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**THE LIMITS OF COST-BENEFIT  
ANALYSIS AS A GUIDE  
TO PRIORITY-SETTING  
IN REHABILITATION**

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*Policy makers and program managers concerned with targeting resources to meet the rehabilitation needs of the nation cannot rely on the backlog of 18 cost-benefit studies to decide among alternative kinds and amounts of investment. Overly simplistic forecasting of the future earnings of rehabilitants, the insufficiencies of data concerning the benefits and costs of rehabilitation, and the extreme sensitivity of the cost-benefit model's results to its untested underlying assumptions argue against priority-setting based on intuitively appealing class-specific calculations that appear to show greater rates of return for investments in some kinds of disabled persons over others. Until substantial upgrading of the state of the art along certain recommended lines takes place, the political process looks like the only sensible and fair way to approach choice and the assertion of priorities.*

## THE LIMITS OF COST-BENEFIT ANALYSIS AS A GUIDE TO PRIORITY-SETTING IN REHABILITATION

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Sir William Petty (1623-1687) estimated, on the assumption of £7 yearly per capita income and 5% annual interest, that the 6 million Englishmen of his time had a capitalized value of £520 million. He argued the utility of this estimate for computing "the loss we have sustained by the plague, by the slaughter of men in war, and by sending them abroad into the service of foreign Princes" (quoted in Dublin and Lotka, 1946: 9). Economists since Sir William Petty, in the process of multiplying the purposes served by studies of the economic value of human life, have striven to improve both the theory of human capital and their methods of quantification.

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Applications now extend well beyond the original demonstrations of the power of nations, the costs of illness and war, or the results of migration. Courts consider the amounts of lost or reduced lifetime income when determining damages in tort actions involving death or impairment. Commercial insurance firms recommend sufficient protection to offset estimated earnings loss due to premature death or disability. Advocates of various health programs predict the savings that will accrue by prevention or postponement of death or morbidity. And educational, manpower, and rehabilitation programs are justified by assertion of increased lifetime income attributable to schooling and job training or retraining (Dublin and Lotka, 1946; Prest and Turvey, 1965; Kiker, 1966; Rice and Cooper, 1967; Hardin, 1969; Musgrave, 1969; Stromsdorfer, 1972; Klarman, 1973; Nay et al., 1973).

The Office of Management and Budget directive of 1965, which required agencies of the federal government to adopt the Planning-Programming-Budgeting System (PPBS), has given impetus to numerous applications of human capital theory in the form of cost-benefit analysis. No less than 18 cost-benefit studies of the Federal-State Rehabilitation Programs as a whole or of its component parts have been published since 1965 (Conley, 1965, 1967, 1969, 1973; Mars, 1967; U.S. Department of Health, Education and Welfare, 1969; Wright et al., 1969; Grigg et al., 1969; Michigan Department of Education, 1971; Bellante, 1971; Institute of Interdisciplinary Studies, 1972; Berkeley Planning Associates, 1973, 1975; Kakalik et al., 1974; National Analysts, 1974; Berkowitz and Anderson, 1974; Abt Associates, 1975; Bureau of Economic Research, 1975). These studies have been used primarily to win support for increased program expenditures from federal and state legislatures and budget authorities. In theory, policy makers and program managers concerned with targeting resources to meet the rehabilitation needs of the nation can rely on this backlog of studies to decide among alternative kinds and amounts of investment. Cost-benefit analysis, after all, is supposed to provide the information necessary to make economically efficient decisions, i.e., those that either maximize social welfare or limit expenditures to no more than the expected value of benefits at the time of investment.

The insufficiency of resources to satisfy every community desire makes choice necessary and forces consideration of priorities not only with respect to which persons are to be served, but also as to the kinds of R&D to be supported. This paper questions the capability of cost-benefit analysis to conclude anything about priorities in the field of rehabilitation. It concludes that the state of the art is still extremely

### THE COST-BENEFIT MODEL

Cost-benefit analysis seeks to identify investment projects or decisions that will "maximize the present value of all benefits less that of all costs, subject to specified constraints" (Prest and Turvey, 1965: 686). Expressed in the language of welfare economics, the objective is to rank alternative investments in order to select those which have potential for yielding the Pareto optimum—an improvement that makes at least one person better off and nobody worse off. In principle, all effects of a project capable of enhancing or detracting from individual well-being should be specified, measured, discounted to present value, and compared. A net social gain results if benefits exceed costs.<sup>1</sup>

The British economist Alan Williams (1974) points out the seven assumptions to which we commit ourselves when we accept the principle that services should be provided only if their benefits outweigh the costs. They are:

- (1) services can be separated from one another in a sensible way;
- (2) choice among them is possible;
- (3) outcomes associated with alternative services can be measured;
- (4) values can be placed on these outcomes;
- (5) costs of providing each service can be estimated;
- (6) costs and benefits can be weighed one against the other; and
- (7) we should cease providing those services for which the costs outweigh the benefits.

Comparison of the benefits of services with their costs requires answers to two major questions: "Who benefits?" and "Who bears the costs?" With respect to rehabilitation services, the answers reflect at least four points of view:

- (1) society as a whole;
- (2) individual rehabilitants and their families;
- (3) employers of rehabilitants; and
- (4) the government and its service providers.

Figure 1 specifies, according to analytic perspective, the benefits and costs attributable to rehabilitation.

Economists have largely adopted the societal perspective, but have been unable to document all the possible social benefits and costs of

crude, due to overly simplistic forecasting of the future earnings of rehabilitants, the insufficiencies of data concerning the benefits and costs of rehabilitation, and the extreme sensitivity of the results of the cost-benefit model to its untested underlying assumptions. This paper argues, therefore, against priority-setting by reference to intuitively appealing class-specific calculations that might appear to show greater rates of return for investments in some kinds of disabled persons over others and, a fortiori, against using these calculations as the basis for R&D planning. Finally, it recommends steps to enhance the empirical knowledge base upon which cost-benefit analysis depends for validity.

### THE REHABILITATION PROGRAM

The Federal-State Rehabilitation Program in the United States offers grants-in-aid to the states on an 80% matching basis to help them meet the costs of providing rehabilitation services to persons whose physical or mental impairments present a substantial handicap to gainful employment. Between the federal share and the contributions of the states, annual expenditures reached nearly one billion dollars in fiscal year 1976.

