability and lack of parental guidance and know-how to provide homemaking and economic skills among poor families is true.

Change in Preferences. It is difficult enough to evaluate consumption benefits when one assumes that a person's tastes and preferences stay the same, thus assuring that the relative weights one attaches to a benefit or cost do not change. However, the purpose of education, including vocational and technical education, is to change a person's preferences, tastes and attitudes. Several points are of concern here. (See Wiseman, 1965, I.)

First, since it can be assumed that education changes tastes and preferences, the value and weights—that is, relative prices one will put on consumption, home production and leisure activities *before* one undergoes an education program is likely to be different from the valuation one assigns to these economic activities *after* one has completed his education. Which set of valuations or prices is the correct one? Should we add or deduct any differences in valuation between the two periods? Should only the valuation and prices after the educational process be considered even though the valuation and prices were created by the education process itself?

Next, this change in tastes and preferences may alter one's taste for leisure, work, and investment in education. Persons with higher levels of education generally work longer hours so the marginal value of leisure-time may be higher

for this type of person. In any case, if work-leisure-investment preferences change, this will change the measurement of opportunity costs as well as benefits.

Risk and Lumpy Investments. Human life is finite. Investments in human capital often extend over longer periods of time than investments in physical capital. And, persons cannot ordinarily train for more than one occupation or occupational set at a time. If a mistake is made--that is, one takes training in a skill which proves incompatible with one's needs or which has its demand eliminated by changing technology or tastes or competition, then, there may be very little time left to recoup one's losses or to retrain in a new occupation area. The only meaningful alternative, as with many older displaced Appalachian coal miners, for instance, may be to drop out of the labor force altogether.

Two observations on vocational and technical education and manpower training are pertinent at this point.

First, while it is conceptually reasonable to train for the "job of tomorrow," our manpower forecasting techniques are not accurate enough to permit this type of educational strategy. Hence, the focus on quick job placement and training-relatedness is a proper one in vocational education even though to date, indices to measure training relatedness are still too crude to be of much assistance in guiding investment decisions in the area of occupational training.

Second, given the flexibility of manpower training and the general short duration of such training, the gestation period of this investment strategy is relatively short and hence the opportunity costs, especially due to the risk of making a mistake in occupational choice, are relatively low so that manpower training has the flexibility to overcome the general lumpiness of human capital investment.

Next, this lumpiness of human capital argues for a shortening of the gestation period whenever possible. There is no ironclad reason, after all, why high school must last four calendar years or why summer vacations must occur. Thus, the relative cost position of vocational and technical education can improve vis-a-vis its close competing substitutes, such as the general or college preparatory program, if efforts are made to shorten the training periods. In this regard, also, cooperative vocational education may have a relative cost advantage over other types of education including straight vocational; since opportunity costs of foregone wages are less, the students often work and attend school all year round, and job placement may be more quickly achieved.

In short, while secondary vocational and technical education generally cost more than the general or college preparatory curriculums, this cost differential can be narrowed significantly by appropriate educational planning. Since foregone wages are a major cost of education even at the high school level, coop programs and programs designed to shorten the calendar time in school may represent appropriate educational strategies.

Complementarity, Substitutability, and Inseparability of Skills. This phenomenon arises from the fact mentioned earlier that it is impossible to separate one's human capital from his person. As a corollary, it is difficult to estimate the separate net effects of different kinds of human capital simultaneously embodied in the human agent and thereby determine the

contribution of each to one's earnings or welfare. This problem is especially significant in the area of vocational and technical education due to the presence of on-the-job training. It is important to measure the contribution of one's general education courses, his vocational courses and, since we are usually discussing a followup period of employment, his on-the-job training in order to make appropriate judgments as to the optimum relative mix of each kind of training. The problem is further compounded by the fact that much on-the-job training is informal rather than formal. It is possible to sort out these separate effects statistically, but the average effects of the investment elements are difficult to estimate with any precision where they interact jointly. Jacob Mincer (1962, III) did estimate the amount of on-the-job training costs by essentially working backwards from estimated rate of return differentials between groups with different amounts of education. His methodology is useful where direct measurement of on-the-job training is not possible. However, studies using interview data can collect the necessary information on wage differentials among skill levels within the same occupation to arrive at cost estimates and time spent in on-the-job training. Such cost and time estimates can then be entered appropriately in a regression model to control for the effects of on-the-job training.

Finally, cooperative training carries with it the same measurement problem. Namely, how much of the measured benefit is due each to the general, vocational and work experience components of the educational program? These separate costs and effects should be identified in order to make decisions as to the optimal mix among them in the training strategy.

Externality. An externality is an economic effect caused by an economic agent which bestows economic costs or benefits on secondary parties. The secondary party has no control over the receipt of these costs or benefits, but they influence his own economic behavior in positive or negative ways. On the other hand, the individual creating the externality is indifferent with respect to whom or where the cost or benefit finally resides. By its very nature, the externality cannot be priced and hence, rationed among possible recipients. As a result, the creator of the externality is indifferent to its existence, and the fact that he may be creating costs or benefits elsewhere in the economy does not enter into his own investment decision.

The standard example of an externality is air pollution. In the area of vocational or technical education, an example would be the existence of complementarity between a given skilled technician and the remaining members of a research team such that the technician's productivity raised or reduced the productivity of the remaining members of the team. To the extent that the other members' productivity rose (fell), their wage rates would rise (fall), but there would be no way that the technician could request (or be charged) a portion of the other parties' gain (or loss) in wages due to his role as a team member. To some extent, the entrepreneur who brought the research team together would capture these external benefits. His role is to internalize them within the company. But *he* captures the benefit and not the worker, whose activity results in the external benefit.

With respect to a given skill, such externalities should be accounted for in any complete accounting of costs and benefits, but this is difficult to do for several reasons. First, because there is no market mechanism (though one could often be established) to price and ration these benefits, their quantities and recipients are indeterminant. As a corollary, the very pervasiveness of externalities makes many of them take on the characteristic of a pure public good, so that in the case of a benefit, the consumption of this externality by one individual does not deny the use of any part of that benefit by other individuals. Since the externality is not rationed and since different persons weigh the value of it to them differently, in the absence of prices, one simply cannot estimate the total quantity of benefit bestowed on individuals or society.

In addition, it is difficult to identify externalities and a real possibility for double counting and, hence, overestimating costs or benefits exists. For instance, Burton Weisbrod (1964, I.) lists socially desirable attitudes and behavior as an external nonmonetary benefit of education. Is this really an externality or just a direct noneconomic benefit of socialization? It is, in part, both. My socially appropriate behavior will yield direct economic and psychic returns to me. To the extent that my behavior is appropriate and predictable, other individuals benefit from a more stable, predictable environment. Due to my behavior, their level of security and happiness will rise as well as their wage rate or earnings, yet they will not compensate me for this improvement in their well-being. For society, part of the externality, then, is directly measured by the second parties' increased earnings, but how much? Of course, the rise in happiness eludes measurement at this state of the art.

In the recent past, education has had a good press partly due to presumed large external benefits. The extent of these benefits of course is unknown, since they are, by their nature, unmeasurable in most cases given existing economic institutions and market structures. Recently, however, the presumed large external benefits to education, especially post-secondary education, are being vigorously challenged in the literature. (See Hansen and Weisbrod, 1969, I.)

Income Redistribution. Income distribution changes present a major problem in the estimation of the benefits and costs to an educational program. The issue is as follows: A given benefit-cost analysis must take as a given or constant the distribution of income before a given educational program is implemented since the distribution of income is a major determinant of prices, wages, interest rates and rents. However, the very purpose of educational programs, including vocational and manpower training programs, is to alter the distribution of income in favor of some target population, such as youth, the disadvantaged, blacks, or Appalachian coal miners. Thus, relative prices will change if the program has any noticeable impact at all, and the problem becomes one of choosing which set of prices to use in evaluating the investment value of the program. The before and after states are non-comparable, especially if the program is a large one, such as a nationwide expansion of cooperative vocational education, area vocational-technical schools, or two-year community or post-secondary technical schools. Thus, the logical basis on which to make the investment judgment is lost.

A less serious problem is the direct income redistribution effects which can occur as a result of a given educational program. Thus, an area vocational-technical school may flood a labor market with welders to the extent that the increase in supply reduces the wage rate of the existing journeymen welders in the market. This represents a capital loss to the existing journeymen welders who undertook the expenses of their training under the assumption of receiving the higher wage rate necessary to yield them a profitable rate of return on their investment. An awareness of the impact of vocational programs on the supply of skills results in craft unions not taking kindly to the attempts of public education officials to expand their apprenticeship programs or otherwise train deserving groups, such as blacks, in their skill areas.

The Problem of Unemployment. Concerns such as the above exist even when there is full employment in the economy. When cylical or deficient demand employment exists, the problem is compounded mainly because the implications of income redistribution become so much more direct. In situations of less than full employment due to deficient aggregate demand, there is always the very strong possibility that a retrained worker from a manpower program will simply displace an equally deserving worker who is not formally trained. Here, the concern is not only one of income redistribution, but one of the realization that there may be no net increase in national product while valuable resources have been expended, thus resulting in a net loss for society and a gain for one group of individuals that may not even totally offset the losses in welfare of the displaced group. (See Borus, 1966, III, where he terms this phenomenon the "displacement effect.") Of course, even under full employment, if there is income redistribution due to a program, one can, strictly speaking, make no judgment as to whether social welfare has improved because of the change in the structure of relative prices and the theoretical inability to make interpersonal comparisons among people concerning their relative losses or gains of utility due to the change. Where, then, does this leave us? Possible income redistribution effects should be taken account of and measured. To date no benefit-cost study does much more than provide lip service to this issue.

The existence of less than full employment compounds the measurement problems of benefit-cost analysis in other ways. For instance, as the level of unemployment as well as its distribution among occupational classes changes, the value of the embodied human capital represented by these acquired skills among occupational groups changes. Thus, no unique capital value for a given skill exists. The expected capital value fluctuates for reasons independent of any fundamental underlying demand for the skill.

The question is, should one allow his measures of the value of human capital created by an educational program reflect the phenomenon of cyclical unemployment? From a private standpoint, earnings benefits as well as foregone earnings should reflect unemployment experience. However, it is not certain that this type of adjustment should be made for an estimation of social benefits or social opportunity costs. For the social case, one wishes to know what alternatives were foregone in a real sense-what society *could* have produced. A moment's reflection will indicate the arbitrariness of making an adjustment for unemployment for society when you try to estimate social opportunity costs of

education in, say, 1932, as opposed to 1944. (See Bowman, 1966, p. 431, I; Haveman and Krutilla, 1967, I.) Fiscal and monetary techniques exist for the use of government to control the level of employment. A given educational investment should not be made to reflect the vagaries of a price level or income and employment policy whose social and political impetus may have nothing to do with the educational policy.

An additional issue is linked with the unemployment problem. With the existence of unemployment, the question arises as to which is a better measure of productivity-wage rates or earnings? It is contended that wage rates are less likely to reflect the vagaries of unemployment and, hence, do not penalize educational programs due to the effects of fiscal and monetary policies which are irrelevant to the purposes of education. In short, wage rates are a more stable measure of the productivity of educational investment than are earnings in an environment of cyclical unemployment. Yet, to the extent that wages are flexible downward (and this is only slightly), they, too, will reflect the impact of unemployment. To the extent that they are not flexible downward, the validity of wages as measures of productivity is brought into question. Thus, the use of earnings becomes more meaningful as a measure of relative productivity in labor markets characterized by sticky wages and structural unemployment. In such markets a person may undergo continuing cycles of employment and unemployment because his productivity is less than the wage rate at which he is hired. Once it becomes apparent to the employer that a man's productivity is less than his wage rate, he is laid off. Manpower retraining can serve to increase a person's productivity up to the point where it equals the going wage rate. When this retrained person is compared against a comparable person in a control group, no difference in wage rates may be discerned, but the trainee will experience more stable employment and higher earnings. It would be incorrect to argue in such a case, as do Earl D. Main (1968, III) and David Sewell (1969, III), that there are no necessary benefits to the training program since wage rates have not risen.

In line with this general problem of unemployment is the problem of estimating the costs of foregone wages in a labor market where structural unemployment exists.

If unemployment is completely structural, there are no opportunity costs during the training process. The worker cannot perform the existing jobs at all without the retraining. Likewise, once he is retrained, the structural assumption implies that the person's entire earnings be ascribed to the benefits of the training program. However, as an empirical matter, it is difficult to accept these assumptions which ascribe no opportunity costs during training and treats the total amount of earnings after training as a benefit. In the first case, the argument is that the trainee had no economic alternatives before him. In the extreme, this implies that his marginal revenue product (productivity of a marginal unit of labor times the price of the marginal unit of labor's output) is zero. Next, by counting the entire wage bill as a benefit, one is assuming that the trainee's marginal revenue product was zero at the time he entered training and the probability of untrained workers filling that job slot was zero.

However, the evidence in all these retraining studies is that trainees did forego earnings since members of a control group had earnings during the training period. Members of the control group got jobs in the same areas as trainees Thus, a zero probability of employment in these jobs by both the trainee and the control group does not exist. Therefore, it is incorrect to treat the entire post-training wage as a benefit, or opportunity costs during retraining as zero. The reason is that no market is ever completely dominated by structural unemployment.

In short, a person's expected earnings are almost never zero even at high levels of cyclical unemployment. Also, it is almost never the case that pure structural unemployment exists. Unemployment will usually be a mixture of the two types--a mixture which cannot be theoretically or empirically untangled.

But what if there are high levels of cyclical unemployment? If a worker begins retraining, he is eliminated for a time from the labor market. The probability that remaining unemployed workers may now become employed is at least the same and may now be higher, since the supply of labor in the market is reduced. If the probability that remaining workers in the labor force will be employed increases such that the zero likelihood of employment by the worker being retrained is exactly compensated for, then no social opportunity costs exist in terms of foregone earnings. There has simply been an income redistribution. However, private opportunity costs do exist for the worker being retrained since a positive expectation of employment now becomes zero during the training process. This is the "vacuum effect" of Borus (1966, Iii).

Practical Issues and Suggestions in the Measurement of Costs and Benefits

Identification of Costs under Conditions of Matching Grants. The Vocational Education Act of 1963 and its Amendments as well as such manpower acts as the Economic Opportunity Act set up conditions whereby the receipt of federal funds is contingent on the establishment of matching shares or partial cost sharing by the grant recipient.

Two broad problems exist when one attempts to measure the social costs of the Neighborhood Youth Corps (NYC) program, vocational education or similar social legislation involving federal-local cost sharing provisions. The first deals with the problem of measuring the social value of the sponsor share when the social program may be only partially funded by federal monies. The second problem deals with federal reimbursement of the sponsor for the use of certain sponsor facilities. These are common issues in any matching grant case.

The Sponsor Share. The federal expenditure represents an actual outlay for the federal government and is a cost to the federal government. However, from the standpoint of social economic cost, there is some question as to the validity and accuracy of the cost measure of the sponsor share. There are three problems involved here.

1) First, if the sponsor, often a school district, has excess physical capacity, the use of which is restricted to the school district, the cost to the sponsor for using this excess capacity is zero up to the limit of the designed capacity.

2) Second, if this restricted sponsor input, such as a school building, is used to simultaneously produce both a sponsor output and an NYC output, the marginal cost of using that input for the NYC project is zero up to the limit of the designed capacity.

3) Finally, even when there are no joint inputs or excess capacity, many of the inputs to the NYC program do not have market prices so that the prices of these inputs must be estimated or "shadow priced."

The combined result of these three factors is likely to be an overstatement of true total costs to the combined government units (sponsor plus federal) as well as an overstatement of total social costs. Shadow pricing or price estimation and the joint cost problem are discussed below.

Federal Reimbursement for Sponsor Inputs. An issue separate from the 10 percent sponsor share concerns the federal reimbursement of the sponsor for use of certain sponsor inputs, such as building space. Again, the three issues of possible excess capacity, joint outputs, and shadow pricing arise.

The problem is made more complex because cost to the federal government is not necessarily the same as cost to the sponsor. A rental payment to a sponsor can be an overestimate of the true cost to the sponsor even though it might cost the federal government more to rent the same facilities on the open market. For instance, if a school system has excess classroom capacity, the marginal or extra cost of using that excess capacity is zero up to the limit of designed capacity, as indicated above. If the federal government does not have access to that excess capacity, it must pay a rent in the market for comparable space. Thus, the alternative cost to the federal government justifies the payment of a rent to the school system, even though the true marginal cost to the school system may be less than that rent. As long as the federal government pays the school system less or no more than it would have to pay in the market, then this payment is rational from the standpoint of the federal government. To the extent that the school system has excess capacity, it receives a windfall gain. In fact, since the federal government has not rented in the market but has rented from the school district, then, if excess capacity exists in the school district, some or part of the rental payment is a transfer payment and not a social cost.[1] Thus, it is reasonable to assume that total federal costs may also overstate this portion of the social cost of the program. The same result would arise if the federal government reimbursed a sponsor for the use of a joint input which was being employed to produce sponsor output not associated with the educational program in question as well as to produce the program output itself.

Shadow Pricing. Even though the sponsor may be required by law to contribute a certain percent of the total cost of the program, the sponsor's share can often be in the form of goods in kind whose market prices are then estimated or "shadow-priced" in negotiations between the local sponsor and federal government officials. (See McKean in Chase, 1968, I.) The federal regulations are not very explicit about procedures for this shadow pricing. (See Federal Procurement Regulations, 1968, pp. 1501-1520, I.) Thus, considerable

[1] A transfer payment is defined as a payment for which no compensating service has been rendered. Its effect is to redistribute income.

arbitrariness can creep into the estimate of the sponsor's share. And, it is not at all inconceivable that different shadow prices could be attached to the same set of real resources being used in different projects across the nation even though the opportunity cost in each location could, conceivably, be the same.

Table 2 indicates the range of price estimates on classroom space which occurred in the establishment of the resource value of the sponsor's share of Neighborhood Youth Corps (NYC) project operation in the greater Los Angeles area. The estimates range from $1.60 per day per classroom to $40 per day per classroom. The General Accounting Office felt that a figure of $5.25 per day per classroom would be most reasonable, based on a 20-day month. (See Comptroller General's Report, 1968, pp. 39-41, III.)

TABLE 2

DIFFERENTIAL SHADOW PRICE ESTIMATES OF THE VALUE OF CLASSROOM SPACE, GREATER LOS ANGELES AREA

Educational Organization	Rate Per Day Per Classroom
Los Angeles Unified School District	$10, $34, and $40
Los Angeles County School Districts:	
Willowbrook School Districts	$6 and $9
Compton City School Districts	$5
Compton Union High School District	$1.60
Archdiocese of Los Angeles	$3.60 and $6
U.S. General Accounting Office	$5.50

Source: Comptroller General's Report to the Congress, *Review of the Community Action Program in the Los Angeles Area Under the Economic Opportunity Act*, Office of Economic Opportunity, B-162865, March 11, 1968, p. 40.

Because of these differences in estimates of shadow prices, the resulting differences in estimates of total attributed costs can be large. For instance, for two NYC projects in the Los Angeles area, the Government Accounting Office's estimate of total value of contributed classroom space was $318,309 while the estimate of the Los Angeles Unified School District was $1,048,500, a difference of $730,191. (See Comptroller General's Report, 1968, p. 41, III.)

It is not clear what the resolution of this inconsistency might be, since these school inputs have no comparable market inputs upon which to get a more valid economic measure of cost.

Three possible treatments for valuing this capital exist. First, one can argue that once the capital stock exists, especially the physical plant and buildings, it becomes specific to the educational process and thus has no alternative use. In this case, social capital costs would be zero in the short run, since no opportunity cost is involved in their use for a cohort of students who use the capital after the decision was made to create the school. This is a tenuous

assumption, though, for it is easy to discover alternative uses for such capital stock. Thus, the value of the educational physical plant is not zero in competing uses, but since it is not a perfect substitute for these competing uses, the market value of the competing uses does not exactly reflect the opportunity cost of using the non-renovated physical plant for educational purposes. If one went to the market to price the value of the non-renovated educational plant in terms of its potential value as a hospital simply by observing what the value of a hospital was, the value would be overstated. Thus, the value is not zero, but it is less than the apparent value of alternatives since, without renovation, it is not a perfect substitute. And, even with renovation, such factors as location, which cannot be changed, continue to exist and affect the degree of substitutability, thus forcing one to further adjust the implied opportunity costs.

Second, historical costs of building construction and site acquisition can be used, but these historical costs are essentially irrelevant since they have no necessary bearing on the present opportunity costs involved in using the capital stock in question. They do not reveal the current economic value of the capital resource. Current economic value could be less than, equal to, or greater than historical cost.

Third, the use of replacement costs is a possibility in the attempt to measure capital costs. However, it is obvious that in many cases it would cost more to exactly replace a building than the building is currently worth in economic terms. The use of replacement costs would over-value the capital resource, given a rising price level and assuming no compensating technological changes in construction technique.

In short, it is not obvious what price resulting among these three choices should be attached to the capital inputs to get a measure of the opportunity costs. None of the above is correct in a pure theoretical sense.

The Capital Recovery Factor. Even if the true economic value of the capital resources in use has been measured, the problem still remains as to the measurement of the rate at which the given capital stock is used up over the course of the investment process when more than one cohort of students employs the capital stock. Two courses of action have been suggested for use. One is to attempt to measure an imputed rent and depreciation to the capital stock by making analogies with respect to what amount of rent (i.e., return on the capital investment) the capital item would yield if it were being employed in the private sector of the economy. Some estimate of depreciation is added to this. But such a technique is subject to a great deal of arbitrariness and uncertainty. (See Corazzini, 1966, II.) Legal rules for depreciation allowances do not reflect economic realities.

