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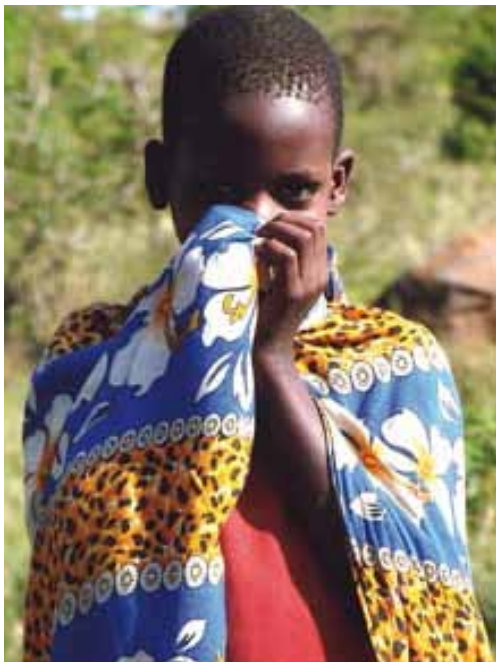


The Broader Impact of Advancing Education

Rising education levels provide many private and social benefits.[1] An analysis of policy choices that affect the speed of increase in education participation and attainment should address both private and social benefits. It is incumbent upon us to explore whether the benefits of an accelerated advance of education, like that of the normative scenario, appear to outweigh its costs.

Some social benefits, especially increased economic productivity, growth, and resultant tax revenues, can potentially repay the public investment in education over time, making possible a rather traditional cost-benefit analysis.[2] Lower youth dependency ratios and higher portions of the population in the workforce (the economic dividend of declining fertility) generally produce greater economic growth. Similarly, lower fertility rates generally accompany the education of women and allow them to enter the workforce much more easily. And smaller family sizes can enhance the ability of parents and societies to better educate and provide better health care for their children and therefore potentially again to increase economic productivity.

Moving beyond the strictly economic benefits of reduced fertility, analysts point to the greater ability of women to control their own lives (especially through increased "bargaining power" within households), to the way in which more educated and healthier youth provide greater social stability, and to the potentially positive environmental implications associated with the pressure of fewer people. Related to many of these implications of reduced fertility, children in smaller families generally have wider, freer life choices. Through all these paths, education affects the distribution of well-being in a society, not just its amount, and there are inevitably competing perspectives in societies concerning such social change. We should not underestimate, for example, the challenges that change of this type pose to the traditional dominance of men and therefore to cultural patterns of millennia.

Given the breadth and complexity of the impacts of education, as well as the differential valuation of such impacts, it is not possible to satisfactorily monetize the full range of costs and benefits of education's advance.[3] Nonetheless, an analysis that combines attention to a broad range of its economic and noneconomic implications is possible. The approach of this chapter will be to compare many different socioeconomic implications of the base case and the normative scenario, comparing some of the measurable economic consequences to the incremental costs of the normative scenario but also exploring beyond the easily measurable implications of accelerated education advance.

In this chapter, we explore some of the monetary and nonmonetary private and social impacts of education.

Education and Economic Development

The education attainment levels of adults, not enrollment patterns of school-age populations, drive most of the forward linkages from education to a host of economic and broader social impacts. We have seen how slowly those attainment levels percolate across the age-cohort structures of populations. Partly because of that slow speed of transformation, understanding the broader impact of education becomes very complex. Adding further complication, databases are not always sufficiently long to fully observe those transformations play out, and over such long horizons many other important contextual variables also change significantly. Among the advantages of exploration of the consequences of education's advance with the IFs model is its integration of many interacting global systems over the long run.[4] We begin our exploration by looking at one of the potentially most direct beneficiaries of accelerating education transitions—the economy. How much impact does the normative scenario have?

Productivity and growth

There is a very large literature on the relationship between advance in education and economic productivity, growth, and development (including income distribution). And there is agreement across the literature with respect to the microlevel returns to education: individuals who have more education earn more (UIS 2002: 34).

The preponderance of literature also supports the proposition that greater education attainment and/or education expenditure contributes to higher economic growth (Durlauf, Johnson, and Temple 2005). A significant literature has extended the discussion to consider the differential impact for economic growth of investment in various levels of formal education (for instance, see Psacharopoulos and Patrinos 2002).[5] There is, however, much uncertainty about the magnitude and character of the relationship between education and growth. Easterly (2001) questioned whether special efforts to push education forward have any positive impact on growth (which would suggest that individuals might acquire credentials and gain a larger share of the pie without increasing that pie), and Pritchett (1996) found no relationship between rising education attainment and growth; Pritchett (2004) further questioned the common use of aggregate cross-national data for analysis of the impact of education.

Still, the empirical literature generally finds that education contributes to higher GDP and GDP per capita.[6] That literature also tends to presume or argue that the impact of education on GDP exceeds the private returns that wages capture (which would be the case if advances in productivity spilled over to other workers). One widely cited study (OECD 2003: 76–78) found that an additional year of education (about a 10 percent rise in human capital in the countries of the analysis) raised GDP per capita in the long run by 4–7 percent. Cohen and Soto (2007: 71) found that an extra year of schooling in a country adds slightly more than 12 percent to income over the long term.

The empirical literature generally finds that education contributes to higher GDP and GDP per capita.

There is, of course, absolutely no uncertainty about the very strong cross-country correlation between higher education attainment levels and higher GDP per capita; the debate is only about the extent to which greater education explains higher GDP per capita. The strongest probable causal path in that direction is the impact of education on productivity and therefore on economic growth.

The IFs model represents that path and needs to specify its strength. Barro and Sala-i-Martin (1999: 431; see also Barro 1999: 19–20) reported that a 1 standard deviation increase in male secondary attainment (equivalent to 0.68 years) raised economic growth by 1.1 percentage points per year, and a 1 standard deviation or 0.091-year increase in male higher education raised it

by 0.5 percentage points.[7] More modestly, Chen and Dahlman (2004: 1) concluded that a rise of 20 percent in average years of schooling raises annual growth by 0.15 percentage points and that an increase in average years by one year raises growth by 0.11 percentage points, whereas Bosworth and Collins (2003: 17) determined that each year of additional education adds about 0.3 percentage points to annual growth. Baldacci et al. (2004: 22) found that "one year of additional primary and secondary education is associated with an increase in growth ranging between 0.4 and 0.8 percentage points per year, depending on the country group." The IFs base case and normative scenario both use the value of 0.2 percentage points of growth in multifactor productivity per incremental year of education, a conservative specification given these studies (the fact that there are other paths from education to growth in addition to that via productivity calls for a conservative approach).

Still another group of studies has looked at the impact of education spending on growth. Although one could argue that expenditures on education should generate no direct increase in productivity or growth and that the entire return to education should be expected through the increased education attainment of adults, there are more immediate returns to education spending. Especially at the tertiary level but also through agricultural institutes, vocational education, and other connections to lower levels of education, spending potentially contributes to relatively rapid returns from the generation and diffusion of knowledge. Education spending can also improve economic performance fairly quickly by targeting lifelong learning, an element of attainment not generally captured by average years of education. In addition, much education investment replaces workers who retire or die with new workers; the new workers may not add years of attainment to the population, but they do embody more recent knowledge and technology. Barro and Sala-i-Martin (1999: 432) concluded that increasing education spending as a portion of GDP by 1.5 points (one standard deviation) raised growth by 0.3 percentage points per year. Baldacci et al. (2004: 24) found that raising education spending in developing countries by 1 percent of GDP per year and keeping it higher added about 0.5 percent per year to growth rates and that sub-Saharan African countries and low-income countries benefited the most. The IFs base case and normative scenario both use the value of 0.2 percentage points of growth per additional percent of GDP directed to education. That is, again, a conservative parameterization, selected in part because we represent both the attainment and the spending effects.[8] The model is available for others to explore the implications of alternative parameters.

Relative to the base case, the normative scenario forecasts 4.2 percent greater GDP per capita in 2060 globally and 14.3 percent greater in sub-Saharan Africa.

The aggregate impact of the normative scenario on economic well-being

Table 8.1 compares GDP per capita for the UNESCO regions in the normative scenario with that of the base case. The results of the normative scenario, however, reflect more than the direct impact on economic productivity of education attainment and spending because the normative scenario affects population and other sociopolitical forecasts in ways that in turn have further positive economic impacts (as we shall see later in this chapter). For instance, Table 8.1 also reflects the effects of the normative scenario on fertility rates and population size (see McMahon 1999 for similar combined analysis).

The largest percentage changes are those in sub-Saharan Africa. The normative scenario gives rise to a GDP per capita nearly $900 higher in 2060 than that of the base case, resulting in a GDP per capita in 2060 that is 14 percent higher than the base case. The returns for other developing regions vary. In absolute terms, the GDP per capita (PPP) in South and West Asia is $1,450 higher in 2060 under the assumptions of the normative scenario. Because the base case forecast of GDP per capita for that region in 2060 is nearly three times that of sub-Saharan Africa, however, the relative gain is lower. The impact of the normative scenario is also positive, although considerably smaller, for all other UNESCO regions. At the country level, and especially through 2030, the normative scenario can actually reduce GDP—it is important to remember that the scenario leads to increased spending per student in many countries and that the shifts by governments of funds from other uses to education also have costs; the net result need not be economic gain.