The program is authorized to provide a broad range of goods and services to eligible applicants: from general counseling to physical and mental restorative services, such as surgery, prosthetic and orthotic appliances, and psychiatric care; to training in vocational schools and institutions of higher education; to income maintenance and transportation while undergoing treatment; to purchase of occupational tools and licenses; to job placement and follow-up services. State agency counselors and their counterparts in agencies providing services under contract work with clients to develop an individualized plan that combines the goods and services deemed necessary for the achievement of a specific and mutually agreed upon vocational goal.

Since the Federal-State Rehabilitation Program attempts to combine the technologies of medical care, education, and the social services to achieve explicit outcomes, examination of the state of the art of cost-benefit analysis in rehabilitation and its ability to direct priorities offers insight and commentary on the state of the art with respect to human service programs in general. Characteristic of these programs are lack of consensus about the nature of the processes leading to desired outcomes and very often conflicting opinions about appropriate goals and objectives.

rehabilitation due to measurement problems and data insufficiencies. On the one hand, although aware of their possible existence, economists avoid evaluation of such possible direct benefits to the disabled as improved capacity for self-care, increased mobility, reduced pain and suffering, and increased satisfaction with life. Also not considered are the possible beneficial effects of rehabilitation on the labor force participation of other family members and on general family functioning. On the other hand, increased homemaker services and other unpaid work often receive an imputed value.

Economists, as a consequence of these measurement problems, have emphasized the impact of rehabilitation investments on the gross national product (GNP). More specifically, they define benefits as the lifetime earnings that would have been lost had not rehabilitation been provided to persons who are considered "disabled."<sup>2</sup> As such, rehabilitation benefits represent the expected increase over some lesser amount of earnings that might otherwise have occurred.

The costs of rehabilitation include not only program costs—consisting of case service expenditures, administrative and overhead costs, and so on—but also the "social" or "opportunity" costs of rehabilitation. These latter costs are defined as "the value of resources that would have been available for other uses had special services not been rendered" (Conley, 1969: 227). Estimates of social costs, in the opinion of one of the first economists to apply cost-benefit analysis to rehabilitation, are quite speculative (Conley, 1975).

### DATA AND ASSUMPTIONS

To estimate the lifetime increase in earnings attributable to rehabilitation, most cost-benefit studies have had to rely on before and after estimates of earnings without benefit of a control group against which to compare what would have actually happened if services had been withheld or had a different set of services been administered. The present value of aggregate benefits (PV) is derived by discounting by some rate of interest ( $r$ ) expected earnings (EE) occurring over time as a probability function of survival (S), employment (Em), age (A), sex (Sx), race (R), education (Ed), type of impairment (I), recurring disability (D), and average growth in the economy due to increased productivity (G). This can be expressed by the general formula:

Benefits and Costs		Analytic Perspective	
		Individuals and Families	Employers/Private Sector
A. Benefits Increases			
1. Earnings		X	
a. Net of taxes		X	
b. Taxes			X
2. Homemaker services		X	
3. Unpaid work		X	
4. Satisfaction with life		X	
5. Earnings of family members		X	
a. Net of taxes		X	
b. Taxes			X
6. Decreased medical, nursing, and custodial costs (a + b + c = 1)		aX	bX
7. Lower turnover in labor markets			cX
Society			

Figure 1: Benefits and Costs of Rehabilitation by Analytic Perspective

$$PV = \sum_{i=1}^n \frac{EE_i p(S, Em, A, Sx, R, Ed, I, D, G)}{(1+r)^i}$$

where

n = retirement age minus age at completion of rehabilitation, and

EE<sub>i</sub> = expected earnings in i<sup>th</sup> year.

The studies actually employ formulas that vary with the number and the complexity of the factors and assumptions they attempt to encompass.

Typically, five principal assumptions are combined with earnings before and after rehabilitation to forecast the future earnings of rehabilitants. One—the annual increase in earnings due to the rising productivity of the workforce—affects positively the earnings growth for each age cohort, while the rest act as depressants. The assumptions affecting the magnitude of future earnings vary considerably from study to study.

Productivity increases are sometimes ignored, but more often they are considered a fixed or variable factor. When treated as a variable factor, the studies either apply different simple rates to different segments of each cohort's expected worklife or test the effects of different compound rates over the entire span of worklife. One study (Michigan Department of Education, 1971) assumed different compound rates for earnings before and after rehabilitation. Assumptions about unemployment are either ignored, considered a fixed factor, or varied by reference to client characteristics or segment of worklife. Most studies make no assumptions about recurring disability or subsume it under unemployment. All studies except one make use of life tables from one or more sources to obtain age-related mortality rates. Most studies set the age of retirement at 65. The exceptions use either 62, 70, or a variable age dependent on the client's age at time of case closure.

Significant differences in benefit and cost concepts, discount rates, and the populations studied make direct comparison between the 18 studies and their results extremely difficult. Table 1 gives indication of these differences. The populations studied range from single to multi-year clientele of the entire Federal-State Rehabilitation Program in the United States; from programs in single states to combinations of two or more single state programs; from single special projects to combinations of several; from all cases accepted for service and both paid and unpaid outcomes to only cases with earnings at closure or with

Figure 1 (Continued)

Analytic Perspective		Benefits and Costs			
		Individuals and Families	Employers/Private Sector	Government	Society
B. Costs	1. Case service expenditures (a + b + c = 1)	aX	bX	cX	X
	2. Administrative and overhead expenses (a + b = 1)		aX	bX	X
	3. Income loss/foregone earnings during program	X			X
	a. Net of taxes b. Taxes			X	
	4. Research, training, and facility costs (a + b = 1)		aX	bX	X

TABLE I  
Study Population, Benefit and Cost Concepts, Discount Rates, and B/C Ratios

