

Can Cost-Benefit Analysis Guide Education Policy in Developing Countries?

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Abstract

Cost-benefit analysis in education is an important tool in the economists' arsenal. However, it is essential that research, especially on the social benefits of education, make further progress to make cost-benefit analysis more useful. There is a need for more research on the effects of policy interventions on outcomes beyond access to a

year in school and what they earn as a result, such as on what children actually learn. Such research should focus on ensuring that the interventions are attributable to outcomes. Nevertheless, it is worthwhile to go through the discipline of noting the benefits and costs, even if social rates of return cannot be calculated robustly.

This paper—a product of the Human Development Network, Education Team—is part of a larger effort in the department to document the benefits of investments in education. Policy Research Working Papers are also posted on the Web at <http://econ.worldbank.org>. The author may be contacted at hpatrinos@worldbank.org.

The Policy Research Working Paper Series disseminates the findings of work in progress to encourage the exchange of ideas about development issues. An objective of the series is to get the findings out quickly, even if the presentations are less than fully polished. The papers carry the names of the authors and should be cited accordingly. The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the views of the International Bank for Reconstruction and Development/World Bank and its affiliated organizations, or those of the Executive Directors of the World Bank or the governments they represent.

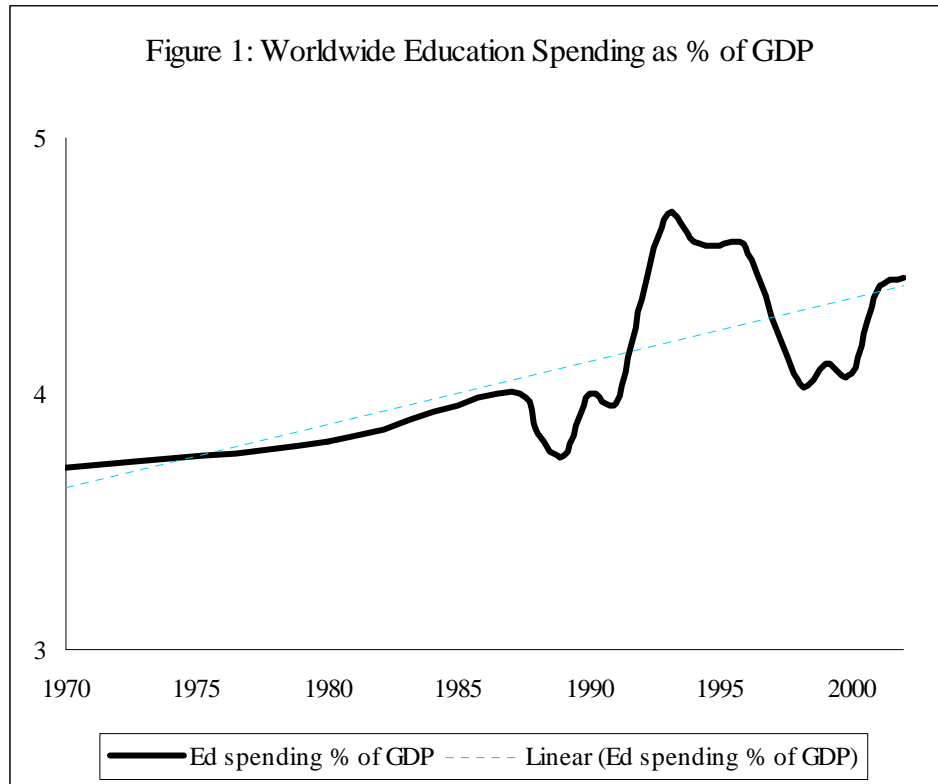
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If the true test of the value of an economic theory is longevity, the human capital model passes with flying colors. Its basics are simple and empirically testable (and generally validated). An individual will invest in his or her human capital—an additional year of schooling or on-the-job training—as long as the marginal gain from that investment exceeds its added cost. The gains extend over a lifetime and are discounted to the present. If some of these gains accrue to others, governments need to stimulate individuals to take them into account in making decisions. Public action may also be needed if poor individuals cannot mobilize the resources to finance the investment now, despite a promise of big gains in the future.

This human capital framework has been a driving force for the huge investments in education in developing countries in the past 40 years. In addition to education's social benefits, the recognition of its long-term economic benefits has spurred finance and budget ministries to action. In global terms, education spending has mushroomed from 3.7 percent in 1970 to 4.5 percent of GDP in 2002 (see Figure 1). This has led, by some accounts, to profound increases in the number of young people going to school, particularly at primary levels. There were more than 688 million children enrolled in primary schools globally in 2005, up 6 percent from 1999 alone. Worldwide average schooling level for the population was 5.0 years of schooling in 1970 attained across 103 countries (based on calculations from Barro and Lee's (2000) database). There was a 31 percent increase by 1999, when average schooling went up 1.5 years of schooling to above 6.5 years.



Because the framework is one of an economic investment, cost-benefit analysis (CBA) should be an important tool in making key decisions about the amount and types of investments. As reviewed in section 1 of this paper, the methods to apply this tool are well-established. And, as described in section 2, the applications of these methods have played a strong role in advocating for greater overall spending on education as a national priority.

But CBA has been less successful as a guide to set priorities for public policy. Section 3 shows that using such analysis, and specifically quantified analysis of rates of return (ROR), net present value (NPV) or even cost-effectiveness (CE), to guide aggregate government spending has not been widespread. And at the micro level, CBA has also not been used extensively in justifying specific education projects. Why not? We argue that some key methodological shortcomings have been responsible: specifically, the difficulty of estimating social, as opposed

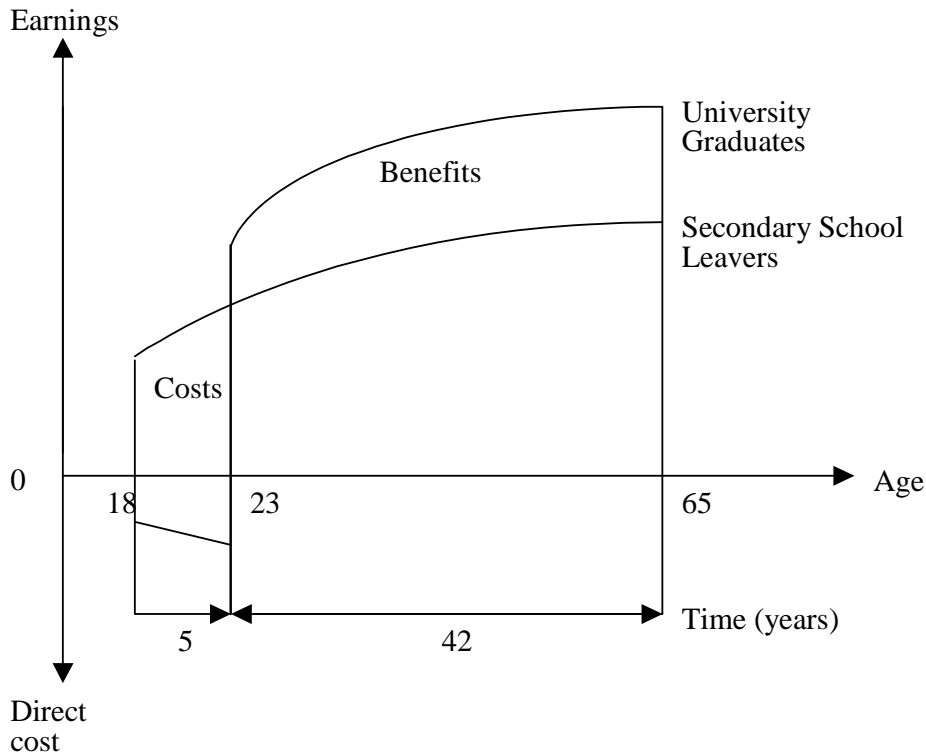
to private, benefits; the complexity of measuring the costs and benefits of other dimensions of education other than access to a year of attending an educational institution; and attribution of outcomes to actual interventions. Addressing these issues are the key research challenges for the future.

