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ABSTRACT

A study reviewed the measurement problems that would confront a study team performing a national cost-benefit analysis of vocational education and presented alternative strategies to overcome these measurement problems and to provide input into assessing the feasibility of conducting a national cost-benefit study. To meet these objectives, researchers made a comprehensive literature review of works dealing with cost-benefit methodologies in general, cost-benefit analysis of vocational education, and cost-benefit analysis in other social welfare areas. In addition, a variety of technical experts was consulted. Data obtained from these two sources were organized into synopses dealing with the scope of vocational education, cost-benefit analysis, general cost-benefit measurement problems, and problems specific to measuring vocational education costs and benefits. Analysis of these data indicated that cost-benefit analysis can be a meaningful tool that contributes to the policy process. However, it does have some limitations, including several in the following areas: analytical evaluation techniques that relate costs to benefits, methods for measuring costs and benefits, and characteristics of vocational education. (Related reports on other components of the project and the final project report are available separately through ERIC--see note.) (MN)

ED208187

DESIGN OF A NATIONAL COST-BENEFIT STUDY OF VOCATIONAL EDUCATION AT THE SECONDARY, POSTSECONDARY AND ADULT LEVELS: COST-BENEFIT MEASUREMENT REPORT

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TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

LIST OF TABLES

SECTION 1
INTRODUCTION

Cost-benefit analysis is one important method for improving resource allocation in the general area of social welfare. The Department of Education has contracted with Rehab Group, Inc. for a study assessing the feasibility of performing a national cost-benefit analysis of secondary, postsecondary, and adult vocational education. The components of this study include:

- An analysis of the measurement problems in performing a national cost-benefit study.
- An assessment of the state of the art in applying cost-benefit methodologies to vocational education.
- Recommendations concerning the feasibility of performing a national cost-benefit study.

Each of these study components is examined in a separate document. The reports are written as companion pieces utilizing similar format and terminology. In addition, a final report synthesizes the major findings of all study areas into one document.

MEASUREMENT REPORT OBJECTIVES

This report is designed to fulfill two objectives. One is to review the measurement problems that would confront a study team performing a national cost-benefit analysis of vocational education and present alternative strategies to overcome these measurement problems. The other is to provide input into assessing the feasibility of conducting a national cost-benefit study. The importance of the latter objective is that a critical component in determining the feasibility of a national study is the accuracy of available measures of costs and benefits.

A methodology consisting of a comprehensive literature review and consultation with technical experts was undertaken to identify cost-benefit measurement obstacles and strategies, and thereby meet the first objective.

Among the literature analyzed were books, journal articles, government studies, and unpublished papers and dissertations dealing with cost-benefit methodologies in general, cost-benefit analysis of vocational education, and cost-benefit analysis in other social welfare areas. Technical experts consulted included economists, vocational educators, Department of Education staff, and practitioners from diverse disciplines who are knowledgeable about or had utilized cost-benefit techniques.

It is difficult to discuss measurement problems and strategies to resolve these problems without making normative judgements on the severity of the obstacle or the utility of the strategy. This report does critique many of these problems and strategies. However, the critique is quite general in nature and, consistent with the second report objective, is intended to provide input into assessing the feasibility of performing a national cost-benefit study. Therefore, this report does not undertake a rigorous analysis of the impact of measurement problems and strategies on the feasibility of performing a national cost-benefit study of vocational education. This is accomplished in a separate document, Design of a National Cost-Benefit Study of Vocational Education at the Secondary, Postsecondary and Adult Levels: Cost-Benefit Feasibility Report.

MEASUREMENT REPORT FORMAT

The report is organized into six sections. Section 2 presents a brief description of the breadth of vocational education. Section 3 explains various analytic approaches to relate costs and benefits in a cost-benefit analysis. In other words, these two sections respectively review "What is vocational education?" and "What is cost-benefit analysis?"

Section 4 is the first of two related discussions of cost-benefit measurement problems. It evaluates general problems, including data limitations, in measuring the costs and benefits of vocational education. Section 5 analyzes problems specific to measuring the costs of vocational education and the obstacles to measurement on the benefits side of a vocational education cost-benefit analysis. Section 6 presents general conclusions.

SECTION 2
BREADTH OF VOCATIONAL EDUCATION

OVERVIEW

Vocational education, in its broadest sense, can be defined as learning experiences provided to students in one or more skilled, semi-skilled, or technical occupations. However, this very general definition does not accurately reflect the diversity within the vocational education enterprise. Vocational education provides an array of programs and curricula to varied student populations with dissimilar needs through numerous delivery systems on the secondary, postsecondary, and adult levels.

This section describes some of the components that contribute to the breadth of vocational education. Such a discussion is undertaken because an awareness of this diversity is necessary to fully appreciate many of the measurement problems in cost-benefit analysis of vocational education. It also facilitates a presentation of definitions relevant to vocational education that are used throughout the report.

PROGRAM LEVELS

Vocational education may be provided on the secondary, postsecondary, and adult levels. There is much confusion in the use of these terms, particularly concerning the distinction between postsecondary and adult vocational education. As typically used, these categories are not mutually exclusive. For example, an adult who has a high school diploma and is in a matriculating vocational program may be categorized as a postsecondary vocational education student in one state and an adult vocational education student in another. In a third state it is possible that the student might be double-counted.

In an effort to clarify existing definitional confusion, several distinctions between levels are used throughout this report. Postsecondary vocational education is defined as programs provided on an ongoing basis in a post-high school setting that teach job skills to their participants. By comparison, adult vocational education provides specially established, rather than ongoing, courses that are developed to meet the specific occupational or manpower needs of a community or an employer. Adult vocational education courses may be offered in either secondary or postsecondary institutions and are very often taken by individuals desiring to retrain in order to enter a new career or to improve their skills so that they can advance in their present career.

Adult vocational education is also differentiated from adult education in this report. While the former develops job skills, adult education is basic instruction, often in occupational subject areas, that is consumed solely for personal enrichment. Adult education courses may be given in secondary or postsecondary schools, but are apart from the regular matriculating program. The distinction between adult vocational education and adult education is solely definitional and is not meant to diminish the importance of adult education courses. Either program level may be the subject of a cost-benefit analysis.

One final definitional clarification must be made between secondary vocational education and practical arts. Secondary vocational education provides high school level programs that teach occupational skills and prepare a student to hold a job. Practical arts comprises courses that are prevocational, exploratory, and/or for personal consumption by secondary level students.

PROGRAM AREAS

Vocational education is not a uniform educational program teaching occupational skills. Rather, it is a complex offering of diverse courses and program areas. Currently, vocational education lists courses in over 400 instructional categories. Vocational course offerings are often updated in order to respond to technological developments and shifts in occupational demand. Vocational courses have traditionally been grouped into the following seven major occupational program areas: agriculture, occupational home economics, business and office occupations, trade and industrial occupations, distributive education, health occupations, and technical education.

DELIVERY SYSTEMS

Vocational education is provided in a variety of settings. On the secondary level, vocational courses are taught primarily in general high schools, comprehensive high schools, vocational high schools, and area vocational centers. A general high school teaches courses primarily in general and academic education. It does, however, offer a limited number of vocational programs. A comprehensive high school offers general, academic, and vocational curricula. It is distinguished from a general high school because its vocational offerings are more diverse and extensive. A comprehensive high school must have at least five different vocational programs. A vocational high school specializes in vocational curricula, while also teaching academic subjects. All or nearly all of its students are full time vocational education program participants. An area vocational center generally provides only occupational training. A student attending an area vocational center has a dual enrollment, attending the area vocational center part time for vocational curricula and a separate secondary school part time for academic classes. Instruction at an area vocational center is available to residents of a state, county, city, or other geographic area that is usually larger than the local basic administrative unit.

Postsecondary vocational training is available primarily at community colleges, technical institutes, area vocational schools, and proprietary schools. A community college offers two year matriculating programs in both general and vocational education. Like a community college, a technical institute is also a two-year degree-granting institution. However, its curricula is primarily vocational. An area vocational school offers a non-matriculating and exclusively vocational program and provides instruction to students from throughout a particular region. Proprietary schools are private for-profit institutions that usually offer training in a particular occupational area such as business or cosmetology.

Although the above categories are considered the traditional vocational education delivery systems, occupational training may be gained through a number of alternative means. These include cooperative education programs between schools and industry, on-the-job training, apprenticeships, and federally-funded skill centers.

STUDENT POPULATIONS

Vocational education programs are consumed by a variety of populations with differing needs. In addition to the general student population, active participants in vocational education include the following special populations: adults seeking retraining, senior citizens, displaced homemakers, prison inmates, educationally and economically disadvantaged, limited English speaking, and handicapped.

CONCLUSION

Vocational education is a complex enterprise that cannot be simply defined or neatly categorized. It delivers services on secondary, postsecondary, and adult levels; offers over 400 course types in seven occupational program areas; provides technical instruction in a variety of institutional settings; and teaches diverse student populations with varying educational needs.

It is probable that the returns on investment in vocational education differ by program level, program area, delivery system, and/or student population. This hypothesis, particularly concerning program level and program area, is supported by many past research efforts.[1] Therefore, the complexity of vocational education provides a conceptual problem to the design of a national cost-benefit analysis of vocational education. The extent of this problem is discussed in Section 4, "General Cost-Benefit Measurement Problems."

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[1] Findings for many cost-benefit studies of vocational education are discussed in a companion volume to this report entitled Design of a National Cost-Benefit Study of Vocational Education at the Secondary, Postsecondary, and Adult Levels: State of the Art Report.

SECTION 3
REVIEW OF COST-BENEFIT ANALYSIS

OVERVIEW

Cost-benefit analysis is an evaluative process which relates the benefits of an investment choice to the costs associated with actualizing that investment. It differs from cost-effectiveness analysis which evaluates the cost-effectiveness of various options in obtaining a predetermined goal. Cost-effectiveness analysis can suggest that option A is more cost-effective than option B in obtaining desired goal C. However, this analytic procedure produces no absolute statement about the worth of goal C. In contrast, cost-benefit analysis attempts to quantify the merits of a proposed investment and relates those merits to the costs involved.