Author	Population	Benefits	Costs	Discount Rates and B/C Ratios
1. Conley (1965)	Total FSVR Program rehabilitants with earnings, FY 1959-1963 (N = 393,381)	Increased earnings by excluding homemakers and unpaid family workers	Annual federal and state VR program costs	4% 8% 13.5 - 17.1 9.5 - 12.0
2. Mars (1967)	Total FSVR Program, FY 1966 (N = 203,248)	Increased earnings of (a) rehabilitants; (b) homemakers, valued at \$1,832 mean wage for full-time maid in 1964; (c) unpaid family workers valued at \$1,990 annual wage; and (d) wage earnings of nonrehabili- tants, whose earnings at closure were known	Annual federal and state VR program costs, ex- cluding costs of R&D, training, facilities, and international program and without adjustment for foregone earnings of clients while undergoing treatment	4% 4.5 0.60 0.05
3. Conley (1967)	Total FSVR Program rehabilitants with earnings, FY 1958-1966 (N = 957,151)	Same as (1965)	Same as (1965)	4% 8% 10.9 - 14.8 7.6 - 10.4
4. Conley (1969)	Total FSVR Program rehabilitants, FY 1958- 1967 (N = 1,130,745)	Increased earnings by fiscal year of rehabili- tants, excluding home- makers and unpaid family workers	Annual federal and state VR program costs, plus 35% of estimated annual earnings of rehabili- tants at closure to reflect full social costs	0 4% 8% 7.9 - 10.9 4.8 - 6.7 3.3 - 4.7

TABLE I (Continued)

Author	Population	Benefits	Costs	Discount Rates and B/C Ratios
5. U.S. Dept. of HEW (1969)	Total FSVR Program and 19 selected groups of clients, FY 1967 (N unspecified)	Increased earnings of (a) rehabilitants; (b) home- makers, valued at (i) zero and (ii) mean earnings of employed; and (c) unpaid family workers, valued as homemakers in (b) (i) and (ii) above	(a) Direct case service costs; and (b) full costs after adjustments upward of (i) 11.6% for services paid by others and (ii) 67.8% for administration, counseling, and capital outlays	Full costs—1.97* Direct service costs and with homemakers and unpaid family workers (a) included—4.35, (b) excluded—3.58 *Strictly speaking, not a B/C ratio but ratio of earnings at closure to costs, without a forecast of what the value of these earnings might become if they continue into the future under usual B/C assumptions
6. Wright et al. (1969)	Rehabilitants of Wisconsin DVR Demon- stration Project, Wood and Eau Claire Counties, July 1, 1966-June 30, 1968 (N = 988)	Increased earnings of (a) rehabilitants; (b) homemakers, valued at \$1,832 mean wage for full-time maid in 1964; and (c) unpaid family workers, valued at \$2,883 annual wage	Case service expenditure by disability, plus esti- mated share of (a) 18% administrative overhead and counselor salaries and (b) costs of program dropouts	4% 23.38 33.48 40.60 17.93 69.51 —
7. Grigg et al. (1969)	Rehabilitants of special VR/PA demonstration projects in 13 states and the District of Columbia, 1963-1967 (N = 1,100)	Increased earnings of rehabilitants, excluding homemakers and persons for whom information on PA expenditures and earnings at closure was lacking, estimated for 72 client groups via regres- sion analysis	Case service expendi- tures, including mainte- nance (health care, living expenses, and transporta- tion) during the life of the project, allocated to 72 client groups via regression against age, sex, race, education, disability type, PA type, and presence of spouse	10% 7.56 - 69.94

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[355]

TABLE I (Continued)

Author	Population	Benefits	Costs	Discount Rates and B/C Ratios
10. Institute for Interdisciplinary Studies (1972)	Minnesota DVR—all closed cases (N = 6,097) and West Virginia DVR-rehabilitants only (N = 6,570), FY 1970	Separate and combined earnings of 56 groups of rehabilitants, defined by disability type, age, and sex, and (b) benefits to the government, resulting from (i) total increase in tax revenues, assumed as twice that of income tax payments alone and (ii) reduced P/A payments	Case service expenditures, plus multiplier reflecting administrative and counseling costs, (b) service costs for nonrehabilitants; (c) proportion of costs for recent and future rehabilitants contained in annual program costs	-2.56 - 5.11 3%
11. Conley (1973)	Age by sex by retardation level profiles derived from a variety of sources, FY 1970 (N unspecified)	Lifetime earnings for all continuously employed retardates, excluding homemakers, adjusted downward by (a) 20% to reflect expected unemployment after rehabilitation and (b) 50% of remainder to represent earnings portion attributable to VR services	Case service expenditures, plus (a) estimated share of administration and counseling and (b) 50% increase for (i) "repeaters," (ii) costs of services provided by other agencies, (iii) earnings forgone while undergoing rehabilitation, and (iv) prior research, training, and facility expenditures	14.2 - 10.7 8.3 - 5.7 2.2 - 1.7 1.3 - 0.9 Male Female Mild (IQ 50-69) Moderate (IQ 40-49) Male Female

TABLE I (Continued)

Author	Population	Benefits	Costs	Discount Rates and B/C Ratios
8. Michigan Dept. of Education (1971)	Michigan DVR rehabilitants, FY 1969, two years after case closure (N = 417)	Increased earnings of (a) family workers, valued at 0 to \$40 per week, plus decrease in economic dependency (P/A payments), minus an adjustment for the value of earnings forgone while undergoing treatment	Case service costs for 5 types of rehabilitants, plus estimated share of expenditures for family workers, valued at \$1.25/hr. for 20 hour work week—otherwise, at same rate for 40 hours; and (c) unpaid family workers valued at \$1.25 per hour for 40 hour work week. Benefits estimated via regression analysis for combinations of 10 variables	22.88 2.98 2.69 30.43 3.53 18.07 2.43 39.34 4.57 1.17 — 6% Physically Disabled Mentally III Mentally Retarded Public Assistance Workers' Compensation Homemakers & Unpaid Family Workers Productivity
9. Bellante (1971)	Florida DVR clients accepted for services, FY 1969 (N = 13,888)	Increased earnings of (a) rehabilitants, (b) homemakers valued, if single and without dependents at \$1.25/hr. for 20 hour work week—otherwise, at same rate for 40 hours; and (c) unpaid family workers valued at \$1.25 per hour for 40 hour work week. Benefits estimated via regression analysis for combinations of 10 variables	Case service expenditures, plus estimated share of administrative and counseling costs, allocated via regression analysis for combinations of 10 variables	0 3% 20.02 31.68 9.69 13.08 4% 10% Productivity