While research on the computation of more robust quantifications of costs and benefits continues, CBA should still be used to guide public investment. We argue in Section 4 that the discipline of describing the costs and benefits of a project does help decision-making – far more than the practice of simply saying that such investments are ‘socially’ justified. Combined with sound overall sectoral analysis, CBA is crucial to providing the rigorous framework that allows public authorities to make tough choices among competing investment projects.

1. Applying Cost-Benefit Analysis to Education: Principles

The application of cost-benefit analysis (CBA) to education is straightforward and is well-treated in some of the most recent textbooks in development economics (see Perkins, Radelet and Lindauer 2006). A schematic of the benefits and costs of investing in an additional year of education beyond the primary level is shown in Figure 2. The private benefit (B) of investing in another year of education is the gain in earnings for the rest of a person’s working life. The private cost (C) will include any fees or direct cost that the individual pays plus the opportunity cost in terms of foregone income. Because these values occur over time, they must be discounted to the present to be comparable. The Net Present Value (NPV) is the difference between the discounted values of the net present streams of benefits and costs.

Figure 2: Stylized Age-Earnings Profile



A rational investor – in this case a student or his/her family – will undertake the investment – such as an additional level of schooling – if the net present value is positive. Another criterion would be to calculate the internal rate of return and compare it with the returns from alternative investments. From this schematic, if t represents a unit of time, the private rate of return to education (r) is computed straightforwardly from the following formula:

$$\sum B_t/(1+r)^t = \sum C_t/(1+r)^t$$

The social benefit (SB) is the monetized value of the gains to others in society, such as the positive effects of having educated people interact with each other, greater social cohesion,

and so on. The social cost (SC) is the monetized value of the cost to others in society, such as the fiscal cost if the education is subsidized, including the deadweight cost of mobilizing public resources. The social return is computed by replacing B and C by SB and SC in the equation above.

Estimating these returns has led to a mini-cottage industry of scholarship (for a review, see Psacharopoulos and Patrinos 2004). One method is to compare earnings profiles for people with different educational levels. In the case of university education, for example, the formula to compute the private rate of return is:

$$\sum_{t=1}^{42} \frac{(W_u - W_s)_t}{(1+r)^t} = \sum_{t=1}^5 (W_s + C_u)(1+r)^t$$

where $(W_u - W_s)$ is the earnings differential between a university graduate (subscript u) and a secondary school graduate (subscript s , the control group). C_u represents the direct costs of university education (tuition and fees, books), and W_s denotes the student's foregone earnings or indirect costs. A similar calculation can be made for the other levels of education. However, there is an important asymmetry between computing the returns to primary education and those to the other levels. Primary school children, mostly aged 6 to 12 years, do not forego earnings during the entire length of their studies. On the assumption that children aged 11 and 12 help in agricultural labor, two or three years of foregone earnings while in primary schooling have been used in the empirical literature (Psacharopoulos 1995).

To compute the social rates of return to education, which are the appropriate guide for public investment, one must make adjustments. On the cost side, the costs would need to include society's spending on education. Hence, in the above example, C_u would include the rental of

buildings and professorial salaries. Gross earnings (that is, before taxes and other deductions) should be used in a social rate of return calculation, and such earnings should also include income in-kind where this information is available. A key assumption in a social rate of return calculation is that observed wages are a good proxy for the marginal product of labor, especially in a competitive economy using data from the private sector of the economy. Civil service pay scales are irrelevant for a social rate of return calculation, although they may be used in a private one. The *social* attribute of the estimated rate of return refers to the inclusion of the full resource cost of the investment (direct cost and foregone earnings).

Ideally, the social benefits should include non-monetary or external effects of education (for example, lower fertility or lives saved because of improved sanitation conditions followed by a more educated woman who never participates in the formal labor market). Given the scant empirical evidence on the external effects of education, social rate of return estimates are usually based on directly observable monetary costs and benefits of education. Since the costs are higher in a social rate of return calculation relative to the one from the private point of view, estimated social returns are typically lower than a private rate of return. The difference between the private and the social rate of return reflects the degree of public subsidization of education.

The discounting of actual net age-earnings profiles is the most appropriate method of estimating the returns to education because it takes into account the most important part of the early earning history of the individual. However, this method requires comprehensive data – one must have a sufficient number of observations in a given age-educational level cell for constructing “well-behaved” age-earnings profiles (that is, not intersecting with each other).

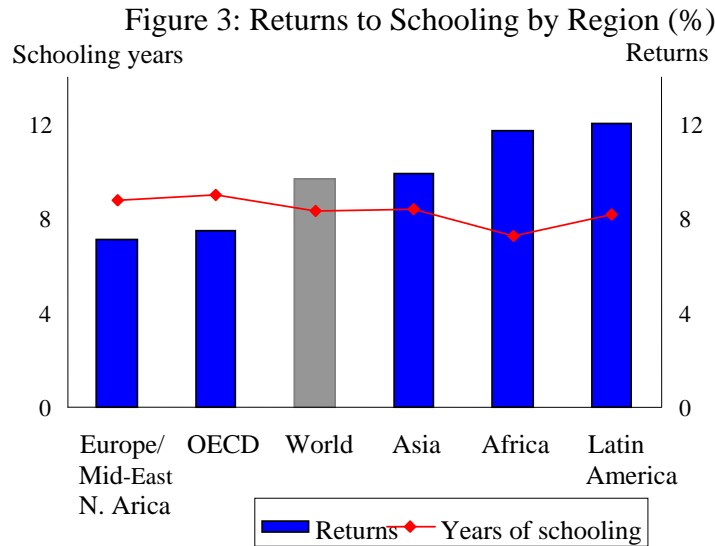
The earnings function method, also known as the Mincerian method (see Mincer 1974), involves the fitting of a function of log-wages (LnW) – usually hourly or weekly, using years of schooling (S), years of labor market experience (X) and its square (X^2) as independent variables. Thus, the basic earnings function is:

$$\ln W_i = \alpha + \beta S_i + \gamma_1 X_i + \gamma_2 X_i^2 + \varepsilon_i$$

In this semi-log specification, the coefficient on years of schooling (β) can be interpreted as the average private rate of return to one additional year of schooling, regardless of the educational level this year of schooling refers to. Also, the earnings function method can be used to estimate returns to education at different levels by converting the continuous years of schooling variable (S) into a series of dummy variables, say Dp , Ds and Du , to denote the fact that a person has completed the corresponding level of education (primary, secondary, university), and that, of course, there are also people in the sample with no education in order to avoid matrix singularity. Then, after fitting an extended earnings function using the above dummies instead of years of schooling in the earnings function, the private rate of return to different levels of education can be derived. Again, care has to be taken regarding the foregone earnings of primary school-aged children. Although convenient because it requires less data, this method is slightly inferior to the previous one as it, in fact, assumes flat age-earnings profiles for different levels of education (see Psacharopoulos and Layard 1979).

2. Applying Cost-Benefit Analysis to Education: Practice

The analysis described in the preceding section to estimate the rate of return to education has been applied often to argue why nations ought to invest more national resources to education. The latest results indicate that the average private rate of return to another year of schooling averaged over 100 countries is 10 percent (Psacharopoulos and Patrinos 2004). The returns are higher in lower income areas. The same diminishing returns apply across countries: the more developed the country, the lower the returns to education at all levels. The high returns to education in low-income countries must be attributed to the relative scarcity of human capital. The average private returns to another year of schooling by region are presented in Figure 3. The highest overall returns are found in Latin America, followed by sub-Saharan Africa. The lowest returns are in the educationally-advanced OECD and non-OECD Europe/Middle East/North Africa. Overall, women receive higher returns on their schooling investments; but for other reasons, in most countries, women receive less pay, regardless of occupation.



