How to present program cost information in a useful way to understand program cost-effectiveness[§]

Prepared for: Grand Challenges Canada SB TTS program
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This document complements the information provided in the *Costing Sheet Sample* for early childhood interventions prepared in May 2019. The objective of this document is to describe different ways in which program costing data can be presented in order to convey useful information about the program's cost-effectiveness, i.e., whether the cost at which the program's benefits on its beneficiaries are attained is *reasonable*. This implies understanding how big the benefits of the program are in relation to its costs (benefits would have to outweigh the costs in order for this investment to make sense), as well as, trying to say something about whether those same benefits could have been achieved at a lower cost.

When you advocate for your project, so that it can be scaled up by a government or another partner, it is of utmost importance that you can show that the program was *effective* (it had significant benefits on its beneficiaries with respect to non-beneficiaries), and also that it was implemented *efficiently* (that the benefits on the beneficiaries were achieved at a reasonable cost and/or that the program is operating at its optimal level in terms of costs).

Your potential partner would first want to know the cost of delivering your program. You can answer this question by providing the cost per child (per unit of time, e.g., year) that you computed using the *Costing Sheet*. This is a necessary first step. However, it is not sufficient just to provide that cost per child. It is typically important that you also show that the benefit of the program on beneficiaries was "big enough" relative to how much it cost to serve those beneficiaries. Efficiency is typically understood as a *relative term*; in other words, understanding the program's cost in contrast with other different programs aimed at improving the same dimensions of well-being of the same population of interest. The program is efficient or more efficient *relative to other alternatives* designed with similar objectives and target populations.

The gold standard to report whether a program is efficient or not, is to compute the benefit-to-cost ratio.[1] In particular, it is the ratio between the present value of all (private and social) benefits associated with the delivery of the program relative to the present value of all the costs associated with the delivery of the program. If this ratio equals one, then the discounted flows of benefits are equal to the discounted flows of costs. Any number above one indicates that the benefit flows are higher than the cost flows, so the higher the benefit-to-cost rate, the better is the program in

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[1] It is similar to a project's internal rate of return which corresponds to the discount rate that makes the net present value of all project's cash flows equal to zero.

terms of cost-efficiency. If the ratio is less than one then it means the cost of the program is higher than what the beneficiary receives in return, so it is not a good investment.

The calculation of the benefit-to-cost ratio is complicated and we will describe it briefly at the end of this document. However, we will begin by presenting other alternative ways of conveying similar information without having to go through the complete benefit-to-cost ratio calculation.

All of these simpler versions of how to present costing data are imperfect and rely on strong assumptions that might seem plausible but are difficult to prove. It is important that if you choose to present costing data using these simpler methods, you keep in mind the underlying assumptions required for the calculations and can pin down the implications of these for your analysis.[2] These are useful ways to think about costing and efficiency, which are somewhat easier to compute than the full benefit-to-cost analysis, but are not ideal and are likely to be subject to many technical objections. Thus, we strongly recommend that whenever feasible –given your team's expertise– you provide the complete benefit-to-cost analysis (see section 5.). Either way, it is highly recommended that you hire an expert in project evaluation or economic analysis to assist your team with this task.

1. **Compare the relationship between the benefits of the program (in a given time unit) and the cost of delivering the program (in a given time unit) across similar programs with the same objectives.**

   In order to be able to present this comparison you would need to have impact evaluations and costs of your program, and the same data for other alternative programs with similar objectives. This is not always feasible but, for the moment, assume that you do have studies for other interventions that are similar in nature to yours and, at least, aim at the same outcome variables (e.g., nutrition, language or health).

   The benefits of all the programs you want to compare have to be expressed in the same metric. For example, change in labor earnings associated with the intervention, change in height-for-age, or change in cognitive development, etc. The comparison will be unreliable if the benefits are measured in different metrics, e.g., a program reports impacts on nutrition but another one reports impacts on vocabulary. You would need to make sure that the programs' impacts are reported in a common metric.