The results in Table 8.1 for sub-Saharan Africa suggest a considerable return on the incremental

investment of the normative education scenario. In fact, the numbers are modest compared to some of the aggregate empirical analyses of the impact of education on growth discussed earlier. By 2030, the normative scenario adds 0.8 years of education to the average of those fifteen and older relative to the base case; by 2060, it adds nearly 2 years relative to the base case. The related increment to the economic growth rate in the normative scenario between 2030 and 2060 is only 0.15 percent, well within the range of the studies cited earlier. For South and West Asia, the normative scenario adds an average of 0.35 years of education for those fifteen and older by 2030 and 0.8 years by 2060. The increment to economic growth for the region in the normative scenario is 0.16 percent. The normative scenario's impact on GDP per capita for sub-Saharan Africa in Table 8.1 is greater than the impact for South and West Asia because of the greater reduction in fertility that the normative scenario generates in sub-Saharan Africa, not because the impact on GDP is greater.

Comparing economic costs and benefits

This report cannot provide a full cost-benefit analysis. Doing so would require monetizing not just the costs of potentially lower life expectancy were money for education diverted from health (which would generally be a poor idea) but also assigning monetary value to such factors as enhanced life opportunities for women and much more. It is, however, possible to examine the strictly economic streams of increased education spending and increased GDP in the normative scenario (see Table 8.2).

On a global basis and for half the regions, the cumulative incremental GDP stream from the normative scenario relative to the base case falls short of the cumulative incremental spending stream through 2030. Even by that year, however, East Asia and the Pacific (Poorer), South and West Asia, and sub-Saharan Africa experience net benefits from the normative scenario, and the Arab States break even.

By 2060, the world as a whole and most regions individually benefit considerably from the normative scenario. In the case of East Asia and the Pacific (Poorer), the ratio of benefits to costs is especially dramatic (the cumulative outlays of the region are not that high), yet the Arab States, South and West Asia, and sub-Saharan Africa all also post at least a fivefold return on the investment by 2060.

It takes a considerable time—about a full generation and sometimes more—for regions to reach a break-even point and begin to reap net returns to the investment. For East Asia and the Pacific (Poorer), it happens in 2025; for South and West Asia, it occurs in 2024; and for sub-Saharan Africa, the year is 2029. But for Latin America and the Caribbean, it takes

By 2060, incremental global GDP associated with the normative scenario is over five times the incremental education spending associated with it.

Table 8.1 GDP per capita at PPP: Normative scenario relative to base case

	GDP per capita at purchasing power parity					Normative scenario relative to base case	
		2030		2060			
	2005	Base	Normative	Base	Normative	2030	2060
Arab States	5,752	9,397	9,477	18,480	19,220	0.9%	4.0%
Central and Eastern Europe	9,310	20,090	20,110	39,060	39,190	0.1%	0.3%
Central Asia	3,383	8,658	8,696	12,310	12,480	0.4%	1.4%
East Asia and the Pacific (Poorer)	3,482	11,210	11,280	41,330	41,970	0.6%	1.5%
Latin America and the Caribbean	7,472	12,890	13,030	29,440	30,380	1.1%	3.2%
South and West Asia	2,122	5,608	5,726	17,820	19,270	2.1%	8.1%
Sub-Saharan Africa	1,521	2,401	2,460	6,255	7,150	2.5%	14.3%
East Asia and the Pacific (Richer)	25,430	43,480	43,590	90,760	90,980	0.3%	0.2%
North America and Western Europe	31,110	50,790	50,780	100,100	100,200	0.0%	0.1%
World	7,695	13,750	13,860	31,250	32,570	0.8%	4.2%

Source: IFs Version 6.12.

Table 8.2 Cumulative incremental education spending and GDP: Normative scenario relative to base case

	2030			2060		
	Incremental spending	Incremental GDP	GDP/spending	Incremental spending	Incremental GDP	GDP/spending
Arab States	72	75	1.0	156	865	5.5
Central and Eastern Europe	89	22	0.2	192	184	1.0
Central Asia	26	7	0.3	54	61	1.1
East Asia and the Pacific (Poorer)	206	333	1.6	279	5,150	18.4
Latin America and the Caribbean	378	298	0.8	790	2,844	3.6
South and West Asia	305	499	1.6	1,050	9,106	8.7
Sub-Saharan Africa	80	91	1.1	347	1,860	5.4
North America and Western Europe	206	–32	–0.2	377	–52	–0.1
East Asia and the Pacific (Richer)	216	95	0.4	376	320	0.9
World	1,579	1,389	0.9	3,625	20,367	5.6

Note: Both spending and GDP are in billions in 2000 dollars, discounted by 3 percent per year.

Source: IFs Version 6.12.

In some regions, it takes about a full generation to begin to reap net economic returns from the incremental education investment.

until 2034, and for East Asia and the Pacific (Richer), it is nearly reached only in 2060. North America and Western Europe actually have a small negative return to the normative scenario because it slightly raises the spending per student at the primary and secondary levels (the model does not calculate any potential gains that would come with that increase) and because the increment in education spending crowds out other economically valuable spending choices. The exclusion from the normative scenario of targets at the tertiary level explains much of the failure of high-income regions to recognize net gains from it (again, Volume 4 in this series will return to the issue).

For those regions that reap gains, the surplus of return relative to investment grows steadily and often rapidly after the break-even point. In fact, during the course of the normative scenario, the higher GDP becomes a significant force in pushing forward investment in education relative to the base case. The long delay in return to investment and the continued growth in the magnitude of that return help us understand the great difficulty that many nondynamic empirical studies have in estimating the growth benefits of investment in education—the patterns are highly nonlinear.

Higher GDP includes, of course, the private returns of education that workers obtain in wages. If those benefits are spread very widely, the GDP can be a general indicator of social return to the additional public investment in education. An alternative and more demanding measure of social return, however, and one less subject to capture by a subpopulation is increased government revenue itself. Whereas the cumulative discounted stream of incremental GDP in the normative case exceeds the cumulative discounted incremental stream of government spending in sub-Saharan Africa in 2029, the cumulative stream of incremental governmental revenue does so only in 2045. For South and West Asia, the delay is from 2024 to 2048; for the Arab States, from 2030 to 2043; for Latin America and the Caribbean, from 2034 to 2059; and for the poorer countries of East Asia and the Pacific, from 2025 to 2040. For the world as a whole, the delay in "payback" is from 2032 to 2050. Because of the compounding effects of economic growth and the positive feedback loops around it, the gaps between the GDPs in the normative scenario and those in the base case rapidly rise and generate increasingly high government revenues. Even with this more conservative measure of return, payback occurs in about two generations.

Uncertainties in analysis

Cost-benefit analysis is, of course, sensitive not just to discount rates but also and even more so to assumptions concerning the linkages between education's advance and economic growth. The discussion of literature explored to some extent the debates about those linkages. The preceding analysis, although we believe it to be conservative with respect to estimating break-even points, could either overestimate or underestimate the delays in returns to education investment and their ultimate magnitude. As a partial check on the danger of overestimating them (and therefore overselling the case for incremental investments in education), we did a sensitivity analysis in which we completely eliminated the direct linkage between education spending and economic growth, leaving only the modest linkage between years of adult education and growth. For sub-Saharan Africa, that pushes the break-even point out to 2047 (two generations), and for South and West Asia, it pushes the break-even point beyond 2060. Given the typically higher estimates for growth linkages in the empirical literature, we believe these to be unreasonably conservative values, but it is impossible to be certain.

Interim costs of diverting money to education

The long delay between investment in education and aggregate economic returns to it also raises the question of the interim costs of the diversion. Such costs would depend in part, of course, on the origin of the incremental domestic funds shifted into education. Looking again at sub-Saharan Africa, we can see that the governments of the continent already (according to data and IFs estimates) spend about 4.3 percent of GDP on education, as much as on the military (1.6 percent) and health (2.7 percent) combined, for a total of just over 8.6 percent of GDP on these three uses. Somewhat more than another 8 percent goes to other consumption and administrative expenses.

It is commonly argued that the moneys currently directed to military spending would be the appropriate source of additional investment in human capital and that they could, on average, provide the 0.5–1.1 percent of GDP required for the normative education scenario. Yet the need of sub-Saharan African countries to build competent and honest security forces makes clear that any suggestion of taking the funds from the military may be too simplistic. The Costa Rican model of spending 0.5 percent or less of GDP on the military certainly has many attractions, and it has contributed substantially to the country's investment in its human capital. But sociopolitical and geopolitical conditions (including ethnic fractionalization) are markedly different throughout most of Africa. Also, improved internal security and stability need to be in place before external donors find provision of support attractive (see Chapter 7 for a discussion of external funds). Similarly, although it would be manageable without substantial harm for some countries—most especially those rife with corruption—a diversion of funds from other consumption and administrative expenditure categories probably cannot be expected in support of higher spending on education.

For the purposes of the analysis here, however, incremental education costs were taken proportionately from all other categories, including health. Doing so offered an opportunity to make clear that almost any reallocation of funds has potential costs as well as benefits. What, for example, might be the health implications of such sharing in additional education funding? The analysis with IFs suggests that, even with outside donors paying for part of the increase, a proportional diversion of government funds from other uses to education in sub-Saharan Africa could cost, on average across the continent, up to 0.4 years of life expectancy for a period of about ten years, definitely a significant cost.[9] That reduction, however, probably overstates the impact of fund diversion because education itself has a significant impact on health improvement, which this strictly economic assessment does not include. A later section will correct this estimate by adding that direct beneficial impact of education for health back into the analysis.