Source: Psacharopoulos and Patrinos 2004

For a long time the returns on educational investment were higher at lower levels of schooling. The scarcity of human capital in low-income countries provided a significant premium to investing in education. The high returns on primary education provide an added justification for making education a priority in developing countries. Over time, on average, the rate of return to education has fallen. This decline coincides with a significant increase in average years of schooling for the population as a whole. During the last 12 years, average returns on schooling have declined by 0.6 percentage points (Psacharopoulos and Patrinos 2004). At the same time, average schooling levels have increased. Therefore, and according to theory, everything else being the same, an increase in the supply of education has led to a slight decrease in the returns on schooling. That is, if there are no “shocks” – such as changes in technology – that increase the demand for schooling, then an increase in overall schooling levels should lead to a decrease in the returns to schooling.

Over the recent decades, we have seen the returns to schooling decline in many low-income countries, while the technological revolution has increased demand for skilled labor in some developed countries and the returns to schooling have increased. Amidst the fluctuations, there has been a downward trend in the returns to schooling since the 1980s. The proportion of the population with secondary schooling and above has risen markedly over the decades while the proportion of the population with only primary has declined. This means that primary education has become almost universal; subsequently the returns to primary schooling have declined the most over time. For secondary education, both rate of returns and the proportion of

population have risen together until the 1980s when the proportion of the secondary education population appears to be inversely related to the private rate of return to secondary education.

Estimates such as these have been used extensively in policy fora to argue that more needed to be invested in education, especially basic education. For example, in the campaigns for “Education for All,” analysts have used these rates of return as a call to action. While education is seen by many as a basic human right, these economic arguments are seen as essential to releasing the national resources to invest in schools and universities. In the 2002 Education for All Global Monitoring Report it is stated that “available estimates of rates of return for developing countries consistently show that both private and social returns to primary schooling are higher than at secondary and tertiary levels. Their magnitudes are generally greater than typical returns to capital in other economic sectors” (UNESCO 2002: 34). The Global Campaign for Education (2005: 3) argues that: “education, especially for girls, empowers families to break the cycle of poverty for good. Young women with a primary education are twice as likely to stay safe from AIDS, and their earnings will be 10-20 percent higher for every year of schooling completed. Evidence gathered over 30 years shows that educating women is the single most powerful weapon against malnutrition – more effective even than improving food supply. Without universal primary education, the other Millennium Development Goals – stopping AIDS, halving the number of people living in poverty, ending unnecessary hunger and child death, amongst others – are not going to be achieved.”

3. Limits to Applying Cost-Benefit Analysis to Guide Public Investments

While compelling for advocacy nationally and even globally, the rate of return estimates have proven to be less useful as a guide for setting government spending priorities at the

aggregate level. For example, the World Bank's *Public Expenditure Reviews* (PERs) are undertaken:

“to assist the borrowers in understanding their development problems and potential solutions as well as help illuminate the World Bank's own country assistance strategy. One of the major factors contributing to the success of the ensuing country lending program is therefore the quality of analysis undertaken in the PER. In an effort to improve the treatment in PERs of human development issues in general, and education sector issues in particular, the Human Development Network of the World Bank has formulated guidance notes for analyzing public expenditure in the human development sectors.”

<http://go.worldbank.org/6837YTCIR0>

When one looks at these guidance notes for education, including the section helpfully labeled, “Bottom line: How much is enough? Is public spending adequate and sustainable?” there is no mention of CBA.

At the micro level, the record is also, at best, mixed. Cost-benefit analysis was originally developed to guide public investments, especially in infrastructure, that are packaged as individual ‘projects’ which have well-defined time-bound objectives. While a great deal of education recurrent spending goes towards salaries, much public investment for capital, including that funded by international donors, are “projectized.”

Has CBA been used to justify these projects? The short answer is “not really.” The World Bank, as the world's premier investor in such projects, shows that while most have some sort of economic justification, only 39 percent were judged “good,” and a further 35 percent

were judged acceptable; the remaining 26 percent were judged marginal. Only 39 percent had a good cost-benefit analysis.

So, why has CBA, despite being so ‘naturally’ suited to guide educational investments, not been used to inform choices? The main reason is that, while it has been relatively straightforward to obtain estimates of the private returns to education, credible estimates of the social returns, which are necessary for public investment analysis, remain elusive. Indeed, until recently, education projects in developing countries were “exempt” from cost-benefit analysis because the benefits of such projects were “social” and were considered inherently unmeasurable. The World Bank’s Operational Policy – part of the procedures and policies defining lending and supervision activities of the World Bank for World Bank credits – 10.04, Economic Evaluation of Investment Operations (April 1994), states that “if the project is expected to generate benefits that cannot be measured in monetary terms, the analysis (a) clearly defines and justifies the project objectives, reviewing broader sectoral or economywide programs to ensure that the objectives have been appropriately chosen, and (b) shows that the project represents the least-cost way of attaining the stated objectives.” Besides a lack of formal cost-benefit analysis in education projects, this exemption also meant that education projects did not specify outcomes; it was also extremely rare to find any unit costs or quantitative analysis of alternatives. It also led some economists to consider the sector as “soft” and to reluctance among some finance ministers to borrow for education. While we would agree that the true benefits are difficult to measure, it is nevertheless possible to measure them.

Aside from the inability to obtain credible and robust estimates of social returns, two other critical constraints have prevented CBA from being a truly practical tool in public decision-

making. One is the CBA's shortcomings in accounting for the diverse nature of the outcomes of educational investments – beyond a year spent in school. And the other is the lack of evidence in attributing outcomes to investments. We discuss the need for more progress to be made in research in these areas.

Estimating social returns

Getting the counterfactual right. Traditional CBA assumes that the public sector is the sole financier and provider of education. The alternative to the public investment is often assumed to be no education at all. Therefore, the cost of the project is simply the cost of alternative investments to education (and the cost of mobilizing public funds, although that is often overlooked as well – see Devarajan, Squire and Suthiwart-Narueput 1997).

This simplistic assumption leads to problems in the analysis and could lead to an overestimate of the returns to the investment. In many countries, especially beyond basic education, the public sector is no longer a monopolist. What does this imply for CBA? At the very least, the counterfactual needs to take the effect on the private sector into account. When there is an active private sector, the expansion of public schools could simply draw students away from private schools. For example, in the Philippines, the share of the public sector has shifted from 1/3 of all secondary school students to 2/3. A recent study estimates that a project to expand public secondary schools would lead to an increase in enrollment that was 40 to 50 percent less than might be expected because of the substitution effect away from private schools (Jimenez and Sawada 2001). This phenomenon has spread to primary schools (see Table 1). In Pakistan, private schools at the primary level now account for 30 percent of total enrollment

(Andrabi et al. 2007). In India, almost 20 percent of rural students are enrolled in private schools, and almost 30 percent are in private schools in urban areas (Kingdon 2007).

Table 1: Private Enrollment Share, Selected Countries (%)

	Primary			Secondary		
	1990	2005	Δ	1990	2005	Δ
Benin	3	12	300	8	25	213
Bolivia	10	9	-14	26	16	-39
Brazil	14	10	-28	35	12	-65
Burkina Faso	9	14	56	41	39	-5
Chile	39	51	31	49	52	6
Colombia	15	19	27	39	24	-38
Eritrea	31	8	-74	11	6	-45
Indonesia	18	17	-6	49	44	-10
Jordan	23	30	30	6	16	167
Netherlands	69	69	0	83	83	0
Peru	13	16	23	15	22	47
Senegal	9	12	33	24	23	-3
South Africa	1	2	100	2	3	50
Thailand	10	16	60	16	13	-19
Togo	25	42	68	17	28	65
Tunisia	1	1	0	12	5	-58
United States	10	10	0	10	9	-10
Venezuela	14	14	0	26	25	-4

Source: UNESCO, OECD, EDSTATS

CBA also needs to estimate the “social” benefits and costs of the intervention by accounting for externalities, redistribution and correcting for other market failures.