Four basic techniques have been developed for comparing the costs and benefits of an activity or potential investment alternative. These four techniques are discussed in the following sub-section. This section concludes with a discussion of the limitations of each of the four cost-benefit analysis techniques.

ANALYTIC APPROACHES

The most obvious approach to relating costs and benefits is to sum all the costs and benefits of a program and compare them. This comparison may be performed, for example, by subtracting costs from benefits (simple net benefit method) or by dividing benefits by costs (simple benefit-cost ratio). An investment or activity is worthwhile under the simple net benefit method if the difference is positive or, under the simple benefit-cost ratio method if the quotient is greater than one. Should more than one investment option be available, both methods could be used to rank order the desirability of the available options. However, the two methods may not rank the options consistently. This is illustrated in Table 3.1, which displays the expected costs and benefits of six investment options and calculations of their simple net benefit and their simple benefit-cost ratio.[1] Both evaluation methods would exclude option E from the set of desirable investments. This is indicated by the negative value for the simple net benefit and the simple benefit-cost ratio being less than 1. Of the viable investments, the simple net benefit method would rank option A as the most desirable since it has the greatest positive value. In contrast, investment option D has the highest ratio and, therefore, is ranked first by the simple benefit-cost ratio method.

Table 3.1

Comparison of Investment Options Using the Simple Net Benefit and Simple Benefit-Cost Ratio Evaluation Methods

	Expected Costs	Expected Benefits	Evaluation Method	
			Simple Net Benefit	Simple Benefit-Cost Ratio
Investment Option	$\sum_{t}^{N} C_t$	$\sum_{t}^{N} B_t$	$\sum_{t}^{N} (B_t - C_t)$	$\sum_{t}^{N} B_t/C_t$
A	$100	$110	$10	1.10
B	50	55	5	1.10
C	100	105	5	1.05
D	60	69	9	1.15
E	100	90	-10	0.90
F	50	56	6	1.12

Both the simple net benefit and simple benefit-cost ratio evaluation methods have serious limitations as analytic approaches. The former method does not indicate the efficiency of an investment (returns relative to cost). The latter method does calculate the efficiency of an investment but does not directly indicate the net benefit to be gained by an investment. An additional limitation of this technique is that it depends on a distinction between costs

[1] For the ease of example, all investment options are assumed to be riskless.

and negative benefits. Costs are generally assumed to be expenditures incurred in operating a program. Negative benefits are generally outcomes resulting from vocational education which have a negative impact (for example, workers being displaced by automation). However, the distinction between costs and negative benefits is often vague and an argument can be made for entering a particular term on either the cost side of an analysis or the benefits side of an analysis as a negative benefit. For instance, downstream operating costs that result from the implementation of a program may also be considered a negative benefit of a program. This is important because the magnitude of the simple benefit-cost ratio may be significantly affected by this distinction.[2]

The major deficiency with both the simple net benefit and simple benefit-cost methods is that neither accounts for differences in the flow of benefits and costs over time. Therefore, two investment options each costing $100 and yielding benefits totalling $125 would be ranked equally by the simple net benefit and simple benefit-cost ratio methods even if the second investment took twice as long to yield the same benefits. Since a typical consumer prefers immediate income to the same amount of income in the future (termed a positive rate of time preference) the first investment option clearly appears to be the more attractive. Four basic evaluative methods which attempt to account for this positive rate of time preference are discussed in the following sub-sections.[3]

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2 Perhaps this point is best illustrated by example. Assume there is an investment plan with positive benefits valued at $300, negative benefits valued at $50, and direct costs of $100. The simple benefit-cost ratio (B_t/C_t) will compute different values depending on how one treats negative benefits. If they are considered on the benefits side of the equation, a ratio of 2.5 is computed:

$$(300-50)/100 = 2.5$$

If negative benefits are considered a component of cost, a ratio of 2.0 is achieved:

$$300/(100+50) = 2.0$$

As this example illustrates, the interpretation of negative benefits may alter the valuation of an investment.

3 A more thorough discussion of the rate of time preference and associated measurement difficulties is presented later in this report.

Payback Period

The payback period method calculates the length of time required by an investment alternative to recover its costs. Investment alternatives are then ranked inversely to the duration of this payback period. Therefore, positive rates of time preference are recognized since a shorter payback period is considered superior to a longer payback period. This method is represented equationally, when solving for N, by:

$$\sum_{t=0}^{N} B_t - \sum_{t=0}^{N} C_t = 0, \text{ where}$$

N = the total number of time periods

B_t = the benefits accuring in time period t

C_t = the costs incurred in time period t.

There are two major deficiencies with this method. First, it disregards any benefits or costs occuring after the time period when the sum of the benefits equals the sum of the costs. Second, the methodology does not distinguish between differences in the timing of benefits enroute to equalling costs. Table 3-2 helps clarify these points.

Using the payback period evaluation methodology, all three options depicted in Table 3.2 would be ranked equally since in each case the total cost of investment ($100 dollars) is recouped by the second time period. However, everything else being equal, investment option B appears to be the most desirable since an additional return of $50 in benefits occurs after the point where the benefits from the investment equal the costs. Therefore, the total benefits through the third time period are greatest under investment option B. Illustrative of the second objection to this methodology is that the payback period does not distinguish between options A and C although A is apparently superior to C because more of the returns occur sooner. ($90 in the first time period for investment option A and $10 in the same time period for investment option C.)

Table 3.2
Comparison of Investment Options Using the
Payback Period Evaluation Methodology

Investment Option	Total Cost of Investment $\sum_{t=0}^{N} C_t$	Sum of Total Benefits Over Time $\sum_{t=0}^{1} B_t$	$\sum_{t=0}^{2} B_t$	$\sum_{t=0}^{3} B_t$
A	$100	$ 90	$100	$100
B	100	90	100	150
C	100	10	100	100

An additional deficiency of the payback period method is its implication that projects should be evaluated upon the speed with which they can recover costs. Investors are not interested in merely recovering their costs. Rather, they desire to maximize their benefits. Further, investments are not justified on the basis of recovering initial costs. For example, as shown in Table 3.2, options A and C both recover their costs, assuming that all benefits are measured and no benefits occur after the third time period. Neither investment is justified on this basis because the $100 in benefits resulting by the second time period would be valued less, given a positive rate of time preference, than the $100 worth of consumption foregone to make the investment.

As the preceeding discussion suggests, the payback period method has severe limitations. For these reasons it is seldom employed in cost-benefit analysis. This method is appealing based on its conceptual simplicity, but suffers from its inability to specifically account for time preferences of consumption. Three more satisfactory methodologies are discussed in the following sub-sections.

Net Present Value

The net present value (NPV) method is one of the most commonly used techniques to relate costs and benefits. It is fundamentally similar to the simple net benefit method but also incorporates a factor for time preference. It shares a basic characteristic of the simple net benefit method in that it indicates the value but not the efficiency of an investment. This method is represented by:

$$NPV = \sum_{t=0}^{N} \frac{B_t - C_t}{(1+i)^t}, \text{ where}$$

N = the total number of time periods

$B_t - C_t$ = the net benefits occuring in time period t

i = the social rate of discount.

The net present value method subtracts costs from benefits for each time period and then adjusts the net figure to a present value. As can be seen from the equation, the adjustment factor, 1+i, grows at an exponential rate. Therefore, the size of i significantly affects the magnitude of the calculated net present value. In particular, the larger the magnitude of i, the higher those projects with most of their benefits accruing early on will be valuated. Table 3.3 helps illustrate this point.

Table 3.3
Comparison of Investment Options Using the Net Present Value Evaluation Methodology

Investment Option	Net Benefits Per Time Period B_0-C_0	B_1-C_1	B_2-C_2	B_3-C_3	Net Present Value Criterion i =0.0	i=0.1	i=0.2
A	$-100	$150	$0	$0	$50	$36	$25
B	-100	55	55	55	65	37	16
C	-100	0	0	170	70	28	-2

Table 3.3 shows that the choice of the appropriate value for i may have significant impact on the ranking of alternate investments. For example, investment option C is ranked the highest (the net present value equals $70)

assuming i equals zero. However, it returns a negative net present value (-$2) when a time preference of 20 percent (i=.2) is assumed. The reader should also notice that when i equals zero, the net present value criterion ranks the investment options exactly the same as the simple net benefit method since both assumed either implicitly (the simple net benefit method) or explicitly (the net present value method when i equals zero) a zero rate of discount.

Benefit-Cost Ratio

The benefit-cost ratio (BCR) is theoretically similar to the net present value method. Both methods discount the flow of costs and benefits to their present values. The benefit-cost ratio divides the present value of the benefits by the present value of the cost. This procedure is equationally represented by:

$$BCR = \frac{\sum_{t=0}^{N} \frac{B_t}{(1+i)^t}}{\sum_{t=0}^{N} \frac{C_t}{(1+i)^t}}, \text{ where}$$

N = the total number of time periods
B_t = the benefits occurring in time period t
C_t = the costs incurred in time period t
i = the social rate of discount.

The resulting value is an indicator of the efficiency of an investment.

The benefit-cost ratio exhibits the same general properties of the simple benefit-cost ratio discussed previously except that all future benefits and costs have been discounted to their present values. In particular, the benefit-cost ratio does not reveal the amount of money to be gained from an investment and is susceptible to various interpretations of negative benefits.

A research team directed by David Cardus, Marcus Fuhrer, and Robert Thrall has developed an interesting adaptation of the traditional benefit-cost ratio.[4] They suggest that making a distinction between current year budget requirements and other future program costs may, in many instances, lead to a more efficient allocation of an agency's current year budget among competing alternatives. They use the term critical costs (CC) in their study which is defined as "the amount of the current...budget that is required to fund (a) project."[5] Other program costs (CO) may include "set-up costs, operational costs, and also downstream...(program) funding."[6] Equationally, total costs (C) are represented by:

$$C = CC+CO.$$

Cardus, Fuhrer, and Thrall have proposed that in many instances when there are both present costs and downstream costs, a more appropriate method to relate costs to benefits is represented by:

$$\frac{NPV}{CC} = \frac{\sum_{t=0}^{N} \frac{B_t-C_t}{(1+i)^t}}{CC}, \text{ where}$$

N = the total number of time periods

B_t-C_t = net benefits occurring in time period t

i = social rate of discount

NPV = net present value

CC = critical costs.

