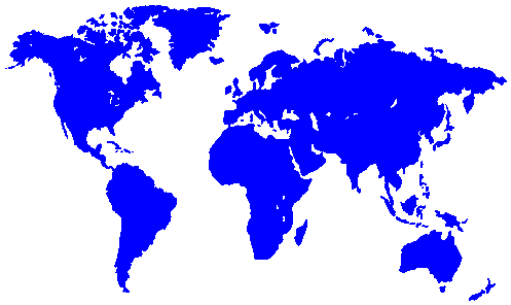

Patterns of Potential Human Progress

Volume 2: Enhancing Global Education

Janet R. Dickson, University of Denver
Barry B. Hughes, University of Denver
(Corresponding author: bhughes@du.edu)
Mohammod T. Irfan, University of Denver

Discussion Draft
Feedback Very Welcome

Note: Paradigm Publishers (Boulder) and Oxford University Press (New Delhi) are publishing Volume 1 of the PPHP series, *Reducing Global Poverty*, in October, 2008. Text available upon request.

PARDEE CENTER for International Futures

Josef Korbel School
of International Studies
University of Denver
September, 2008
www.ifs.du.edu

International Futures

Preface

It is a pleasure to bring you the second in a series of volumes on Patterns of Potential Human Progress, a series that explores prospects for human development and the improvement of the global human condition. Each volume considers one key aspect of how development appears to be unfolding globally and locally, how we would like it to evolve, and how better to assure that we move it in desired directions.

The first volume began with the central issue of global poverty reduction. It presented a long-range, base case forecast—an elaboration of the path we appear to be on. And it explored an extensive set of variations in that path, each tied to alternative domestic and international interventions. The third volume will similarly look at the improvement of global health.

The volumes emerge from the Frederick S. Pardee Center for International Futures at the University of Denver's Josef Korbel School of International Studies. The International Futures (IFs) modelling and analysis project has worked for three decades to develop and use the strongest possible global, long-term, multiple issue capability for exploring the future of key global issues. Among the philosophical underpinnings of the IFs project are the beliefs that (1) prediction is impossible, but forecasting is necessary for understanding change and in support of policy making and (2) analysis should always be built around alternative possible futures and (3) the tools for forecasting should be fully open and transparent.

This second volume drills down into one of, and arguably the most important of all human options for consciously making the future for most humans better than the past, the expansion of global educational opportunities and levels of educational attainment. It explores the remarkable transformation of global education that, at least on the time scale of most historic human change, is moving us with quite incredible speed towards universal basic education and literacy, for women and for men. And the transformation is not stopping there. More advanced levels of education are also spreading rapidly across the global population. The century of change between 1960 and 2060, roughly our focal horizon, promises to be of historic importance in the evolution of human development.

Education brings private gain, but is also a public good, conferring benefit on the broader society. As a public good, society always risks the under provision of it by those who cannot hope to capture the full reward of their personal investment. Fortunately, societies largely recognize this and are acting to enhance educational opportunities. Nonetheless, one of the central questions for this volume is whether a further acceleration, represented in a normative scenario for educational expansion, would bring those societies still greater return on their investment.

Overall, the answer to that question is a resounding "yes." The delays in payoff to education can be long, another reason that investment tends to fall short of the ideal, but

the pay-offs are huge. There can simply be no sustainable, global society with widely distributed well-being unless that society is highly educated. And it is important for us to emphasize that the benefits that we all wish to attain through education range far beyond monetary return. The capabilities of individual human beings to function successfully and to live well depend on education. Their incomes are important indicators of such functioning, but represent only a part of the fulfillment that education brings. The potential of communities to provide a setting with peace and justice in which humans live long and happy lives depends on education. Again, incomes suggest that potential, but constitute only a portion of the strength of communities.

We fully recognize that what we do in this volume is easy compared to the real work of bringing about transformation of global education. It is too easy for authors of books and articles to identify some countries or regions of the world that can be said to lag in providing education and urge them to do better (or urge others to help them do so). We will attempt in this volume not to be judgmental. With few exceptions, the human community is collectively engaged already in the monumentally important transformation of global education and hundreds of millions of people contribute daily to that process. We hope only that the attempt here to describe what is happening, and to explore the benefits of continuing and enhancing those efforts, can make its own small contribution to the process.

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Important notes: Chapter 9 (Conclusions) is yet to be drafted. The text of the volume will be followed by extensive tables forecasting PPHP variables by country and region (see *Reducing Global Poverty* for the general approach).

1. Introduction

This book is the story—or perhaps more aptly a set of stories—of wide-spread change that is underway in the extent of formal education among populations globally. Together these stories of change constitute a major global education transition. The temporal starting point for our analysis is 1960, when education data began to become quite widely available. Our reach, with forecasts to 2060, extends a full century.

In looking forward there are, of course, multiple possible paths for the story line. One path is the extension of change in participation that is already well underway. Another possible path is still further acceleration in the provision and acquisition of education. Using the International Futures (IFs) modeling system, we explore both the current path and the prospects for, and the benefits of, an accelerated scenario. We conclude not only that acceleration is possible, but that in the longer run the economic and broader benefits of education will, in most instances, generously reward those societies that embrace more rapid expansion of education.

1.1 Where are we? A brief look at enrollment rates

Article 26 of the 1948 United Nations' Universal Declaration of Human Rights asserted that a minimum level of education is a basic right of every individual[1]—an assertion that both signaled and sparked education awareness and effort globally. An early study of the ensuing "world educational revolution" provided enrollment rates in 1950 for the world as a whole, and for groupings such as "richer countries" and "poorer countries" (Meyer, Ramirez, Rubinson, and Boli-Bennett 1977). At the primary level in 1950 the global gross enrollment ratio was 58 percent, whereas at the secondary level it was 12.7 percent, and at the tertiary level 1.4 percent (Meyer, et al., 1977: 244). In 2005, fifty-five years later, global gross enrollment rates were strikingly higher: 101 percent at the primary level, [2] 66 percent at the secondary level, and 24 percent at the tertiary level (UNESCO 2007b: 291, 315, 322). [3]

Why then, if there has been so much progress, are we still interested in knowing if rates of expanded participation in educational systems can be accelerated? The answer, at its

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[1] The first part of Article 26 states: "Everyone has the right to education. Education shall be free, at least in the elementary and fundamental stages. Elementary education shall be compulsory. Technical and professional education shall be made generally available and higher education shall be equally accessible to all on the basis of merit." (Available at http://www.un.org/Overview/rights.html:4)

[2] Gross enrollment rates refer to the total enrollment of students in a given level of education as a percent of the number of persons in the age group defined by an education system as appropriate for that level of education. The rate can exceed 100% because of enrolled students who are younger or older than the defined age range for the educational level.

[3] There are significant methodological differences that complicate comparison across time. The 1977 study had data from 1950 for fewer countries than recent studies cover, and it used simple country averages rather than population-weighted averages. However, these differences do not significantly change the overall conclusion of dramatic growth in education.

core, arises from the issue of equity in access to education and—because of education's relationship to other dimensions of quality-of-life, including poverty reduction—to equitable opportunities more broadly. To demonstrate, despite remarkable global progress since 1950, Table 1.1 displays striking disparities that remained in the gross education participation rates of populations in low-income, middle-income, and high-income countries in 2005, particularly at secondary and tertiary levels.[4]

	Primary	Secondary	Tertiary
Low-income countries	105.8	46.1	9.2
Low middle-income countries	110.1	74.0	28.1
Upper middle-income countries	110.9	86.9	43.4
High-income countries	101.7	101.2	68.6

Table 1.1 Gross enrollment rates by country income and level of education, 2005
Source: IFs 6.005.
Note: UNESCO Institute for Statistics (UIS) data organized by World Bank country groupings.

Table 1.2 presents similar data for the enrollment of "age-appropriate" students (conventionally referred to as the "net enrollment rate") at the primary and secondary levels.[5] The relatively small difference in primary net enrollment rates across country income groupings reflects enormous progress toward universal primary enrollment over the past several decades. On the other hand, primary net enrollment rates in all country groupings were still below the goal of enrolling all children, and particularly so in the low-income grouping. Even more striking, the net enrollment rate at the secondary level was three times higher in high-income than in low-income countries–a reality that places the low-income countries and their populations at ever-greater disadvantage in today's globalized world.

	Primary	Secondary
Low-income countries	82.5	31.3
Low middle-income countries	92.3	65.4
Upper middle-income countries	92.8	73.3
High-income countries	95.6	91.6

Table 1.2 Net enrollment rates by country income and level of education, 2005
Source: IFs 6.005.
Note: UIS data organized by World Bank country groupings.

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[4] Primary gross enrollment rates above 100 percent for low and middle-income countries in 2005 result from two factors in these countries: higher proportions of children entering earlier or later than designated entry ages, and higher rates of grade-level repetition, resulting in the persistence of "over-age" students.

[5] Participation in higher education may take place at any or at various points during adulthood, and tertiary data are conventionally presented only as gross enrollment rates.

Differentials in education participation rates exist not just by the income level of countries, but also by other social and individual characteristics. Throughout the world, enrollment rates of girls and young women have typically been lower than those of boys and young men prior to—and often after—the transition to large-scale participation or "mass education" is under way. Table 1.3 shows the differential gross enrollment rates for females and males in 2005 by the same country-income groupings as in the earlier tables. To be female in a low-income country is still to experience the lowest enrollment rate across all educational levels and country groupings, even though the disparities in female/male enrollment rates have narrowed markedly.

For the other country income groupings, females and males now enroll at essentially the same rates at primary and secondary levels, while at the tertiary level women enroll at higher rates than men—most notably in high-income countries, but also in middle-income countries. [6]

	Primary		Secondary		Tertiary	
	F	M	F	M	F	M
Low-income countries	101.8	109.6	41.3	50.1	7.57	10.8
Low middle-income countries	109.0	111.2	73.9	74.2	29.0	26.9
Upper middle-income countries	109.8	111.9	86.2	87.4	49.8	41.0
High-income countries	101.2	102.2	101.4	101.1	75.4	62.1

Table 1.3 Gross enrollment rates by sex, country income and education level, 2005
Source: IFs 6.005.
Note: UIS data organized by World Bank country groupings.

1.2 Where might we be going? Global education goals

1.2.1 The primacy of universal primary education

In 1948, Article 26 of the Declaration of Human Rights first formally proclaimed universal primary education (UPE) as a global goal. It specified no target date for meeting the goal. Since then, target dates have been set three different times, for three successively later dates.

The first target dates were set when UNESCO convened regional education conferences during the 1960s (Asia in 1960; Africa in 1961; Latin America and the Caribbean in 1962; and Arab States in 1966), following which each region promulgated its own plan—with differently defined markers of progress—for achieving universal primary education by 1980.[7] While an analysis based on 1977 data showed "spectacular enrolment growth" in all regions (Fredriksen 1980: 1), none of the four regions was "on track" to reach universal primary education by 1980. The primary reason for "falling short" was growth

[6] The difference between female and male tertiary enrolment rates is highest in North America and Western Europe; in 2005 the female gross enrolment rate was 80.0, while the male rate was 60.0.

[7] Latin America and the Caribbean's plan actually set a target date of 1970.

in the number of school-age children beyond—and sometimes far beyond—the numbers that the planning processes had estimated.[8] Africa is the extreme example, with approximately 53.5 million children between 6-11 years of age in 1980, compared to the 32.8 million that the planning process had anticipated twenty years earlier (Fredriksen 1980: 9). The result is that while Africa met or exceeded its 1980 headcount targets, its primary gross enrollment rate reached approximately 81 percent rather than the 100 percent target.[9]

Ten years after the regional conferences first set UPE target dates, the first World Conference on Education for All took place in Jomtien, Thailand (1990). In the "Jomtien Declaration," delegates from 155 countries framed and affirmed global education goals in a "basic education" framework (a point we will return to later), including universal primary education "before the end of the decade".[10]

Developing countries, as a whole, further increased their primary participation rates during the 1990s, although generally quite modestly, and assessments prepared for a second global education meeting in 2000 (the World Education Forum in Dakar, Senegal) identified regions and countries still short of universal primary education. The "Dakar Framework for Action" reaffirmed the goal, this time setting a target date of 2015 in a statement that clarified what UPE might encompass: ". . . ensuring that . . . all children, particularly girls, children in difficult circumstances and those belonging to ethnic minorities, have access to and complete, free and compulsory primary education of good quality" (UNESCO 2000: 8).

Later that same year the United Nations Millennium Summit was held in New York. The resulting Millennium Declaration, reflecting a commitment to "human dignity, equality, and equity," included eight specific global Millennium Development Goals (MDGs), the second of which is "To ensure that by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling and that girls and boys will have equal access to all levels of education." [11]

By virtue of its inclusion on the "short list" of eight MDG goals, selected from among all possible human development choices for commitments of the global community from

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[8] High repetition and drop-out rates were also significant reasons for missing the target in some regions.

[9] The 1980 enrollment estimate is from IFs version 6.005 and UNESCO data. African countries were just emerging from colonial status as the UNESCO African regional education conference and planning took place. Fredriksen pointed out that a complete population census had never been conducted in many of these countries, and hence the actual size of their school-age populations was difficult to estimate and foresee (1980: 15).

[10] See http://www.unesco.org/education/efa/ed_for_all/background.

[11] The other goals include eradicating extreme poverty and hunger; promoting gender equality and empowering women; reducing child mortality; improving maternal health; combating HIV/AIDS, malaria and other diseases; ensuring environmental sustainability; and developing a global partnership for development. (available at http://www.un.org/millenniumgoals.

2000 to 2015, universal primary education attained a position of global prominence. The UNESCO Institute for Statistics (UIS) further assures focused global attention through its mandated annual monitoring and reporting on progress, processes that have the important secondary consequence of improving data definition, collection, and dissemination.

This positive attention, however, is not free from complications. One set of complications stems from the dubious wisdom of establishing a single and relatively short time frame for all countries to achieve UPE, regardless of vast initial differences in their primary educational coverage, resources, and other compelling circumstances. For some of the countries with the lowest primary enrollment rates in 2000, the annual growth rates required to attain universal primary education by 2015—particularly if the country is still experiencing growth in the size of the primary school population—appear untenable, no matter how much "political will" exists and regardless of possible ongoing expansion at "blistering speed" in comparison with those countries that completed the transition to universal primary education in earlier periods.[12] Progress might be better served in these countries if ambitious context-specific targets for rates of change in primary school entry, persistence, and completion rates were set and monitored

Also, even while acknowledging the importance of universal primary education, one might also question whether so much focus on tracking and attaining this one goal has detracted from the important job of setting goals for, and preparing for changes in, other levels of formal education—or even from exploring what a "balanced" approach might look like under different country circumstances. One outcome from too great or too exclusive a focus on primary education might be that secondary education systems are not prepared to serve increased numbers of primary graduates who, as more and more people attain a primary education, see a need for further education for economic advancement. Further, regardless of the extent of participation in primary education, some benefits of education come only at secondary and tertiary levels. In an environment of constrained—and often severely constrained—resources, can we be certain during a period of education transition that a 100 percent primary enrollment rate with a 35 percent secondary enrollment rate (as an example) would always contribute more to social, economic, and individual well-being than, say, an 85 percent primary enrollment rate and a 50 percent secondary enrollment rate?

While there is surely no one answer to the question of balance, it is clear that different countries have selected different paths in their pursuit of educational advancement. As a recent Rand Corporation study reported, China and India are a case in point (Goldman, Kumar, and Liu 2008):

> The two countries started building their national education systems under comparable conditions in the late 1940s. However, different policies,

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[12] "Blistering speed" has become a widely used term to describe the pace of the education transition in today's developing countries. It was first used in this context by Michael Clemens in a background paper authored for the UN Millennium Project Task Force on Education and Gender Equality (Clemens 2004: 22).

> strategies, and historical circumstances have led them through different routes. China has out-performed India in primary and secondary education along a broad spectrum of access, quality, and delivery indicators. India, on the other hand, enjoys a competitive edge over China in higher education. Recently, India has begun catching up with China in K-12 education, while China has already overtaken India in terms of the college enrollment and number of graduates (Goldman, Kumar and Liu 2008: xi).

We do not offer our cautions about a single time-frame and a single sequential pathway for advancing educational participation and coverage as criticisms of the goal of universal primary education. Indeed, the selection of universal primary education as the starting point for addressing the education commitment articulated in the United Nations Declaration of Human Rights is easily understood. Primary education is not only typically seen as the avenue to universal basic literacy and numeracy, and therefore key to personal empowerment, but also is the prerequisite for other levels of formal education. Our argument is simply that a serious look at advancing participation in formal education needs to take individual country differences into account and needs to look more broadly across all levels of education systems during the education transition.

1.2.2 Other global goals for expansion of education

Gender parity. Education is explicitly central to another MDG goal—the goal of promoting gender equality and empowering women. The MDG target statement for this goal is the elimination of gender disparity in primary and secondary education, preferably by 2005 (five years after the MDGs were adopted and now several years in the past), and in all levels of education no later than 2015 (United Nations 2000: Item III.20).

Historically, in low-enrollment and transitional environments, boys and men have enrolled in higher—and often far higher—proportions than girls and women. However, as Table 1.3 showed, only in low-income countries as a group were girls and women still enrolled in disproportionately low numbers in 2005,[13] and in fact, in upper middle-income and high-income countries women were pursuing tertiary education in substantially higher proportions than men—a pattern that continues. Thus, the question of gender parity in education has become more complicated than was perhaps anticipated when parity in enrollment rates was selected as the MDG target for promoting gender equality and empowering women.

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[13] There are still individual countries in every income group in which the educational participation of girls and women remains substantially below that of boys and men, and our presentation of aggregate data should not be interpreted as suggesting continued attention in these countries is unimportant. Country-specific data and forecast tables at the back of this volume include measures of gender parity.

Basic education. So far we have limited our discussion of goals to those included within the Millennium Development Goal framework. However, both the Jomtien and Dakar documents articulate a broader framework—that of basic education more generally. In particular, the Dakar Framework for Action adopted six global goals, two of which—universal primary education and the elimination of gender disparities—served as the impetus for the education MDGs. The other four, in combination with those two, speak to basic learning needs of people of all ages, not just children and youth, in both formal and non-formal settings.

The other four basic education goals articulated in the Dakar Framework are: early childhood care and education; learning and life skills programs for young people and adults through equitable access to basic and continuing education; a 50% improvement in adult literacy by 2015, especially for women; and improving the quality of education for the achievement of measurable outcomes, ". . . especially in literacy, numeracy, and essential life skills" (UNESCO 2000: 1-2).

While not setting goals for post-primary formal education, the Dakar Framework includes a sentence that reflects and invites consideration of secondary education and its relationship to basic education. Supporting text to the goal statement relating to learning and life skills programs for young people and adults reads as follows:

> No country can be expected to develop into a modern and open economy without a certain proportion of its work force having completed secondary education. In most countries this requires an expansion of the secondary system (UNESCO 2000: 16).

This statement, while at least specifically introducing secondary education to the dialogue, was so brief and so general as to provide little guidance. Instead, the Dakar Framework's greatest significance may be the breadth of the vision with which it defines and considers *basic* education. As the term has come to be used, there is now a general consensus that the early years of secondary education ("lower secondary") are the culminating years of basic education, while the latter years ("upper secondary") provide more advanced and specialized preparation for work or for tertiary education. In fact, interestingly, it has been noted that many who attended the World Forum and endorsed the Dakar Framework believed the term "primary education" was a proxy for basic education encompassing (generally) eight years of schooling, a period corresponding more often to primary and lower secondary together than to primary alone (Sperling 2006: xii).

Current status of post-primary goals. While there is growing consensus that universal lower secondary education should be a global goal, there is less thrust toward compulsory or universally available upper secondary education. Even the recent UBASE project of the American Academy of Arts and Sciences, which is committed to universal basic and secondary education for

all children ages 6-16, extends attention to ten years rather than the twelve (or more) that constitute the full course of secondary education in most countries, including those throughout developing regions.

Human development and preparation for informed citizenship are the rationales for public support of universal basic education. The rationales for upper secondary education, and in particular for public support of broadly available upper secondary education, are more complicated and, in today's environment, are receiving needed new attention. Historically, upper secondary education—with its emphasis on preparation for work or advanced study—has often been viewed, at least economically, as providing more personal benefits than social or public benefits, and hence has not had the same public rationale. Given the knowledge and skill requirements for country and individual success in today's global environment, this becomes an increasingly dubious perspective. Nonetheless, it seems clear that the pace and extent of expansion can only occur within the context of region and country-specific economic circumstances and opportunities.

The same things are true with respect to tertiary education, with some added complications. One is that tertiary education is typically very expensive, both publicly and privately, and especially so in countries that have lower tertiary participation rates. Another is the migration of highly educated individuals from lower income countries to countries that are able to offer more opportunities for personal advancement.

In summary, we believe that a single global goal for either upper secondary or tertiary education is not a reasonable expectation at this time. However, recent developments that encourage country and region-specific analyses and planning processes seem promising. At the secondary level, one example is the Secondary Education in Africa (SEIA) project that the World Bank initiated in 2003 in conjunction with African countries and donor agencies. At the tertiary level, examples include the projects and publications of the United Nations' Global University Network for Innovation (GUNI), with regional networks of participants from Africa, the Arab States, Asia and the Pacific, Europe, and Latin America and the Caribbean, as well as projects hosted by the Boston College Center for International Higher Education, such as the International Network for Higher Education in Africa. On an operational level, applications for World Bank funds now require Poverty Reduction Strategy Papers that provide county-level analyses, goals, and plans spanning the primary, secondary, and tertiary education sectors.

1.3 Why this book?

1.3.1 Analysis and modeling of global education expansion

Global education expansion is a complex process, not only in its own right but also as a component of even more complex social and human development systems. Given the juxtaposition of global trends and goals on the one hand, with enormous differences in country and regional circumstances on the other, the challenges are great for those who seek to understand, support, and further encourage global participation in education. We need tools that contribute to our understanding of patterns in education participation and expansion—past and current—and that also provide a platform for exploring possible future patterns and outcomes within education and in its relationships to other human and social development systems.