Education and economic distribution within societies

Although education almost certainly enhances the economic well-being of the average individual attaining it and improves the overall performance of an economy, albeit with long lags, its impact on social inequality is less clear-cut (Hannum and

It takes longer (about two generations rather than one) for incremental government revenues to exceed the incremental investment in education.

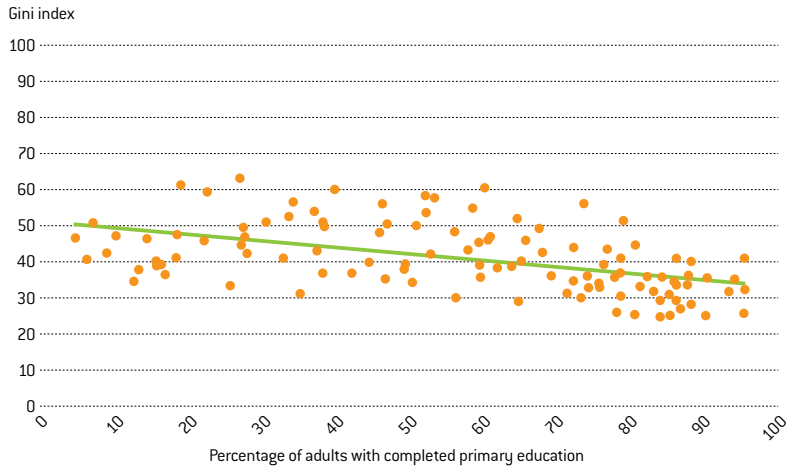
The expansion of education—and particularly the movement toward UPE—tends to spread education attainment more equally across society.

The accelerated advance of education appears to reduce income disparities across countries.

Buchmann 2006: 507–517). Logically, that impact depends heavily on the distribution of education attainment in the society as a whole. Perversely, raising education attainment could simply open new levels of advancement to an elite and further concentrate economic opportunities. For instance, it is reasonable to assume that, when starting from extremely low rates of participation in education at any level, expanding it to what are then a select few would actually increase inequality. Only above a threshold would further expansion decrease inequality of educational attainment again.

More often, the expansion of education, particularly the movement toward universal education, tends to spread education attainment more equally across society (leaving aside whether or not advances in education equality automatically improve social equality). Cross-nationally, the curve that relates average years of education to the Gini coefficient for education in societies (higher values of Gini being less egalitarian) is quite steeply downward-sloping (World Bank 2000: 60). Longitudinal analysis of select countries also shows decreases in inequality of education with expansion of education access. Thus, we can reasonably expect that, in almost all cases, the normative scenario will improve the distribution of education relative to the base case by increasing average attainment levels.

Figure 8.1 Relationship between extent of primary education and Gini index of income distribution



*Note: Equation: y = 51.1478 – 0.1821 * (x); R-squared = 0.26*

Source: IFs Version 6.12 using UIS and WDI data (most recent by country).

Does the distribution of education affect the distribution of income? Figure 8.1 suggests that it may, by showing the cross-sectional relationship between the portion of a society's adult population that has completed primary education (higher percentages again indicating greater equality of education) and the Gini coefficient for income of the country. As one might expect, income inequality declines most clearly with the approach of universality.

Because GDP per capita is highly correlated with the extent of primary education and significantly (and inversely) correlated with income inequality, the relationship in Figure 8.1 could be spurious (that is, higher income could lead to both greater education and greater equality). Controlling for GDP per capita suggests, however, that the relationship remains.

Greater education in a population has other social benefits that can either flow from improved income distribution or be more direct. For instance, Kunst and Mackenbach (1994) found that the inequalities in mortality of the United States, France, and Italy were about twice as large as those in the Netherlands, Sweden, Denmark, and Norway and that the inequality in access to education partially explained the differential. Taking the analysis still further, Woolf et al. (2007) found that elimination of education-associated mortality differences in the United States could avert about eight times as many deaths as medical advances did in the 1996–2002 period. The path between improved education and health, long recognized to be quite powerful, may run in part through the distribution of income or may be directly linked to healthier behavior patterns that are at least partially independent of income.

Education and economic distribution across societies

Education advance affects not only the domestic distribution of income but also its global distribution because of the relatively greater improvement it makes in the GDP per capita of low-income regions. Figure 8.2 shows for the base case the steady decline of global income inequality that logically follows from the forecasted continued economic growth per capita in China, India, and other large, emerging countries in excess of that in North America and Western Europe. The normative

scenario reduces global Gini in 2060 by an additional 0.02 points on the 0–1 scale used in Figure 8.2. The Gini displayed is across peoples, taking into account intracountry distributions, not just country averages.

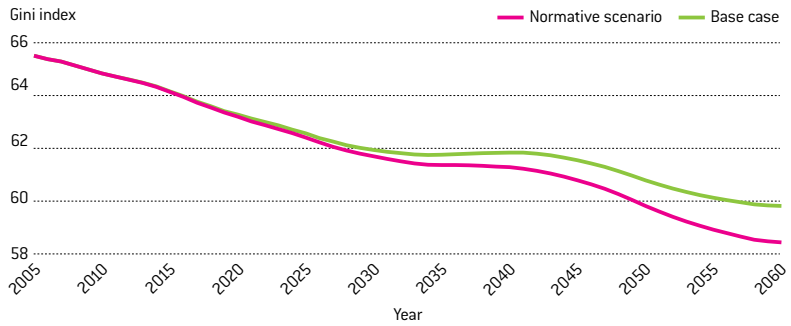
Even though the global Gini has begun to decline after years of advance, the income ratio between the very richest and very poorest peoples of the world has continued to grow for at least two centuries, and in the base case, it continues to grow until after 2040. Figure 8.3 shows that in the normative scenario, that ratio could begin to decline relative to the base case by about 2020 and more significantly by 2040. That relative pattern again reflects the approximately one- to two-generation time difference in many aspects of the base case and normative scenario because the normative scenario advances the education transition by roughly that amount of time.

Global poverty

The first volume in this series, *Reducing Global Poverty* (Hughes et al. 2008), explored the future of global poverty in detail. The portion of people in the world who live in extreme poverty (with an income of less than $1 per day) has been falling because incomes have been rising. The decline in extreme poverty in sub-Saharan Africa has been slower than targeted by the Millennium Development Goals, which called for cutting the poverty rate in half between 1990 and 2015—in fact, the absolute number of those living in poverty there has long increased. In contrast, the decline in China has significantly exceeded the target. The base case of IFs shows mostly similar worldwide patterns going forward, except that the numbers of poor in sub-Saharan Africa should actually decline because of growth expectations that exceed historical ones and slowing population growth. *Reducing Global Poverty* concluded that a faster advance in education attainment could increase the rate of poverty's reduction.

In 2060 in the normative education scenario of this volume, 50 million fewer people in the Least Developed Countries of the world suffer extreme poverty, defined as income of less than $1 per day, as compared to the base case (see Figure 8.4). Across sub-Saharan Africa, the reduction is about 70 million. Globally, nearly 200 million fewer individuals are living on less

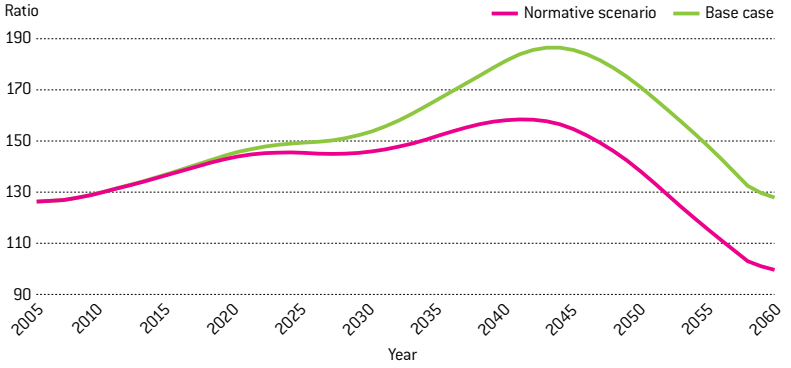
Figure 8.2 Global Gini index of income distribution: Normative scenario relative to base case



Note: Values are 5-year moving averages; the bulge in midyears reflects the impact of higher energy prices in the peak-oil years of the IFs energy model and resultant deterioration in global income distribution.

Source: IFs Version 6.12.

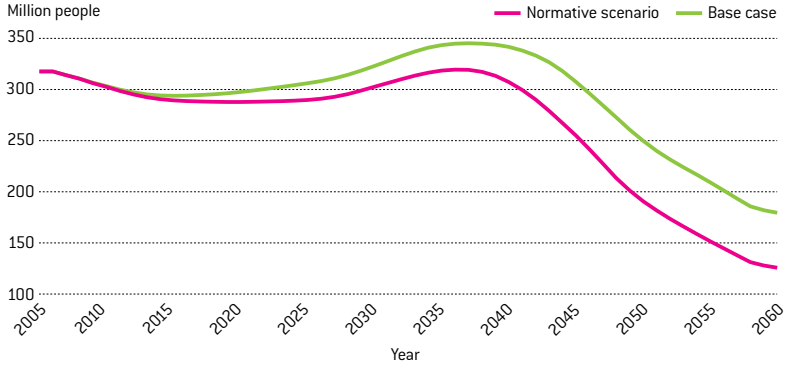
Figure 8.3 Global income ratio of the richest and poorest 10 percent of individuals: Normative scenario relative to base case



Note: Values are 5-year moving averages.

Source: IFs Version 6.12.