   The cost of the program corresponds to the cost of delivering the "amount" of intervention required to attain the benefits reported. If the benefit was attained after one year of intervention, then the cost per beneficiary per year has to be used in the analysis. As in the case of the measurement of benefits, it is very important that the **cost** of the programs that you will use as reference for yours, measure the same thing. As we have mentioned, the cost can be the direct cost of delivering the program or it can also include indirect (pecuniary or non-pecuniary) costs associated with the participation in the program, such as, the

[2] These assumptions and implications will become clearer in section 5, when we contrast the full benefit-to-cost analysis with the simpler alternatives presented in sections 1, 2, 3 and 4.

opportunity cost of the time that participants have to devote to the program. To take another example, some programs report costing without taking account of in-kind contributions (e.g. space, equipment, staff or administrative time) contributed by agencies implementing the program, while others do include all or some of those costs. In order for the comparison across similar programs to be reliable, you need to make sure that the benefits and the costs are measured in the same metric.

For these simpler versions of a benefit-to-cost comparison, we suggest just using the **direct** benefit associated with the program, in other words, the benefit accrued by the beneficiary of the program in relation to his/her participation in the program. This implies that we would not include social benefits, such as externalities or savings in government expenses associated to the improved lives of our beneficiaries.[3]

Similarly, we suggest reporting just the **direct** cost of program delivery, and no other private or social pecuniary or non-pecuniary costs associated with program participation such as the value of beneficiaries' time required for program participation, transportation costs, opportunity cost, etc. Just the cost of delivering the program as reported from your computations in the *Costing Sheet*.

As an example, we will compare one early childhood intervention (call it "Program 1") with other three programs delivering similar early childhood interventions, all aimed at improving children's *cognitive outcomes*.[4] For all four programs, we have reliable program impacts on cognitive development, as well as, comparable costing data. In particular, we know the total direct cost of delivering each program (no externalities or non-pecuniary costs) for the duration of exposure that resulted in the benefit reported by each evaluation study. Using these program impacts and costing data, we can compare the programs graphically, as shown in Figure 1. Say for instance that program 1 is a teacher-training program, program 2 is a center-based early education program, 3 is a group-based parenting program, and program 4 provides pedagogical materials and books to centers.

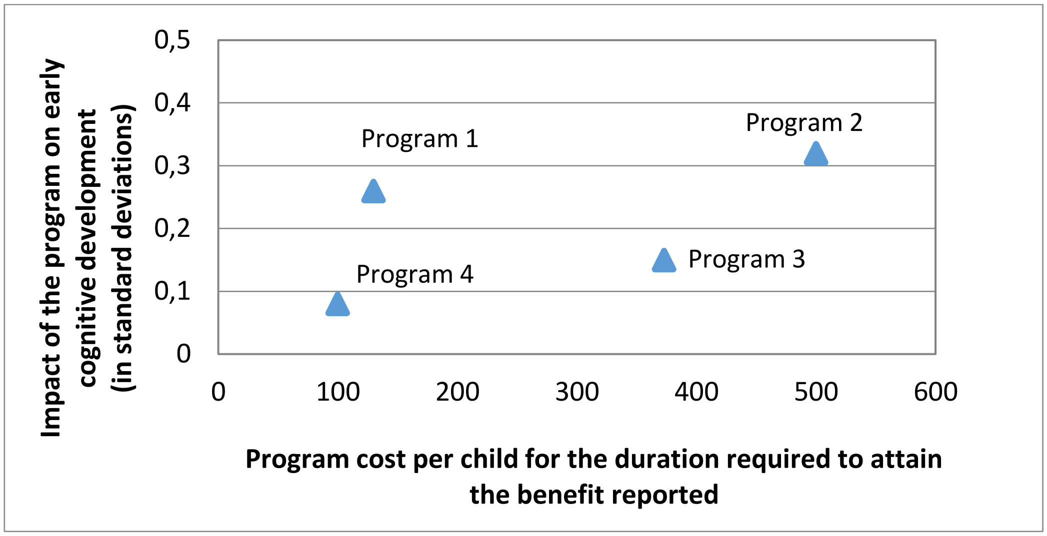
Each triangle represents the combination of direct benefits accrued by program beneficiaries in terms of cognitive development (vertical axis) and the direct cost of program delivery for the duration of exposure associated with that benefit (horizontal axis). The benefits accrued by direct beneficiaries of the program are all reported in standard deviations of cognitive development, so that they are readily comparable. A visual inspection of the graph indicates that Program 2 yields a benefit that is similar to that of program 1 but at a much higher cost. On the other hand, program 3 yields a benefit of almost half as that of program 1 but costs almost three times more than program 1. Finally, program 4 is cheaper than program 1 but its impact is significantly lower than that of program 1. Overall, program 1 seems like a good

[3] We will come back to the issue of macro-level savings associated with impacts on beneficiaries at the micro level, later in this section. This might be of interest to some of the projects.