We begin our attempt to represent complexity by grounding our approach in the following:

- The need for analysis and exploration over a long time horizon
- The need for global and regional analysis in combination with the ability to flexibly explore a wide variety of country groupings and individual countries
- The need for analysis and exploration of all levels of formal education within a development framework

Our choice of a long time horizon (100 years) reflects the extended duration of most major social transitions, with different countries and global regions entering a transition phase at different times and speeds and in very different circumstances. It also reflects the particular nature of education, whereby schooling itself extends (or potentially extends) over many years, and many more years pass before changes in school participation rates are pervasively reflected in the education attainment patterns of the adult population.

Individual countries (183) are the basic building blocks in our model. Country-level analyses and explorations can be grouped and combined not only globally and by standard geographical regions, but also by targeted groupings such as income level or participation in special programs such as the Fast Tracks Initiative[14] or the World

[14] The Fast Tracks Initiative (FTI) was launched in 2002 by the World Bank as a project between donor and developing countries to focus domestic and international attention and resources on accelerating progress toward UPE. Participating countries are required to have "education sector plans" that encompass all levels of formal education. As of October 2007, there were 32 countries with endorsed education sector plans, with 4 more anticipated by the end of 2007, another 7 by the end of 2008, and 13 more in 2009; in addition another 12 countries are listed as "eligible" (World Bank 2007c: 9).

Education Indicators project.[15] While rich as well as poor countries are included, our special interest is the developing world.

The focus on education within a broad development framework also leads to a number of analytical decisions, beginning with the inclusion of all levels of formal education (primary, secondary, and tertiary) and the connections and patterns between them (including the separate representation of lower secondary and upper secondary). Attention to education and human development also leads to explicit exploration of alternative patterns of growth in student intake and progression. And it leads us to explore the resources invested in education (which could be invested elsewhere) and to consider the educational and human development outcomes of alternative education expenditure patterns. While not as easily measured as we would hope, human development—broadly defined— serves as the framework and metric for analysis of progress and success.

1.3.2 Questions to be answered

Within the framework described above, this volume attempts to make a positive contribution to the understanding of three central questions. The questions are:

- Where are we in the global education transition and where will we be in 2060 if current paths of expansion continue to unfold? (This question is addressed in a *base case,* which includes *framing uncertainties*.)
- Are there ways the transition can be accelerated, and if so, by how much? (This question is addressed in a *normative scenario.*)
- What human development outcomes are associated with the education transition represented in the base case and in the normative scenario, and what costs, both in terms of financial resources and foregone progress in other dimensions of human development, are associated with them?

[15] The World Education Indicators (WEI) project is a joint program involving UNESCO, OECD, and now 19 middle-income countries (12 when the project was initiated in 1997). The program focuses on the development of policy-relevant education indicators, and includes data collection and reporting. The most recent project report, *Education Counts: Benchmarking Progress in 19 WEI Countries*, provided comparative education outcomes for the WEI participants and OECD member countries (UNESCO Institute of Statistics 2006).

1.3.3 The International Futures (IFs) global modeling system

International Futures (IFs) is a computer software tool with dynamic simulation capabilities whose central purpose is to facilitate exploration of possible global futures through the creation and analysis of alternative scenarios. As a result of development over the past thirty years, the IFs system includes extensive data bases extending back to 1960, as well as forecasting capability through the integration of demographic, economic, agricultural, socio-political, environmental, and energy models. This book builds upon the recent development and addition of an education model that represents the national education systems of the 183 countries in IFs. Historical data and forecasting capability encompass participation rates, attainment levels, government support, and per student and aggregate costs for primary, secondary, and tertiary education.

IFs represents dynamic connections among all of its various subsystems or domains. Its forecasts draw their strength from these connections which, although aggregated and simplified, seek to capture key elements in the dynamic complexity of social and human phenomena. In the case of education, rates and levels of educational participation and attainment, and changes in them, are associated with changes in economic, demographic, and socio-political trends and patterns *(drivers)*. In turn, the changes in education participation and attainment affect economic, demographic and socio-political systems through *forward linkages*, creating further *feedback loops*. This means that the forecasts IFs produces, while they rest on historical data, are not extrapolations, but rather represent the results of dynamic interplay between variables in multiple domains. In addition, the IFs user interface allows the exploration of impacts of policy choices *(policy levers*) on outcomes, as well as exploration of the consequences of *framing uncertainties* with respect to major factors affecting the supply of, and demand for, education (e.g., varying economic and population growth rate assumptions).

The particular strengths of IFs—and in fact its unique features with respect to education modeling and forecasting—derive in combination from its extended time frame, its extensive geographic coverage and capability for flexible groupings of countries for analysis and display, and its dynamic nature across multiple human systems. In addition, it is the only developed global education model we know of that encompasses all three levels of formal education in student flows or cohorts, and the only one that represents lower and upper secondary education separately—an important separation given their differing purposes, cost structures, and participation rates.

There are of course also limitations, as well as caveats and cautions about the use of IFs. A significant structural limitation is that the current version of IFs cannot be used to forecast differential education participation and attainment rates for various ethnic groups and indigenous populations, for the poorer or poorest citizens of a country, or for residents of rural areas, all of whom are known to be at an educational disadvantage. In fact, other than the capability to separately forecast female and male participation and attainment, IFs currently is not able to differentiate patterns of education participation and attainment below the country level. A second limitation, arising in large part from insufficient data, is the absence of forecasts of private education and private funding even though private education and/or funding are prevalent in many developing countries;

however, sufficient data exist for us to at least include some discussion of these topics. A third limitation, also arising from shortage of data (and in this case an almost total lack of data) is the absence of forecasts pertaining to the non-formal education sector, such as adult literacy and training programs.[16]

Other cautions are associated with the enterprise of modeling more generally, and include the following:

- Available historical data, which provide the foundation for the model, vary in quality and extent
- The specification of relationships between variables is never perfect, nor would it be even if historical data were complete and of uniformly high quality
- As complex as IFs is, there is a limit to the number and type of dynamic connections and interactions it—or any model—can capture, and even for those it does include it must make simplifying assumptions

In summary, we consider IFs to be a thinking tool, not a predicting tool. Our results are presented with the request that readers view them as descriptions of what might plausibly occur under alternative specifications of circumstances or policy interventions. Our hope is that by providing a structure and context for analysis and debate about possible futures, IFs will be a contributor to enhanced understanding and to the quality of choices made in policy arenas.

1.4 Roadmap for the volume

Chapter 2: Presentation of frameworks for understanding education and its importance, including its role in broader human development processes.

Chapter 3: Consideration of approaches to modeling the education transition, namely early models, other current models, and IFs (both the education model and the broader forecasting system).

Chapter 4: Analysis of historical patterns, especially 1960 through 2005, so as to understand the historical context for forecasting the future of the education transition.

Chapter 5: Exploration of the IFs base case, including comparison with other forecasts and analysis of framing uncertainties.

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[16] The Education Policy and Data Center background paper for the 2008 Global Monitoring Report used USAID-sponsored MICS household surveys from 28 countries to begin the important task of understanding and quantifying the contemporary role and extent of non-formal education in developing countries (EPDC 2007: 35-42). The report notes "Non-formal programs are an umbrella designation for a wide array of activities, including alternative primary schools, youth training, literacy programs, and professional education" (EPDC 2007: 35). Religious schools that do not offer a full, standard curriculum are cited as one example of alternative primary schools (EPDC 2007: 36).

Chapter 6: Analysis of the potential for accelerating the education transition and development of a normative scenario.

Chapter 7: Presentation of the IFs normative scenario in comparison with the base case.

Chapter 8: Investigation of the broader economic and socio-political consequences of educational advancement in the base case and in the normative scenario, in part to consider the costs and benefits of pursuing the more aggressive normative scenario.

2. Frameworks for Viewing Education and Its Importance

2.1 Purposes of education: a brief introduction

Education has been a powerful instrument to serve social purposes since the times of ancient civilizations. Often those purposes have included the perpetuation of a privileged status quo. However, as the Millennium Task Force on Education and Gender Equality pointed out, education can also be a key stimulus for social change:

> Educating the poor is particularly important for triggering broader social change. Education has a special quality: the human capital acquired through formal education cannot be appropriated. In that respect it is different from land or financial assets. Education is an asset that enables its owner to earn more and to communicate and obtain information more successfully (Birdsall, Levine, and Ibrahim 2005: 25).

Formal education was the province of elite groups and members of societies until relatively recently. The widespread dispersion of primary education began in the western industrialized countries only in the latter half of the 19th Century, and the United States was in the forefront of that expansion. Massachusetts mandated compulsory primary education in 1852;[17] other countries that formally mandated compulsory primary education after that but before the end of the 19th Century were Great Britain, Canada, Australia, Italy, New Zealand, France, and Japan (Clemens 2004: 51).

Industrial workforce needs were in large part responsible for the expansion of basic education in industrialized countries in the latter half of the 19th century. Public funding for education came with the expectation of economic growth and economic returns at the national level. Only after World War II did the 1948 United Nations Declaration of Human Rights articulate access to some basic level of education as a right of all people, globally. And still additional years passed before sub Saharan Africa and much of Asia became free of colonial status and colonial education systems whose purpose had been the preparation of a relatively small number of functionaries to serve in the colonial bureaucracies.

The co-existence of these different purposes or rationales for education—the perpetuation of an established order, a force for social change, the role of human beings in producing wealth, and the rights of the individual—complicates discourse, research, and policy to this day. Some advocates of educational expansion focus on the various (and sometimes conflicting) instrumental roles that education might play, while others focus on the intrinsic value of education as a human right.[18] Either position can be—and sometimes

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[17] Clemens noted, citing Goldin 1999, that it was not until 1918 that all states in the U.S. had compulsory basic education laws (Clemens 2004: 23).

[18] "Instrumental" typically refers to economic outcomes associated with increased education, and sometimes also to non-economic but still measurable outcomes such as fertility reduction or improved child health.

is—adopted or expressed as if the various instrumental and intrinsic outcomes are dichotomous rather than, as is surely the case, interwoven in complex interacting patterns. As the Millennium Task Force on Education and Gender Equality notes, "Both the inputs to and the outputs from education are far more complex than much of the usual international discourse suggests" (Birdsall, Levine, and Ibrahim 2005: 23).

Public education policies are likely to differ markedly depending on varying perceptions of the rationales and consequences of education and its expansion. Despite the assertion of education as a universal human right in 1948, most analyses of education in that period focused on instrumental rationales and consequences within the then-emerging fields of development studies and development economics. Dominated by the need for reconstruction in the aftermath of World War II, and by the emergence of sub-Saharan Africa and large portions of Asia from colonial status, early development studies typically focused exclusively on economic growth and development, and particularly on the role of capital inputs.

The role of labor as a factor in production ("human capital") emerged as a development focus during the 1960s, and education came into the picture insofar as it was seen to enhance the contribution of labor to the production function.[19] Typically, during this period, studies focused on individual and social rates of return to education as manifested solely in individual wage and national income differentials associated with different levels of education. Public and private costs of education were typically compared with the wage and income results to produce cost-benefit analyses, and non-wage impacts of education (even if they might have a future connection to further economic growth) were typically excluded.

In countries where women were not represented in large proportions in the wage economy, it was not unusual for a study that focused only on immediate, direct economic benefits of education to find that education was likely to be less profitable for women than for men (Woodhall 2004: 87). Obviously such a finding did not necessarily mean that the authors were advocating withholding education from women. Nonetheless, the approach could be used to support such a conclusion, particularly in a state with scarce resources and/or a repressive tradition toward girls and women. Even from a rather strict economic development perspective, however, one could take such a finding to task on the grounds that there are potential and measurable non-wage benefits of female education, and also that education might encourage women to enter the wage sector of the economy and thereby contribute to economic growth as wage-earners.

On the other hand, the term "intrinsic" often comes up when the reference is to not-easily-measured states of well-being and life satisfaction.

[19] Gary Becker and T. W. Schultz, in particular, were key in the development of the human capital perspective. In a 1961 paper in *The American Economic Review,* Schultz used the term "human capital" in the title, making the case for the importance of human skills and knowledge as a form of capital (Schultz 1961).

By focusing on the critical role associated with the qualities of the workforce, the human capital approach clearly advanced understanding of how economic growth and development might be enhanced. Not surprisingly, however, critiques of the human capital approach arose, centered on the extent to which it focused on earnings and "observed output" to the exclusion of other aspects of development. One response to such critiques was an effort to extend cost/benefit analyses to include the value of education's "non-market" economic effects. In a seminal study published in 1984, Haveman and Wolfe include what they describe as a "catalog of impacts of schooling, nature of impacts, and evidence on magnitude of level and value of impact" (Haveman and Wolfe 1984, 382-386). The catalog includes, among others, health, fertility, crime reduction, social cohesion, savings, and charitable giving. Two things are noteworthy. The first is the broad extension of the range of possible impacts from increased education. The second, however, is the continued centrality of economic benefits as the sole assumed metric for evaluation.[20]

However, a new development framework has emerged that is both broadening and refocusing the inquiry. The approach, founded by Amartya Sen, focuses on human capabilities (rather than on humans as a form of capital), and emphasizes the role of development in expanding personal freedoms by enhancing those capabilities. As stated by Sen:

> Development can be seen, it is argued here, as a process of expanding the real freedoms that people enjoy. Focusing on human freedoms contrasts with narrower views of development, such as identifying development with the growth of gross national product, or with the rise in personal incomes, or with industrialization, or with technological advance, or with social modernization (Sen 1997: 3).
>
> We must go *beyond* the notion of human capital, after acknowledging its relevance and reach. The broadening that is needed is additional and inclusive, rather than, in any sense, an *alternative* to the "human capital" perspective (Sen 1997: 296).

In seeking to further clarify the relationship between the human capabilities approach and the human capital approach, Mahbub ul Haq wrote:

> None of the economic issues is ignored, but they all are related to the ultimate objective of development: people. And people are analyzed not merely as the beneficiaries of economic growth but as the real agents of every change in society whether economic, political, social or cultural. To establish the supremacy of people in the process of development – as the classical writers always did – is not to denigrate economic growth but to rediscover its real purpose. (2003:21)

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[20] Grossman has continued to explore the relationships between education and a variety of nonmarket outcomes within a human capital framework. In a recent paper he provided an in-depth analysis of the relationship between education and various dimensions and indicators of health (Grossman 2005: 32-68).

In addition to rejecting the view that economic growth alone, as measured by GDP per capita, will provide for other central human needs, the capability approach to development is tied to concepts of social justice and the removal of disparities in opportunity and entitlement (Walker 2006; Maddox 2008:185). As stated by Nussbaum (2003: 328), ". . . it is very important to insist that development is a normative concept and that we should not assume that the human norms we want will be delivered simply through a policy of fostering economic growth."

Not surprisingly, education is an important focus in the human capability framework. Nussbaum (2003: 335) described education's especially significant and central role in developing and enhancing women's capabilities as follows:

> Literacy (and education in general) is very much connected to women's ability to form social relationships on a basis of equality with others and to achieve the important social good of self-respect. It is important, as well, to mobility (through access to jobs and the political process), [and] to health and life (through the connection to bodily integrity and exit options). . .

As Nussbaum's statement suggests, in the human capability framework to be illiterate and innumerate is, inter alia, to be deprived of an enabling environment for the enjoyment of a long, healthy, and creative life.[21] Further, in a recent discussion of the capability model of education, Robeyns described education's contribution to personal empowerment and personal enjoyment (its intrinsic value) and also its personal and collective instrumental value, including but not limited to economic impacts (Robeyns 2006: 69). The human capability approach thus leads us away from the false dichotomy between instrumental and intrinsic rationales (or between solely utilitarian rationales and a rationale based solely on an abstract concept of rights) for the global expansion of education.

In closing, just as the human capability approach affords importance to economic concerns and impacts as one aspect of human development, economic analysis is also very important in the IFs approach to education expansion and its impacts. Nonetheless, as we will demonstrate in coming sections and chapters, and despite difficulties in conceptualization and measurement, we include the economic analysis in a broader conceptualization of human development.

2.2 Education Systems

Education systems themselves are a component of human development systems. An understanding of global education patterns requires understanding something about their structure and components. Fortunately for our purposes, and despite important

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[21] In a background statement for the first UNDP Human Development Report, Mahbub ul Haq defined the purpose of development as the creation of "an enabling environment for people to enjoy long, healthy, and creative lives" (see http://hdr.undp.org/en/humandev\)..

variations, there is enough global standardization in the arrangement of the common ingredients of education—students, teachers, and resources—that a comparative study of the expansion of education is possible.

With respect, first, to levels of education, there has been, since the early 1970s, an International Standard Classification of Education, or ISCED. Designed by UNESCO, and most recently refined in 1997, ISCED provides guidelines for countries to classify their educational programs by level, and at some levels by field, in order to establish an ongoing global repository of education indicators and statistics (UNESCO 1997: 1). The classifications are:

Level 0—Pre-primary education
Level 1—Primary education
Level 2—Lower secondary education
Level 3—Upper secondary education
Level 4—Post-secondary non-tertiary education
Level 5—First stage of tertiary education
Level 6—Second stage of tertiary education

A number of refining principles and guidelines further clarify the categories:

- The pre-primary level includes both pre-school and kindergarten programs

- The primary level is the first stage of basic education and the lower secondary level is the second stage of basic education

- At the lower and upper secondary levels, there is a further division into general programs and vocational or technical programs

- The post-secondary non-tertiary level encompasses "programmes that straddle the boundary between upper-secondary and post-secondary education" (UNESCO 1997: 17)[22]

- The tertiary level is divided first into two categories: level 5 refers to programs that do not lead to an "advanced research qualification," while level 6 refers to programs that do lead to such a qualification

- Following this division, sub-categories in level 5 distinguish between theoretically based or research programs and programs that prepare students for practice in high-skill professions (5A), and programs that are practical, technical, and "occupationally specific" (5B).

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[22] A further clarification states "Typical examples are programmes designed to prepare students for studies at level 5 who, although having completed ISCED level 3, did not follow a curriculum which would allow entry to level 5" UNESCO 1997: 17).

The specification of primary and lower secondary levels as the two stages of basic education, and the separation of lower and upper secondary levels, are especially important in the context of this volume. The ISCED classification system describes the distinguishing characteristic of primary education as the "beginning of apprenticeship of reading, writing, and mathematics," and the distinguishing characteristic of lower secondary education as the "full implementation of basic skills and foundation for lifelong learning" (UNESCO 1997: 10). In distinction, upper secondary programs move beyond basic education to prepare students for higher-level entry to the labor market or for advanced (tertiary) study.

The very different purposes of lower and upper secondary education, as well as widespread agreement on the importance of universal basic education through the lower secondary level (as well as differing enrollment patterns at the two secondary levels) resulted in our decision to build capability into the IFs education module to represent lower and upper secondary levels separately, further including the separation into general versus vocational or technical programs insofar as possible.[23]

Table 2.1 displays recent percentages of students in vocational and technical programs at lower and upper secondary levels. In all regions, very small proportions of students are enrolled in defined vocational and technical programs at the lower secondary level, but for all regions except South and West Asia (4.6 percent) and Sub Saharan Africa (16.4 percent) at least 20 percent of upper secondary students are in vocational and technical programs.[24] The greatest proportion at the upper secondary level is 42 percent in Central and East Europe.

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[23] The IFs education module includes ISCED level 1, ISCED level 2, and ISCED level 3 separately. ISCED levels 0 (pre-primary) and 4 (post-secondary non-tertiary) are not represented unless otherwise noted, and levels 5 and 6 (first and second stages of tertiary education) are combined. A future volume in the Patterns of Potential Human Progress series focusing on infrastructure will include considerably more detail at the tertiary level.

[24] It is important to remember that within regions these are population-weighted averages. South and West Asia is dominated by India, whose 2005 percent of upper secondary vocational and technical enrollments at 1.9% is the highest reported for India since data were first collected in 1999. The range in the region extended upward to 40.7% for Maldives.

	Lower Secondary	Upper Secondary
Arab States	2.5	23.8
Central/Eastern Europe	0.1	42.2
Central Asia	0.0	20.9
East Asia/Pacific, less developed	0.6	32.3
East Asia/Pacific, more developed	2.4	29.2
Latin America/Caribbean	4.9	22.0
North America/Western Europe	1.5	29.8
South and West Asia	1.0	4.6
Sub-Saharan Africa	3.2	16.4

Table 2.1 Enrollment in vocational and technical programs as percent of total secondary enrollment
Source: UIS data, 2005 or most recent year

A perhaps surprising degree of similarity exists in the duration of the various levels of education across the world. Six years is the most frequent duration for primary education, three years for lower secondary, and three years again for upper secondary. What regional differences there are by level are minimized when the durations are summed across the three levels. The average total duration for two regions (Central and East Europe, and Central Asia) is eleven years. The longest average duration is thirteen years in Sub Saharan Africa, and the average duration in the remaining five regions is twelve years. Importantly, no matter how primary and lower secondary are divided, the minimum number of years constituting basic education is eight (see Table 2.2).

	Col. A Primary	Col. B Lower Secondary	Col. A+B Basic Education	Col. C Upper Secondary	Col. A+B+C Primary through Upper Secondary
Arab States	6	3	9	3	12
Central & East Europe	4	4	8	3	11
Central Asia	4	5	9	2	11
East Asia & the Pacific	6	3	9	3	12
Latin America & Carribbean	6	3	9	3	12
No. America & West Europe	6	3	9	3	12
South & West Asia	5	3	8	4	12
Sub Saharan Africa	7	3	10	3	13

Table 2.2 Average duration of primary through secondary levels of education by UNESCO region
Source: IFs calculation from UIS data, 2005 or most recent year

The extent to which education is at least nominally compulsory is also perhaps surprising. Gambia is the only one of the 197 countries included in UIS data for 2005 that reported less than compulsory primary education.[25] Globally, 73 percent of countries (with a range

[25] Gambia reported 5 years of compulsory education and 6 years as the duration of primary education.

from 31 percent to 100 percent by region) reported having compulsory education through the lower secondary level. Perhaps also somewhat surprising, only 12 percent of the countries (with a regional range from 0 percent to 29 percent) reported having compulsory upper secondary education, another clear indication of the different ways in which lower and upper secondary education are viewed.

