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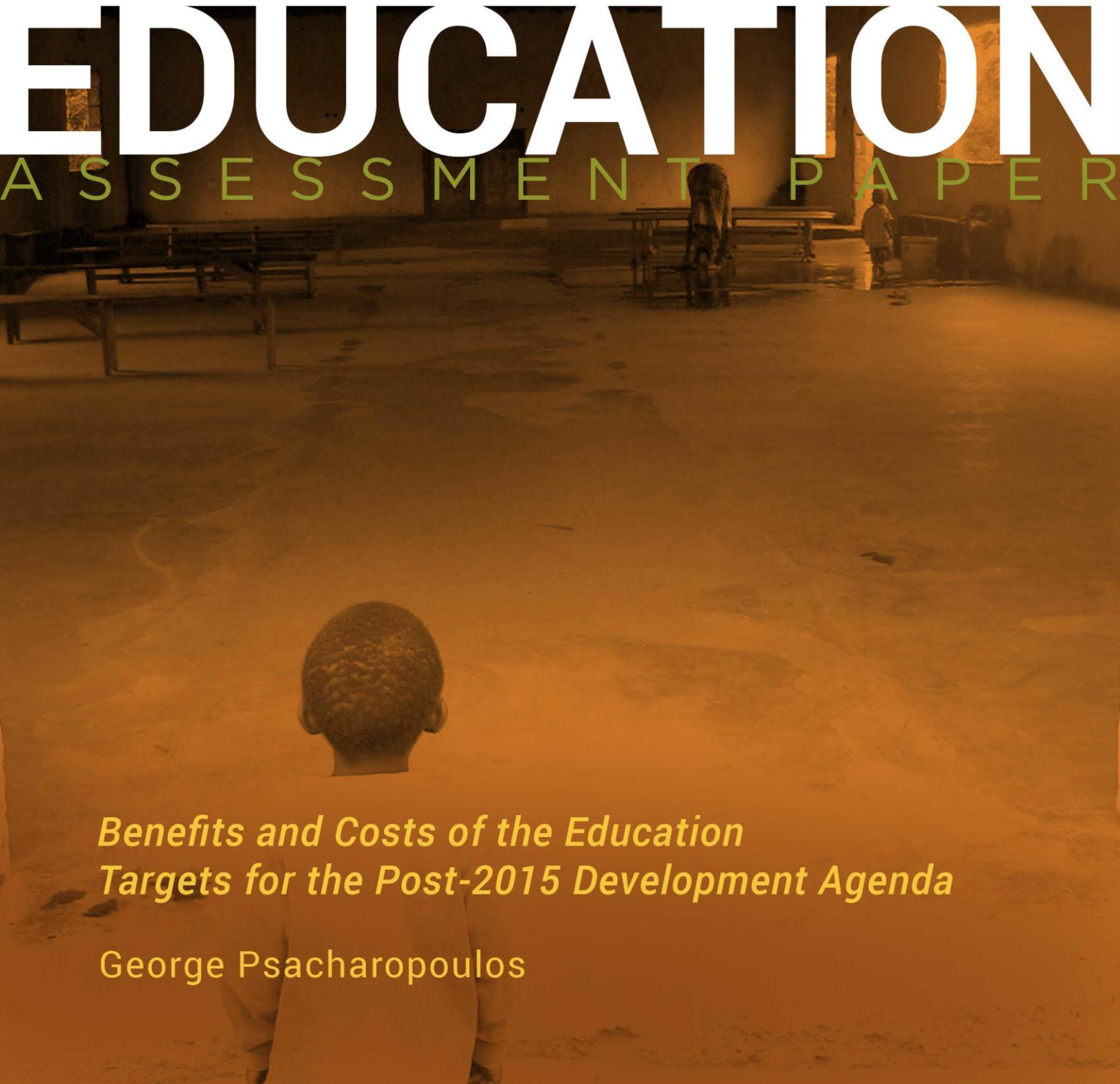

Benefits and Costs of the Education Targets for the Post-2015 Development Agenda

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POST-2015 CONSENSUS

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Highlights

Within education, the targets that have the highest benefit-cost ratios are:

- Increase the preschool enrollment ratio is Sub-Saharan Africa from the present 18% to 59%, which has a benefit-cost ratio of 28 to 37.
- Increasing the primary education enrollment ratio in sub-Saharan Africa from 75% to 100%, which has a benefit-cost ratio between 5 and 8.
- Improving school quality by increasing student test scores by one standard deviation, which has a benefit-cost ratio between 3 and 5.

A valuable target within the focus area is:

- Ensuring secondary school completion which has a 3 to 4 benefit-cost ratio.

The following targets are relatively ineffective or there is large uncertainty regarding the benefit-cost ratio:

- Providing vocational education within the main school system.
- Education and training programs for older workers.

Benefit-cost ratios for selected 2030 education targets

Domain	Target	Discount rate	
		3%	5%
Preschool	Increase the preschool enrollment ratio is Sub-Saharan Africa from the present 18% to 59%	37	28
Primary	Increase the primary enrollment ratio is Sub-Saharan Africa from the present 75% to 100%	8	5
Quality	Increase student test scores by one standard deviation	5	3
Secondary	Ensure secondary school completion	4	3

Introduction

The Post-2015 MDG discourse has generated an omnibus of education goals and targets to be fulfilled by 2030. The aim of this paper is to have a closer look at such targets and identify the most concrete and prominent ones that are amenable to cost-benefit analysis. Based on existing research, the targets are evaluated according to findings in the economics of education literature. A short list of education targets is prioritized that are likely to be most cost-effective if reached by 2030.

The following section presents a historical perspective of international target settings in education. Section 3 reviews the education targets in the ongoing Post-2015 discourse. Section 4 presents the methodology that has been used in the literature for cost-benefit analysis of education. Section 5 presents empirical findings on the profitability of investment in education. Section 6 reviews the current education conditions on which future targets are built. Section 7 estimates benefit-cost ratios for the most prominent targets. The paper concludes with some remarks on the utility and possible future content of international target setting in education.

Among the many Post-2015 targets the paper identified investment in preschool and primary education in Africa having the highest benefit-cost ratios relative to other targets. This finding can be explained in terms of the relative scarcity of human capital in Africa vs. other regions. Improving the quality of education of education also has an acceptable benefit-cost ratio. Targets relating to vocational education and adult learning cannot be prioritized as there is a high degree of uncertainty regarding their profitability.

An overall conclusion of the paper is that the vast majority of the Post-2015 education targets could not be achieved by 2030. Hence the need to prioritize based on the findings of cost-benefit analysis.

Historical perspective

There is a long history of international organizations setting numerical targets for education. As of today, none of these targets has been achieved.

- In 1961 UNESCO convened a high level conference of African States in Addis Ababa on the development of education Africa (UNESCO, 1961a). A goal was set that by 1980 primary enrolment in Africa should be 100%, relative to 40% in 1960 (UNESCO, 1961b). Yet, by 1980 the net primary enrollment ratio in sub-Saharan Africa stood at 56% (UNESCO, 1993).

- In 1990 UNESCO, UNICEF, the World Bank and UNDP joined forces in another high-level conference in Jom Tien to launch the "Education for All" (EFA) campaign (WCEFA, 1990). EFA set a goal of universal primary education by the year 2000. By 1999 the net enrolment ratio is Africa was 57% (UNESCO, 2002).

- At the 2000 Dakar World Education Forum, given the earlier target had not achieved, the target year of EFA was shifted to 2015. This target was reaffirmed at the 2000 United Nations Millennium Summit where world leaders set a goal of achieving universal primary education by 2015 (UNDP, 2013): "Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling" and set the net primary enrollment ratio as the monitoring indicator. Yet, according to the latest figures, today there are about 60 million children out of school (Unesco, 2014) and over 100 million youth aged 15-24 lack basic reading and writing skills (UNDP, 2013).

- In 2011 the World Bank issued its education strategy for 2020 pledging learning for all, meaning that "all students …acquire the knowledge and skills they need to live happy, productive lives" (World Bank, 2011). Although the target year of this noble goal is six years away, one wonders how it would be achieved given the huge gaps in educational achievement documented in the recent OECD (2013b) PISA report.

Setting never-fulfilled education targets is not only a phenomenon in developing countries.

- At the 2000 European Council in Lisbon, the Union set a goal that "the proportion of early school leavers should be no more than 10% by 2010" (European Commission, 2000). Early school leavers are defined as those 18 to 24 year olds with only lower-secondary level education who are not in further education and training. As of 2008, only 6 out of the 27 EU countries had reached this goal (European Commission, 2009). According to the latest Eurostat (2013) data, 14% of those aged 18 to 24 are early leavers from education and training, with at most a lower secondary education.

It is a pity that no lessons were learned from past grandiose but unrealistic education target settings in the current Post-2015 MDG discourse (Psacharopoulos 1989, Clemens et al., 2007).

Lack of finance is the most cited reason for failing to meet targets, calling for increased foreign aid (Oxfam, 2002; Global Campaign for Education, 2003). However, even if plenty of finance were available, there are many reasons why parents may not want to send their children to school (Glewwe et al., 2006). Culture is one factor, e.g., in some countries parents not allowing girls to attend school beyond puberty. Poverty is another factor, when child labor is necessary to supplement family income. Another factor is high personal discount rates and lack of information on the lifetime benefits of education. Other reasons relate to the political climate in these countries or the high incidents of orphans and single-parents. An additional reason is that the quality of schooling might be too low for parents to expect a value in return.