[4] We assume that the impact evaluations of all four programs show program impacts on a relevant measure of cognitive development (see, for example, Table 10 in Attanasio et al. (2018)).

investment because it is in the ballpark of "high impacts" for comparable interventions at the same time that it is in the ballpark of "low costs".

Figure 1. Program impacts on cognitive development and the cost of program delivery



In this example, we assumed that all the studies presented in Figure 1 measured the impact of the program on cognitive outcomes. However, it is possible that the programs you want to compare do not have a common metric to measure the programs' benefits. In this case, it would be necessary to include an additional step to the analysis, which consists of "translating" the impacts reported by the studies to a common metric. For example, changes in different dimensions of early development (nutrition, health, cognition, etc.) could all be translated into changes in years of schooling or gains in labor earnings during adulthood. This calculation is typically based on estimates available in the literature.

Suppose that you have evaluated the impacts of your early childhood program on cognitive development, while the program to which you want to compare it measured the impacts on children's height-for-age. Strauss and Thomas (1998) report that a 1% increase in height-for-age during childhood is associated with wages that are 2.4% higher during adulthood (in Brazil).[5] Similarly, Alderman et al. (1996) report that a 1% increase in cognitive ability during childhood increases labor earnings by 0.23% (in Pakistan).[6] Most likely, you will not find similar studies for every country, but you can use results reported for a developing country that is similar to your own. Using these estimates, you can compute how much the program's benefit on cognitive development implies in terms of adult wages, and similarly, how much the other program's benefit on nutritional status implies in terms of adult wages. Now the benefits of both programs are measured in the same metric (change in labor earnings) and are, thus, comparable.

[5] Strauss, J. y D. Thomas (1998), "Health, Nutrition and Economic Development", Journal of Economic Literature vol 36 (2), pp. 716-817.

[6] Alderman, H., Behrman, J., Ross, D., and Sabot, R. (1996). The returns to endogenous human capital in Pakistan's rural wage labor market. Oxford Bulletin of Economics and Statistics, 58 (1), 29-55.

2. **Reporting social benefits associated with a program that improved individual outcomes**

We have focused, and will continue to do so in what follows, on *private* benefits. That is, the direct impacts on the lives of beneficiaries associated with an intervention. In many cases, however, the key partner of a project is the government. If so, it might be important and appealing to try to price some of the project's externalities so that the government can understand not only how program participants benefitted directly, but also how the government saved resources because these lives were improved. This might require researchers to collect additional information from primary or secondary sources, which complicates things further. We present here a simple example for illustration of how this could be done.

Let us use a health intervention as an example. Assume a preventive care program; in particular, the program consists of three free of charge (for families) preventive medical consultations during the first year of life of a child. Each medical consultation costs US 2.5. The evaluation of the preventive care program indicates that the increase in the use of preventive consultations during the first year of life of a child was 2.84 (that means, almost perfect compliance with the program).

In addition, the study reports that this increase in medical consultations reduced hospitalizations in 0.11 per child. In this population, the average number of days per hospitalization episode of a child younger than one year of age was 4.6 days. Each night of hospitalization for a child younger than one costs USD 43.8. That means that a reduction in 0.11 hospitalizations per child implied a decrease in hospitalization costs of -0.11 x USD 43.8 x 4.6= USD 22.4.

Note that the increase in preventive consultations cost USD 2.5 x 2.84= USD 7.2 per child. So taking into account just the effect of preventive medical consultations on the reduction of hospitalizations costs, this program was quite efficient. One could further calculate the total savings for the health system of this country by multiplying the savings *per child* by the average number of children younger than 1 that are hospitalized in a given year in this country (which assumes universal enrollment of the preventive care program).[7] For these calculations, one would need to have precise data for the costs of different medical services in order to be able to provide a reasonable approximation of the project's impacts on public health expenditure.