	Percentage of Countries within Region Requiring		
	at Least Primary	at Least Lower Secondary	Upper Secondary
Arab States	100.0	85.0	5.0
Central/Eastern Europe	100.0	94.7	10.5
Central Asia	100.0	100.0	22.2
East Asia/Pacific	100.0	74.2	6.5
Latin America/Caribbean	100.0	82.9	29.3
North America/Western Europe	100.0	96.2	19.2
South and West Asia	100.0	44.4	0.0
Sub-Saharan Africa	97.6	31.0	0.0
World	99.5	72.6	12.2

Table 2.3 Compulsory education levels by UNESCO region
Source: UIS 2005 data

Clearly, the formal requirements of compulsory primary and lower secondary education do not guarantee universal coverage. At the primary level, with all but one country reporting a compulsory education requirement, the 2005 global average net enrollment rate was just over 88 percent, and approximately 11 percent of countries reported a primary net enrollment rate below 70 percent. At the lower secondary level, the average gross enrollment ratio in 2005 was 88 percent for all countries (e.g., both those with and those without a compulsory requirement). However, 13 percent of the countries reporting a compulsory lower secondary education requirement had gross lower secondary enrollment ratios below the global average. Nonetheless, the existence of formal requirements speaks to some level of public awareness and potential commitment at a minimum, and provides a handle or lever that is at least nominally available for policy attention.[26]

Another distinction in education systems is that between public and private schools. In its reporting, UNESCO " . . . distinguishes between public and private education according to whether a public agency or a private entity has ultimate control over the

[26] In a classic paper, Caldwell (1980) explored the relationship between universal or compulsory education legislation and the actual advent of "mass schooling" in the western industrialized countries in the 19th Century. He noted (1980:233) that ". . . universal education legislation in many countries was the end point of a movement over several decades to bring all children into schools," lending credence to the idea that while compulsory education does not guarantee universal coverage, it at least signals and assists in movement in that direction.

institution, regardless of the source of funds" (UNESCO 2007: 46). The percentages of students enrolled in private institutions at primary and secondary levels appear in Table 2.4, and reflect very different regional patterns both within and across the levels.[27]

	Primary	Secondary
Arab States	21.8	12.2
Central/Eastern Europe	1.5	2.4
Central Asia	0.8	0.7
East Asia/Pacific, less developed	5.3	11.1
East Asia/Pacific, more developed	3.3	21.3
Latin America/Caribbean	14.4	19.6
North America/Western Europe	11.0	13.2
South and West Asia	18.2	38.6
Sub-Saharan Africa	8.0	14.5

Table 2.4 Enrollment in private institutions as percent of total by UNESCO regions
Source: UIS data, 2005 or most recent year

As the UNESCO citation suggests, education systems around the world frequently display a complex intermingling of public and private auspices and funding. Public funds, particularly in developing regions, frequently support, in whole or in part, the educational costs of students in private schools.[28] In fact, UNESCO distinguishes between "government-dependent private schools," and "independent private schools." While local communities, individuals or private entities manage both types, the former receive a majority of their funds from public sources, while the latter raise the majority of their funds from fees or other private entities (UNESCO 2007: 46, 48). In some countries, many of the independent private schools are affiliated with religious organizations, whereas many of the government-dependent private schools have been established specifically to provide needed increased capacity.

Just as enrollment in a private institution does not necessarily signal financial costs to families, particularly at the primary level, neither does enrollment in a public primary institution necessarily indicate families need pay no tuition. Despite the Dakar Famework's stipulation of free and compulsory primary education, 35 countries still required private tuition fees of students attending public primary schools in 2006. However, 13 other countries abolished fees at the primary level between 2000 and 2006.[29]

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[27] While UIS has data, albeit spotty, on private versus public expenditures at the tertiary level, it does not include enrollment in private versus public tertiary institutions in its published data series.

[28] To the extent that public funds are allocated directly to private schools, UIS reflects them in public expenditure data (e.g., both education expenditures as a percent of GDP and education expenditures per student as a percent of GDP per capita are defined as including such support).

[29] The 2008 Education for All Global Monitoring Report (UNESCO 2007: 112) identified countries that abolished fees for primary education between 2000 and 2006: Benin, Burundi, Cambodia, Ghana, Kenya,

UIS reporting of private funding by educational level began with 1999 data. However, the reporting remains extremely spotty; for example, in 2005 only 47 of the 207 countries in the UIS database included any private funding data, and many of those provided only partial data (e.g., aggregate across all levels or specified for some levels but omitted at others). Nonetheless, we include some discussion of private funding in Chapter 4. As a consequence of sparse data on private funding, when this volume talks about specific costs associated with increasing enrollment headcount and rates, we refer only to public funding. Implicitly our methodology assumes that private funds can and will increase to cover the same proportions of educational costs that they currently cover—an assumption that is highly questionable. However, the general lack of private funding data makes it impossible to regionally—let alone globally—quantify these cost implications in our forecasts. [30]

2.3 Participation in and attainment of education: A conceptual framework

The level of education attainment among an adult population is the time-lagged result of the participation of members of that population in an education system or systems. This study, as mentioned previously, focuses only on attainment acquired through participation in formal education systems. For our purposes, measuring levels of attainment or progress toward educational goals begins with measurement of the participation rates or *flows* of individuals into and across components of educational systems (e.g., entry into school and then progression from grade to grade, or from the primary to the secondary level or the secondary to the tertiary level). It continues by tracking students' progress to an indicator of attainment (e.g., partial or complete primary, lower or upper secondary, or tertiary education). It then proceeds with the movement of student-aged populations into the demographic cohorts of the adult population, carrying with them, as they age, their experiences of partial or full completion of educational programs. In the terminology of systems dynamics, those experiences of the adult population (or across a population of any age) constitute a *stock* of educational attainment, an important indicator of human capabilities.[31]
Figure 2.1 presents a simplified high level view of education system flows and stocks.

Lesotho, Madagascar, Mozambiquae, Tanzania, Timor-Leste, Viet Nam, Yemen and Zambia. At the same time, the report notes legal tuition fees at the primary level were still charged in 35 countries in 2006: Djibouti and Qatar in the Arab States; the Republic of Moldova in Central and Eastern Europe; Krygyzstand in Central Asia; China, Fiji, Indonesia, Laos, Malaysia, Papua New Guinea, Singapore, and Vanuatu in East Asia and the Pacific; Colombia, Dominican Republic, Ecuador, El Salvador, Grenada, Haiti, Saint Lucia, and St. Vincent-Grenadines in Latin American and the Caribbean; Maldives and Pakistan in South and West Asia; and Angola, Burkina Faso, Central African Republic, Comoros, Cote D'Ivoire, Democratic Republic of Congo, Ethiopia, Eritrea, Namibia, Rwanda, South Africa, Swaziland, and Zimbabwe in Sub Saharan Africa. It is important to note that this list is specific to tuition fees, and does not include far more widely levied fees for such things as books, uniforms, and transportation costs.

[30] In a later chapter we will select a small number of countries from among those providing private funding data by education level to quantify the implications of either increased private funding or a greater increase in public spending as a percentage of GDP.

[31]

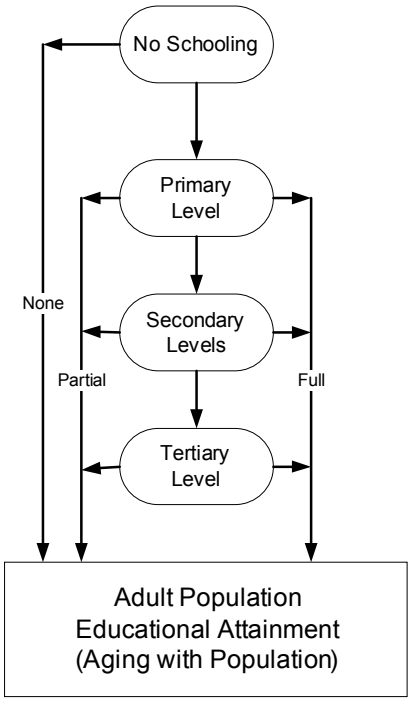

Figure 2.1 Education flows and stocks

2.3.1 Student flow patterns

In reality, patterns of participation (flows) are considerably more complex than Figure 2.1 suggests, and are likely to be particularly so in countries in transition from low to high (or higher) levels of enrollment. Complexity arises because:

- Children may enter the system at various ages, such as the designated entry age (most typically 6 for primary school), or below or above the designated entry age.
- They may progress without interruption from one grade to the next, or they may repeat grades, and/or drop-out either during the year or at the end of the year.
- Some of those who drop-out will subsequently re-enter; others will not.
- Of those who complete the primary level, some will transition immediately to the lower secondary level, some will enroll in lower secondary after one or a number of years out of school, and some will never enroll in lower secondary.

The paths of those who do enter the lower secondary level will also vary, with some progressing from grade to grade without interruption, some repeating grades, some dropping-out, and some re-entering. Similar patterns occur at the upper secondary and tertiary levels, although typically a smaller proportion of the population enters and completes each subsequently higher level. Figure 2.2 below shows these flow patterns in

detail at the primary level, including patterns of transition to the lower secondary level, where again (and also at higher levels) similar flow patterns can be diagrammed..

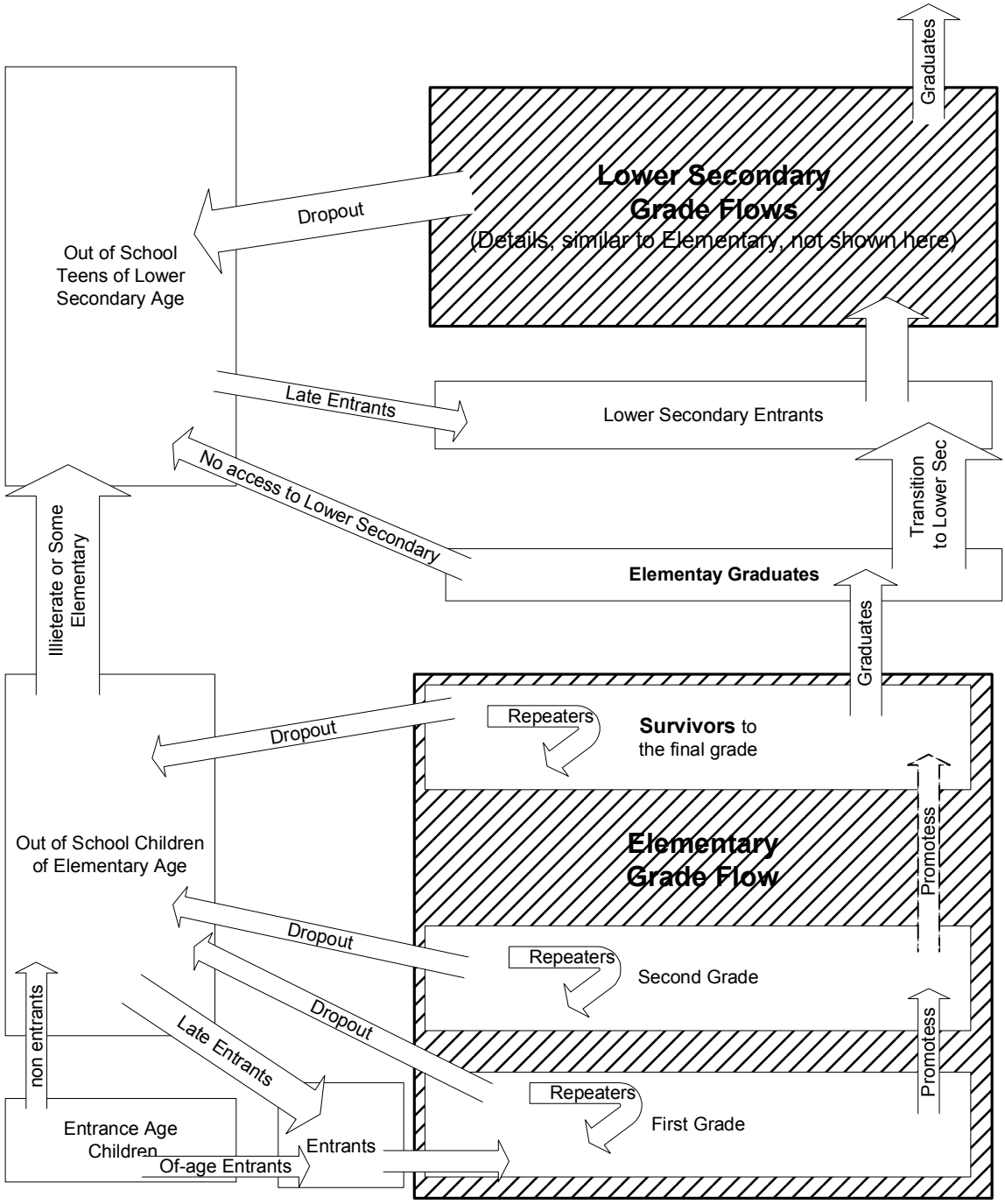

Figure 2.2 Patterns of student flows (primary level as example)
Source: Adapted from Irfan (2008).

A variety of indicators measure patterns of education flows. The most frequent measure is enrollment rates. Gross enrollment rates refer to the total number of enrolled students at a given level as a percent of the population in the age-range defined as "normal" for that level. Net enrollment rates, on the other hand, refer to the number of enrolled

students within the age-range defined as "normal" for a given level as a percentage of the population in that age-range. Whereas net enrollment rates, by definition, cannot exceed 100%, gross enrollment rates can and often do, sometimes by substantial margins. Three factors contribute to this possibility: (1) the entry of students who are either under the defined "normal" age range; (2) students who are enrolled beyond the normal age range either because they were older than the "normal" entry age when they started or because of repetition of one or more grades; and (3) re-entry of students who drop-out for a period and subsequently return.

Gross and net enrollment rate data, both aggregate and for males and females separately, are available for primary education and for total secondary education (lower and upper secondary levels combined) for the period from 1970-1997 for many or most countries on one UIS (UNESCO Institute for Statistics) website and for 1999 through the present on another.[32] Data on primary intake or entry rates by age categories (and by sex) are also available for the period from 1999-2007 on the second website, as are data on primary repetition rates.

Specific data on primary drop-out and re-entry rates are not currently available from UIS. However, the net effect of both, along with the progression of students whose enrollment is continuous (whether with or without grade level repetition) is captured in what is referred to as primary "survival rates," defined as the percentage of an entering cohort that persists to the beginning of the final year of a given level of education. UIS does provide primary survival rate data.

UIS also collects and disseminates measures of primary completion rates, which are defined not as a proportion of an entering cohort, but rather as the ratio between the number of students completing primary education and the number of children in the population at large who are the "normal" age to complete the primary level, given the duration of the country's educational levels and the system-defined entry age. However, because different countries have very different conventions as to what constitutes "completion"—ranging from "simply" progressing through a series of grades to successfully completing an exit examination—and also because fewer countries report primary completion data than report survival data, survival is more frequently used as a proxy to track progress toward universal primary education.

Obviously, however, universal primary education is achieved only if 100% of school age children enter the primary level and all 100% subsequently progress or "survive" through all primary grades. Enrollment rates reflect the composite effect of specific entry rates along with specific grade-to-grade survival rates, but in and of themselves do not describe

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[32] Data for the period 1970-1997 are found at http://www.uis.unesco.org/statsen/centre.htm, and data for the period 1999 (and sometimes earlier) through the present are found at http://stats.uis.unesco.org/unesco/TableViewer/document.aspx?ReportId=143&IF.

those underlying dynamics. The same enrollment rate, for example, might result from a high entry rate combined with a low survival rate, or from a lower entry rate combined with a higher survival rate. Therefore, decomposing enrollment rates into the two component parts (entry and progression or survival) provides more information about actual flow patterns, such as whether a country is successful at providing access—as reflected by high entry rates—but is less successful in persistence—as reflected by low survival rates.

Whenever possible, enrollment rates are decomposed into their underlying dynamics of entry and persistence or survival in the IFs system, as we describe in the next chapter. We do not, however, explicitly represent primary repetition rates, but rather see their combined effect, along with drop-out and re-entry rates, in the year-to-year progression and enrollment data and forecasts. High gross enrollment rates are not necessarily the result of large numbers of "over-age" or "under-age" children entering a given level of education; they also result from large numbers of children repeating grades, and indeed, many countries experience high repetition rates. Table 2.5 displays the primary first-year repetition and the overall primary repetition rates by UNESCO region.[33]

	Primary	Secondary
Arab States	8.0	8.8
Central/Eastern Europe	2.1	2.1
Central Asia	1.0	0.6
East Asia/Pacific, less developed	7.2	3.8
East Asia/Pacific, more developed	no data	no data
Latin America/Caribbean	14.4	10.2
North America/Western Europe	1.9	2.2
South and West Asia	4.7	3.8
Sub-Saharan Africa	12.1	9.6

Table 2.5 Percentage of primary repeaters by UNESCO region
Source: UIS data, 2005 or most recent year

The human consequences of high repetition rates are significant, as children who repeat one or more grades are less likely to persist to primary completion (UNESCO 2007: 52). The resource consequences are also significant; a country with a 10 percent primary repetition rate could, other things being equal, enroll 10 percent more children at the primary level, or additional children at lower or upper secondary levels, for the same outlay of resources.[34]

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[33] Per UIS on-line Data Centre, 25% or more of 1st grade students were repeaters in 2005 in the following countries: Brazil, Burundi, Cambodia, Cameroon, Central African Republic, Comoros, Republic of Congo, Equatorial Guinea, Gabon, Guatemala, Laos, Lesotho, Malawi, Nepal, Sao Tome and Principe, Suriname, and Togo.

[34] Obviously, not all else is equal. First, it is not necessarily possible or appropriate to have a zero repetition rate. Second, in some cases low expenditures per student may be contributing to high repetition rates, and in those cases expenditures per student may need to increase in order to reduce the repetition rate. In any case, high repetition rates warrant analysis of underlying causes so that quality issues can be identified and addressed and financial resources used efficiently.

So far our discussion of flow patterns has emphasized the primary level. This is not surprising, given that UIS—in its official role as the primary agency responsible for tracking progress toward the MDG goal of universal primary education—gathers and disseminates extensive primary level flow rate data, and less extensive flow rate data at other levels (and particularly so at the separate lower secondary and upper secondary levels). Nonetheless, even at these other levels UIS provides extensive series of raw data (e.g., grade-by-grade enrollment headcounts) which, in combination with other data series within IFs, allow the calculation of key student and expenditure flow rates. We discuss these calculations as part of the presentation of the IFs methodology in Chapter 3.

2.3.2 Levels of educational attainment

The previous section focused on student flow rates, or patterns of activity, within education systems. The consequence of these patterns of activity is the state of educational attainment within a population at any given point in time, often referred to as the educational *stock* (or human capital) of a society.[35]

Analysts most frequently use two types of measures of educational attainment.. One is the average years of education within the adult population (typically either the population 25 years of age and older or the population 15 years of age and older). The other is the distribution of educational attainment by specific levels of education and by age cohorts.

There are problems and limitations with both measures. Conceptually, because of its highly aggregated nature, greater limitations are associated with the use of average years of education as an indicator of capabilities. As a single measure, it provides no indication of the distribution of educational attainment around the average; for instance, an average educational attainment of 5 years could mean that all adults have 5 years of education or that half of them have 10 years and half have none. Another limitation associated with the aggregation into a single population-wide average is the inability to see differential attainment rates by age groups, even though the average is constructed by age cohorts.

Nonetheless, comparisons of population-wide measures of average education years at different points do provide useful information for comparisons between countries and trends over time.. Often also the numbers are available separately for females and males, so that parity, as measured by average years of education, can be analyzed.

The second type of measure—the distribution of educational attainment by specific levels of education and by age cohorts—attempts to address these issues. In this second approach, an overall population is typically divided into five-year age cohorts (e.g., 25-29, 30-34, and so on) by sex, and the proportion of each cohort attaining all or part of varying levels of education (e.g., no education, primary education, secondary education, and tertiary education) is estimated. This approach allows richer exploration of relationships between varying education/age/sex combinations and other dimensions of

[35] We use this term, despite some discomfort with its tone, as an indicator of the extent of important human capabilities among a population, and of opportunities for development associated with those capabilities.

human development.[36] In addition, the distributions of educational attainment are frequently displayed in education/age/sex population pyramids that visually reinforce the analysis, including making clear the time-lagged nature of increases in enrollment rates among children and educational attainment levels throughout the adult population. Education/age/sex pyramids generated by IFs for Albania and Bolivia in 2000 appear in Figure 2.3; while the average years of education for adults 25 and over are just a bit below 6 years in both countries, the pyramids show quite different age structures and patterns of educational attainment, and would appropriately suggest probable differences in other indicators of human development in the two countries. (The figure also shows forecasts for 2030 in the IFs base case.)