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4 These findings are reported in D. Cardus, M.J. Fuhrer, R.M. Thrall, et al., A Benefit-Cost Approach to the Prioritization of Rehabilitative Research (Houston, TX: Baylor College of Medicine, the Institute for Rehabilitation and Research), 1980.

5 Cardus, Fuhrer, and Thrall, p. 82.

6 Cardus, Fuhrer, and Thrall, p. 82.

The idea represented by this equation is to calculate the net present value of the expected benefits from an investment alternative. If these net expected benefits are positive (or as the study team points out, significantly positive[7]), the project would be a worthy investment choice, given unlimited funds. These net benefits should then be divided by the project's critical costs to provide a ranking of the relative merit of the various investment alternatives.

Cardus, Fuhrer, and Thrall provide several examples in which their expected net benefits-critical costs ratio is preferred to the traditional benefit-cost ratio. They also readily admit that this evaluation method has numerous shortcomings.

Rate-of-Return

The values generated by both the net present value and the benefit-cost ratio methods depend upon the selection of the rate-of-time preference. This may be considered a deficiency because the magnitude of the discount rate significantly affects the valuation of an investment option and, yet, considerable controversy exists over the appropriate value for the discount rate. The rate-of-return method (RR) successfully circumvents this problem by establishing a rate of discount which equates the flow of benefits and costs over time. This is represented equationally by:

$$RR = r \text{ such that } \sum_{t=0}^{n} \frac{B_t - C_t}{(1+r)^t} = 0, \text{ where}$$

N = the total number of time periods

$B_t - C_t$ = net benefits occurring in time period t

r = the rate-of-return.

7 Estimated net benefits are "significantly positive" when they are great enough to assure the evaluator that their positive nature is not solely the result of possible measurement errors.

Investment options can be ranked by the magnitude of r, with an investment yielding a larger r preferred to an investment yielding a smaller r.

Table 3.4 gives the valuation of 12 investment options using the rate-of-return method. For comparison, the valuation of these investments has also been illustrated using the payback period, net present value, and benefit-cost ratio methods. Three valuations are provided for the net present value and benefit-cost ratio methods. Each reflects different assumptions concerning the rate of discount.

Investment option A provides a rate-of-return of 20 percent. In other words, the value of 0.2 for r equates the values of the cost and benefit streams over time.[8] The rates-of-return have been calculated in a similar manner for the other investment options.

The utility of the rate-of-return method is that this rate can be compared to an individual's personal rate of time preference. If the calculated rate-of-return exceeds the individual's personal rate of time preference, the investment is worthwhile.

The rate of return method does have some limitations. One relatively minor criticism of the method is that for some investments, more than one value for the discount rate will equate the values of the cost and benefit streams. This may occur when costs exceed benefits in more than one period or when an investment yields benefits which accrue over more than two periods.

SUMMARY

As the preceding discussion suggests, there are numerous mechanisms to relate costs and benefits in a cost-benefit analysis. Each has particular strengths and limitations which are summarized in this sub-section.

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[8] This is shown in the following calculation:

$$-100/(1+.2)^0 + 120/(1+.2)^1 = -100/1 + 120/1.2 = 0$$

Table 3.4
Comparison of Investment Options Using the
Rate-of-Return Evaluation Methodology

Invesment Option	Expected Net Benefits[1]				
	$B_0 - C_0$	$B_1 - C_1$	$B_2 - C_2$	$B_3 - C_3$	$B_4 - C_4$
A	$-100	$120.0	$ 0.0	$ 0.0	$ 0.0
B	-100	120.0	20.0	20.0	20.0
C	-100	50.0	50.0	0.0	0.0
D	-100	55.0	60.5	0.0	0.0
E	-100	60.0	72.0	0.0	0.0
F	-100	45.4	41.3	0.0	0.0
G	-100	25.0	25.0	25.0	25.0
H	-100	27.5	30.2	33.3	36.6
I	-100	30.0	36.0	43.2	51.8
J	-100	22.7	20.7	18.8	17.1
K	-100	72.0	60.0	0.0	0.0
L	-100	0.0	0.0	0.0	0.0

Investment Option	Payback Period	Net Present Value			Benefit-Cost Ratio[2]			Rate-of-Return
		i=0	i=.1	i=.2	i=0	i=.1	i=.2	
A	1	$20.0	$ 9.1	$ 0.0	1.2	1.1	1.0	20%
B	1	80.0	54.3	35.1	1.8	1.5	1.4	49
C	2	0.0	-13.2	-23.6	1.0	0.9	0.8	0
D	2	15.5	0.0	-12.2	1.2	1.0	0.9	10
E	2	32.0	14.0	0.0	1.3	1.1	1.0	20
F	-	-13.3	-24.6	-33.5	0.9	0.8	0.7	-10
G	4	0.0	-20.8	-35.3	1.0	0.8	0.6	0
H	4	27.7	0.0	-19.1	1.3	1.0	0.8	10
I	4	61.0	25.0	0.0	1.6	1.2	1.0	20
J	-	-20.7	-36.5	-47.6	0.8	0.6	0.5	-10
K	2	32.0	15.0	1.7	1.3	1.1	1.0	21
L	4	46.4	0.0	-29.4	1.5	1.0	0.7	10

[1]For ease of example, all costs are assumed to occur in the period of initial investment.

[2]Since there are no downstream costs in this example, the ratio created by Cardus, Fuhrer, and Thrall would be identical to the benefit-cost ratio minus one.

The simple net benefit method and the simple benefit-cost ratio method suffer because they do not account for the positive rate of time preference for most individuals. A positive rate of time preference assumes that a typical consumer prefers immediate income to the same amount of income in some future time period. If for no other reason, $100 today is preferred to $100 a year from now because money on hand can be invested in a "riskless" asset and return $100 plus interest in one year.

The payback period method is appealing because it is conceptually straightforward and analyzes the length of time an investment option takes to recover its costs. A shorter payback period is considered superior to a longer payback period. This evaluation method has two primary deficiencies. First, it fails to account for differences in total benefits which occur after the time period when costs have been recovered. Second, it will rank two investments that pay off their costs in the same time period equally, even if a considerably higher percentage of costs are returned significantly earlier in one investment.

The net present value method provides an indication of the value of an investment but it gives no indication of the efficiency of that investment. The primary limitation of this evaluation technique is that it may provide significantly different valuations of an investment depending on the rate of discount that is used.

Unlike the net present value, the benefit-cost ratio method does provide an indication of the efficiency of an investment but does not indicate the net value expected to result from an investment. Like the net present value method, this evaluation technique may produce significantly different results depending on the rate of discount used. In addition, the calculated value depends upon the treatment of negative benefits.

The rate-of-return method improves upon other evaluation criteria because its valuation is independent of the rate of time preference utilized. However, a tradeoff with this evaluation technique is that it is unable to create specific rankings of investment options for different individuals with particular rates of time preference.

In summary, there are numerous tradeoffs in the strengths and weaknesses of the various analytic techniques to relate program costs to benefits. None of the deficiencies are fatal as long as the user has an adequate understanding of the properties of the selected valuation method. Since the appeal of one method versus another is subjective, and because various methods may lead to differing results, it is logical that an evaluator employ multiple evaluation measures in a cost-benefit analysis.

The biases of the analytic approaches discussed in this section enter into a cost-benefit evaluation even before the difficulties associated with measuring the costs and benefits of a program are encountered. The measurement problems associated with performing a cost-benefit analysis of vocational education are discussed in the following two sections.

SECTION 4

GENERAL COST-BENEFIT MEASUREMENT PROBLEMS

OVERVIEW

There are measurement problems in cost-benefit analysis which affect the valuation of both costs and benefits. These include determining the appropriate measure of student units, controlling for differences in program quality, selecting appropriate comparison groups, overaggregation in data analysis, calculating an appropriate discount rate, measuring the private and social benefits of vocational education, and adjusting for the limitations in available data sources. Each of these general measurement problems is discussed in the following subsections.

MEASURING STUDENT UNITS

The relationship between inputs and outputs in vocational education cost-benefit analysis is typically expressed in per pupil units. Counting the number of students in a school district, in general, and in vocational education programs, in particular, is not as easy a task as it first appears because there are alternative measures of student counts. Selecting among these alternatives requires normative judgement.

The number of students is traditionally measured as either average daily attendance (ADA) or average daily membership (ADM). ADA is computed as the sum of each day's attendance divided by the number of school days in the year. ADM is computed as the sum of school enrollment on each school day divided by the number of school days. ADM is, therefore, larger than ADA.

Both measures of student counts are normatively defensible. Since ADA is a measure of the number of students in actual attendance, it is a truer indication of educational consumption. In addition, ADA is often included in funding formulas because it provides a fiscal incentive for schools to promote regular school attendance. ADM is justifiable because many administrative decisions, such as the number of teachers to be hired and teaching materials to be purchased, must be determined by the maximum potential number of enrollees.

The choice between ADA and ADM as a basis for student counts would be academic if attendance rates were approximately equal in all school districts. This is not the case, however. The characteristics of families that reside in a school district, the environment of the school district's community, and the size of the district are among the diverse factors that affect the level of attendance.[1]

For example, school attendance is usually greater among high income, well-educated families. This may be because these parents recognize the long-term benefits of investing in education and instill these values in their children.

Absences are often higher in urban school districts. This is partially explained by the clustering of low income and poorly educated families in urban areas. In addition, urban districts have a greater proportion of mentally and physically handicapped students who may not be able to attend school regularly.[2] Also, urban school districts are often underfunded (due in part to the greater competition for the tax dollar in heterogeneous communities) relative to their needs (which are disproportionately high due to the high cost of education in cities). As a result, many students in urban districts feel that their educational demands are not being fulfilled and fail to attend classes regularly.

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1 For a more thorough discussion of these variables, see M.T. Katzman, "Distribution and Production in a Big City Elementary System," Yale Economic Essays 8 (Spring 1968) or M.A. Shugoll, "The Productivity of Educational Revenues: A Concern in the Coming Decade," paper presented at the annual meeting of the American Education Finance Association, New Orleans, LA, 1981.