Accounting for Externalities. The benefits of education may extend to others beyond the individual student. So, the true benefit from a year of education cannot be captured by the difference in earnings as a result of that year. According to Lucas (1988), for example, a worker's schooling enhances his or her own productivity as well as those of co-workers, thereby giving

rise to classical externalities or spillover effects. The general level of education in the workforce also expands production possibilities, by facilitating the discovery, adaptation and use of more economically rewarding, albeit technologically more demanding and knowledge-intensive, production processes.

Besides its direct impact on economic production, education can yield other, community-level benefits. These non-market effects include the possible contribution of education to improving social equity, strengthening national cohesiveness, reducing environmental stress through its effect on fertility and population growth, reducing crime rates, and so on (see Table 2 for a partial list).

Some studies have succeeded in identifying positive externalities, and have quantified them (see Weisbrod 1964; Haveman and Wolfe 1984; Wolfe and Zuvekas 1997). If one could include externalities to typical estimates, then social rates of return might well be higher than private rates of return on education, perhaps more than double (Haveman and Wolfe 1984; Wolfe and Zuvekas 1997). Rauch (1993) finds higher social returns (at 8.1 percent), compared to private returns (4.8 percent), by comparing worker's educational level and increases in wages with average educational level attained in United States metropolitan statistical areas. Acemoglu and Angrist (2000) also find higher social returns (9.1 percent versus 7.4 percent) by instrumenting quarter of birth dummies for individual education, and compulsory school attendance laws and child labor laws in states of birth for average education (see also Moretti 2002).

Table 2: Nonmarket and External Benefits of Education

Benefit type	Findings
Child education	Parental education affects child's educational level & achievement
Child health	Child's health positively related to parental education
Fertility	Mother's education lowers daughter's births
Own health	More education increases life expectancy
Spouse's health	More schooling improves spouse's health & lowers mortality
Job search efficiency	More schooling reduces cost of search, increases mobility
Desired family size	More schooling improves contraceptive efficiency
Technological change	Schooling helps R&D, diffusion
Social cohesion	Schooling increases voting & reduces alienation
Crime	Education reduces criminal activity

Source: Based on and adapted from Wolfe and Zuvekas (1997)

Externalities may be generated at all levels of education, but their magnitude may differ, implying different levels of subsidies. Many analysts would agree that lower levels of education produce more externalities than higher levels. Literacy and other knowledge imparted at the lower levels of education are generally seen as an effective means for achieving national identity and cohesiveness. Unfortunately, there is very little empirical evidence on the magnitude of externalities across education levels, though there are some intriguing new results. A one-year rise in the average primary schooling of neighboring farmers is associated with a 4.3 percent rise in output, compared to a 2.8 percent effect of one's own primary education in Uganda (Appleton 2000). Another study found that neighboring farmers' education raises productivity by 56 percent, while one's own education raises productivity by only 2 percent in Ethiopia (Appleton 2000); however, the 56 percent figure seems rather high. Overall, the results are inconclusive. In India, researchers have argued that, because other members of a household benefit from having even just one literate member who can read and write for them, the 'true' literacy rate is underestimated (Basu and Foster 1998).

Not having information about the magnitude of externalities can lead to inconclusive policy analysis. For example, for purely measurement reasons, most rate of return computations obtain estimates of social rates of return that are lower than those for private returns: social and private benefits are assumed to be the same because the former are almost impossible to estimate; and while the private costs include only the opportunity costs of children, the social costs are assumed to include the costs to the government as well. Taken at face value, this would imply that education should be privately provided and, in fact, need not be subsidized at all. The fact that the projects went ahead anyway with public funding may have been the right policy conclusion. Nevertheless, clearly the decision did not arise from the quantitative analysis.

Estimating distributional objectives. Income redistribution and poverty reduction are by now well-accepted social benefits (see World Bank 2006). Because it is so difficult in developing countries to use taxes and other revenues to redistribute income, societies must use spending to do so. Investments in education can be an important tool because it not only redistributes present income, it redistributes the opportunity to earn over the long term.

It is difficult to capture the redistribution objective in standard cost-benefit analysis. The theory of how to do so has been well established for many years. Squire and van der Tak's (1975) pioneering work showed how the standard rate of return formula could be adjusted with the proper distribution weights to come up with the right magnitude. In practice, however, it has been difficult to define such weights.

Recent analyses of the incidence of public spending indicate that the extent to which the social deviates from private benefits will vary by level of education. In fact, when one takes redistribution into account, the social benefit to primary education would be boosted relative to that of other levels of education. This point is illustrated in Table 3 which shows that the poorest quintile in several countries do not benefit from public subsidies to tertiary education.

Table 3: Proportion of Public Subsidy Received by the Poorest Quintile by Education Level

	Primary	Secondary	Tertiary
Colombia, 1992	39	21	5
Kenya, 1992/93	22	7	2
Ghana, 1991/92	22	15	6
Mexico, 1996	30	19 ^a	1
Morocco, 1998/9	17	4	2

^a For junior secondary education; for senior secondary education, the proportion is 5%
Source: Filmer 2003

Correcting for Market Failures. Another reason that wage differentials fail to capture the true returns to education is because of imperfect labor markets. The screening literature, for example, argues that the estimated earnings gains may overestimate the value of education because these gains are not necessarily due to the added productivity of the young student but because of the labor market values the sorting that schooling does between the highly and lowly skilled. If so, then, correcting for such information failures may be a better investment than the large capital and recurrent costs needed to expand a school system. This would argue for a social benefit curve that is lower than the private one depicted in Figure 2. However, we know of no studies in developing countries that can provide evidence of this.

Accounting for diverse educational outcomes

Most education projects no longer just aim to expand the number of years education, which has been the only outcome used in most CBA. As stated earlier, many countries have made exceptional progress in its goal of access to primary education. As projects expand their objectives to include quality improvements and more efficient management, CBA that measures only the returns to staying another year in school is no longer adequate.

Present techniques are ill-equipped to contend with a more diverse set of project outcomes. In the World Bank's assessment, only 64 percent of all project appraisal documents included provision for testing for learning performance which was judged good. Two others (9 percent) were judged acceptable. Six projects (27 percent) were judged to be only marginal in their arrangements for testing for learning performance. (One project financed only technical assistance and so testing was not applicable.)

One issue is how to estimate the rate of return, not to inducing another child to stay in school one more year, but to having that child learn more than he or she would have otherwise. The literature on what affects learning outcomes has been fraught with many pitfalls. The role of improved schooling, a central part of most development strategies, has become controversial because expansion of school attainment has not guaranteed improved economic conditions. The evidence is just beginning to be gathered. Hanushek and Woessmann (2007) review the role of education in promoting economic well-being, focusing on the role of educational quality. They conclude that there is strong evidence that the cognitive skills of the population – rather than

mere school attainment – are powerfully related to individual earnings, to the distribution of income, and to economic growth. New empirical results show the importance of both minimal and high-level skills, the complementarity of skills and the quality of economic institutions, and the robustness of the relationship between skills and growth. International comparisons incorporating expanded data on cognitive skills reveal much larger skill deficits in developing countries than generally derived from just school enrollment and attainment. The magnitude of change needed makes it clear that closing the economic gap with industrial countries will require major structural changes in schooling institutions.

Glewwe and Kremer (2006) argue that schools in developing countries face significant challenges. These include distortions in educational budgets often leading to inefficient allocation and spending of funds; weak teacher incentives leading to problems such as high rates of teacher absenteeism; and curriculums often focused excessively on the strongest students and not well-matched with the typical student, especially considering the high rates of teacher and student absenteeism. Numerous school reform initiatives have been proposed, ranging from programs designed to strengthen links between teacher pay and performance, to reforms to decentralize budget authority, to voucher and school choice programs. Although the evidence is scarce on teacher incentive programs in developing countries, results from Israel suggest that teacher incentives positively and significantly affected student education outcomes (and mainly for weaker students). Results from Kenya suggest that teacher incentives increased teachers' efforts on short-run outcomes (test scores) but not on stimulating long-run learning (through changes in teacher attendance, student dropout rates, or pedagogy) (Glewwe, Ilias and Kremer 2003). Decentralization programs appear promising, but the results of decentralization policies

appear to be very heavily dependent on the details of implementation. Finally, a school choice program in Colombia yielded dramatic benefits for participants (Angrist et al. 2002; Angrist, Bettinger and Kremer 2006), but evidence from voucher programs in Chile (Hsieh and Urquiola 2006) and developed countries suggests that more research is needed to gauge the generalizability of such program impacts.