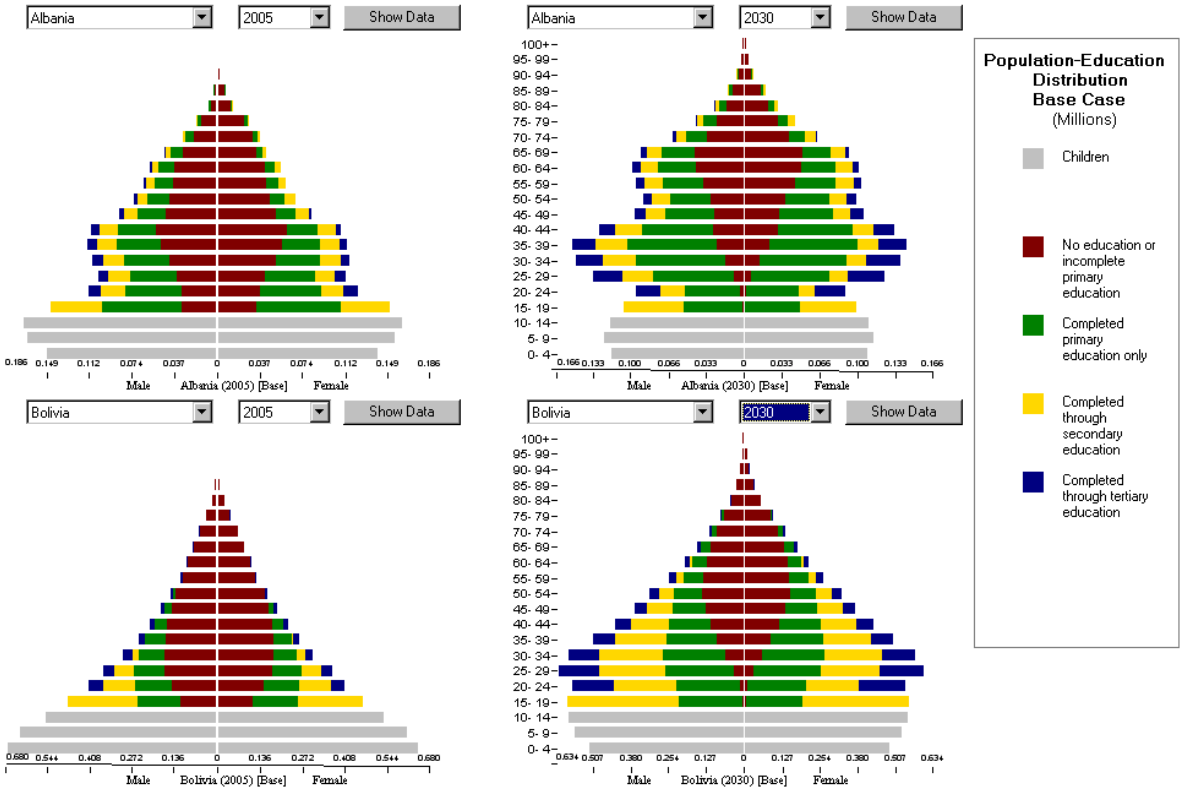

Figure 2.3 Age-sex-education distribution
Source: IFs 6.03.

[36]For example, a paper by Cuaresma and Lutz (2007: iii) noted that "differences in the education level of the younger age groups explain the differences in income per capita across countries significantly better than aggregate measures such as the education level of the entire adult population."

2.4 Placing education in a human development framework

It is possible to conceptualize the components of human development systems and the connections between them in many ways. Figure 2.4 provides a simple schematic of connections among demographic, educational, economic, and socio-political systems, giving education—since it is our focus here—a place of central prominence. Certainly, depending on the purpose of an analysis, any one of these components might be placed at the center of the diagram.

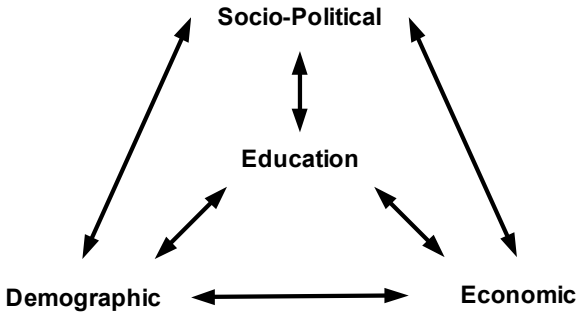

Figure 2.4 Education within a broader human development system

The connections between the components are highly interactive and complex, and in this regard we emphasize two points. First, the connections between education and each of the other major components of the system are bi-directional—not only does education affect demography via its impact on health and fertility rates, for example, but demography obviously also affects education via the size and characteristics of school-age and older populations. Second, in addition to the direct bi-directional linkages shown in the diagram, there are multiple secondary or indirect impacts. Consider education and the economy. A *direct* impact of education might be enhanced economic growth as a result of a literate and skilled workforce. An *indirect* impact might be enhanced economic growth as a result of a workforce that is healthier, a condition to which education has also made a contribution.

We consider three aspects of education's connections to other components of the human development system in the remainder of this chapter. We look first at some of the ways other components affect education. Next we turn to education's impacts on other components, a topic that Chapter 8 explores in some depth. And finally, we suggest some of the factors that complicate analyses and forecasts of education in a human development system.

2.4.1 The impact of the broader human development system on education

Let us briefly consider how each of the other components in Figure 2.4 might separately affect demand for and supply of educational opportunity. Demographic relationships are among the most obvious.

At the level of aggregate demand, other things being equal, larger school-age populations place greater demand on education systems. However, two factors significantly interact with the absolute size of the school-age population in shaping demand pressures. A school-age or youth population that is large as a percentage of the overall population— and especially if it is growing relative to the economically-active population— will translate into greater effective or felt demand. And a marked increase in desire for schooling at the individual household level has a similar aggregate effect, regardless of the absolute size of the population, by increasing enrollment rates.

Turning to the micro level, the demographic characteristics of families also affect demand for schooling. The children of educated parents, all else equal, have higher school participation rates than the children of uneducated parents. On the other hand, children from poor families, children in linguistic and ethnic minority groups, children who live in rural areas, as well as children who have disabilities, are less likely to attend school.[37]. And in a number of countries, parents are still less likely to send girls to school.

Economic factors are closely connected to both demand and supply, as we see from a quite consistent positive relationship between enrollment rates and GDP per capita. On the demand side, parents in low-income economies may not be in a position to afford direct costs associated with education for their children (such things as books, uniforms, transportation, and sometimes tuition—even at the primary level, as we saw earlier in this chapter). Perhaps depressing demand even more than direct costs, families may not be able to afford giving up the paid or unpaid work that children forgo to attend school.. Because of the extreme hardship involved for many families in sending their children to school, it is important that they be able to anticipate future returns from education.[38] Are there reasons for families to believe, for example, that more jobs and better jobs will be available for educated individuals than for those who have not been to school? And how much education will their children need in order to have access to these jobs?[39]

On the supply side, the strength of its economy obviously shapes the ability of a country to create additional enrollment capacity in an environment with a growing school-age population, or an environment where an increasing proportion of families want to send their children to school. Economies are especially challenged when both dynamics are

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[37] Certainly some portion, and sometimes the largest portion, of the lower enrollment rates of these children is explained by supply-side gaps, but some too is explained by differentials in demand.

[38] Speaking to this point, Clemens, in a paper prepared for the Millennium Project Task Force on Education and Gender Equality, referred to a "take-off" that occurs in primary enrollment rates when GDP per capita reaches a level that signals likely returns for education (2004:18).

[39] Birdsall et al. noted that because a secondary education is often perceived and/or required as a prerequisite to an individual's participating in and benefiting from a growing economy, parents may decide whether or not to send their children to primary school in the context of their perceived opportunities to pursue a secondary education (Birdsall, Levine and Irbahim 2005: 65).

occurring at the same time, as they currently are in most sub-Saharan African countries.. That, in turn, brings us to considering the role of socio-political systems. No matter what a country's economic circumstances might be, governments ultimately make decisions about the priority given to education in the face of difficult choices. We conclude this section with some of the questions that confront the public sector with respect to education :

- How much needs to be spent per student to provide an adequate education at the primary, secondary and tertiary levels?
- What would it cost to provide universal primary education of adequate quality?
- What costs, if any, should be the responsibility of families? What happens when families cannot afford these costs?
- Are there sub-populations or groups of school-age children who are particularly at risk, both with respect to entry and with respect to progression and completion?
- Does the public sector need to provide incentives to increase families' demand for education?
- Should there be a focus on increasing primary intake rates even if per-student funding, at least for a time, consequently decreases to a level where quality will inevitably suffer?
- What pressures do increased primary enrollment rates put on lower and upper secondary levels? Are there pressures at the tertiary level?
- What should be the balance of emphasis on primary, lower secondary, upper secondary, and tertiary education, in light of unique national history and circumstances?[40]
- Is there reason to believe there will be jobs for increased numbers of educated youth and adults?
- How should decisions be made about the relative proportion of public sector resources that will go to education, to health, to the military, to the direct creation of jobs, and to other compelling public needs?
- Is international assistance available to help with funding gaps? Are the conditions attached to such assistance reasonable?

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[40] One approach to this question appears in a report of the UNESCO Regional Office for Education in Africa (BREDA). In making recommendations with respect to "student flow management," the report argued for a phased approach across levels, and suggested that a number of African countries will need to consider reducing transition rates to the lower secondary level during the transition to UPE (UNESCO 2005b: 17, 134).

2.4.2 Education's impact on other aspects of human development

The discussion of the impact of the rest of the human development system on education identified trade-offs and complicated questions that individuals, families, governments, and societies face when confronting decisions about participation and investments in education. Clearly, however, education has benefits as well as costs. As we turn to the impact of education on broader human development, the focus is most often on such benefits. A very large body of literature has sought to understand those benefits, and also to consider possible neutral or even adverse consequences.

Hannum and Buchmann recently completed a literature review of 126 such documents, most of which are "empirical studies in sociology, demography, economics, political science, and anthropology" (2006: 496). In this section, we use Hannum and Buchmann's framework to introduce the topic of education's impacts. We use it again as the starting point, in conjunction with numerous other studies, for the explorations and forecasts of education's impacts using IFs that are the subject of Chapter 8.

Specifically, Hannum and Buchmann analyzed an extensive body of research findings relative to the following assertions (Hannum and Buchmann 2006: 496): [41]

- Human capital stock is central to national economic development, as better-educated citizens are more productive. *(Economic System)*

- Within societies, the expansion of educational opportunities enables individuals to improve their economic circumstances. *(Economic System)*

- Educational expansion narrows social inequalities within countries by promoting a meritocratic basis for status attainment. *(Socio-Political Systems)*

- Countries with better-educated citizens have healthier populations, as educated individuals make more informed health choices, live longer, and have healthier children. *(Demographic Systems)*

- The population of countries with more educated people grow more slowly, as educated citizens are able to implement a virtuous cycle of having fewer children. *(Demographic Systems)*

Countries with more educated populations are more democratic, as their citizens are able to make more informed political decisions. *(Socio-Political Systems)*

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[41] Each of the bulleted items is quoted directly from Hannum and Buchmann. At the end of each bulleted item we have inserted, in *italics,* the component of Figure 2.4 (presented earlier in this chapter) to which the item most directly relates.

From their review, Hannum and Buchmann conclude that empirical evidence most strongly supports the assertions of positive health impacts and reduced fertility from expanded participation in primary and secondary education, as well as enhanced—although not ensured—economic circumstances of individuals. They point to a more ambiguous outcome with respect to national economic development, stating (2006: 521) that "Many empirical studies find a positive relationship, but other studies cast doubt on it"—a point to which Chapter 8 of this volume returns in some detail. In the meantime, we quote at greater length their finding with respect to education's impact on narrowing social inequalities:

> . . . numerous empirical studies in sociology have indicated that while educational expansion tends to offer absolute benefits to disadvantaged groups, it is less likely to erode social inequalities rapidly, except perhaps for inequalities associated with gender. Inequalities associated with economic origins or ethnicity often prove resistant to educational expansion, as educational access may expand faster for advantaged than disadvantaged groups (Hannum and Buchmann 2006: 521).

They also find an ambiguous relationship between education—particularly at the primary and secondary levels—and democratization noting (2006: 522):

> . . .though expansions of primary and secondary education are likely to improve the informed citizenship of individuals . . . democratization, perhaps more so than other outcomes, may hinge directly on the hard-to-measure content of education. This possibility is suggested in studies that find larger effects of tertiary education than lower levels of education.

We return to each of these posited relationships in Chapter 8. In addition, our analysis there of socio-political systems extends beyond democratization to include government effectiveness, corruption, and state failure.

2.4.3 What makes analysis of educational change and broader human development difficult?

Many factors complicate our ability to understand education as a phenomenon of social change, both in terms of the education transition itself and also its relationships to other aspects of human and social development. Some arise from the inherent complexity of individual human and social phenomena, creating difficulties for their conceptualization and measurement. Further problems plague understanding the processes through which phenomena interact and change, including the complications of sorting out causality. Still additional problems flow from methodological issues around the treatment of time and movement across levels of analysis (movement from looking at individuals to looking at societies).

Some examples of these complicating factors are:

- Conceptualization issues. For instance, understanding exactly what universal primary enrollment means is not simple. Does it apply to students of particular

ages or to any students? How should one think about repeating and returning students?

- Data issues. Our primary source for education data is the UNESCO Institute for Statistics (UIS), the body charged with global responsibility for collecting, collating, and distributing country-level education data and for monitoring progress toward the MDG education goals of universal primary education and gender equity.[42] In cooperation with other international organizations and with countries, UIS is greatly increasing the quality and coverage of global education data. Quite a few data series extend back as far as 1960 (and some to 1950), providing the opportunity for analysis over a significant time period, which is obviously desirable when the goal is to track, understand, and forecast medium to long-term patterns of significant social change. Nonetheless, data are very spotty for some series, such as primary completion rates, and sometimes missing almost altogether for individual countries, especially for countries in crisis.[43]

- Bivariate causality issues. Problems arise in the interpretation of the direction of causality between related variables. For example, even when an association between levels of education and economic growth can be demonstrated, the extent to which education enables the economic growth, in distinction from the extent to which economic growth stimulates demand for education because of opportunities for individual economic rewards, is not clear.

- Multivariate relationship issues: spurious or false correlations. It is even theoretically possible that there is not—and or not strongly—a causal relationship between education and economic growth, but rather an association driven by a third variable or a constellation of other variables. For example, to what extent might technological advance drive both education demand and economic growth?

- Multivariate relationship issues: interaction effects. Third variables may affect or condition the relationship between two under direct examination, by largely determining one of them or by intervening between two of them. For example, Hanushek (2004) finds education quality—as measured by standardized international assessments— to have a greater association with economic growth

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[42] Before the UNESCO Institute for Statistics was established in 1999, first the UNESCO Division of Statistics on Education and then later the UNESCO Office of Statistics took a lead role in education data collection and dissemination. The first UNESCO Statistical Yearbook was published in 1963. Many analytic studies were undertaken during the 1980s, including trends and projections of enrollment by country, level of education and age for the period 1960-2000 (UNESCO Division of Statistics on Education 1983). Reports in 1989 and 1993 updated trends and projections to 2025 (UNESCO Division of Statistics on Education 1989, and UNESCO Division of Statistics 1993).

[43] However, many new data series, with data extending from 1999 forward, allow exploration of relationships at greater levels of refinement than previously possible. The separation of secondary enrollment and expenditure data into lower secondary and upper secondary levels is an example of a new series with great potential benefit given wide consensus on the different content and purposes of the two levels, as well as their generally quite different cost structures and resource requirements.

than education quantity.[44] Similarly, the strength of an association between education and many other social phenomena is conditioned by the different contexts within which persons with given levels of education seek to apply the knowledge, skills, and capabilities acquired from their schooling (that is to say that there are interaction affects in systems with multiple interacting variables). For example, Jamison, Jamison, and Hanushek (2006: 14) found a stronger relationship between education and economic growth in an open economy than in a closed economy. This is but one aspect of how the state of an economy might affect the impacts of education. Others include the extent to which resources can be mobilized to stimulate employment, and whether different levels of education have more impact at different stages of economic development.

- Temporal dynamic issues. Still another difficulty arises from generalizing relationships at a single point in time over an extended time frame. For example, a relationship between growth in income levels and expansion of lower secondary education will change as the proportion of a population with lower secondary education moves toward one hundred per cent.[45] Another time problem involves lags, sometimes very long ones, in relationships between variables, such as that between increase in education participation rates and increases in per capita income. An increase in primary entry or intake rates of children at age 6, assuming these children continue on to the secondary level, may take ten years or more before it impacts in measurable ways the life choices and circumstances of these children as they become young adults.

2.5 Conclusions

Thinking about the future of education involves many conceptual and analytic dimensions. These include the normative and foundational one, namely the purpose or purposes of education. This chapter has identified a range of values placed on education, including instrumental and intrinsic elements. We have identified our own orientation as that of considering education in a broad human development framework, in which education has both instrumental purposes and intrinsic value.

Considering educational futures also, of course, requires that we understand what we mean by education. We have described flow patterns of students and the concepts by

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[44] See Table 6.2 for participation rates in standardized tests and Chapter 6 for some discussion of educational quality and its correlates.

[45] Moving beyond problems of generalization created by time, there are also problems related to generalization across levels of analysis. Woodhall describes a problem associated with scale that occurs when an attempt is made to extrapolate from a marginal analysis (in this case, a current supply/demand relationship) to a large-scale system change with a very different supply/demand relationship (Woodhall 2004: 58). Best known, perhaps, is the difficulty understanding relationships between micro (individual-level) returns to education and whole economy returns to education (analyses at the different levels frequently produce conflicting conclusions and we cannot generalize from one level to the other).

which we understand those. And we have identified the attainment of education by adult populations, the stocks of education, as a critical interest.

Returning to education in a human development context we have considered the close interactions of education with broader demographic, economic, and socio-political systems. And we have noted the great complexity involved in understanding those relationships. Like others before us, that complexity will make our exploration of educational futures difficult. We turn next to thinking about methods and tools with which it is possible to undertake such exploration.

3. Forecasting Education

As in any other issue domain, there are many approaches to discussion of forecasting tools and models focused on global education. It is possible to talk about them in terms of their coverage and aggregation—whether they are country-specific or multi-country; whether they focus on primary education or look also at other levels of education; whether they consider only enrollment levels or also intake and survival patterns; whether they forecast for 10 years or 25 years. It is also possible to talk about them with respect to their concern with, and treatment of, related issue areas—whether they consider demographics and economics explicitly and dynamically in interaction with education; whether they consider primarily the impact of such other issues on education or also look to the implications of education for other issues. It is also possible to talk about tools and models in terms of their basic methodological characteristics—whether they are largely extrapolative of select variables or more broadly structural in their representation of multiple, interacting facets of educational systems; whether they tend primarily to be accounting systems with exogenously (externally) provided assumptions about change or whether they more dynamically represent households, governments and other potential agents in interaction.

The most fundamental distinguishing characteristic is, however, something else—namely the purpose and desired outcome of the use of the tool or model. Most broadly, forecasting tools and models are organized around two purposes. Exploratory tools seek to understand the path of a system. At the simplest extreme, an exploratory tool on education might forecast enrollment rate trends without any consideration of demographic trends, costs, or financial resources. Normative tools explicitly identify a desired future and redirect the path of a system as required to attain or move toward that outcome. Turning again to the simplest extreme, a normative analysis might be purely a mathematical exercise—for example, calculating how much intake and survival rates would need to increase each year between now and 2015 to meet the MDG goal of universal primary education.

This volume combines exploratory and normative purposes. The questions that we seek to address are: (1) What path does the formal global educational system, as a collection of countries, appear to be on as we look forward fifty years? (2) What is an aggressive, but still reasonable acceleration of that path? (3) What might be the broader consequences of such a normative, but attainable acceleration? Given those purposes and questions, and understanding that all models are simplifications of reality and therefore fall short of being ideal tools, what are some of the general characteristics of the "ideal" tool that we might want for such investigation?

3.1 Characteristics of ideal education forecasting models and tools

There is a considerable distance between the characteristics of the simplest possible exploratory and normative education forecasting models and tools and the elements that would characterize an ideal model or tool for this volume. We list below some desirable elements of a tool with a mid-to-long term temporal reach, fully recognizing, as stated previously, that all models will inevitably be less than ideal. We begin with the desirable characteristics of an exploratory model:

- An "accounting system" that keeps track of student flows by education level across all levels and grades and of education attainment in the adult population, with as much detail as possible around elements that vary from one component of a population to another (e.g., sex, age, rural-urban residence, income status, and thnicity)

- Representation of the dynamics that are the immediate drivers of student flows (and hence ultimately of attainment levels), including separate representations of demand and supply dynamics and constraints

    - With respect to demand, the ideal exploratory system represents the dynamics of enrollment patterns (intake/transition and survival) in the context of family circumstances and demographic trends, and includes the ability to forecast costs associated with various enrollment dynamics and demographic patterns

    - With respect to supply, the ideal tool has the capability to estimate the aggregate resource requirements of various enrollment patterns and to determine the likely need for and availability of public, private, and international funds[46]

- Representation not only of demographic and economic impacts and constraints on education, but also representation of education's impact on demography and economic systems, as well as bi-directional feedback loops between education and other aspects of human development systems, such as poverty reduction and the characteristics of socio-political systems[47]

These same elements would characterize an ideal mid to long-range normative forecasting model or tool. However, in addition the ideal normative tool would also include the following:

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[46] Even at this step a tool with desirable characteristics goes beyond the education system to consider impacts on it arising from the demographic and economic context in which it functions

[47] The time lag between initial changes in intake rates and the possibility of impacts from increased education on other aspects of human development systems is the reason we stipulate earlier in this section that these are characteristics we see associated with a forecasting tool with a mid to long-range time frame.

- Specification of points of intervention and an assessment of their reasonableness[48]
- Evaluation of the impacts of the interventions not just on education participation and attainment but also on broader systems (demographic, economic, and socio-political)
- At least some elements of a cost-benefit analysis

This chapter describes the IFs modeling system, which operates within a broad human development framework and includes an integrated education model. The system is useful for both exploratory and normative analyses. However, before presenting the IFs system in some detail and discussing its strengths and weaknesses, we briefly introduce recent major education modeling and forecasting approaches that others have developed. Our brief discussion of other models and tools will highlight the purpose of the model or tool (exploratory, normative, or some combination of the two) and some of the key characteristics of its approach. In Chapter 5 we draw upon the actual forecasts from these tools in comparison with those from IFs.

3.2 Recent education modeling and forecasting approaches

3.2.1 McMahon

McMahon first published *Education and Development: Measuring Social Benefits* in 1999. It describes McMahon's development and implementation of an econometric "interactive macrodynamic model" (McMahon 2001: ix), the purpose of which is exploration of the "total social benefits of education" (McMahon 2001: 179), defined as both the direct and the indirect impacts of primary and secondary education on economic development; on population growth via health and fertility; on democracy, human rights and political stability; on poverty and inequality; on the environment; and on crime.

The book begins with a "base case" or exploratory analysis that assumed the continuation of past education policies and the associated unfolding of education and its impacts. Simulations of two specific normative education policy changes and how they might enhance the extension of education and its impacts move beyond the base case. The first normative scenario is built on a two percentage-point increase in public investment in education as a per cent of GNP; the second normative scenario assumes a 20 percentage-point increase in male and female secondary education enrolment rates (McMahon 2001: 185-86).