3. **Calculating a "back-of-the-envelope" annual returns to be compared with other programs not necessarily similar to your own program**

In order to be able to present a comparison as in 1., one would require to have impact evaluations and costing analyses for more than one program aimed at the same objectives and population as your program. This is not always feasible. In the absence of close comparisons, one could potentially contrast the program to other interventions that are not

[7] For a more detailed example, see Camacho and Ortiz (2019).

as similar but are *close* in nature. For example, if your program is related to human capital investments, you could look for other human capital interventions; if your program is a rural development project then you could search for other interventions related with rural development, etc.

In our example, we could compare the impact of your early childhood intervention with the impact of a job-training program for young adults (being this a human capital investment program as well), and try to express the benefits of both types of programs in a common metric, such as *gains in labor earnings* during adulthood. En the table below, we show the information relating to program benefits and program costs for your own program (early childhood) and for a job-training program for young adults, which happens to have results from a rigorous impact evaluation as well as data on program costing.

Example:

Table 1

Program	Benefit reported	Cost reported
Early childhood program	10% gain in cognitive development	USD 200
Job-training for young adults	4% increase in labor earnings	USD 500

Suppose your program, which cost USD 200 per child (for the duration of the project), has an impact of 10% on child cognitive outcomes. Based on the estimates provided by Alderman et al. (1996), we could say that this would translate into 2.3% higher wages during adulthood. Using average wages (computed from country household surveys) one could translate this change in labor earnings into actual amounts, for example, this 2.3% is equivalent to USD 100 higher annual labor earnings[8] of socioeconomically vulnerable populations, for every year that the beneficiary is employed.

Then, the same calculation would have to be presented for the job-training program. Suppose that the impact evaluation of this program reports an increase of 4% in wages for a one-year participation in the program.[9] This one-year program cost USD 500. This impact on beneficiaries would imply close to USD 174 higher earnings for every year that the beneficiary is employed, in a similar socioeconomically vulnerable population.

Then one would contrast each annual benefit with the cost of providing the program to the target populations, which is what we do in the following table.

[8] This is a hypothetical value. One would have to compute the average wages of an adult in socioeconomic vulnerability in the country of interest. Then calculate how much 2.3% would represent of that average wage. In this example, we are assuming that average wages of an adult from the lower tail of the income distribution (socioeconomically vulnerable and, thus, eligible for our program) would be approximately USD 4,350 dollars per year, so that 2.3% of that is close to USD 100.

[9] In this case, we are assuming that the impact evaluation study of the job-training program directly assessed the impact of program participation on young adults' wages. Thus, the effect is already represented as a percentage change of wages.

Table 2

Program	Back-of-the-envelope annual return (benefit/cost)
Early childhood program	100/200=0.5
Job-training for young adults	174/500=0.35

Our program has a "back-of-the envelope" annual return of 0.5, which could be roughly interpreted as: an average program beneficiary receives 0.5 dollars due to higher labor earnings associated to the program (*every year* he/she is employed during his/her adulthood) for every dollar that we invested in the program. A similar interpretation applies for the 0.35 annual return reported for the job-training program for young adults. In this case, the 0.5 annual return of our early childhood intervention exceeds the 0.35 of a comparable program also offered to socioeconomically vulnerable populations, which also aimed at improving beneficiaries' human capital.

As expected, investing earlier is "cheaper" because the brain is still very malleable and the trajectories are still reversible, while older individuals have experienced more years of bad investments (in their households and in the education systems) and as a result is more difficult and more costly to revert these bad trajectories. In this case, we can safely say that it is more profitable to invest in our program than in a comparable human capital intervention, such as this job-training intervention.

It is important to note that the comparison presented in Table 2 might not be as accurate as we would like to because the benefits from a job-training program might be received sooner than the benefits accrued from an early childhood program. That is because a young person participating in a job-training program might start working immediately after the program, while a child participating in an early childhood intervention needs to grow up before starting to earn wages. That means that while the "back-of-the-envelope" annual return from the job-training program is lower than that of the early childhood program, the benefits from the former can be received *sooner* than the latter. Typically, individuals prefer to receive benefits sooner than later, and that is why future flows of income have to be **discounted** (with an interest rate or discount rate) to estimate how much these future income flows are worth to the individual in the present (more details about this discounting in section 5.).