2 J.J. Callahan, W.H. Wilken, and M.T. Sillerman, Urban Schools and School Finance Reform: Promise and Reality. (Washington, DC: National Urban Coalition, 1973), p. 14.

Attendance rates in large school districts regularly fall below the rates in smaller districts, in part, because large districts tend to be urban. Educators also theorize that large schools are less successful at meeting the academic and guidance needs of individual students.

As the previous examples suggest, the calculation of the size of a school or district may vary based on whether ADA or ADM units are counted. One solution to the ADA versus ADM dilemma is to utilize both measures in the calculation of student units. Some states compute student units as the average of ADA and ADM figures.

Additional student unit measurement problems occur in special programs, such as vocational education, where students may attend programs on a part-time basis. First, there is great variation in what constitutes a vocational education program participant. In some states, any student taking one or more vocational classes is considered a program participant. In other states, the minimum number of classes used to determine a program enrollee is some number greater than one. In still other states, in order to be classified a vocational enrollee, a student must complete a logical progression of related classes designed to meet an occupational objective.

Similarly, the methods utilized to measure the level of program participation often produce inaccurate counts. Some states aggregate class enrollments to obtain total program enrollment. This severely overestimates the level of program participation since most students enroll in more than one vocational class (e.g., industrial mathematics, vocational English, and auto mechanics). For example, if a student is currently taking three different vocational classes, he/she may be counted as a program enrollee three times.

Alternatively, overall participation rates are often calculated as the sum of participation in each vocational education program area. Since certain classes may be part of more than one program area, duplicative student counts are again obtained.

The unreliability of vocational education enrollment figures is underscored by the following extreme, but not improbable, example. Assume that the number of vocational students is determined by summing program area enrollments. Further, each program area enrollment is calculated by aggregating class enrollments. If in the example used earlier, three vocational classes are jointly taken by a student and each falls into two different program areas, the same program participant could conceivably be counted six different times in enrollment figures.

One student unit measurement technique that corrects for inflated pupil counts is full-time equivalent (FTE) students. In an FTE system, vocational education program participants are determined by calculating the sum of the proportion of the school year which each student spends in vocational classes. To simplify the calculation, this proportion could be calculated at intermittent periods, rather than every day. For example, Florida calculates FTEs by sampling during one week in the fall and one week in the spring.

The advantages of the FTE measurement method are numerous. First, it minimizes the impact of students enrolled in only one vocational course on overall vocational program enrollment levels. For example, assume that a state calculates FTEs by a one week sampling procedure. In this state, if a student is taking one vocational course that meets daily for one hour, and if the school week is 25 hours long, his/her participation in the program is 5/25 or .2 of an FTE. This is far more realistic than weighting this student equally to a student taking 25 hours a week of vocational instruction.

The FTE methodology also controls for duplicate student counts resulting from calculating vocational curriculum participation by course or by program area. Only the length of time spent in vocational classes is a component of this computation. Therefore, in ordinary cases, each student cannot exceed a value of 1.0 of an FTE.

One additional advantage of the FTE measure over the other measures discussed is that it incorporates information on the duration of and exposure to vocational education. Computations based on simple classroom or program counts ignore the fact that the length and number of meetings may vary for different classes or different types of programs. Without FTE counting, it is probable that classes meeting daily and those meeting biweekly would carry the same weight in total enrollment figures, as would intensive classes running two school periods and those completed in a single period.

However, FTE is not a perfect measure of program participation when performing a cost-benefit analysis. Two limitations are particularly apparent. First, the FTE measure assumes a linear relationship between program participation and resulting benefits. It is possible, though, that as the intensity of vocational training increases, the rate of assimilation also rises. For example, assume that in a 1,000 hour school year, two students respectively take 500 hours (.50 of an FTE) and 250 hours (.25 of an FTE) of vocational classes. The former student may find that his/her greater vocational class load may result in a higher reinforcement of what is learned. Therefore, the benefits accruing to the student receiving 500 hours of vocational training may be more than twice as great as those to the 250 hour-a-year student.

A second limitation of the FTE method is that it is particularly susceptible to sampling bias. This results from its sensitivity to program duration and class exposure. For example, a vocational program may have a "life cycle" which requires the majority of courses to be taken in the first year. If a student count of program participation is taken for a particular high school class based on second year FTE enrollments, the figure would underestimate actual participation.

These criticisms of the FTE method result exclusively from its sensitivity to duration and exposure. Although this sensitivity presents some measurement limitations, FTE is usually preferable to other student unit calculations which completely disregard duration and exposure.

DIFFERENCES IN PROGRAM QUALITY

In the private sector production process, two firms may manufacture products that are identical except for differences in their quality. In order to properly compare the efficiency (defined as output per unit of input) of these two firms' production processes, the quantity of output must be adjusted to reflect the quality differences. This can be done by weighting each output by its current market price to represent the total value of the output. The contention, although not always reliable in the absence of a perfect market economy, is that higher quality output has a higher market price.[3]

A cost-benefit analysis in vocational education is analogous to an efficiency evaluation of a production process because it relates the level of inputs (costs) to the level of outputs (benefits or outcomes). Just as the quality of similar products may differ in private sector production, so may the quality of outputs of public sector services. For example, one measure of the outputs (benefits) of vocational education is the total number of hours a vocational student spends in class. As Ross and Burkhead suggest, "Certainly those hours differ in terms of what is learned."[4] An hour of instruction in one classroom is not necessarily equal in quality to an hour of instruction in a second classroom. Unlike the private sector, however, direct market prices are not available to adjust for quality differences. Rather, adjustments for quality differences must be made with proxy variables. Examples of proxy variables often used to adjust for differences in the quality of learning during classroom hours are pupil/teacher ratio, teacher experience, and teacher education.

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3 The reliability of predicting quality from price is discussed in J.E. Triplett, The Theory of Hedonic Quality Measurement and Its Use in Price Indexes (Washington, DC: Bureau of Labor and Statistics, Staff Paper No. 6, 1971).

4 J.P. Ross and J. Burkhead, Productivity in the Local Government Sector (Lexington, MA: D.C. Heath and Company, 1974), p. 36.

There are numerous limitations in utilizing proxies to adjust for differences in output quality. First, the justifications for most proxy variables are laden with assumptions. For example, pupil/teacher ratio is utilized as a quality proxy because it indicates the frequency of personal contact between student and educator. The assumption that there is a direct relationship between frequency of contact and school quality is arguable, however. Teacher experience and education are used as proxies because they are thought to measure the quality of teacher-student contact. There are many educators, however, who would argue that experience and education are not determinants of teacher quality.

A second limitation of using proxy variables to control for quality differences is that outputs often have more than one quality dimension. This is true in the example of the number of classroom hours just cited. Therefore, numerous subjective decisions must be made such as whether each proxy should be weighted equally, and if not, how should the weights be determined.

A third problem is that proxies for output quality are often measured as inputs in the production process. For example, as suggested earlier, the quality of education is said to vary with the pupil/teacher ratio, an educational input. Ross and Burkhead doubt the methodological legitimacy of using changes in input quantity as a proxy for changes in the quality of output:

> By adjusting the quality of output with proxies representing changes in the quality or quantity of both inputs and outputs, one is never sure if he has adequately adjusted for all quality changes or if he has merely double-counted.[5]

A final problem is that existing research has had difficulty consistently validating the relationship between quality proxies and educational output. The effects of these variables vary from study to study and even within the same study when multiple measures of output are used. Quality proxy variables found to be significant most often in existing research include: teacher quality measures such as experience, salary, educational

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[5] Ross and Burkhead, p. 38.

degree level, and verbal ability; frequency of teacher contact such as pupil/teacher ratio and the size of the school; quality of school facilities such as the age of the building and the number of books in the library; and expenditure per pupil.[6]

The statistical significance of the latter variable, expenditure per pupil, suggests a potential alternative approach to controlling for differences in output quality. It is theoretically probable that higher quality programs are more costly than those of lesser quality. If this assumption is correct, quality differences are apparently already controlled for on the cost side of a cost-benefit analysis. However, this is only true among school districts that face similar prices for educational goods and services. The cost of hiring good teachers, maintaining school buildings, or acquiring sites for future building construction often varies between school districts. Costs are particularly high in urban districts, for example. An additional factor undermining the previous assumption is that, as in the private sector, the efficiency of the production process is not constant between school districts. Therefore, districts with comparable levels of school revenue may not produce outputs of similar quantity or quality.

In summary, cost-benefit study teams face numerous measurement obstacles related to program quality. First, they must decide whether program quality is an appropriate concern of cost-benefit analysis or whether it is already controlled for in the calculation of program costs. If additional statistical controls are necessary, researchers have to determine whether proxy variables are a satisfactory measurement alternative. Finally, if proxy variables are to be employed, precise operational definitions must be selected from a broad range of possibilities.

DETERMINING COMPARISON GROUPS

Most cost-benefit analyses of vocational education fit into one of two categories. The majority compare the efficiency of vocational education

6 H.A. Averch, S.J. Carroll, T.S. Donaldson, H.J. Kiesling, and J. Pincus, How Effective is Schooling? A Critical Review of Research (Englewood Cliffs, NJ: Educational Technology Publications, 1974).

to academic or general education. The balance primarily contrasts the returns of alternative vocational programs. An important measurement issue that impacts the results of any cost-benefit analysis is the determination of an appropriate comparison group. The choice of comparison group may alter the assessment of whether or not, and to what degree, vocational education programs are an efficient investment alternative.

A basic consideration is selecting a comparison group similar in academic and social background to that of vocational students. This is necessary because numerous non-educational variables are thought to affect learning potential. These variables include innate ability (often measured by I.Q. scores), richness of the home environment (measured, for example, by the number of books and magazines in the home), and family background (often measured by parent's income and educational background).

The impact of non-educational variables on student learning results in a serious measurement problem for cost-benefit study teams comparing vocational education to general or academic education. In theory, selecting similar student populations allows the impact of the actual educational training on pupil benefits to be distinguished from uncontrollable environmental variables. In practice, it is often difficult for cost-benefit study teams to match vocational students with students in general or academic curricula on social background variables. This is because these environmental variables are determinants in a student's choice of curriculum. For example, students enrolled in vocational programs tend to score lower on achievement tests and come from families where parents' educational attainment is lower than parents of students enrolled in general or academic programs (although this is becoming somewhat less prevalent).[7] Therefore, researchers must utilize non-experimental methods such as regression analysis to control for non-educational impacts.