The analysis used historical data for the period 1965-1995, and its forecasts extended to 2035; the countries included (78) were those for which consistent data were available on all key variables. The model incorporated empirically tested varying time lags between

[48] In an ideal system, the points of intervention are sufficiently "actionable" that policy makers can readily discern implications for policy choices and implementation strategies. However, even more abstractly defined interventions (e.g., "focusing on increasing survival rates") can be helpful in providing a course for improved outcomes.

changes in primary and secondary education and changes in other components of development; it included bi-directional feedback loops; its mathematical equations incorporated the concept of long-run equilibrium relationships; and its parameters were estimated from cross-sectional analyses examining relationships between variables across many countries at one point in time. While the model does little to help us understand student flows (for example, it uses only the gross enrollment rate to represent students), it considered both primary and secondary education and it played an extraordinary role in placing the broad direct and indirect social impacts of education at the center of analysis[49] and in attempting to calculate a net return associated with extending education participation.

3.2.2 Delamonica, Mehrotra and Vandemoortele

In a study published by UNICEF, Delamonica, Mehrotra, and Vandemortele (2001) projected the incremental costs associated with moving from the level of each developing country's net primary enrollment rate in 2000 to universal primary education for all (128) developing countries by 2015. The project was undertaken in order to update global and regional cost estimates for the period from 2000 to 2015, in distinction from cost estimates based on enrollment patterns in the early to mid 1990s (2001:2). The purpose and approach were normative.

Delamonica et al. used population projections from the UN Population Division as a basis for their cost projections. They then assumed the increases needed to bring each country's net enrollment rate to 100% by 2015 would uniformly occur in a linear fashion. They also made the uniform assumption that all countries would absorb any incremental costs arising from population trends at constant enrollment rates (i.e., that the country could find the resources to educate the then-current proportion of its population of school-age children, no matter what the size of that school-age population would be over the 2000-2015 period, or its relative size in the overall population). Their methodology held GDP per capita constant for the period from 2000 to 2015.

Delamonica et al. estimated costs in four discrete categories: (1) recurrent expenditures related to net enrollment rate increases; (2) quality improvements as reflected by an adjustment in unit costs to allow 15% of recurrent costs for non-wage items (e.g., instructional materials) without a reduction in teacher salaries; (3) reducing pupil-teacher ratios to an average of 40; and (4) capital costs for those countries where the increase in students from the expanded net enrollment ratio would be greater than the decrease in the school population from trends in the decline of expected births. Items (1) and (4) were added to the costs as increases in the net enrollment ratio brought new students into the school system, whereas items (2) and (3) were added across the school population in the first year of estimated costs (2001:12-13). While the only dynamic element of the model

[49] It is notable that McMahon refused to follow economists' more frequent convention of referring to "market" and "non-market" returns, as if the other returns were somehow of lesser importance. By instead referring to "social returns," and including economic development among them, McMahon was applying econometric analysis in a human development framework.

was its use of school-age population projections as the basis for estimating costs of a linear increase to UPE, the model provided a framework for considering various cost components (including quality improvements and capital outlays) and overall resource requirements to be met domestically through economic growth or reallocation of government funds or by international donors.

3.2.3 Bruns, Mingat and Rakotomalala

Bruns, Mingat, and Rakotomalala (2003) authored a seminal normative study entitled *Achieving Universal Primary Education by 2015: A Chance for Every Child*. The study utilized a simulation model developed by Rakotomalala and subsequently adopted for use by the countries selected to participate in the Education for All Fast-Track Partnership sponsored by the World Bank, UNESCO, UNICEF, and the regional development banks.

The study focused on a detailed analysis of the 47 low-income countries that were furthest in 2000 from the MDG goal of universal primary education, with an estimate added for Afghanistan (2002: 20). The study focused on estimating, under certain normative targets or benchmarks, the following: (1) what it would cost to achieve the goals in terms of incremental funding between 2000 and 2015;[50] (2) the portion of that funding that developing countries could afford; and (3) where and how much international assistance would be needed under the assumption of a 5 percent economic growth rate applied across all countries.

World Bank task teams collected enrollment data for the then most-recent year (usually 2000) directly from the education ministries of the 47 low-income countries included in the study. UNESCO published data (usually for 1997) were used when more recent data were not available from the education ministries. Population data were from the United Nations/World Bank population database used by the World Bank (2003: 39, 41).

The study began with an exploratory component, which was an analysis of the characteristics of the low-income countries that were making accelerated progress toward the goals in 2000 compared to countries that were not (2003: 8). From this empirical analysis, a "best practices" or normative framework was created to provide guidelines for policy levers to achieve universal primary completion at "minimum adequate cost" (2003: 109). The framework included benchmarks or targets for quality improvements, for efficiency improvements, and for domestic resource mobilization (2003: 82). The financing benchmarks included a cap on the portion of educational expenditures from government revenues going to primary education in order to avoid stripping resources from secondary and tertiary education. The various benchmarks were combined in different ways to produce alternative scenarios and incremental costs (including estimates of gaps in domestic funding capacities) were generated for each scenario. The approach

[50] Like the study undertaken by Delamonica et al., this study focused on costs associated with achieving a normative target. Unlike the Delamonica study, however, Bruns et al. focused on incremental costs associated both with rate changes and with population dynamics, and then compared these total incremental costs within a resource framework that, although simple in its assumptions, considered an impact from economic growth.

connected education to broader systems via population projections, benchmarks for funding and resource mobilization, and the inclusion of an economic growth rate assumption (albeit a single assumption for all countries). The model also took a step towards inclusion of enrollment dynamics by measuring costs associated with a targeted upper limit on repetition rates and a targeted completion rate rather than a single enrollment rate alone.

3.2.4 Clemens

In 2004 the Center for Global Development published a paper prepared by Michael Clemens for the Millennium Project Task Force on Education and Gender Equality. Clemens' focus was on understanding if there is a typical transition pathway from low to high primary schooling for most developing countries, and to what degree the transition can be accelerated by government policies. He raised these questions in the context of exploring the feasibility of meeting the MDG goal of universal primary education by 2015; his approach was primarily exploratory, but included some elements of normative analysis.

To explore these questions, Clemens developed an aggregated flow model that focused on transition speeds as measured by overall net primary enrollment rates, using administrative data compiled by UNESCO field offices from school registers for the years from 1960-2000 for over 100 developing countries. From these data, Clemens produced S-curve extrapolations of the number of years, based on the typical developing country experience between 1960 and 2000, that it will take individual countries and multi-country regions to reach 90 percent net primary enrollment (2004:42, 52). Clemens used the same UNESCO data to model a typical "gender transition speed" in primary and secondary enrollment.

Clemens explored three other dimensions in his effort to evaluate the feasibility of achieving universal primary education by 2015: (1) he compared the 1960-2000 transition rates in developing countries with the rates of today's rich countries during their earlier transition to universal primary education; (2) he estimated the necessary transition speeds if today's developing countries are to meet the 2015 goal of universal primary education (2004: 55); and (3) he used cross-country data to explore relationships between education transition rates and a number of social, economic, and education policy variables at a single point in time (1980) (2004: 45). Clemens also reviewed an extensive body of literature on drivers of education participation, pointing out the importance of the relationship between household income and parental level of education in family schooling decisions (e.g., demand factors).

While Clemens' approach did not include enrollment dynamics or costs, it called attention to critically important aspects of the education transition: (1) the importance of policy attention not just to education availability and supply, but also to circumstances that influence demand for education; (2) the importance of placing the transition to mass primary education in developing countries in a longer historical context in order to set aggressive but realistic goals with respect to time-frames; and (2) the need to take individual countries' circumstances into account in goal setting.

3.2.5 Wils, O'Connor and Somerville

An exploratory model developed by Wils, O'Connor, and Somerville, and published in a 2005 paper written by Wils, Carrol, and Barrow for the Education Policy and Data Center (EPDC)[51] focuses on the concept of growth paths toward universal primary education. The context, as it was with Clemens' study, is an exploration of the feasibility of meeting the MDG goal of universal primary education by 2015 (Wils, O'Connor, and Somerville 2005).

This model deals exclusively with student flows at the primary level, and operates by extrapolation of flow rates without regard to population dynamics or resource requirements and availability. However, it advances the conceptualization and implementation of flow dynamics in modeling by using and comparing two measures of primary education coverage, entry and completion, rather than using a single enrollment rate. Individual average entry and completion rate patterns are estimated for each of 70 low-income countries for the historical period from 1950-2000, and then projected forward in S-shaped extrapolations.[52] The descriptor used by Wils et al. for the trajectories of the paths is the number of years it will take each country to go from a primary completion rate of 10 percent to a primary completion rate of 90 percent, represented as T10-90 (2005:10), and considerable variability in growth patterns is demonstrated by their approach. In an exception to the statement in the introduction to this section that we will focus here on purposes and methodology of models rather than findings, we note that analysis by Wils, Carrol, and Barrows (in contrast to that of Clemens) does not suggest that the global focus on education in recent decades has coincided with a noticeable acceleration in long-term entry and completion growth rates (2005: 28-31).

A significant difference between this and earlier models is its use of household surveys and population censuses (rather than administrative data) as the preferred data source (2005: 2).[53] Another difference is its use of a "backward looking" lens to establish historical entry and completion rates. The authors divided the population of 15-65 year olds participating in the household surveys between 1999-2001 into one-year age cohorts. They used the percentage of each cohort that was 14 years old in each year between 1950 and 2000 that reported at least some primary schooling in order to estimate primary entry rates for each of those years. They applied a similar methodology, using 19 as the age to estimate primary completion rates for the same historical period. The use of household data also allowed identification of out-of-school children on a variety of dimensions as

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[51] The Education Policy and Data Center was established in 2004 to contribute to global education policy and planning through data and analysis. It is part of the Academy for Educational Development (AED), and is funded in part by both AED and USAID (EPDC 2007: 6).

[52] S-curves fit a broad scale social changes, because change processes often start slowly, then build rapidly in a middle range, and slow as they approach a limit (like 100 percent).

[53] Most typically these are the USAID-sponsored Demographic and Health Surveys (DHS) and the UNICEF-sponsored Multiple Indicators Cluster Surveys (MICS) (Wils et al, 2005: 2).

well as analyses of inequality, such as entry and completion gaps between urban males and rural females (2005: 39).

3.2.6 Lutz, Goujon and Wils

A paper by Lutz, Goujon, and Wils, also published by the Education Policy and Data Center in 2005, elaborated the application of what is described as a "multi-state demographic method" to forecast the extent of educational attainment among adult populations.[54] The model used in this paper is primarily exploratory but includes some normative aspects, and it differs from the previously-discussed models and tools in a number of important ways. First, its focus is not education system flows, but rather the stock of human capital as reflected by the educational attainments of a population by age and sex across four categories: no education, primary education, secondary education, and tertiary education.[55] Second, other than purely extrapolative enrollment trend projections produced by UNESCO in the 1980s and 1990s,[56] it is the first model or tool of which we are aware that looks across all levels of formal education. Third, by focusing on education levels in the adult population—and further, on education levels by age and sex—it facilitates exploration of the relationships between levels of education in a population and other human development systems (e.g., fertility, life expectancy, and economic growth).

The developers initialized the model with UN population data by age and sex extending back to 1937, and produced visual representations of population characteristics in population pyramids (see Chapter 2, Figure 2.3, for examples of these kinds of pyramids) of the current population of three pilot countries (Guinea, Zambia, and Nicaragua) by age and sex in five year intervals. Upon these pyramids, they superimposed educational attainment levels from USAID Demographic and Health Surveys. They then also estimated fertility levels and infant and child mortality levels by mother's education from the Demographic and Health Surveys. Moving forward, the population projections reflect impacts of changes in educational attainment, with both fertility and child mortality decreasing as education increases. This is the first example of which we are

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[54] Demographic multi-state projection models were first developed at the International Institute for Applied Systems Analysis (IIASA) in the 1970s to reflect and project the distribution of various characteristics or "states" across a population (or sub-population) segmented by age and by sex.

[55] The definition of levels of education attainment used by Lutz et al. (2005:16) differs from the definitions used by many other systems. Lutz et al. define "no education" as never having gone to school or completing less than one year of primary education. They place people in the category of primary education if they complete at least one year of primary school; in the category of secondary education if they ever entered secondary school, and in the category of higher education if they ever entered tertiary education after completion of secondary school. The use of these definitions produces a higher profile of education attainment than the use of completion measures would, and needs to be taken into account when comparing their results with those of some other models and analyses, including IFs.

[56] Although purely extrapolative, these earlier UNESCO projections were important and ambitious projects, particularly because they included all levels of formal education. One study released in 1989 provided trends and projections of enrolment by level of education and by age for the period 1960-2025 (UNESCO 1989), and another in 1993 provided updated projections for the same span of years (UNESCO 1993).

aware of a model with a bi-directional feedback loop between education and demography.

However, at least at the time the paper was written, the model used stylized rather than dynamically formulated assumptions to advance the pyramids to 2030 with respect to initial entry rates and transition rates between one level of education and the next. The authors created three scenarios, using differing stylized or normative assumptions as follows: (1) constant (current) entry and transition rates; (2) trend entry and transition rates; and (3) MDG goal fulfilling entry rates (with constant or trend transition rates).

The IIASA model and its pyramidal displays clearly illustrate that education is a long-term investment by displaying the time lag between increases in educational attainment among young members of a population and increases in the overall structure and pattern of "human capital stock" in the total population. Further, the authors point out that by using the distribution of educational attainment (rather than mean years of schooling) as an indicator of human capital, it becomes possible to explore relationships between age, sex, levels of education, and other variables (e.g., health, poverty, and economic growth). They also point to the possibility of sub-national forecasts, as the methodology can be applied to any population that is clearly defined and for which there is the necessary information by age, sex, and level of education (2005:33). Continuing work is underway at IIASA to extend the model to a large number of countries (2005:37) and to further exploration of relationships between age, sex, levels of education, and other variables, one example is a a backward-reconstruction of populations by age, sex, and level of educational attainment for 120 countries for the period 1970-2000 (IIASA 2007).

3.2.7 Hilderink

A 2007 working paper authored by Hilderink (Netherlands' Ministry of Health and Environment) described an exploratory education module being developed and embedded in the established PHOENIX dynamic population and health model (Hilderink 2007). At the time of the paper, the education module used enrollment rates as the single measure of education flows; however, the plan is to use intake and drop-out rates in a subsequent phase. Education attainment levels and literacy are other components of the model. Geographic regions are the unit of analysis, and the model extends across primary, secondary, and tertiary levels.

The model was initialized with education data from UIS and economic data from the World Bank's World Development Indicators. Simulations for the period 1950-2000 were being used to calibrate and validate the model; the paper provided forecasts for the period 2000-2025, but mentioned a simulation period extending to 2050. The model includes bi-directional connections between education levels, mortality, and fertility. It also introduces the concept of education demand and education supply, by dynamically connecting both enrollment rates and education expenditures to GDP per capita, with the assumption that demand and supply are equal. While still in a developmental stage, the model is being designed as a comprehensive tool for forecasting education dynamics in conjunction with a number of connections to broader systems.

3.2.8 Wils, Barrow, Oliver, Chaluda, Goodfriend, Kim, and Sylla

In this EPDC background paper prepared for the Education for All Global Monitoring Report, Wils et al described and presented initial results from ProEnrol, an exploratory cohort projection model under development by the Education Policy and Data Center. The background paper, entitled "School Attendance and Enrolment: Global trends and projections," also included projections of primary and general secondary enrollment rates, student headcounts, and gender parity indices, under the assumption of a continuation of current education policies, using the ProEnrol model.

Cohort projection models focus on the grade-by-grade dynamics of student flows. Countries often use them to meet education system operational planning needs by projecting numbers of students by grade and level and the school resources therefore needed. Individual countries may also use them to understand the dynamics of their student flows and to assess education system functioning with respect to these dynamics (e.g., entry, promotion, repetition, drop-out, re-entry, survival, and completion).[57]

However, with respect to ProEnrol, the background paper noted:

> The Cohort projection model developed by the EPDC is the first effort to make cohort projections in an international, global series and is done here on an experimental basis. The intention of the GMR [Global Monitoring Report] at this point is to test this method (EPDC 2007: 69).

The background paper included projections of primary net enrollment rates and student headcounts for 60 countries using ProEnrol, projections of primary gross enrollment rates and student headcounts for 129 countries using ProEnrol, and projections of general secondary gross enrollment rates and student headcounts for 82 countries (EPDC 2007: 70). The EPDC made projections for two points in time, 2015 and 2030, and calculated a gender parity index for each projected series.

ProEnrol was initialized with historical enrollment data (1999 forward) from UIS on pupils by grade (female and both sexes combined) at the primary and secondary levels. It used United Nations medium population projections for the period 2000-2025 to calculate gross and net entering school populations by multiplying the projected population of school entry age children by projected gross and net entry rates. Extrapolations from past trends in intake rates were used to project future intake rates, and country-specific constant values (equal

[57] Porta and Wils described and compared four such detailed education system planning tools in a 2006 EPDC paper: (1) the World Bank tool associated with the Bruns, Mingat, and Rakotomalala project described earlier in this chapter; (2) the UNESCO EPSSim model; (3) the MNF model used by Nicaragua and Guatemala; and (4) the EPDC DemoEd model (Porta and Wils 2006).

to the most recent year data were available) were used for promotion and repetition rates.[58] [59]

The model's only linkage with systems outside education, at least at the time of the background paper, was its use of UN population projections of school-entry age children as a foundation for projecting school enrollments via the application of entry rates. It neither calculated resource requirements[60] nor compared potential enrollments with estimates of resource availability. Neither did it flow forward and impact projections of fertility rates and hence projections of school entry-age populations in 2015 or 2030 (though some effect of increased education can hardly fail to be already included, at least implicitly, in the UN population projections). Perhaps more importantly at this stage, a protocol needs to be developed for projecting reasonable changes in promotion and repetition rates over time since they are flow components subject to dynamic changes. Nevertheless, ProEnrol has made an extremely important contribution by developing and testing a significant representation of a grade-by-grade cohort projection methodology on a global scale.

3.3 Modeling education in IFs

Turning to IFs, as stated previously, its particular strengths derive in combination from its extended time frame, its extensive geographic coverage with capability to flexibly group countries for analysis and display, and its dynamic integration of multiple human systems. In addition, it is the only developed global education model we know of that represents all three levels of formal education in student flows or cohorts, and the only one that represents lower and upper secondary education separately. IFs can be used both for exploratory analyses of dynamic trends and patterns and for the creation of normative scenarios and explorations of their respective impacts.

In the sections that follow, we first provide a brief overview of the broader IFs system of models and then present the major components of the IFs education model, once again attempting to understand strengths and weaknesses in comparison with the characteristics of an ideal education forecasting tool. Complete documentation of the IFs modeling system, including the education model, is available at www.ifs.du.edu. The model itself is also available there to users in both on-line and downloadable forms.

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[58] The report noted the model could also have used trend values or user-set values for promotion and repetition rates. However, trend rates were not used in the report because of the extreme projected values they sometimes produced (EPDC 2007: 77).

[59] The report also noted that grade-by-grade specific repetition rates were used when data at that level of detail were available; when they were not the average repetition rate was applied to each grade (EPDC 2007: 77)

[60] However, it would appear that component might rather easily be added since the model calculates student headcounts, and per-student costs are widely available from UIS.

3.3.1 The broader IFs modeling system

International Futures (IFs) is a large-scale, long-term, integrated global modeling system. It represents demographic, economic, energy, agricultural, socio-political, and environmental subsystems for 183 countries interacting in the global system.[61] The central purpose of IFs is to facilitate exploration of global futures through alternative scenarios.

The goals that motivated the design of IFs fall generally into three categories: human development, social fairness and security, and environmental sustainability (see Table 3.1). Across these domains, the project especially looks to Sen (1999) for his emphasis on freedom and individual development, Rawls (1971) for his emphasis on fairness within society, and Brundtland (UN 1987) for her seminal definition of sustainability. In combination, these emphases provide a philosophical framework for exploration of human beings as individuals, of human beings with each other, and of human beings with the environment.

Humans as Individuals	Personal Development/Freedom
Humans with Each Other	Peace and Security/Social Fairness
Humans with the Environment	Sustainable Material Well-Being

Table 3.1 The human systems and issues of interest to the IFs project

Fundamentally, IFs is a thinking tool, allowing variable time horizons up to 100 years, for exploring human leverage with respect to pursuit of key goals in the face of great uncertainty. IFs assists with:

- Understanding the state of the world and the future we may see
    - Identifying tensions and inconsistencies that suggest political risk or economic risk in the near and middle term (a "watch list" functionality)
    - Exploring longer-term trends and considering where they might be taking us
    - Learning about the dynamics of global systems
- Thinking about the future we want to see
    - Clarifying goals/priorities
    - Developing alternative scenarios (if-then statements) about the future
    - Investigating the leverage that humans may have in shaping the future

[61] For introduction to the character and use of the model see Hughes and Hillebrand (2006).

Human systems fundamentally involve agents (economists often represent them as individuals in households or firms; political scientists add governments) interacting with each other in various structures (economists focus on markets; political scientists look to action-reaction systems and international regimes; sociologists add societies and demographic structures; anthropologists focus on cultures; physical scientists extend the reach to ecosystems). In general scientists seek to understand the co-creation and evolution of agent behavior and structural characteristics.

IFs attempts to capture some of that richness. It is a structure-based (with extensive representation of underlying accounting systems such as demographic structures and the exchanges of goods, services, and finance), agent-class driven (so as to provide a basis for representing change), dynamic modeling system. That is, it tries to represent typical behavior patterns of major agent-classes (households, governments, firms) interacting in a variety of global structures (demographic, economic, social, and environmental). The system draws upon standard approaches to modeling specific issue areas whenever possible, extending those as necessary and integrating them across issue areas. For instance, the demographic model uses the typical "cohort-component" representation, tracking country-specific populations over time by age and sex (extended by education as discussed later). Within that structural or accounting framework the model represents the fertility decisions of households (influenced by income and education) as well as mortality and migration patterns.