Essentially, the young person participating in the job-training program can receive 0.35 USD for each dollar invested in him, each year during his working life *immediately after* the end of the program and all the way up to retirement. On the other hand, the child in our early childhood intervention will have to wait approximately 10-15 years in order to start receiving his/her yearly 0.5 USD for each dollar invested in him/her during early childhood. Thus, for a more reliable comparison between the two programs one would have to discount the flow of yearly 0.5 USD additional labor earnings over the child's working life to obtain its present value.[10] We postpone the computation of this discounting to section 5. Whether you decide

[10] In order to calculate the present value (value discounted to present) of the 0.5 USD one could use equation (3) in section 5. for a given interest rate *r*. The details are discussed in section 5.

to discount the benefits of the early childhood program or not, it is important that when presenting these data you acknowledge that, a difference in timing (of the benefits) exists between the two programs you are comparing. Moreover, this issue might attenuate the difference in cost-effectiveness between programs observed in Table 2, depending on the interest rate used for the discounting.

4. **Calculating a "back-of-the-envelope" annual return to be compared with other correlates of your outcome variable of interest.**

For the first strategy proposed, you would need to have information on impact evaluations of other similar early childhood interventions in a context similar to yours, as well as costing information for those interventions. For the second strategy, you would need both, impact evaluations and costing data, for other programs or policies, which are similar in nature to your program (e.g., human capital, unemployment, health, etc.). It might be the case, that none of these data are available in your context. In this case, you could try to compare your program to other relevant variables that are correlated with your outcome of interest (for example, with child development in the examples we have been presenting) that are available in your own evaluation dataset, and for which you could find some data on costs. These correlates do not need to be comparable programs.

Let us continue with our early childhood intervention example. In this case, your outcome variable of interest is early child development, e.g., cognitive development. Your impact evaluation shows an effect of 10% on cognitive outcomes after one year of intervention, which cost USD 200 per child. From your dataset, you can check the correlation between *maternal education* and child cognitive development. Say, for example, that this correlation is 20% (i.e. one additional year of maternal education is associated with an increase of 20% in child cognitive outcomes)[11]. We summarize this information in the table below.

Table 3.

Program and comparison	**Effect (or correlation) on child cognitive development**	**Increase in wage associated with that change in early cognitive development [12]**	**Cost of providing**
Early childhood intervention	10%	2.3%	USD 200
Maternal education	20%	4.6%	USD 400

That means that our program would increase our beneficiary's wage (in adulthood) by close to 2.3% (using Alderman et al. (1996) estimates). That is around USD 100 higher annual labor

[11] This might not be a causal impact but a simple correlation between maternal education and child development computed directly from your own data. This correlation would work for the purpose of our comparison.

[12] Based on the estimates found in Alderman et al. (1996).

earnings during adulthood.[13] Similarly, one year of maternal education increases cognitive development by 20%. This would translate into a wage increase of 4.6% (= 20% x 0.23%) when the child of a more educated mother reaches adulthood. This would represent an increase in wages of about USD 200 (4.6% of USD 4,350 = USD 200).

You also know that providing the early childhood program for one year cost USD 200 and providing a full year of education to the child's mother would cost, say, USD 400[14]. Contrasting the annual benefits (in terms of increased labor earnings in adulthood) with the cost of achieving that benefit either through our program or through increased maternal education would yield:

Table 4

Program and comparison	**Back-of-the-envelope annual return**
Early childhood intervention	=100/200=0.5
Maternal education	=200/400=0.5

In this example, both, our program and providing an additional full year of education to the child's mother, would yield the same annual return, i.e., 0.5 USD in increased labor earnings for every dollar we invested in the child. We know that maternal education is extremely relevant in predicting child outcomes, and there is abundant evidence about inter-generational persistence of poverty. Given that increasing maternal schooling by one full year is extremely difficult in socioeconomically vulnerable contexts, it seems that the impact per cost of our early childhood intervention is very promising.[15]