A similar issue is selecting a comparison group with comparable cost characteristics. The cost of providing education is not constant across

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[7] G. Bottoms, Executive Director of the American Vocational Association, in a statement delivered before the House Subcommittee on Elementary, Secondary, and Vocational Education, September, 1980.

school districts. Different school districts face differing prices for equivalent goods and services due to variant supply factors. As a result, some districts may have to pay more to purchase the same quantities of textbooks, teachers, or property for school sites. For example, if a school is in an isolated area, if working conditions are poor, or if the cost of living in the area is high, districts may have to pay higher salaries to attract good teachers. Differences in cost that are a function of supply conditions and, therefore, are beyond the control of a school district, need to be recognized by cost-benefit analysts. In an analysis of secondary vocational education, this problem can often be resolved by selecting a comparison group from the same school or school district as the vocational class.

There are additional concerns in selecting comparison groups that are unique to the level of vocational education under study. In measuring vocational versus non-vocational program effects on the postsecondary level, a primary issue is whether the appropriate control group is students enrolled in a non-vocational postsecondary program or students who have no formal postsecondary training. This is a critical decision because of the radical differences in the cost term that will be entered in the cost-benefit calculation. The costs of a postsecondary academic education are considerable while the cost term for students with a terminal high school degree is zero since no additional educational expenditures are incurred.

In the analysis of secondary vocational versus non-vocational education, the choice of an appropriate control group first appears to be between students in a general curriculum (which usually includes non-college bound students) and those in an academic curriculum (which includes college preparatory students). Most research suggests that if the vocational option were not available, the majority of students enrolled in that program would choose the general curriculum option. Therefore, this comparison group is often utilized in existing cost-benefit studies. Since some students would choose the academic curriculum, however, an alternative approach is to measure the sum of the costs and benefits of general and academic curricula weighted in both cases by the proportion of students who choose each option.

A confounding issue in secondary vocational cost-benefit analysis is how to treat high school dropouts. It is probable that if vocational education programs were not available, some students would assess the personal benefits of remaining in school as quite low and choose to drop out. Therefore, a third potential comparison population may be high school dropouts. Many researchers ignore this comparison group in their analyses. A superior methodology is to enter dropouts as a third component, along with general and academic curriculum students, in a weighted average of comparison group costs and benefits.

The introduction of high school dropouts as a comparison group suggests an interesting cost implication. If the provision of vocational training increases the holding power (defined as the inverse of the dropout rate) of a school district, that district must provide education for more students than it would in the absence of vocational education. If this is the case, a calculation of the costs of vocational education should theoretically include the added costs to the school district of training these additional students who, under different circumstances, would no longer be in school. Measuring this added cost is extremely difficult.

A final problem related to dropouts is how to treat leavers of vocational programs in a cost-benefit analysis. A vocational program dropout may have learned enough about an occupational skill or holding a job during his/her limited enrollment to have benefited from the program. It is difficult to resolve how and where these students should be included in an analysis of the costs and benefits of vocational education.

As the previous discussion illustrates, there are numerous measurement problems inherent in cost-benefit methodologies comparing the efficiency of vocational to non-vocational education. Some critics suggest that the methodology of contrasting the returns of vocational and non-vocational education is itself inadequate on an a priori basis. This conclusion is based on the contention that vocational and non-vocational education programs are not merely different means of achieving the same ends. Rather, the two educational approaches serve different populations and are designed to fulfill unique needs. As a result, comparing their benefit-cost ratios may produce misleading results.[8]

Cost-benefit study teams must, therefore, resolve the following dilemma: is it justifiable to compare vocational and non-vocational education or should comparisons be limited to those between alternative vocational programs? One possible compromise solution to this question is to justify the comparison of vocational programs to general or academic programs solely on the grounds of establishing a base of comparison between programs. In other words, the comparison is not intended to contrast the relative efficiencies of the programs but merely to provide a point of reference for an analysis of the returns from vocational education.

LEVEL OF AGGREGATION

If the results of cost-benefit analyses in vocational education are to be policy relevant, the problem of over-aggregation must be avoided. As indicated during the discussion of the breadth of vocational education in Section 2, vocational education has many unique components that must be examined individually. For example, the returns on vocational education are likely to differ by level of study. One should, therefore, not aggregate the impact of secondary, postsecondary, and adult vocational education programs. Similarly, within levels of vocational education, the source of education training may maintain independent effects. The impact of postsecondary vocational training, for example, will differ if the training was received at a community college, a technical institute, a proprietary school, or on the job.

The relationship between program costs and benefits may also vary by student population (e.g., economically disadvantaged, limited English speaking, handicapped), program area (e.g., agriculture, business and office occupations, trade and industrial occupations), and the length of the training process (some programs may entail a three-year series of related courses while others may be just one year in duration). All of the idiosyncrasies in vocational education should be maintained and not disguised through over-aggregation.

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[8] B. Reinhart and H. Blomgren, Cost-Benefit Analysis -- Trade and Technical Education (Final Report). (Los Angeles, CA: University of California, Division of Vocational Education, 1969).

DETERMINING APPROPRIATE DISCOUNT RATES

A typical consumer prefers immediate income to the same amount of income at some point in the future. In order to induce a consumer to forego income until a future date, a stipend must be offered. Conversely, to equate future levels of income with present values, the future income must be discounted by some amount. A discount rate equates various levels of expenditure and income to a present value.

The discount rate is comprised of two main components. The first is the rate of time preference. This describes a consumer's preference to consume today rather than in the future. The second component is a factor for inflation. This adjusts growth in annual earnings for increases in the level of prices. Use of a discount rate is essential for cost-benefit analysis in order to relate a future stream of benefits to current costs. The determination of an appropriate discount rate is crucial since the magnitude of this rate may significantly alter the outcome of the analysis. In particular, a high rate of discount favors projects where the major benefits accrue in the relatively near future.

The central measurement problem related to discount rates is determining the appropriate level of discount. The market rate of interest is often suggested as an appropriate discount rate. This rate is determined by consumers' (or at least corporations') expectations of inflation and rate of time preference. An alternative measure often proposed is the interest rate on government bonds. This rate has the advantage of reflecting the opportunity cost to the government of spending money on a particular project.

A third alternative is to use an even lower rate of discount to compensate for underestimation biases in benefits measurement resulting from the use of cross-sectional data to forecast future earnings,[9] and, the inability to measure many non-pecuniary benefits. Weisbrod effectively

[9] H. P. Miller, "Response to Burton A. Weisbrod," Measuring Benefits of Government Investments, R. Dorfman, ed. (Washington, DC: The Brookings Institution, 1965), p. 166.

counters this argument for a reduced rate of discount by pointing out that the issues of an appropriate discount rate and biases in cost and benefit estimates are separate issues and should not be confounded.[10] However, downwardly scaled discount rates are often also proposed because the alternatives, the market rate of interest and the rate for government bonds, are accused of being inflated since they are determined by the present generation. Therefore, the preferences of future generations are under-represented, skewing interest rates toward preference for current consumption rather than for consumption by future generations. Market rates of interest are further faulted for being too high because their magnitude, in part, reflects a degree of uncertainty of return. Alternatively, many feel that policymakers should use the same investment criteria (and therefore, interest rate) to evaluate potential investments as private industry.

An additional discount rate measurement problem is that different segments of the population have varying preferences for future income. This is particularly problematic in a cost-benefit analysis of vocational education because young adults (including those age groups who would typically be enrolled in vocational education) may have higher rates of time preference than the general population. This suggests that two rates of discount may be appropriate: one used in the estimation of social costs and benefits, and a higher value used to discount the costs and benefits accruing to the program enrollee.

PRIVATE AND SOCIAL COSTS AND BENEFITS

The costs and benefits of vocational education may accrue solely to the consumer of vocational education (private costs and benefits) or they may spill over to society as a whole (social costs and benefits). An example of a private benefit of vocational education is an individual's greater occupational marketability and higher earnings. An example of a social benefit of vocational training is the increased productivity of the workforce.

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10 B. A. Weisbrod, 'Preventing High School Dropouts--Concluding Statement," Measuring Benefits of Government Investments. R. Dorfman, ed. (Washington, D.C.: The Brookings Institution, 1965), p. 167.

Cost-benefit analysis may compare social costs and benefits, private costs and benefits, or both. An important measurement issue in cost-benefit analysis of vocational education is determining the proper level of analysis. This choice is significant because there are numerous instances where private and social costs and benefits diverge. For example, assume that a vocational education graduate takes a job for $10,000. Prior to enrolling in the vocational program, this individual received a transfer payment from the federal government (either unemployment compensation or welfare payments) of $4,000 annually. In this case, the private benefit of vocational training is the difference between the individual's current salary ($10,000) and past transfer payments ($4,000), which totals $6,000. However, the social benefit is the private benefit ($6,000) plus the decrease cost to taxpayers of transfer payments ($4,000), for a total of $10,000.

For most federally subsidized programs, the appropriate sphere of concern in a cost-benefit analysis appears to be the national population. This is because all taxpayers contribute to the funding of the program. Accordingly, social costs and social benefits are generally the level of comparison. In some federally subsidized programs, such as vocational education, each individual decides whether to consume the service. (In services that are pure public goods such as defense, no individual consumption choice is made.) In programs with consumer discretion, the private benefits resulting to an individual must exceed private costs to induce that individual to participate in a program. Therefore, in a cost-benefit evaluation of vocational education, calculation of both private and social costs and benefits appears to be appropriate.

The potential divergence between social benefits and costs and private benefits and costs has considerable implications for the investment of dollars in vocational education. In situations where the social benefits of a program exceed social costs, but the private benefits of program enrollees are less than private costs, a government agency has incentives to increase the size of private benefits relative to private costs. For example, if a special program yielded a positive net social benefit of $100 per program participant, then the sponsoring agency would have an incentive to pay program participants up to $100 to participate in the program.