In order to get a measure of the rental opportunity cost, it is necessary to go to the market place and attempt to identify capital resources which represent alternatives to the resources employed in the educational process. This will allow one to determine the value of foregone alternatives. But, again, any imputed rent based on market observations will most likely overstate the value of the capital resources which are already committed to education. Thus, a great deal of judgment is involved in adjusting the observed market prices so that they more closely reflect the true opportunity costs.

An alternative technique for estimating the rate of capital use lies in employing the "capital recovery factor" (CRF). The application of this technique automatically accounts for both rent (interest) and depreciation.

The capital recovery factor is that factor which " . . . when multiplied by the present value of capital costs, is the level (average) end-of-year annual amount over the life of the project necessary to pay interest on and recover the capital costs in full" (Hirshleifer, *et al.*, 1960, I. Chapter VII).

The formula is as follows:

$$c = \frac{C_0 i (1+i)^n}{(1+i)^n - 1}$$

where c is the capital recovery factor (annual level capital cost); C_0 is the present value of capital in use; i is the social opportunity cost rate of capital or investment funds; and n is the number of years over which benefits (of the capital in question) are returned, that is, the project life. In some respects, this technique is no less arbitrary than that which imputes rent and depreciation. Apart from the problem of establishing the present value of the capital in use, essentially arbitrary judgments must be made with respect to the values of *n* and *i*. In addition, the rate of capital use is projected as a constant annual amount, whereas the true rate of capital use is quite likely to vary over time. This, of course, can create a bias in one's estimate of present value or rate of return.

Joint Costs. In addition to the shadow pricing problem, it is clear that much of the sponsor input into an educational program is really of the nature of a joint cost or joint input. The school physical plant is a case in point. In such situations, the input is being used to produce simultaneously two or more separate outputs. For instance, space in a currently operating school may be contributed to house the staff of a newly established, federally supported program. The total cost of operating the physical plant of the school is then prorated among the various outputs, including the new program; yet, it may cost no more to operate the physical plant after the presence of the new program than it did before.

Two types of overestimation of costs can enter the analysis. First, a positive price may be put on in-kind resources contributed by the sponsor as its share of project costs when, in fact, the marginal cost of this resource use may be zero. This results in an upward bias in the estimate of sponsor share cost. Second, when the federal government reimburses a sponsor for indirect costs, the resource input in question may be a joint input, thus resulting in an upward bias in the measure of economic costs of the program in question as distinct from accounting or financial costs of the federal government. This latter situation is not unlikely.

The problem of joint costs affects the benefit-cost analysis in two ways. First, as is discussed below, there is no non-arbitrary measure of total cost and average cost. Since we often will not know what judgments may have been made when the sponsors prorated joint costs, one has to accept whatever upward bias is present in the total costs reported for the sponsor share as well as in the federally reimbursed sponsor costs. This situation exists for the measure of marginal cost also; however, the conceptual problem of proration is handled differently.

Issues in Prorating Joint Costs. There are two points of view with respect to the problem of proration when marginal benefit-cost comparisons are being made. The first advises against prorating. The second argues that proration is possible. The first point of view is supported by such persons as Hitch and McKean (1965, I) and Enthoven (in Hitch and McKean, 1965, I). They argue that the existence of joint costs does not affect the determination of marginal costs, and, since efficient investment decisions among two or more alternative programs are made on the basis of marginal costs, the presence of joint costs presents no basic problems for benefit-cost analysis. Not only is joint cost allocation necessarily arbitrary in nature, it is not needed, given the emphasis on marginal costs. True marginal costs are zero. When joint costs occur and involve two or more programs or outputs, the total cost of the set of programs or outputs can be measured. Then the combined total discounted benefits of the set of programs or outputs should equal or exceed their combined total discounted costs. But total average costs of each of the two programs simply cannot be measured in any non-arbitrary economic sense. This is no real loss, though, since to repeat, investment decisions among two or more *competing* programs are correctly made on the basis of marginal and not average cost and benefit comparisons.

Within very broad limits joint inputs are similar to what is known in economic analysis as a public good. Just as the benefits from a public good, such as national defense, are pervasive and need not be rationed or allocated on an individual basis among consumers (since one person's consumption does not diminish the consumption of that same good by other consumers), so, too, a joint input need not be allocated among the outputs stemming from it because each output can use the joint input without limiting the use of the input by all other outputs. The major problem here is that, except for such services as national defense, it is very difficult to identify a pure public good. A secondary problem is that the production process should be operating below capacity for the statement above to hold.

The argument for proration has been advanced recently by R. L. Weil (1968, pp. 1342-1345, I; also, Judy in Somers and Wood, 1969, III). Given a joint input, X, such as the physical plant of a school district which, along with general outputs, produces the output of a federally supported program, the argument for proration goes as follows: Estimate the total demand and the marginal revenues for each of the outputs in question. The marginal revenues of each of the outputs in question are then used to allocate the joint costs. The sum of the marginal revenues for the outputs in question must equal the price of the joint input. Thus, the cost of the joint input is allocated to each output according to its relative share of marginal revenue. The allocation of costs in this example will depend to a large extent on the conditions of demand for each of the outputs of the school district in question. Thus, for an identical production technique occurring in two markets with different demands for the outputs in question, different allocations of joint costs could occur.

The major problem with implementing this technique is that it is extremely difficult to estimate demand curves for goods and services– especially quasi-public goods like education–and it is even more difficult to identify

specific points on these curves. Thus, the operational practicality of the technique is questionable, given the current state of the art.

The controversy over allocating joint costs has not yet been resolved, but the author of the present cost-effectiveness study tends to agree that joint costs should not be prorated, even though a pure joint input, like a pure public good, is difficult to find in-actual practice.

Finally, to the extent that previously existing physical facilities are being used, these can be treated as "sunk" costs from society's standpoint. As such, their cost in use for the new program is zero if they have no alternative use. In short, in terms of clarity of the cost concept, the federal share is less ambiguous of the two major cost components--federal and sponsor. And, the federal share may be closer representation of true social economic costs than the measure based on federal and sponsor share combined.

Cost Issues with Wage Payments in Manpower Programs. The NYC program, the Job Corps and cooperative vocational education are of special interest to this analysis due to the special problems created by the wage that is received by the program participant. Total costs should be increased to the extent that the time of the program participant is undervalued by the wage rate he receives. That is, if, on the average, a student could earn more at some job other than his job with the NYC or Job Corps, then the difference between the two earnings would need to be added to total social costs to get a true measure of total foregone opportunities. Likewise, if this person would earn less on a job other than the job on the manpower program, the difference between the two is a transfer payment in favor of the participant and should be subtracted from the total social cost measure.

In this regard, transfer payments, which simply redistribute income among groups, are not considered social costs. It is in the nature of a transfer payment that what is given up by one individual or social group is, in turn, gained by a different individual or social group, so that, ignoring the problem of interpersonal comparisons of utility or the capacity to enjoy economic goods and services, there is no net loss of welfare within society as a whole.

The use of the total wage payment to the program participant as a cost probably overstates true social cost. If a program is designed to provide income to young persons who otherwise would be in the labor force, but would remain totally or partially unemployed, then some of the payment to them is a transfer payment. Indeed, it could be assumed that the NYC or the Job Corps program is not fulfilling its function unless the typical participant would have been earning less without the manpower job. This difference over and above what the participant could have earned is not an opportunity cost to him.

On the other hand, the manpower program participant is making some contribution to social benefits, since it is unlikely that his productivity is zero. Since he is contributing to social output, this benefit should be added to the other benefits of the program, in order to balance the benefit-cost ledger.

Problems similar to the above exist in treating the wage payment in a manpower program as a private opportunity cost.[2] First, economic theory

[2] I am indebted to Thomas Ribich for clarification of the issues discussed in this and the previous section.

would argue that the costs of participating in the program are the costs of foregone leisure. The earnings of the participant represent his cost of participating in the program. However, the wage payment, in turn, is a benefit and must also be added to the benefit side of the ledger. Thus, if the participant incurred no other cost or benefit, his private benefit-cost ratio would be equal to one.

Another problem arises if the program is providing earnings which the participant otherwise would not have earned due to involuntary unemployment or the receipt of a lower wage rate in the market. In this case, if the program earnings are equal to or greater than the earnings one could receive in the market, then the foregone earnings resulting from participation in the program are zero or negative. Negative foregone earnings are a benefit which must be added to the benefit side of the benefit-cost ledger.

Finally, there is the possibility that some of the participants may earn less in the program than they could have in the market. In such a case, private opportunity costs are understated. However, the overall presumption is that private costs are overstated or, what amounts to the same thing, private benefits are understated.

To determine if the manpower program wage is an over- or under- estimate of the foregone earnings of the participant, one could appeal to earnings measures for this age group reported in the census. However, at least two points ought to be made. First, these participants are different from those reported in the census, since, apparently, some proportion of the program participants would either have been chronically unemployed or not in the labor force in the absence of the program. Second, conceptually, a relatively large influx of young persons into the labor market should lower the earnings of this group relative to the average earnings reported in the census. Thus, use of census data would result in an upward bias. Of course, this problem is even more serious when one intends to measure foregone earnings to the primary and secondary school population in general. Nor does it help to indicate that child labor laws prohibit the employment of much of this group, for such laws, having been passed, can be repealed. Experiments in cooperative vocational education of 14 and 15 year olds are in progress even at this moment under an experimental program operated by the Bureau of Labor Standards, entitled the Work Experience and Career Exploration Program. Should it prove to be a success, one could anticipate increasing numbers of 14 and 15 year olds in the labor market.

The Extrapolation of Benefits. A major problem in benefit-cost analysis is the determination of the length of time which benefits extend into the future as well as the shape of this benefit stream. Average benefit streams for various types of educational benefits simply are not known with any precision. Most benefit-cost studies of manpower programs have only a few months to one or two years as a followup period after training. The benefits to vocational and technical education have been variously estimated as continuing for six to 10 years before vanishing (Hu, *et al.*, 1969, II; and Eninger, 1965, II). The reasons for this are unclear. One possibility is that general and college preparatory graduates acquire more on-the-job training after leaving high school than do vocational graduates, though this has not yet been verified. Another possibility is

that the more general flexible nature of the general and college preparatory education allows the sampling of a group of jobs which, on the average, have a greater earnings growth progression. Vocational graduates may enter their jobs at wage rates closer to their peak lifetime earnings than do students in competing curriculums. Finally, the option value–the degree to which a given level of education allows access to additional formal or on-the-job training–may be higher for the general and college preparatory curriculums. All these are possible answers, but the reasons for the converging earnings time profiles still have not been fully investigated.

In the absence of any precision concerning earnings profiles, the best course is to employ sensitivity analysis to estimate the range of effects under different assumptions concerning earnings profiles. Borus and Tash (1970, I) propose a useful sensitivity matrix which allows for variations in the growth of the earnings profile at negative, zero and positive rates as well as benefit streams which last for a short, medium and lifetime earning period. This is the best solution to the problem at this point. But, it leaves one with a variety of estimates, no one of which is clearly a measure of the true value.

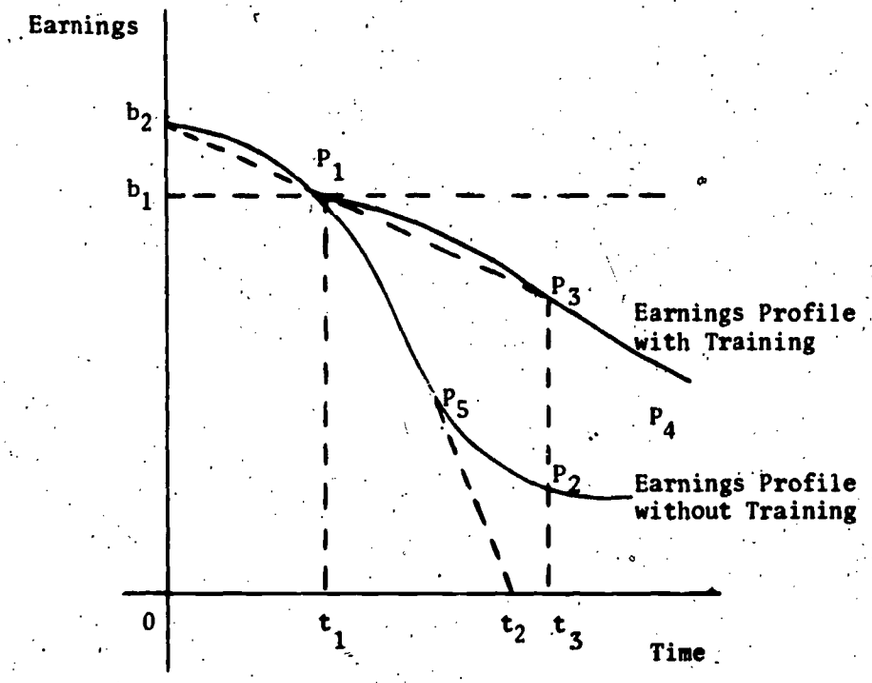
The Problem of the Control Group. A final issue in the measurement of costs and benefits deals with the use of control groups. Ideally, the control group should come from the same population as the experimental group. Data should be collected for both groups on such things as sociodemographic characteristics, program inputs, and program outputs, both *before, during,* and *after* the program treatment. As a practical matter, though, this is almost never done. The study of the in-school Neighborhood Youth Corps in Cincinnati by Gerald Robin (1969, III) is an exception to this statement.

Most studies of educational and manpower programs are retrospective in nature and hence must generate a control group after the fact. Two general approaches have been used. The first is simply to compare the experiences program participants had before the program with experiences they had after the program. The second method is to attempt to develop a comparable group of persons who have never had the treatment to serve as a basis for comparison.

With the before/after comparison, one is troubled by the fact that changes other than the treatment occur over time which can affect the measure of program outcomes. By their very nature, it is difficult to control for these factors. For instance, given that earnings and employment are a measure of outcome, one will get biased results if the pre-, during, and post-program measurement periods extend over a business cycle. On what basis do you adjust wages and employment up or down to reflect a full employment level of employment and earnings for the experimental group over the study period?

Before/after comparisons can distort one's measures of costs and benefits in other ways. Figure 5 shows the before/after earnings profile of a person who was structurally unemployed but who then took retraining. Ideally, what one wishes to measure as a benefit is the area under the curves bounded by P_1, P_3, P_2, P_5. This cannot be done, since, once the person takes training, the line segment P_1P_2 is no longer observable. Thus, a possible strategy to get a measure of earnings change is to compare earnings at the time of entrance to the program, t_1, with the profile of earnings after the program. As can be seen,

FIGURE 5
HYPOTHETICAL BEFORE/AFTER EARNINGS PROFILE OF STRUCTURALLY UNEMPLOYED MANPOWER TRAINEE



however, the result will be to measure negative benefits to the trainees. This is not an unlikely result when you are dealing with workers in high wage industries, such as West Virginia coal miners who become technologically displaced and structurally unemployed rather abruptly. Another strategy would be to estimate the slope of the line b_2P_1, extrapolate it to P_3 and subtract this earnings projection from the line segment P_1P_3. This will result in positive benefits, but a considerable understatement. A third alternative would be to estimate the slope of the curve $b_2P_1t_2$ and subtract this difference from the curve $P_1P_3P_4$. This will result in an overstatement of benefits, since the earnings profile has an inflection point (it changes direction of slope) at Point P_5. Thus, none of these alternatives is very satisfactory.

Hardin and Borus (1969, III) experimented with their Michigan retraining data and found the gains from retraining were $1,524 using a before/after method; when using a control group, the gains were only $216 in the 365-day period after training–a difference by a factor of more than seven. Thus, depending where one begins his before/after estimation on the time profile of income, serious under- or over-estimates of benefits can occur.

However, serious problems also exist in the absence of a true experimental study model where the experimental and control groups are selected before treatment from a similar population of subjects. Manpower training benefit-cost

studies have variously used program dropouts, unemployed or underemployed registrants at employment security offices, and eligible persons who were accepted into the program but who did not participate. Although most sociodemographic characteristics can be controlled for, the persistent problem of self-selection into the program remains to bias results. No technique thus far has been too successful in controlling for such bias, though the estimation of a discriminant function is a help. A discriminant function permits an estimate of the probability of a person who is included in the control group being a member of the experimental group. One general statistical estimation technique for the discriminant function is known as *probit* analysis. (See Laumann, 1965, I; Somers and Stromsdorfer, 1970, III.)

Vocational and technical education presents a particularly difficult problem when one seeks to develop a meaningful control group. Generally, participants in vocational or technical programs are compared against those in the general or college preparatory curriculums. However, there exists a fundamental problem in that all these groups do not come from the same population of students. It can be expected that each of these persons will place a different weight on earnings, job status, the value of additional college education, and other factors associated with the multiple outcomes of education. Generally, these relative weights are not known. Thus, for instance, if wage rates or earnings are used as a simple index of program benefits, a bias can result. If vocational graduates place less emphasis on job status and more emphasis on earnings than from the standpoint of, say, college preparatory students whose emphasis may be the reverse, benefits to vocational education may be over-estimated. Due to the fact that the different types of students are attempting to maximize different sets of satisfactions (or utility functions), there is, as yet, an unresolvable problem with the use of these types of curriculums as control or comparison groups with vocational or technical graduates.

Summary

All costs, regardless of their institutional form or problems of measurement, are opportunity costs. As such, they represent the value of the next best alternative to which funds could be put were they not expended on vocational or manpower training.

Benefits are the opposite of costs and represent opportunities gained as a result of undertaking a particular activity.

A variety of conceptual and measurement problems faces the analysis of educational investment in human beings. These are the following:

1) Earnings maximization versus utility maximization;
2) Complementarity in production and consumption;
3) Joint costs of production, consumption and investment;
4) Non-market production and consumption;
5) Impact of education on values and preferences;
6) Risk;
7) Complementarity, substitutability, and inseparability of human skills;

8) External effects;
9) Income redistribution effects;
10) The influence of unemployment on the determination of costs and benefits; and
11) The problem of the control group.

Briefly, these problems affect the analysis as follows:

Benefit-cost analysis should measure the increase in welfare or utility due to an educational program. No direct measures of utility are possible. Earnings and other measures of program effect therefore become indices of utility but always measure it imperfectly.

Education and training create simultaneous production and consumption benefits. The latter are extremely difficult to measure and have not been as yet. The result is to underestimate the benefits to education.

Many educational inputs, such as a school building, simultaneously create more than one output. Such inputs are known as joint inputs. An unresolved debate, hampered by severe measurement problems, exists over the advisability of prorating of these input costs. Hitch, McKean and Enthoven argue that the true marginal cost in a joint input situation is zero for each of the outputs produced. Each output uses the input without detracting from the ability of other outputs to employ it, at least up to the designed capacity of the input. Thus, the marginal cost is zero. Weil argues that joint costs should be prorated in accordance with the relative degree to which the outputs produced by them add to total benefits. But this requires the estimation of demand curves for the various outputs in question. Statistical estimation of demand is very difficult to do, especially for quasi-public goods like education.

The failure to measure non-market production and consumption, which may be a very large component of benefit to education and training, may seriously understate total benefits.

Changes in values, tastes or preferences due to the act of education or training alter the structure of relative prices and hence the measure of costs and benefits to any educational investment. Costs may no longer be measured on the same basis as benefits, since the structure of relative prices before and during the investment will be different after the investment. This is a crucial point, since one of the purposes of investment in education is to change noneconomic behavior.

Risk and the finiteness of human life, linked with the fact that usually only one particular type of investment can be undertaken by a human at a time (that is, training as a doctor precludes simultaneous training as a butcher), cause difficult policy problems concerning the type of education to be provided–specific or general–and the realtive lengths of time this education should continue. Partial solution to the high school dropout problem hinges on appropriate analysis of these factors.

Investments in human beings are complementary and cannot be separated from the human agent in which they are embodied. Since a person undertakes a series of investments over time, it is difficult to empirically sort out the net effect of any given educational investment on human performance and welfare. Apparently, for instance, the more education one gets, the greater is his

opportunity to gain on-the-job training. Any measurement of benefits to the original education over time must adjust for the existence of this on-the-job training. Also, to what extent should the original training and the on-the-job training which it enables be considered the same or separate investments?

External effects are either costs or benefits created by an economic act which affect the economic behavior of second or third parties but which are not taken into economic consideration by the person or persons originally causing them. Such effects are difficult to account for since they often do not occur in an institutional setting where prices can be assigned directly to them.

Education is also asserted to provide considerable external benefits, but, at least at the post-secondary level, this has recently been strongly challenged by Weisbrod and Hansen, among others. To the extent that such external effects do occur, however, they should be measured. Few studies have attempted even a partial measure to date. What is the exact value to a given person due to the fact that all other persons in the society are literate? How can this effect be measured?

Changes in the distribution of income cause problems similar to those discussed under changes in values, tastes and preferences. In addition, it is not necessarily the case that a dollar of income taken from one person and given to another has no net effect on total social welfare. It is quite possible that each values the utility of the dollar gained or lost differently. This is especially a serious problem in evaluating the benefits of manpower training where, given the existence of cyclical unemployment, the placement of a trainee in a job may mean a non-trainee has been displaced from it. The gain of the one man is cancelled in whole or part by the loss of the other. Also, educational programs financed by taxes imply the existence of transfer payments from the non-school to the school population. How does one evaluate the impact of these transfers on social welfare and, hence, on social costs? No benefit-cost study in secondary or post-secondary vocational education or manpower training has attempted to quantify these effects.