It is necessary to incorporate in the analysis the effects some of the likely challenges one will face in implementing education programs in developing countries. Inefficient spending will lead to leakage and delays in program implementation, thus affecting the benefit stream. Low teacher effort will affect the quality of the interventions, also affecting the benefit stream. Some of this “inefficiency” may be a result not only from lack of capacity, but also from a lack of fiduciary controls that guard against corruption. Teacher and student absenteeism can also be incorporated in the sensitivity analysis. These realities then become checks on our assumptions and allow us to produce a more reliable range of likely cost-benefit streams. In addition, more research is needed on the effects of reform initiatives, which are often the components of education projects, on what students learn.

Attribution

Many projects seek to expand the educational system of a country. One problem is attributing any change in outcomes to the project, as opposed to the myriad of other factors which could lead to an expansion of enrollment. This could in principle be corrected for by comparing expected educational outcomes in a project site with those places not included in the project. However, it could be that the population in a project site is not strictly comparable with

those outside the project. Educational authorities, for example, could target disadvantaged areas and this could lead to an underestimate of project benefits because the expected gain in the project areas would be less due to the characteristics of people there.

The attribution problem can be addressed when proper impact evaluations of earlier projects are used for prospective evaluations. This is still a work in progress. At the World Bank, for example, only 26 percent of all education projects approved in the 2006 fiscal year contained evidence from, or a plan for, an impact evaluation.

Impact evaluations of projects and programs provide important information for decision makers in determining how to prioritize and fund interventions (Cook 2003; Barrow and Rouse 2005). Sometimes the additional cost of doing a thorough impact evaluation is actually quite small. When projects are results-oriented and require baseline data, an intelligently designed initial collection of data can determine whether or not an impact evaluation will be feasible – sometimes without any additional data collection. The main cost of a random assignment study is the cost of collecting data, and the cost of collecting data for a bad study is just as high as collecting data for a good one (Angrist 2004).

Critics sometimes claim that impact evaluations only tell us whether something has an impact without telling us why and how. But a good impact evaluation can provide reliable evidence about how the outcome is achieved when it simultaneously collects information on processes and intermediate outcomes. Impact evaluations are not a replacement for theories, models, needs assessments, and monitoring, all of which are needed to complement the analysis

of impact. However, it is equally true that the knowledge gained from impact evaluations is a necessary complement to these other kinds of analyses (Savedoff and others 2005).

While policymakers are keen to know the likely impacts on student academic achievement of various policy interventions, retrospective studies offer only limited guidance. Even the best retrospective studies suffer from serious estimation problems, the most serious being omitted variable bias with respect to school and teacher characteristics, unobserved child and household characteristics that are correlated with observed school and teacher variables, and measurement error in school and teacher data. This has turned attention in recent years to many studies based on natural experiments and randomized trials.

Evidence from recent natural experiments in middle-income countries suggests that increases in school resources (as measured by the student-teacher ratio) raise academic achievement on reading tests (but not math tests) among black students in South Africa (Case and Deaton 1999). Case and Deaton (1999) examined education outcomes in South Africa using data collected in 1993, when government funding for schools was highly centralized and blacks had virtually no political representation of any kind. The authors argue that blacks did not control the funds provided to their children's schools and that tight migration controls limited their ability to migrate to areas with better schools. Studies using Israeli data indicate that reducing class size raises reading scores and (less often) math scores (Angrist and Lavy 1999) and that providing computers has no effect on academic performance (Angrist and Lavy 2002).

Randomized trials offer evidence from some relatively poorer developing countries as well. In Nicaragua, workbooks and radio instruction had significant impacts on pupils' math

scores, and the impact of radio education was particularly high (Jamison et al. 1981). Provision of textbooks raised performance on academic tests in the Philippines (Tan, Lane and Coustere 1997), but in Kenya the only effect of textbooks was among the better students (most likely because the textbooks were too difficult for many students) (Glewwe, Kremer and Moulin 2006). Evidence from Kenya also suggests little impact on test scores of reductions in class size (Glewwe, Kremer and Moulin 2006), flip charts (Glewwe et al. 2004) and deworming medicine (Miguel and Kremer 2004), although school meals were found to have positive impacts on test scores as long as teachers were well trained (Vermeersch and Kremer 2004). A remedial education program in urban India, focused on improving the learning environment in public schools, appears to have increased test scores at a low cost (Banerjee et al. 2000).

While these natural experiments and randomized trials are beginning to build a database of results that are less likely to suffer from the estimation problems that plague retrospective studies, a much larger set of results is needed before they can be used in CBA and general conclusions can be drawn for policymakers. But even, some results are evident. One interpretation of these results is that in many developing countries, the most effective means of improving school quality may be through addressing the problem of weak teaching. The remedial education program in urban India, the radio mathematics program in Nicaragua, and the computer instruction program in India all provided inputs which addressed the problem of weak teaching, whereas programs which provided inputs that were dependent on use by the teachers themselves (such as the flipcharts and, to some extent, the textbook program in Kenya) were less effective.

4. Can Cost-Benefit Analysis still be a useful guide for education policy?

Given the difficulties of calculating social rates of return in education, one might be tempted to eschew cost-benefit analysis all together. In fact, as noted earlier, some agencies have done exactly that, by exempting education projects, say, from undergoing CBA, which infrastructure projects go through. The argument simply is that education investments are worthwhile to do for non-economic reasons and in that case, policy analysts need only ensure that it is provided at least cost.

If CBA is narrowly construed to be rate of return or NPV calculation, then, we believe that, for the reasons outlined earlier, it will continue to have limited applicability in real-world policy settings for education. The empirical literature to date is simply too limited for analysts to obtain robust estimates of social benefits. However, if CBA is defined less as an exercise to calculate one figure, such as an IRR or NPV that is the go or no-go decision criterion, and more as a rigorous argumentation that the benefits of an investment outweigh the costs, even if not all of them are quantified, then they can greatly improve policy-making.

Such an analysis will be necessary to convince policy makers, especially core economic ministries such as finance, budget or planning, to allocate the appropriate budget for education, especially as developing countries make crucial decisions that go well-beyond expanding primary education, where the social benefits are uncontroversial. Almost all countries recognize the need to provide basic education for all as a *sine qua non* of nationhood. But the trade-offs become more obvious as countries decide how much to invest in improving what goes on in schools, in expanding access to secondary and even tertiary level institutions, and in rationalizing

the technical and vocational education curriculum with an academic one. In these decisions, CBA, even if it does not produce the ‘classical’ IRR, is crucial in informing the tough choices that policy makers need to make.

Research shows that good project economic analysis, including cost-benefit analysis, is strongly associated with better project outcomes. In fact the quality of the cost-benefit analysis is associated with higher quality of project outcomes. The probability of less than satisfactory project outcomes given a poor economic analysis rating at the design stage is four times higher than that for a project with good quality economic analysis (Vawda *et al.* 2003). Moreover, from a political economy point of view, simply arguing that it is worthwhile to invest in education because it is a social responsibility may not carry much weight in hard-nosed discussions with finance and budget ministries that must make hard choices across all sectors.

