# Selecting Programs Based on Cost-Effectiveness and Cost-Benefit Analysis

**How do we know if it is worthwhile to spend scarce tax resources on a particular strategy or program? How can we choose between alternatives? Is any intervention always better than none?** Much of the work discussed in this toolkit is conducted by agencies acting in the public trust. These agencies have an obligation to measure the returns to alternative investments, to understand the returns to the expenditure of public funds, and to invest public resources as effectively and efficiently as possible. In principle, a policy is worth adopting when its benefits exceed its costs, and it is preferable to others when it produces the greatest net benefit, for a given expenditure. But how do we measure costs and benefits? How do we account for the fact that costs and benefits accrue to different groups, or at different times? This note will discuss two related tools used to measure the social returns to investments: cost-effectiveness (CE) and cost-benefit (CB) analysis. The main difference between them is that CE analysis usually denominates benefits in physical units, whereas CB denominates benefits in money equivalent terms.

The first thing to know is whether the policy is **effective**: that is, does it produce a positive outcome? This isn't as easy or obvious as it sounds. Many programs are undertaken without any evidence of effectiveness. For example, it is common to conduct evaluations on the basis of program outputs, rather than outcomes. But one condom distributed does not translate into one condom used, or into one less case of HIV. A program can train a hundred young people in alternative conflict resolution methods, but that doesn't in itself guarantee a decline in youth violence. It is important that the CE or CB analysis be conducted in terms of outcomes—for example, the number of HIV infections prevented, or the number of young people employed, relative to the number there would have been in the absence of the intervention. Ideally, this information would come from a well-controlled impact evaluation study (see From Wishlist to Action # 3).

The next task is to measure program **costs**. This is essential for both CE and CB analysis. In principle, it's a matter of measuring quantities of inputs (Q), prices of inputs (P), and multiplying to get the total (C=Q*P). But the devil is in the details. First, there is the distinction between *financial* costs and *economic* costs. *Financial* costs are simply the amount of money that is spent on inputs. This assumes that any input for which the project does not actually pay has a cost of zero. But there's a problem with that assumption. Volunteer time, for example, can have many uses. It can produce program outputs, or it can be used for entirely different purposes unrelated to the program. The *economic* cost of free inputs is the value of the best alternative use of those inputs: this is known as the *opportunity* cost of the inputs. Strictly financial accounting of costs ignores the true value of these ostensibly free goods.

Second, there is the distinction between *average* and *marginal* costs. *Average* costs are the total expenditure divided by the number of things produced (or outcomes achieved). *Marginal* costs are the amount of money you'd have to spend to produce one more unit of output, or achieve one more target outcome. This can be approximated by the total cost of producing $n$ outputs minus the total cost of producing $n-1$ outputs. This matters partly because of the related distinction between *fixed* and *variable* costs. *Fixed* costs are the expenditures incurred before you can produce even the first unit of output: buildings, licenses and fees, and so on. These fixed expenditures are things you need only spend money on once; after that, you can produce $n$ units of output without having to spend money on them again (until you run out of physical capacity). *Variable* costs are the costs of actually producing the outputs, once the fixed costs have been incurred. These include staff, electricity, and disposable or consumable items (such as condoms, syringes, or office supplies). Average costs are computed using the sum of fixed and variable costs; marginal costs are usually computed using variable costs only. Average costs usually decline as the volume of output increases; marginal costs may

be going up or down, and are a better indicator of how much a program would have to spend if it wants to expand output.

Third, it is important to consider the cost of the money that is used to provide these benefits—the *cost of public funds*. Say the program is funded through general taxes, on income or on goods. Income taxes have a direct impact on the welfare of the population, and goods taxes increase the costs of production, part of which decreases the returns to producers and part of which is passed on to consumers. It is also essential to understand the opportunity cost of these funds. What would be the best alternative use of the money? The computation of total costs must consider these effects: what is the direct cost to the population, what are the indirect costs in terms of changes in the prices of goods and services, and what are the consequences for economic growth.

Finally, one must consider how to *discount* future costs (as well as benefits). If the program will continue to produce services over time, it is important to understand today what the costs will be over the life of the program. Higher discount rates will reduce the present value of future costs and benefits. At a discount rate of zero, the present value of the total cost of a 30-year program that spends $100 per year is $3,000; at a discount rate of three percent, the present value is about $2,000, and at a discount rate of six percent it is about $1,000. It is important that as future costs are discounted, so are future benefits. The present value of the benefits of a program that only begins to produce results in later years is lower, other things being equal, than a program that produces results more quickly. Whatever discount rate is used, it is important to consider both long-term and short-term costs and benefits. Programs that appear effective in the short term may have long-term negative consequences, such as the *mano dura* strategies that promote youth incarceration, reduce crime in the short term but ultimately lead to greater recidivism and more serious crime in the longer term.