Unemployment is defined as either cyclical or fractional. Cyclical unemployment is due to a lack of demand in the economy. Structural unemployment is simply long-duration fractional unemployment, where, for any number of reasons, the available jobs in a labor market do not match the available skills.

The existence of cyclical unemployment creates problems of measurement in both costs and benefits. These are described as "vacuum" and "displacement" effects by Borus and represent cost or benefit biases due to changes in the income distribution brought about through the dynamics of manpower training or similar programs. The existence of structural unemployment does not cause these income transfers to occur.

The calculation of social and governmental benefits under conditions where federal monies are matched by local government contributions causes severe problems of measurement of the value of social costs. Often the sponsor inputs are donated in-kind and their prices must be estimated or shadow-priced. The local inputs may represent the use of existing excess capacity which, for a variety of institutional reasons, may have no noneducational purpose. Thus, the true social cost of the use of these inputs may be very low or even zero. Finally,

the local sponsor, school or district, may be employing its resources to produce jointly two programs, one of which is partially supported by federal monies and one which is not. With such a joint input, there is no unambiguous theoretical guidance on how this joint input should be prorated. While the argument is unresolved, it is almost certain that prorating the costs of a school's commonly used physical plant on the basis of square feet per student or some other arbitrary rule lends bias to the estimate of average and total cost.

Before/after comparisons of program effects are inferior to those based on the use of a properly selected control group. The choice of a control group to use depends on the purpose of the analysis. Different control group comparisons tell different things about a program. For some purposes it is desirable to use only academic or general students as a control for vocational students. For other comparison, one may wish to use the student body of a comprehensive high school. One will get different results for a manpower training program if he designates dropouts as the control group as distinct from a random sample of the unemployed or those eligible who did not enter a program.

It is not commonly understood that observations on variables for the control and experimental groups should be taken both *before, during* and *after* the training process. It would be too harsh to suggest that the use of a control group is not fully appreciated, but, certainly once the control group is designated, the sample units from it should be selected randomly. This fact is often not appreciated, though departures from random selection are, of course, necessary if one wishes to pick a judgment sample for a very specific purpose. Under such conditions, however, the narrow purposes of such a methodology should clearly be recognized.

A REVIEW AND SYNTHESIS OF BENEFIT-COST AND COST-EFFECTIVENESS STUDIES

There are hundreds of studies, papers, reports and monographs which attempt to evaluate vocational, technical and manpower training programs. Some insights can be gained from most of these. However, relatively few studies exist which deal successfully with the investment aspects of such educational activity. This chapter provides a summary of cost-effectiveness analysis of secondary and post-secondary vocational-technical education as well as an analysis of two-year junior college education. Where similarities among the populations served warrant it, the above three types of education will be compared in economic investment terms with selected Federal government manpower programs such as the MDTA, JOBS, Job Corps or the NYC. The objectives of the various manpower programs, as well as the population each is intended to serve, are displayed in Table 3. Characteristics of the actual populations served are displayed in Table 4.

When treating these various programs as substitutes for each other, one should note that the superficial similarities among the populations they serve obscure some very significant dissimilarities. For instance, those served by the MDTA and those served by vocational education will differ in terms of age, family life cycle, the opportunity costs (foregone wages) they bear while being trained, quality and quantity of prior education, and other significant characteristics. These two programs cannot be thought of as perfect substitutes for each other. For another contrast NYC is being refocused on 16 and 17 year-old high school dropouts. The group is clearly different from the persons generally served by the institutional MDTA. The MDTA enrollees may or may not be high school dropouts, and over 85 percent of them are 19 years old or older. Finally, the in-school NYC is a rather imperfect substitute for cooperative vocational education–some would argue it is no substitute at all.

Table 4 shows how the clientele of the various programs differ in broad terms. Vocational education is a program which largely serves white youths, both males and females. The MDTA programs serve mainly whites and are adult programs. The JOB Corps, and JOBS program serve mainly black males with the JOB Corps concentrating on youths while JOBS concentrates on adults. The Concentrated Employment Program (CEP) mainly concentrates on black adults, while Operation Mainstream serves mainly white adults. The NYC programs are evenly divided between whites and blacks and concentrate on youths.

Thus, one should take care in assuming that all these programs are close substitutes for each other. Data on other socioeconomic or sociodemographic

TABLE 3
OBJECTIVES AND POPULATION TO BE SERVED FOR SELECTED FEDERAL MANPOWER PROGRAMS

Program and Date Started	Objectives[1] and Services	Population Served[2]
Concentrated Employment Program (CEP) May, 1967	Coordinated program of manpower and supportive services	Hardcore, unemployed youths and adults in selected areas where they are concentrated
Job Corps January, 1965	Residential program of intensive education, skill training and related services	Low income, disadvantaged youth 16 to 21 years of age
Job opportunities in the Business Sector (JOBS) March, 1968	Uses private industry to hire, train, retain and upgrade the program population	Hardcore unemployed 18 years of age and over
MDTA Institutional and On-the-Job Training, August, 1962	Provides occupational training or retraining in a classroom setting or instruction combined with supervised work at the job site under contracts with private and public employers	Unemployed and underemployed persons 16 years of age and over, two-thirds of which must be disadvantaged
Neighborhood Youth Corps (NYC) Out-of-School, January, 1965	Job preparation through paid work experience with remedial services	Disadvantaged youth of high school age (14-21). New design of out-of-school NYC limits population to 16-17-year-old dropouts
Vocational Education 1917	Full-or part-time vocational training, primarily in a classroom setting to reduce the flow of unskilled or ill-prepared youth into the labor market	Youth or adults, in or out of public schools. New emphasis on poor and disadvantaged

Notes:

1 For all of these programs, the major objective is to upgrade or provide occupational skills that will be of value in the labor market. Each program cites additional objectives, some of which are economic in nature and some of which are psychological or social in nature; but the major goal of each of these programs is to enhance the earnings and employment of the group served.

2 "Disadvantaged" means poor, not having suitable employment and either (a) a school dropout, (b) a member of a minority, (c) under 22 years of age, (d) 45 years of age or over, or (e) handicapped.

Source: U.S. Department of Labor, *Manpower Report of the President*, March, 1970, Appendix A: "Guide to Federally Assisted Manpower Training and Support Programs."

characteristics would likely show even greater dissimilarities. Thus, the populations served do differ a great deal. For this reason it is not likely that the programs are close substitutes since, although teaching technology may be similar – that is, the same concepts, etc. are needed to teach machine shop in MDTA institutional as in secondary vocational education, other institutional factors surrounding the teaching process and which affect the process, may differ and may also be needed to serve the particular groups.

Likewise, one should not strongly generalize that manpower training serves as a "remedial" program for the "mistakes" of secondary vocational or comprehensive education. The great disparity in the age distributions as well as race indicates that significant cultural, social and economic factors can intervene between the time one leaves high school and the five, 10 or 15 years or so later when he may take manpower training. Such changes may occur and do occur that no educational planner in high school is even likely to be able to anticipate.

Next, one should be aware that the benefit-cost studies summarized here report only monetary economic costs and benefits or reductions in unemployment. They do not account for nonmonetary economic costs or benefits, or benefits such as job satisfaction. However, for a fairly narrow investment analysis the monetary measures are considered to subsume the major portion of all costs and benefits.

It is also important to note that each of these studies uses different methodologies; for instance, each controls for different sociodemographic variables and some studies use different control groups. Several studies use no control group at all but rely on before/after comparisons. The tables reveal some of these differences in methodologies. While different concepts of cost or benefit can be and were adjusted for, the basic methodologies underlying the studies cannot be changed. Hence, this analysis is a summary statement of what has been done but, to some extent, the studies are not comparable, even when populations served are the same.

The remainder of the chapter is organized as follows. First, the major benefit-cost studies will be analyzed in broad terms. Secondary vocational-technical education will be compared in investment terms with selected secondary education alternatives, such as graduation from a comprehensive high school. Then, post-secondary vocational technical education and two-year junior college will be analyzed. Finally, the manpower programs will be analyzed in the same terms, starting with MDTA, then Job Corps, NYC, JOBS, and CEP.

Second, the impact of the programs on various sociodemographic groups are considered. Only limited benefit-cost analysis is presented here, though some of the data are previously unpublished.

Third, the earnings and employment benefits of program areas and skills are presented. Most of the analysis in these three sections relys heavily on multiple regression analysis to estimate net program effects.

TABLE 4

STUDENT CHARACTERISTICS BY RACE, SEX, AGE AND PROGRAM IN PERCENT, 1969***

	Vocational Education	MDTA Institutional	MDTA On-the-Job	Job Corps	JOBS	CEP	WIN	Operation Mainstream	NYC I/S	NYC O/S
White	79.5**	59.2	66.8	26.2	12.7	28.0	56.0	61.6	46.3	48.2
Black	13.6	36.0	30.3	60.8	77.5	65.0	40.0	24.0	47.4	47.5
Male	45.0	55.6	65.1	74.0	70.8	58.0	40.0	70.8	53.4	46.0
Female	55.0	44.4	34.9	26.0	29.2	42.0	60.0	29.2	46.6	54.0
Under 19 Years of Age	94.3	12.5	11.1	91.1	17.3	38.4*	16.0	2.0	96.1	80.6

Notes: * Under 22 years.
** Contains both whites and Orientals.
*** Some of these data refer to fiscal year while others refer to particular time periods in 1969.

Source: *Vocational Education: Characteristics of Teachers and Students, 1969*, OE-80073, National Center for Educational Statistics, U.S. Office of Education, Washington, D.C.: U.S. Government Printing Office, December, 1970; and
Manpower Report of the President, U.S. Department of Labor, Washington, D.C.: U.S. Government Printing Office, 1971.

Summary of Results: Broad Program Effects

Secondary Vocational-Technical Education. Among the secondary curricula, it is most reasonable to evaluate the secondary vocational-technical curriculum in economic terms. However, there is a problem in choosing the appropriate control or comparison group against which to judge the net economic performance of this curriculum. Table 5 displays the benefit-cost analysis of vocational-technical education with respect to two different control groups. The first control group is the combined curricula of the comprehensive high school. This control group would include the academic or college preparatory curriculum as well as the general and vocational-comprehensive curriculum. The latter is essentially a general curriculum wedded with a group of vocational courses, none of which is intensive enough to give the student any specific highly marketable skills. The other comparison is against the academic or college preparatory curriculum alone. Using either of these broad control groups creates problems of comparison, since the objectives of the various curricula are somewhat different. Additionally, the sociodemographic characteristics and personal objectives and goals of the groups partaking of the various curricula are different. For instance as noted earlier, the vocational-technical graduate, as compared to the academic graduate, may put a heavier weight on earnings than on the nonmonetary gratification to be had from a job. Thus, when the two types of graduates are compared, the benefits to the vocational-technical graduate vis-a-vis the academic graduate may be overstated since having immediate money income may be less important to the academic graduate than to the vocational-technical graduate. The fact that there is a higher dropout rate from vocational than from academic programs may be an expression of the fact that students who choose vocational courses may make judgments over a shorter time horizon and weight immediate financial reward more heavily than do academic curriculum students. This issue will be investigated at greater length in subsequent discussion.

The data in Table 5 display both internal rates of return–the profit rate of the program–and net present capital values–the present value of benefits minus the present value of costs. Three of the seven studies listed are nationwide in scope, while three relate to specific locales. Major reliance for policy decisions should be placed on the three studies which are nationwide in the scope of their sample.

Average Costs and Benefits. The Fernbach and Somers study (1970, II) indicates that vocational-technical graduates earn an average of $667 more per year than do secondary academic graduates. Total social costs, including direct operating costs, capital costs, and foregone earnings, amount to an average of about $720 per year. Thus, the average rate of return to vocational-technical education for the Fernbach-Somers sample of vocational-technical graduates is approximately 21.4 percent for the investment over a projected 10-year period.

TABLE 5

COMPARATIVE ANALYSIS OF COST AND BENEFIT ESTIMATIONS OF SELECTED STUDIES OF SECONDARY VOCATIONAL-TECHNICAL EDUCATION

Name of Study	Time Period of Study[1]	Locus of Study	Experimental Group	Control Group	Cost/Year[5]		Benefit/Year[6]		Duration of Training in Years	Duration of Benefits in Years[4]	Rate of Return (percent)	Present Value In Dollars	
					Marginal	Average[8]	Marginal	Average[8]				5%	10%
1. Hu, Lee, and Stromsdorfer	1959-66	Baltimore, Philadelphia Detroit	Vocational-Technical[7]	Comprehensive[7]									
a. [2]1		Philadelphia			464		343		3	6	9.3	240	Neg
2.		Detroit			386		643		3	6	33.6	1776	1152
b. [2]1.		Philadelphia			485		343		3	6	8.2	183	Neg
2.		Detroit			403		643		3	6	31.8	1772	1102
2. Fernbach and Somers	1964-69	Nationwide	Vocational-Technical	Secondary Academic									
a.						592;596; 615[3]		667	3	10	25.9	2811	1583
b.						711; 715; 738		667	3	10	21.4	2484	1283
3. Project TALENT (Males only)	1958-65	Nationwide	Vocational-Technical	College Preparatory									
a.						465; 483; 485[3]		375	3	10	17.7	1200	542
b.						560; 574; 585		375	3	10	13.8	943	307
4. Corazzini (Males only)	1963-64	Worchester, Massachusetts	Vocational-Technical	Comprehensive									
a. 1.					512		312		2	10	23.1	1059	596
2.						964		312	2	10	7.4	219	Neg
b. 1.					618		312		2	10	17.9	862	412
2.						1129		312	2	10	4.1	Neg	Neg

5. Eninger (Males only)	1950-64	Nationwide	Vocational-Technical	Academic									
1956-65;													
a.						435;447; 465[3]	412	412	3	10	21.2	1624	783
b.						522;547; 569	412	412	3	10	18.3	1358	631
1960-64													
a.						485; 491; 496[3]		577	3	10	27.4	2512	1443
b.						582; 589; 595		577	3	10	22.8	2245	1199
6. Kaufman and Lewis	1958-65	Three cities in Pennsylvania	Vocational-Technical	Combined Academic and General									
1960					548;553; 562[3, 9]		837		3	10	34.5	4278	2735
1962					562;567; 576[3, 9]		611		3	10	25.2	2655	1549
7. Taussig	1962-65	New York City	Vocational-Technical	Combined Academic and General									
a.					389;412; 417[12]		240	[10] 0 [11]	3	10	6.8	255	Neg
									3	10	—	Neg	Neg
b.					484;509; 519[12]		240	[10] 0 [11]	3	10	4.6	Neg	Neg
									3	10	—	Neg	Neg

Notes:
1 Time period of study includes the training period as well as the available time for follow-up at the time the data were gathered.

2 (a) Signifies current operating costs; (b) signifies total resource costs to society including current operating costs, capital costs and opportunity costs where applicable. This is the case for all the following similar tables.

3 Each cost figure applies to a different year in the relevant three-year training period.

4 The six-year benefit for Hu, *et al.*, is based on the estimated length of time benefits persisted in the three-city study. The 10-year benefit period is based on Eninger, *Process and Product . . . : The Product, op. cit.*

5 Costs per year are relatively low since opportunity costs (foregone wages) are assumed to be the same between secondary vocational students and comprehensive students. Also, to the extent that they exist, these opportunity costs to society are assumed to be quite low since the influx of all high school students into the labor market at once would depress considerably an already low level of earnings for this age group.

6 All benefits are before-tax earnings and represent a social benefit, that is, an increase in value added to the gross national product.

7 Neither of these two groups had any post-secondary or junior college or college education in the six-year followup period.

8 The costs are true average costs. The benefits are differences between averages of the two comparison groups. Thus, the estimated rates shown here understate the actual average rate of return.

9 Exact components of these cost fugures are not known. They include at least current operating costs. Note that they are generally consistent with the other figures on the table. These figures are deflated, assuming costs were $553/annum in 1959, the base year.

10 For males only, in training related jobs, assuming a 12 cent per hour gain and a 2,000 hour working year. Unadjusted for any sociodemographic differences except sex.

11 Females only, in training related jobs, unadjusted for any sociodemographic differences except sex.

12 Each cost figure is for a separate year, deflated from the 1964-65 base year. Costs are for males and females combined. Costs are differences between two averages.

Sources:

1. Teh-wei Hu, *et al.*, *A Cost Effectiveness Study of Vocational Education: A Comparison of Vocational and Nonvocational Education in Secondary Schools*, University Park, Pennsylvania, March, 1969.
2. Benefit Data are from: Susan Fernbach and Gerald G. Somers, *An Analysis of the Economic Benefits of Vocational Education at the Secondary, Post Secondary, and Junior College Levels*, Preliminary Report, Madison, Wisconsin. May, 1970. Cost data are from: American Institutes for Research, *An Analysis of Cost and Performance Factors for the Operation and Administration of Vocational Schools for Secondary Programs*, Pittsburgh, Pennsylvania, May, 1967.
3. Benefit data are from: U.S. Office of Education, Office of Program Planning and Evaluation, unpublished *Project TALENT* data, 5-year followup information on high school graduates of 1960 cited in Howard Vincent, "An Analysis of Vocational Education in Our Secondary Schools," July, 15 9 (revised), mimeo. Cost data are from: American Institutes for Research, *An Analysis of Cost . . . op. cit.*, May, 1967
4. Arthur J. Corazzini, "The Decision to Invest in Vocational Education: An Analysis of Benefits," in *The Journal of Human Resources*, Supplement: *Vocational Education*, Vol. III, 1968.
5. Benefit data are from: Max U. Eninger, *The Process and Product of T and I High School Level Vocational Education in the United States. The Product*, American Institutes for Research, Pittsburgh, Pennsylvania, September, 1965. Costs data are from: American Institute for Research, *An Analysis of Costs . . ., op. cit.*, May, 1967.
6. Cost and benefit data are from Jacob J. Kaufman and Morgan V. Lewis, *The Potential of Vocational Education: Observations and Conclusions*, University Park, Pennsylvania, May, 1968.
7. Cost and benefit data are from: Michael K. Taussig, "An Economic Analysis of Vocational Education in New York City," *Journal of Human Resources*, Supplement, *Vocational Education*, Vol. III, 1968.

If the average social cost rate of capital is 10 percent, then vocational technical education yields a relatively high rate of return.[3]

Marginal Costs and Benefits. Given their obvious qualifications the above studies indicate that the average costs of vocational-technical education are more than covered by the average benefits of the program. Thus, in absolute terms, the program is operating in the black. However, a second question involves the economic returns to vocational-technical education relative to alternative uses of social capital. For example, should additional funds be spent on vocational-technical education relative to competing secondary curricula? The answer to this question requires an estimation of the additional or extra benefits yielded by vocational-technical education for each additional dollar spent. In economic parlance, marginal (or extra) benefits must be compared to marginal (or extra) costs

To repeat, the distinction between average and marginal is as follows. Average costs (or benefits) equal total costs (or benefits) divided by total persons in the program. Marginal costs (or benefits) are the additional costs (or benefits) due to adding an extra person to the program. Marginal costs in this analysis are usually estimated with a statistical cost function by relating total costs to total enrollments in a program to see how total costs *change* as total enrollment *changes by one unit.* However, in some cases marginal cost in these studies is shown as the difference between two average costs-that of the experimental group and that of the control. Marginal benefits in this analysis are estimated by comparing the difference in average performance of the experimental group and the control group. Strictly speaking, all the marginal benefits in this survey analysis are differences between two averages. But, if one accepts the assumption that shifting a person from one group to the other increases the average benefit by the amount of the differences in the two averages, then this difference can be assumed to approximate a marginal difference. A similar assumption must be made when differences in average costs are treated as marginal costs.

The studies of specific cities by Hu, *et al.*, (1969, II) Kaufman and Lewis, (1968, II) and that by Corazzini (1968, II) and Taussig (1968, II), indicate that the marginal rate of return to vocational-technical education only falls below the lower bound of five percent for the social rate of return to capital for New York City. The marginal rate of return to vocational-technical (compared to the curricula of the comprehensive high school) is 31.8 percent in Detroit, 8.2 percent in Philadelphia, and 17.9 percent in Worchester, Massachusetts. It is 4.6 percent for males in training related jobs in New York City but zero for females.

One qualification should be noted at this point. The analysis suggests that secondary vocational-technical graduates *as a group* do better (earn more) than

[3] Ten percent is the usual upper limit placed on the social opportunity cost rate of capital. Under current conditions of high interest rates, one might argue for a higher upper limit. However, to the extent that this higher rate of interest is due to inflation, it should be deflated. The social rate of interest or the social opportunity cost rate is usually defined as the riskless, deflated interest cost rate. The term "riskless" implies no risk of default on payment of interest or principal. It does not imply a lack or risk that the investment may yield no real benefit.