IFs is heavily data-based, as well as being rooted in the theory of various disciplines and sub-specializations. Data come heavily from the various member organizations of the United Nations family, but the system also uses other sources extensively. The database underlying IFs, and integrated with the system for use by others, includes data for 183 countries over as much of the period since 1960 as possible. The model system itself[62] runs in annual time steps from its initial year (currently 2005), while the model interface facilitates user interventions flexibly across time, issue area, and geography. Figure 3.1 shows the major conceptual blocks of the International Futures system. The elements of the technology block are, in fact, scattered throughout the model. The named linkages between blocks and the linkages themselves are a small illustrative sub-set, not an exhaustive listing.

[62] More technically, the model structure is recursive (it computes equations sequentially in each time step without simultaneous solution). It combines features of systems dynamics (notably the accounting structures with careful attention to both flows and stocks) and econometrics (using estimated equations for the dynamic behavior of the agent classes).

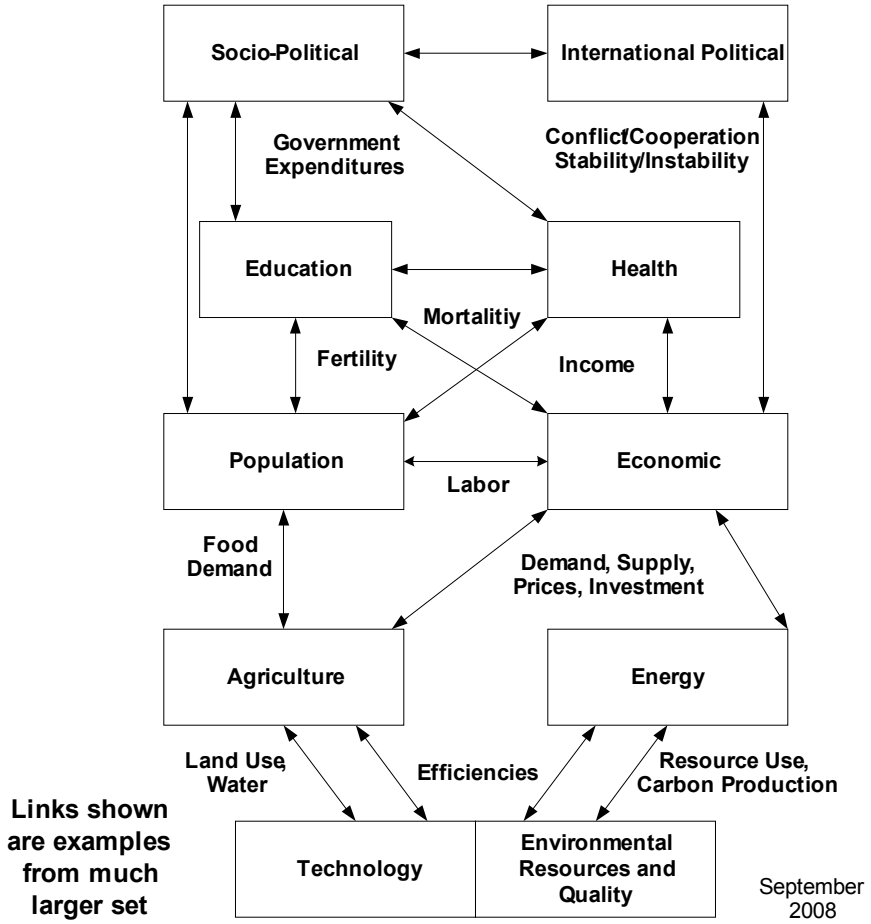

Figure 3.1 The major modules of the IFs modeling system and example connections

The two models within the IFs system that interact mostly closely with the education model are the population and economic models. Some of the key characteristics of the population model are that it:

- represents 22 age-sex cohorts to age 100+ in a standard cohort-component structure (but computationally spreads the 5-year cohorts initially to 1-year cohorts and calculates change in 1-year time steps)
- calculates change in cohort-specific fertility of households in response to income, income distribution, education levels, and contraception use
- calculates change in mortality rates in response to income, income distribution, education, and assumptions about technological change affecting mortality
- separately represents the evolution of HIV infection rates and deaths from AIDS
- computes average life expectancy at birth, literacy rate, and overall measures of human development (HDI)
- represents migration, which ties to flows of remittances

Some of the most important characteristics of the economic model are that it:

- represents the economy in six sectors: agriculture, materials, energy, industry, services, and information/communications technology or ICT (other sectors could

be configured because the system uses raw data from the Global Trade and Analysis (GTAP) project with 57 sectors in Release 6)
- computes and uses input-output matrices that change dynamically with development level
- is a general equilibrium-seeking model that does not assume exact equilibrium will exist in any given year; rather it uses inventories as buffer stocks and to provide price signals so that the model chases equilibrium over time
- contains a Cobb-Douglas production function that (following insights of Solow and Romer) endogenously represents contributions to growth in multifactor productivity from human capital (education and health), social capital and governance, physical and natural capital (infrastructure and energy prices), and knowledge development and diffusion (R&D and economic integration with the outside world)
- uses a Linear Expenditure System to represent changing consumption patterns
- utilizes a "pooled" rather than bilateral trade approach for international trade
- has been imbedded in a social accounting matrix (SAM) envelope that ties economic production and consumption to representation of intra-actor financial flows (it represents, however, only the skilled and unskilled households of the GTAP project)

The socio-political model also interacts quite closely with the education model (as well as with the economic and demographic models. Some of its relevant features are that it:

- represents fiscal policy through taxing and spending decisions
- shows six categories of government spending: military, health, education, R&D, foreign aid, and a residual category
- represents changes in social conditions of individuals (like fertility rates, literacy levels or poverty), attitudes of individuals (such as the level of materialism/post-materialism of a society from the World Values Survey), and the social organization of people (such as the status of women)
- represents the evolution of democracy
- represents the prospects for state instability or failure

Although initially developed as an educational tool, IFs is increasingly being used in research and policy analysis. It was a core component of a project exploring the New Economy sponsored by the European Commission in the TERRA project. Forecasts from IFs supported Project 2020 (*Mapping the Global Future*) of the National Intelligence Council (US NIC 2004) and supported the NIC's subsequent study of Global Trends 2025. IFs also provided driver forecasts and some integrating analysis for the *Global Environment Outlook-4* of the United Nations Environment Program (2008).

The menu-drive interface of the International Futures software system allows display of history since 1960 in combination with results from the base case and from alternative scenarios over time horizons from 2005 through 2100. It provides tables, standard graphical formats, and a basic Geographic Information System (GIS) or mapping

capability. It also provides specialized display formats, such as age-sex and age-sex-education cohort structures and social accounting matrices.

The system facilitates scenario development and policy analysis via a "scenario-tree" that simplifies changes in framing assumptions and agent-class interventions. Users can save scenarios for development and refinement over time, including the normative educational scenario that subsequent chapters analyze. Standard framing scenarios, such as those from the United Nations Environmental Programme's *Global Environmental Outlook-4*, are available with the model for others to explore and potentially develop further.

3.3.2 Overview of the education model

The education model of IFs simulates patterns of education participation and attainment in 183 countries over a long time horizon under alternative assumptions about uncertainties and interventions (Irfan 2008). Its purpose is to serve as a generalized thinking and analysis tool for educational futures within a broader human development context.

At the accounting level, the major flows within the model (see Table 3.2) are student and budgetary flows, while the major stock is that of gender-differentiated educational attainment of the adult population. The model structurally represents the formal education system from primary through tertiary levels. It further divides secondary level students into lower and upper secondary levels and into general and vocational categories within each of the levels. It tracks students by grade and by gender.

Education Model Aspect	Key Elements
Accounting System	• flows of students through the grades • flows of public spending into education system • stocks of adults with different levels of educational attainment
Key Dynamics	• intake/transition rate • survival rate • per student cost
Dominant Relationships and Algorithms	• demand for intake positively correlated with household income • survival rate (dropout rate) correlated with income • intake and survival together determine enrollment • per student cost correlated with per capita income • supply of education funding constrained by budget availability • school graduates and demographics determine levels of education attainment in the youth and adult populations

Table 3.2 Foundational elements of the education model

Intake (or transition to a higher educational level) and persistence (or survival) rates are the two variables that most immediately determine the dynamics of student participation and progression through the educational system. In the larger dynamics, however, the costs per student are a third key variable in helping understand the balance between the demand for education and its availability or supply.

Thus the dominant or most important relationships in the model are those that determine the intake/transition and survival rates and the costs of education per student. At the same time, however, the education model must integrate the accounting systems and the dynamics. This requires a number of algorithmic structures (logical procedures for integrating calculations and maintaining accounting systems), as well as equations. One such algorithm manages student progression through the grades. On the budgetary side, another balances funding demand and availability to shape the actual enrollment and spending levels. And still another addresses the flows of graduates into and through the adult population. The discussion below provides some information on those processes. Again, the interested reader is referred to www.ifs.du.edu for full documentation.

As emphasized repeatedly in this volume education is in reality an integrated part of the larger human development system, and the education model in IFs is similarly an integral component of the IFs system of models (see Figure 3.2). The relationships of the education model and other components of IFs are bi-directional. For example, during each year of simulation, the IFs cohort-specific demographic model provides the school age population to the education module. In turn, the education model feeds its calculations of educational attainment to the population model's determination of women's fertility**.** Similarly, the broader economic and socio-political systems provide funding for education, and levels of educational attainment affect economic productivity and growth, and therefore also education spending. Figure 3.2 shows a small portion of the complexity in such relationships.

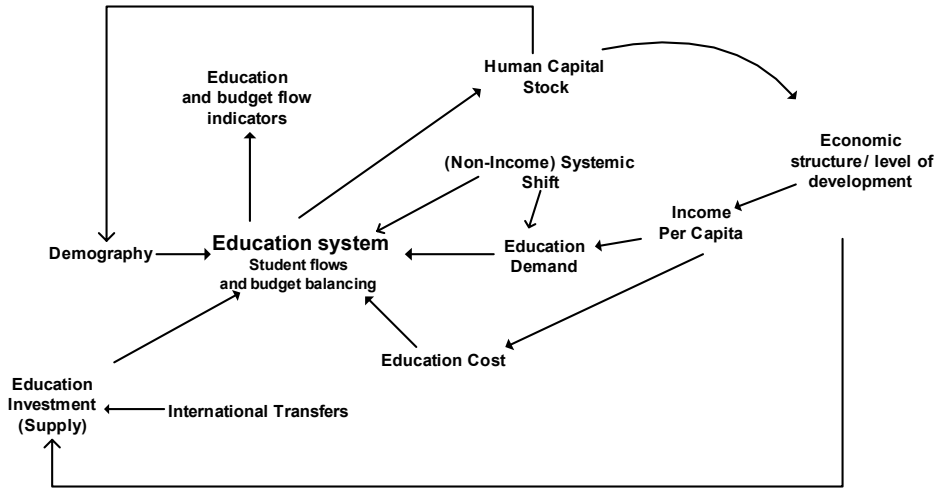

Figure 3.2 Selected relationships of education to broader human development

3.3.3 Student flows

A conceptual description of student flows begins with entry in the first grade of primary school. At the end of each year, students either progress to the next grade, repeat the current grade, or drop-out. Eventually some proportion of the entering cohort reaches the beginning of the final grade; that proportion constitutes the "survival rate" as discussed earlier in Chapter 2. Further, of those who persist to the beginning of the last grade, most subsequently graduate and become eligible to continue to the lower secondary level. The "transition rate" identifies the portion of those completing the primary level that continue as new entrants into the lower secondary level,[63] following which a new pattern of grade-level progression, repetition, and drop-out ensues. Conceptually, similar flows (albeit at different rates) take place at the upper secondary level and at the tertiary level.

IFs accounts for education participation by simulating gender-specific grade-by-grade student flows, using country-specific entry ages and years of schooling at each level. We focus on intake rates[64] and survival rates, and calculate enrollment rates as the combined result of those two variables. This allows us to simulate the dynamic components of enrollment (entry and progression) since changes in enrollment rates are the result of changes in either (or both) intake and survival. This approach provides more useful information than a focus on enrollment rates, because the same enrollment rate might result from different combinations of intake and survival rates. It also provides points for simulating interventions that correspond with the actual dynamics of enrollment.

Before explaining the dynamic formulation for the forecasting of intake rates in the IFs education model, it is important for us to define and describe a unique intake concept that we developed and use. The concept, which we call "adjusted primary net intake," sums the intake rates of children who are precisely of a country's official school entry age with those of children one year over and one year under that age. We are able to do this because UIS provides data not only on gross and net intake rates at the primary level,[65] but also on the proportion who are one year younger or older than official entry age and the proportion who are two or more years younger or older.

In developing countries the differences between gross and net intake rates are often great. However, as is strikingly evident from Table 3.3, far more entering children are just one year over or under the system-defined entry ages than are two or more years older or younger. Further, historical data show that such an entry pattern of children one year over or under the designated entry age often persists indefinitely, even as the rates of children two or more years away from the system-defined entry age frequently spike when the education transition first speeds up, and then subsequently decline. Table 3.3. shows that in sub-Saharan Africa, the region with the lowest of-age intake rate and the

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[63] Technically, the rate is calculated as the proportion of those in the last primary grade who enter the lower secondary level the following year.

[64] At the lower and upper secondary levels the salient indicator is transition rates.

[65] See Chapter 2 for definitions of basic education terminology.

highest intake rate of children two or more years over or under that age, considerably more entering children are just one year older or younger than the official entry age than are two or more years older or younger.

	Of-Age	Overage 1 Year	Underage 1 Year	Overage or Underage 2 Plus Years
Arab States	62.9	9.4	17.7	6.6
Central & Eastern Europe	73.9	12.0	9.0	1.5
Central Asia	67.0	17.1	19.7	6.3
East Asia & Pacific	66.5	17.8	11.6	10.2
Latin America & Caribbean	69.6	16.7	14.4	7.6
North America and Europe	78.9	16.4	1.8	2.2
South and West Asia	72.2	23.3	1.6	17.4
Sub-Saharan Africa	49.0	25.2	10.6	18.5

Table 3.3 Primary intake rates by age categories and UNESCO region
Source: UIS 2005 data (un-weighted country averages)

Were our focus to be only on entry of precisely of-age students, we would significantly distort our mental image of education in developing countries and their evolving education systems. Hence, in place of the conventional net intake measure, we simulate an "adjusted net intake rate," which is the intake rate of children at the system-defined entry age plus the children one year above or below that age. The difference between the adjusted net intake rate and the gross intake rate then becomes the indicator of divergence from age-appropriate universal primary intake. In our model, simulated primary gross entry rates gradually converge towards the adjusted net intake rate as more students enter "on time" and the pool of potential late entrants diminishes.

We turn now to the dynamic formulation for the forecasting of intake rates, which begins with the relationship between GDP per capita and adjusted net intake at the primary level (see Figure 3.3).[66] Such cross-sectional representations, looking at relationships between variables across countries at a given time point, help us understand something about the typical developmental patterns of countries globally and thus give insight also into likely longitudinal dynamics.[67] It is important to emphasize, however, that low correlations suggest much room for extended analysis of potential dynamics for countries (to which we will return).

Clearly there is a significant tendency for primary intake rates to increase with GDP per capita, particularly at lower levels of GDP per capita (below about $5,000 at purchasing power parity). This relationship reflects, in part, changing economic structures and demand for the skills acquired through education, as well as the growing ability of richer societies to provide education.

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[66] IFs generates all such relationships for males and females separately in order to capture sex-related variations in education participation patterns vis-à-vis GDP per capita.

[67] See McMahon (1999: 13-14) on the manner in which cross-sectional analysis helps represent patterns of long-term change.

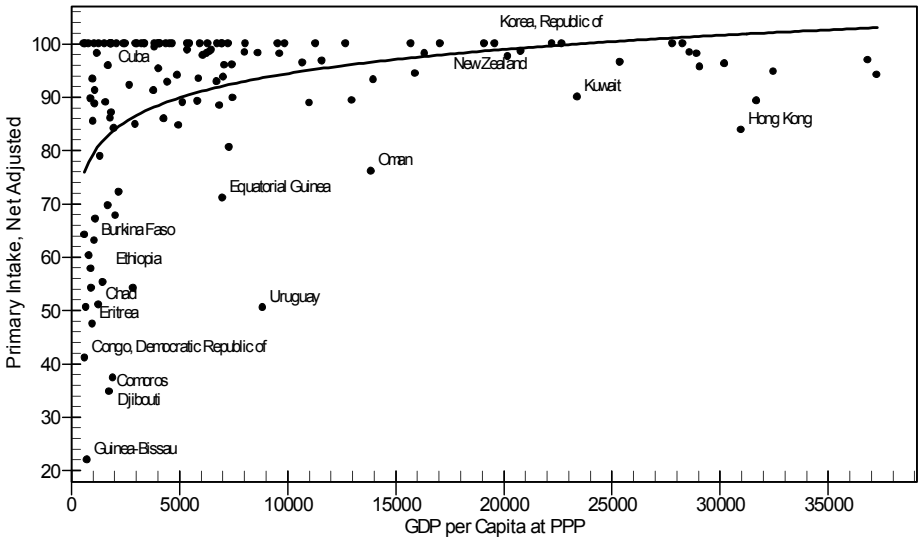

Figure 3.3 The relationship of female adjusted net primary intake and GDP per capita
Source: IFs 6.03
Note: R-squared=0.19; most recent data used (mostly 2005)

It is obvious from Figure 3.3, however, that much more than GDP per capita influences intake rates. We know, for instance, that parental education is a key determinant of intake rates (Clemens 2004: 4) and the omission of its explicit treatment from the IFs formulation for intake is a weakness (adding the percentage of adult women with secondary education to the formulation with GDP per capita raises the R-squared to 0.25).

Yet much more than parental education is involved. Geographic factors, ethnic and religious patterns, and cultural traditions influence intake rates, helping to create country-specific and region-specific historic path dependencies of great importance. The IFs formulation recognizes those collectively by computing the differences between the formulation with GDP per capita and the country-specific initial conditions for intake and only slowly converging country-specific patterns to the general tendency.[68]

It is important also to recognize that the general cross-sectional pattern of relationship itself changes over time. Figure 3.4 shows the "systemic shift" upward of intake rates for males in relation to GDP per capita during the 1990s, reflecting the additional emphasis that individuals and governments have placed on education in recent years regardless of income levels. It seems reasonable to conclude that the greater emphasis on education in recent years has an ideational component, not solely a material one.

[68] The length of such convergence periods is specific to each set of relationships. The typical length is between 30-100 years.

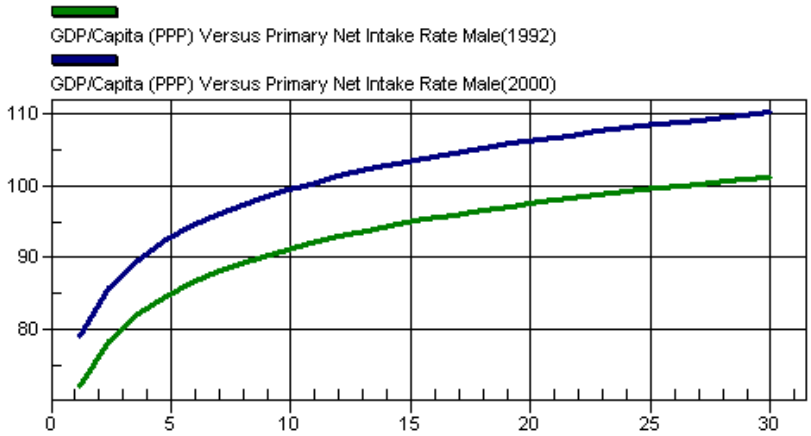

Figure 3.4 The changing relationship of male adjusted net primary intake and GDP per capita
Source: IFs 6.03

More generally, the education model uses this constellation of elements (GDP per capita; historic uniqueness of countries and their movement toward convergence over an extended time-frame; and the representation of systemically shifting patterns) in its basic formulations for intake/transition and survival rates. On top of those formulations, used in exploratory analysis, the model also makes it possible for the user to target growth rates for more normative analysis, for instance by specifying a two percentage point annual increase of intake rates across a forecast horizon. Chapters 6-8 are based on such normative use of the model.

The accounting and algorithmic elements of student flows are also important and Figure 3.5 helps convey those by comparing the data for grade-by-grade enrollment in Bangladesh in 1988 with the simulated grade-by-grade pattern that IFs fits to such flows in initial and subsequent years. Our grade-by-grade student flow model uses two significant simplifying assumptions in its calculations and forecasts. The first is the assumption that new entrants constitute the total enrollment of primary grade 1 (there are no repeaters in an entering cohort), and the second is that we can use an average country-specific drop-out rate (the difference between intake and survival) across all primary grades. The first assumption results, other things being equal, in under-representing grade 1 primary enrollment by the first-year repetition rate, which as we saw in Chapter 2 can be substantial.[69] On the other hand, the assumption of a constant drop-out rate across all grades tends to over-state enrollment. The reason is that 1st year drop-out rates are typically higher than the drop-out rates in subsequent years, and by using a constant rate our model advances and carries some students for more years than they would actually attend. Inspection of the results of our model, such as in Figure 3.5, confirms that the net effect of these two opposing simplifying assumptions produces reasonable results with

[69] The structure of IFs student flows implicitly represents students repeating subsequent grades, although it does not separately identify them.

respect to overall enrollment rates, headcounts, and hence also resource requirements (the forecasts of Chapter 5, in comparison with historical patterns, extend this discussion).