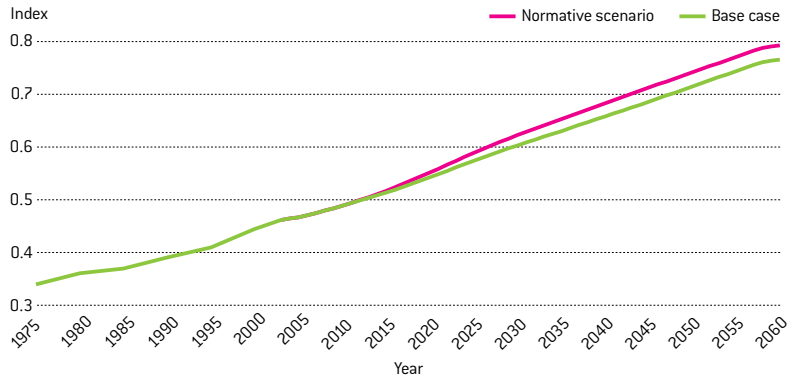
Figure 8.4 People (millions) in Least Developed Countries living on less than $1 per day: Normative scenario compared to base case



Note: Values are 5-year moving averages.

Source: IFs Version 6.12.

Figure 8.5 Path of the Human Development Index in Least Developed Countries: Normative scenario relative to base case



Note: Values are 5-year moving averages.

Source: IFs Version 6.12.

Relative to the base case, in the normative scenario 50 million fewer people in the Least Developed Countries of the world suffer extreme poverty in 2060.

than $2 per day, including 35 million in South and West Asia. (The tables at the back of this volume provide much more information on the future of poverty by region and country.)

Figure 8.5 compares the Human Development Index of the United Nations Development Program (UNDP) across the two scenarios. That measure of human capabilities combines data on education, health, and income. The normative scenario could provide a significant boost to its values in LDCs relative to an already rapidly improving pattern in the base case.

Education and Demographics

Just as education has a direct impact on economic productivity and growth, it also has a direct impact on fertility and life expectancy, the key drivers of demographic change. And just as education has an additional and indirect impact on economic growth via its links through demography, education's linkages to economic change further shape its longer-term impact on demography. In short, the complex relationships within human development across education, economic, and demographic systems are messy. In this section, we first review what we know about how education helps shape fertility and mortality. Then we will look at the overall impact of the normative scenario on population.

Fertility

Evidence of the existence of a strong relationship between increasing education, particularly of women, and lower fertility is incontrovertible. The fundamental logic of the relationship between education's advance and fertility reduction at the micro level seems powerful. Easterlin (1961) and Becker (1973 and 1974) emphasized economic arguments: as education increases and brings a variety of opportunities for individuals and households, the costs of childbearing rise relative to the benefits of limiting or foregoing it. Castro-Martín and Juárez (1994) elaborated the microlevel elements in terms of changes as a result of education in (1) knowledge, (2) opportunities, and (3) worldviews and values.

At the macro level, the cross-sectional and longitudinal evidence seems overwhelming. The identification and elaboration of that relationship go back at least to Notestein (1945), who provided the modern formulation of the demographic transition and saw its relationship to education, urbanization, industrialization, and other aspects of modernization more generally. Yet in spite of the long attention given to it, the exact nature of the relationship and the patterns of causality are extremely complex and by no means fully understood. Statistically, a key problem is multicolinearity—when multiple variables are highly correlated, small changes in the dataset can quickly shift the apparent ranking of their importance and the apparent direction of causality. More qualitatively and theoretically, the sequencing and causal patterns of such dynamic multivariate systems are likely to be subject to variation over time and space, making precise statements of cause and effect impossible.

What, then, can be said concretely about the patterns in the relationship between education and fertility that can help us in developing forecasting formulations? A very large literature, including a significant series of expert studies organized by the United Nations Population Division (2002), has teased out insights. Among them are:

- Secondary education seems particularly important. Hannum and Buchmann (2006: 516) found "that a 10 percent expansion in primary gross enrollment ratios leads to an average reduction in the total fertility rate of 0.1 children; the corresponding increase in secondary enrollment ratios is associated with a reduction of 0.2 children."

- Primary education has a less clear-cut relationship with fertility reduction, and studies seem mixed. The United Nations Population Division (2003: 21) reported that in some countries, early ages of marriage, sexual activity, and first birth have been higher in populations with some primary education, but are consistently and substantially lower in those with secondary education. Diamond, Newby, and Varle (1999) reviewed and explored the relationships of different education levels to fertility and found that earlier conclusions suggesting some primary education might actually increase fertility no longer hold up well.[10]
- Breadth of access to education, or the development of "mass education," appears especially important. John Caldwell (1980: 249) found that breadth of access is more important than extent of education. Even the advent of universal education requirements seems to begin a process of cultural change. The United Nations Population Division (2002: 143) found that in many countries, even when at a macro level more education is related to lower fertility, fertility "declined fastest among women with no education." Male education is important as well as female education (Castro-Martín and Juárez 1994).

Figure 8.6 shows the cross-sectional relationship between the average years of education of adult female populations fifteen years of age and older and fertility rate. As indicated earlier, other measures of education attainment, including the portion of women or men who have completed primary education or secondary education, also correlate strongly with reductions in fertility. The analysis of the IFs project found that other and more specific measures do not, however, enhance statistical explanatory power relative to average years of female education; moreover, average years has strong, long-term forecasting power because it encompasses transitions across primary, secondary, and even tertiary education. Hence, our analysis uses it.

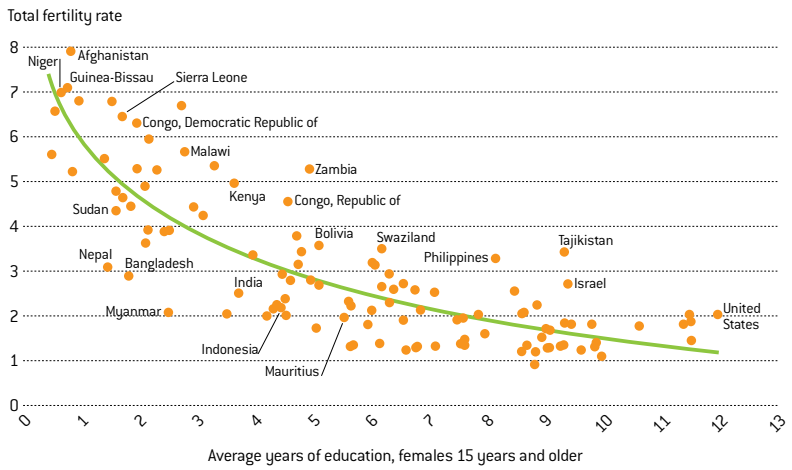
Figure 8.6 also suggests one of the complications of forecasting based on such a relationship. It is obvious that a significant number of sub-Saharan African countries, including the two Congos, Kenya, Rwanda, Sierra Leone, and Uganda, populate the upper left-hand corner of the distribution, falling above the regression line. It may be that cultural values and mores have slowed the pace of the fertility reduction transition relative to what education levels would suggest. Or it may be that the onset of rapid fertility change has been delayed, as has been the case in many other countries that subsequently experienced an especially rapid decline. The infant mortality levels of these countries, an important determinant of onset, are still the highest in the world, ranging from 80 to 160 deaths per thousand in 2005. The forecasting formulation, as is the general pattern in the IFs system of models, protects the initial conditions but assumes that there will be convergence of such countries toward the general tendency over time.

Many other variables clearly affect fertility. In formulating the relationship for IFs, it was found that GDP per capita at PPP did not add significantly to the power of education alone (although its correlation is not much lower). It was found that contraception use rates do, however, make an independent incremental contribution—in addition to the likely path from education to fertility reduction via contraception use—and raise the overall adjusted R-squared to 0.77. Because the literature also suggests the importance of the availability and use of modern

Evidence of the existence of a strong relationship between increasing education, particularly of women, and lower fertility is incontrovertible.

The nature of the education-fertility relationship is complex and by no means fully understood.

Figure 8.6 Total fertility rate as a function of average adult female education years



*Note: Equation: y = 5.9471 – 0.1821 * (x); R-squared = 0.71*

Source: IFs Version 6.12 using WDI and Barro and Lee (2001) data (most recent by country).

Analysis of the impact of education on mortality emphasizes different issues and paths in developed and developing countries.

contraceptive techniques among proximate factors, contraceptive use is included in the IFs formulation.

Figure 8.7 shows the resultant forecasts of total fertility rates in the three education subgroupings of sub-Saharan Africa, the region of clearly greatest impact, in the base case and normative scenario. The acceleration of decline in the normative scenario takes time to appear; a formulation driven only by the education attainment of women aged fifteen to forty-nine (instead of all women, as currently in IFs) would somewhat accelerate the onset of decline and would have a commonsense basis. The impact of the normative scenario is considerably greater in the low-education (and highest-fertility) grouping, but it also is clearly apparent in the middle-education grouping.