TABLE 6
COMPARATIVE ANALYSIS OF COST AND BENEFIT ESTIMATES OF SELECTED STUDIES OF POST-SECONDARY VOCATIONAL-TECHNICAL EDUCATION AND JUNIOR COLLEGE EDUCATION

Name of Study	Time Period of Study[1]	Locus of Study	Experimental Group	Control Group	Cost/Year		Benefit/Year[6]		Duration of Training in Years	Duration of Benefits in Years[4]	Rate of Return (percent)	Present Value in Dollars	
					Marginal	Average	Marginal	Average				5%	10%
1. Fernbach and Somers	1964-69	Nationwide	Post-secondary vocational education	Secondary[5] Academic									
a.[2]					2494, 2519[7]		996		2	10	8.7	1198	Neg
b.					3084, 3132		996		2	10	6.8	642	Neg
2. Somers, *et al.*	1964-69	Nationwide	Post-secondary vocational education	Secondary vocational education									
a.					2814 2839[7]		329		2	10	Neg	Neg	Neg
b.					3504, 3552		329		2	10	Neg	Neg	Neg
3. Somers, *et al.*	1964-69	Nationwide	Junior college	Post-Secondary vocational education									
a.					2598, 26167		1642		2	10	24.9	6986	4196
b.					3110, 3144		1642		2	10	20.0	5971	3204
4. Carroll and Ihnen	1959-64	North Carolina	Post-secondary vocational education	Secondary Academic	3551 3874[8]		555[3]		2	43	16.5	15523	5157

5. Somers, *et al.*	1964-69	Nationwide	Junior college	Secondary vocational education	3474, 3474[7]		1656		2	10	17.6	5400	2617
b.													

Notes:
1. Time period of study includes the training period as well as the available time for followup at the time the data were gathered.
2. (a) includes current operating costs and opportunity costs; (b) includes current operating costs, capital costs and opportunity costs.
3. Benefits are estimated to increase at a rate of $161 per year and reach $1,038 in the fourth year after graduation. In general, a two percent growth rate was applied to the earnings differential between the post-secondary technical graduates and their control group, comprehensive high school graduates.
4. Except in the case of the Carroll and Ihnen study, benefit duration is based on the estimate of Max U. Eninger, *The Process and Product of T and I High School Level Vocational Education in the United States: The Product*, Pittsburgh, Pennsylvania, 1965.
5. Opportunity costs are based on the earnings experience of secondary vocational rather than secondary academic. This results in an upward bias in the cost estimate and a corresponding reduction in net benefits.
6. All benefits are before-tax earnings and represent a social benefit, that is, an increase in value-added in the gross national product.
7. Costs are expressed for each of the two successive years of training.
8. Costs are total social costs, which include current operating costs, capital costs and opportunity costs.

Sources:
1. Benefit data from: Susan Fernbach and Gerald G. Somers, *An Analysis of the Economic Benefits of Vocational Education at the Secondary, Post-Secondary and Junior College Levels*, Preliminary Report, Madison, Wisconsin, May, 1970.
   Cost data are from: Fernbach and Somers, *Analysis ... op. cit.*, May, 1970, and William C. Morsch, *Study of Community Colleges and Vocational Training Centers: Cost Analysis*, Washington, D.C., 1970.
2. Benefit data are from Gerald G. Somers, *et al. The Effectiveness of Vocational and Technical Programs: A National Followup Survey*, Madison, Wisconsin, 1970.
   Cost data are from Fernbach and Somers, *Analysis ... op. cit.*, May, 1970 and Morsch, *Study*, 1970.
3. Benefit data are from Somers, *et al.*, *Survey*, ... *op. cit.*, 1971.
   Cost data are from Fernbach and Somers, *Analysis ... op. cit.*, May, 1970 and Morsch, *Study*, 1970.
4. Adger B. Carroll and Loren A. Ihnen, "Costs and Returns for Two Years of Post Secondary Technical Schooling: A Pilot Study," *Journal of Political Economy*, Vol. 75, No. 6, December, 1967.
5. Benefit and cost data are from Somers, *et al.*, *Survey ... op. cit.*, 1971.

academic or comprehensive high school graduates. But not all occupational specialties in vocational-technical education pay off equally well. The benefit-cost analysis, thus far, only answers the question of which broad curriculum area society should invest its additional social capital in; it does not indicate which occupational skill or specialty one should choose within that broad curriculum, given the qualifications to the analyses. It does indicate that the average mix of skills in vocational education gains a higher rate of return than the average mix of skills in the comparisons area.

Two additional comments should be made. First, the marginal rate of return is higher in the Hu, *et al.* and Kaufman-Lewis studies, where there has been multivariate control for various sociodemographic variables (see Table II) than in the Corazzini and Taussig studies which control only for sex. Next, the Hu, *et al.* and Kaufman-Lewis studies depend for their data on more elaborate labor market questionnaires than do the Corazzini and Taussig studies. For example, a six year employment and earnings history exists for the Hu, *et al.* study while Corazzini uses starting wage differentials. Thus, based on these differences in methodology more confidence should be placed in the relative magnitudes of the results in Hu, *et al.* and Kaufman-Lewis than in the other two single city studies. By this, we mean that the Corazzini and Taussig results may understate somewhat the money value of vocational-technical education. Nevertheless, these are all case studies and, in the final analysis, do not present a base of results broad enough on which to base national expenditure decisions.

The studies of Fernbach and Somers, Project TALENT and Eninger are all based on national samples. The rates of return here more closely approximate average rates of return. As can be seen, the rates are relatively high and consistent even given the differing methodologies, nonresponse rates, etc. The rates appear to be well above this study's presumed upper bound of 10 percent for the social opportunity cost rate of capital. The study in process by the National Planning Association should dispel any remaining ambiguities as to the actual money value of vocational technical education (See Chapter V).

Post-Secondary Vocational-Technical Education and Junior College. The second major context for decisions regarding the training of the U.S. labor force lies in the area of post-secondary vocational-technical education. The study upon which the bulk of this analysis is based was done at the University of Wisconsin and the Bureau of Social Science Research (See Table 6). The analysis pertains to a nationwide sample of secondary academic and vocational-technical graduates and post-secondary vocational-technical and junior college graduates. As can be seen in Table 6, the marginal rate of return for post-secondary vocational-technical education is 6.8 percent with respect to secondary academic education (see Fernbach and Somers (1970, II) study I in Table 6). While the 6.8 percent rate is less than the assumed 10 percent social cost of capital, it is still higher than the usual lower bound of the social capital cost estimate, which is five percent. Based on these results, it is economically efficient for society to invest in post-secondary vocational-technical education for a person who is an academic curriculum high school graduate. This judgment is borne out by the Carroll and Ihnen study (1967, II) which shows a marginal rate of return of 16.5 percent for post-secondary vocational education relative to academic high school

graduation in North Carolina. However, Somers, *et al.* (1971, IV), also shows that a person who is a graduate of a secondary vocational-technical curriculum suffers a net economic loss if he undertakes two additional years of post-secondary vocational-technical education. It may be that on *economic efficiency grounds therefore, society should discourage this educational sequence,* unless or until additional empirical evidence shows a more favorable rate of return. Of course, this judgment can be tempered by nonefficiency considerations. Namely, it may not be politically possible or socially desirable to prohibit this educational sequence in a free society. Also, some economic and all noneconomic benefits are unaccounted for.

Somers, *et al.* (1971, IV) also provide evidence on the economic returns to junior college training. The marginal rate of return to junior college relative to post-secondary vocational-technical education is 20 percent. Thus, it may be economically more rational for society to invest in two years of junior college than for it to invest in two years of post-secondary vocational-technical education. Finally, unlike post-secondary vocational-technical education, two years of junior college relative to secondary vocational training yield a marginal rate of return of 17.6 percent.

There remains the problem, noted at the outset, that the populations served by the two types of school may differ. To the extent that this is so, benefit-cost comparisons between the two types of post-secondary education are not strictly valid. One may object that the disaggregation of each type of post-secondary education into its skill or course components will reveal that each has some skills that pay off well in economic terms and others that are of low economic value. The point to be made here, however, is that the *average* mix of skills and courses taught in the junior college yields a higher rate of return than the *average* mix of skills and courses taught in post-secondary vocational-technical institutions.

Institutional and On-the-Job Manpower Training. It is often asserted that vocational education should be training the labor force for jobs in the future—the "jobs of tomorrow." However, reflection on the hazards of economic planning and economic projection in general, given a technologically dynamic economy, should bring one to the realization that this is a counsel of perfection. Many people change occupations several times during their lives, and those who do not normally do so, such as professional persons, find the requirements of their jobs to be a constantly evolving process which only assiduous on-the-job training can keep one abreast of. Even if vocational education were training appropriately for the "jobs of today," the short run in which most of us live, it would not be unreasonable to expect the national manpower retraining effort to upgrade the labor force as the technological requirements for human capital change. Also, training for the jobs of tomorrow implies benefits which will not arrive until tomorrow, either, with the attendant fact that these benefits are discounted at higher geometrically compounded discount factors. Thus, manpower training is certainly complementary to and not necessarily competitive with or a substitute for vocational training. However, as will be indicated below, vocational education might learn some lessons from manpower training, which concentrates the educational effort in a relatively short calendar time period.

TABLE 7

COMPARATIVE ANALYSIS OF COST AND BENEFIT ESTIMATES OF SELECTED STUDIES OF MDTA INSTITUTIONAL AND ON-THE-JOB RETRAINING AND ARA RETRAINING

Name of Study[6]	Time Period of Study[1]	Locus of Study	Experimental Group	Control Group	Cost/Year[2]		Benefit/Year[3]		Duration of Training in Years[4]	Duration of Benefits in Years[5]	Rate of Return (percent)	Present Value in dollars	
					Marginal	Average	Marginal	Average				5%	10%
1. Main	1965-66	Nationwide	MDTA graduates and dropouts	Unemployed relatives or neighbors	1983 1983		409 409		1 1	10 35	15.9 20.2	1110 4490	482 1783
2. Hardin and Borus	1962-65	Michigan	MDTA enrollees	MDTA applicants	1272 1272		251 251		1 1	10 35	14.7 19.7	634 2703	246 1044
3. Muir, *et al.* a. Institutional	1963-65	Nationwide Judgment Sample	MDTA graduates	Before-after comparison	2444 2444		1338 1338		1 1	10 33	54.0 54.7	7512 18064	5252 9418
b. On-the-Job	1963-65	Nationwide Judgment Sample	MDTA graduates	Before-after comparison	2132 2132		1208 1208		1 1	10 32	56.0 56.7	6853 16150	4800 8524
4. Stromsdorfer	1959-63	West Virginia	ARA and state program graduates	___[7]	632 632		874 874		1 1	10 33	138.0 138.3	5826 13172	4308 7114
5. Borus	1962-63	Connecticut	ARA and state program graduates	___[8]	1413 1413		459 459		1 1	10 39	30.2 32.5	2029 6093	1279 2786
6. Page	1958-61	Massachusetts	MDTA graduates	___[7]	1693 1693		874 874		1 1	10 35	50.8 51.6	4815 12017	3343 6124

7. Sewell-	1965-67	North	MDTA gra-	Non-	2138		296		1	10	6.3	148	Neg
a. Institutional		Carolina	duates:dis-	trainee	2138		296		1	31	13.5	2477	668
			advantaged	applicant									
			rural										
			workers										
b. On-The-Job					1206		603		1	10	49.0	3450	2499
					1206		603		1	33	49.9	8444	4564

Notes:
1. Time period of study includes both the training period and the period available for measuring benefits at the time of data collection.
2. All costs are total social costs and thus include current operating costs, capital costs and opportunity costs.
3. All benefits are before-tax earnings and represent a social benefit, that is, an increase in value-added in the gross national product.
4. Most MDTA and ARA training lasted less than one year. The one-year duration assumption, therefore, understates the present value of costs and the rate of return a small amount in the discount process; however, it was used for purposes of simplification.
5. The 10-year period of benefits is an arbitrary period chosen for comparison with the estimated duration of benefits accruing to secondary vocational-technical education. The longer periods are the net estimated working life of the trainees after the end of training.
6. The study of James L. Stern, "Consequences of Plant Closure," *Journal of Human Resources*, Winter, 1972, forthcoming, is not reported here. In a study using Social Security Administration earnings data for MDTA trainees in the Kansas City labor market for the years 1964-67, Stern found that workers retrained after a plant shutdown earned $572 less in 1967 than did displaced workers from the same plant shutdown who sought work on their own in the market. Thus, the present value of the trainees' earnings is negative as well as the rate of return.
7. Workers unemployed during Program.
8. Unemployed workers who refused retraining.

Sources:
1. Benefits are taken from: Earl D. Main, "A Nationwide Evaluation of MDTA Institutional Job Training," *Journal of Human Resources*, Vol. III, No. 2, Spring, 1968. Costs are taken from: Ralph E. Smith, "Foregone Earnings During Manpower Training," Working Paper 350-11, The Urban Institute, 28 January 1970. published in *Hearings: Joint Economic Committee, Subcommittee on Economy in Government, National Priorities*, 1-18 June 1970, and Garth Mangum, *MDTA: Foundation of Federal Manpower Policy*, the Johns Hopkins Press, 1968.
2. Einar Hardin and Michael E. Borus, *Economic Benefits and Costs of Retraining Courses in Michigan*, East Lansing, Michigan, December, 1969.
3. Benefits are taken from: Allan H. Muir, *et al.*, *Cost/Effectiveness Analysis of On-the-Job and Institutional Courses*, Washington, D. C., June, 1967. Costs are taken from: Ralph E. Smith, "Earnings. . .," *op. cit.*, 1970.

4. Ernst W. Stromsdorfer, "Determinants of Economic Success in Retraining the Unemployed," *Journal of Human Resources*, Vol. III, No. 2, Spring, 1968.
5. Benefits are taken from: Michael E. Borus, "A Benefit-Cost Analysis of the Economic Effectiveness of Retraining the Unemployed,, "*Yale Economic Essays*, Vol. 4, No. 2, Fall, 1964. Costs are taken from: Ralph E. Smith, "Earnings . . . " *op. cit.*, 1970.
6. Benefits are taken from: David A. Page, "Retraining Under the Manpower Development Act: A Cost-Benefit Analysis," in John D. Montgomery and Arthur Smithies, *Public Policy*, Vol. 13, Harvard University Press, 1964. Costs are taken from: Ralph E. Smith, "Earnings . . . ," *op. cit.*, 1970.
7. Benefits and costs are taken from: David O. Sewell, *Training the Poor*, Kingston, Ontario, 1971.

TABLE 5
COMPARATIVE ANALYSIS OF COST AND BENEFIT ESTIMATES OF SELECTED STUDIES OF THE JOBS AND CEP PROGRAMS

Name of Study	Time Period of Study	Locus of Study	Experimental Group	Control Group	Cost/Year		Benefit/Year		Duration of Training in Years	Duration of Benefits in Years	Rate of Return (percent)	Present Value in Dollars	
					Marginal	Average	Marginal	Average				5%	10%
JOBS:													
1. Greenleigh Associates, Inc.	1969-70	10 SMSAs	Program enrollees	Before-after comparison	3488[1] 3488		2274[2] 2274		1[3] 1	10[4] 40	64.8 65.2	14237 33836	2966 13401
2. Department of Labor	1966-68	Nationwide	Program enrollees	Before-after comparison	3239[1] 3239		1015[2] 1015		1[3] 1	10[4] 40	28.9 31.3	4380 13503	2725 6079
CEP:													
3. Operations Research, Inc.	1967-68	7 central cities	Enrollees placed in jobs	Before-after comparison	3470 3470		2228[5] 2228		1 1	10 37	63.7 64.2	13080 31255	9291 16504

Notes:

1. Costs are total social costs and include all payments to the firm plus opportunity costs represented by the participants' starting wage and final wage differential. These costs may overstate true social costs since some of the costs imputed by firms may be payments for idle capacity, the use of which does not represent a social cost; that is, in the absence of the JOBS program, the capacity would not have had any alternative use.
2. Benefit differentials are deflated by the Consumer Price Index as a partial adjustment for changes in labor market conditions between the "before" and "after" measurement periods.
3. The one-year on-the-job training period is an obvious simplification for computational purposes. The Subcommittee on Employment, Manpower, and Poverty, 1970, suggests that the on-the-job training period is about nine months. See p. 169.
4. The 10-year discount period is an arbitrary period chosen for purposes of standard comparison. The 40-year period represents the average working life remaining to the JOBS enrollee after his on-the-job training is completed.
5. These are gross weighted wage rate differentials based upon the wage rate experience of minority disadvantaged males, age 18-21 and age 22-44, and minority disadvantaged females, age 18-21 and 22-44.

Sources:

1. Benefit data are from: Greenleigh Associates, Inc., *The Job Opportunities in the Business Sector Program: An Evaluation of Impact in Ten Standard Metropolitan Statistical Areas*, Washington, D. C., 1970. Cost data are from: System Development Corporation, *Evaluation of the JOBS Program in Nine Cities*, Falls Church, Virginia, 1969.
2. Benefit data are from: U.S. Senate, Committee on Labor and Public Welfare, Subcommittee on Employment, Manpower and Poverty, *The JOBS Program* (Job Opportunities in the Business Sector), Background Information, 91st Congress, 2nd Session, April, 1970. Cost data are from: System Development Corporation, *Evaluation . . . op. cit.*, 1969.
3. Benefit data are from; Operations Research, Inc., *CEP Evaluation Methodology, Phase I Report*, Technical Report 617, Draft, Silver Spring, Maryland, 13 July 1970. Cost data are from: Leasco Systems and Research Corporation, *Quantitative Analysis of the Concentrated Employment Program*, Vol. II, Silver Spring, Maryland, 1969.

Seven different studies of manpower training exist that present a benefit-cost analysis. (See Table 7.) The Main study (1968, III.) is judged to give an accurate assessment of the net returns to institutional manpower training, since its methodology involves the use of an appropriate control group for a nationwide sample and adjustments were made for major sociodemographic, motivational, and economic variables. If the benefits to such training are assumed to last only 10 years, then the marginal rate of return is 15.9 percent. If the benefits are assumed to last the remaining working life of the trainee, 35 years, then the marginal rate of return is 20.2 percent. Note that because the benefit increments are very high, the extra 25 years of benefit stream add little to the rate of return. The high benefits relative to costs imply a high discount rate which makes the extra years of benefit relatively unimportant. The other nationwide study, by Muir *et al.* (1967, III) shows much higher marginal rates of return for institutional MDTA training, but there is an upward bias in these estimates due to the use of a "before/after" labor market comparison for the trainee rather than a control group comparison. In short, manpower training is a necessary complement to vocational training in a technologically evolving economy. The fact that different populations may be served by the two programs also reinforces their complementarity. The marginal rates of return to manpower training at least equal and are probably higher than those to secondary vocational education. But, to repeat, one should not necessarily draw the conclusion that manpower training can be substituted for vocational education, however, since the two programs do serve different social groups.

Next, it should be noted that for the MDTA program, the marginal rates of return to the institutional and the on-the-job components of the program are similar, based on the benefits by the Muir *et al.* study. Thus, given present data, there is no economic efficiency basis for expanding one of these program components at the expense of the other.

One troublesome aspect of these studies which casts some doubt on the empirical reasonableness of these high rates of return is the consistent failure of the market to provide funds for what appears to be a return of liberal proportions. The response to this may be in the institutional constraints surrounding the capital market-mainly the quasi-illegalilty of indenturing oneself plus the fact that the created capital is inseparable from the human agent and hence, not separately capitalizable and marketable. However, with such high returns one suspects that the market would eventually respond with institutional arrangements to make the funds available. That it hasn't makes one suspect that major risk factors which would reduce these rates remain unaccounted for.

Finally, the study by Stern should be noted (forthcoming 1972, III) (See Table 7, notes). While his is not a benefit-cost study, Stern reports that displaced workers who were retrained did considerably less well than displaced persons from the same plants who either transferred to a new job on the firm's invitation (not too surprising a result) or who, more importantly, simply sought new jobs in the market on their own initiative. Since Stern controlled for a variety of sociodemographic variables and used social security data for his wage measures, there should be little reporting error in it, though the method of extrapolating the data does impart some bias. In short, for all locales and all populations of workers, the final word is not in yet.

JOBS and CEP. The JOBS and CEP training programs are close substitutes for MDTA training. The JOBS program is similar to the MDTA on-the-job training program except insofar as the initiative of the JOBS program may be more with private employers. The CEP contains elements of the institutional and on-the-job MDTA training. The study results appear in Table 8.

Unfortunately, before/after comparisons of enrollee experience must be relied upon for evaluating JOBS and CEP, rather than the use of more suitable control groups. The best analysis of the costs and benefits of the JOBS program is that by the U.S. Department of Labor. This analysis is based on a national random sample taken from social security records. A before/after comparison is used to measure benefits. If a 10-year benefit period is assumed, the marginal rate of return is 28.9 percent, while the rate is 31.3 percent when benefits are assumed to last the remainder of an enrollee's working life. The MDTA study that is most similar to the JOBS analysis is the nationwide evaluation by Muir, *et al.*, which also uses a before/after comparison. Comparable rates of return to on-the-job MDTA training are 56.0 percent for a 10-year benefit period and 56.7 percent for remaining working life after training. Thus, under current arrangements, MDTA on-the-job training is yielding a marginal rate of return which is almost twice that of the JOBS program. Other things being equal, then, it may be desirable to devote additional social capital to MDTA on-the-job training rather than to the JOBS program. Other things may not be equal, however, since it may be desirable to maintain or expand the present level of the JOBS program to continue private involvement and intitiative in manpower training. In any case, the recent economic downturns have seen a drastic cutback in the JOBS program, additional evidence that manpower policies in the absence of general high demand will have little effectiveness.