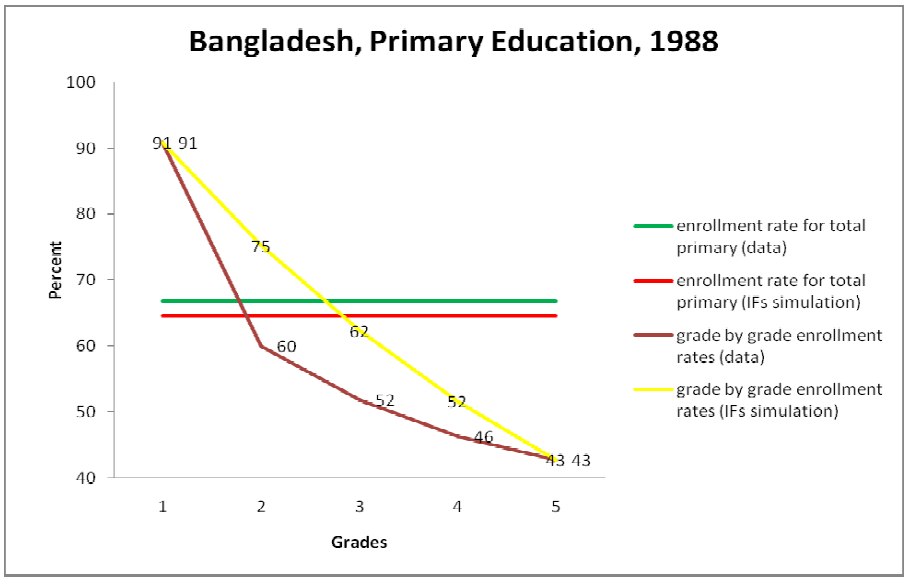

Figure 3.5 Grade flow data and simulation approach
Source: IFs 6.03

A separate algorithmic structure helps represent gross enrollment patterns at the primary level. Specifically, the model tracks the pool of potential students who are two or more years overage (as a result of never enrolling or of having dropped out) and brings back some of those students (dependent on initial conditions with respect to gross versus net enrollments) for the dynamic calculation of total gross enrollments.

A generally similar grade-flow methodology is used to model lower secondary and upper secondary student flows, including country-specific entrance ages and durations at each level. However, two adaptations were necessary. First, all lower and upper secondary enrollment data provided by UIS are gross rates, so our lower and upper secondary forecasts are also expressed only as gross rates. Second, while UIS provides transition rate data from the primary to the secondary level—which in effect is the transition rate into lower secondary—it does not provide calculated transition rates from the lower secondary to the upper secondary level. However, UIS does provide grade-by-grade secondary headcount time series, from which the IFs model calculates historical lower-to-upper secondary transition rates as the starting point for forecasts of future rates.

In the ISCED taxonomy of educational programs (see Chapter 2) the greatest complexity occurs with respect to tertiary education. Not only are there two categories (programs that lead to an "advanced research qualification" and programs that do not), but there are also two sub-categories within programs that do not lead to an advanced research qualification. One sub-category—itself quite broad—encompasses theoretically-based programs and programs that prepare students for practice in high-skill professions; the second category includes programs that are practical, technical, and "occupationally specific."

Despite this complexity (or perhaps because of it), more simplifying assumptions are made at the total tertiary level, both in some aspects of UIS treatment of data and in IFs current representation of student flows. For example, rather than using country-specific and tertiary category-specific program durations to calculate flows, both UIS and IFs base calculations of tertiary flow rates on an assumed five-year program period. To initialize the model, we first use the total UIS headcount of graduates of all programs to calculate an overall gross tertiary graduation rate based on the assumed five-year program period. We then use the calculated overall graduation rate and the total tertiary gross enrollment rate from UIS to calculate an overall tertiary gross intake rate.[70] [71]

Relative to more purely extrapolative analyses, the IFs structural approach to student flows has both clear strengths and weaknesses. With respect to strengths, it portrays educational systems more structurally and more extensively than extrapolative analysis. That allows a richer representation of relationships and dynamics within those systems, including constraints and trade-offs. At the same time, however, the approach is very data intensive, it is not as complete as it could be (for instance, the omission of specific grade-level repetition), and the dynamics of change in intake and survival—foundational elements of the system—are very challenging to represent. The next sub-section turns to still another element of that representation, the impact of budgets on intake and survival rates.

3.3.4 Public spending flows

The IFs education model simulates flows of public spending on education through a multi-stage process that we conceptualize as "demand-driven and supply-constrained." The stages in the process are as follows:

- The potential demand for education at each level is estimated in stage one (taking into account, of course, the outputs of the demographic model), as are the costs associated with those potential demand levels, calculated by multiplying simulated headcount at each level by level-specific projected per student public costs. (Chapter 6 will explore in some detail patterns of per student costs, their change with income levels, and targets for them in normative analyses.)

- In stage two, an initial estimate is made of public resources available to support education. These come from the government budgeting representation within the socio-political module, in turn heavily influenced by the economic model.

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[70] UIS has a data series for tertiary entry rates. However, we developed the procedure described above because the UIS series has data for only about 30 percent of all countries and for very few developing countries.

[71] A future volume in this series will focus on infrastructure, and will include more differentiated analyses and forecasts of tertiary education, making use of program specific UIS tertiary data to initialize the model.

- Reconciliation of any differences between public funding associated with the forecast demand and supply levels begins in stage three, through allocation of the simulated available funds to the various educational levels proportional to their simulated demand-driven share of total costs.

- In stage four, final adjustments are made to the forecast intake and survival rates and to per-student costs, depending on whether stage three identifies a budget surplus relative to demand or a budget deficit relative to demand.

Stages 3 and 4, the reconciliation of imbalances between demand and supply sides of the educational model and adjustments of intake and survival rates, of per-student costs, and of funding levels, are the core of this process. The theoretical foundation guiding the building of the budget reconciliation algorithm is based on the concept of incrementalism.[72] Even an algorithmic representation of an incremental decision-making process, however, requires parameterization with respect to the trade-offs between spending at different levels of education and between total spending and enrollment and per-student student spending levels. For the purposes of the model that parameterization was done via analysis of the behavior of the model, a process that modelers commonly call "tuning".

In normative analysis, the budgetary link between demand and supply sides can be turned off and the demand can force the spending on the supply side. Chapters 6-8 explore this use of the model. Even in this situation, however, it is important that the required spending on the demand side be accounted for in the government budgeting model, thereby reducing funds available for expenditure in other areas and/or requiring additional government revenues. The social accounting matrix (SAM) of the IFs economic and socio-political models makes it possible to do this and to trace the consequences. Figure 3.6 ties the budgeting representation to the larger development system.

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[72] As early as 1940, V.O. Key drew attention to the central question: "on what basis shall it be decided to allocate *x* dollars to activity A instead of activity B?" (Key 1940: 1138). Later experts in the field of public finance, for example Wildavsky (1988), helped establish incrementalism as the dominant paradigm in budgeting. As Lindblom (1959: 81) put it, political decisions are made more through "successive limited comparisons" rather than any rational-actor-based (Allison 1971) comparison among possible alternatives.

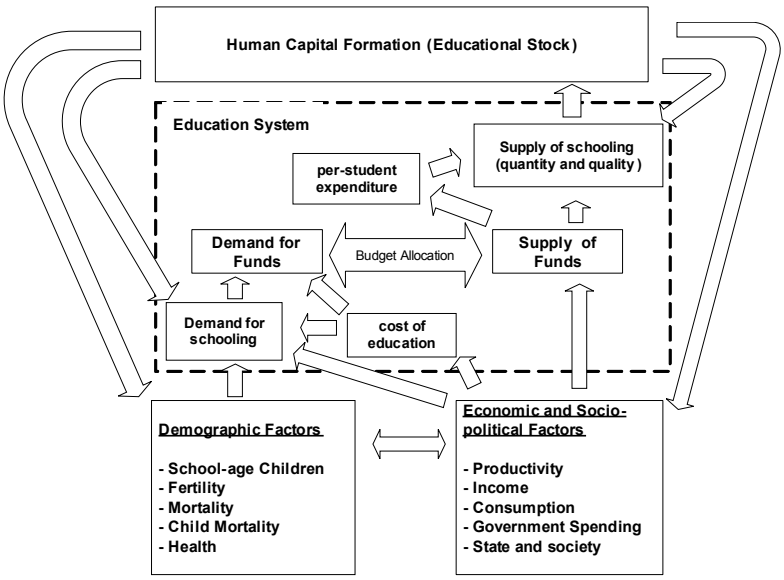

Figure 3.6 Education system budgeting in the context of the broader links to human development.
Source: IFs 6.03

3.3.5 Levels of educational attainment

The algorithm for the tracking of educational attainment is very straight-forward. The model tracks the cohort structure of the population not only by age and sex, but also by education. In each year of the model's run, the youngest adult cohorts are assigned the appropriate total years of education (and also assigned specific and appropriate levels of completion, such as primary or lower secondary). The model advances each cohort in age after subtracting deaths. The primary weakness of the approach, common to many but not all other models,[73] is that it doesn't represent differential mortality rates associated with different levels of education attainment. This leads, other things equal, to a modest underestimate of adult educational attainment, growing with the length of the forecast horizon.[74]

[73] The multi-state demographic method developed and utilized by IIASA, and described earlier in this chapter, does include education-specific mortality rates

[74] The current education model tracks adult educational cohorts by 5-year intervals rather than 1-year intervals. In a model with a 1-year time step this means that 1/5 of each cohort advances annually. In an environment of increasing education participation and attainment, the process creates some degree of numerical diffusion as a portion of the educational attainment assigned to the youngest cohort advances too rapidly to the next cohort.. This means also that some of the stock of educational attainment ages and dies too rapidly, slightly exacerbating the underestimate.

3.3.6 Initializing the model

The base year of the IFs education model and the larger IFs system is 2005, and data primarily from that year initialize the forecasts. Base year values of student and education financial flows come from the UIS, base year demographic data are primarily from the United Nations Population Division, economic data come heavily from the World Bank, and socio-political data are from many disparate sources. We store these data in historical series of the IFs modeling system's database. Before the model can use them, however, significant data extension, cleaning and reconciliation are necessary.

Data extension. As we have stated before, UIS provides student and financial flow rate data for many measures of education participation, particularly at the primary level. In other instances—and particularly with respect to the division between lower and upper secondary levels—UIS provides raw data (e.g., headcounts), but not flow rates. In the instances when UIS provides flow rates, we import those directly into the IFs historical series. When UIS provides only raw data (e.g., grade-by-grade headcounts, or total expenditures and total number of students), we calculate rates from those series "off-line", using spread-sheet applications or auxiliary programs, and then enter the results in the IFs historical series. Examples of data series handled this way include the lower and upper secondary survival rates, the transition rate from the lower to the upper secondary level, the tertiary intake rate and the overall tertiary graduation rate, and differentiated per-student costs at the lower and upper secondary levels. We also use such auxiliary processing to create the data series for the adjusted primary net intake rate (discussed earlier in this chapter).

Data cleaning and reconciliation. Whenever possible, however, we use an important automated subsystem of IFs that we call the "pre-processor" to help prepare initial conditions. This system uses algorithms that simplify the preparation of initial conditions for the model from the raw data. Among other benefits, it makes possible rapid re-computation of initial conditions when a new data update becomes available. We list below, and then briefly discuss, with a focus on the education model, the two major functions of the pre-processor:

- Filling base year values from data or estimation
- Reconciling incongruent data or estimates

Filling base year values from data or estimation. When 2005 data are missing for a county, the IFs system estimates 2005 values rather than excluding the country from forecasts. We apply the following estimation techniques, normally in the order in which they are listed: (1) using the most recent data point for the country if it is temporally proximate; (2) calculating an imputed data point from a longitudinal temporal regression if a recent data point is not available but a longer historical series exists; or (3) estimating the data value from a cross-sectional relationship stored in the system, most often as a function of GDP per capita (PPP).

There are some specialized algorithms in the pre-processor (or in some cases done in the first model year) to handle particular issues. For instance, some code computes the size

of the over-age pool available for primary intake. Other code examines the extent of enrollment in vocational programs at lower and upper secondary levels in all countries and uses that data to determine a portion of the total enrollment at those levels in such programs (the model currently assumes that portion to be stable over time).

An especially important specialized process takes the educational attainment data (which are not in our database by age cohort) and spreads the attainment levels across those cohorts in order to initialize the ongoing calculation of attainment that the previous section described. That spread process takes into account the percentage of the adult population with a certain level of education, the current graduate rates at that level of education, and the age structure of the adult population. Knowing that graduation rates almost always exceed the average attainment levels (that is, educational levels are increasing over time and therefore decrease across progressively older cohorts) , a factor for age-related decline in attainment levels can be computed in an iterative process.[75]

Reconciling incongruent data or estimates. Incongruities among the base year primary flow rates (intake, survival, and enrollment) can arise either from reported data values that, in combination, do not make sense, or from the use of "stand-alone" cross-sectional estimations to fill holes. Such incongruities might arise among flow rates within a single level of education (e.g., primary intake, survival, and enrollment rates that are incompatible) or between flow rates across two levels of education (e.g., primary completion rate and lower secondary intake rate).

The IFs education model uses algorithms to reconcile incongruent flow values. They work by (1) analyzing incongruities; (2) applying protocols that are intended to identify and retain the data or estimations that are likely to be of higher quality; and (3) substituting recomputed values for the data or estimations that are likely to be of lesser quality (this substitution is only for model initialization; the preprocessor does not change data in the historic series). For example, at the primary level, enrollment rate data are more extensive and more straight-forward than either intake or survival data; in turn, intake rates have fewer missing values and are arguably more reliable measures than survival rates. In the case, then, of incongruity among the three primary flow rates when all are from data, a survival rate congruent with the enrollment rate and the intake rate will be computed and substituted. In a situation where some of the values are from data and some are from estimates, the data values are favored in the reconciling algorithm. And in the relatively rare instance when all three values are from cross-sectional estimates, the estimation function with the most data is given priority (again, enrollment first, then intake, and survival last).

[75] Weishuang Qu of the Millennium Institute provided information on that approach, used also in the T-21 model.

3.4 Conclusion

Modeling and forecasting systems simplify reality, in part to allow us to better understand its dominant structures and dynamics.. In fact, that is the fundamental reason we do modeling. Simplified representations help us clarify and extend our own mental models. They also allow us to think about how systems might be unfolding and therefore to produce forecasts with and without interventions.

In the process of simplification, of course, much of the complexity of reality is lost and very often the models fail to capture the richly path-dependent interactions of actors and systems that will account for their unique futures. We should never confuse forecasting with prediction, and we should always treat models as tools for exploration of possible alternative futures.

This chapter has provided some basic information, attempting to provide information about both strengths and weaknesses, about many of the tools that analysts have used to think about global educational futures. It has also provided some basic information about the International Futures (IFs) tool, which serves as the basis for this volume, again attending to both strengths and weaknesses. Although this project has tried to conceptualize some valuable elements of an ideal forecasting system for exploring global educational futures as a way of guiding efforts in model development and use, the ideal model does not yet, and may never, exist.

The succeeding chapters turn to the use of our tools and the forecasts they produce. Chapter 4 begins by using the increasingly rich historical database on global education, especially that organized by UNESCO, to understand better those path-dependencies as a foundation for where countries, regions, and the larger global system appear to be going. Chapter 5 and subsequent chapters turn explicitly to the future, presenting both the base case of IFs and alternative forecasts developed around it.

4. The Historic Context

Recent years have seen much focus on and often remarkable progress in global educational participation and completion. Some understanding of trends and progress over the past several decades is a requisite starting point for thinking about possible paths into the future. Accordingly, this chapter provides a review of key indicators of educational patterns of societies, such as relatively recent enrollment and adult educational attainment trends.

The world is undergoing an educational transition somewhat analogous to the much better known demographic transition from high to low fertility and mortality. The demographic transition is far advanced in higher-income countries and therefore has generally mapped a path that lower-income ones have generally followed, albeit more rapidly than their predecessors. There remain, of course, some important uncertainties, not least of which is the future of below-replacement fertility rates in many high-income countries.

The course of the education transition in high-income countries is also still in flux, and similarly makes the path elsewhere in the world less than fully clear. For instance, tertiary education in high-income countries has by no means reached stability in terms of enrollment rates, much less in the very long-term growth of educational level among adults. In fact, even at the upper secondary level, although most high-income countries have reached near universality (about 90 percent), it is somewhat uncertain that truly universal upper secondary education is an inevitable part of the transition for high-income countries, and the balance between general and vocational education at that level varies much across countries.

Yet the experience of high-income and increasingly also of lower income countries provides us basis for fairly strong expectations. It is useful to think in terms of multiple, somewhat sequential and interacting stages of the educational transition. These include the completion of universal primary education, followed by universal basic (primary plus lower secondary) education, followed again by very significant (if not definitively universal) levels of higher secondary education, and then by high levels (with an uncertain upper limit, almost certainly short of universality) of tertiary education. It is such progression that this chapter explores.

Countries do not move through the stages in the same manner. At the primary stage, for instance, most countries have gross enrollment, including repeating students and those over age for primary education, that are no more than 10-20 percent higher than their net or of-age, on-track enrollment. (Chapter 3 explained net and gross enrollment, as well as other basic concepts in more detail.) A number, however, find themselves in "primary catch-up" mode. Afghanistan in the middle of this century's first decade had a gross enrollment just over 100 percent and a net enrollment of just under 30 percent, a vivid reflection of years under the Taliban and the desire of families to return to educational pursuit. Similarly, Gabon had a gross enrollment of about 150 percent but a net enrollment under 80 percent. Other countries in catch-up mode (and/or with very high

rates of repetition) included Comoros, Ethiopia, Haiti, Nigeria, Rwanda, Saudi Arabia, and to a lesser extent Angola. Although the pattern can often be inefficient educationally, disrupted and rapidly transforming societies may find it necessary.

Similarly, the relationships between net primary enrollments and net secondary enrollments vary. When net primary enrollments are between 60-70 percent, most countries experience net lower secondary enrollments about 40 percent below those net primary enrollment rates. As net primary enrollment grows to 80 percent and above, most societies have net secondary enrollments about 30 percent lower. But some countries (call them "build primary first") even more heavily emphasize high levels of primary enrollment before building substantial lower secondary systems. This set includes Tanzania, Rwanda, Uganda, Rwanda, Mauritania, and Mozambique. Another set of countries ("build them together") have lower secondary enrollments that largely track levels of net primary enrollment while they are still well below 80 percent net primary levels. For instance, Ethiopia, Ghana, and the Sudan have comparable rates at the two levels. Some countries even find themselves with gross lower secondary rates that exceed net primary enrollments: Saudi Arabia, the United Arab Emirates, Oman, and Kenya might be considered countries in "big push" mode, trying not just to catch up at the primary level but to build out more substantial systems. This pattern can reach up into tertiary education as well, where both the United Arab Emirates and Saudi Arabia have pushed gross tertiary enrollment above 20 percent well before reaching universal net primary levels.[76]

Overlaying these stages is movement to gender parity in education, necessarily attained no latter than the achievement of universality, but typically achieved quite a bit earlier. As Wils and Goujon (1998: 367) described it, "the male-to-female ratio of enrollment approaches unity … at enrollment levels beyond 60 percent for primary and secondary education, and at levels of 20-40 percent for tertiary education."

Lagging well behind this enrollment transition of school-aged children is the transition of the adult population to universal completion (or at least significantly high levels) of education at the various levels. Given working lives and life-spans that each encompass multiple generations and the very low completion rates of formal education at older ages for many countries, the playing out of this transition across a country's entire population require 50-100 years. For instance, Wils (2002: 3) calculated that the "rise from 10 percent adult literacy to 90 percent takes from 60-100 years" and that the "rise from 10 percent adult primary education (and even less secondary) to 90 percent secondary education among adults takes about 150 years or 7 generations."[77]

In addition to looking across educational levels, this review therefore needs to look also across life stage. Specifically, we need to distinguish students and their enrollment

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[76] It is also possible that non-formal education in Madrassas meets some primary school education needs in Islamic countries like Saudi Arabia. [Janet, is this reasonable?]

[77] Among the useful historic reviews of change in global education are Meyer, Ramirez, Rubinson, and Boli-Bennett (1977), looking back to 1950, Fredriksen (1980), Wils and Goujon (1998), Bloom (2006), Lutz, Goujon, K.C. [editor, yes is right], and Sanderson (2007).

patterns from adults and their educational attainment levels. Moreover, across the discussion it is important to consider gender balance or imbalance and to report something of what is known about other intra-societal differences in enrollment and attainment patterns. Finally, we need to consider the financing of education, always a constraint.[78]

Box 4.1 Regionalization of country-level data.

In much of the analysis of this and subsequent chapters of the volume we will group data and forecasts for presentation using the eight standard regions of UNESCO: Arab States, Central and Eastern Europe, Central Asia, East Asia and Pacific countries, Latin American and the Caribbean, North America and Western Europe, South and West Asia, and Sub-Saharan Africa. The typical UNESCO regional groupings differ from those of other United Nations agencies and the World Bank and have their own strengths and weaknesses. We use them because UNESCO is the premier international organization in the global educational arena. One clear weakness is the aggregation within the East Asia and Pacific grouping of Australia, Japan, Republic of Korea, New Zealand, Singapore and Taiwan with many lower-income countries. For the purposes of this volume we will most often divide that grouping into two sub-groupings, a higher-income or "rich" one and a lower-income or, in short-hand "poor" one.

4.1 Student populations: participation in education

Forecasting of future educational attainment levels (stocks) depends on understanding the historic patterns of flow of students into and through educational systems. Policy-oriented forecasts must pay close attention to the supply and demand forces that shape those flows across time. Hence we want to describe historical patterns, but also to understand them

4.1.1 All regions, all levels

Table 4.1 documents the enrollment increases at all levels of education in recent decades. Today the most widely watched variable in global education is primary enrollment rate, because the second Millennium Development Goal called for universal enrollment (which is being measured by net primary enrollment) and completion of primary education by 2015. Therefore Table 4.1 traces net primary enrollment rates as well as gross primary, secondary, and tertiary enrollments.

Table 4.1 supports a number of insights. Most fundamentally, quite remarkable progress has been made in the global educational transition across all educational levels. At the primary level global net enrollment has climbed up into the 85-90 percent range (88 percent in 2005). Gross primary enrollment is now near or above 100 percent for all

[78] Data availability and quality problems increase the further back we look (Chapter 3 discussed data sources and issues). However, to provide a meaningful context for understanding the scope of the education transition that is underway, our historical summaries begin with 1960 data whenever possible. When data to 1960 are unavailable or very questionable, we use data from the closest available year.

global regions, even though the net enrollment data indicate that repeaters and over-age students make up a significant portion of that gross enrollment, especially in Sub-Saharan Africa. Global gross enrollment at the secondary level has grown even faster, more than doubling since 1970 at the lower secondary level and increasing by similar percentage points for all secondary students, including upper secondary. Gross tertiary enrollments, from a much lower base, have dramatically increased in relative terms, pushing up above 30 percent.