Once we have estimates of costs, we can estimate the program's **cost-effectiveness**; that is, the volume of outputs per dollar spent on the program. The effects are measured in physical units. Ideally, they are the intended goals that the program, for example the number of HIV cases averted. In practice, the measures used are often proxies for these goals, often in terms of program outputs, such as the number of young people who receive training, or the number of condoms distributed.[1] It can be argued that any program that is cost-effective is worth undertaking. But because we have a responsibility to use public resources efficiently, we must be able to compare the cost-effectiveness of a range of plausible alternative uses of the resources. If we are trying to decide among different ways of producing the same type of output, we can compute cost-effectiveness ratios and choose the one that produces the greatest outcome per dollar spent.

However, CE is limited in that it denominates the benefits of an intervention in unit terms. This does not allow us to understand whether the value of the benefits exceeds the cost of producing them. It may be that even though the program benefits many people, the net value of the benefit is small—and even smaller than the cost of the program. This is the role of CB analysis. It is important to understand that even though a program is cost-effective, it may not be cost-beneficial.

CB analysis is also useful to compare interventions in unrelated areas that might advance the ultimate goals more effectively. This kind of analysis can help policy makers both choose a potential policy direction and evaluate an already implemented program in comparison with others. For instance, improved welfare can be obtained through investments in clean water that yields better health; it can also be obtained by increasing school enrollments. Which is preferable? CB analysis involves measuring otherwise noncomparable outcomes in similar terms—that is, the value of the flow of benefits to program recipients and others.

In addition, CB analysis permits the comparison of programs whose benefits and costs accrue to different people. How can we compare improvements in well-being across households? For example, both greater access to clean water and expanded access to primary health care are beneficial. But they will probably improve the health of different households differently, depending on their status and composition, and even of different household members. One advantage of understanding the costs and benefits accruing to different

groups in the economy is to see who can be expected to gain (and therefore support the policy) and who may lose (and thus oppose it).

Decisions on the general direction of policy or investment are often taken for political rather than economic reasons. Cost-effectiveness analysis can be used when the outputs or general direction of investment have already been decided, and when the outcomes are clearly defined and measurable—for instance, when the goal is "increased enrollment," and the analysis is geared to finding the best of a similar set of tools that can achieve that goal. Cost-benefit analysis can be used to compare the relative value, in money terms, of the costs of achieving a specific, measured increase in enrollment and the value of that increased enrollment to the individual beneficiaries and to society. A total net increase in enrollment can be described in money terms—as a function of the increased wages that beneficiaries might command, the decrease in risk behaviors that education confers, and so forth. Yet even when the general direction of policy has been decided, it is still useful to understand the net social benefit of the policy decision; it may even be negative.

Determining the value of the benefit delivered to participants is often difficult and contentious. In the case where the good or service has a market price, the task seems simple. As with costs, the task is to compute the product of the value of the benefit ($V$) and the number of people who receive it ($N$) to get the total benefit ($B=V*N$). In many cases, such as education and skills training, but also health care investments, direct benefits can be estimated in terms of increased wages and the greater likelihood of employment. In principle, one should adjust for the possibility that an increase in the supply of skilled workers may reduce their wages in the labor market, which in turn reduces the number of people interested in receiving the training. There are many examples of subsidies that reduce prices sufficiently to discourage domestic production and encourage wasteful consumption.

There are many cases where the market price is not available, or is not a good indicator of the social value of the benefit. For example, the market for the good or service may not function well, or may not even exist. There is no private market—and hence no external valuation—for reductions in social exclusion or abuse, or improved self-esteem. Items may also have significant *externalities*: that is, the benefits accrue to those who don't pay for them directly, such as clean air and water, or crime reduction. The direct benefits accrue to those whose houses and businesses are not burgled; but others benefit through improved feelings of personal safety; all of these can lead to changes in property values, investments, and growth.[2] These longer-term and less tangible impacts are difficult to measure directly.

Where market prices don't exist or are poor indicators of value, it may be possible to estimate value using other methods. *Hedonic pricing* infers values for attributes that make up a composite good or service. To take the crime reduction example mentioned above, even though there is no market for crime, changes in crime do lead to changes in property values. Neighborhood crime rates can be thought of as an attribute of the house, just as neighborhood schools or parks. The value of crime reduction is obtained by comparing the prices of properties that are similar in every way, but differ in crime rates. *Contingent valuation* (CV) methods ask people what they would be willing to pay to achieve or avoid a certain outcome, or what compensation they would require to put up with it. CV methods are common in environmental economics, but are tricky to implement. They require carefully-tested questionnaires and sensitivity analysis, because the answers obtained can change depending on the wording or order of questions. "How much would you pay to save the whales?" elicits a very different response from "How much would I have to pay you so that you wouldn't object to having all the whales killed?"