TABLE I (Continued)

Author	Population	Benefits	Costs	Discount Rates and B/C Ratios
14. Berkowitz & Anderson (1974)	Perth Ambroy Diagnostic and Employment Center (PADEC), Aug. 1971- July 1973 (N = 671, linear forecasting model; N = 645, curvilinear model)	Increased earnings of rehabilitants, excluding homemakers and unpaid family workers, estimated alternatively on basis of (a) wages at time of application (E <sub>1</sub> ), (b) employment and wage experience of prior year (E <sub>2</sub> ), and (c) wage experience of prior year with prior years' unemployment rate applied to earnings after rehabilitation in projections of future earnings (E <sub>3</sub> )	Case service expenditures, plus (a) administrative and counseling costs, (b) research and evaluation expenses, and (c) forgone earnings of clients while undergoing rehabilitation, allocated to specific groups according to resource use —(i) hours of counseling, (ii) average weeks active at PADEC, and (iii) average cost per case and percentage of cases in each group	Model with 6% Discount Benefit Definition E <sub>1</sub> 88 E <sub>2</sub> 16 E <sub>3</sub> 3 Linear Curvilinear *4%, 8%, 10% also computed

TABLE I (Continued)

Author	Population	Benefits	Costs	Discount Rates and B/C Ratios
12. Berkeley Planning Associates (1973)	Washington DVR rehabilitants, FY 1972 (N = 2,805)	Earnings increase, adjusted downward by 10% to reflect displacement of nondisabled from jobs in high unemployment economy of Washington, of (a) rehabilitants, and (b) output of homemakers and unpaid family workers, estimated as the ratio of unpaid to paid work in sample multiplied by average increase in paid work	Case service expenditures, plus estimated share of 7 disability groups in costs of (a) administration and counseling, (b) repeaters, (c) services provided by other agencies, (d) earnings forgone while undergoing rehabilitation, (e) prior research and training, minus (i) carryover costs and (ii) maintenance payments	4% 6.2 - 21.1 7% 4.3 - 14.8 10% 3.3 - 11.3
13. National Analysis (1974)	Sample of DVR clients in California, Georgia, Illinois, New Hampshire, and Pennsylvania, FY 1967-1969 (N = 3,437)	Increased earnings for 10 age by sex groups of rehabilitants, excluding homemakers and unpaid family workers	Average expenditures per case incurred under Sections 2 and 3 of the VR Act and the Social Security Trust Fund, plus portion of indirect costs proportionate to direct costs	4% 9.8 8% 7.1 Overall Males 4 - 17.1 Females 6 - 14.9 Under 18-60+ Age Range .3 - 11.4 .5 - 10.6





certain kinds of disability; and from universes of clients to samples followed up over varying time periods. One study (Conley, 1973) eschews analysis of any particular data base and instead derives client profiles from a variety of sources.

Benefit and cost concepts vary considerably in scope and operational definition. Some studies restrict the concept of benefit to paid work; others include the increased value of homemaker and unpaid work activities. The lack of consensus about the value of homemaker activity or how to go about measuring it is reflected, not unexpectedly, in diverse methods for estimating this outcome. Imputed values typically flow from an external reference point, such as the wage paid to a full-time maid, or from analysis within the study population of the relationship between paid and unpaid work. Last, important variations are found in the operational definition of "earnings before rehabilitation," which influences the magnitude of the difference between "before" and "after" earnings and, hence, the inferred earnings increase due to rehabilitation. Wide variations in resultant benefit-cost ratios occur when "earnings before rehabilitation" is operationalized as the earnings during the week prior or at time of acceptance for services rather than as those of the full prior year.

The 18 studies are also distinguishable by whether or not the concept of social costs is applied and how it is operationalized. Only half of the 18 studies make upward adjustments to reflect the full social costs of rehabilitation. Among these, the most generous assumption about full social costs is made by Conley (1969), who increases total annual program costs of the national Federal-State Rehabilitation Program by 42% and adds 35% of estimated annual earnings at closure to represent the earnings foregone by rehabilitants while undergoing treatment. Last, the studies that undertake class-specific calculations vary on the basis of the methods they employ to estimate and allocate administrative, counseling, and certain other indirect costs to different kinds of clients. With but one exception, they all assume proportionality between direct case service expenditures and the rest of program costs.

All studies except one discount the future benefits expected to result from investments in rehabilitation to their present value in order to show the opportunity costs of making the investment. Conceivably, government funds invested in rehabilitation could produce a higher return in some alternative use in either the private or public sector. Of course, one major rationale for government investment is to foster beneficial activities whose attraction is not sufficient, for a variety of reasons, to draw private resources away from more profitable uses

TABLE I (Continued)

Author	Population	Benefits	Costs	Discount Rates and B/C Ratios
18. Bureau of Economic Research (1975)	Random sample of FSVR Program closures FY 1970 (N = 3,743 rehabilitants; 1,063 unsuccessful closures)	Increased lifetime earnings of male rehabilitants, including unpaid family workers but not homemakers, valued at mean wage of their stratified cohort; benefits estimated via regression analysis for combinations of 10 variables, following Bellante (1971). Usual adjustments for income transfers, repeaters, carryovers, client opportunity costs, and research and training are omitted on the grounds that severe assumptions concerning benefits obviate need for them	Case service expenditures, plus estimated share of linear and curvilinear projection techniques and combinations of assumptions about productivity and discount rates (4%, 8%, 10%), range from -7.57 (non-white mental retardate, aged 54 or more) to +49.9 (non-white, mental retardate, aged 35-44)	

(Musgrave and Musgrave, 1973). The proper choice of the social discount rate is important, nonetheless, because it is believed to influence the balance of investment between the public and private sectors with attendant effects on immediate and future consumption (Feldstein, 1964a). Controversy surrounds this issue and centers on whether or not observable private sector interest rates are appropriate for discounting the net benefits of social investments (favoring private rates, see Hirschleifer, 1966; Nichols, 1969; Seagraves, 1970; opposed, see Marglin, 1963; Sen, 1961; Feldstein, 1964b; Mishan, 1967). Pertinent economic theory and procedures for estimating both the private opportunity cost of capital and the rate of social time preference are still quite rudimentary (Lurito and Dinkelacker, 1971). In any event, the 18 studies under discussion apply discount rates, ranging from 0 to 13%, and, more often than not, test the sensitivity of their results to alternative rates. Regardless of the rationale for its selection and the pitfalls associated with its use, the discount rate chosen tends to dominate: the higher the rate, the lower the present value of future benefits and resultant benefit-cost ratios.