Education in the Post-2015 Agenda

An international call for defining Post-2015 millennium goals and targets has generated an omnibus of proposals (North-South Institute, 2013). Annex 1 lists a consolidation of the proposals.

The dominant characteristic of the proposals is their very general nature. They express well-intended directions of educational systems, but with very few specifics, (CIGI, 2012), e.g.:

- Establish Sufficient Education System Accessible to All at All Levels
- Lifelong Learning
- Continued Pursuit of Lifelong Learning
- Equal Right to Education
- Socio-economic Equality

Past MDG targets that are not likely to be achieved by 2015 are repeated with 2030 as a new target date (North-South Institute, 2013), e.g.:

- By 2030, reduce adult illiteracy by 50% and expand lifelong learning
- By 2030, all children and youth should complete primary and lower secondary education
- By 2030, all countries have strong education systems in place which support learning
- By 2030, improve school readiness by reducing by 50% the proportion of young children, including marginalized and vulnerable groups, who are not attending early childhood care and education programs
- By 2030, all children and youth receive and complete a quality primary and lower-secondary education with expected learning outcomes
- By 2030 we will ensure all children receive a good-quality education and have good learning outcomes
- By 2030 everyone has an equal opportunity to learn the basics, whatever their circumstances

Many of the goals or targets are expressed in very general terms that defy rigorous economic analysis, e.g., calls for a "strong" or "sufficient" educational system. The keywords "all" or "every child" are used repeatedly, meaning zero target, i.e., elimination of the related problem by the target date (United Nations, 2013), e.g.:

- Ensure every child, regardless of circumstance, completes primary education able to read, write and count well enough to meet minimum learning standards

- Ensure every child, regardless of circumstance, has access to lower secondary education

In terms of indicators for monitoring the achievement of targets, the enrollment ratio is dominant, meaning that 100 percent of school-age children should be attending school by 2030.

Pulling the threads together, Post-2015 MDG goals and targets could be grouped into the following major clusters for contrasting with findings in the economics of education literature:

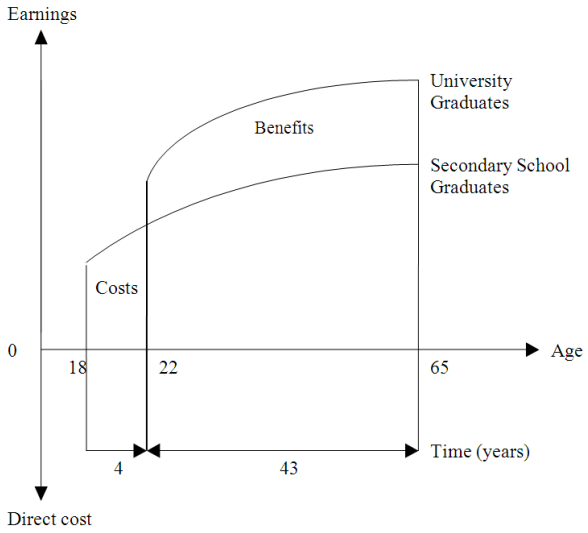
- Preschool
- Primary
- Secondary
- Tertiary
- Education quality
- Vocational education
- Education finance

Cost-Benefit Analysis of Investment in Education

Before presenting the available evidence on cost-benefit analysis of the above goals, it is important to review the alternative methods that have been used in the empirical literature to arrive at such estimates.

Considering the typical age-earnings profiles of graduates from two adjacent levels of education, a comparison is made between the discounted annual costs and benefits of providing the higher level of education over the base one, say, university over secondary education, as illustrated in Figure 1.

Figure 1. Typical age-earnings profiles by level of education



The benefits of education amount to what the more educated individual earns above the control group of individuals with less education. The costs are measured by the expenses to keep a student in school, plus his/her foregone earnings while studying.

The stream of annual costs (C) and benefits (W) for the two educational levels, university (u) and secondary education (s) subscripts in our example, are discounted to a given point in time for comparison. The result of the comparison can be expressed as three metrics:

(a) **The internal rate of return** (r) of the investment is found by solving the following equation for r:

$$\sum_{t=1}^{43} \frac{(W_u - W_s)_t}{(1+r)^t} = \sum_{t=1}^{4} (W_s + C_u)_t (1+r)^t$$

(b) **The net present value** (NPV) of the investment is found by subtracting the benefits from the costs that have been discounted at a given discount rate (i):

$$\text{NPV} = \sum_{t=1}^{43} \frac{(W_u - W_s)_t}{(1+r)^t} - \sum_{t=1}^{4} (W_s + C_u)_t (1+r)^t$$

(c) **The benefit-cost ratio** is found by dividing the benefits by the costs

$$\text{B/C ratio} = \frac{\sum_{t=1}^{43} \frac{(W_u - W_s)_t}{(1+r)^t}}{\sum_{t=1}^{4} (W_s + C_u)_t (1+r)^t}$$

Given the costs of investment in education occur within a time span of 4 years and the benefits last over 40 years, the rate of return to such investment could be estimated by the so-called short-cut formula,

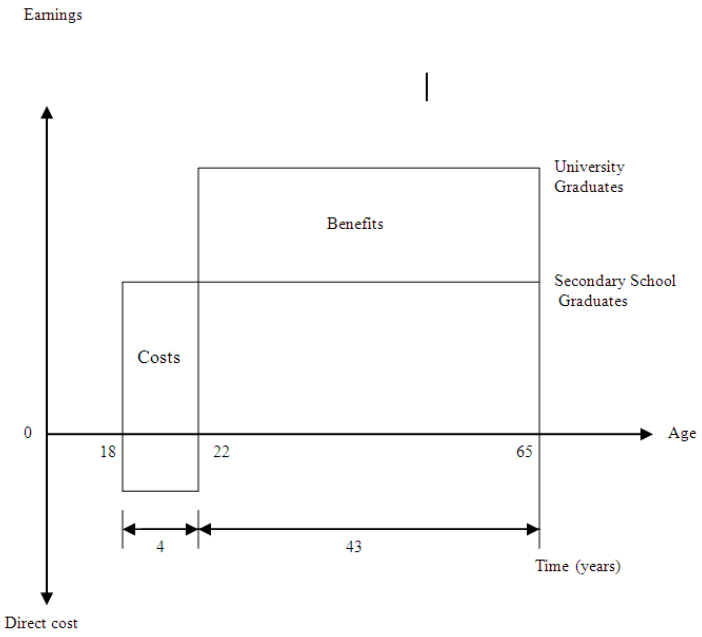
$$r_{\text{private}} = \frac{\overline{W}_u - \overline{W}_s}{4(\overline{W}_u)}$$

where a bar over variables denotes mean annual values of earnings and cost. This method assumes that age-earnings profiles are flat, as depicted in Figure 2. The calculation is similar

to putting \$100 in a bank deposit account and getting \$5 annual interest, implying a 5% return,

$$r = \frac{\text{Annual benefit}}{\text{Total cost}}$$

Figure 2. Flat age-earnings profiles



The Earnings Function Method

This method is also known as the "Mincerian" method and involves the fitting of a function of log-wages (LnW), using years of schooling (S), years of labor market experience (EX) and its square as independent variables (Mincer 1974),

$$\ln W_i = \alpha + \beta S_i + \gamma_1 EX_i + \gamma_2 EX_i^2,$$

where S is the number of years of schooling of the worker, and EX stands for years of labor market experience, defined as ($Age - S - School\ starting\ age$). In this function, the β coefficient on years of schooling can be interpreted as the average rate of return to one additional year of schooling. Since $\beta = \frac{\partial \ln W}{\partial S}$, this is the relative increase in wages following an increase in S, or the rate of return to the marginal year of schooling. This method assumes that forgone earnings represent the only cost of education, and so measures

only the private rate of return. It assumes further that individuals have an infinite working horizon.

In addition, this function does not distinguish between different levels of schooling. To solve this problem, the extended earnings function substitutes a series of 0-1 dummy variables for S, corresponding to discrete educational levels,

$$\ln W_i = \alpha + \beta_p D_p + \beta_p D_p + \beta_u D_u + \gamma_1 EX_i + \gamma_2 EX_i^2$$

where D is the dummy variable for the subscripted level of schooling. To avoid matrix singularity one of the mutually exclusive education categories is omitted, for example, the dummy corresponding to those with no schooling.

The private rates of return between levels of education can then be calculated from the extended earnings function by the following formulas:

$$r_p = \frac{\beta_p}{S_p},$$

$$r_s = \frac{\beta_s - \beta_p}{S_s - S_p},$$

$$r_u = \frac{\beta_u - \beta_s}{S_u - S_s},$$

where rp is the rate of return to primary schooling, rs is the rate of return to secondary, and ru is the rate of return to university. This calculation resembles the short-cut method in that the rate of return is computed as a ratio of a constant annual benefits flow to the total education cost for attaining the next level of education.

The advantage of the Mincerian way of estimating the returns to education is that it can smooth out and handle low-count cells in an age-earnings profile matrix by level of education. Although convenient, this method is slightly inferior to the full discounting method presented above as it assumes flat age-earnings profiles for different levels of education (see Psacharopoulos and Layard, 1979).