The only study of CEP which allows a benefit-cost comparison relates to data gathered from seven central cities. The marginal rates of return based on a before/after comparison are quite high and fall in the mid-range of rates estimated for institutional MDTA training. Thus, there is little basis at this time for making a distinction between the two types of programs on efficiency grounds. A nationwide evaluation of CEP based on an appropriate random sample with an appropriate control group would be useful though the similarity of this program to the various MDTA components may make this superfluous.

Finally, there is no economic evaluation of the Work Incentive (WIN) program. Evaluations which do exist focus on the administrative efficiency of the program, mainly within a sociological context.

The Job Corps and NYC. The Job Corps and the out-of-school NYC are approximate substitutes for each other. As Table 9 shows, the costs of the Job Corps are considerably higher than those of the out-of-school NYC. This is not necessarily a criticism of the Job Corps, since it is patently wrong to make efficiency judgments solely on the basis of cost comparisons without knowledge of relative program benefits. However, from the limited information available, the benefits of the Job Corps and the out-of-school NYC appear to be of similar magnitude.

The Cain (1967, III) study and the Resource Management Corporation study (1969, III) of the Job Corps are based on the same set of data, namely,

TABLE 9

COMPARATIVE ANALYSIS OF COST AND BENEFIT ESTIMATES OF SELECTED STUDIES OF THE JOB CORPS AND NEIGHBORHOOD YOUTH CORPS (NYC)

Name of Study	Time Period of Study	Locus of Study	Experimental Group	Control Group	Cost/Year		Benefit/Year		Duration of Training in Years	Duration Of Benefits in Years	Rate of Return (percent)	Present Value in Dollars	
					Marginal	Average	Marginal	Average				5%	10%
JOB CORPS:													
1. Cain	1966-67	Nationwide Judgment Sample	Program Participants	No-shows	3756		193		1	10	Neg	Neg	Neg
					3756		193		1	45	4.4	Neg	Neg
2. OEO	1966-68	Nationwide	Program Participants	Before-after comparison	3613		774		1	10	16.9	2251	1039
					3613		774		1	45	21.4	9661	3655
3. Resource Management Corporation	1965-68	Nationwide Judgment Sample	Program Participants	No-shows									
a. Males					3756		87		1	10	Neg	Neg	Neg
					3756		87		1	46	Neg	Neg	Neg
b. Females					3756		135		1	10	Neg	Neg	Neg
					3756		135		1	46	2.4	Neg	Neg
NYC Out-of-School:													
4. Borus, *et al.*	1967	Indiana	Program Participants	No-shows, Eligible Non-participants	561		172		1	10	28.1	731	451
					561		172		1	47	30.7	2411	1036
NYC in-School and Summer[5]													
5. Somers and Stromsdorfer	1965-69	Nationwide	Program Participants	Eligible Non-Participants									

a. In-School					60[2]		50[2]		7[3]	18[3]	80.4	429	382
b. Summer					46		26[4]		4	21	128.0	332	305
c. Combined In-School and Summer[1]					41		44		10	18	60.0	331	285

Notes:
1. This category is for NYC participants who participated in both a summer and an in-school project.
2. These are monthly costs.
3. Duration is expressed in months.
4. This monthly benefit is not statistically different from zero.
5. Gerald D. Robin in his study of the in-school Neighborhood Youth Corps found no effect for the program in reducing the dropout rate for NYC participants. (See Robin, 1969,III.) Since this study was an actual controlled experiment model, the results are of some interest. Somers and Stromsdorfer (1970, III) found only a minimal effect of the in-school and summer NYC on reducing the dropout rate. Namely, an additional month in the program increased school attendance by one additional day.

Sources:
1. Glen G. Cain, "Benefit/Cost Analyses for Job Corps," Madison, Wisconsin, 1967.
2. Office of Economic Opportunity, *A and R Reports No. II*, "Job Corps Benefit/Cost Study," Evaluation and Research Branch, Plans and Evaluation Division, Plans and Program Directorate, Job Corps, Washington, D.C.
3. Benefits are taken from: Resource Management Corporation, *Evaluations of the War on Poverty: The Feasibility of Benefit-Cost Analysis for Manpower Programs*, RMC Report UR-054, Bethesda, Maryland, 1969. Costs are taken from: Glen G. Cain, "Benefit/Cost . . .," *op. cit.*, 1967.
4. Borus, Michael E., *et al.*, "A Benefit Cost Analysis of the Neighborhood Youth Corps: The Out-of-School Program in Indiana," *Journal of Human Resources*, 5, 139-159, Spring, 1970.
5. Somers, Gerald G. and Stromsdorfer, Ernst W., *A Cost-Effectiveness Study of the In-School and Summer Neighborhood Youth Corps*, Madison, Wisconsin, 1970.

TABLE 10

COMPARATIVE ANALYSIS OF UNEMPLOYMENT REDUCTION OF MDTA AND ARA INSTITUTIONAL RETRAINING

Name of Study	Time Period of Study	Locus of Study	Experimental Group	Control Group	Variables Controlled	Method of Control[1]	Reduction in Unemployment Rate (Percentage points)	Period Measured	Number of Observations
1. Borus	1962-63	Connecticut	ARA and state program graduates	Unemployed workers who refused training	Age; Education; Marital status; No. of dependents; course area; weeks from end of training to interview; training status.	Regression[2]	Complete-Did not use Training: -9.5 Dropout without employment: -12.5	End of training to interview	285
2. Gibbard & Somers	1959-63	West Virginia	ARA and state program graduates	Unemployed and underemployed workers training	Age; Education; Marital status; sex; race; labor market area; prior labor force experience; regular occupation; previous mobility; year and quarter of training end; training status.	Regression .16	Dropouts: no difference. Not accepted: -27.7 Did not report: -20.8 Nontrainees: -28.8	1 year after training	1065
3. Main	1965-66	Nationwide	MDTA graduates and dropouts	Unemployed relatives and neighbors	Age; Education; Marital status; sex; race; region; months unemployed 1 year before training; main wage earner; children under 18; training status.	Regression[2]	Controls: -20.0	End of training to interview	2260
4. Solie (males only)	1962-64	Tennessee	ARA graduates	Rejects Dropouts Nontrainees	Age; education; marital status; labor market area; prior labor force experience; occupation; mobility; previous training; training status.	Regression .25	Rejects: No difference Dropouts: -12.5 Nontrainees: -13.0	24 months after training	217

5. Stromsdorfer	1959-63	West Virginia	ARA graduates	Dropouts Rejects Non-reporters Nontrainees	Age; education; marital status; sex; race; labor market area; prior labor force experience; regular occupation; mobility; training status.	Regression .27	Dropouts: -8.1 Rejects: -26.0 Non-reporters: -26.7 Nontrainees: -19.5	18-month period after training	879

Notes:
1. The value in the column is the coefficient of the multiple determination. Thus, in the Gibbard and Somers study, the variables included in the regression accounted for 16 percent of the variance in the rate of employment in the 12-month period after the end of training.
2. Coefficient of multiple determination was not reported.

Sources: For Main, Borus and Stromsdorfer, see Table 7.
2. Harold A. Gibbard and Gerald G. Somers, "Government Retraining of the Unemployed in West Virginia," in Gerald G. Somers, (ed.), *Retraining the Unemployed*, Madison, Wisconsin: University of Wisconsin Press, 1968.
4. Richard J. Solie, "An Evaluation of the Effects of Retraining in Tennessee," in Gerald G. Somers, (ed.). *Retraining the Unemployed*. Madison, Wisconsin: University of Wisconsin Press, 1968.

TABLE 11
COMPARATIVE ANALYSIS OF PERCENT OF TIME EMPLOYED FOR VOCATIONAL SECONDARY EDUCATION

Name of Study	Time Period of Study	Locus of Study	Experimental Group	Control Group	Variables Controlled	Method of Control[1]	Differential Reduction in Unemployment rate (percentage points)	Period Measured	Number of Observations
1. Hu, Lee, Stromsdorfer	1959-66	Baltimore, Philadelphia, Detroit	Vocational-Technical	Academic	Curriculum; labor market; sex; IQ; race; marital status; father's education.	Regression 1st year: .11 6th year: .28 6-year average: .18	1st yr.: 14.2 6th yr.: 10.1 6-yr. average: 7.5	1st year, 6th year, average	1255
2. Kaufman and Lewis	1958-65	Three cities in Pennsylvania	Vocational-Technical and General Business	Academic	City size; IQ; curriculum; sex; race; occupation on first job; post-high school training; training relatedness of occupation.	Regression .12	Vocational-Technical: 5.7 General Business: 6.1	Period since graduation	1226

Notes: [1] The value in the column is the coefficient of multiple determination. Thus, in the Hu, *et al.* study, the variables controlled account for 11 percent of the variance in the percent of time employed in the first year after graduating from vocational high school.

Sources: See Table 5.

follow-up data collected by Louis Harris Associates. Although the assumptions these studies make concerning relative benefits differ somewhat, the differences are not great enough to cause major divergences in the estimated marginal rate of return. In both studies, the rate of return is less than the five percent lower bound assumed for the social cost rate of capital. The OEO study (study #2 in Table 9) of the Job Corps bases benefits on a before/after comparison. Such a comparison has a built-in upward bias to it, although the magnitude of the bias is not known. If forced to make a judgment, we would judge that the NYC is a more efficient social investment than the Job Corps, since the study of Borus *et al.* (1970, III) has had to make fewer compromises with optimal social science methodology.

Finally, the in-school NYC has some of the attributes of a cooperative vocational education or a work study program. That is, while the main focus of the in-school NYC is to reduce the opportunity costs of going to school, the work experience is also intended to impart some skills, though there is no necessary tie between the skills one uses on the NYC job and the courses one takes in school. However, the in-school NYC is a substitute for cooperative vocational education insofar as it improves work discipline and reduces the opportunity costs of high school education. While the Somers-Stromsdorfer study (1970, III) shows almost no effect of the in-school and summer NYC in reducing the high school dropout rate, as the table shows, the earnings benefits attributable to the program are very high, especially in light of the short 18 month benefit period.

Cost-Effectiveness Aspects of Education and Training. Those studies which used regression analysis to estimate benefits also provided estimates of the net gain in employment due to their particular programs. Tables 10 and 11 display the results as well as show the basic structure of the regression models.

The similarity of the results is noteworthy, given the differences in methodologies. The Gibbard and Somers (1968, III) Main (1968, III) and Solie (1968, III) studies all suggest a gain in employment over the nontrainee comparison group of greater than 10 percentage points but less than 30. Perhaps the Main estimate of a 20 percentage point gain is the best estimate. The Stromsdorfer data is essentially the same as the Gibbard-Somers data. The only conflict in the data is with respect to the experience of dropouts. Gibbard and Somers report no difference for dropouts vis-a-vis trainees, while Solie, Stromsdorfer (1968, III) and Borus (1964, III) report trainee employment gains over dropouts in the area of 10 percentage points.

With respect to secondary vocational-technical education, the employment gains over the study periods measured appear to fall in a range from five to 10 percent. (See Table 11.)

Impacts of Vocational and Manpower Training on Selected Sociodemographic Groups

Tables 12 through 20 display the effects of vocational, technical and manpower training on selected sociodemographic groups. Generally, this analysis suffers from the fact that small cell sizes exist for many critical sociodemographic subgroups, thus resulting in ambiguous results.

TABLE 12

NET EFFECTS ON EARNINGS (IN DOLLARS) AND EMPLOYMENT (IN PERCENTAGE POINTS), VOCATIONAL VERSUS COMPREHENSIVE GRADUATES FOR SEPARATE REGRESSIONS BY RACE AND SEX

Sample Groups	First Year After Graduation		Sixth Year After Graduation		Average in Six Years	
	E[2]	N[2]	E	N	E	N
White Male						
Comprehensive[1]						
Vocational	43**[3]	9.0**	30	2.0	44**	5.7**
n=854	(14)	(3.0)	(16)	(1.8)	(14)	(2.1)
Nonwhite male						
Comprehensive[1]						
Vocational	21	9.0	61	7.1	49	9.7
n=98	(27)	(8.7)	(38)	(5.5)	(29)	(6.1)
White female						
Comprehensive[1]						
Vocational	65**	19.5**	9	4.4	46**	12.7**
n=1522	(7)	(2.1)	(11)	(2.4)	(7)	(1.6)
Nonwhite female						
Comprehensive[1]						
Vocational	42**	10.8*	32	5.4	43**	9.3*
n=293	(13)	(4.7)	(21)	(4.5)	(13)	(3.6)

Source: Teh-wei Hu, *et al.*, "Economic Returns to Vocational and Comprehensive High School Graduates," *Journal of Human Resources*, VI (1), Winter, 1971.

1 This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor. The variables of labor market, IQ, marital status, and father's education are included in the separate equations, but the coefficients are deleted here.

2 E denotes average before tax monthly earnings, and N denotes percent of time employed.

3 These statistics are the partial regression coefficient and (in parentheses) the standard error of the coefficient. The statistic indicates that white male vocational graduates earned $43 more per month than did white male comprehensive graduates in the first year after graduation.

* significant at the .05 level of significance, two-tailed test.
** significant at the .01 level of significance, two-tailed test.

One of the major questions plaguing the analysis of the effects of vocational education is the issue concerning the length of time that benefits persist. Table 12 shows that for one study for white and nonwhite males and females, benefits to vocational education tend to disappear after about six years. This contrasts with the results in Eninger's study (1965, II) of T and I education for males which estimated that benefits tend to disappear after 10 years. Thus, it

seems apparent that the high advantage vocational graduates experience does tend to disappear. The question is why, and this has not been adequately analyzed. The reason may be that comprehensive students gain more on-the-job training than do vocational students. Hu, *et al.* (1969,II) found that high school graduates completing some post-high school education had higher earnings ($396 per year) in the sixth year after leaving high school and were employed two more weeks during that year. But they did not investigate the exact reasons for the convergence of earnings from the standpoint of on-the-job training.

It may also be possible that comprehensive graduates have access to job ladders which allow a more rapid earnings progression (which also implies greater opportunity for on-the-job training). This hypothesis, too, remains to be investigated.

Vocational Education and Blacks. Table 13 displays evidence of the premium which blacks pay to participate in the labor market.

The socially disruptive effects of racial discrimination extend throughout the labor market and result in generally lower earnings and employment of nonwhites, both for those who elect a comprehensive high school curriculum and those who study within the vocational-technical curriculum.

Labor market discrimination based on race may be considered as of two kinds. The first can be termed "historical discrimination," attributable to practices and institutions that result in a generally lower level of health, education, and training for the nonwhite population compared to the white population. The second can be termed "current labor market discrimination," the result of discrimination between nonwhites and whites who have equal productivity in the labor market.

The analysis which follows is one of current labor market discrimination. The sample of observations are derived from nonwhite and white high school graduates from the 1959-60 graduating classes in Detroit, Philadelphia, and Baltimore. None of these graduates had any post-secondary or two year or four year college education at the time they were interviewed, six years after their graduation. In addition, the white and nonwhite samples were further standardized on the basis of IQ, father's education, sex, marital status, type of curriculum followed in high school, and condition of the labor market at the time of graduation. To our knowledge, this is the only major study of racial discrimination in the labor market that controls for all the above influences simultaneously and, hence, isolates in its present form the effects of current labor market discrimination on nonwhites. Table 13 shows the results of the analysis of a random sample of white and nonwhite high school graduates in three northern cities.

In the first year after graduation white vocational-academic graduates earn $124 more per month than do nonwhite graduates from that curriculum. Also, the whites are employed 30.63 percentage points more than nonwhite graduates. By the sixth year after high school graduation there is no statistically significant difference in the earnings of white and nonwhite vocational-academic graduates. However, in order to achieve earning equality, nonwhites must be employed 8.44 percentage points more than whites.

TABLE 13

EFFECTS OF RACIAL DISCRIMINATION ON EARNINGS AND EMPLOYMENT FOR GRADUATES FROM SELECTED SECONDARY CURRICULUMS THREE NORTHERN CITIES, 1959-60-1966[1]

Sample Groups	Average Monthly Before Tax Earnings			Percent of Time Employed		
	First[2]	Sixth	6-Year Average	First	Sixth	6-Year Average
Vocational-Academic and Vocational-Technical Secondary Graduates						
Total Sample n = 1080	124** (13)	-6 (19)	81** (14)	30.61** (3.91)	-8.4* (3.5)	12.0** (2.6)
Males n = 322	144** (33)	106** (35)	145** (31)	22.11** (10.4)	2.0 (4.4)	9.7* (4.5)
Females n= 758	120** (14)	-20 (20)	71** (14)	32.9** (3.6)	-7.6 (4.5)	15.8** (3.0)
Comprehensive Secondary Graduates						
Total Sample n = 1687	100** (12)	24 (17)	76** (11)	23.6** (3.1)	-6.0* (2.9)	11.1** (2.3)
Males n = 630	99** (27)	145** (32)	123** (26)	17.1** (6.0)	7.0 (3.9)	10.9* (4.3)
Females n = 1057	93** (11)	-11 (18)	59** (11)	24.0** (3.6)	-8.7* (3.7)	11.1** (2.7)

Source: Unpublished data from Teh-wei Hu, *et al., A Cost Effectiveness Analysis of Vocational Education,* Institute for Research on Human Resources, The Pennsylvania State University, University Park, Pennsylvania, March, 1969.

1. This analysis standardizes for the effects of month and year of high school graduation, labor market at the time of graduation, IQ, post-high school training other than 2-year or 4-year college, education, marital status, sex and father's education. Thus, the differences between whites and blacks in this analysis are a very close measure of current racial discrimination practices as they existed in three northern cities from 1959-60 through 1966.

   These statistics are the partial regression coefficients and their standard errors in parentheses. The partial regression coefficient is interpreted as follows: It measures the difference between average earnings or employment of white graduates and black graduates. Thus, white vocational-technical graduates earned $124 more per month than black vocational graduates in the first year after they graduated.

2. First = first year after graduation; Sixth = sixth year after graduation; 6-year average = average experience during the 6-year period after graduation.

** significant at the .01 level of significance, two-tailed test.
* significant at the .05 level of significance, two-tailed test.

The data show that discrimination as measured by monthly earnings is more serious in an absolute sense for nonwhite male vocational-technical graduates than it is for their nonwhite female counterparts. White male vocational-technical graduates earn $144 more per month than their nonwhite counterparts in the first year after graduation; white female vocational-technical graduates earn $120 more per month in the first year after graduation than their nonwhite counterparts.

In the sixth year after graduation white males earn $106 more than their nonwhite male vocational-technical counterparts. Although there is no statistically significant difference between the earnings of the two female ethnic groups, the nonwhite females are financially better off in that they are earning an average of $20 per month more and working an average 7.56 percentage points less time than their white female counterparts. The nonwhite male vocational-technical graduates, in addition to earning $106 per month less than the white graduates, are shown as working more (2.0 percentage points).

The picture is slightly different for comprehensive high school graduates. In the first year after graduation, whites earn $100 a month more than nonwhites and whites are employed 23.57 percentage points more. In the sixth year after graduation there is no difference in monthly earnings between these racial groupings, but to achieve this, nonwhites must work six percentage points more than their white comprehensive program counterparts. Whereas for nonwhite male vocational-technical graduates the absolute earnings cost of discrimination improved somewhat over the six-year post-graduation period, for nonwhite male comprehensive graduates the impact of discrimination increased. In the first year nonwhites earned only $99 per month less than their white counterparts; the difference increased to $145 per month in the sixth year after graduation. For nonwhite female comprehensive graduates the earnings situation improved. There was a $93 per month difference in the first year. In the sixth year there was no statistically significant difference in earnings, but this was achieved only because nonwhite female comprehensive graduates worked 8.69 percentage points more in the sixth year than did their white female counterparts.

Thus, for a black male or other nonwhite male, it is better in the long run to be a vocational-technical graduate than a comprehensive high school graduate. It will cost about $39 a month less in current labor market discrimination. Among nonwhite females, however, the absolute discrimination cost is lower for comprehensive graduates than for vocational-technical graduates.

Secondary Education and Dropout Behavior. High school dropouts are an important sociodemographic group whose needs are apparently not being met by the educational system. There has been much criticism of vocational education because its dropout rate has been higher than that of the academic curriculum. Table 14 gives the relative dropout rates for Project TALENT males. This criticism of vocational-technical education is warranted, but is more complex than a simple condemnation of the program, as the discussion following the table suggests.

As suggested previously, the student who takes the vocational-technical curriculum is somewhat different from the academic student in terms of

TABLE 14

DROPOUT RATES OF HIGH SCHOOL STUDENTS BY PROGRAM AND ABILITY QUARTILE[1]

High School Program	Total	Ability Quartile			
		Low	II	III	High
General	16.2	25.6	16.7	9.1	5.7
College Prep	3.9	22.5	6.8	1.9	1.4
Commercial	12.5	18.3	10.9	9.3	5.7
Vocational	22.4	29.8	18.7	8.7	___[2]
Agriculture	27.3	39.3	9.9	___[2]	___[2]

1 Dropout rates are based on information collected on 10th graders in 1960 and follow-up analysis in 1963; both males and females are included.