### SENSITIVITY OF THE MODEL

In view of these widely differing approaches, one naturally wonders how sensitive the cost-benefit model is to its assumptions. Moreover, are the data undergirding the assumptions sufficiently robust to support inferences about specific kinds of rehabilitants? When all factors influencing an outcome but one are held constant, the effects on the outcome of the one allowed to vary can be estimated. This basic scientific paradigm for causal inference can be applied, in the absence of hard data, to cost-benefit and other simulation models by trying alternative values for one parameter at a time while holding the rest constant in order to test the sensitivity of the model to its assumptions. Table 2 displays the results of the sensitivity analyses undertaken by several of the studies.

The cost-benefit model is quite sensitive to each of its principal assumptions. A 3% increase in assumed productivity can inflate by 50% the resultant benefit-cost ratios. One-half of 1% increase in assumed unemployment can produce a downward shift of 5%. Alternatively, assuming 20% greater unemployment five years after case closure can diminish the ratio by as much as 50% or as little as 25%, depending on whether a high or low baseline is used for comparison.

TABLE 2  
Sensitivity of B/C Ratios to Varied Assumptions

<i>Assumption and Study</i>	<i>Values/Definitions</i>	<i>Resultant B/C Ratios</i>	<i>Percent Difference</i>
<b>A. Productivity Increase</b>			
Averous et al. (1971)	-1.5% vs. 2.5% for both "before" and "after" earnings	7.11 - 10.21	+44
Bellante (1971)	0 vs. 3%	20.02 - 31.68	+58
<b>B. Employment</b>			
Averous et al. (1971)	Rate of Decline: 0.5%	8.07 - 7.63	-5
Kakaik et al. (1974)	Rate at 5 years: 80% vs. 60% 60% vs. 40% 40% vs. 20%	10.80 - 8.10 8.10 - 5.40 5.40 - 2.70	-25 -33 -50
Berkeley Planning Associates (1975)	Rate at 5 years: 80% vs. 60%	9.14 - 6.84	-25
<b>C. Mortality</b>			
Averous et al. (1971)	Railroad Retirement disability annuitants (high) vs. U.S. population (low)	7.16 - 9.12	+27
Berkeley Planning Associates (1975)	Railroad Retirement disability annuitants vs. Society of Actuaries estimate	9.14 - 12.40	+36
<b>D. Definition of "earnings before rehabilitation"</b>			
Averous et al. (1971)	\$900 vs. \$1,800	12.01 - 8.77	-27
Berkowitz and Anderson (1974)	Earnings at application (E-1) vs. prior year (E-2)	53.00 - 16.00	-70
Conley (1969)	Earnings for week vs. year prior to acceptance (1964)	16.50 - 12.20	-26
<b>E. Definition of Cost</b>			
Conley (1969)	Program vs. Social (1958)	14.20 - 6.60	-54

"rehabilitated" would have, without services, averaged the federal minimum wage can diminish the ratio by 27% to 58%—again depending on the baseline used for comparison.

Thus, concatenation of overly optimistic or overly pessimistic assumptions can easily give rise to very high or very low benefit-cost ratios. The sensitivity of the cost-benefit model to its assumptions makes clear how critically important it is to have valid information about the long-term impact of rehabilitation on the labor market experience of different kinds of disabled persons. If small changes in assumptions amplify to such large effects on overall benefit-cost ratios, how much more sensitive must be class-specific ratios?

Let us consider the empirical foundations for a couple of the assumptions in order to illustrate the point. First, economists assume that continued technological progress will lead to real economic growth and increased earnings for the general work force. Even occupations without much capacity for higher productivity, such as teaching and hair-styling, are thought to share in the productivity gains of the rest of the economy, because, to keep workers in these occupations, more must be paid for their services by the rest of society. And while this is true on the average, wage growth is likely to be uneven among specific classes of workers and dependent on both worker characteristics and local and institutional demand conditions. For this reason, valid class-specific cost-benefit calculations will have to be sensitive to the factors that predict wage changes among low wage earners. For, as shown in Table 3, the vast majority of rehabilitants at case closure fall into the lower end of the wage continuum.

Data from the OEO Panel Study of Income Dynamics, which show the wage change patterns that apply to male head versus wives and female heads of household at different wage levels in the general population, tend to support this conclusion. For the period covered, 1967-1971, the GNP grew an average of 8% per year. Roughly 5% of it was due to inflation, and 3% to real growth (Morgan et al., 1974). As indicated in Table 4, significantly more low wage earners experienced a decline in wages or failed to keep up with inflation than did medium to high wage earners. Moreover, behind the profiles for high and low earning males and females lie differently ordered combinations of worker characteristics and local and institutional demand conditions that predict wage changes within each group. Local and institutional demand conditions, for example, are among the four best predictors of wage change for low-earning wives and female heads of households but are much less influential for low-earning male heads.

TABLE 2 (Continued)

Assumption and Study	Values/Definitions	Resultant B/C Ratios	Percent Difference
Berkeley Planning Associates (1973)	Program vs. Social	23.70 - 15.50	-35
Abt Associates (1975)	Program vs. Social	14.40 - 10.70	-26
F. Definition of Output			
Averous et al. (1971)	Ratio of value of unpaid to paid work—25% vs. 75%	6.56 - 7.55	+15
U.S. Dept. of HEW (1969)	Unpaid work excluded vs. included	3.58 - 4.35	+22
Abt Associates (1975)	Unpaid work excluded vs. included	9.90 - 10.70	+8
G. Discount Rate			
Averous et al. (1971)	0% vs. 4%	19.60 - 11.66	-41
	4% vs. 8%	11.66 - 8.07	-31
	8% vs. 12%	8.07 - 6.15	-24
Berkeley Planning Associates (1975)	0% vs. 4%	43.30 - 21.08	-51
	4% vs. 7%	21.08 - 14.12	-33
	7% vs. 10%	14.12 - 10.34	-27
	10% vs. 13%	10.34 - 8.08	-22
H. Employment Without VR Services			
Kakalik et al. (1974)	Employed without VR at average of the Federal minimum wage—		
	25% vs. 50%	9.40 - 6.90	-27
	50% vs. 75%	6.90 - 4.30	-38
	75% vs. 100%	4.30 - 1.80	-58