Of course there is a relationship between the above three alternative metrics, in the sense that if the rate of return found by the full discounting method exceeds the discount rate, the net present value must be positive, and the benefit-cost ratio must exceed 1. Given that the net benefit stream of an education investment is "well behaved", in the sense of not giving rise to multiple rate of return solutions (Hirshleifer, 1958) anyone of the three metrics would give the same answer regarding the ranking of the profitability of the investment.

In the empirical literature the vast majority of education cost-benefit studies are in terms of rates of return. The reason for the rate of return popularity among researchers is that it compares easily across countries, exchanges and discount rates.

Rate of Return Types

Two types of returns are usually estimated, each answering a different question: First, the private rate of return, that compares the costs and benefits of education as incurred by and realized by the individual student who undertakes the investment. And second, the social rate of return that compares costs and benefits from the country-as-a-whole or society's point of view.

The main computational difference between private and social rates of return is that, for a social rate of return calculation, the costs include the state's or society's at large spending on education. Hence, in the above example, Cu would include the rental of buildings and professorial salaries. Gross earnings (that is, before taxes and other deductions) are used in a social rate of return calculation, and such earnings should also include income in kind where this information is available.

There exists some confusion in the literature regarding the "social" adjective attached to rates of return to investment in education. It has been the tradition in the mainstream economics of education literature to mean by a "social" rate, a private rate adjusted for the full cost of schooling, rather than just what the individual pays for his or her education.

However, in the economics literature at large, a "social" rate should include externalities, that is, benefits beyond those captured by the individual investor. e.g.,
lower fertility or lives saved because of improved sanitation conditions followed by a more educated woman who may never participate in the formal labor market (Summers, 1992). 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.

Traditional social returns to education are called "narrow-social," and returns that include externalities "wide-social." The distinction between narrow and wide social returns is more than theoretical. By adding externalities to the narrow-social returns, one can reach diametrically opposite policy conclusions, e.g., if primary and tertiary education have differential externalities, by considering the latter the ranking of profitable education investments could be changed.

Since the costs are higher in a social rate of return calculation relative to the one from the private point of view, 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.

Estimation Method Popularity

In the early days of the economics of education literature, the full discount method was used to estimate returns to education. As individual age-earnings-education characteristics

became available over the years in censuses and household surveys, the Mincerian method became more dominant.

Net present values of education investments have been published in a number of instances, but the measure has not been popular because of the difficulty of comparing returns across countries and exchanges. Interestingly, benefit-cost ratios have been published for preschool education.

Cost-benefit Evidence On The Proposals

In presenting the evidence we will follow the school ladder - from preschool to tertiary and vocational education.

Early Childhood Education

There are many studies on the effect of preschooling on eventual educational attainment and adult earnings (for a list see Behrman et al. 2004, Appendix D). But very few contain cost-benefit analysis. Due to longitudinal data availability on preschoolers in the United States, this level of education has been the subject of extensive cost-benefit analysis. The data permitted estimates of wide social returns that include benefits from education externalities such as high school graduation and reduced crime. It also happens that benefit-cost ratios have been estimated for preschool education.

Table 1 presents rates of return and benefit-cost ratios of four preschool programs. Experimentally-induced changes in non-cognitive skills at an early age explain a sizable portion of later education, employment and earnings (Heckman 2000, 2008).

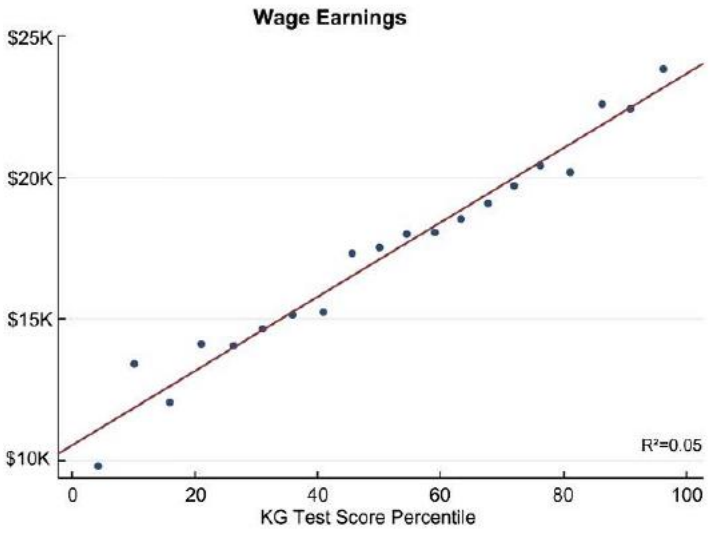
Table 1. Rate of return and benefit-cost ratios of preschool programs in the United States

Program	Target group	Rate of return (%)	B-C ratio (3% discount rate)
(1)	(2)	(3)	(4)
Chicago parent-child	3 - 4 years	18	6.9
High Scope Perry	3 - 4 years	10	7.2
Abecedarian	3 months – 4 years	7	2.7

Source: Col. (3), Wall Street Journal (2013), p. A2.
Col. (4), Temple and Reynolds (2007).

The importance of kindergarten on adult earnings has been documented in an experimental study in the United States (Project STAR) as shown in Figure 2a.

Figure 2a. From kindergarten to adult earnings



Source: Chetty et al. (2011).

An experimental study with a 20-year follow-up of graduates in Jamaica found that a preschool intervention increased the average earnings of participants by 42 percent relative to the control group (Gertler at al., 2013).

In an early childhood development project in Indonesia, preschool had an impact on reducing achievement gaps between richer and poorer children, thus permitting the latter to progress in the education system (Jung and Hasan, 2014).

Table 2 presents benefit-cost ratios of preschool programs in developing countries. Preschool programs typically contain a health/nutrition element and affect lifetime earnings through better health, reduced grade repetition, increased cognitive skills and adult earnings.

Table 2. Benefit-cost ratios of preschool programs in developing countries

Country	Discount rate		
	3%	6%	Unspecified in source
Bolivia	3.7	2.3	
Kenya	77.0	50.6	
Brazil			2.0
Egypt			2.3
Philippines	3.0		

Source: Bolivia and Kenya from Orazem et al. (2008), Table 4.
Egypt from Janssens et al. (2001).
Other countries from Patrinos (2007), Tables 2 and 4.

Evidence On The Main School System

Below we present three compilations of the returns to investment in education covering over 100 countries. The estimates are not strictly comparable between them because of the date they refer to, differences in methodology used and country coverage. The social rates of return, on which the rest of this paper is based, have been estimated by comparing the costs to the benefits of education. Costs are defined as foregone earnings while in school plus the direct resource cost of keeping a student in school. Benefits are defined as the difference between earnings of graduates of one particular level of education relative to graduates of a lower level of education.

World Bank 2004 compilation

The estimates in Table 3 are based on the full discounting method. Private returns are higher than social returns where the latter is defined on the basis of private benefits but total resource costs. The difference between the private and social rates of return reflects the regressivity of public subsidization of education, i.e., subsidization increases with the level of education.

Average returns to schooling are highest in the Latin America and the Caribbean region and for the Sub-Saharan Africa region. Returns to schooling for Asia are at about the world average. The returns are lower in the high-income countries of the OECD. Based on the social calculation, primary education exhibits the highest returns, followed by secondary and higher education.

Table 3. Social and private returns to investment in education by level and region (%)

Region	Social			Private		
	Primary	Secondary	Higher	Primary	Secondary	Higher
Asia*	16.2	11.1	11.0	20.0	15.8	18.2
Europe/Middle East/North Africa*	15.6	9.7	9.9	13.8	13.6	18.8
Latin America/Caribbean	17.4	12.9	12.3	26.6	17.0	19.5
OECD	8.5	9.4	8.5	13.4	11.3	11.6
Sub-Saharan Africa	25.4	18.4	11.3	37.6	24.6	27.8
World	18.9	13.1	10.8	26.6	17.0	19.0

Source: Psacharopoulos and Patrinos (2004)
* non-OECD

World Bank 2012 compilation

The estimates in Table 4 were based on the Mincerian method, hence only private returns are given. Returns to tertiary education are highest among the three levels. It should be noted, however, that returns to education estimates on the basis of the Mincerian method grossly underestimate the true returns because of the tacit inclusion of foregone earnings to the cost of keeping children in school.

Table 4. Private returns to investment in education by region (%)

Region	Primary	Secondary	Tertiary
Middle East and North Africa	9.4	3.5	8.9
South Asia	9.6	6.3	18.4
Eastern and Central Europe	8.	4.0	10.1
High Income Economies	4.8	5.3	11.0
East Asia and Pacific	11.0	6.3	15.4
Latin America and Caribbean	9.3	6.6	17.6
Sub-Saharan Africa	13.4	10.8	21.9
World	10.3	6.9	16.8

Source: Montenegro and Patrinos (2012).

The OECD 2013 compilation

Given primary education is universal in OECD countries, the OECD produces estimates of the returns to education only for upper secondary and tertiary education (Table 5).

Table 5. Average returns to education in 29 OECD countries (%)

Return type	Educational level	
	Upper secondary	Tertiary
Social	8.4	11.2
Private	14.5	13.0

Source: OECD (2013a), men.