Unfortunately, there are few robust studies of the cost-effectiveness or cost-benefit of youth investments. Most focus on education and nutrition interventions, and some evidence exists on the benefits of youth employment programs and on crime prevention, although here the evidence is primarily U.S.-based. Here we present a few examples of interventions with robust evaluations and good CB analyses:[3]

***De-worming in Rural Primary Schools in Kenya***. This study was designed to identify cost-effective interventions to improve schooling outcomes at the primary level. The study randomized the timing of the introduction of de-worming treatment across 75 schools. The treatment significantly reduced disease prevalence, and increased school attendance by about seven percent. The study estimated that discounted benefits are over US$30 per treated child, primarily from gains in lifetime income. This implies that the benefits are more than 60 times greater than costs, based on an estimated cost of US$0.49 per treated pupil.

***Scholarships for Poor Secondary School Students in Urban Colombia***. This program provided vouchers for children from poor families to attend private secondary schools in selected urban areas in which public schools were already enrolled to full capacity. The vouchers were randomly assigned to students by lottery. After three years, lottery winners had completed more schooling (due to reduced repetition rates), and scored higher on standardized tests than students who had not received the vouchers. Depending on the discount rate used, the benefits of the program are estimated to be 1.4 to 3.8 times program costs.

***A Youth Training Program (Programa Joven) in Argentina***. This program provided intensive skills training to poor unemployed youth, male and female, with limited education and without work experience. The program reimbursed participants for their transportation expenses, provided a stipend for women with children under five, medical checkups, books, materials, work clothing, and an eight-week internship in a firm. The program yielded significantly improved earnings for male youth (16–20) and female adults (21–35), and improved the probability of finding employment among female adults. For these two groups, the present value of benefits exceeds costs after 9–12 years. However, for all participants, or if a higher discount rate and longer time horizon are used, the present value of costs exceeds the benefits.

Studies of youth crime interventions strongly support the contention that both prevention and rehabilitation are much more efficient and effective than incarceration; but even among the more successful categories of intervention there are many programs that did not yield positive benefits.[4] Similarly, a recent review conducted by the World Bank of 289 youth employment interventions found that only 10 contained sufficient information to conclude that they had a positive impact and were cost-effective.[5]

Perhaps most important, both of these studies found that evaluations that were conducted using weaker methods were more likely to find favorable results. Rigorous impact evaluation and strict cost-benefit standards lead us—correctly—to reject false or weakly founded claims of program success. This should not be an excuse for inaction, but a strong motivation for further research.

## Endnotes and Further Reading

1. It is extremely important to acknowledge the limitations of such proxies. The hypothesized link between the proxy, or "proximate cause," and the intended outcome must be clearly stated. One condom distributed does not mean that one condom is used.
2. Note that changes in property values partly reflect these other changes, so including all of them is likely to be double-counting. These changes in property values are useful for *hedonic* valuation methods.
3. Knowles, J.C., and J.R. Behrman. 2005. "The Economic Returns to Investing in Youth in Developing Countries: A Review of the Literature." Health, Nutrition, and Population Discussion Paper. World Bank, Washington, D.C., January.
4. Aos, S., R. Lieb, J. Mayfield, M. Miller, and A. Pennucci. 2004. "Benefits and Costs of Prevention and Early Intervention Programs for Youth." Washington State Institute for Public Policy, Olympia, WA.
5. Betcherman, G., M. Godfrey, S. Puerto, F. Rother, and A. Stavreska. 2007. "A Review of Interventions to Support Young Workers: Findings of the Youth Employment Inventory." SP Discussion Paper Number 0715. World Bank, Washington, D.C., October.

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2. Knowles, J.C., and J.R. Behrman. 2004. "A Practical Guide to Economic Analysis of Youth Projects." Health, Nutrition and Population Discussion Paper. World Bank, Washington, D.C., November.


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1. Campbell, H.F., and R.P.C. Brown. 2003. *Benefit-Cost Analysis: Financial and Economic Appraisal using Spreadsheets.* Cambridge: Cambridge University Press.
2. Gramlich, E. 1997. *A Guide to Benefit-Cost Analysis*, 2nd edition. Long Grove, IL: Waveland Press.
3. Layard, R., and S. Glaister. 1994. *Cost-Benefit Analysis*, 2nd edition. Cambridge: Cambridge University Press.