Lower mortality rates can give rise to ratios 27% to 36% greater than what higher rates would yield. Using a longer versus shorter accounting period to define "earnings before rehabilitation" can reduce ratios by 26% to 70%. Inflating program costs to reflect full social costs—depending on the size of the adjustment—can lower resultant ratios by 26% to 54%. Including unpaid work and/or varying its values relative to that of paid work can increase ratios by 8% to 22%. A discount rate of 13% can yield a benefit-cost ratio 62% less than would a rate of 4%. Last, varying by 25% the assumption of how many persons declared

**TABLE 3**  
Wages\* at Closure for Rehabilitants Reporting Earnings,  
FY 1970 (N = 3,058)

Wage	Males	Females
≤\$3.00	75.0%	91.5%
3.01 - 4.25	16.8%	6.1%
4.26 +	7.7%	1.4%
Missing Data	0.5%	1.0%
Total	100.0%	100.0%

SOURCE: Special tabulation by Ohio State University of 10,000 random sample of all FY 1970 closures in the R-300 statistical reporting system of the Rehabilitation Services Administration, Department of Health, Education and Welfare.  
\*Assuming 35 hour average work week.

Second, the empirical foundation for allocating administrative, counseling, and other indirect costs to specific classes of rehabilitants is extremely weak. Every study except one had to make use of available case-by-case reported expenditures for purchased goods and services under the assumption of proportionality between these and administrative, counseling, and other indirect costs because of the lack of full information about resource use on behalf of individual clients. Biasing of cost allocations thus becomes a real danger. Purchased services can be substituted for those that the rehabilitation agency might otherwise provide directly. There may even be an inverse relationship between counseling time and effort on behalf of clients for whom orthotic and prosthetic devices and/or other goods and services are purchased and their vouchered value.

The one study that, in addition to expenditures for purchased goods and services, had individualized data on case counseling and facility use illustrates the other kind of distortion that can occur. Berkowitz and Anderson (1974) isolate a class of clientele ready for job placement. They require no counseling and very little beyond referral. The class-specific benefit-cost ratio for this kind of rehabilitant was 11:1 in contrast to 3.6:1 for the rest. Pooling employment-ready clients with others to form additional classes for evaluation clearly inflates the ratios for these classes. If employment-ready clients are excluded, how much lower would the overall and class-specific ratios appear?

But just as critical as the availability of appropriately disaggregated data is its quality. There is evidence to suggest that reported statistics and their underlying sources are insufficiently reliable to support class-specific cost-benefit calculations. Unverified and incomplete

**TABLE 4**  
Changes in Wage Rates by Level of Wage Rates in 1969—Male Heads versus Wives and Female Heads of Households

Change	Low Wage Rate (< \$3.00)	Medium to High Wage Rate (> \$3.00)	Wives and Female Heads	Male Heads	Wives and Female Heads	Male Heads
Decreased	19.6%	13.9%	11.7%	19.4%	22.6%	4.8%
Increased by less than inflation (0%-4%)	20.7%	24.5%	19.4%	20.7%	22.6%	22.6%
Average increase (5%-9%)	19.6%	22.3%	33.9%	19.6%	38.6%	38.6%
Greater than average increase (10%-14%)	17.7%	22.1%	21.5%	17.7%	20.6%	20.6%
Substantial increase (15% or more)	22.4%	17.2%	13.5%	22.4%	13.3%	13.3%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Average annual percentage change	7.6%	7.8%	7.7%	7.6%	8.3%	8.3%

SOURCE: Adapted from Morgan et al. (1974: 156, 162).

TABLE 5

Differences in Mean Case Service Expenditures in Rehabilitant Records Containing Usable Versus 1% or Greater Amounts of Missing Data on Key Variables, FY 1970 (N = 4,806)

Variable	Mean expenditure in records with usable data	Mean expenditure in records with missing data
Race	\$564	\$655
Education	\$558	\$919
Public assistance status	\$560	\$1,017
Number of dependents	\$561	\$776
Secondary disabling condition	\$578	\$403

SOURCE: Special analysis by Ohio State University of 10,000 random sample of all FY 1970 closures in the R-300 statistical reporting system of the Rehabilitation Services Administration, Department of Health, Education and Welfare.

records are a special hazard. Indicative of the possible size of the problem is the recent disclosure of the inability of the Social Security Administration to verify more than 58.8% of state rehabilitation agency reports of 68,000 Disability Insurance beneficiary rehabilitants in fiscal years 1967-1974 (Treitel, 1975).<sup>3</sup>

Incomplete records in the computerized files of the federal agency responsible for generating official statistics for the Federal-State Rehabilitation Program can create significant biases. Discarding unusable records in preparation of class-specific profiles reduced the official count of rehabilitants by 23% in a year when the quality of records was relatively good (Bureau of Economic Research, 1975). This, plus prima facie evidence of large biasing effects due to missing data on variables used by several investigators to make class-specific calculations, argues against the acceptance of such calculations as the basis for priority-setting.<sup>4</sup> Tables 5 and 6 indicate the extent to which bias can arise from missing data on certain key variables.

This leaves a final issue concerned with causal inference. We have observed how sensitive the cost-benefit model is to the definition and values given to "earnings before rehabilitation." In view of this, it is highly unsatisfactory to estimate what would have happened without services on the basis of earnings reported for some period prior to application without comparison to a control group. "Creaming," "quotas," and "headcounting" in the Federal-State Rehabilitation Program offer a very plausible rival explanation for differences in earnings observed before and after rehabilitation.<sup>5</sup> These practices appear to promote systematic overstatement of program effects.