Quantification of the spillovers resulting from vocational education is extremely difficult, although this does not make their impact on social welfare any less real. However, as Stromsdorfer suggests, the inclusion of certain intangible benefits of vocational education in a cost-benefit analysis, such as increased mobility or labor force discipline, may be redundant since these are most probably already reflected in the economic benefits of higher wages.[11]

An interesting caveat to the measurement problems of costs and benefits arises from the examination of private costs and benefits of vocational education. For a rational person to enroll in a vocational program, this person must perceive that the private benefits exceed the private costs. In a situation where a cost-benefit analysis estimates that the private costs exceed the private benefits, and yet students remain enrolled in the program, the estimated difference between private costs and benefits may be at least a partial indicator that there are significant non-measurable benefits accruing to the program enrollee. This caveat may also be extended to other actors in the vocational education governance structure (e.g., individual schools, local school systems, local communities, the state vocational education agency) who presumably support vocational education based on the assumption that the benefits achieved exceed their costs.

LIMITATIONS IN VOCATIONAL EDUCATION DATA SOURCES

Numerous sources of vocational education data are available. These sources vary in quality, comprehensiveness, and timeliness. Among those that could be used in a cost-benefit analysis of vocational education are the:

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11 E.W. Stromsdorfer, "Economic Concepts and Criteria for Investment in Vocational Education," Occupational Education--Planning and Programming. Volume Two. A. Kotz, ed. (Menlo Park, CA: Stanford Research Institute, 1967).

- National Center for Education Statistics' (NCES) Vocational Education Data System (VEDS)
- Bureau of Occupational and Adult Education's (BOAE) Statistical Reports, 1973-1978
- NCES' High School and Beyond Longitudinal Survey (1980)
- Department of Labor's (DOL) National Longitudinal Survey (1979)
- NCES' National Longitudinal Survey of the High School Class of 1972
- National Institute of Education's (NIE) Survey of Vocational Schools in Ten States (1980)
- NCES' Survey of Non-collegiate Postsecondary Students and Schools (1972-1980)
- Assistant Secretary for Planning and Evaluation's (ASPE) Survey of Vocational Education Students and Teachers (1972)
- Office of Civil Rights' (OCR) Survey of Vocational Education Schools (1979)
- Office of Education's (OE) "437 Files" (Grants and Expenditures under State Administered Programs)
- Census Bureau's Current Population Survey Supplement
- Project Talent Data Base
- NCES' Survey of Course Offerings and Enrollments (1973)
- Survey Research Center's Youth in Transition Data Base (1966).

These individual data bases, with one exception, are not reviewed in this document since such an evaluation was recently conducted by the U.S. Office of Education, Office of the Assistant Secretary for Planning and Evaluation (ASPE).[12] The exception is VEDS on which a brief discussion is included since it was recently introduced as a resource that will overcome many past reporting inaccuracies.

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12 L. Brown, R. Barnes, M. Currence, and D. Henderson, Research and Data Resources in Vocational Education: An Assessment (Washington, DC: U.S. Office of Education, Office of the Assistant Secretary for Planning and Evaluation, 1980).

The focus of this sub-section is on identifying the problems that commonly plague vocational education data collection mechanisms, and consequently, vocational education data bases. These data deficiencies are so severe that ASPE concluded in its general review of vocational education data collection resources that "Current official statistics are, at best inaccurate; at worst they are deceptive."[13] This discussion will be limited to problem identification only. For an assessment of the impact of these data deficiencies on the feasibility of conducting a national cost-benefit analysis of vocational education, the reader is referred to the companion report entitled Design of a National Cost-Benefit Study of Vocational Education at the Secondary Postsecondary, and Adult Levels: Cost-Benefit Feasibility Report.

General Limitations

There are many limitations that generally plague vocational education data bases. First, much of the data are cross-sectional without follow-up information. This is a problem for a cost-benefit study team because most vocational programs are multi-year with different levels of exposure and duration throughout the training process. Therefore, data collected on a vocational education program at one point in time may misrepresent the overall program. The actual effectiveness of multi-year programs can only be determined with longitudinal data covering the life-cycle of a program.

Cross-sectional data that excludes follow-up information also present difficulties in measuring the returns over time to vocational education. This issue is important since the benefits of vocational training, particularly in terms of personal income, are not necessarily constant. Some data bases do maintain information on vocational students for one or two years after graduation. However, even this limited longitudinal data may be deficient in accurately assessing the effectiveness of vocational education. For example, if the greater benefits of vocational education compared to general or academic education are equalized after the first few years, data bases limited to two year follow-ups will not capture this effect.

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13 Brown, Barnes, Currence, and Henderson, p. 32.

A second concern with vocational education data is the source of the data. Data on enrollment and curricula are usually provided to cost-benefit study teams by school administrators or a survey of school records. Information on employment is often provided by the students. Each of these three sources of data contains biases of which researchers must be aware. Very often data inconsistencies are a result of the varying primary sources of vocational data.

A third data problem is changes over time in standard vocational definitions. As record keeping becomes more precise and deficiencies in previous definitional processes are corrected, comparisons of annual data may become misleading. Definitional changes are most obvious in the area of program enrollment. Some of the reported increase in vocational program participation is attributable to such changes in definition.

Fourth, data are often collected only within the seven broad occupational areas described earlier. As a result, data may be available on agriculture and trade and industrial occupations. However, very little information may exist on individual training programs such as farm mechanics. The effectiveness of specific training programs within occupational areas is likely to vary. Nevertheless, the extent of the variance often cannot be determined due to the predominance of data aggregated by occupational area.

State and Sub-State Data

Education has traditionally been a shared local and state responsibility. As a result of this decentralization, great disparities in vocational education data availability, quality, and level of computerization exist both between and within states. Data incompatibility is, therefore, a potentially critical problem to cost-benefit evaluators of vocational education.

The types of data available in local education agencies (LEAs) and state education agencies (SEAs) differ sharply. For example, some LEAs and SEAs maintain comprehensive placement records by student characteristic (e.g., sex, race, ethnicity, handicapped, disadvantaged). Others maintain summary placement data that cannot be disaggregated by pupil type. Still others have no placement data on file.

Cost-benefit study teams must also overcome inconsistencies in data quality and reliability. Data quality is in part determined by the timeliness and thoroughness of information files. The quality of data suffers in some states, for example, because information is collected from a sample of school districts and then projected for the balance of the state. This approach diminishes data quality because of the idiosyncrasies in many vocational programs, such as differences in program duration and exposure.

The level of automated record keeping varies distinctly on an inter-state and intra-state basis. Many LEAs and SEAs still rely almost entirely on manual data files. Disparities in the level of computerization are important since an automated system increases the sophistication and speed with which an agency can analyze program impacts, and, of more relevance to a cost-benefit study team, facilitates the efficient tracking of a student through the educational process and into the job market. Districts utilizing manual files have difficulty tracking individual students and very often only have data readily accessible for the current school year.

Decentralization of the educational process has also led to variations in data definitions. As described earlier, this is a particular problem for cost-benefit research in terms of enrollment figures. For example, some LEAs and SEAs are more successful than others in distinguishing between program participants and class enrollees. Recording adult vocational enrollments is a second example of inter-state and intra-state definitional disparities. Some states or school districts regard all adult vocational education students as postsecondary participants. In others, an adult taking an evening vocational course in a nigh school is categorized as a secondary student.

Federal Data Sources

The fragmented process of data collection and record keeping plays havoc on federal attempts to centralize information on vocational education. The utility of many federal data bases is severely undermined by the inter- and intra-state variations in data availability, quality, and definitions. Inconsistencies on the state and sub-state level are magnified into serious incompatibilities at the national level.

Although much of the deficiency in federal data bases may be traced to their sources, some potentially problematic reporting practices by the federal government must also be discussed. First, the federal government invariably asks the states for some data types that are unavailable. Second, many states and school districts are forced to report to the federal government from files that were not designed for that purpose. A result of both of these factors is that much guesswork on the part of states and school districts is necessary to comply with federal reporting requirements. This further diminishes the utility of federal data sources. In addition, many school districts feel that the constant federal requests for data, on top of already complicated state reporting requirements, are bothersome, repetitive, and uncalled for. Therefore, numerous districts do not take the time necessary for accurate reporting. A third problem is that, despite the two preceding state reporting deficiencies and other widely acknowledged state data limitations, the federal government accepts almost all state data as reported and without challenge. Thus, there is a serious question of quality control in federal level data bases and major *a priori* limitations to using these data in cost-benefit analyses.

A new data resource which was designed to overcome many of the preceding problems is VEDS. All states are required to submit VEDS reporting forms. VEDS was introduced in a scaled-down version in 1978-79. 1979-80 represented the first year of complete reporting. The government is currently working to make the 1979-80 data available to the public.

VEDS collects information on five principal areas:

- program enrollment and completion
- number of people completing or leaving vocational programs
- assessments by employers of the technical expertise of program graduates
- teacher/staffing reports
- financial reports.

Despite the obvious contribution of providing timely annual data on vocational education, it has become apparent that VEDS does not successfully overcome the deficiencies of prior reporting efforts. First, many states do not believe there is a need for these data and feel that the system has been forced upon them by the federal government. Second, despite lengthy pages of reporting definitions and standards, there is still no standard definition of a program participant. Further, states are left to their own discretion on how to collect enrollment data. Some states collect information from a sample of LEAs and make projections for the balance of the state. Thus, there are extreme comparability problems across states on enrollment figures. Fourth, there are no data on program exposure or duration. Fifth, the federal government has provided inadequate funding and staffing to oversee the reporting process and institute quality control procedures. Sixth, the implementation of VEDS came at the expense of much political compromise which reduced, and in some cases completely eliminated, many of the innovative aspects of the system.

The use of VEDS data, perhaps supplemented with some additional primary data collection, should be considered in a national cost-benefit analysis of vocational education primarily because of their timeliness. However, as the preceding discussion indicates, these data are subject to most of the same data limitations that generally plague existing vocational education information.

SECTION 5

PROBLEMS SPECIFIC TO MEASURING VOCATIONAL EDUCATION COSTS AND BENEFITS

OVERVIEW

Measuring the specific costs and benefits of vocational education programs is subject to numerous difficulties. On the cost side these difficulties include the calculation of joint costs, capital costs, and opportunity costs. Problems in benefits measurement include measuring the investment and consumption components of vocational education, determining unbiased estimates of income differentials, conceptualizing the impact of an earnings multiplier effect, and operationalizing non-pecuniary benefits.