There have been several more disaggregated cost-benefit analyses of investment in education for sub-populations or programs. A common finding is that educating girls has a higher rate of return relative to educating boys. Summers (1992) reports that in Pakistan the wide social rate of return on girls' education exceeds 20%.

In the United States there have been several cost-benefit studies of programs to diminish secondary school dropouts. Table 6 shows that the benefit-cost ratio of such interventions ranges from 2.1 to 4.4.

Table 6. Benefit-cost ratios of secondary school completion programs, USA

Program	Benefit-cost ratio
First Things First	4.4
Chicago Parent-School	3.8
Perry school centers	2.8
Class size reduction	2.6
Teacher salary increase	2.1

Source: Levin et al. (2007), Table 4 at 3.5% discount rate.

Education Quality

Unfortunately, cost-benefit analysis of education quality is not as plenty as for education quantity. Although there are many studies documenting the effect of school quality on cognitive achievement and later earnings, they do not typically consider the cost of delivering better quality in order to compare it to the benefit. In fact, many econometric studies have found that increased resources for education (an input measure of school quality) have not led to statistically significant improvements in test scores – a standard measure of education quality (Hanushek, 2007). Based on evidence from the United States and the rest of the world, growth of resources devoted to schools are not accompanied better student outcomes. In a survey of 376 education production functions relating school resources to student achievement, most studies report negative or insignificant effects of expenditure per student, teacher salaries or class size (Hanushek, 2003).

Project STAR in the United States used an experimental method to randomly assign students to classes of about 15 or 23 students (Word et al., 1990). It was found that this reduction in class size was associated with only 0.2 standard deviation improvement in school performance. Given a series of methodological considerations, this experimental study has not provided evidence that school resources relate to student outcomes (Hanushek, 1999). Institutional changes such as the introduction of monitoring and evaluation systems, central examinations, teacher incentives and accountability are more likely to improve school quality, although difficult to cost (Hanushek and Woessmann, 2011).

A review of 30 randomized control trials designed to improve test scores in the developing world, found that two-thirds of them report near zero or insignificant effects of alleged school quality enhancing interventions such as textbooks, improved buildings or smaller class sizes (Kremer et al., 2013).

The evidence on the cost side of school quality improvements is problematic. A meta-analysis of 76 quality-improvement experiments in developing countries concluded that there are insufficient data to assess the relative cost-effectiveness of interventions (McEwan, 2013). More than half of the studies reported no details on costs, while the rest reported minimal details.

Among the few studies that report costs, a typical finding is that an increase of 1 standard deviation of test scores costs $100 (Kremer et al., 2013). But a study in India reports a cost of $0.67 per standard deviation increase in test score (Banerjee et al. 2007).

Even if we knew the cost and effect of school quality improvements, for the purpose of this paper the effect must be mapped to $ benefits. Glewwe (1996) reports a social rate of return of improving middle school quality in Ghana of about 25%. Following our conversion methodology this corresponds to 5 and 8.3 benefit-cost ratios for discount rates 5% and 3%, respectively.

From another study in Chile, we know that an improvement of 1 standard deviation of test scores is associated with about $700 increase in annual earnings (Patrinos and Sakellariou, 2011 and correspondence with the authors). So, and given the many caveats associated with

this statistic, one may be tempted to conclude that the benefit-cost ratio of quality improvements is roughly 7. The same study in Chile reports a 17% average private rate of return to test score improvements that must correspond to about 13% social returns.

A study on Pakistan found that attending a higher quality rather than a poor quality primary school has a 13% social rate of return (Behrman et al. 2008, Table 3). School quality was defined by student exposure to teachers of better quality. School equipment and infrastructure had little influence on school effectiveness.

Adopting a 15% average social return to investments in school quality improvements from the above studies, gives 5 and 3 benefit-cost ratios for school quality at 3% and 5% discount rates, respectively. However, it should be emphasized that the benefit-cost ratios for school quality are not based on an equally rich research base as those for school quantity reported above.

Vocational Education

There have been many studies assessing the returns to vocational vs. general education in both high-income and developing countries. The typical finding is summarized in a OECD report on the subject: "the question 'Is it worthwhile to invest in VET?' remains open at this stage" (OECD, 2008).

In many countries, the wage returns to academic qualifications are significantly higher than the returns to vocational qualifications, government training programs and adult basic skills training (Blundell, Dearden and Sianesi, 2005; Dearden et al., 2002; Dickerson 2005; Carneiro and Heckman (2003).

In a large World Bank follow-up study of students in the technical-vocational curriculum stream of secondary education in Colombia and Tanzania, it was found that the graduates did not seek or find employment in the sector they studied. Within levels of education, and counter intuitively, general secondary education is more profitable than vocational education (Table 7). The reason is that whereas general and vocational secondary school graduates have more or less equal earnings after graduation, the vocational track of secondary schools costs about twice that of the general track (Psacharopoulos and Loxley, 1985). It was such findings that made the World Bank change its lending profile as late as 1991 away from secondary vocational schools, an activity the institution had been engaged nearly exclusively since its inception.

Table 7. Social returns to investment in upper secondary school streams, Tanzania

Curriculum type	Rate of return (%)
Academic	6.3
Technical	1.7

Source: Psacharopoulos (1985).

Lower returns to secondary vocational relative to general education have been found in Egypt, with the gap increasing over time (Said and El-Hamidi, 2008.). The same finding has been reported for Indonesia (Newhouse and Suryadarma, 2011). Another study reported higher

returns to general upper secondary relative to vocational in Egypt and and Iran (Salehi-Isfahani, 2009). A more recent study on Egypt found that the returns to vocational secondary education for recent graduates are near zero, concluding that formal vocational secondary education is not the best route to employable skills and higher wages (Kraft, 2013). Two studies have found private returns to vocational schooling similar to general in South Africa (Pugatch, 2012) or higher in Thailand (Moenjak and Worswick, 2003) Given the resource cost of vocational schooling is higher than the academic, the returns to the latter must have been higher.

Education Financing

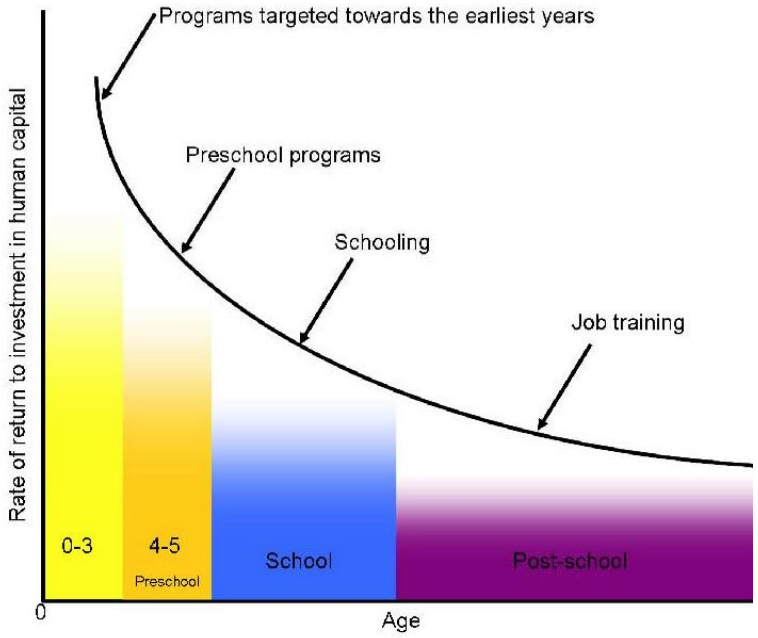
One of the broad goals of the Post-2015 MDG proposals is "sufficient financing" of education systems, measured by the expenditure per student or the share of GDP devoted to education. It should be noted, however, that education financing is a means of achieving goals, not a goal in itself. Hence it cannot be subjected to cost-benefit analysis.

Lessons From The Literature

One solid conclusion following from the above review is that investments in expanding any level and type of education passes in general a cost-benefit test evaluated at a 3% or 5% discount rate. But some education investments are more profitable than others.

Economics Nobel Laureate James Heckman in a series of papers has succinctly summarized priorities in educational investments as in Figure 3. Mastering a large body of rigorous evidence he came to the conclusion that skill formation is most efficient in the early ages and levels of education (Heckman and Masterov, 2005; Cunha et al., 2006; Heckman, 2008).

Figure 3. A grand summary of education investment returns



Source: Heckman and Masterov (2005), Heckman (2011).

Present Conditions

Before assessing specific targets among the Post-2015 MDG goals, let us review where the world stands in terms of educational development.

On the eve of the MDG-2015 target for having achieved universal primary education, there are about 60 million children out of school, more than half of them in sub-Saharan Africa. Table 8 shows the latest data on school coverage in three levels of schooling. The gross enrollment ration refers to the number of school level children enrolled in a particular school level, regardless of age, expressed as a percentage of the total number of children of official school age in the population. The net enrollment ratio refers to the number of children of the official age group expressed as a percentage of that age group in the population.

Twenty three percent of primary school age children in sub-Saharan Africa are out of school. Even advanced industrial countries fall short of the 100% net enrollment ratio – the main MDG indicator for monitoring progress towards the 100% zero-target date.
In fact, there seems to be an asymptote below the 100% mark regarding school coverage for many reasons other than flailed education policy or lack of finance, as noted above.