2 The size of the population within the cell did not warrant the calculation of dropout rates.

Source: Unpublished data from Project TALENT. Reported in Howard Vincent, "An Analysis of Vocational Education in Our Secondary Schools," Office of Program Planning and Evaluation, U.S. Office of Education, July 27, 1967.

sociodemographic background as well as in reasons for choosing a specific kind of education. He may have a shorter time horizon–that is, he may value present economic gain more highly than future economic gain. This is an understandable behavior pattern for the disadvantaged person who is enrolled in vocational courses. Likewise, the vocational student may value the money income of a job more highly and the status of a job less highly than would an academic graduate. Also, he is training for a job in which he is to be employed immediately upon leaving high school. When labor markets are tight he does not necessarily need to be a high school graduate to get this job as long as he has the skills necessary to meet the occupational minimum. (There is a direct relation between the unemployment rate and the high school retention rate which backs up this hypothesis). Thus, he may, in effect, be able to fulfill the purpose of the program–placement in a job–by dropping out of school. In contrast, the academic student *must* have a high school diploma in order to proceed to the next step in his occupational career–college attendance. Also, the ultimate job the college-bound student strives for is different from that for which the vocational graduate strives. One may be able to get such a job if he is a college dropout, but not if he is a high school dropout. In short, the combination of different sociodemographic background, different weights on income versus status, different time horizons, and different constraints on job entry (e.g., high school diploma necessary/not necessary) make it inevitable that there will be a higher gross dropout rate for vocational-technical education. The phenomenon is, in fact, built into the program.

What the data in Table 14 suggest, therefore, is that the calendar time spent in a vocational-technical program may be too long. This possible excessive time is actually the result of a curriculum mix that is forced upon the students

TABLE 15

PRESENT VALUE OF EARNING STREAMS FOR MALES AGE 17 BY OCCUPATION, YEARS OF SCHOOL COMPLETED, AND ETHNIC CATEGORY, FOR THE UNITED STATES, 1960[1]

	White	Nonwhite
1. Experienced Civilian Labor Force		
HS 4	$38,384	$26,329
HS 1-3	35,960	23,645
	2,424	2,684
2. Experienced Civilian Labor Force		
HS 4	39,018[2]	
HS 1-3	36,601[2]	
	2,417	
3. Professional, Technical and Kindred		
HS 4	44,428	33,037[3]
HS 1-3	42,448	
	1,980	
4. Designers and Draftsmen		
HS 4	46,980	
HS 1-3	46,411	
	569	
5. Farmers and Farm Managers		
HS 4	22,762	
HS 1-3	21,507	
	1,255	
6. Managers, Officials and Proprietors		
HS 4	45,941	
HS 1-3	45,869	
	72	
7. Buyers and Department Store Heads		
HS 4	46,049	
HS 1-3	46,891	
	-842	
8. Clerical and Kindred		
HS 4	37,066	31,713
HS 1-3	35,770	30,952
	1,296	761
9. Bookkeepers		
HS 4	35,902	
HS 1-3	35,065	
	837	
10. Shipping and Receiving Clerks		
HS 4	34,730	31,988[2]
HS 1-3	35,689	36,213
	-959	-4,225
11. All Other Clerical		
HS 4	36,525	28,767[3]
HS 1-3	35,699	28,012
	1,826	755

	White	Nonwhite
12. Sales Workers		
HS 4	$38,067	$28,2812
HS 1-3	32,178	23,4642
	5,889	4,817
13. Insurance, Brokers and Underwriters		
HS 4	44,430	
HS 1-3	45,464	
	−1,034	
14. Craftsmen, Foremen and Kindred		
HS 4	42,548	30,956
HS 1-3	42,155	28,727
	393	2,229
15. Brickmasons, Stonemasons and Tile		
HS 4	45,081	
HS 1-3	42,539	
	2,542	
16. Carpenters		
HS 4	38,449	
HS 1-3	38,624	
	−175	
17. Compositors and Typesetters		
HS 4	42,859	
HS 1-3	44,979	
	−2,120	
18. Electricians		
HS 4	46,103	
HS 1-3	48,358	
	−2,255	
19. Lineman and Service		
HS 4	46,889	
HS 1-3	48,992	
	−2,033	
20. Machinists		
HS 4	43,707	
HS 1-3	44,187	
	−480	
21. Mechanics and Repairmen		
HS 4	38,816	
HS 1-3	38,769	
	47	
22. Airplane Mechanics and Repair		
HS 4	45,0493	
HS 1-3	45,149	
	−100	
23. Auto Mechanics and Repair		
HS 4	35,962	
HS 1-3	36,428	
	−466	

	White	Nonwhite
24. Painters, Construction and Maintenance		
HS 4	$35,511	
HS 1-3	32,925	
	2,586	
25. Plumbers and Pipefitters		
HS 4	46,446	
HS 1-3	45,427	
	1,109	
26. Toolmakers and Diemakers, Setters		
HS 4	52,847	
HS 1-3	53,211	
	-384	
27. Operatives and Kindred		
HS 4	37,576	27,167
HS 1-3	36,821	26,519
	765	648
28. Truck and Tractor Drivers		
HS 4	37,502	
HS 1-3	38,997	
	-1,495	
29. Other Specified Operatives		
HS 4	37,089	25,907[3]
HS 1-3	35,256	25,729
	1,833	178
30. Service Workers		
HS 4	30,860	21,249
HS 1-3	27,431	20,170
	3,429	1,079
31. Barbers		
HS 4	33,622	
HS 1-3	35,645	
	-2,023	
32. Protective Service Workers		
HS 4	41,895	
HS 1-3	40,453	
	1,442	
33. Other Service Including Households		
HS 4	24,659	20,330
HS 1-3	22,720	19,754
	1,939	576
34. Farm Laborers & Foremen		
HS 4	18,693	11,602[2]
HS 1-3	16,540	9,784[2]
	2,153	1,818

Notes:
1 The data presented were calculated as follows:

$$\text{Return to 4 at age 17} = \frac{Y^4_{17}}{(1+r)^1} + \frac{Y^4_{18}}{(1+r)^2} \cdot 85 + \ldots \frac{Y^4_{64}}{(1+r)^{48}}$$

$$\text{Return to 1-3 at age 17} = \frac{Y^{1\text{-}3}_{17}}{(1+r)^1} + \frac{Y^{1\text{-}3}_{18}}{(1+r)^2} + \frac{Y^{1\text{-}3}_{64}}{(1+r)^{48}}$$

where

Y^4 and $Y^{1\text{-}3}$ = median earnings of those with 4 years of high school and 1-3 years, respectively, subscripts refer to age,

and

Y^4_{17} = 0 by assumption.

Also

$$Y_{18} = Y_{19} = \ldots = Y_{24}$$

$$Y_{25} = Y_{26} = \ldots = Y_{34}$$

$$Y_{55} = Y_{56} = \ldots = Y_{64} \text{ for } Y^4 \text{ and } Y^{1\text{-}3},$$

again, by assumption,

and

r = 10 percent

2 Age 18-24 and 25-64 cohorts used.

3 Age 55-64 cohort earnings estimated.

Source:

Stuart O. Schweitzer, "Occupational Choice, High School Graduation, and Investment in Human Capital," *Hearings of the Joint Economic Committee, Subcommittee on Economy in Government, National Priorities, 1-18 June 1970.*

but which may not correspond to labor market realities or the needs and long-term plans of students. The MDTA program purports to give a man entry level skills after no more than 52 weeks or one calendar year of training. What point is there in dragging out the education for this equivalent goal to two calendar years in high school? The dropout rate from vocational-technical education might be reduced if the calendar time spent in high school were cut, by one year, from four to three years. As Table 15 shows, an additional calendar year of high school is a detriment to preparation in a number of occupations, such as electrician and machinist. One should note, also, that most of the occupations listed represent skill specialties offered in vocational-technical schools.

Finally, further evidence to support this hypothesis is found in the study on low achievers (defined as those potential inductees who failed to pass the Armed Forces Qualification Test) by Hansen, Weisbrod and Scanlon (1970, II). The authors found that extra education, in the sense of additional years of schooling, was of much less value in improving earnings than were various types of skill training learned outside of school. In short, they point up the crucial difference between extended time in school versus what one actually learns in school.

TABLE 16

IMPACT OF MANPOWER TRAINING ON SELECTED SOCIODEMOGRAPHIC GROUPS, PERCENT OF TIME EMPLOYED IN 18-MONTH POST-TRAINING PERIOD

Sample Subgroup	Dropout	Did Not Report	Non-Trainee	
	b (s)	b (s)	b (s)	m (s)
Total Sample (n=854)	-8.9* (3.5)	-25.2* (5.6)	-18.1* (3.6)	60.3 (36.9)
Education				
0-8 (n=207)	-26.3* (9.9)	-47.6* (12.5)	-29.8* (8.6)	46.3 (38.6)
9-11 (n=254)	-9.5 (6.4)	-16.4 (10.1)	-21.4* (6.6)	59.9 (35.8)
12 (n=320)	-6.0 (5.2)	-18.4* (8.7)	-10.9 (5.8)	68.0 (35.1)
13 and over (n=73)	-10.4 (10.6)	-4.0 (28.8)	-40.0* (10.7)	67.5 (32.5)
Age				
30 or less (n=408)	-5.5 (4.7)	-14.7 (6.9)	-8.9 (5.0)	63.9 (34.7)
31-45 (n=321)	-9.6 (6.0)	-30.2* (10.1)	-21.7* (6.2)	59.0 (38.3)
46 and over (n=125)	-42.0* (12.5)	-86.3* (22.6)	-36.9* (11.5)	51.9 (39.3)
Sex				
Male (n=618)	-5.4 (3.8)	-25.0* (6.5)	-14.7* (4.5)	63.8 (36.2)
Female (n=236)	-7.0 (8.8)	-21.7* (10.2)	-15.4* (6.4)	50.9 (37.4)
Age and Sex				
Male				
30 or less (n=318)	-7.0 (5.0)	-19.1* (8.1)	-12.0 (6.2)	68.8 (33.4)
31-45 (n=218)	-3.8 (7.3)	-30.6* (13.2)	-19.7* (8.3)	62.7 (37.6)
46 and over (n=82)	-24.1 (21.3)	-68.5* (34.2)	-16.4 (21.9)	47.9 (38.0)
Female				
30 or less (n=90)	-0.6 (14.2)	-21.1 (14.0)	2.4 (9.2)	46.4 (33.5)
31-45 (n=103)	-25.1* (12.0)	-17.4 (15.2)	-23.4* (9.8)	51.3 (33.7)

45 and over	-97.5*	-102.4	-61.5*	59.6
(n=43)	(33.4)	(42.3)	(25.1)	(41.0)
Prior Labor Force Experience				
NLF	-17.5	-40.5*	-23.3*	52.5
(n=131)	(9.9)	(15.9)	(9.0)	(39.2)
UE 6 mos. or less	-2.7	-23.0	-19.1*	67.9
(n=173)	(6.6)	(13.9)	(7.7)	(33.1)
UE over 6 months	14.6*	-20.5*	-23.6*	46.8
(n=242)	(6.6)	(11.8)	(7.2)	(38.4)
EMP 6 mos. or less	1.7	5.9	17.1	66.9
(n=69)	(23.0)	(22.2)	(21.0)	(34.4)
EMP over 6 months	0.9	-11.8	-4.2	70.8
(n=239)	(7.8)	(10.2)	(7.6)	(32.3)
Ethnic Origin				
White	-9.2*	-24.1*	-18.1*	60.7
(n=831)	(3.5)	(5.8)	(3.6)	(36.8)
Marital Status				
Married	-9.7*	-24.8*	-17.0*	60.6
(n=586)	(4.2)	(7.1)	(4.3)	(38.0)
Single	-4.4	-23.7*	-16.3*	60.3
(n=198)	(7.6)	(10.1)	(7.6)	(34.5)
Widowed, Separated, or Divorced	-6.2	-21.0	-1.6	57.2
(n=70)	(15.3)	(27.6)	(17.0)	(35.3)

Notes: * Significant at the .05 level or higher.
b is the partial regression coefficient.
(s) is the standard error of the partial regression coefficient or standard deviation of the mean.
m mean of the dependent variable.
(n) is the number of observations in the interaction subsample.

In addition to what is shown in the table for each interaction equation:

1. All equations contain a labor market variable in dummy form.
2. All equations contain a job placement variable in dummy form.
3. No equation contains the age-sex interaction sets.
4. Age and age squared are in equations containing an education variable.
5. Education and education squared are in the equations containing an age variable.
6. All equations contain a mobility variable in dummy form.
7. The regressor for the "Reject" training status is included in the model but omitted in the table.

Thus, for example, for all respondents who have only 0-8 years of education, the following independent variables are used to explain earnings and employment: age and age squared; sex for male and female; labor market area for Charleston and Huntington, and McDowell, Monongalia, and Harrison counties; prior labor force experience–NLF 6 mos. or less, NLF over 6 mos., UE 6 mos. or less, UE over 6 mos., EMP 6 mos. or less and EMP over 6 mos.; placement effort–metal working skills and training for a specific company; marital status–married, single, widowed and separated or divorced; race–white and nonwhite; mobility–whether or not a person moved any distance at all; and, finally, the training status variable as shown. Thus, the same equation is run for the respondents who are 30 years old or less, except that education and education squared are substituted for the age variable.

The values of the partial regression coefficients for the training status variable are differences from the trainee regressor which enters the intercept term. Thus, those nontrainees who had only 0-8 years of education were employed 29.9 percentage points less time than the trainees over the 18-month post-retraining period.

Source:

Unpublished data, West Virginia Retraining Research Project, Department of Economics, University of Wisconsin, Madison, Wisconsin.

Effects of Manpower Training on Sociodemographic Groups. Tables 16 and 17 give a detailed analysis of the effects of Area Redevelopment Training on several crucial sociodemographic groups in terms of earnings and employment. The pattern of net effects of retraining among the independent variables is different in terms of size, sign, and statistical significance for the two dependent variables. The independent variables generally explain more of the variation in the earnings variable than they do for the employment variable. The coefficients of determination as a group tend to be significant at a higher level of statistical significance with respect to the earnings compared to the employment variable.

Employment. Major interest in this study lies in the size, sign, and statistical significance of the partial regression coefficient of the nontrainee regressor of the training status variable. If retraining is effective, nontrainees should have less favorable employment and earnings experience than trainees. Therefore, the sign of the partial regression coefficient of the nontrainee regressor should be negative since the nontrainee experience is interpreted in terms of its deviation from the trainee experience. Retraining should raise the marginal productivity of the trainee, other things equal, and hence, trainees should have higher employment or earnings than nontrainees.[4] With respect to employment, this is generally the case. Exclusive of the results for the total sample, 16 of the equations in Table 16 show that retraining has a positive and statistically significant effect on post-training employment. Eight equations show no statistical difference, though the signs are negative but for two cases.

Of interest is the suggestion in the data that retraining has been of greater help to those persons with greater labor market disabilities than to those persons who have higher labor market qualifications. Thus, for those with only 0-8 years of education, trainees are employed 29.9 percentage points more or 5.4 months (18 x 29.9) longer than nontrainees. For those with 9-11 years education the difference is 21.4 percentage points, or 3.8 months. And for those with 12 years education the net employment difference between trainees and nontrainees drops to 10.9 percentage points, or 1.9 months. This is not entirely unexpected since it is theoretically reasonable to assume that a given amount of retraining will have a larger impact on marginal productivity for a person with a low stock of skill or acquired ability than it will for a person with a high stock of skill. The 13 and over education group represents an abberation from this trend. A possible reason for this abberation could be that the trainees with 13 or more years of education are still attending college while the nontrainee counterparts

[4] For a given level of wages, employment will increase if productivity increases since this will increase the demand for labor. For a given level of employment, wages will increase if productivity increases employment because the rise in productivity, other things equal, will increase the demand for labor.

are not. College students may be using the training process itself as a means to acquire part-time employment. However, the trend holds up for the age and the prior labor force experience subgroups. For those who are employed prior to the time when retraining began, there is no statistically significant post-training employment difference between trainees and nontrainees. For males or females under 30 years of age there is no statistical difference between trainees and nontrainees. These results suggest that, if a goal of retraining is to increase employment, retraining efforts should be concentrated on those persons with labor market disabilities – the older, the less educated and the unemployed or the non-labor force participant. The younger, more educated persons who have a history of very recent or consistent employment tend to benefit very little from retraining in terms of net increases in employment.

The pattern of statistical significance for dropouts is of interest since those dropouts who suffer the more severe labor market disabilities such as low education, advanced age or long-term unemployment, fare significantly worse than the trainees. However, for most other sample subgroups, there is no statistically significant difference in employment between trainees and dropouts. This phenomenon does not mean that completion of retraining was of little benefit to the trainees, since dropouts had, on the average, completed about one-third of their retraining before dropping out and often took jobs in related training areas. However, one implication might be that, on the average, certain groups of the unemployed need less training to prepare them for employment in a given job than was being offered to those groups in the retraining programs. Of course, this is the theme underlying the discussion of dropout behavior above.

Effects on Earnings. The advantages of retraining are less dramatic with respect to increasing earnings than they are with respect to increasing employment. If one of the major objectives of retraining is to significantly increase earnings, then, for the total sample, this objective is achieved. For the total sample, trainees earn $43 per month more over the 18-month period than do nontrainees. The difference is significant at the .01 level of significance. However, the picture differs among the 24 sample subgroups. For these 24 subgroups, only nine of the differences in earnings between trainees and nontrainees are statistically significant. Four of the coefficients for the nontrainees have a positive sign, implying negative benefits to retraining; but the coefficients are not statistically significant, and so there is, in effect, no difference in earnings between the trainees and the nontrainees for those groups. Also, the lack of statistical significance for other groups, even though the regression coefficient has the appropriate negative sign, indicates no difference between trainees and nontrainees.

Again, there is a tendency, though not nearly as clear cut as with employment, for retraining to have the greatest absolute impact on earnings for those with the more severe labor market disabilities. Trainees with 0-8 and 9-11 years of education earn significantly more than nontrainees in the same educational subgroups but there is no statistical difference in earnings between trainees and nontrainees for 12 and 13 years or over of education. For those who were not in the labor force or who were unemployed for over six months before retraining began, retraining has a significant effect. But for those who

TABLE 17
IMPACT OF TRAINING ON SELECTED SOCIODEMOGRAPHIC GROUPS
TOTAL 18-MONTH POST-TRAINING EARNINGS, IN DOLLARS

Sample Subgroup	Dropout	Did not Report	Non-Trainee	
	b (s)	b (s)	b (s)	m (s)
Total Sample	-651*	-1297*	-782*	3199
n=(854)	(226)	(359)	(229)	(2628)
Education				
0-8	-1137	-2318*	-1137*	2509
(n=207)	(668)	(825)	(583)	(2562)
9-11	-514	-709	-1290*	3005
(n=254)	(404)	(639)	(420)	(2592)
12	-677*	-1032*	-99	3614
(n=320)	(298)	(502)	(330)	(2532)
13 and over	-1129	3406	-742	4010
(n=73)	(918)	(2488)	(919)	(2837)
Age				
30 or less	-978*	-970*	-534	3402
(n=408)	(283)	(416)	(299)	(2452)
31-45	-119	-1266	-1081*	3272
(n=321)	(425)	(706)	(433)	(2893)
46 and over	-1529*	-3598*	-595	2348
(n=125)	(774)	(1398)	(713)	(2300)
Sex				
Male	-612*	-1582*	-800*	3868
(n=618)	(280)	(484)	(329)	(2695)
Female	-343	-746	-273	1446
(n=236)	(331)	(385)	(242)	(1319)
Age and Sex				
Male				
30 or less	-1122	-1394*	-745	3985
(n=318)	(326)	(535)	(410)	(2404)
31-45	110	-1458	-979	4908
(n=218)	(586)	(1059)	(666)	(3039)
45 and over	-864	-3582	162	2808
(n=82)	(1520)	(2436)	(1560)	(2572)
Female				
30 or less	-90	-972	116	1344

(n=90)	(518)	(509)	(334)	(1192)
31-45	-262	-353	-348	1524
(n=103)	(502)	(638)	(409)	(1438)
46 and over	-2629*	-3062*	-1324	1472
(n=43)	(1019)	(1293)	(768)	(1288)
Prior Labor Force Experience				
NLF	-757	-1584	-758*	2034
(n=131)	(485)	(780)	(442)	(2026)
UE 6 mos or less	-816	-1673	-805	4004
(n=173)	(440)	(926)	(518)	(2550)
UE over 6 mos	-934*	-790	-1348*	2433
(n=242)	(399)	(718)	(434)	(2534)
EMP 6 mos or less	-173	-1494	149	3825
(n=69)	(1779)	(1718)	(1628)	(3064)
EMP over 6 mos	318	-541	-62	3844
(n=239)	(555)	(726)	(541)	(2504)
Race				
White	-689*	1244*	-816*	3220
(n=831)	(226)	(375)	(228)	(2617)
Marital Status				
Married	-337	-1110*	-664*	3418
(n=586)	(277)	(468)	(282)	(2762)
Single	-1364	-1443*	-1129*	2942
(n=198)	(450)	(597)	(453)	(2332)
Widowed, Separated or Divorced	175	-925	1064	2091
(n=70)	(794)	(1430)	(879)	(1822)

Note: The notes of Table 16 all apply to Table 17.

were employed before retraining or who were unemployed only six months or less, there is no statistical difference in earnings between the trainees and nontrainees. In short, while retraining pays well for the study sample in the aggregate, important subgroups within the sample have tended not to benefit at all on the average. These results, of course, apply only to the specific sample in this study and refer to a very specific locale and time so that generalizations beyond this sample are risky if not inappropriate.