Health and mortality

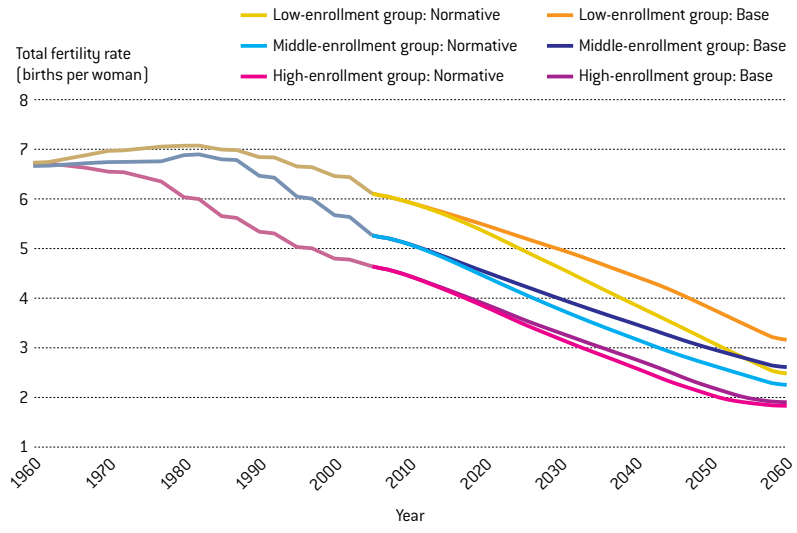
Mortality reduction is the other half of the demographic transition, complementing and, in terms of onset, typically preceding fertility reduction.[11] Elaborating the process of mortality reduction, Omran (2001) developed in 1971 the original explication of the epidemiological transition (the progression from high to low mortality rates in association with the movement from infectious to degenerative disease as the primary causes of death). He emphasized (2001: 167) that a "vast array of social, economic, and demographic" factors shape the transition, but he did not draw any special attention to education. Research since that time has substantiated the importance of education attainment in reducing mortality or, stated more positively, increasing life expectancy. Caldwell (1989) identified a range of micro evidence that individual parental education, especially of the mother, reduces infant and child mortality, as well as macro evidence on the impact of education on mortality.

An analysis of the impact of education on mortality emphasizes different issues and paths in developed and developing countries because their patterns of mortality are so different. In high-income countries generally, education differentials seem particularly important with respect to cardiovascular disease (United Nations Population Division 2003: 36). Case (2006: 272-273) reported findings that "each additional year of schooling for men in the United States is associated with an 8% reduction in mortality, a result consistent with those found in many European countries" and that "in 1960, an additional year of education increased life expectancy at age thirty-five by as much as 1.7 years."[12]

In developing countries, the focus of attention has been overwhelmingly on the impact of education on maternal and child mortality. Omran (2001: 165) emphasized, back in 1971, that maternal and child mortality are central to the epidemiological transition. Caldwell (1989: 103) made the strong assertion that "there is little doubt that mortality levels close to those of the industrialized countries can be achieved within two decades if nearly all children are educated through elementary school." He further argued (Caldwell 1990) that education usually has more impact on mortality than does access to medical services, income, or nutritional levels. And he cited a UN study finding that, after controlling for other variables, an additional year of education for a mother reduces child mortality by 3.4 percent (Caldwell 1993: 128).[13]

There are not only direct linkages of education to health (such as mothers being able to read informational materials and improve behavioral choices) but also important

Figure 8.7 Fertility in sub-Saharan Africa country groups by primary enrollment rates: Normative scenario relative to base case



Note: Values are 5-year moving averages.

Source: IFs Version 6.12 using UIS and WDI data and IFs base case and normative scenario.

further linkages to economic growth and income, which in turn affect health in a positive feedback loop. Bloom and Canning (2005: 2) noted that "health improvements can influence the pace of income growth via their effects on labor market participation, worker productivity, investments in human capital, savings, fertility, and population age structure," and they pointed to a large literature on the positive impact of health on economic productivity and growth. E. Jamison, D. Jamison, and Hanushek (2006: 21) observed that "improved education levels and improved health conditions each account for perhaps 10–15 percent of economic growth in the later decades of the 20th century" (see also López-Casanovas, Rivera, and Currais 2005).

Much economic literature on the drivers of productivity growth emphasizes the importance of research and development to technological advance. That suggests still another path via which education might affect health, namely, the relationship between tertiary education and the advance of health-related knowledge and practices, including new technologies for treatment.

Given the research around the impacts of education, income, and technology on mortality, it is not surprising that three key distal or indirect factors drive the mortality forecasting model of the World Health Organization's Global Burden of Disease (GBD) project: "(1) average income per capita, measured as gross domestic product (GDP) per capita; (2) the average number of years of schooling in adults, referred to as 'human capital'; and (3) time, a proxy measure for the impact of technological change on health status" (Mathers and Loncar 2006: 2013).

The GBD analysts, though understanding that proximate or immediate factors (such as a bacterial infection and treatment for the infection) truly determine health outcomes, also found that the three distal drivers correlate highly with such proximate factors and thus the outcomes themselves. The GBD model represents the relationship between the three drivers and mortality for each age-cohort, sex, and cause group in their analysis.[14] The IFs project has completed the initial implementation of a health model that replicates the GBD distal-driver approach and that will be used for the third volume in this series. Because of the linkage of education to health in that distal-driver formulation, the IFs model can already estimate the mortality reduction or life expectancy expansion associated with the normative education scenario.

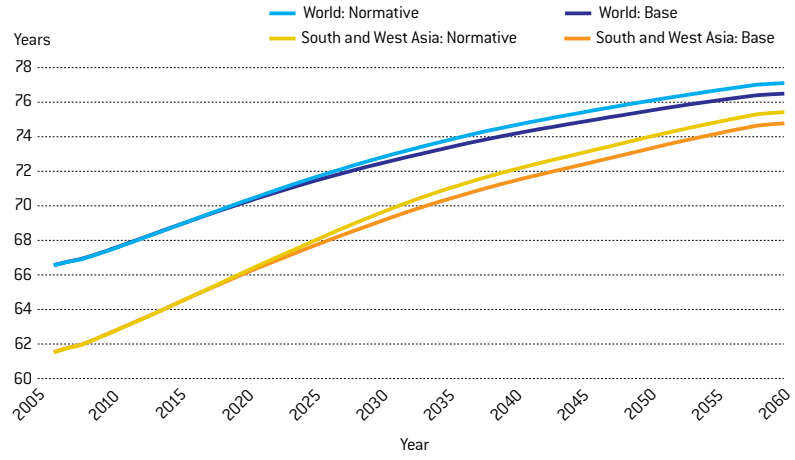
Figure 8.8 shows comparative forecasts of life expectancy in the world and in South and West Asia as an illustrative region across the base case and normative scenario.

Globally, the incremental life expectancy in the normative scenario is about 0.2 years already by 2030, and it grows to about 0.5 years by 2060. In South and West Asia, the increment is 0.3 years in 2030, increasing to more than 0.5 years in 2060. Focusing on this high-population region, it is possible to gain some sense of the monetary payoff of education in terms of improved health. A rough estimate of life-years saved in the region over the thirty years from 2030 through 2060 is 200 million (the numbers before 2030 are much smaller).[15] Following common practice in cost-benefit analysis and valuing those life-years at an embarrassingly low level of $10,000 (approximately the likely GDP per capita at PPP at the midpoint of the analysis range in 2045) yields a monetary value of $2,000 billion for the additional life-years in the normative scenario. The cumulative incremental spending of the region on education in the normative scenario through 2060 would

In developing countries, the focus of attention has been overwhelmingly on the impact of education on maternal and child health.

Incremental life expectancy in the normative scenario grows to about 0.5 years by 2060.

Figure 8.8 Life expectancy in world and in South and West Asia: Normative scenario relative to base case



Note: Values are 5-year moving averages.

Source: IFs Version 6.12.

The population-reducing effects of fertility change are much larger than the population-increasing effects of mortality change.

The population of sub-Saharan Africa is 150 million lower in 2060 in the normative scenario, which is about 8 percent less than in the base case.

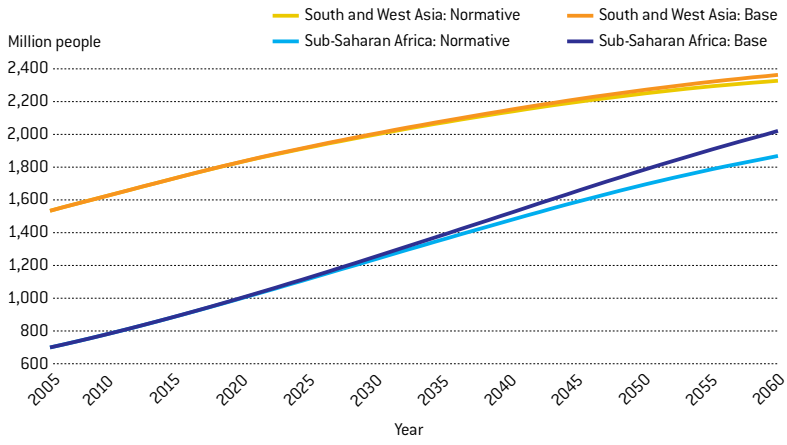
be $3,100 billion (without discounting). Thus, the payoff to investment in education in terms of reduced mortality from 2030 to 2060 alone (not even including the reduced mortality before 2030 or the reduced morbidity across the period) would seem to be close to 65 percent of the cost of the incremental investment of the normative scenario. That is a tidy bonus to put on top of the direct economic return calculated in Table 8.2.

The impact of the normative scenario is somewhat higher for sub-Saharan Africa, where the incremental life expectancy is 0.6 years by 2030 and 1.1 years by 2060. In general, there is some saturation in gains in life expectancy over time, so the higher the life expectancy of a region, the lower the impact. By 2060, the gain for Latin America is 0.2 years, and that for East Asia and the Pacific (Poorer) is 0.1 years.