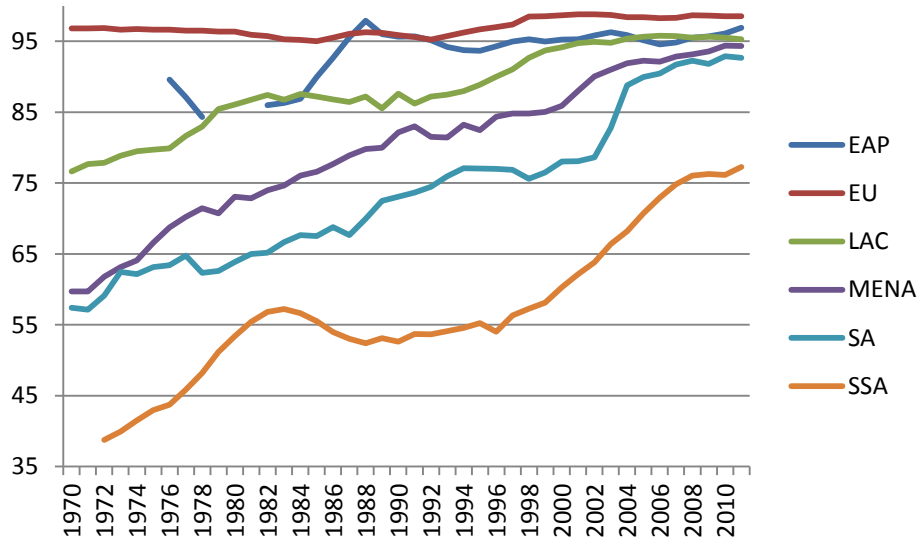
Table 8. Primary school enrollment ratio, latest data (%)

Region	Preschool (Gross)	Primary (Net)	Secondary (Net)
East Asia & Pacific	50	96.9	73.0
European Union/OECD	81	98.5	92.2
Latin America & Caribbean	69	95.3	76.1
Middle East & North Africa	22	94.3	70.3
South Asia	47	92.7	50.1
Sub-Saharan Africa	18	77.3	24.7
World	46	91.2	62.7

Source: Preschool from UNICEF (2014), no net available.
Primary and secondary from World Bank (2014).

Figure 4 illustrates the long way towards universal primary education and the impossibility (sharp deviation from the trend) of achieving the 2015 zero-target of 100% enrollment in Africa.

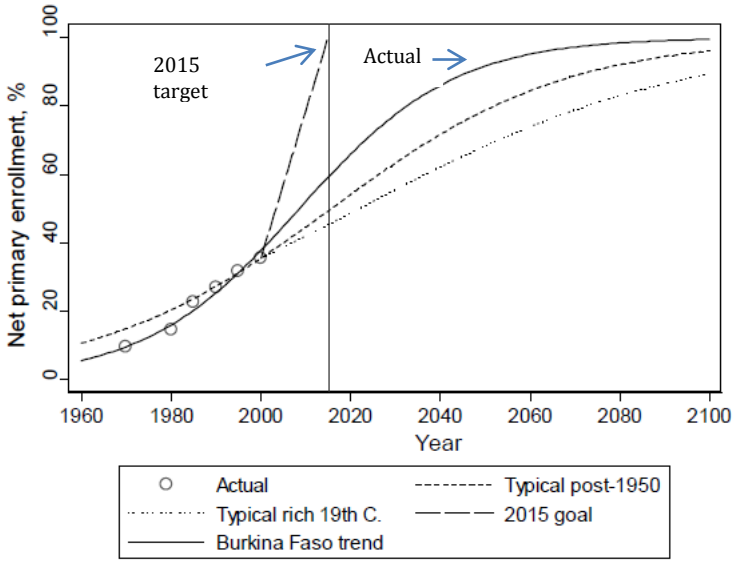
Figure 4. Net primary enrollment ratio trend by region



Source: Plotted from World Bank (2014) data.

Figure 5 illustrates the impossibility of achieving universal education in Burkina Faso by 2015. Following past trends, a more likely target date is 2100!

Figure 5. How realistic are MDG targets? Burkina Faso example



Source: Adapted from Clemens (2004).

Preschool

Table 9 shows that preschool coverage varies widely between regions - from an enrollment ratio of 18% in sub-Saharan Africa to 81% in industrialized countries.

Table 9. Preprimary gross enrollment ratio (%)

Region	Enrollment ratio 2010 or latest year
Sub-Saharan Africa	18
Middle East & N. Africa	22
South Asia	47
East Asia & Pacific	50
Latin America and Caribbean	69
Industrialized countries	81
World	46

Source: UNICEF (2014).

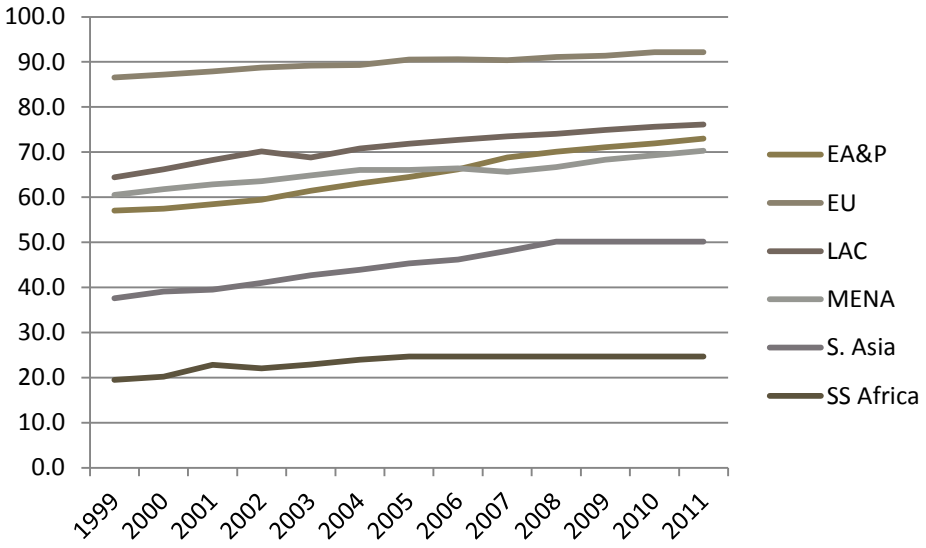
Regarding secondary education, there are about 70 million children without access to it, most of whom in South Asia and sub-Saharan Africa.

Table 10. Secondary enrollment indicators, 2011 or latest year

Region	Out of lower secondary (millions)	Net secondary enrollment ratio (%)
East Asia	9.0	73.0
European Union	0.7	92.2
Latin America & Caribbean	1.5	76.1
Middle East & N. Africa	2.8	70.3
South Asia	31.2	50.1
Sub-Saharan Africa	22.8	24.7
World	69.5	62.7

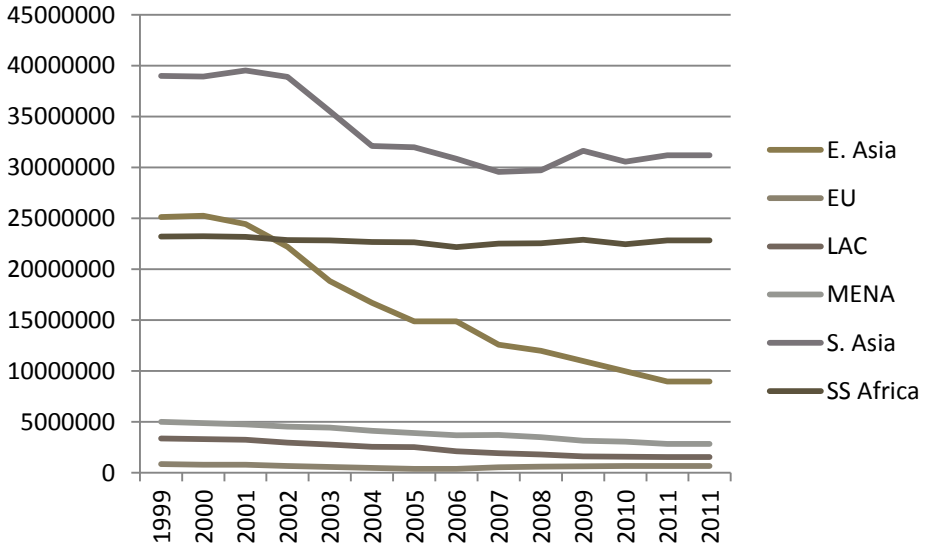
Source: World Bank (2014)

Figure 6. Net secondary enrollment ratio (%)



Source: World Bank (2014)

Figure 7. Out of school children of lower secondary age

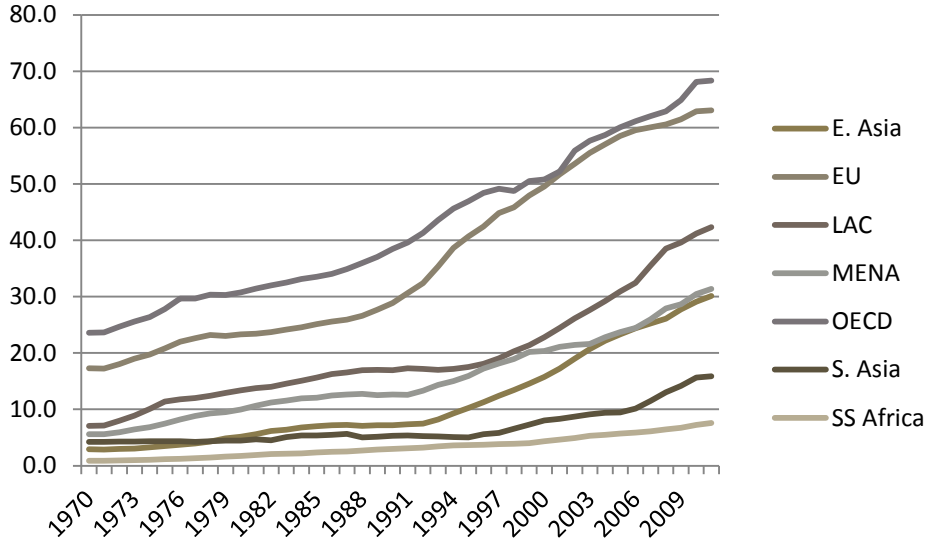


Source: World Bank (2014)

Universities

The number of students enrolled in tertiary education per 100,000 inhabitants is listed among the post-2015 goals, although no specific targets are given. Figure 8 shows the vast disparities between regions in tertiary education coverage.