TABLE 6

Rehabilitant Records Containing Usable versus 1% or Greater Amounts of Missing Data on Key Variables, FY 1970

Sources of variation	Degrees of freedom	Between groups mean squares	Within group mean squares	F
Race	1	500,736	836,100	0.60
Education	1	12,392,192	833,639	14.87**
Public assistance status	1	11,333,120	833,846	13.58**
Number of dependents	1	4,499,712	835,270	5.39*
Secondary disabling conditions	1	9,579,952	834,244	11.51**
Within groups	4804			
Total	4805			

SOURCE: Special analysis by Ohio State University of 10,000 random sample of all FY 1970 closures in the R-300 statistical reporting system of the Rehabilitation Services Administration, Department of Health, Education and Welfare.

\*p < .02.  
\*\*p < .001.

When unrealistic quotas force counselors to seek out the "easiest" cases, such as the employment-ready persons described in the Berkowitz-Anderson (1974) study, is it not questionable to credit the counselor and his agency fully for the job placement and the stream of earnings that ensues? To the extent that the easiest cases are persons for whom "spontaneous remission" and the general processes of healing lead to renewed work activities, is it not reasonable to ask whether the services were actually needed? And to the extent that the easiest cases are discernible and sought out to make the record look good, what is the wisdom of spending scarce resources for this purpose? Only a valid control group will reveal how much of a difference provision of services actually makes.<sup>6</sup>

### IMPLICATIONS AND RECOMMENDATIONS

Beyond these considerations lies the more worrisome issue—should economists, laboring under the burden of the contaminated and "noisy" program data that now exist, undertake class-specific cost-benefit

scientists. Ideally, R&D should be directed toward populations and problems wherein the current rehabilitation investment is yielding negative or low rates of return. The goal of technological innovation should be to improve the rate of return. Recourse to the political process, however, as the means of overcoming the knowledge/choice dilemma may not be the most auspicious way to go. Other alternatives are: consumer choice, scientist opinion, administrative fiat, or some combination of these.<sup>7</sup> Except, perhaps, for consumer choice, some amount of politicking inevitably enters into each approach and thereby compromises the more preferable decision-making criteria of objectivity and scientific expertise.

My own bias is toward the kind of peer review of scientist opinion that goes beyond review of project proposals and appraisal of progress to assessment of final research products in terms of their scientific worth and practical utility to consumers and practitioners (Noble, 1974). If the results of such end-product reviews are made conspicuous through publication, interested parties—consumers, practitioners, scientists, program administrators, and legislators—can decide for themselves how much to rely on specific research findings and/or new technologies for their own purposes. While not by any means flawless, in the long run peer review appears superior to reliance on consumer choice, administrative fiat, or legislative politics as a guide to setting R&D priorities. If carefully managed and subjected to public monitoring, peer review can optimize on objectivity and scientific expertise and minimize potentially counterproductive special interest pleadings.

The state of the art needs substantial upgrading before cost-benefit analysis can be taken seriously as a guide to priority setting in the field of rehabilitation. To this end, I make the following recommendations.

First, there is need for research to create better instruments for measuring the full range of benefits that may flow from rehabilitation, including homemaker and other unpaid outputs, reduction of functional limitations in activities of daily living, and improved social and psychological well-being.

Second, there is need to improve cost-accounting data—most notably with respect to counselors' use of time on behalf of specific kinds of clients. The Berkowitz-Anderson (1974) cost-benefit study comes closest to what is desired. Rehabilitation agency administrators and counselors may resist on the grounds that it takes time away from services to clients, but no real progress is possible without a breakthrough here.

Third, the entire statistical reporting system, upon which cost-benefit analysis of the Federal-State Rehabilitation Program has

analyses? I think not, and for two reasons. First, they are likely to mesmerize themselves into believing their results, and, second, there is grave risk that policy makers might believe the believers and set priorities based on misleading evidence. Until welfare, social insurance, and compensation programs provide income to the disabled more nearly commensurate with what they might have received had they been able to work, curtailing rehabilitation opportunities on the basis of presently realizable knowledge about the benefits and costs of services to specific kinds of people may lead to gross inequities.

How, then, are we to proceed? The insufficiency of resources forces choice and assertion of priorities. Yet the knowledge base is too weak to justify decisions. Until the requisite knowledge becomes available, the political process appears to allow one means of escape from the dilemma. The Congress, by virtue of the Rehabilitation Act of 1973 (P.L. 93-112) and Amendments of 1974 (P.L. 93-516), has placed priority on serving the severely disabled.

The legislation, *inter alia*, requires early determination of eligibility for services, individualized written programs of services to be provided, detailed records for evaluation of persons declared ineligible and the reasons for the decision, and continual statewide studies of the needs of the disabled, including review of the efficacy of the criteria used for selection/rejection. It also requires that the determination of ineligibility be made only after full efforts to develop a vocational goal have failed and the rehabilitation counselor has certified that the applicant is incapable beyond a reasonable doubt of achieving such a goal.

Thus, the intent of the legislation is for improved economic analysis of rehabilitation benefits and costs—for what, after all, can justify withholding of services but knowledge that their costs outweigh their benefits? Indeed, equitable resolution of the litigation that may someday arise over certification of incapacity to achieve a vocational goal could well depend on more adequate evidence than is now available concerning the benefits of rehabilitation for specific kinds of people. If certification of incapacity established a rebuttable presumption of eligibility for income maintenance under Social Security Disability Insurance or the Supplementary Security Income Program, the potential dollar drain on these funds might accentuate the urgency of the need for better information. Unfortunately, a rebuttable presumption or other such policy-coordinating mechanism does not exist, and rejected applicants are left to fend for themselves (Nagi, 1969).

In the case of R&D planning, the lack of reliable knowledge about rehabilitation benefits and costs presents special hazards for applied

depended for validity, stands in need of quality assurance. The quality of data strains the credibility of class-specific cost-benefit calculations.

Fourth, there is need for study of the values that individuals and families place on the potential range of rehabilitation benefits. Such study would help us to understand how to translate into monetary units observed changes in homemaker and other unpaid work outputs and in activities-of-daily-living (ADL) functioning. This might make it possible to combine both market and nonmarket measures of benefits into a single global measure that could be compared to costs.