Population effects in combination

The fertility and mortality effects of education's advance in the normative scenario relative to the base case affect total population in different directions, but the population-reducing effects of fertility change greatly overshadow the population-increasing effects of mortality change. Figure 8.9 shows the resultant population forecasts. The implications of the normative scenario are the greatest in sub-Saharan Africa and somewhat less pronounced in South and West Asia, and they are not significant in other regions.

Figure 8.9 Population in sub-Saharan Africa and South and West Asia: Normative scenario relative to base case



Source: IFs Version 6.12.

The population of sub-Saharan Africa is 150 million lower in 2060 in the normative scenario, or about 8 percent less than in the base case (1,873 million instead of 2,026 million). The reduction in the current low primary enrollment countries is 71 million, or 11 percent of the base case; the middle-education country set has a larger population, and the reduction there would be 66 million. In other words, population reduction itself would also further facilitate the process of educating African youth by reducing the overall demand for resources relative to constrained supply.

As discussed in Chapter 7, the normative scenario also affects the age distribution of the population, especially in sub-Saharan Africa. The portion of the population there under fifteen falls even in the base case from 44 percent in 2005 to 27.5 percent in 2060, a decline that will effectively move the continent past the demographic phase of greatest challenge to education systems. The acceleration of education in the normative scenario reduces the youth share another 2.5 percentage points by 2060, a positive feedback loop that further assists the demographic and education transitions. In combination with a relatively unchanged population share above age sixty-five in the normative scenario (up only about 0.6 percentage points), this reduction provides Africa with some further "demographic dividend" in the form of a proportionately larger working-age population.

A slightly different way of looking at dependency burdens involves considering the youth bulge. The threshold for a youth bulge is variously determined among scholars, but according to one common definition, such a bulge exists when the population between fifteen and twenty-nine years of age exceeds 40 percent of the total population (Cincotta, Engelman, and Anastasion 2003: 43). Such high proportions of young people can create many social problems, including difficulty in providing adequate employment for new entrants to the labor pool and the political and social instability often associated with large numbers of unemployed young males. Sub-Saharan Africa in the aggregate currently suffers a youth bulge that promises to persist well into the twenty-first century. South and West Asia has one that is likely to disappear formally by about 2013,

followed by a rapid drop in that age category through the forecast horizon. The normative scenario would likely eliminate the youth bulge of sub-Saharan Africa only slightly faster than does the base case.

Education and Sociopolitical Change

Although the preceding discussion stressed the marginal impacts of the normative scenario on economic and demographic change, we should not lose sight of the more fundamental and wide-ranging implications of the education transition that the base case itself represents. Neither the sustained and extraordinarily rapid global economic growth of the last two centuries nor the human demographic transition, with its rapid bulge of population growth in the face of mortality decline and now falling fertility, could have played out in the absence of a close interaction with the spread of mass basic education, adult literacy, and now increasingly advanced education.

The story is the same with respect to broader sociopolitical change. Education shapes an understanding of the world, affects values, and therefore alters human behavior. Such impacts cannot help but dramatically affect the ways in which humans interact with each other and organize their social institutions. Culture involves ideas, beliefs, and values as well as social practices and relationships and, most broadly, the informal and formal institutions that build upon and perpetuate these. Thus, education fundamentally shapes culture, even as culture shapes education.

In much of the high-income, Western world, this mutual shaping and reshaping may appear to mean the maintenance and transmission of relatively slowly evolving cultures (although reflection on even the last two generations of change in North America and Western Europe might call into question such a characterization). In much of the developing world, however, there is no doubt that education, in combination with economic and demographic change, is involved in a revolutionary reshaping of traditional cultures. Caldwell (1980) argued that the adoption of Western mass education throughout the world transforms cultures, beginning—when children are sent outside the home for education—with the restructuring of family relationships from those dependent on largely self-sufficient family production to those that integrate the family with an external economy and continuing with transformations of fertility and understandings of gender roles.

In this discussion, we do not seek to elaborate the depth and breadth of such transformative processes. Our focus is again on the marginal implications of the normative education scenario, not on the massive change already associated with the base case. We therefore consider a select few more easily measurable manifestations of the impact of education, including processes of democratization and other aspects of governance. Table 8.3 provides context for the discussion by showing the strength of cross-sectional relationships of assorted socioeconomic variables with both GDP per capita at purchasing power parity and years of education attainment by the adult population fifteen years of age and older.

The resulting age distribution of sub-Saharan Africa's population would provide a "demographic dividend" to the region.

Education shapes an understanding of the world, affects values, and therefore alters human behavior.

Democratization

Social scientists who have looked at the influence of education on sociopolitical systems have paid special attention to its role in support of democratization since at least the time when John Dewey (1916) wrote *Democracy and Education: An Introduction to the Philosophy of Education*. In another classic statement on the important relationship, Seymour Martin Lipset (1959: 80) wrote, "If we cannot say that a 'high' level of education is a sufficient condition for democracy, the available evidence does suggest that it comes close to being a necessary condition."[16]

Table 8.3 Relationships of sociopolitical variables with GDP per capita at PPP and years of education (R-squared)

	GDP per capita at PPP	Education years at age 15+	Together
Freedom (Freedom House)	0.30 (log)	0.33 (lin)	0.42
Democracy (Polity Project)	0.29 (log)	0.36 (lin)	0.42
Government effectiveness (World Bank)	0.72 (log)	0.58 (lin)	0.78
Corruption (World Bank)	0.75 (lin)	0.53 (lin)	0.83
Corruption (Transparency International)	0.82 (lin)	0.51 (lin)	0.83
State failure (Fund for Peace)	0.74 (lin)	0.57 (lin)	0.79

Note: Data analysis with IFs using most recent data from organizations indicated, with elaboration in the text; (log) refers to logarithmic relationships and (lin) to linear ones; the relationships in the table structure those in the model.

Source: IFs Version 6.12.

A cross-sectional relationship exists between the education attainment of societies and the extent of democracy, but the relationship appears especially complex.

Once again, however, the existence of a cross-sectional relationship between the education attainment levels of societies and the extent of democracy—a relationship that no one questions—does not prove causality. Much less does it help us understand the details of possible causal dynamics, including the level or type of education that might most enhance processes of democratization.

In the attempt to unravel the relationship and give it theoretical content, early studies tended to emphasize mass education and literacy (Lipset 1959; Cutright 1969), often in the spirit of modernization theory more generally. This is partially satisfying because educated individuals do tend to be better informed and more politically active. Yet mass education at lower levels also serves a socialization and homogenization function; Durkheim (1956), Green and Preston (2001), and Kornhauser (1959) documented well the potential downsides of politics in mass society, including the ability of elites to mobilize publics in support of Nazism and totalitarian communism.[17]

More contemporary analysis tends to take an institutional perspective in which education is seen as an integral part of a broad and complicated "social and political construction of society" (Hannum and Buchmann 2006: 518). For instance, variations in the manner in which the highly educated are brought (or not brought) into political systems can affect their support for existing systems. Glaeser, Ponzetto, and Shleifer (2007: 3–4) pointed to the vital role of universities and their students from Oxford, Bologna, Paris, and Wittenberg (where students supported Martin Luther) in the Middle Ages, through the overthrow of Juan Perón in Argentina and the Hungarian Revolution, to the widespread student riots in 1967 and the Tiananmen student uprising in the China of 1989. Still more recently, the pictures of Pakistani lawyers in their suits protesting in the streets from 2007 to 2009 impressed peoples around the world with the power of an educated and at least potential elite.

Just as the perspectives of general publics with primary or lower secondary education are not always democratic, the activism of the highly educated is, of course, not always supportive of democracy either, and the empirical work of Acemoglu et al. (2004) questioned the causality of the education-to-democracy relationship. In the literature that does support a primarily positive impact of education, some of the theoretical elaboration of the relationship emphasizes the importance of cognitive growth (Inglehart and Welzel 2005: 37) and therefore the greater understanding of the virtues of majority rule and of the protection of minorities.

Understanding that multiple factors determine social change, the IFs project looked not just to levels of education attainment in societies as a driver of change in democracy level but also to GDP per capita at PPP because that variable serves as a proxy for income level, which in turn strongly correlates with nearly all aspects of social change (Hughes 2001). Table 8.3 showed that GDP per capita by itself has a logarithmic relationship (R-squared of 0.30) with a measure of freedom/democracy built from the sum of the two individual measures of Freedom House (Gwartney et al. 2007).[18] The relationship using the Polity Project's measure of democracy is nearly identical. The variable for education years at age fifteen has a linear relationship with both measures of democracy. Income and education together are both significant and raise the R-squared.[19] The IFs formulations for forecasting build on these relationships.

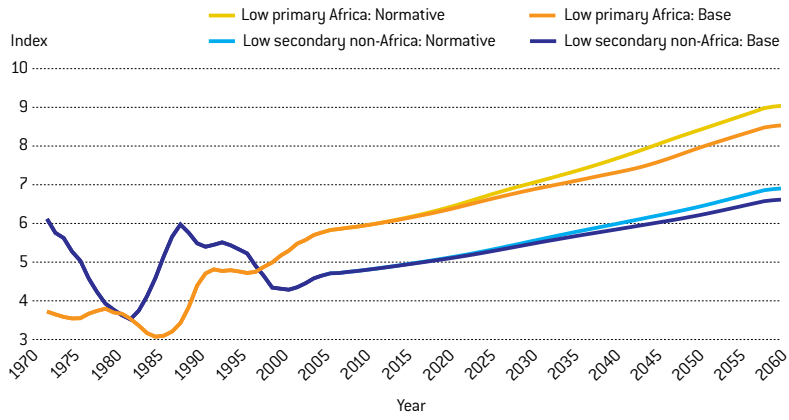
The countries where education advance in the base case and the normative scenario is likely to be the greatest are typically the countries with the lowest current levels of democracy. Figure 8.10 thus focuses on two groupings to which we have returned throughout this volume, namely, the countries of sub-Saharan Africa with the lowest levels of primary enrollment in 2005 and the countries outside Africa with the lowest levels of enrollment at the secondary level in 2005 (see Tables 3.4 and 3.5 for country groupings).