Figure 8. Tertiary education gross enrollment ratio by region



Source: World Bank (2014).

Education Quality

Regarding the quality of schooling, 123 million youth aged 15 to 24 lack basic reading and writing skills Over 60 per cent of them are young women (United Nations (2013b). In Ethiopia the best-off children are almost 20 times more likely to be literate than the poorest children (Save the Children, 2013). In Pakistan less than half of grade 5 children in Balochistan could solve a two-digit subtraction, compared to 73% in the wealthier province of Punjab (Unesco, 2014). Table 11 shows the vast disparities between countries in terms of educational achievement measured by OECD's standardized PISA score.

Table 11. Countries at the top and bottom of the 2012 PISA score

Country	Mathematics	Reading	Science
Shanghai-China	613	570	580
Singapore	573	542	551
Hong Kong-China	561	545	555
Chinese Taipei	560	523	523
Korea	554	536	538
.....	.....	.....	.....
Brazil	391	410	405
Argentina	388	396	406
Tunisia	388	404	398
Jordan	386	399	409
Colombia	376	403	399
Qatar	376	388	384
Indonesia	375	396	382
Peru	368	384	373

Source: OECD (2013b).

Assessing the Post-2015 MDG Targets

Out of the three rate of return compilations presented above, the one reported in Table 3 is the most suitable to use as a base for a benefit-cost assessment of the Post-2015 targets. (The OECD one refers mainly to advanced industrial countries, and the World Bank 2012 compilation refers only to private returns). Table 12 presents benefit-cost ratios of expanding at the margin education coverage under current conditions. All benefit-cost ratios exceed 1 and are highest for primary education. In sub-Saharan Africa the benefit-cost ratio is about 9 at 3% discount rate. It should be noted that the benefit-cost ratios reported in Table 12 are lower estimates of the wide-social profitability of investment in education as they are based only on labor market rewards omitting externalities.

Table 12. Benefit-cost ratios by level of schooling and region - Base scenario

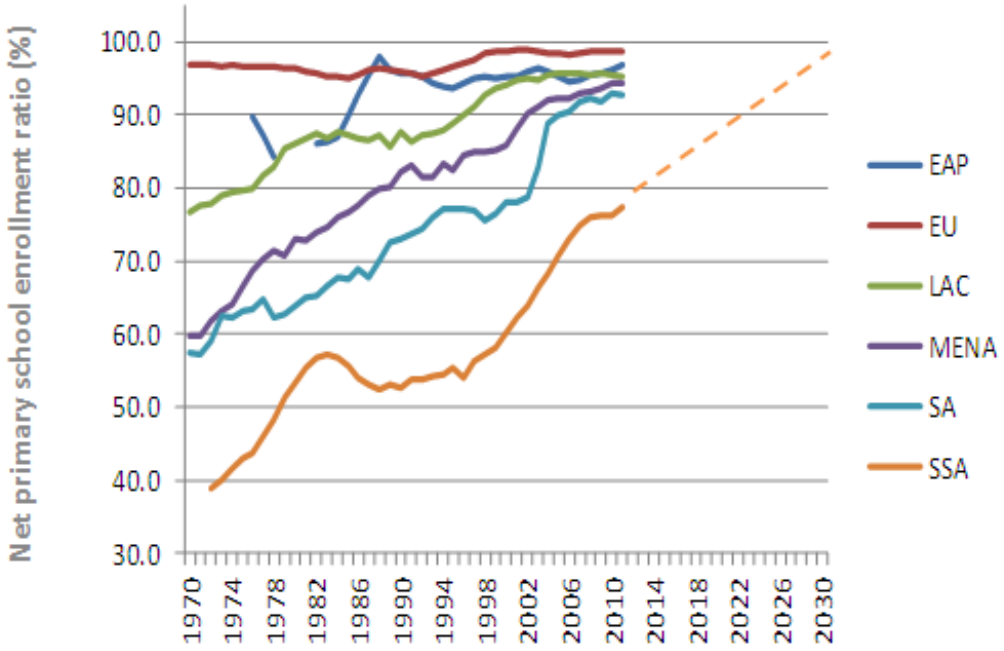
Region/Educational level	3% discount rate			5% discount rate		
	Primary	Secondary	Higher	Primary	Secondary	Higher
Asia	5.4	3.7	3.7	3.2	2.2	2.2
Europe/M. East/ N. Africa	5.2	3.2	3.3	3.1	1.9	2.0
Latin America/ Caribbean	5.8	4.3	4.1	3.5	2.6	2.5
OECD	2.8	3.1	2.8	1.7	1.9	1.7
Sub-Saharan Africa	8.5	6.1	3.8	5.1	3.7	2.3
World	6.3	4.4	3.6	3.8	2.6	2.2

Source: Based on the social returns in Table 3, and the returns to B-C ratio conversion process described in Annex 2.

From the Base Scenario to the Zero Target

Universal primary education is the most prominent target in the Post-2015 MDG goals. Given in most regions primary school enrollment is converging towards the below 100% asymptote described earlier, let us focus on sub-Saharan Africa that presents the greatest challenge of meeting the zero-target by 2030 (dotted line in Figure 9).

Figure 9. Moving towards the zero-target of primary school coverage



Source: Adapted from World Bank (2014).

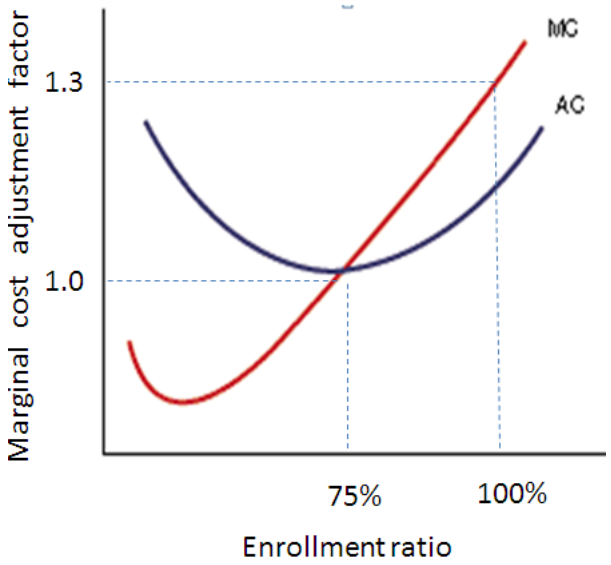
To increase the net primary enrollment ratio 23 percentage points to 100% by 2030 raises issues of cost and feasibility. Most studies attempting to cost Education for All multiply the additional number of students by the average cost per student in the base year (Dejavaran, 2002; Bruns et al., 2003).

Although the average cost of schooling might be valid for a marginal expansion of the school system, it cannot hold for expanding school capacity by one quarter of its present value. Building more schools in rural areas, hiring qualified teachers and operating more schools puts a strain on resources hence raising the marginal cost of schooling.

From economics 101 we know that the marginal cost of schooling increases after the minimum average cost point (Figure 10). Since the benefit cost ratios in Table 12 have been estimated on the basis of the average cost of schooling, they have to be adjusted downwards as we move to the zero-target.

Assuming that education systems operate somewhere in the region of the lowest average cost, we assume that a 5 percentage points increment of the enrollment ratio is associated with 5 percent increase in cost over the previous cost value. In other words, given there are no cost observations beyond the base scenario, we assume that the elasticity of the marginal cost curve in Figure 10 is equal to 1. Given this scenario, the direct cost per primary school student would increase over the years as shown in Table 13, col. (3).

Figure 10. The marginal cost of schooling increases with enrollment



It should be noted that the cost increase applies only to the direct cost of schooling which is about 20% of the total cost of schooling at the primary level according to evidence from developing countries, the rest being foregone earnings (Psacharopoulos, 1995, Table 1). Hence the benefit-cost ratios should be adjusted downwards by 20% of the incremental values in Table 13, col. (3). The last two columns in Table 13 show the adjusted benefit-cost ratios for achieving the zero target of full primary school coverage in sub-Saharan Africa by 2030. Depending on the discount rate, the benefit-cost ratios range from about 5 to 9.