These results also highlight an important policy issue concerning the private and social objectives of retraining. If the objective of retraining is simply to get people back to work, regardless of the wage rate they receive, then, on the average, even for rather specific categories of people, retraining can be judged a success for this sample. But, if the goal of retraining is to yield a net money benefit over money costs, then retraining has not been very effective, for, certain

TABLE 18

ESTIMATED NET EXPECTED INTERNAL RATES OF RETURN TO SELECTED TRAINEE SUBGROUPS

Trainee Subgroup	Average[1] Costs	Difference in Average Benefits	Social Rate of Return[4]
Education			
0-8	742	758	98.9
9-11	558	860	152.9
12	515	662	4.8
13 and over	590	495[2]	79.4
Age			
30 or less	656	356[2]	46.1
31-45	548	720	129.3
46 and over	525	397[2]	70.3
Sex			
Male	789	533	61.4
Female	401	182[2]	35.4
Sex and Age			
Male			
30 or less	789	497	56.2
31-45	789	653	78.2
46 and over	789	-108	---[3]
Female			
30 or less	401	-77[2]	---[3]
31-45	401	323[2]	50.3
46 and over	401	882[2]	219.3
Prior Labor Force Experience			
NFL	321	505	155.9
UE 6 months or less	696	573[2]	77.7
UE over 6 months	590	898	150.7
EMP 6 months or less	628	-99[2]	---[3]
EMP over 6 months	687	41[2]	---[3]
Race			
White	576	544	90.7
Marital Status			
Married	599	443	168.5
Single	688	752	106.4
Widowed, Separated, Divorced	334	-709[2]	---[3]

Notes: 1 These earnings differentials are the 18 month benefit differentials adjusted to a 12 month basis.

2 Not statistically significant.

3 Negative rates of return are implied.

4 A 10 year post-training benefit period is assumed.

Source: Costs: Glen G. Cain and Ernst W. Stromsdorfer, "An Economic Evaluation of Government Retraining Programs in West Virginia." in Gerald G. Somers, (ed.), *Retraining the Unemployed.* Madison, Wisconsin, 1968. Table IX.2, p. 313.

Benefits: Unpublished data: West Virginia Retraining Project.

sample subgroups gain little or no net monetary benefit on the average. Two implications arise. First, perhaps some of these subgroups simply did not require retraining or required less of it or different kinds than that which was offered. Second, morale may fail and general disenchantment may result among those subgroups who do not benefit in money terms. Such an effect could threaten the social and political commitment of society to the entire retraining program and could deprive of retraining those subgroups which can receive some benefit from the programs.

Investment Effects. The earnings data in Table 17 can be combined with cost data from Cain and Stromsdorfer (1969, III) to provide estimates of the social rates of return for these various groups. Table 18 displays the results. For those cases where the benefits are statistically significant, the rates are generally very high. In addition, the subgroups with the greatest labor market disabilities tend to benefit the most. However, no female subgroup has benefit differentials which are statistically significant. For those benefit differentials which lack statistical significance, the rate of return is effectively zero. Were it true that the negative benefits for certain subgroups such as single trainees were statistically significant, then the internal rates here would be negative. Since they are not statistically significant, the rate of return for these subgroups is effectively zero, too.

When benefits are statistically significant, they equal the cost outlays in a year or two, well within the data estimation period of this study. Thus, even if considerable underestimation of money costs exists, which is not the case, adjustment for this cost underestimation would still leave the rates very high. The same holds true for potential overestimation of benefits due to the fact that benefits are assumed to accrue by a constant amount for 10 years after training.

The results from the Sewell study generally corroborate the findings in the West Virginia Study. As Table 19 shows, for both on-the-job and institutional training, blacks benefit more than whites in terms of earnings; those over 44 years benefit more than those under 21 years. And farmers and sharecroppers benefit even more than those persons unemployed over six months. For on-the-job training, those with 0-8 years of education earn 13 dollars more per week than their control groups, and surpass those with 9-11 grades of education by two dollars per week, while the situation is reverse with respect to institutional training.

Finally, Table 20 brings additional evidence to bear on these issues based on the Hardin and Borus study (1969, III). In addition it shows the effect of different lengths of training. Whereas the West Virginia study shows trainees earning about $780 more than nontrainees in an 18 month period after training, the Hardin and Borus study shows trainees in shorter (60-200 class hours)

TABLE 19

IMPACT OF MANPOWER TRAINING ON WEEKLY EARNINGS AND HOURS WORKED PER WEEK FOR SELECTED DISADVANTAGED GROUPS

Sample Subgroup	Weekly earnings (dollars)		Hours worked per week	
	On-the-job Training[1]	Institutional[2]	On-the-job Training	Institutional
Labor Force experience prior to training				
Farmer (96)	17.8**	14.7**	4.1*	8.1**
Unemployed over 6 months (37)	10.1*	8.4	4.3	0.5
Color				
Nonwhite (416)	8.9**	7.5**	2.1*	2.1
Age as of 1 Jan., 1966				
44 years & over (95)	14.7**	7.8	6.2**	7.3*
Under 21 years (79)	0.0	-8.8	2.6	0.9
Education				
0-8 grades (224)	13.0**	7.0*	4.8*	4.0*
9-11 grades (140)	11.0**	11.5**	3.8*	0.2

Notes: * Significant at the .05 level.
** Significant at the .01 level.
1 Net regression coefficient for on-the-job training.
2 Net regression coefficient for institutional training.
Numbers in parenthesis are the sample sizes.

Source: David O. Sewell, *Training the Poor*, Kingston, Ontario, 1971, Table 8, p. 76.

training programs earning about $980 in a 12 month period, or about twice the monthly benefits. However, the patterns of return wih respect to increasing levels of education is similar, more educated people benefit less as one might expect. Also, those who were previously on welfare benefited more than those who were not prior to the time training began. Again, it is interesting to note the generally *negative* benefits gained by those groups other than nonwhites and those whites of 5-8 years education who stayed in the training program for over 200 hours of class instruction.

Effects of Vocational and Manpower Training by Program Area and Skill

There are very few good studies of the differential earnings benefits of vocational program areas or occupational skills. There are no useful benefit-cost analyses by skills, mainly because of the difficulty of collecting cost data by skill. It is difficult enough to collect on the basis of broad curriculum areas or

TABLE 20
SOCIAL ECONOMIC BENEFITS OF TRAINING BY SOCIOECONOMIC GROUPS FOR VARYING LENGTHS OF TRAINING, IN DOLLARS

Socioeconomic Group	Classroom Hours Per Trainee	
	60-200	201-1920
Whole Sample	$ 976	negative
White Men	670	-3
White Women	998	-129
Nonwhite Men	1,385	-247
Nonwhite Women	1,312	-60
White, 5-8 Years Education	1,002	305
White, 9-11 Years Education	829	171
White, 12 years & over Education	750	-151
Nonwhite, 5-8 Years Education	1,330	------[2]
Nonwhite, 9-11 Years Education	1,293	2,001
Nonwhite, 12 Years & Over Education	1,359	1,553
Prior Welfare:		
Yes	1,049	-44
No	959	-61
Training Occupation:		
Factory	845	-15
Health Care	1,140	-251
Office	------[1]	-98
Auto Repair	716	10
Other	1,060	-123

Notes: 1 No. 60-200 hour classes were intended for office occupations.
2 There is only one observation for this subgroup.

Source: Adapted from Hardin, Einar and Borus, Michael E., *Economic Benefits and Costs of Retraining.* (Lexington, Mass.: (Lexington Books, D.C., Heath and Co., 1971), Chapter 12, Tables 12-2, p. 144; 12-3, p. 146; 12-4, p. 147; 12-5, p. 149; 12-6, p. 151; and 12-7, p. 152.

even for a vocational school if this school is part of a larger school district such that accounting records are aggregated. To be sure, there are separate benefit-cost studies of given skills, in a case study context; however, the wide diversity of methodologies, with the fact that the studies do not contain all the necessary data or information on their methodologies, makes it extremely difficult to make valid comparisons among skills.

Secondary Vocational Courses. The Hu, *et al.* study (1969, II) provides earnings and employment comparisons among 12 different vocational skills offered in vocational-technical programs in three northern cities. Using regression analysis to stadardize for the effects of such factors as sex, age, IQ, race, marital status and father's education, it was found that there was no statistically significant difference among the skills when compared with the

TABLE 21

PERCENT OF TIME EMPLOYED IN PERCENTAGE POINTS AND AVERAGE BEFORE TAX MONTHLY EARNINGS FOR NON-COLLEGE ATTENDING VOCATIONAL-TECHNICAL HIGH SCHOOL GRADUATES

Variable	Average in Six Years		First Year After Graduation		Sixth Year After Graduation	
	b	(s)	b	(s)	b	(s)
Courses[1]	Percent of Time Employed					
n=565						
Commercial[2]						
Food Service	-5.8	(7.3)	-13.6	(8.3)	-4.4	(11.8)
Building Trades Occupations	-3.3	(12.6)	15.5	(14.2)	-18.6	(20.4)
Mechanical and Repair	-2.2	(6.4)	-8.4	(7.2)	2.2	(10.3)
Tool Design	1.4	(6.5)	0.3	(7.3)	8.2	(10.5)
Wood Working Occupations	2.7	(8.6)	-7.8	(9.7)	9.0	(13.9)
Electrical and Electronics	2.8	(6.6)	-6.8	(7.5)	1.9	(10.7)
Agriculture & Horticulture	4.5	(17.2)	-18.5	(19.3)	-0.8	(27.7)
Professional Occupations	-2.4	(4.6)	-4.6	(5.2)	5.9	(7.4)
Distributive Education	-6.0	(10.6)	16.2	(11.9)	-22.1	(17.1)
Personal Services	10.8	(5.5)	-4.4	(6.2)	-0.2	(8.8)
Clothing and Fabrics	-8.8	(7.4)	6.5	(8.3)	-21.6	(11.9)
	Average Before-Tax Monthly Earnings					
Commercial[2]						
Food Service	-21	(44)	-70	(41)	-16	(59)
Building Trades Occupations	-87	(76)	-36	(71)	-166	(101)
Mechanical and Repair	4	(38)	-58	(36)	45	(51)
Tool Design	98*	(38)	94**	(36)	100*	(52)
Wood Working Occupations	51	(52)	-21	(48)	69	(69)
Electrical and Electronics	8	(40)	-0	(37)	8	(53)
Agriculture & Horticulture	34	(103)	-108	(96)	140	(138)
Professional Occupations	26	(28)	-30	(26)	79	(37)
Distributive Education	-49	(64)	3	(60)	-71	(85)
Personal Services	-85**	(33)	-75*	(31)	-84*	(44)
Clothing and Fabrics	-23	(44)	11	(41)	-49	(59)

Notes: * Significant at the .05 level.
** Significant at the .01 level.
b is the partial regression coefficient.
(s) is the standard error of the partial regression coefficient.

[1] The regression model controls for the influence of labor market at time of graduation, sex, IQ, race, marital status and father's education.

[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, over the six year period after graduation, persons trained in food service occupations were employed 5.8 percentage points less than those who were trained in commerical occupations. However, this difference is not statistically significant.

Source: Teh-wei Hu., *et at., A Cost-Effectiveness Study of Vocational Education.* University Park, Pennsylvania, 1969.

commercial courses, either in the first, or sixth year after high school graduation as well as over the six year average. (See Table 21.) Tool design yields approximately $100 a month more than commercial courses during the first, sixth, and six year average after high school graduation. Personal services courses such as beautician courses, earn from $75 to $85 less, as shown in Table 21.

However, if some course other than commercial were taken as the standard of comparison, a different pattern of earnings and employment differentials would emerge, so the evidence in this and similar tables in this presentation is not always conclusive. A slightly different portrayal of the data could give a different set of impressions. However, the general lack of statistical significance in Table 21 is striking and might well persist if other skills were used as a comparison, especially with respect to the employment variable.

Table 22 contrasts the earnings and employment of the six vocational program areas against the academic curriculum. Thus, the average hourly starting wage rate for distributive education graduates was 21 cents less than that of students who graduated from the academic curriculum.

Likewise, graduates from the technical program earned 23 cents more on their first job than did the academic graduates. Up to three years later, office graduates were earning 22 cents more per hour on their current or last job, trade and industry, 19 cents more and technical 26 cents more. But there was no difference between the hourly earnings of the academic graduates and the distributive, health or agriculture graduates.

Unlike the results shown in Table 21, there are marked differences in employment level, with, for instance, office graduates experiencing 14.1 percentage points more of employment than academic graduates. These results would be more interesting, however, had they been shown by sex and possibly, ethnic origin.

Junior College and the Vocational Program Areas. Table 23 shows a somewhat similar comparison for junior college graduates, although here the contrast is between the technical program area and the five other areas. Curiously, the health occupations group earned about 34 cents more per hour on its starting wage rate than did the technical graduates. The Hardin and Borus

TABLE 22

REGRESSION ANALYSIS OF STARTING WAGE, CURRENT WAGE, AVERAGE MONTHLY EARNINGS AND PERCENT OF TIME EMPLOYED, BY PROGRAM AREA, FOR SECONDARY VOCATIONAL GRADUATES

Program	Starting Wage n=1224		Current Wage n=1224		Earnings n=519		Percent of Time n=1028	
	b[3]	(s)[3]	b	(s)	b	(s)	b	(s)
Academic[2]								
Office	.17**	.06	.22**	.07	77**	19	14.1**	2.9
Trade & Industry	.05	.07	.19*	.08	26	21	9.4**	3.3
Distributive	.21**	.08	.09	.09	37	24	11.3**	3.9
Health	.17	.17	.26	.19	58	45	14.9	8.2
Agriculture	.04	.09	.002	.11	7	30	5.3	4.5
Technical	.23**	.09	.26*	.11	68*	31	6.5	4.5

* Significant at the .05 level of significance.
** Significant at the .01 level of significance.
All significance tests are two-tailed tests.

Notes:

[1]The wage rate regression equations also control for the effects of region, father's education, sex, marital status, socioeconomic status, race and additional education after graduation. The earnings equation controls for all the above except socioeconomic status and additional education after graduation. The employment equation controls for all of the above except socioeconomic status.

[2]Base variable against which the others are compared. Thus, students in office occupations had a starting wage 17 cents higher than students in the academic curriculum.

[3]b is the partial regression coefficient. (s) is the standard error of the partial regression coefficient.

Source:

Susan Fernbach and Gerald G. Somers, *An Analysis of the Economic Benefits of Vocational Studies in Vocational and Technical Education*, Madison, Wisconsin, 1970. Tables 5.3, 5.6, and 5.9.

study (1969, III) also shows health occupations achieving earnings greater than those of factory workers. (See Table 20.) In addition, those in the agriculture program earned 39 cents per hour less than technical graduates with respect to their current wage rate, a direction of effect which is not unreasonable. There is no statistically significant difference in current wage rate between technical education and distributive, office or trade and industry. While the lack of difference between the current hourly wage rates of technical and trade and industry is not unreasonable, it does not seem likely that there should be no differential between technical and office or distributive education where there is a high concentration of females. This is so even in light of the fact that Sharp and Myint (1970, II) control for sex in in their regression model, since interaction effects between sex and the various programs have not been accounted for in the model.

Tables 24, 25, and 26 show the interaction effects between level of education and vocational program area. The striking fact about these results is the general lack of statistical significance between educational levels for each of

TABLE 23
RELATIVE HOURLY WAGE RATES, BY PROGRAM AREA, FOR JUNIOR COLLEGE GRADUATES

Program n=568	Starting Wage Rate		Current Wage Rate	
	Partial Regression Coefficient	Significance Level	Partial Regression Coefficient	Significance Level
Technical[1]				
Health	.344	.0099	.347	.0829
Distributive Education	-.177	.1251	.031	.8586
Agriculture	-.075	.4687	-.392	.0123
Office	-.024	.8411	-.186	.3048
Trade and Industry	.001	.9940	-.073	.6568

Notes:

[1]In addition, this regression model controls for the effects of relatedness of work to training; additional education, sex, region, age, marital status, race, father's occupation, father's education, and socioeconomic status. Since technical occupations are contrasted against each of the other skills, the table shows, for instance, that health occupations earned 34.4 cents more for their starting wage rate than did technical occupations.

Source:

Laure M. Sharp and Thelma Myint, *Graduates of Vocational-Technical Programs in Junior Colleges*, Washington, D.C., September, 1970. Tables 5.33 and 5.34.

the program areas. Thus, it is only in health occupations that the junior college level earns a higher last or current wage rate than vocational high school. There is no difference in first, last or current wage rate or earnings between vocational high school and post-vocational high school education. However, this result is supported also by the study of Corazzini (1966, II) for limited occupations in the trade and industry program area. Clearly, since the sample sizes for the program areas are relatively large, this pattern of results is of great importance if further research substantiates the results. Since Morsch (1970, II) found that for given skill areas there was little difference in cost between post-vocational high school and junior college, yet both levels of education cost more than vocational or technical high school education, then the efficacy of these two extra years of education is called into question.

One study is insufficient evidence on which to make far-reaching policy conclusions of an educational institution such as the junior college, community college or post-secondary school system. First, we are talking only in terms of money returns. Next, the study, although nationwide in scope, has problems from the standpoint of non-response bias. Finally, when program areas are aggregated, junior college yields a significant return over vocational high school, though the benefit of post-secondary school over vocational or technical seocndary education is less clear cut and may be non-existent.

Tables 25 and 26 also show the interaction between vocational program areas and education levels, but in this case, office education is compared against

TABLE 24

REGRESSION ANALYSIS OF WAGE RATE ON FIRST JOB, WAGE RATE ON LAST OR CURRENT JOB, AND AVERAGE MONTHLY EARNINGS, BY EDUCATION LEVEL, FOR SEPARATE REGRESSIONS BY PROGRAM AREA

Educational Level [1]	Office		Trade and Industry		Distributive		Health		Agriculture		Technical	
	b	(s)	b	(s)	b	(s)	b	(s)	b	(s)	b	(s)
Wage Rate, First Job[2]	n=495		n=300		n=88		n=197		n=82		n=362	
Post-Vocational High School	.01	.08	-.04	.13	.91*	.39	.22	.18	-.09	.39	.07	.12
Junior College	-.10	.13	.18	.21	.12	.51	.67**	.16	-.28	.36	.09	.14
Wage Rate, Last or Current Job	n=495		n=300		n=88		n=197		n=82		n=362	
Post-Vocational High School	.01	.12	.001	.19	.02	.45	.07	.29	-.24	.56	-.02	.16
Junior College	-.03	.20	.41	.30	.78	.61	.85**	.27	-.60	.52	.07	.19
Average Monthly Earnings	n=428		n=256		n=73		n=175		n=68		n=337	
Post-Vocational High School	+[3]		+		–		+		+		+	
	+		+		+		191		+		+	

Notes: * Significant at the .05 level of significance, two-tailed test.
** Significant at the .01 level of significance, two-tailed test.
b is the partial regression coefficient.
(s) is the standard error of the partial regression coefficient.

1 The regression models for first, last or current wage rate control for region, relatedness of job to training, socioeconomic status, father's education, sex, age, marital status, race, urban-rural setting and grade point average. The model is the same for average monthly earnings except that relatedness of job to training is expressed for both first and current or last job.

2 Secondary vocational graduates are the group against which these coefficients are to be compared. Thus, those office occupation graduates from post-secondary vocational school earned one cent an hour less on their first jobs than did office occupation graduates from secondary high school.

3 + indicates that the partial regression coefficient is positive but not statistically significant; - indicates that the partial regression coefficient is negative but not statistically significant.

Source: Gerald G. Somers, *et al.*, *The Effectiveness of Vocational and Technical Programs: A National Follow-up Survey*, Madison, Wisconsin, 1971. Table VI.13, Table VI.18, Appendix Table 23.

TABLE 25

REGRESSION ANALYSIS OF WAGE RATE ON FIRST JOB, WAGE RATE ON CURRENT OR LAST JOB AND AVERAGE MONTHLY EARNINGS, BY PROGRAM AREA, BY EDUCATION LEVEL

Education Level[1]	Trade and Industry[3]		Distributive		Health		Agriculture		Technical	
	b	(s)	b	(s)	b	(s)	b	(s)	b	(s)
Wage Rate, First Job										
Vocational High School n=572	.09	.10	-.21	.11	-.04	.19	.01	.13	.13	.10
Post-Vocational High School n=725	.26**	.10	.29*	.13	.15	.09	-.10	.30	.33**	.10
Junior College n=321	.13	.20	.23	.21	.43**	.15	-.02	.17	.13	.15
Wage Rate, Current or Last Job[4]										
Vocational High School	.20	.15	-.20	16	.21	.28	.06	.18	.16	.15
Post-Vocational High School	.42**	.13	.43**	.17	.14	.21	-.16	.40	.36**	.13
Junior College	-.12	.33	.27	.34	.27	.24	-.15	.28	.02	.25
Average Monthly Earnings										
Vocational High School n=435		+2		—		+		—		—
Post-Vocational High School n=647		69*		—		+		+		64*
Junior College		+		+		+		—		+

Notes:
- * Significant at the .05 level of significance, two-tailed test.
- ** Significant at the .01 level of significance, two-tailed test.
- b is the partial regression coefficient.
- (s) is the standard error of the partial regression coefficient

1 Each regression model controls for graduate or dropout status, region, socioeconomic status, relatedness of job to training, father's education, sex, age, marital status, race, added education, urban-rural setting, and grade point average.

2 + indicates the partial regression coefficient is positive but not statistically significant; - indicates the partial regression coefficient is negative but not statistically significant.