Fifth, better mortality information is needed. Conceivably, the federal government could develop standardized life tables for all ten of its disability transfer payment programs.<sup>8</sup>

Sixth, there is need for a national panel study of disability, paralleling the OEO Panel Study of Income Dynamics. Although expensive, I see no other feasible alternative for obtaining the longitudinal data needed to test the critical assumptions of cost-benefit analysis concerning the labor market experiences of different kinds of disabled persons.

Seventh, there is great need for controlled studies of the comparative benefits and costs of rehabilitation. The Rehabilitation Amendments of 1974, by placing priority on services to the severely disabled, imply that the "creaming" of the easiest cases is no longer acceptable practice within the Federal-State Rehabilitation Program. To the extent that resources for a given fiscal year are insufficient to serve everybody, it seems ethical to propose comparison over relatively short time periods of outcomes for immediately accepted versus delayed clients. With assurance that services will eventually be provided, applicants might consent to being randomly selected from the queue and accept delays of more than one year. It may also be possible by means of experiment to study how consumers would value certain rehabilitation outcomes if given predetermined amounts of money or their equivalent in vouchers to spend as they see fit. Consumer willingness to pay, while an imperfect guide to how much society ought to spend for rehabilitation, would at least identify for policy makers the minimum amount and its preferred uses (Fromm, 1966).

Last, it might be strategic for the Federal-State Rehabilitation Program to deemphasize competitive work as its principal objective. An economy with an oversupply of qualified workers places competitive work beyond the reach of many handicapped persons whose need for assistance in achieving improvement in other areas of functioning is a legitimate goal for government action. To the extent that the program maintains too narrow a vocational orientation, the basis for

its constituency support may erode: increasing numbers of handicapped persons will appear incapable of achieving a vocational objective. And, as the value of wages at case closure fails to offset the work disincentives of higher income and medical coverage available through the Social Security Disability Insurance and Supplemental Security Income programs, legislative and budget authorities may begin to question the wisdom of spending additional sums for vocational rehabilitation (General Accounting Office, 1976). In consequence, medical rehabilitationists, caught in the fiscal squeeze yet unable to jettison responsibilities for persons incapable of achieving vocational objectives, may have to turn to other legislative authorities for support both of their service activities and of R&D needs.

New legislation will be required if pursuit of nonvocational objectives is to be made an explicit and legitimate goal of the Federal-State Rehabilitation Program. Resistance to such change appears likely in face of traditional understandings of the productive consequences of vocational rehabilitation. Therein lies the dilemma. Perhaps national health insurance will permit coverage of the service needs of the most severely handicapped under an expanded definition of health care.

Of course, when all has been said and done to improve the efficiency of investments in rehabilitation, still left—beyond the scope of cost-benefit analysis—are important economic and political issues concerning the distributional effects and equity of these investments. This is nearly virgin territory for economists interested in the field of rehabilitation.

## NOTES

1. In theory, the compensating variations ( $V$ ) or monetary values attached to the benefits or losses sustained by each person ( $i$ ) affected by an investment project can be distributed. There is potential Pareto improvement or net social gain if

$$\sum_j^n V_j > 0;$$

i.e., there is a surplus after algebraically summing the maximum amounts that gainers will pay (+) rather than forego the project and the minimum amounts that losers will accept as compensation (-) to put up with it (Mishan, 1971).

2. Suffice it to say that the concept of disability and the criteria applied by disability-related programs to determine eligibility for services are complex matters. The Federal-State Rehabilitation Program, the object of the 18 studies under discussion, applies



three linked criteria before accepting a person for services. There must be evidence of (a) a physical or mental condition, acting as (b) a substantial handicap to gainful employment, for which (c) services can be expected to lead to achievement of a vocational goal (Nagi, 1969).

3. Unfortunately, available information does not permit determination of how much of the discrepancy is due to faulty records processing and how much is due to false reporting. The pressure of meeting "quotas" does at times lead to falsification of records and sporadically gets reported by the press. One recent probe disclosed 12 of 164 counselors falsifying between 5 and 26 records each—the larger number representing more than half of one counselor's caseload (Knudson, 1975).

4. And given the increasing sophistication of the courts in matters of statistical inference (Katz, 1975), it seems unlikely that priorities based on class-specific estimates would be sustained in litigation involving rejected applicants for services.

5. Persons who enroll in rehabilitation and other job training programs do so typically when their earnings have reached an ebb point—lower than both what they were and what they will be. Those who are more motivated and thus more likely to succeed without help are probably among the first to seek services. This is the "cream" that is skimmed by rehabilitation and manpower training agencies in the quest for statistics showing program "success." (For discussion of "creaming," "quotas," and "head-counting," see U.S. Congress, 1972; and National Citizens Advisory Council for Vocational Rehabilitation, 1968.)

6. Even then, the so-called "displacement effect" may complicate interpretation of a positive benefit-cost ratio in presence of a valid control group. In an employment market where available jobs are fewer than the number of unemployed, simply providing preferential access to jobs for some may result in their gain to the detriment of others with equal or higher skills. While it is not clear that displacement effects can ever be filtered out by means of an experiment, nonetheless, comparison of persons who receive rehabilitation services—with and without direct job placement—would clarify the relationship between benefits and the components of treatment. It is possible that the wage benefits of rehabilitation are more the result of preferential access to jobs than due to the provision of other, possibly more expensive services. (For discussion of displacement effects in manpower training programs, see Sewell, 1969.)

7. The review process can and often does blend varying judgmental criteria in reaching the decision to fund or withhold support from proposed applied research projects. Moreover, these criteria can be applied either simultaneously or in successive stages of review by the same or different panels of judges. A project can, for example, be graded first for scientific merit by a scientist panel and then for its potential policy utility by nonscientist officials of the funding agency or an advisory council of consumers, practitioners, or any other kind of representation that may be desired. In practice, a mixed review process that trades off competing scientific and policy or political considerations, more often than not, will find it expedient to compromise the exacting, costly, and future-oriented demands of science in favor of more immediate gains.

8. The relevant federal programs are Social Security Disability Insurance, the Supplemental Security Income Program, Federal Employees' Compensation, the Veterans Compensation and Disability Pension Programs, Armed Forces Retirement, Federal Civil Service Retirement, Railroad Retirement, the "Black Lung" Benefits Program, and the compensation program under the Longshoremen's and Harbor Workers' Act.

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