Such results have prompted large institutions that finance much of education spending in developing countries, such as the World Bank, to reevaluate the earlier exemptions against CBA and to begin go reemphasize CBA as part of its economic analysis of projects. The economic analysis of a project is supposed to help select and design projects that contribute to the welfare of a country. Various tools of economic analysis help determine the economic and fiscal impact of the project, including the impact on society and the major stakeholders involved, as well as the project’s risks and sustainability (see Box 1)

Box 1: A Good Economic Analysis Answers the Questions

1. What is the objective of the project? This helps identify tools for the analysis. A clearly defined objective also helps in identifying the possible alternatives to the project.
2. What will be the impact of the project? This question concerns a counterfactual as the difference between the situation with or without the project is crucial for assessing the incremental costs and benefits of the project.
3. Are there any alternatives to the project? If so how would costs and benefits of the alternatives to achieve the same goal compare to the project in question?
4. Is there economic justification of each separable component of the project?
5. Who gains and who loses if the project is implemented? The analysis has to make sure that the most benefit accrues to the poor.
6. What is the fiscal impact of the project?
7. Is the project financially sustainable and what are the risks involved?
8. Are there any other externalities? What is the environmental impact of the project?

Source: Belli 1996

Even if one cannot do a CBA that produces an IRR for an entire project, it is often very useful to do such calculations on a subset of project components where quantification is more feasible. This type of CBA, limited though it may be, can still produce very useful practical guidance, as shown in the Ethiopia example below. In other cases, it may be better to simply limit oneself to cost-effective analysis, as shown in the example from the Philippines which follows the discussion on Ethiopia.

CBA on a project component: Ethiopia

The World Bank's Ethiopia Education Sector Development Program (ESDP) is noteworthy for its complexity. The ESDP is an expenditure program to restructure and expand Ethiopia's educational system, aims to improve overall educational attainment while achieving greater social equity. Its longer-term objective is to achieve universal basic education by 2015. The project to support it has many components, including the building, upgrading and renovation

of primary schools, curricular reform, teacher upgrading, book provision at the basic education level. At the secondary level, the program contributes to the expansion of secondary school facilities, curriculum revision, teacher upgrading, and instructional materials and equipment. For technical and vocational education and training, the program supports employer and market surveys and the encouragement of private participation. For teacher training the program contributes to upgrading and expansion of teacher training facilities, curriculum revision, distance education, head teacher training, and establishment of national standards. The fifth component assists in the expansion of the tertiary sector. Finally, an institutional development component supports planning, financial management, implementation, and monitoring and evaluation capacities of the Ministry of Education. A comprehensive CBA of such a program would not be feasible given issues pointed out in the earlier sections of estimating social returns, the distributive effects and attribution. Moreover, the data in Ethiopia are sparse and of low quality.

The economic analysis of this project was guided by the questions listed in Box 1. The work included fiscal impact analysis, institutional risk analysis, analysis of alternatives, and poverty analysis, all supported by broader country and economic work. A crucial part of the work also includes cost-benefit analysis of one part of the project – which could have led to different design alternatives had it not been undertaken.

One of the main activities is the building, upgrading and renovation of primary schools. In fact, there will be 2,423 new first cycle primary schools built within walking distance of communities. The massive civil works campaign requires the coordinated effort of planners,

educators, communities and contractors. New primary school construction alone is a costly exercise (912 million Ethiopian *Birr* or US\$ 325 million), representing 25 percent of the capital expenditure of ESDP. These schools will need to accommodate the students required to enroll in order for the project to attain the enrollment targets set in the ESDP.

To make it a good investment, the schools will have to last beyond the period of the ESDP, so that Ethiopia can attain the goal of universal primary education by the year 2015, as set in the Government plan. In order for schools to last, maintenance becomes an issue. Historically, schools in Ethiopia have been built with a variety of materials, depending on local conditions, donor involvement and community participation. During the previous regime, enrollment drives necessitated the construction of *chika* – mud and thatch – schools, which are quick and cheap to construct, but require heavy maintenance and in any case do not last many years. In more recent years a variety of cheap techniques have been used in order to increase enrollments, including open-air schools. Parents and communities do not appreciate the *chika* schools, which do not resist termites and wash away in the rain. The building of *chika* schools also contributes to the depletion of forests. Routine maintenance of school buildings is not a tradition in Ethiopia. Very little maintenance and repair activities have been performed over the years. However, it is demonstrated that the community is more interested in maintaining the element schools because they value them more than the *chika* schools. Still, school committees are not interested in maintaining schools, regardless of government proclamation. It is necessary, therefore, that the government makes routine maintenance a priority and take appropriate policy decisions. Any kind of *chika* structure requires more maintenance than schools built by element (hollow concrete block, stone, concrete element).

Under ESDP, schools will be built by something other than *chika*, unless there are no local alternatives. *Chika* schools are considered uneconomical and should be abandoned. But does this make economic sense? CBA was employed to answer this question.

Household survey data was used to estimate the returns to schooling. In 1996, in Ethiopia the returns to schooling are high. Overall, another year of schooling is associated with a 23 percent gain in earnings. Returns are high for both males and females, at 23 and 22 percent; in rural and urban areas, at 21 and 15 percent; and by level, that is, primary, secondary and university, at 25, 24 and 27 percent. So while these estimates might tell us that education overall is a good investment in Ethiopia, they offer no guidance on what level is more appropriate, nor do they give any guidance about the main investment objective, getting more children into school, or more specifically what sort of buildings should be constructed.

Chika schools certainly are a cheap initial investment (Table 4). However, the maintenance requirements are heavy and even a fully maintained *chika* school will not last much longer than ten years.

Table 4: Cost Comparison of School Buildings, 1992 Birr*

Material	Capital (Investment)	Recurrent (Maintenance)	Life time (years)	Cost/year Lifetime
Concrete element	213,000	2,130	40	7,455
Stone	189,284	1,893	40	6,625
Brick	170,400	5,000	30	10,680
Hollow Concrete Block	127,800	1,278	30	5,538
<i>Chika</i>	85,200	6,000	10	14,520
Corrugated Iron Sheet	31,950	5,000	10	8,195

The question of which technology to adopt for school buildings depends on crossover discount rates (Hirshleifer 1958). The lower the discount rate the more attractive are materials other than *chika*. Using information on construction, transportation and maintenance costs, a cost-benefit analysis was carried out to determine which building material would be the best choice for ESDP, assuming a 30 year time profile, so that concrete and stone involve one project, brick and hollow concrete block involve 1.33 projects, and *chika* and corrugated iron sheet involve four projects. The results of the analysis are summarized in Table 5. Fully maintained, hollow concrete block is a much better alternative. Assuming a discount rate of 12 percent, then the preferred investment option is hollow concrete block.

Table 5: Summary Cost-Benefit Analysis of School Buildings
Internal Rates of Return*

Material	Full Maintenance	Half Maintenance	Transportation Difficulties: Cost Escalation		
			10%	20%	30%
Concrete element	6%	9%	7%	5%	2%
Stone	8%	11%	10%	8%	6%
Brick	5%	12%	10%	6%	3%
Hollow Concrete Block	17%	23%	19%	14%	8%
<i>Chika</i>	(base case)	(base case)	(base)	(base)	(base)

Note: Since the estimates of the life span of school buildings is arbitrary, then it is assumed that concrete, stone, brick and concrete block buildings last for 40 years. Since stone is not transported, but only the concrete necessary, the transportation cost increases are reduced to 5, 10 and 15 percent