5. Full cost-benefit analysis by estimating the benefit-to-cost ratio

The estimation of the benefit-to-cost ratio consists of the comparison of the present value of all (private and social) benefits associated with the delivery of the program (throughout the entire period in which the individual can accrue these benefits),[16] with the present value of all the costs associated with the delivery of the program. Typically, one would have to consider both, private and social benefits and costs. For example, the direct private benefits are the gains accrued by direct program beneficiaries through their participation in the program. If our intervention were an early childhood program then this would mean the impacts on nutrition, health, cognitive and/or socioemotional development, etc. In addition, we could

[13] We had assumed this in our previous example. As mentioned earlier, this computation would require an estimate of average adult wages of your population of interest (e.g. the most socioeconomically vulnerable) which can be done using national household surveys in your country.
[14] These are all hypothetical values used as an example. However, the cost of providing one additional year of schooling could easily be found in the ministries of education or planning in your own country.
[15] The issue of differential *timing* between the program of interest and the counterfactual, discussed in section 3, is not a problem here. In this example, the same child will accrue the benefits either from the early childhood intervention or from higher maternal education at the same time, that is, when his working life begins.
[16] For example, the fraction of his/her life cycle during which he/she is economically active.

also include social benefits such as program externalities. In our example, these could be things like government savings associated with the fact that program beneficiaries are less likely to be poor (during adulthood) or government savings associated with better health outcomes of program beneficiaries.

Something similar occurs with the costs. These should include the direct cost of the program (how much it cost to serve a program beneficiary) and indirect costs associated with program participation such as the opportunity cost of the beneficiary's time, transportation costs not paid for by the program, etc. The need to keep track of both, private and social, and direct and indirect benefits and costs complicates significantly the cost-benefit analysis. This would require that you have additional sources of information to compute the social gains of the program and the private costs of the programs that are borne by program participants.

For simplicity, we will abstract from these difficulties in the description that follows. We will focus on the *private* benefits of the program on beneficiaries and the *direct* cost of the program per beneficiary. We will briefly describe how to use the impact evaluation results of your program and cost information, to compute the present value of flows of benefits and the present value of flows of costs throughout the individual's life cycle.

Example:

We will assume an early childhood program with a program impact of *30% on children's cognitive ability*. The direct cost of the program was USD 200 child/year. The total duration of the program was one year.

In order to be able to "price" this increase in cognitive ability to compute the program's flow of private benefits throughout the individual's life cycle, we will use the existing literature to translate this change in cognitive ability into increased adult wages. We know that, an increase in cognitive abilities directly improves adult earnings, possibly through increased educational attainment and reduced grade repetition. In particular, Alderman et al. (1996) report that a 1% increase in cognitive skills increases labor earnings by 0.23%. In our example, this would imply that the cognitive ability gains from our program would represent a 6.9% (=0.23 x 30) increase in adult wages.

We had assumed that average wages of an average adult from the lower tail of the income distribution (our average program beneficiary) were approximately USD 4,350 dollars per year. That means that the annual increase in labor earnings associated with the program is USD 300 (=USD 4,350 x 6.9%). For every year that the individual is employed he/she would earn this additional salary as a result of his/her participation in the program. We then have to discount the flow of benefits throughout an individual's working life to compute a total benefit in present value (i.e., how much these future flows are worth to the individual today). To do this, we have to assume an interest rate (or discount factor) to discount the flow of future benefits to present value. We call this interest rate r.

We also need to define the time horizon during which the individual could accrue these gains from the program. In this case, it could be, for example, the duration of his/her working life.

First, we define T as the age of the individual at the end of his working life. Similarly, we define a as the age at completing school. The individual would work from a to T. T would typically be the age of retirement in a given country. We define $y(s)$ as the labor earnings of an individual with s years of schooling.

The present value of the earnings for an individual would be given by: [17]

$$\int_a^T y(s)e^{-rt}dt = r^{-1}y(s)(e^{-ra} - e^{-rT}) \quad (1)$$

Define $\bar{y}(s)$ as the average earnings for an individual with s grades of schooling completed.[18]

If we denote e% as the impact of our program in terms of labor earnings (i.e., our 6.9% in our example above), then the present value of the gains accrued from the participation in the program in terms of increases in labor earnings over the working life would be given by:

$$\bar{y}(s) \times e\% \times r^{-1}(e^{-ra} - e^{-rT}) \quad (2)$$

If the cost of the program was c per child per year, and the program had been offered for t years when the child was between ages a_1 and a_2 then the present value of the cost would be:

$$\$c\int_{a1}^{a2} e^{-rt}dt \quad (3)$$

The benefit-to-cost ratio (BC) is the ratio between (2) and (3). The higher the BC, the more profitable the program. If the BC equals one that would be equivalent to a “break-even” project, while a BC higher than 1 would represent more profitable projects.