Table 13. Benefit-cost ratios of meeting the 100% net primary enrollment target in sub-Saharan Africa by 2030

Year	Primary enrollment ratio (%)	MC index	Direct cost adjustment factor	MC-adjusted B/C ratio	
				3% discount	5% discount
(1)	(2)	(3)	(4)	(5)	(6)
2015	75	1.00	1.00	8.5	5.1
1018	80	1.05	1.01	8.4	5.0
2021	85	1.10	1.02	8.3	5.0
2024	90	1.16	1.03	8.3	5.0
2027	95	1.22	1.04	8.2	4.9
2030	100	1.28	1.06	8.0	4.8

Notes: Col. (2), hypothetical net primary enrollment ratio
Col. (3), marginal cost index assuming a unitary elasticity of direct schooling costs to enrollment
Col. (4), marginal cost index applicable to the direct cost of schooling in the benefit-cost estimation
Col. (5) and (6). Sub-Saharan benefit-cost ratios from Table 12 for base year divided by Col. (4) for successive years.

Table 13a reports the results of the same exercise for the World, the benefit-cost ratios ranging from 2.6 to 6.3.

Table 13a. Benefit-cost ratios of meeting the 100% net primary enrollment target in World by 2030

Year	Primary enrollment ratio (%)	MC index	Direct cost adjustment factor	MC-adjusted B/C ratio	
				3% discount	5% discount
(1)	(2)	(3)	(4)	(5)	(6)
2015	90	1.0	1.0	6.3	3.8
1018	92	1.1	1.0	6.2	3.8
2021	94	1.1	1.0	6.2	3.7
2024	96	1.2	1.0	6.1	3.7
2027	98	1.2	1.0	6.1	3.7
2030	100	1.3	1.1	5.9	3.6

Notes: Col. (2), hypothetical net primary enrollment ratio
Col. (3), marginal cost index assuming a unitary elasticity of direct schooling costs to enrollment
Col. (4), marginal cost index applicable to the direct cost of schooling in the benefit-cost estimation
Col. (5) and (6). World benefit-cost ratios from Table 12 for base year divided by Col. (4) for successive years.

Needless to say that the 15-years projection raises issues of general equilibrium, such as the increased share of the labor force with primary education reducing the rate of return on the investment. Yet it has been observed that rates of return over time do not fluctuate much because of what Tinbergen (1975) described as the race between education and technology. As the supply of educated labor increases, so does the demand for higher skills, hence not depressing the returns to education.

Preschool

One of the Post-2015 MDG targets is to reduce by 50% the proportion of children who are not attending early childhood care and education programs. Table 14 presents the preschool enrollment ratios in the base and target years under this scenario.

Table 14. Preschool enrollment ratio 2010 and target year, (%)

Region	Enrollment ratio 2010 or latest year	2030 target enrollment ratio
(1)	(2)	(3)
Sub-Saharan Africa	18	59
Middle East and N. Africa	22	61
South Asia	47	74
East Asia & Pacific	50	75

Latin America & Caribbean	69	85
Industrialized countries	81	91
World	46	73

Source: UNICEF (2014)
Note: Col. (3) =100 - [(100 – col. (2) * 0.5]

Focusing again on sub-Saharan Africa that presents the greatest challenge in meeting the target, one could use Kenya's known benefit-cost ratio for preschool programs of 77. Since the intervention on which this benefit-cost ratio is based includes a nutrition element, we adopted half of its value. Table 15 shows that the benefit-cost ratios exceed 28 to 39 depending on the discount rate.

Table 15. Benefit-cost ratios of meeting the 50% reduction of children who are not attending preschool in sub-Saharan Africa by 2030

Year	Preschool enrollment ratio (%)	MC-adjusted B/C ratio	
		3% discount	5% discount
(1)	(2)	(5)	(6)
2010	18	39	30
2015	24	38	29
1018	31	38	29
2021	37	38	29
2024	44	37	29
2027	51	37	28
2030	59	37	28

Notes: Col. (2), hypothetical preschool enrollment progression to target year.
2010 benefit-cost ratios from Table 2, Kenya row, adjusted to 5% discount rate and reduced by one half to exclude the nutrition component of the intervention. Other years based on a 1% increase of cost of preschooling for every seven percentage points of increase in the enrollment ratio.

Externalities

One important qualification regarding the cost-benefit figures presented in this paper is that they are based on observed market returns to education excluding externalities. Educating one member of society is associated with a series of benefits that accrue not only to the educated person but also to others (Unesco, 2013). Including such externalities would raise the benefit-cost ratios reported in this paper. And since different levels of education may be associated with differential externalities, priorities for investment in education could be reversed.

Quantifying education externalities has been the holy grail of empirical work in the economics of education (Foster and Rosenzweig, 1994). Barring the difficulties, we have solid evidence that parents' education has a positive effect on health and child survival. Children of better-educated parents have a higher chance of survival and are more likely to go to school and

receive regular health checks. More educated women have lower maternal and infant mortality rates and improved reproductive health. From the Netherlands (Groot and Brink, 2007) and Pakistan (Asghar et al., 2009) to Morocco (Glewwe, 1999) and Mozambique (Lindelow 2008) it has been found that education has positive externalities though its effect on health and child survival. The case is especially strong for mother's education (Schultz 2002).

In Pakistan, for example, more than one third of men with less than primary education are in poor health, vs. 5% for those with higher education (Asghar et al., 2009). One well documented non-market effect is that educating women reduces fertility and child mortality. Also in Pakistan, it has been found that giving 1000 girls one extra year of schooling reduces fertility and child mortality rates by about 8%. (Summers, 1992). In Taiwan mothers with 9 vs. 6 years of education resulted in saving one child life per 1000 births (Chou et al., 2010). A child born to a mother who can read stands a 50% greater chance of surviving past age five (United Nations, 2014).

Beyond health, it has been found that each additional year of education on average reduces a country's chances of falling into civil war by 3.6 percent (Winthrop and Graff, 2010).

What Will It Cost?

After the Jom Tien conference in 1990 there have been many estimates of what it would cost to achieve education for all, over and above what governments are already spending for primary education. Due to the lack of data in many countries, differing demographic projections of the school-age population and the effect of HIV, the estimates vary wildly.

Lassibille and Navarro Gomez (1990) put the cost at $7.2 billion per year in 1985 dollars). Colclough and Lewin (1993) estimated that achieving a gross primary enrolment ratio of 100 would require an additional annual public expenditure of $5-6 billion during the 1990s (in 1986 dollars).

After setting the 2015 MDG goals in 2000, UNICEF put the annual additional cost of achieving education for all in developing countries at $9.1 billion per year of in 1998 dollars (Delamonica et al., 2001). The World Bank estimated the same cost between $10 - $30 billion annually depending on assumptions (Devajaran et al., 2002).

In 2010 Unesco estimated that it would take another $16 billion per year in external financing to achieve basic education for in low income countries by 2015. The latest Unesco estimate is that it would take an additional $29 billion per year to achieve basic education by 2015 (Unesco, 2014).

Post-2015 global education goals are expected to be more ambitious than the EFA goals extending to lower secondary education. Unesco (2014) estimates that the shortfall in the financing necessary to achieve universal basic and lower secondary education by 2015 is estimated at US$38 billion annually. Thus, a conservative assumption is that extra financing of this order would be required to meet the 2030 targets. Adding extended preschool

coverage would bring the cost above not only what governments can afford, but also foreign aid.

According to the latest data, there are 57 million children out of school, most of them in sub-Saharan Africa. A rough estimate of the cost per primary school student in sub-Saharan Africa is $300 (based on Unesco, 2011). Thus an additional $17 billion per year would be needed to reach the zero target by 2030. To put the above figures in context, total international aid for basic education in low income countries in 2011 was $5.8 billion. Looking at the other side of the coin, Unesco (2014) reports that the cost of 250 million children not learning the basics is equivalent to $129 billion.

Bringing in the cost perspective and the declining trend of international aid for education in recent years, enhances the case on how unrealistic are the Post-2015 education targets.

Concluding Comments

Table 16 summarizes the results of cost-benefit analysis applied to education targets

Table 16. Benefit-cost ratios for selected 2030 education targets

Domain	Target	Discount rate	
		3%	5%
Preschool	Increase the preschool enrollment ratio is Sub-Saharan Africa from the present 18% to 59%	37	28
Primary	Increase the primary enrollment ratio is Sub-Saharan Africa from the present 75% to 100%	8	5
Quality	Increase student test scores by one standard deviation	5	3
Secondary	Ensure secondary school completion	4	3

The estimates presented above must be considered approximate given data limitations and the many assumptions involved. In addition, for education to translate to earnings and productivity a host of necessary conditions must hold, such as a country to be in non-conflict and have established protection of property rights. Such conditions may not hold in many sub-Saharan countries that rank high in the Fund for Peace (2013) failed States Index.

On the other hand, and subject to the above qualifications, the benefit-cost ratios presented above are based on the market benefits of education. Given a long list of non-market benefits of education, they should be considered as lower estimates of the true wide-social benefit-cost ratios for expanding a particular level of education.