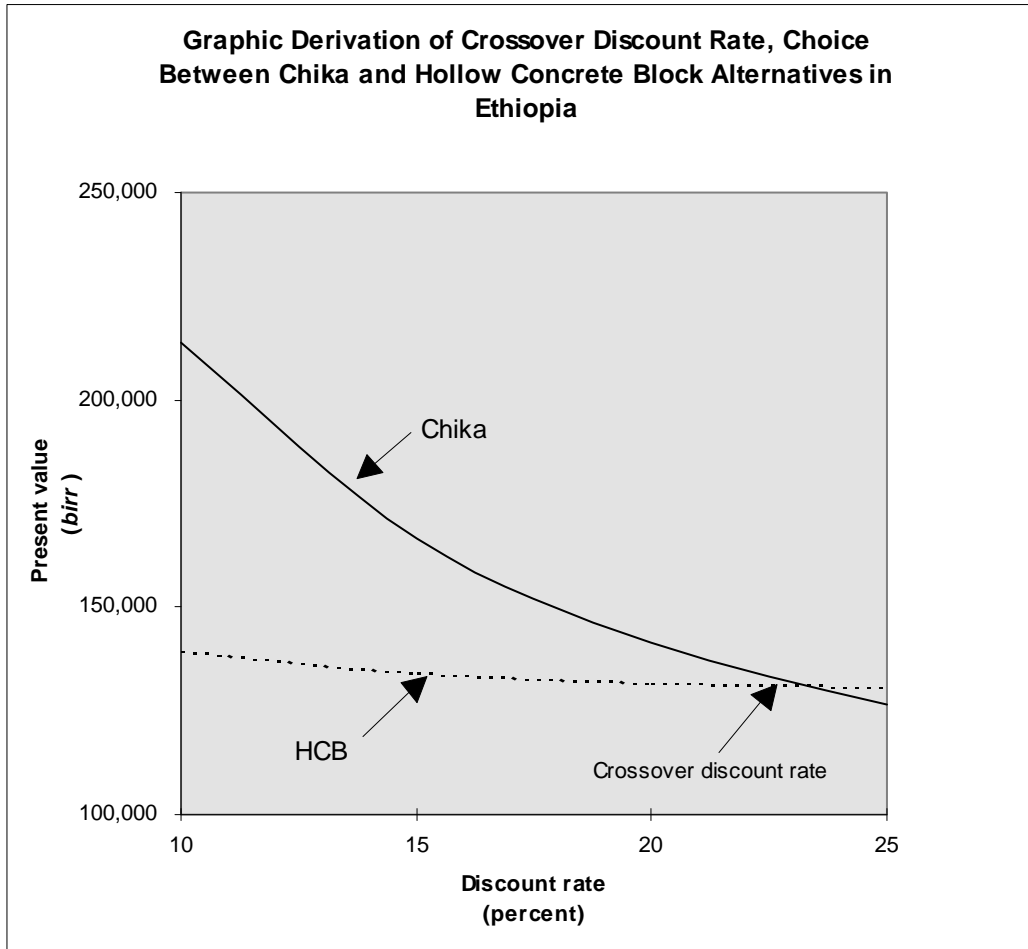
* Internal rate of return calculations based on savings due to selection of material versus *chika*

However, maintenance is an issue in Ethiopia. Experience shows that school buildings are not well maintained in Ethiopia. *Chika* requires heavy maintenance. There is no indication that this will take place. Therefore, the assumption of full maintenance is not realistic. For this reason, a sensitivity analysis considers the more realistic case that maintenance will be less than adequate. For simplicity's sake, half of the required maintenance is assumed to take place. Effectively, this makes all alternative technologies preferable to *chika* construction. Given the fact that parents and communities are more likely to get involved in the maintenance of element schools, then the returns to switching to an alternative technology are likely underestimated here. With the more realistic assumption of half maintenance, brick and stone, and possibly concrete element, are good investments.

The choice of technology of course depends also on the availability of local materials. It may simply not be possible to transport certain materials to remote areas. For many rural areas there will be impossible transportation problems. In such cases there is no alternative other than building with *chika*. In less severe cases there may be roads, but the cost of transporting

materials may be prohibitive. To examine this problem, sensitivity analysis was carried assuming scenarios of cost escalation due to transportation difficulties using orders of magnitude of 10 to 30 percent. The results show that even in the case of hollow concrete block there are instances when it is not a good investment. All of the alternatives to *chika* have a lower present value. However, the total undiscounted cost of using the different alternatives is different and they have differing time profiles. Therefore, the alternative one chooses may depend on the opportunity cost of capital. In the cases examined here, the higher the opportunity cost of capital assumed the greater the likelihood of choosing *chika* over the alternative. This is because with the *chika* model one is postponing investment. In other words, there is a discount rate at which *chika* becomes the preferred option, despite higher undiscounted total cost or lower present value of the alternatives. To illustrate this example, the case of *chika* versus hollow concrete block (HCB) is used. The present value of the two methods, assuming half maintenance costs, is plotted along with the associated discount rate (Figure 4). As is shown in the graph, there is a discount rate at which building *chika* schools is preferred to HCB. This is known as the crossover discount rate (Gittinger 1995), which is 23 percent in the case highlighted. This is the same as the internal rate of return calculated for the benefits (cost-savings) stream presented above for the case of half-maintenance, which is (hopefully) the realistic scenario.

Figure 4



Lose the Social Benefits: Cost-effectiveness analysis in the Philippines

Another practical method that can be used when social benefits are not estimable is to use cost-effective analysis. Cost-effectiveness is appropriate whenever the project has a single goal that is not measurable in monetary terms: for example, to provide education to as many children as possible but through several interventions that simultaneously increase reading speed, comprehension, and vocabulary, but that are not equally effective in achieving each of the goals. Comparing among methods to achieve these aims requires that we reduce the three goals to a single measure, for which we need some weighting scheme.

An example of how to apply this technique is a project in the Philippines. Concern about high dropout rates and poor student performance in elementary schools led the Philippine government to embark on a long-term plan for improvement. Under the 10-year Program for Comprehensive Elementary Education Development launched in 1982, the government invested an estimated \$800 million (in 1981 prices), with support from the World Bank, in such inputs as textbooks, equipment, resource materials, staff training and classroom facilities. In 1990, a follow-up Bank-financed project continued support for investments totaling \$410 million (1990 prices) over a 4-year period. To inform the design of the future investments, Tan, Lane and Coustere (1995) used data generated under the previous two World Bank operations to assess the cost-effectiveness of alternative inputs to improve student learning. The authors first estimated the relation between selected school inputs and student learning using regression analysis, and then estimated the costs of the relevant input. The available data permitted evaluating the individual effects on student learning of workbooks, classroom furniture, class size, teacher qualifications, and preschool education, controlling for variations in student's initial levels of learning and their family background, as well as for differences in classroom and school management practices. Simple division of the costs by the corresponding regression coefficients gave the desired cost-effectiveness ratios.

The results showed that in this particular case smaller classes and higher teacher qualifications had no effect on student performance, and therefore could be ruled out as priorities for policy intervention. Three school inputs – workbooks, classroom furniture, and preschool education – had unambiguously positive effects on learning. Because in this case preschool education was costly, it was less cost-effective than the other two inputs.

5. Conclusions

We have argued that CBA is still a potentially important tool in the economists' arsenal. But it is essential that research especially on the social benefits of education, make further progress if it is to be used on a day-to-day basis to calculate credible rates of return quantitatively. To make CBA a more useful tool, we have also called for more research on the effects of policy interventions on outcomes beyond access to a year in school and what they earn as a result, such as on what children actually learn. Such research should focus on ensuring that the interventions can actually be attributed to observed outcomes. This is now being done with the push for more impact evaluation (Duflo 2004; Duflo and Kremer 2004).

In the meantime, we think that it is still worthwhile to go through the discipline of noting the benefits and costs even if social IRR or NPVs of comprehensive education projects cannot be calculated robustly. Research shows that projects that have some form of competently done CBA have better outcomes than those which do not. We have given examples where CBA on individual project components where it is feasible to estimate benefits and costs or cost-effective analysis have made significant contributions to project design.