In this example, we focus on a *single outcome variable* used for the evaluation of our early childhood intervention, that is, the effect of the program on cognitive development). Typically, evaluation studies might include more than one outcome. For example, it could be nutritional or health outcomes, in addition to cognition. Suppose we know the program also had an impact of 3% on height-for-age. Then one could also translate this 3% increase in height-for-age into labor earnings by using the estimates provided by Strauss and Thomas (1998). That is, a 1% increase in height-for-age leads to 2.4% higher adult earnings, possibly because of better health, enhanced productivity, increased educational attainment and reduced grade repetition. This would yield a 7.2% increase in adult wages.

The question is whether one could add 7.2% to the 6.9% increase in wages associated with improved cognitive outcomes. The answer is not straightforward. While it is possible that the effects are independent (cognition and nutrition) and, thus, adding these two would be reasonable, it is also possible that the effects are synergistic. For example, improved nutrition could feedback into improved cognition, because the child is healthier, skips less days of school, and can focus better if he/she is not hungry. Unless the literature provides a more

[17] This calculation assumes, for simplicity, that the earnings profile is flat over the life cycle, that is, labor earnings in each period depend only on completed years of schooling.
[18] In our example, this corresponds to USD 4,350.

precise estimate of this synergy, the researcher would have to make an assumption about the way in which increased adult wages associated with nutritional outcomes and increased adult wages associated with improved cognitive outcomes relate to each other. One could make an assumption about the synergy and define a total effect on labor earnings and define a total effect that is in the vicinity of the sum of 7.2% and 6.9%[19], or stick to a single outcome variable for simplicity.

An additional difficulty of the BC calculation is that it is very sensitive to the interest rate, *r*, used in the analysis. Thus, it is always a good idea to show how sensitive are the results to different plausible values of *r* in the context of the program (country, economic volatility, financial markets, etc.). Furthermore, there are some economic and policy environments in which it is difficult to agree upon a reasonable social discount rate.

For this reason, it is useful to think about the cost-effectiveness of a project based on the present value of both, flows of benefits and flows of costs, is to compute **internal rate of return** (IRR). That is, the interest rate which makes the *net present value of the project* equal to zero, in other words, the interest rate that makes the difference between the present value of benefit flows and the present value of cost flows equal to zero. In practice, one would have to calculate the interest rate *r*, such that equation (2) - equation (3) = 0. Intuitively, an IRR higher than zero would imply that the present value flows of benefits exceeds the present value of flows of costs, so the project makes sense. Conversely, in the case of negative IRR. Thus, the higher the IRR, the more profitable the project would be.

However, it is very important to bear in mind that both, the BC and the IRR, are effective tools for investment decisions if they are thought in ***relative terms*** (at has been emphasized throughout this document). That is, if the BC or IRR is “better” with respect to similar projects aimed at the same objectives. For example, in and of itself an IRR= 7% seems reasonable but we do not know if it is *good enough*. One would have to compare it with similar projects that aim at the same objective (e.g., improving child’s health, improving adult job training, improving rural productivity, etc.). Likewise, a benefit cost ratio of, say, 2.5 at a particular discount rate may seem favorable, but it should be compared with BC’s for other projects calculated with the same discount rate (and, in for both the target project and the comparison projects, the BC for the alternative “sensitivity case” discount rates.) The advantage of using BC or IRR instead of the simpler alternatives presented in sections 1, 2, 3 and 4, is that both, BC and IRR, represent a cleaner estimate of the flows of benefits and flows of costs throughout the individual’s life cycle as a result of her/his participation in the program. In particular, both take into account any discounting that is required to make the timing of the interventions, the timing of when project participants receive the benefits and the duration of the period during which benefits can be accrued, comparable.

For applications of both BC and IRR, see for example, Barnett (1985), Heckman et al. (2010) and Behrman, Cheng and Todd (2004).

[19] We also recommend showing how robust the calculations are to different assumptions about this synergy.

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