3 For any educational level, each of the program areas is contrasted with Office Education. Thus, Trade and Industry graduates in vocational high school earned nine cents an hour more on their first jobs than did office occupation graduates.

4 Sample sizes are same as for wage rate, first job.

Source: Gerald G. Somers, *et al.*, *The Effectiveness of Vocational and Technical Programs: A National Follow-up Survey*. Madison, Wisconsin, 1971, Table VI.10, Table VI.17, Appendix Table 20.

TABLE 26

REGRESSION ANALYSIS ON WAGE RATE FOR FIRST AND CURRENT OR LAST JOB AND AVERAGE MONTHLY EARNINGS, BY PROGRAM AREA, FOR VOCATIONAL HIGH SCHOOL POST-SECONDARY VOCATIONAL SCHOOL AND JUNIOR COLLEGE GRADUATES, SEPARATE REGRESSIONS

Sample SubGroups	Trade and Industry[2]		Distributive		Health		Agriculture		Technical	
	b	(s)	b	(s)	b	(s)	b	(s)	b	(s)
Wage Rate, First Job										
Total Sample n=1524	-.004	.05	.03	.07	.19**	.07	-.06	.09	.14**	.06
Male n=823	.15	.10	.26*	.13	.18	.40	.14	.12	.31**	.09
Female n=701	-.15	.10	-.11	.08	.14*	.07	no responses		-.08	.10
Wage Rate, Current or Last Job										
Total Sample n=1524	-.08	.09	.11	.10	.24*	.10	-.06	.13	.17*	.08
Male n=823	.34**	.13	.35*	.17	.37	.54	.17	.17	.39**	.12
Female n=701	-.21	.15	.01	.13	.18	.10	no responses		-.17	.16

Average Monthly Earnings					
Total Sample n=1337	+3	–	+	+	35**
Male n=735	69**	+	+	+	60*
Female n=602	-60**	–	+	no responses	+

Notes:
- * Significant at the .05 level of significance, two-tailed test.
- ** Significant at the .01 level of significance, two-tailed test.
- b is the partial regression coefficient
- (e) is the standard error of the partial regression coefficient.
- 1 The regression models all control for level of education, region socioeconomic status, relatedness of job to training, father's education, age, marital status, race, added education, rural-urban setting and grade point average.
- 2 Each of the program areas are contrasted with office education. Thus, for the wage rate, first job, total sample, trade and industry occupations earned .4 cents less per hour than did office occupation skills.
- 3 + indicates a positive but statistically insignificant partial regression coefficient; – indicates a negative but statistically insignificant regression coefficient.

Source: Gerald G. Somers, *et al., The Effectiveness of Vocational and Technical Programs: A National Follow-up Survey*, Madison, Wisconsin, Tables VI.9, VI.15, Appendix Table 18, 1971.

each of the five remaining program areas. In Table 25, some consistent results begin to show. Trade and industry, distributive, and technical education all yield higher first and last or current wage rates than do the office programs. However, except for the health program, junior college shows no net benefit between office education and each of the five other programs. Clearly, this is a startling result, if true, and bears further investigation to substantiate it. An analysis of the added interaction effects of sex would have helped shed more light on these issues, but when one breaks the sample into subgroups cell sizes in critical areas diminish rapidly. This of course, means a very large initial size for the aggregate sample, and, since there are not many economies of scale in this type of survey, especially at the critical data editing stage, it implies very high costs for this kind of complex analysis.

Table 26, however, does shed some light on interaction effects between males and females. Note, for instance, that for the total sample the positive male and negative female earnings benefits of trade and industry compared to office occupations cancel each other out. One would wrongly be led to conclude that there is no difference in earnings between trade and industry and office occupations. Yet the significant fact is that males earn $69 more and females $60 less in trade and industry occupations in contrast to office occupations. Throughout the table one can see how the male and female effects dilute or cancel each other in the analysis of the total sample. It should be clear that no study which purports to measure the impact of education or training on labor market success should neglect the analysis of sex interaction effects. The classical way to do this is to separate the sample into its male and female components, though another way is to add interaction terms to one's regression equation.

In summary, Table 26 displays reasonable results for males for last or current wage rate and for average monthly earnings. A cautious analyst simply must remain skeptical concerning the results in the cells of the remainder of the table.

Manpower Training and Skill Areas. Tables 27 and 28 show the effects of manpower training on improverished rural and farm laborers in North Carolina, most of whom are black. Table 27 again brings out the importance of controlling for sex interactions. (See tables above for further analysis touching on this issue.) Thus, for males OJT completers earn about one dollar a week more than do institutional completers when both are compared with their respective control groups. The table suggests that male OJT dropouts do much worse than male institutional training dropouts so that when dropouts and completers are combined, all institutional trainees earn about a dollar more per week than all OJT trainees. Yet, if one were forced to make a judgment, for this sample and study locale, OJT training seems to have a slight edge over institutional training for males. This is clearly the case for females where both OJT completers and dropouts earned relatively large amounts as contrasted to institutional completers and dropouts who gained no earnings benefits vis-a-vis their respective control groups.

TABLE 27

IMPACT OF MANPOWER TRAINING ON WEEKLY EARNINGS AND HOURS WORKED PER WEEK, MALES AND FEMALES

	Weekly earnings (dollars)	Hours worked per week
Male[1]		
OJT completers	9.5**	0.6
OJT dropouts	0.7	1.9
Institutional completers	8.5**	1.9
Institutional dropouts	8.1	2.9
All OJT trainees	7.4**	0.9
All institutional trainees	8.3**	2.1
Females[1]		
OJT completers	17.0**	10.7**
OJT dropouts	11.4**	4.0
Institutional completers	0.2	-1.2
Institutional dropouts	-3.2	-1.8
All OJT trainees	14.5**	7.7**
All institutional trainees	-0.3*	-1.1

Notes: * Significant at the .01 level.

[1] The coefficients are to be interpreted as deviations from the average experience of the control group members. Thus, male OJT completers earned $9.5 a week more than male control group members and worked .6 hours more per week.

Source: David O. Sewell, *Training the Poor,* Kingston, Ontario, 1971, Table 7, p. 71.

Table 28 displays weekly earnings benefits by occupation for the same sample of rural poor. (See also Table 20.) Only service workers do not experience a net gain in weekly earnings compared to the control group. In view of the heavy concentration of blacks in this study sample, plus changing aspirations and racial attitudes, perhaps it is not too efficacious to train blacks for service jobs. For a variety of reasons, they simply may not succeed at this occupational activity.

Finally, in his study Sewell (1969,III) discusses the issue concerning wage rate improvement versus employment improvement as a measure of the impact of training on productivity. While, as mentioned above, the general argument that the effects of education and training should not be confounded by employment effects is a correct one, it is an argument tempered for an economy where no structural unemployment or other rigidities or structural bottlenecks confuse the picture. Given the obvious structural unemployment and underemployment of his sample, earnings is a better measure of program effect than wage rates. Wage rates can be assumed inflexible downward, especially in the short run, due to such things as the social minimum wage. Thus, they will

TABLE 28

MULTIPLE REGRESSIONS OF WEEKLY EARNINGS AFTER TRAINING, AND THE COMPONENTS OF WEEKLY EARNINGS AFTER TRAINING, ON RESPONDENT CHARACTERISTICS: TRAINING STATUS CLASSIFIED BY TRAINING OCCUPATION

	Weekly earnings (dollars)	Hours worked per week	Hourly earnings (cents)
Institutional Trainees[1]			
Net regression coefficients:			
Building tradesmen	12.9**	-1.0	36.5**
Nurse aide	-2.3	-5.4*	-8.7
"Occupational farm tractor"	0.3	3.9	5.3
Miscellaneous	14.4**	5.1*	26.3**
All Trainees[1]			
Net regression coefficients:			
Clerical and sales workers	26.2**	8.2**	34.3**
Building tradesmen	10.5**	0.5	29.7**
Mechanics	6.7**	4.6**	10.0
Plant operatives	6.4**	1.6	15.7**
Service workers	-0.1	-1.5	-7.0

Notes: *Significant at the .05 level.
** Significant at the .01 level.

1 The coefficients are to be interpreted as deviations from the average experience of control group members; thus building tradesmen under the institutional training component earned $12.90 more per week than their control group counterparts.

Source: David O. Sewell, *Training the Poor*, Kingston, Ontario, 1971, Table 9, page 79.

not adjust themselves downward to allow persons of low productivity to be employed in the market place. Hence, the strategy is to raise worker's productivity up to that level required to justify paying him current money wage levels. When this occurs, the program will show no wage effect but an employment and earnings effect. Thus, Main was incorrect to conclude that retraining had no impact on the productivity of MDTA institutional trainees in his national sample simply because trainee wage rates did not rise. In short, for MDTA trainees and other structurally unemployed workers, employment and earnings and not wage rates are the preferred indices of labor market performance.

Taken in this light, the results reported by Sewell are of some interest, especially since he shows clerical and sales workers receiving greater earnings benefits than building tradesmen, mechanics or plant operatives, occupational areas where, in contrast to clerical and sales, there has been a longer historical penetration by blacks.

SUMMARY, IMPLICATIONS, RECOMMENDATIONS

Summary and Implications

Methodology. The methodology exists to perform benefit-cost studies in an appropriate manner. Much of the current ambiguity that exists concerning the implications of benefit-cost studies is the result of using faulty methodology. The use of control groups is an absolute necessity, for instance, yet many studies, especially the earlier ones, use no control or comparison group.

Adequate sampling procedures and adjustment for non-response bias and self-selection bias are necessities. Random probability samples of the population of interest seem obvious, yet judgment samples continue to be used. It costs more to perform a random sample since the population frame must be established before sampling is performed, but the extra cost is preferable to the possibility that the entire study may have to be junked because no one is sure of the meaning or applicability of the results.

Control for non-response bias is costly, too. It often costs several hundred dollars to run down a single observation. But, in many cases even the most elementary information is lacking with respect to non-response groups. This can usually be traced to the fact that it costs more per unit of information and is distracting to deal with a group of persons on whom there is often no concrete information available.

Self-selection bias, the bane of retrospective evaluations, has not been dealt with adequately in the past. The use of probit analysis, a standard econometric technique, to estimate a discriminant function can help a long way, especially if motivational or other psychological information is available.

Both tabular analysis and regression analysis should be used. Tabulations are valuable in laying out the main dimensions of the study, but it is only regression analysis which has the flexibility to handle large numbers of variables simultaneously. In retrospective studies of population cross-sections, even a basic list of variables to properly investigate labor market influences can run to a dozen; sex, age, race, education, marital status, socioeconomic status, IQ, occupation, industry, labor market structure and geographic region are likely candidates. Tabular presentation simply cannot simultaneously handle this number of variables and their interactions efficiently.

Finally, more attention should be paid beforehand to the acceptable levels of statistical significance (tempered by cost constraints) which are desired. The methodology for establishing desired levels of statistical significance in one's sample is laid out in most elementary statistics texts but the use of it is not apparent in the studies represented in this survey. An example of the use of such a methodology linked with cost constraints is with the Gary Income Maintenance Experiment which is being conducted by Indiana University at

Gary. By establishing control over significance levels beforehand, it would be possible to avoid the calculation of complex results, all or most of which are of little use since one has variances too high to provide definitive results.

From the standpoint of benefit-cost analysis, both average and marginal benefit-cost ratios should be used. Thus far, most studies do not allow comparisons on a marginal basis among program alternatives.

Most of the studies do not compute true marginal benefits. Regression coefficients based on dummy variables yield *differences between averages.* Marginal benefits can be calculated by expressing program benefits as a function of length of exposure to the program. The study by Hardin and Borus (1969, III) does this rather well. If the vocational or technical students and their controls are handled in the analysis by using dummy variables (or by means of cross-classification in tables) the result one gets is a difference between the average experience of the vocational student and that of the control group. A marginal benefit cannot be estimated in this way unless the assumption is made that the difference between the averages is equal to the marginal difference. Not everyone will accept such an assumption.

The discussion over the true value of the social opportunity cost of capital remains unresolved. For groups other than society, the borrowing rate of funds, if the educational investment is financed by borrowing, and the lending rate, if the investment is financed from savings, are the appropriate rates for individuals, firms, and government units other than the federal government.

The proper investment criterion to be used in maximizing the present value of net benefits depends on the constraints which exist in the program's institutional structure. All of the three basic criteria suffer from shortcomings when human capital investments are considered.

Benefit-Cost: Secondary Vocational Education. What can be said? The federal government is still not confident since it has recently funded a new nationwide study of vocational education to be performed by the National Planning Association. Yet the federal government appears too cautious. Except for the Taussig study (1968, II), all of the major studies here show a positive effect of secondary vocational education. A major question mark lies with the data from Project TALENT. These data have been yet to be effectively analyzed by investigators not directly associated with the federal government. Since this data bank is a national sample, it is important that it be appropriately analyzed in the very near future. The major problem with these data lies in a relatively high non-response rate.

In short, based on current evidence, it seems clear that the secondary vocational curriculum yields greater labor market benefits relative to the comprehensive curriculum. This judgment is qualified by the fact that the objective functions of the two groups are not the same and the population served are not identical.

Little or no reliable knowledge of the relative investment gains of vocational courses or program areas exists. The estimates of benefits of program areas are still inconclusive and sound cost measures are yet to be done. Benefit-cost measures which compare sets of vocational skills on which one would be willing to stake millions of dollars simply don't exist. The benefit measures are ambiguous at best and are of no use in any case in the absence of measures of

realtive costs. It does no good to provide tabulations of gross earnings or wage differentials by skill if information on costs is lacking. However, it is worth mentioning at this point that the analysis by Schweitzer (1970, II) suggests that the length of formal schooling for many occupational areas may be too long. The schooling process may be longer than the learning process as further suggested by the Hansen-Weisbrod-Scanlon study.

Benefit-Cost: Post-Secondary Vocational Education and Junior College. The studies are pointing to the likelihood that post-secondary vocational education is a losing proposition for students who already have a sound high school vocational preparation. The junior college, however, does appear to yield substantial benefits over secondary vocational education, though again, the problem exists that the objective functions of the two different populations simply may not be the same.

Morsch (1970, II) reports that the cost for the same occupational training is about the same for post-secondary vocational and junior college education. Thus, if junior college pays on the average while post-secondary vocational education does not, the average *mix* of skills at the two types of institutions may be the critical point to investigate. Of course, as with secondary vocational education, this analysis remains to be done effectively.

Benefit-Cost: Manpower Training. That the present MDTA manpower training program is a worthwhile social investment seems indisputable. It is still not clear, however, whether it is the actual skills learned, the various services that accompany retraining such as placement, or the sheepskin effect as a selective device which is mainly responsible for the high rates of return. An effort should be made to identify the net effects of these three possible causal factors. Yet, one hesitates to recommend the additional investment of social capital in this effort at this time unless it is accompanied by a careful study of the absolute and relative costs and benefits of different occupational skills within the program plus an assessment of the reasons for the continuing "shortage" of persons in occupations such as nurse's aide even in the face of continual retraining.

The studies of the remaining manpower programs are a mixed lot. Both due to subtle and not so subtle differences in populations being served as well as wide variations in methodologies one cannot make reasonable marginal investment adjustments among these programs based on these data. One can only judge that the programs are covering their average costs. There is a basic problem in attempting to use retrospective studies for economic decision-making. The usual approach has been for the government to express interest in a target population, whereupon a program was designed to aid it. This program was then retrospectively evaluated. Two alternatives to this sequence are available. First, planned experiments, as with the three ongoing income maintenance studies in Seattle–Denver, Gary, Indiana, and New Jersey-Pennsylvania should be attempted. Thus, consider what might be the proper training program for welfare mothers: The Work Incentive program (WIN), the MDTA approach, adult or remedial education, and no program at all immediately present themselves as possible alternatives. Experiments with a proper control group design could be devised to see which of these methods is

most effective in alleviating the stress of poverty among welfare mothers, for instance.

Alternatively, a particular target group could be selected among the various ongoing programs to estimate the differential program effects on this population. In terms of research findings these two alternatives may be more expensive than the unit study cost of the present type. However, they might be much less expensive in terms of the amount of usable policy guidance they might provide.

Research in Progress

Vocational Education. At the present time several major evaluations of vocational education are ongoing. The Project METRO study by Max Eninger (1971, II) is a nationwide analysis of secondary vocational education funded by the U.S. Office of Education. These data are based on high school records and a mail labor market questionnaire of the 1968 graduating class. Preliminary tabular analyses of the data are in progress. Regression analysis of benefits will be conducted but there are no estimates of costs based on this sample.

The National Planning Association has just been awarded a major contract by the U.S. Office of Education to study the labor market and other noneconomic effects of vocational education at the secondary level. An effort will be made to estimate the net effects of vocational education by program area and by treatment such as cooperative education. This study is planned to run into 1973. Two cohorts of students will be analyzed—those 10th graders who could have graduated in 1968 and those who could have graduated in 1970. Approximately 20,000 observations are planned for analysis. A mail labor market questionnaire is planned to collect the needed labor market data. Data from school records will also be collected. Costs will not be collected except for a small subsample of schools.

Manpower Studies. Operations Research, Inc., in conjunction with the Office of Economic Opportunity (OEO) is conducting a major benefit-cost study of four manpower programs which promises to be definitive: The programs are MDTA institutional training; the Job Corps; NAB-JOBS; and the out-of-school NYC. Data will be collected by Operations Research, Inc., and analysis will be done by the Office of Economic Opportunity.

This study shows great promise since the response rate has been maintained at over 95 percent and an elaborate sampling procedure was developed to select a sample from a set of large metropolitan areas which themselves were judgmentally selected.

An elaborate personally administered questionnaire is the main data base but large masses of individual records from training centers, and the like, are being collected on approximately 10,000 sample observations.

The cost analysis is being conducted by the present author in conjunction with Operations Research, Inc. Benefit analysis will be conducted by the OEO.

This study promises to be the definitive work on manpower programs to date, especially since it will allow marginal economic comparisons among major manpower programs on the basis of a common methodology throughout.

Finally, the present author is conducting an economic and institutional analysis of the Work Experience and Career Exploration Program (WECEP). WECEP is designed to provide occupational training and career exploration opportunities to disadvantaged, handicapped or otherwise alienated 14 and 15 year old high school youth in an effort to reduce the dropout rate.

This benefit study is nationwide in scope and will rely for its data mainly on records which are collected at the WECEP sites on the experimental group and a preselected sample of controls.

Preliminary analysis of the 1971 class is scheduled for the Spring of 1972 while a final report incorporating the experience of the 1972 class as well is due in the Fall of 1972.

Other Data Sources. For the energetic person, both the data from the Coleman Report and Project TALENT remain to be properly exploited.

Finally, and perhaps most importantly, the 1970 Decennial Census has a section on vocational education based on a five percent sample. These data are currently coded and await proper analysis.

The Future of Benefit-Cost Analysis in Vocational Education

The future of benefit-cost analysis depends in part on what the present state of the art offers. So, the question is, what does the typical benefit-cost study now offer? As suggested above, the study will typically show only that a program appears to pay or does not. (See Barth, 1971, III, on which the discussion of the next few paragraphs is largely based.) The next judgment is whether to expand or contract the program, depending on what the calculated numbers indicate. However, the calculated rate of return or net present value does not tell you how much to expand or contract the program. First, the benefits or costs or both will often be assumed constant over the relevant range of output and for all future periods. But, in the real world, this is an unlikely situation. With a failure to use nonlinear total cost or benefit functions and a general lack of estimating such things as average cost functions, one has no idea whether one is operating in a range of increasing or decreasing returns or costs or what the optimal scale of operation may be. One simply can't tell how far to expand or contract, and knowledge of the future stream of costs and benefits does not exist.

Second, if one expands or contracts a program on the basis of the benefit-cost analysis, it is not clear what one gives up in order to expand the program or what will replace the program in the event that its level of funding is cut. Present benefit-cost studies do not address themselves to these issues, but it is clear that the broader the expanse of alternatives one considers as substitute programs, the less relevant any given efficiency comparison becomes, since the program objectives and outputs begin to differ widely. Benefit-cost studies as yet have not even extensively evaluated different production techniques for the same type of output and program.

Finally, most of the studies have not even calculated marginal costs and benefits so they exhibit a fundamental inability to aid in making choices among alternatives.

With such fundamental problems one may rightly ask, why bother with benefit-cost analysis at all? Yet, in spite of the above defects, benefit-cost analysis should and will continue to be done since it interjects a rational, systematic analysis into an area where judgment and impressionistic analysis formerly operated with little contamination from orderly economic analysis or a clear-cut specification of program objectives, outputs and evaluation methodology.

However, we are clearly not yet at the stage where benefit-cost analysis can be widely adopted and automatically integrated into the very fabric of decision-making at the federal or state educational level much less at the school district level. For the present, too many methodological issues remain to be refined, leaving the estimated measures of benefit too crude. Also, at present it would simply be too expensive to continuously generate data good enough to be used in the resource allocation process on all specific local programs, even if economic considerations had a weight of unity in the decision-making process (which they do not). For the time being, therefore, we may expect to see only a continuation of *ex post* analyses of specific programs or activities for very special purposes. In our judgment, it will be some time even before extensive use of the type of methodological approach in the Operation Research, Inc. - Office of Economic Opportunity's study of four manpower programs is widely adopted. The cost of such types of comparative evaluations, usually several millions, seems an effective deterrent to their widespread adoption at present.

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