The historical series conveys the great fluctuations in level of democratization over time in the two sets of countries and thereby suggests the difficulty in forecasting future values. Countries with historically high political instability populate both of these country sets. Since the late 1970s, democracy has advanced somewhat in the low primary enrollment countries of Africa, but it has faltered in the

low secondary enrollment countries globally. Among the reasons for complex patterns historically are the domestic turmoil in many countries and also the regional and global waves of democratization (Huntington 1991); the recent wave of democratization in Africa is apparent in the 1990s.

Figure 8.10 therefore shows not so much a forecast of democracy ("freedom," in the terminology of Freedom House) in the base case and normative scenario but instead a crude general tendency based on the two driving variables. Upward movement of democracy is likely, on average, with continued education advance and income growth. For our purposes, it is especially important that the model formulations suggest that in 2060, the African set of countries could, again on average, be about 0.5 points more democratic in the normative scenario than in the base case (on a z14-point scale) and the non-African countries could be about 0.3 points more democratic (see also Appiah and McMahon 2002). These potential gains may be small, but they have real value that we cannot easily monetize—for example, democracies, with much else being equal, tend to be more peaceful and less likely to abuse their own citizenry (Oneal and Russett 1999).

Figure 8.10 Extent of freedom in selected regions: Normative scenario relative to base case



Note: Values are 5-year moving averages.

Source: IFs Version 6.12 using historical data from Freedom House and IFs base case and normative scenario.

Government effectiveness and corruption

The World Bank's Governance Indicators Project (Kaufmann, Kraay, and Mastruzzi 2007) emphasizes the richness of variation in governance by organizing data on six interacting and overlapping indices/dimensions. They are:[20]

1. Voice and accountability (similar to the measures of democracy and autocracy from the Polity Project and the measure of freedom from Freedom House)
2. Political instability and violence
3. Government effectiveness
4. Regulatory quality
5. Rule of law
6. Control of corruption (similar to the corruption perceptions index of Transparency International, to be discussed later)

Education attainment is quite strongly correlated with each of these aspects of governance quality. Moreover, the relationships persist after controlling for GDP per capita (see Table 8.3 for two examples). One of the strongest relationships of education attainment is with government effectiveness. As individuals become more educated, they at least have the potential to provide more effective governance, an insight that the Confucian tradition in China has perhaps carried forward into modern Chinese culture societies, even authoritarian ones. Moreover, as citizens become more educated, they should be in a position to, and be motivated to, demand more effective governance. The relationship is presumably bidirectional—more effective governments will provide more, and hopefully better, education and health care. Figure 8.11 shows the relationship between education attainment and government effectiveness and does, indeed, find it to be quite strong.

Generally, democracy is likely to increase with continued education advance and income growth.

The formulation in IFs for forecasting government effectiveness relies upon both GDP per capita at PPP and years of education attainment of those fifteen years of age and older. The combined R-squared for that relationship is a remarkable 0.78. Using the formulation and comparing the values of government effectiveness in sub-Saharan Africa in the base case and the normative education scenario, the aggregate difference for the region by 2060 is about 0.13 points on a 5-point scale. The increase for South and West Asia is 0.14 points, and in Latin America,

Education attainment has a strong relationship with governance quality and especially with government effectiveness.

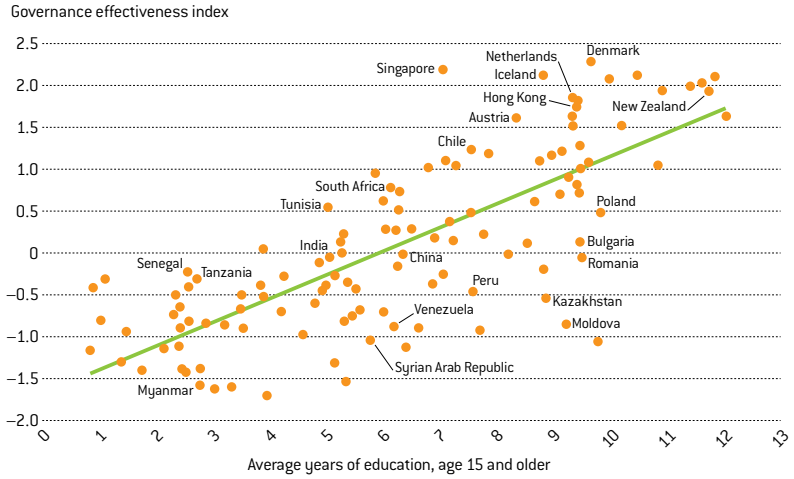
The acceleration of education's advance in the normative scenario is forecast to have a significant impact on government effectiveness.

it is 0.08 points. This is a significant impact of accelerated education in the normative scenario, the full value of which is again nearly impossible to monetize.

Although the World Bank includes a measure of corruption in its set of governance indicators, the Corruption Perceptions Index of Transparency International (Lambsdorff 2003) has become very well-known and is more widely used. Using the CPI, we see that education attainment is highly correlated with reduction in corruption (R-squared of 0.53). However, the correlation of the CPI with GDP per capita at PPP is exceptionally high (R-squared of 0.82), and combining the two drivers of corruption adds minimal additional explained variation (R-squared of 0.83). Thus, the IFs formulation for forecasting corruption relies only on GDP per capita at purchasing power parity.

Still, the importance of education for GDP growth means that education does indirectly influence corruption reduction. Relative to the base case, the normative scenario adds about 0.2 points in 2060 on a 10-point scale to values of transparency (the inverse of corruption) for sub-Saharan Africa, more than 0.3 points for South and West Asia, 0.2 points for Latin America, and nearly 0.1 point for the developing countries of East Asia and the Pacific.

Figure 8.11 Government effectiveness as a function of years of education attainment



*Note: Equation: y = –1.6678 + 0.2812 * (x); R-squared = 0.58*

Source: IFs Version 6.12 using World Bank Indicators and Barro and Lee (2001) data (most recent by country).

State failure

Foreign Policy magazine and the Fund for Peace constructed a failed-state index in terms of vulnerability to violent internal conflict and societal deterioration (a measure that overlaps with several of the World Bank's governance dimensions, including political instability and violence). The index builds on twelve social, economic, political, and military indicators.[21] Figure 8.12 shows the strong negative relationship between the education attainment of societies and their position on the index (that is, education is associated with less state failure). Although the R-squared here is very high, that linking the index and GDP per capita is even higher (0.74). Nonetheless, the combination of the two variables raises the combined adjusted R-squared to 0.79, and both independent variables are significant, suggesting an independent contribution of education attainment.

Some of the statistical outliers in Figure 8.12 (including Tajikistan and Singapore in different quadrants) are the same countries that were outliers in Figure 8.11. Clearly, there are historical path dependencies, reflecting strong elements such as local cultural patterns, ethnicity distributions and relationships, or simply unique historical events, that shape sociopolitical patterns in countries and that may make those patterns resistant to change driven by income, education, or other variables. Nonetheless, the cross-sectional relationships tend to be so strong that they suggest that key dynamic drivers, including education, probably push even outliers along over time (as well as regressing somewhat to the mean).

IFs does not forecast state failure using the Fund for Peace index. The statistical analysis, however, makes it seem highly likely that continued advance in education will contribute to a reduction in the rate of state failure and that the normative scenario would make an incremental difference. Since state failure has extremely painful consequences for citizens, reducing its probability or severity is of great importance.

Still broader impacts of education

Education potentially affects a vast range of other sociopolitical and even broader phenomena. For instance, it has some impact on environmental quality.[22] Smaller but richer

populations in the normative scenario could potentially consume more of many commodities, including energy, water, and food, thereby intensifying stress on the environment. In the IFs forecasts, global energy demand is 1.1 percent higher in 2060 in the normative scenario than in the base case. As usual, the biggest impacts are in sub-Saharan Africa and South and West Asia (up 5.3 percent). The increased energy use has a proportional impact on carbon emissions. The normative scenario does not significantly change the forecast of forest area relative to the base case (a smaller population largely cancels out the effects of the higher-calorie diets of a richer population).