PROBLEMS IN MEASURING VOCATIONAL EDUCATION COSTS

The accurate measurement of vocational education costs provides numerous obstacles to potential cost-benefit study teams. The measurement problems in cost-benefit analysis specific to the cost side are discussed in the following sub-sections.

Joint Costs

Many costs in providing a vocational education program would not be incurred by a school district if it provided only general and academic curricula. One example of these program specific costs is the cost of purchasing vocational training equipment and machinery. These added costs must be computed in a cost-benefit analysis of vocational educat.on.

There are other costs, however, that are basic to an educational facility regardless of the curricula offered. Examples include construction of an auditorium, provision of a school lunch program, and installation of student lockers. These costs are called joint costs because they are commonly shared by more than one school population (for example, vocational and non-vocational students). A second type of joint cost occurs when a facility or input is used by successive student cohort groups. Most pieces of instructional equipment have a life-span of many years and, therefore, are used by students of numerous graduating classes.

It is difficult to allocate accurately the share of a joint cost that should be borne by various student populations or successive student cohort groups. In the case of multiple useage by different populations, the traditional method of allocating joint costs is to prorate total costs based on some common denominator. For example, joint costs may be allocated on the basis of the proportion of total school space used by each student population or a group's proportion of the overall school population. For the case of successive student cohorts, joint costs are often allocated by imputing an annual rental value for a facility or a piece of equipment. The calculation of this rental value is discussed in the following sub-section, "Capital Costs." Both of these methods make numerous assumptions and have serious flaws. In fact, economists and vocational educators have few satisfactory methods for coping with joint costs. Cost-benefit analysts may obtain guidance from game theorists who have made some progress in partialing out the components of joint costs.

Hu and Stromsdorfer suggest that joint costs are not a measurement problem if a school is operating at less than capacity. Under such conditions, the use of a common facility by one student does not reduce the ability of another student to use the same facility. Therefore, the marginal cost of using the facility is zero. Hu and Stromsdorfer write:

> Because efficient investment decisions between two (or more) alternatives are made on the basis of marginal costs, joint costs present no basic problem to cost-benefit analysis.[1]

1 T. Hu and E. W. Stromsdorfer, "Cost-Benefit Analysis of Vocational Education," Handbook of Vocational Education, T. Abramson, C.K. Title, and L. Cohen, eds. (Beverly Hills, CA: Sage Publications, 1979), p. 200.

Hu and Stromsdorfer's argument is apparently based on either one of two premises. First, one might assume that the facilities or equipment that result in many of the joint costs in a school were purchased with a large capital investment at one point in time. In other words, they are sunk costs. Therefore, the marginal cost of utilizing the facility or equipment for each student, after the initial student user, is zero (up until the capacity of the facility or machine is reached).

Alternatively, one might suggest that the initial cost of a facility or machine should be allocated over time. In this case, it is still possible to eliminate the potential problem of joint costs by attributing the costs solely to the student population that is the primary user of the facility or equipment. This approach may be justified because the marginal cost of additional useage by a secondary student population is zero (up until the capacity of the facility or machine is reached).

Two assumptions are arguable in Hu and Stromsdorfer's presentation. First, are the marginal costs of using a common school facility equal to zero? Second, is the use of marginal cost in cost-benefit analysis appropriate? The first of these issues is discussed below while the latter issue is treated in the following sub-section concerning capital costs.

Hu and Stromsdorfer's judgement that the marginal cost of using a common facility, such as an auditorium or cafeteria, is effectively zero is accurate if the facilities are used at less than capacity. However, many other educational inputs that are used by both vocational and non-vocational students are in limited supply. Generally, the fact that vocational students are using an educational input precludes someone else from using it. The most obvious example of this is the case of a vocational education student using a piece of machinery such as a lathe. No other student may use that lathe at the same time and, therefore, the marginal cost of use of that lathe by the vocational student is not equal to zero. True, the marginal cost of a short wait to use a lathe appears small, but for school districts facing increasing demand for vocational classes, the marginal cost of new machinery and shop facilities may be very large. Therefore, joint costs may present a basic problem to cost-benefit analysis. This problem must be addressed by cost-benefit study teams.

Capital Costs

Capital costs are the most obvious example of joint costs. This is because the capital equipment of a school may be used by numerous generations of vocational and general education students. Two approaches are generally used to allocate capital costs: marginal cost and average cost methods.

Marginal cost is the addition to total cost of a unit increase in output. An example of marginal costs might be the additional costs incurred in providing classroom space for one additional vocational student. Average cost equals total cost divided by the number of units produced or consumed. In the case of a piece of equipment, average cost would be calculated as the total cost of the equipment divided by the number of students who use the equipment.

Use of the marginal cost method to allocate capital costs is often preferred to the average cost method for it leads to efficient use of inputs. For example, in situations where a facility or input is being used at less than capacity, the marginal costs of additional students using that facility or input may be close to zero. If a school has a shop classroom that is being used only two periods each day, for instance, the marginal cost of use of the classroom by additional students during other periods in the day is effectively zero (excluding, of course, increases in costs directly attributable to the additional usage such as electricity, maintenance or clean-up). In this case, increased utilization leads to more efficient use of capital equipment since the ratio of the number of users to equipment costs increases. As long as the benefits resulting from an additional student who attends a vocational class are more than the additional costs of providing that student with instruction, efficiency can be increased and enrollment in the class should be encouraged.

Several criticisms of the use of marginal costing in cost-benefit analysis exist, however. These criticisms are also applicable to the Hu and Stromsdorfer treatment of joint costs presented in the previous sub-section. First, an evaluation of marginal cost in some ways is very subjective. For example, if one accepts the validity of treating joint costs by attributing them solely to the primary user group (in itself a subjective judgement), a normative decision must be made in determining who is the primary user. This decision is important in a cost-benefit analysis of vocational versus non-vocational education because it will determine whether these costs are included in the vocational students' or the general or academic students' cost function. This normative decision may seriously impact the findings of such a study.

A second criticism is that marginal cost methods might favor many small vocational programs as adjuncts to conventional programs, rather than a consolidated, separate vocational school which may enjoy economies of scale. That is, if vocational students are assumed to be the consumers of the excess capacity of schools and school facilities (in other words, the secondary users), marginal cost methods would suggest that the costs of providing vocational education as an adjunct to non-vocational programs is less than creating a separate vocational facility. However, this calculation may misrepresent the optimal distribution of school dollars because it ignores the potential economies of scale of having most or all vocational students in a single school.

Third, the marginal cost function of a physical asset is extremely variable. For example, assume that a piece of capital equipment may be efficiently used by up to 30 people. The marginal cost of use of that equipment by the second through thirtieth student is very low. However, the marginal cost of use of the equipment by the thirty-first (as well as the first) student is very high since it implies the purchase of a new piece of equipment.

A final limitation of the marginal cost method is that it does not reveal expected costs. Since cost-benefit analysis is seldom performed to calculate the benefits and costs of teaching a specific student, some measure of expected cost per pupil should be calculated. For all of the preceding reasons, the average cost method for allocating capital costs is often utilized in cost-benefit analysis.

Once an appropriate method of allocating capital costs per student unit has been decided upon, some measure of the cost of using capital equipment must be selected. The most obvious measure is the original cost of the capital equipment, including interest payments. However, this may tend to understate the present costs of using a facility or machine since inflation has distorted the original cost. Alternatively, replacement costs could be used, but this tends to overstate the cost of the current use of the facilities since actual replacement is not necessary. Perhaps the true market value of school space would be the most appropriate measure of the capital costs of school facilities. Since no large market for the long term leasing of school facilities currently exists, however, this value would be difficult to determine.

Opportunity Costs

Opportunity costs measure the value of using an activity's inputs for some alternative purpose. In a cost evaluation of vocational education, opportunity costs enter most prominently as the potential alternative value of the time a vocational student spends in class. This value is usually estimated by the amount of income a student would have earned had he/she been working rather than attending class (foregone income).

There are numerous methods to calculate foregone income. Since many vocational students also have part-time jobs, one technique is to project the student's potential full-time annual earnings based on his/her part-time income. Such extrapolation is likely to result in biases, however, since the hourly wage of students working part-time may be lower than the wage they would receive in a full-time position.

An alternative proxy for the foregone income of vocational students is the average earning power of individuals with similar academic and socio-economic backgrounds who have not elected to continue their education but are working. This approach also has serious biases. First, it is extremely difficult to match students and non-students on their backgrounds. As is the case with selection of types of curricula, which was discussed in Section 4 under the heading "Determining Appropriate Comparison Groups," social variables tend to be a determinant of whether an individual stays in school or drops out in order to work. Second, this figure will overestimate actual earning potential since some students enrolled in vocational programs would be unable to find jobs. Therefore, this measure of foregone income should be discounted based on the percentage of non-students in the comparison group who are currently unemployed.

PROBLEMS IN MEASURING VOCATIONAL EDUCATION BENEFITS

Accurate measurement of the benefits of vocational education is an extremely demanding task. The problems of measuring vocational benefits are discussed in the following sub-sections.

Educational Investment Versus Consumption

Education is a service that has both investment and consumption components. Part of the education process is viewed as investment-oriented because the student is investing in "human capital" with the anticipation of resulting future increases in income. The remaining part is considered consumption since the student consumes the educational process purely for immediate personal gratification. This distinction results in a measurement problem in cost-benefit analysis because the consumption component of education is not directly measurable. As a result, the total returns of education are measurable only in part, and therefore, generally underestimated.

This may be a particular problem in vocational education cost-benefit analyses comparing vocational to non-vocational programs if, as Carroll and

Ihnen suggest, vocational education is more investment oriented than general or academic education.[2] They assume that a higher percentage of course work in vocational education is occupationally related. The measurement consequence of this assumption is that the returns from general or academic education are even further underestimated in relation to vocational education. Thus, the overall comparison of costs and benefits for vocational versus general and academic education may not be comparable, since a higher proportion of the monetary benefits of the latter are unmeasurable.