The generality, ambiguousness and optimism of the Post-2015 MDG targets in the present discourse do not augur well for their implementation by 2030, if not well beyond. Would a

more modest and pragmatic approach be warranted, such as giving priority and focusing action where the social returns on the investment are highest?

Instead of setting well-meaning global targets, should these be country-specific depending on initial conditions in each country? Would progress towards a given target, rather than achieving a zero target, be more appropriate for monitoring progress?

Perhaps, should "Education for All" be replaced by "Education for Some", i.e., the most needy? But such mundane term would never fly in international parlance.

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Annex 1. Education targets in the post-2015 MDG proposals

Target			Indicator	Definition
Establish Sufficient Education System Accessible to All at All Levels (Inputs)	Capacity and Accessibility	Continued Pursuit of Lifelong Learning	Adjusted net intake rate (percentage of population in the same age group)	Total enrollment in primary education of pupils of official primary school entrance age, expressed as a percentage of the population of the same age in a given school year.
			Age-specific enrollment rate (percentage of cohort)	Enrollment of a specific single age enrolled, irrespective of the level of education, as a percentage of the same age.
			ECCE	Programs that, in addition to providing children with care, offer a structured and purposeful set of learning activities, either in a formal institution or as part of a non-formal child development program. ECCE programs are typically designed for children aged three years and over, occurring before primary education.
	Sufficient Financing	Public Expenditure	Government expenditure on education to poorer families	No agreed/universal/international definition.
			Public expenditure on education, total (percentage of GDP)	Total public expenditure (current and capital) on education, expressed as a percentage of the GDP in a given year.
			Public expenditure on education, total (percentage of government expenditure)	Current and capital expenditures on education by local, regional and national governments, expressed as a percentage of total government expenditure on all sectors.
			Expenditure per student, per level (percentage of GDP per capita)	No agreed/universal/international definition.
		Private	Total private expenditure on educational institutions and educational administration, as percentage of GDP	Expenditure by private on educational institutions and administration at a given level of education, expressed as percentage of GDP.
	Equal Right to Education	Equal Right to Education	Ratio of female to male by level of education (percentage)	No agreed/universal/international definition.
			Ratio of female to male net intake rate (percentage)	No agreed/universal/international definition.
			Percentage of female teachers	Number of female teachers at a given level of education, expressed as a percentage of total number of teachers at the same level in a given school year.

		Socio-economic Equality	Duration of compulsory school years	No agreed/universal/international definition.
			Children out of primary school, female and male (percentage of cohort)	Number of children of official primary school age who are not enrolled in primary or secondary school, expressed as a percentage of the population (by gender) of official primary school age.
			Economically active children, ages 7–14, female and male (percentage of cohort)	Economically active children refer to children involved in economic activity (non-school attendance) for at least one hour in the reference week of the survey.
			Ratio of school attendance of orphans to school attendance of non-orphans	No agreed/universal/international definition.
			Population from 5–24 years of age by school attendance, urban and rural residence	No agreed/universal/international definition.
Ensure Active Participation in EFA (Throughputs)	Continued Pursuit of Lifelong Learning	Survival Ratio	Percentage of repeaters	Total number of pupils who are enrolled in the same grade as the previous year, expressed as a percentage of total enrollment in the given grade of education.
			Dropout rate by grade (percentage)	Proportion of pupils from a cohort enrolled in a given grade in a given school year who are no longer enrolled in the following school year.
			Attendance rate (percentage)	Total number of pupils actually attending schools as a percentage of the total registered enrollment.
			Survival rate by grade	Percentage of cohort of pupils enrolled in the first grade of a given level or cycle of education in a given school year who are expected to reach successive grades.
			Persistence to last grade of primary, female and male (percentage of cohort)	Participants in all components of an educational program involved in primary education, irrespective of the result of any potential assessment of the achievement of learning objectives as a percentage of total enrollment registered at the entrance.

			Primary completion rate, female and male (percentage of cohort)	No agreed/universal/international definition.
		Lifelong Learning	Firms offering formal training	Number of firms with formal training programs.
			Adult education	Education specifically targeting individuals who are regarded as adults to improve their technical or professional qualifications, further develop their abilities, enrich their knowledge with the purpose to complete a level of formal education or to acquire knowledge, skills and competencies in a new field, or to refresh or update their knowledge in a particular field.
			Number of students in tertiary education	Number of students enrolled in tertiary education in a given academic year per 100,000 inhabitants.
			Year input per graduate	Estimated average number of pupil-years spent by pupils from a given cohort who graduate from a given cycle or level of education, considering the years of dropout and repetition.
		Advancement	Promotion rate by grade	Proportion of pupils from a cohort enrolled in a given grade at a given school year that study in the next grade in the following school year.
			Effective transition rate	The likelihood of a student moving to a higher level of education represented by the number of new entrants to the first grade of the higher level of education in the following year, expressed as a percentage of the students enrolled in the last grade of the given level of education in the given year who do not repeat that grade the following year.
			New entrants to primary education with ECCE	Pupils entering primary education for the first time and who attended some organized ECCE programs
			Students enrolled by type of institution	For example, students enrolled in adult education programs are categorized separately from the total number of students.

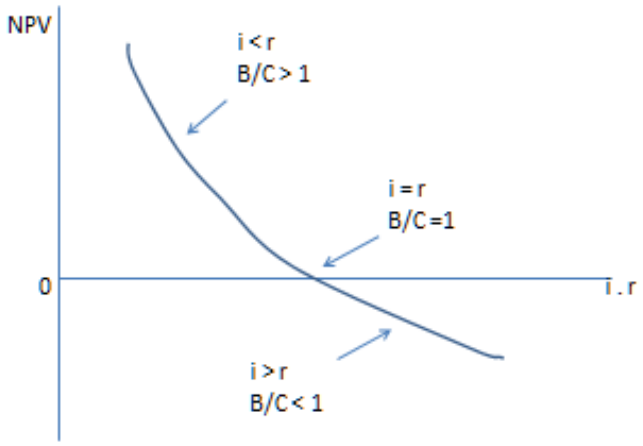
Source: Adapted from CIGI (2012), Table 4.

Annex 2. From rates of return to benefit-cost ratios

Because of the detailed nature of data entering a rate of return estimation, papers reporting returns to education do not contain the full age-earnings profiles on which the estimates are based. So it is not possible to use the original benefit and cost streams to estimate benefit-cost ratios for comparison with other sectors. For this purpose we would have to convert the available rates of return to benefit-cost ratios.

From cost-benefit analysis 101 we know that the rate of return (r) and the discount rate (i) relate to each other in the way depicted in Figure 11, where NPV denotes the net present value of the investment.

Figure 11. Benefit-cost ratio, discount rate and rate of return relationship



Therefore, we know from theory that the benefit-cost ratio is an inverse function of the discount rate – the lower the discount rate used to estimate the net present value, the higher the benefit-cost ratio.

Given we have no information on the net present value, we could make an approximation of the size of the benefit-cost ratio by using the short-cut formula described above to estimate the benefit-cost ratio of an investment for a given discount rate knowing only its rate of return.

Let B denote the annual benefit of the investment, say how much university graduates are earning on average above secondary school graduates ($\overline{W}_u - \overline{W}_s$), and the annual cost equal

foregone earnings ($\overline{W}_s$) plus direct costs ($\overline{C}_u$). According to the short-cut formula the rate of return of the investment can expressed as

$$(1) \quad r = \frac{\overline{W}_u - \overline{W}_s}{4(\overline{W}_s + \overline{C}_u)} = \frac{B}{PVC}$$

where PVC is the lump sum cost of the investment with no discounting involved given the relatively short period within which the costs are incurred.

The present value of the benefits of the investment (PVB) for a given discount rate (i) can be expressed as

$$(2) \quad PVB = B/i.$$

Combining equations (1) and (2), B cancels out giving the required conversion:

$$\frac{PVB}{PVC} = \frac{r}{i} = \text{Benefit-cost ratio}$$

Of course the conversion described above is an approximation, given we do not have information on the elasticity of the NPV–i curve in Figure 11. An experiment was conducted to find out how much a true benefit-cost ratio would be off relative to the approximation described above. "True" in this case means a cost-benefit ratio estimated on the basis of discounted age-earnings profiles by level of education.

Assuming annual flat annual earnings of $\overline{W}_s$ = \$80,000 and $\overline{W}_u$ = \$100,000 associated with a 4-year university degree and a working life of 42 years, the rate of return of the investment is 4.9% In Table 16 a comparison is made between the true benefit-cost ratio of the investment to the estimated one for three alternative discount rates. As expected, the conversion does not match exactly the true benefit-cost ratio, but it is very close.

Table 16. Testing the sensitivity of the internal rate of return to B/C ratio conversion

Discount rate i	Present value of benefits PVB	Present value of costs PVC	True B/C ratio PVB/PVC	Estimated B/C ratio r/i
3%	405,296	297,368	1.4	1.6
4.9%	284,901	284,336	1.0	1.0
6%	236,821	277,208	0.85	0.8

Note: Internal rate of return, r = 4.9%

This paper was written by George Psacharopoulos, member of the CESifo research group for Post-2015 Consensus. The Post-2015 Consensus project brings together more than 50 top economists, NGOs, international agencies and businesses to identify the goals with the greatest benefit-to-cost ratio for the next set of UN development goals.

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