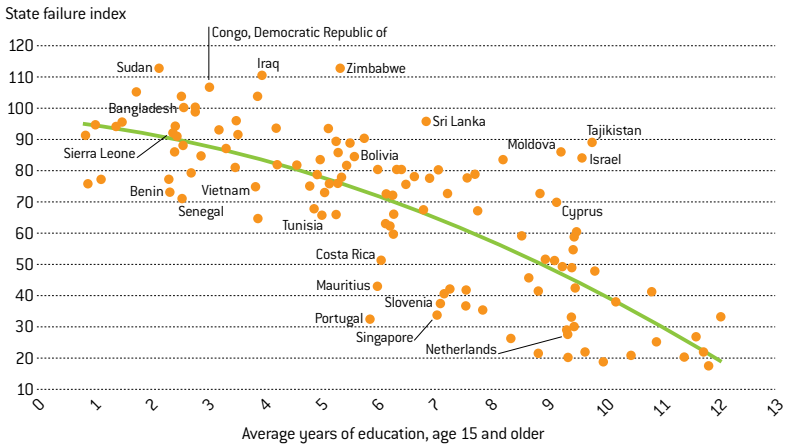
Other environmental variables move in an improved direction with higher education and income. Relative to the base case, access to household water connections in the normative scenario rises 6.5 percentage points in 2060 for sub-Saharan Africa, and access to household sanitation connections rises by 3.7 percentage points. More broadly, richer populations with more sophisticated technologies often find ways to lower their ecological footprints relative to poorer ones. For instance, urban air pollution and untreated waste streams almost always diminish after countries reach middle-income status. In general, we understand there to be indirect effects of education on the environment (especially through higher incomes) and more direct ones (through value change and the advance of technology). The costs and benefits of education's advance in the environmental arena alone would be very difficult to assess in the aggregate and would require extended issue-specific analysis beyond the scope of this volume.

Conclusion

Levels of education attainment in societies correlate strongly with a vast array of important variables in the human development process. It is difficult to know the extent to which those correlations indicate causality, but in a great many cases, good logical and theoretical reasons suggest that some significant part of the correlation does reflect the impact of education on other variables. Looking to the literature and to our own analyses, this chapter considered the magnitude of such potential causality in relationships involving a wide range of economic and sociopolitical variables—economic growth and GDP; fertility and mortality rates (with resultant changes in population size); and several aspects of governance, including democratization, corruption, and overall effectiveness.

We must clearly admit that the complexity of the development process makes understanding, much less modeling, the web of relationships in human development systems a very uncertain process. Yet by incorporating generally conservative estimates of the impact of education into the IFs system of models, we were able to explore a simulated dynamic unfolding of the impact of a normative scenario relative to the base case. With respect to direct economic costs, a fairly traditional cost-benefit analysis suggests that the incremental investment of the normative scenario would pay for itself in terms of higher GDP quite easily before 2060 but that it could take more than twenty to thirty years for some societies to reach the break-even point. Demographic analysis shows that the normative scenario, as well as reducing fertility, adds an increment to life expectancy that, conservatively valued, significantly supplements direct economic returns. Further, education and the higher GDP per capita with which it is associated probably improve performance on a number of key indicators of governance. All of this, of course, is on top of many of the very direct benefits of education to individuals, including the personal satisfaction and freedom of life

Figure 8.12 State failure as a function of education attainment



Note: Equation: $y = 97.0218 - 1.7723 * (x) - 0.3913 * (x^2)$; R-squared = 0.59 (the value in Table 8.3 differs because it used a linear relationship)

Source: IFs Version 6.12 using Fund for Peace and Barro and Lee data (most recent country year).

The normative scenario would have a mixture of positive and negative environmental impacts over the time horizon to 2060.

choices that literacy and other educationally acquired capabilities confer.

Improvements as a result of the normative scenario may not appear large relative to an already rapidly advancing base case, but they are clearly significant in terms of enhancement of the human condition. In the case of sub-Saharan Africa and South and West Asia, a continued rapid and even accelerated advance in education offers some of the best hope for diminishing their disadvantage relative to the rest of the world. Our overall conclusion is therefore that societies should actively pursue accelerated education advance, via aggressive but historically reasonable and sustainable rates of enrollment rate growth.

1 Hannum and Buchmann (2006) surveyed research findings relative to various benefits of education for the project on Universal Basic and Secondary Education, and this chapter uses a similar typology. See also United Nations Population Division (2003). McMahon (1999, 2007, and 2009) cast a wide net in identifying and evaluating the impact of education, expanding the reach of cost-benefit analysis. UNESCO (2007a: 23–24) offered a brief introduction to the literature.

2 Hough (1993) reviewed an extensive development literature of such studies into the early 1990s. Woodhall (2004) provided an explication of the methodology and literature review.

3 See McMahon (1999, 2007, and 2009) for efforts to value a broad range of private and public benefits of education. In moving from education outputs to impact, his analysis looked to enrollment rates and education spending rather than years of education attainment. At least partially for that reason (because our lags would be longer), he tended to find somewhat larger, albeit generally comparable, benefits.

4 The analysis in support of this chapter used the integrated, recursive IFs modeling system. Thus, linkages from years of education to multifactor productivity, to fertility, and to the sociopolitical variables were active in both the base case and the normative scenario, as were the linkages from GDP per capita and population back to education (see Chapter 4). Both corruption and government effectiveness (but not level of democracy) also affect economic productivity, providing an additional indirect channel in both scenarios through which education affects economic growth. These linked systems introduce both delays (education attainment levels and demographic change unfold over very long periods) and positive feedbacks (education improves growth, which pushes forward demand for education). In the analysis of the impact of education on life expectancy, however, a new IFs health model was used as a satellite without linkage back to other models.

5 Mingat and Tan (1996) argued that primary education tends to provide the highest social returns to low-income countries, whereas for high-income countries, the greatest returns are to tertiary education. Krueger and Lindahl (2000) suggested differential impacts of investment in education depending on the society's overall current attainment level. Specifically, they argued that an inverted U-shaped curve structures that relationship, with the greatest impact of increments appearing when average levels of adults' education attainment are near 7.5 years.

6 Jamison, Jamison, and Hanushek (2006) also found a relationship between the quality of education and income growth, primarily via the path of technological progress.

7 Jamison, Lau, and Wang (2004: 4) used the Barro and Lee measure of average years of school for males between fifteen and sixty but concluded that the "effect was small." The UNESCO Institute for Statistics (2002: 8) found that each additional year of education in its World Education Indicators country set raised the long-term economic growth rate by 3.7 percent (this value is so high that it is hard to believe the study did not refer to impact on level of GDP instead of growth rate).

8 For detail on the specification within the IFs model system of linkages between education spending and attainment, on one hand, and economic productivity, on the other, see Hughes (2005 and 2007). The production function of IFs is of Cobb-Douglas form with a dynamic representation of the technology or multifactor productivity (MFP) term. Change in the growth of MFP over time is an additive function of four terms: human capital (which carries both education and health elements), social capital (which reflects governance effectiveness and transparency/lack of corruption), physical capital quality (which carries availability of infrastructure), and knowledge (which reflects R&D spending and the adoption of knowledge encouraged by international trade and financial flows). The human capital contributions link education spending and attainment to change in MFP with the parameterization indicated in the text, applying those to the difference between the forecast levels of spending and attainment and the levels expected (from cross-sectional analysis) at the GDP per capita of the country.

9 Modeling of the relationship between spending on health and health outcomes is exceptionally uncertain in IFs and more generally. The numbers here are very rough estimates.

10 This remains an uncertain, contested, and important issue. In private correspondence, McMahon indicated that up to about tenth grade, the health-of-mother effect decreases infant and child mortality and increases population. Our analysis, using years of attainment, does not include such an effect.

11 Attention to disability-adjusted life years (DALYs) and other measures of morbidity (ill health) would broaden this discussion and almost certainly increase the importance of enhanced education in the analysis of health. DALYs are, however, strongly correlated with mortality, and forecasting of them is much less developed, so we restrict the discussion here to mortality.

12 Studying a large Dutch survey, Groot and Maassen van den Brink (2007: 186) concluded that "the implied health returns to education are 1.3–5.8 percent." Shkolnikov et al. (1998) found that each year of additional education in Russia reduced male adult mortality by 9 percent and female mortality by 7 percent.

13 Other analyses have also generally found a clear relationship between education and mortality but qualified the conclusions. Barrera (1990) and Chandola et al. (2006) argued for the importance of public health programs and health policies in interaction with education. Desai and Alva (1998: 71) concluded that "the relationship between maternal education and child health is considerably weaker than is commonly believed" after introducing individual-level and community-level controls, including community of residence (urban versus rural) and various socioeconomic variables.

14 The three groups of causes are Group I (communicable, maternal, perinatal, and nutritional conditions), Group II (noncommunicable diseases), and Group III (injuries).

15 The estimate is an integration of regional deaths over the thirty years (about 500 million) times 0.4 years of foregone life per death. For simplicity, this economic analysis is done without time discounting.

16 Both Hannum and Buchmann (2006) and Acemoglu et al. (2004) provided useful reviews of the literature, explaining linkages between education and democracy.

17 Castelló-Climent (2006) argued that a more egalitarian distribution of education is supportive of democracy.

18 Details on that project and measure, under the direction of Monty G. Marshall, are available at http://www.systemicpeace.org/polity/polity4.htm.

19 There is much evidence that the relationship between income level and democracy is nonlinear and complex, involving an interim range of income across which democracy is often unstable or unconsolidated (Przeworski et al. 1996).

20 In fact, both the Freedom House and the Polity Project have also emphasized the variation in political regimes and used multiple measures.

21 A computerized Conflict Assessment System Tool (CAST) indexes and scans hundreds of thousands of articles and reports for data on the indicators by country. The 2008 overview of the methods and findings is available at http://www.foreignpolicy.com/story/cms.php?story_id=4350. The Fund for Peace describes the CAST system at http://www.fundforpeace.org/web/index.php?option=com_content&task=view&id=102&Itemid=327#2.

22 McMahon (1999) explored some of the complexity of that set of relationships, as well as the linkages to crime and social cohesion.