References

- Acemoglu, D. and J. Angrist. 2000. "How Large Are Human Capital Externalities? Evidence from Compulsory Schooling Laws." *NBER Macroannual*.
- Andrabi, T., J. Das and AI. Khwaja. 2007. "Religious School Enrollment in Pakistan: A Look at the Data." *Comparative Education Review* 51(4): 446-477.
- Angrist, J.D. 2004. "American Education Research Changes Tack." *Oxford Review of Economic Policy* 20(2): 198-212.
- Angrist, J. and V. Lavy. 2002. "New evidence on classroom computers and pupil learning." *Economic Journal* 112(482): 735-786.
- Angrist, J. and V. Lavy. 1999. "Using Maimonides' rule to estimate the effect of class size on children's academic achievement." *Quarterly Journal of Economics* 114(2): 533-576.
- Angrist, J. and V. Lavy. 1996. "The Effect of Teen Childbearing and Single Parenthood on Childhood Disabilities and Progress in School." National Bureau of Economic Research Working Paper No. 5807.
- Angrist, J., E. Bettinger, E. Bloom, E. King, and M. Kremer. 2002. "Vouchers for Private Schooling in Colombia: Evidence from a Randomized Natural Experiment." *American Economic Review* 92(5): 1535-58.
- Angrist, J., E. Bettinger, and M. Kremer. 2006. "Long-Term Educational Consequences of Secondary School Vouchers: Evidence from Administrative Records in Colombia." *American Economic Review* 96(3): 847-862.
- Appleton, S. 2000. "Education and Health at the Household Level in Sub-Saharan Africa." Center for International Development Working Paper No. 33. Cambridge, MA: Harvard University.

- Banerjee, A., S. Jacob, M. Kremer, J. Lanjouw and P. Lanjouw. 2000. "Promoting school participation in rural Rajasthan: Results from some prospective trials." Mimeo. MIT.
- Barro, R.J. and J.-W. Lee. 2000. "International Data on Educational Attainment: Updates and Implications." CID Working Paper No. 42.
- Barrow, L. and C. Rouse. 2005. "Causality, Causality, Causality: The View of Education Inputs and Outputs from Economics." Working Paper 2005-15, Federal Reserve Bank of Chicago.
- Basu, K. and J.E. Foster. 1998. "On Measuring Literacy." World Bank Policy Research Working Paper No. 1997.
- Belli, P. 1996. *Handbook on Economic Analysis of Investment Operations*. Washington, DC: World Bank.
- Case, A. and A. Deaton. 1999. "School inputs and educational outcomes in South Africa." *Quarterly Journal of Economics* 114(3): 1047–1085.
- Cook, T.D. 2003. "Why have educational evaluators chosen not to do randomized experiments?" *Annals of American Academy of Political and Social Science* 589: 114-149.
- Devarajan, S., L. Squire and S. Suthiwart-Narueput. 1997. "Beyond Rate of Return: Reorienting Project Appraisal." *World Bank Research Observer* 12(1): 35-46.
- Duflo, E. 2004. "Scaling Up and Evaluation," in F. Bourguignon and B. Pleskovic, eds., *Accelerating Development*, World Bank and Oxford University Press: Washington, DC and Oxford.
- Duflo, E. and M. Kremer. 2004. "Use of Randomization in the Evaluation of Development Effectiveness," in O. Feinstein, G.K. Ingram and G.K. Pitman, eds., *Evaluating*

- Development Effectiveness* (World Bank Series on Evaluation and Development, Vol 7),
Transaction Publishers: New Brunswick, NJ.
- Filmer, D. 2003. "The incidence of public expenditures on health and education." Background
Note for World Development Report 2004, World Bank.
- Gittinger, J.P. 1995. *Economic Analysis of Agricultural Projects* (second edition). Baltimore:
Johns Hopkins University Press.
- Glewwe, P. and M. Kremer. 2006. "Schools, Teachers, and Education Outcomes in Developing
Countries," in E.A. Hanushek and F. Welch, eds., *Handbook of the Economics of
Education*, Volume 2. Elsevier.
- Glewwe, P., N. Ilias and M. Kremer. 2003. "Teacher Incentives." Poverty Action Lab Paper
No. 11.
- Glewwe, P., M. Kremer, S. Moulin and E. Zitzewitz. 2004. "Retrospective vs. prospective
analyses of school inputs: The case of flip charts in Kenya." *Journal of Development
Economics* 74: 251–268.
- Glewwe, P., M. Kremer and S. Moulin. 2006. "Textbooks and test scores: Evidence from a
randomized evaluation in Kenya." Mimeo. University of Minnesota and Harvard
University.
- Global Campaign for Education. 2005. *Missing the Mark: A School Report on Rich Countries’
Contribution to Universal Primary Education by 2015*.
- Haveman, R.H. and B. Wolfe. 1984. "Schooling and Economic Well-Being: The Role of Non-
Market Effects." *Journal of Human Resources* 19(3):128-140.
- Hirshleifer, J. 1958. "On the Theory of Optimal Investment Decision." *Journal of Political
Economy* 66(4): 329-352.

- Hsieh, C.-T. and M. Urquiola. 2006. "The effects of generalized school choice on achievement and stratification: Evidence from Chile's voucher program." *Journal of Public Economics* 90 (8-9): 1477-1503.
- Jamison, D., B. Searle, K. Galda and H. Stephen. 1981. "Improving elementary mathematics education in Nicaragua: An experimental study of the impact of textbooks and radio on achievement." *Journal of Educational Psychology* 73(4): 556–567.
- Jimenez, E. and Y. Sawada. 2001. "Public for private: the relationship between public and private school enrollment in the Philippines." *Economics of Education Review* 20(4): 389-399.
- Kingdon, G. 2007. "The progress of school education in India." *Oxford Review of Economic Policy* 23(2): 168–195.
- Lucas, R. 1988. "On the mechanics of economic development." *Journal of Monetary Economics* 22(1): 3-42.
- Miguel, E. and M. Kremer. 2004. "Worms: Identifying impacts on education and health in the presence of treatment externalities." *Econometrica* 72(1): 159–217.
- Mincer, J. 1974. *Schooling, Experience and Earnings*. New York: Columbia University Press.
- Moretti, E. 2002. "Estimating the social return to higher education: evidence from longitudinal and repeated cross-section data." NBER Working Paper 9108, Cambridge, MA.
- Perkins, D.R., S. Radelet and D.L. Lindauer. 2006. *Economics of Development* (6th edition). New York: WW Norton.
- Psacharopoulos, G. 1995. "The Profitability of Investment in Education: Concepts and Methods." Human Capital Development and Operations Policy Working Papers Number 63, World Bank, Washington DC.

- Psacharopoulos, G. and R. Layard. 1979. "Human capital and earnings: British evidence and a critique." *Review of Economic Studies*.
- Psacharopoulos, G. and H.A. Patrinos. 2004. "Returns to investment in education: a further update." *Education Economics* 12(2): 111-134.
- Rauch, J. 1993. "Productivity gains from geographic concentration of human capital, Evidence from the Cities." *Journal of Urban Economics* 34: 384–400.
- Savedoff, W.D., R. Levine and N. Birdsall. 2005. "When Will We Ever Learn? Recommendations to Improve Social Development through Enhanced Impact Evaluation." Consultation Draft, Center for Global Development, Washington, DC.
- Squire, L. and H.G. van der Tak. 1975. *Economic Analysis of Projects*. Washington, DC: World Bank and Johns Hopkins University Press.
- Tan, J.-P., J. Lane and P. Coustere. 1997. "Putting inputs to work in elementary schools: What can be done in the Philippines?" *Economic Development and Cultural Change* 45(4): 857–879.
- UNESCO. 2002. *EFA Global Monitoring Report 2002*. Paris: UNESCO.
- Vawda, A.Y., P. Moock, J.P. Gittinger and H.A. Patrinos. 2003. "Economic Analysis of World Bank Education Projects and Project Outcomes." *International Journal of Educational Development* 23: 645-660.
- Vermeersch, C. and M. Kremer. 2004. "School meals, educational attainment, and school competition: Evidence from a randomized evaluation." World Bank Policy Research Working Paper WPS3523.
- Weisbrod, B.A. 1964. *External Benefits of Education*. Princeton, NJ: Princeton University, Industrial Relations Section.

Wolfe, B. and S. Zuvekas. 1997. "Non-Market Effects of Education." *International Journal of Education Research* 27(6): 491-502.

World Bank. 2006. *World Development Report 2006: Equity and Development*.