Carroll and Ihnen also recognize a counterbalancing argument. Since vocational training is very specialized, a vocational student's marketability is perhaps less adaptable than that of a general or academic education student in regard to changes in market demand conditions. When this factor of job obsolescence is introduced, the proportion of a vocational education that is typically considered investment oriented should be decreased. Although, in theory, this somewhat offsets the proportional differences in the investment component of general and academic versus vocational education, the impact of job obsolescence is not easily measured.

Another consumption/investment measurement problem is how to treat non-occupational vocational students such as enrollees in special programs like consumer homemaking. In many cases, these students are enrolled purely for consumption purposes. Since consumption oriented benefits are so hard to measure, it is difficult to calculate the rate of return from these programs. Similarly, enrollees in single vocational courses (as distinguished from vocational programs) and many adult education courses are concerned only with personal consumption benefits.

A complicating factor in the preceding discussion is that although a student may take vocational classes or enroll in a vocational program for personal consumption, that action may produce monetary benefits. For example, assume a student takes a woodworking class because he/she enjoys the subject.

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[2] A. B. Carroll and L. A. Ihnen, "Costs and Returns for Two Years of Postsecondary Technical Schooling: A Pilot Study," Journal of Political Economy 75 (1967), p. 862.

If at some point this student builds a piece of furniture, the total cost of the furniture likely will be less than if it was purchased in a store. This is an often overlooked monetary (investment) benefit to a student enrolling in vocational education purely for personal satisfaction (consumption) reasons.

Income Measures

One of the principal benefits generally associated with vocational education is increased earning capability which is typically measured by comparing the incomes of a group of vocational graduates with those of a comparison group. As mentioned previously, one measurement problem for cost-benefit evaluations is that the degree of comparability between two groups may substantially influence the results. Since random selection is almost always infeasible in cost-benefit analysis, comparison of income levels for vocational and non-vocational education students may be subject to significant biases resulting from income determining factors other than education.

In order to eliminate these biases, many cost-benefit evaluators use regression analysis to estimate the effect of vocational participation on income. Regression analysis is a useful technique as long as its limitations are recognized. One limitation is that it provides information concerning correlation but not causation. Also, technical problems such as multicollinearity between independent variables may distort variable coefficients. Nonetheless, this approach is a viable mechanism to estimate vocational education's effect on students' income.

Among the additional income measurement problems faced by cost-benefit analysts is choosing between numerous potential measures of earning capability. An appropriate measure of increased earnings should account for income earned through labor rather than investments (unless investing was a subject in a vocational class). In this sense, earnings rather than income is a more appropriate measure of benefits resulting from vocational education. Earnings is also a superior measure to wage rates. This is because wage rates do not account for differences among workers in the probabilty of being unemployed. For example, a worker may have a high wage rate but the work may be seasonal and he/she may face long periods of unemployment. In this case, annual earnings is a more realistic measure of earning capability.

Forecasting earnings differentials into the future is an additional problem for cost-benefit analysis. For example, available longitudinal data may not cover a long enough period to reflect closure between the incomes of vocational students and the respective control group. Ironically, the longer the time period of the available data, the less relevant the information is to present-day vocational programs. This is because, to the extent that vocational education has changed during that time period, the information is relevent solely from a historical viewpoint. For example, longitudinal data which covers a ten year period provide information on the effects of a vocational program that is at least ten years old. Similarly, the income differentials extrapolated from cross-sectional data are indicative of past vocational programs. The biases resulting from these deficiencies are not fatal to a cost-benefit analysis, but an evaluator should be aware of their implications.

Another difficulty in determining the income benefits resulting from vocational education is that the widespread growth in vocational education participation has likely shifted the supply curve of skilled labor. Continued increases in vocational enrollment could radically alter the equilibrium supply and demand conditions for skilled labor. A similar circumstance occurred with college education. Sharply increased enrollments in postsecondary education programs are often credited with altering the supply conditions of college educated job seekers. This sharp increase in the supply of college graduates reduced their value in the demand market, thereby decreasing the measured rate of returns resulting from a college education.

An issue closely related to income measurement is the measurement of fringe benefits. Fringe benefits, e.g., health insurance, vacation time, etc., are becoming an increasingly important portion of most employment packages. The measurement problem here is primarily a lack of data. If data on fringe benefits were readily accessible, such factors as the dollar value of an employer-offered health policy and the wage earned during vacations with pay could be utilized in calculating the total value of a benefits package.

Earnings Multiplier Effect

The real increase in a person's income has economic effects greater than the net change in income experienced by the worker. With a real increase in disposable income, a consumer will typically spend a large portion of that increase. The income that is spent increases the income of another consumer who continues the chain. This chain does not continue indefinitely, however, as leakage exists in the form of savings.[3] Nonetheless, this multiplier effect can be substantial. Therefore, examination solely of income increases severely understates the full effects of vocational education on national income. However, it is extremely difficult to operationalize the impact of an earnings multiplier effect.

Non-Pecuniary Benefits

The major criticism of cost-benefit analysis regards the exclusion of non-pecuniary benefits from the cost-benefit calculation. These benefits are often excluded because no generally accepted mechanism for quantifying them currently exists. Many feel that without inclusion of non-pecuniary benefits the value of cost-benefit analysis is diminished because the non-measurable benefits resulting from vocational education dwarf the measurable benefits. Non-pecuniary benefits which are generally assumed to result from vocational education include: greater opportunities, contentment with one's educational training, higher job satisfaction, positive work attitude, employers' satisfaction with employee performance, permanence of one's job, lower likelihood of committing crimes, better citizenship, and a greater sense of well-being.

3 Increased savings also create a positive effect on national income, but in a smaller and more indirect manner.

Most non-pecuniary benefits are measurable to a degree. However, quantifying these benefits into monetary values is at best subjective. For example, how does one measure the personal benefit of job satisfaction in monetary terms? Because of this difficulty, cost-effectiveness analysis has gained favor since it does not require quantification of non-monetary benefits. Cost-effectiveness analysis evaluates the most cost-effective means to obtain a given set of goals. The trade-off in using cost-effectiveness analysis is that even if a program is the most cost-effective of a set of programs, no absolute statement of its monetary value may be inferred. Also, cost-effectiveness must rely on a subjective scale of measurement and set of goals, and subjectivity over the relative importance of each goal.

The inability to measure non-pecuniary benefits is particularly damaging in using cost-benefit analysis to evaluate government policies and programs. This is because vocational education may play an important role in reducing poverty, redistributing income, increasing inter-generational mobility, and reducing prejudice. Although the value of these variables is not exactly known, the billions of dollars the U.S. government has spent in these areas is indicative of their importance.

Proponents of cost-benefit analysis would tend to agree that exclusion of non-monetary benefits is a serious, but not fatal deficiency. Cost-benefit analysis is effective in comparing the measurable costs and benefits of programs and policies. Such an evaluation provides a useful foundation for analyses of the relative magnitudes of a program's non-measurable benefits and costs.

Cardus, Fuhrer, and Thrall provide a methodology for incorporating non-pecuniary benefits and costs into a cost-benefit framework.[4] They propose a multidimensional model measuring groupings of costs and benefits along unique dimensions. The methodology relies on successive subjective evaluations by a group of evaluators to arrive at a qualitative valuation of total non-monetary benefits. The different benefit and cost dimensions are then summed as a function of a set of parameters determined by the policymaker.

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4 D. Cardus, M. J. Fuhrer, and R. M. Thrall.

SECTION 6
CONCLUSION

Cost-benefit analysis is a complex analytical tool. It can be a meaningful technique that contributes to the policy process if properly utilized and if its limitations are recognized. However, if misused, it can potentially lead to faulty conclusions and unsound policy decisions.

The limitations of applying cost-benefit methodologies to vocational education primarily fall into three categories: analytical evaluation techniques that relate costs to benefits, methods for measuring costs and benefits, and characteristics of vocational education. For the first two categories, alternative analytical techniques and measurement methods are available to cost-benefit study teams. Each technique and method has its advantages and disadvantages. A cost-benefit evaluator must understand the strengths and weaknesses of the techniques and methods he/she employs in that they will have a serious impact on the utility of the findings.

There is no uniformly superior analytical technique or measurement method. Therefore, the selection of an analytical technique or a measurement method is quite normative. Hence, a cost-benefit study design is often enhanced by utilizing multiple techniques and methods.

Multiple measures are particularly relevant to selecting analytical approaches. This is because, as Section 3 of this paper illustrates, different analytical approaches may rank a series of investment options inconsistently. Therefore, a study design may be enhanced by utilizing both net present value and benefit-cost ratio methods, for example, rather than choosing between the techniques.

The characteristics of vocational education, the third category of limitations in applying cost-benefit methodologies to vocational education, are a problem only in terms of their breadth. Vocational education cannot be simply defined or neatly categorized. It is a complex enterprise consisting of multiple program levels, program areas, institutional settings, and student populations. One of the dangers of applying cost-benefit methodologies to vocational education is that these idiosyncrasies may be ignored. A study that makes no effort to distinguish between the diverse components of vocational education may only mask the actual relationship between program costs and benefits.

In today's political and fiscal climate of cost consciousness and limited revenues, one final note of caution must be made about cost-benefit analysis. It should not be treated as a magic formula that can conclusively allocate scarce funds among alternative programs. The methodological limitations inherent in the technique are too great to base such decisions solely on the results of a cost-benefit analysis, particularly if the alternative programs serve different purposes and have dissimilar outputs.

Cost-benefit analysis is most applicable to choosing between alternatives if the options have like purposes and outputs. For example, the methodology is useful in selecting between competitive manufacturers when purchasing a piece of hardware. It is perhaps less applicable to choosing between an education program and a health program, for example. Even a comparison of the returns of vocational education versus non-vocational education may be challenged on the grounds that the two educational approaches serve different populations and are designed to fulfill unique needs.

Nevertheless, cost-benefit analysis can contribute to educated policy making. The process of cost-benefit model building, in itself, can help to bring important policy issues to public attention. The results of a cost-benefit analysis, even if based on an imperfect model, can lead to superior decisions than those based merely on subjective judgment.

In summary, the limitations of cost-benefit analysis are far from fatal. It is a highly informative methodology that can provide significant input to the policy-making process. However, the user must at all times maintain an adequate understanding of the properties of the technique and the potential pitfalls of its misuse.