Clemens (2004) studied patterns of primary transition from 1960-2000 across more than 100 countries. He pointed out that recent rates of growth in net primary enrollments are much faster than those experienced by currently developed countries in the nineteenth and early twentieth centuries. He called the rate of advance from 1960-2000, compared to earlier transitions, a "blistering speed".

That does not mean that the transitions to universal education at the primary or basic level will seem fast in absolute terms. A study of 70 developing countries by Wils, Carrol, and Barrow (2005: 8) found the following:

> Even in countries with fast-growing educational trends, it takes at least six decades to produce anything close to basic education for all when a country starts from nearly zero…. A handful of countries, including Jordan, Gabon, and Indonesia, will have made the leap [from10% primary school completion to 90%] in about 60 years, whereas the average interval for the 70 countries studied is 88 years.

The Educational Policy and Data Center (EPDC 2007:3) concluded that "All countries that have not already completed universal primary entry and completion are on a growth rate of longer than 50 years from the beginning levels of primary entry and completion (say below 10%) to final levels, say above 90%." Many countries with contemporary primary completion rates near 60 percent have already taken 50 or more years to reach that level.

Focusing on the speed of transitions overall, however, should not lead us to ignore the obviously substantial variation in progress across time and geography. The variation across time helps explain that across space. Both Table 4.1 shows that more unambiguous advance globally marked the period from 1960 through 1980 than the years thereafter, perhaps especially 1980-1990, set off for that reason. There are several partial explanations for that, all of which are important for our subsequent efforts to forecast advance in the coming decades.

First, some slowing of progress over time occurs because of saturation effects. Many analysts have both noted and used for forecasting purposes the fact that enrollment increase tends to have an S-shape with the fastest growth near enrollment rates of 50 percent. In particular, countries typically have difficulty achieving the final step from 90 to 100 percent, especially when there are pockets of people who are especially hard to reach (or are systematically excluded) due to remote location, extreme poverty, physical or mental handicaps, or ethnic/religious divisions. The EPDC (2007: 3) found that Kenya was able to move primary school entry from 35 percent in 1950 to 91 percent in 1990, but between 1990 and 2003 they added only another 3 percent entry. Thus the movement of

net primary enrollment in Latin America and the Caribbean above 80 percent in the 1980s would naturally lead to slowing in further growth.

	Net Primary				Gross Primary			
	1970	1980	1990	2005	1960	1980	1990	2005
Arab States	61	80	77	91	53	81	85	98
Central & Eastern Europe	95	97	91	91	97	100	100	111
Central Asia				89	79	111	92	99
East Asia & Pacific (Poor)	70	91	97	93	84	111	121	110
Latin America & Caribbean	77	80	89	94	89	105	106	112
South and West Asia	59	29	64	86	40	77	90	111
Sub-Saharan Africa	57	51	47	69	39	82	76	97
North America and Europe	95	97	97	95	118	102	103	102
East Asia & Pacific (Rich)	98	102	100	99	102	104	101	101
World	72	87	92	88	72	97	103	106

	Gross Lower Secondary				Gross Secondary			
	1970	1980	1990	2005	1960	1980	1990	2005
Arab States	28	52	77	81	17	50	58	72
Central & Eastern Europe	29	74	64	91	51	83	84	91
Central Asia				94	50	112	98	89
East Asia & Pacific (Poor)	22	67	68	79	13	50	52	67
Latin America & Caribbean	31	61	71	94	16	41	47	78
South and West Asia	28	41	50	67	29	37	49	56
Sub-Saharan Africa	8	20	33	40	4	20	25	34
North America and Europe	90	91	98	104	42	86	94	101
East Asia & Pacific (Rich)	93	100	96	100	63	87	95	104
World	37	63	70	78	26	49	55	69

	GrossTertiary			
	1960	1980	1990	2005
Arab States	4	14	13	19
Central & Eastern Europe	11	26	33	52
Central Asia	12	26	28	33
East Asia & Pacific (Poor)	3	3	6	23
Latin America & Caribbean	4	15	17	30
South and West Asia	2	7	7	12
Sub-Saharan Africa	1	2	4	5
North America and Europe	19	38	52	72
East Asia & Pacific (Rich)	9	26	30	66
World	7	13	16	31

Table 4.1 Enrollment rates across time and levels
Source: IFs Version 6.01, using UNESCO data.
Note: Net primary enrollment is adjusted and contains one year over and under age students. Some series are only available since 1970 and all series are partial. Lower secondary data are especially spotty.

Second, demographic pressures have weighed heavily on enrollment growth in some regions of the world. Fredrikson (1980) reported how dramatically both African and Asian planners underestimated the growth in school-aged children when making their plans in the 1960s for movement to universal primary education. The Addis Ababa Plan of 1961 "underestimated (by some 63%) the size of the population of primary school age in 1980" (Frederikson 1980: 7). Thus enrollment numbers overshot the plan by as much as 50 percent, while enrollment rates failed to achieve anticipated growth. The Karachi Plan similarly fell short of goals in part because of an increase by 40 percent of population aged 6-12 in just a 13-year period.

Population pressures continue to be a burden for educational systems. The UIS (2002: 52) noted that those aged 5-14 make up 21 percent of population in the World Education Indicators (WEI) countries as a whole, compared to 13 percent in OECD countries, greatly affecting the provision of primary and lower secondary education. The burden at those levels is for the most part beginning to slacken because global population growth rates peaked in 1969-71. By 1980 the population share under 15 was decreasing in all UNESCO regions except sub-Saharan Africa, where it continued to increase until 1987-88.

[add some information on numbers of students over time at different levels- maybe graph

Globally, however, annual births continue to growth and may peak (at about 137 million) in 2018-19. Those in sub-Saharan Africa may continue to growth until nearly 2040. Thus the absolute numbers of those moving into educational systems will continue to rise and will do so most quickly where total fertility rates remain high and that is primarily sub-Saharan Africa where they exceed 5 compared to 3 in South and West Asia. Thus whereas the UIS forecasts (2002:52) that most WEI countries should see absolute decreases in the size of their populations 5-15 in the coming years, large numbers will not. And populations of upper secondary and tertiary-aged populations will continue to increase for many years.

A smaller but important demographic issue, presentational rather than causal, concerns the aggregation of data by region or globally. The global rate of net primary enrollment in Table 4.1 has been stable since 1980 in part because populations are growing fastest in the developing world, tilting the world average in their lower-enrollment direction.

Third, domestic economies and educational budgets have much to do with educational advance in several ways. For instance, the very success of educational advance in the 1960s and 1970s carried with it increasing expenditure burdens for low-income countries and as students and their families began to complete primary education and increasingly demand secondary education, that burden increased. As the third section of this chapter shows, expenditures of low-income countries on education have risen as a portion of GDP much closer to the level of high-income countries than in 1970. In the process, their head-room for further expansion of spending has almost certainly been reduced. Increased recognition of the need to attend to quality as well as quantity has certainly interacted with budget to increase constraints on enrollment growth.

Another element of economic constraint post 1980 is the high reliance of low- and middle-income countries on agriculture and raw materials relative to high-income

countries. Specific to countries, droughts and patterns of resource discoveries and exploitation can greatly affect government resources.

Fourth and framing the economic issues more broadly, however, the condition of the global political economy cannot help but affect much that happens in all countries, especially lower-income ones. Figure 4.1 supplements Table 4.1 with a continuous portrayal of the growth in gross primary enrollment for the low- and middle-income regions of UNESCO, showing the general slowing of rise in enrollments, and some reversals after 1980. Table 4.1 also showed data for 1980 and 1990 in order to set off that period from earlier and later ones.

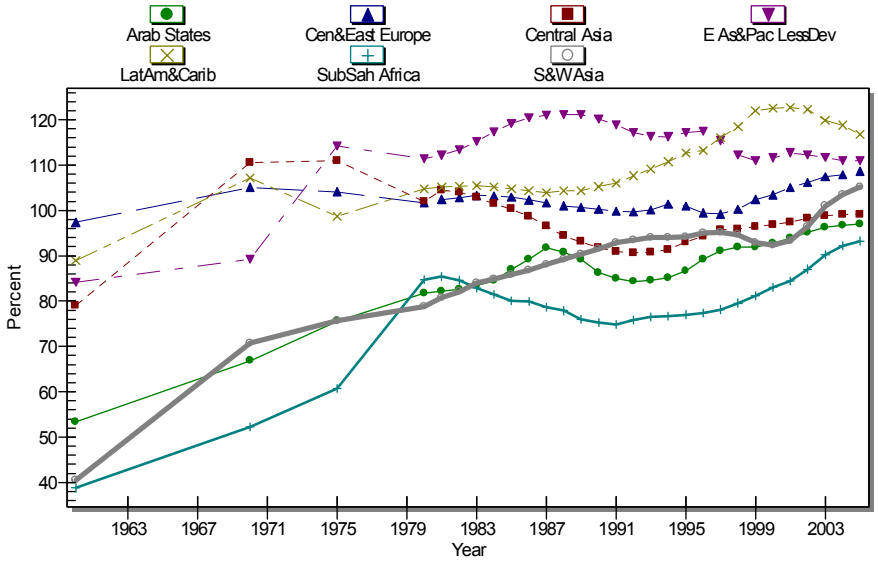

Figure 4.1 Gross primary enrollment rates
Source: IFs Version 6.01, using UNESCO data.
Note: Graph shows 5-year moving average. Reporting countries vary by year, exaggerating temporal variation and complicating analysis of regional patterns.

The patterns in Figure 4.1 seem generally consistent with the impact of such global political-economic forces. The 1970s were a boom period for commodity prices, not unlike the early years of the twenty-first century. When the boom died, economies in Africa and Latin America were especially hard hit. During the boom of the 1970s many economically developing countries also took on large international debt burdens as a result of the recycling of petrodollars. The debt crises of the 1980s contributed to the "lost decade" of development for Latin America and problems stretched on well into the 1990s for much of Africa. The impact on Latin America of the collapse of economic growth is probably clearer at the secondary and tertiary level in Table 4.1; as indicated earlier, the slowing at the primary level could be saturation effects. The developing world has very frequently pointed to the adverse effects on educational systems of conditionality requirements by the IMF that affected government spending on education and encouraged student fees. The collapse of oil prices in the 1980s also took a toll on the Arab oil-exporting states, although their assets helped them fend off the impact for a few years.

On the more heavily political side, the Cold War had considerable impact on the educational spending of the United States and other countries (the financing discussion will return to the issue). The launching of Sputnik galvanized a major push on education. The Afghan war and the collapse of communism in the former Soviet Union similarly were major political-economic forces that affected the countries that emerged from it. See, for instance, the decline in enrollments in Central Asia. More recently, we would expect to see in the data of selected countries the post-crisis effects of restricted government financing following the Asian debt crisis of 1997 and its global contagion.

This discussion suggests some important conclusions for further analysis in this volume. First, the study of educational futures in combination with demographic and political-economic ones is essential. It is somewhat surprising that relatively little educational analysis does reach out beyond the effects of demography to those of political economy (the UIS 2005:63-72 did explore the impact of the 1997 debt crisis and its aftermath). Second, the fairly recent surge in educational enrollments in Africa and elsewhere should be examined carefully with respect to its sustainability, because it is subject to many of the same potential constraints that affected the surge in the 1960s and 1970s.

4.1.2 Sub-Saharan Africa: primary and secondary enrollment concerns

Table 4.1 also helps identify the global regions of special concern. At the primary level, Sub-Saharan Africa is clearly in that category with a net enrollment rate in 2005 that is near 70 percent. At the secondary level, South and West Asia joins Africa as a region of concern, and both the Arab states and the poorer countries of East Asia and the Pacific are quite far from universal enrollment. We need to drill down into these regions in particular to understand the patterns, starting with Africa.

Looking at subgroups of countries can enhance our understanding of transition patterns identified from Table 4.1. In Figure 4.2 we see the net primary enrollment rates since 1985 for all African countries grouped in three clusters. The first cluster includes all African countries that were at or below 50 percent enrollment in 2000. That low-enrollment rate set consists of Angola, Burkina Faso, Djibouti, Eritrea, Ethiopia, Guinea-Bissau, Mali, Niger, Somalia, and the Sudan. Except for Angola, the prominence of countries from the Horn of Africa and across the Sahel is obvious. The second set includes African countries that ranged from 50-70 percent enrollment in 2000. Benin, the Central African Republic, Chad, the Comoros, Cote d'Ivoire, Gambia, Ghana, Kenya, Liberia, Madagascar, Mauritania, Mozambique, Nigeria, Senegal, Tanzania, and Zambia make up that set.[79] One of the striking aspects of this grouping is the downturn in enrollment rates after 1980 for a combination of the reasons discussed above. African countries in a high-primary enrollment set are Algeria, Botswana, Egypt, Gabon, Lesotho, Libya, Malawi, the Maldives, Mauritius, Namibia, Rwanda, Sao Tome and

[79] Outside of Africa, only Afghanistan falls below 50 percent net enrollment and only Nepal, Pakistan, Saudi Arabia, and Yemen fall into the category of 50-70 percent enrollment. Clearly by far the most countries with most significant transitions yet to make are in Africa.

Principe, South Africa, Swaziland, Togo, Tunisia, Uganda, and Zimbabwe. Countries of North and South Africa dominate this grouping.[80]

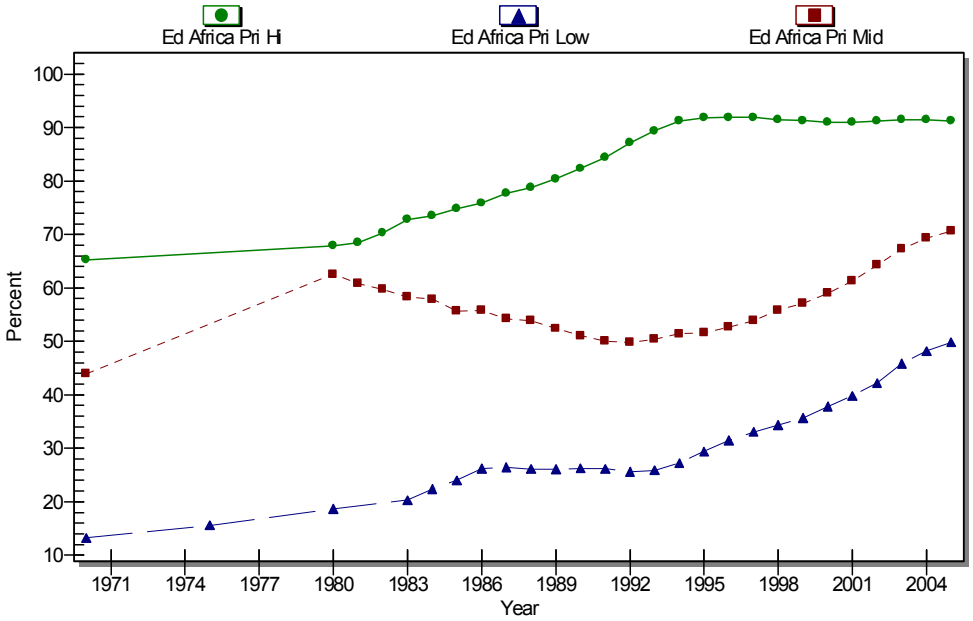

Figure 4.2 Net primary enrollment rates in three African clusters
Source: IFs Version 6.0, using UNESCO data.
Note: Used 5-year moving average after removing 1975 for high- and middle-enrollment groupings and 1981-1982 for the low-enrollment grouping.

Figure 4.2 shows different patterns of change in different portions of Africa. Very slow recent-year progress in net enrollment growth characterizes the countries that have already attained high levels, illustrating again that pockets of population, based on ethnicity, religion, or remote residence make the final step to universality very difficult. In contrast, the middle and especially the lower enrollment groups have, especially since the middle 1990s, made rapid advances.[81]

Figure 4.3 extends the story of change shown in Figure 4.2 by turning to gross secondary enrollment for the same sets of countries. What it makes clear is the rapid advances that the set of African high primary enrollment countries have made in secondary enrollment

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[80] A few African countries such as the Democratic Republic of the Congo do not report data so are not included in these three sets.

[81] The irregularities or transients across time that characterize Figure 4.6 and other historical representations may reflect a variety of types of disruptions as disparate as weather patterns and political turmoil or conflict. Irregularities in representations of country groups very often, however, have a basis in data problems. Specifically, some reflect infrequent and variable reporting patterns of many countries, making the population-weighted regional averages only a rough indicator of long-term change in enrollment rates across changing subsets of regional members. Further, many more data points became available in 1990 and then again in 1998-1999; because newly reporting countries are often among the least advanced educationally, their addition to graphs in recent years can distort the long-term patterns in large regional groupings by introducing a downward bias.

rates since the early 1970s–blistering speed, indeed. The other two groupings remain at very low levels in secondary enrollment rates, a fact that will inevitably hold them back, even in progress at primary levels. Clearly, the middle grouping suffered erosion of rates at the secondary level after 1980, just as they did at the primary level. Many countries in the lower education group have simply not reached high enough levels of primary completion to support a "take-off" of secondary enrollment. Chapter 6 will explore the relationships between the primary and secondary transitions, as well as looking at similarities and differences in the way they unfold.

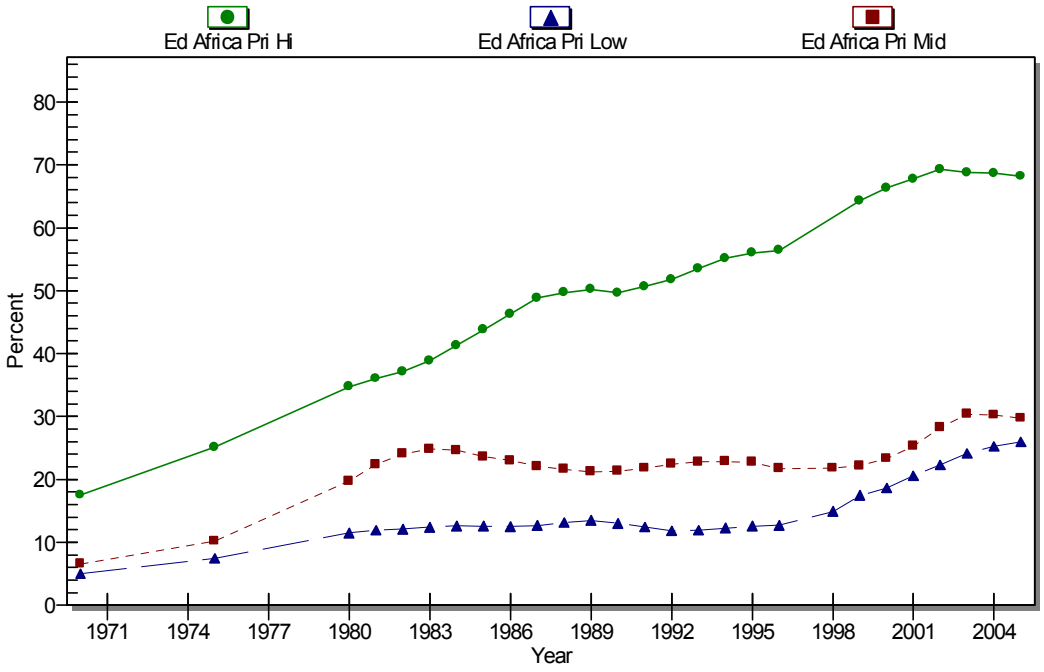

Figure 4.3 Gross secondary enrollment rates in African clusters
Source: IFs Version 6.01, using UNESCO data.
Note: Used 5-year moving average after removing 1997-98 for high-enrollment grouping and 1997 for the middle-enrollment grouping.

The high-primary enrollment countries of Africa have also made some significant progress at the tertiary level. Whereas all three sets of African countries began the 1970s with single digit rates of tertiary enrollment, and the mid- and low-primary enrollment countries entered the twenty-first century with only slight increases, the high-primary enrollment group has pushed rates up into the 15-20 percent range, albeit leaving Sub-Sarahan Africa as a whole below 5 percent.

There are certainly a number of dimensions on which the three sets of African countries differ in a manner that might help us understand their differences in performance over the last four decades. Yet a glance back at the members of the groupings does not make those dimensions very clear, with the exception of the fact that the high enrollment group has a substantial membership of countries from the North and South of the continent. Still, it also includes many countries from across the region, including Botswana, Gabon, and Mauritius. Returning to the theme of the importance of demographics, one striking

difference between the high-enrollment group and the other two is the progression of fertility rates. In 1960 the total fertility rate of all three groupings was 6.5-7.0, and the high-income group was at the high end. By 2005, rates in all groupings had declined, but those in the low- and middle-enrollment groupings were still at 5.6 and 5.2, respectively, while that of the high-enrollment group had fallen to 3.7. As with all processes that occur together, it is difficult to sort out cause and effect in the relationship between educational advance and fertility decline and it is likely that it is two-way.

4.1.3 Beyond Africa: primarily secondary concerns

Although completion of the transition to universal primary education remains an issue, the primary struggle of countries outside of Africa is now most often that of raising low enrollments at the secondary level. As the world increasingly turns its attention to basic education, defined as primary plus lower secondary, it is important to consider countries that are far from achieving universality at the lower secondary level. Outside of Africa, the countries with lower secondary gross enrollment below 60 percent in 2005 were Afghanistan, Bhutan, Cambodia, Guatemala, Haiti, Iraq, Laos, Mynamar, Pakistan, Papua New Guinea, the Solomon Islands, Vanuatu and Yemen. An additional set of countries has lower secondary rates between 60 and 80 percent: Bangladesh, Bosnia, the Dominican Republic, Ecuador, Honduras, India, Indonesia, Moldova, Nepal, Nicaragua, Paraguay, Singapore, Syria, Timor, and Turkmenistan.

Figure 4.4 shows the historic pattern of those countries with respect to total secondary enrollment.[82] Again one can see very substantial progress, but slow transitions. In 35 years the low enrollment group went only from 14 to 33 percent and the mid enrollment group from 23 to 58 percent. Those rates suggest 10-90 percent transition periods of 129 and 123 years, respectively. These countries historically have had the slowest pace in the world outside of Africa.

[82] Data at the lower and upper secondary levels separately show the same general patterns, but upper secondary data exist in useful form only since 1999 and lower secondary data before that year are spotty.

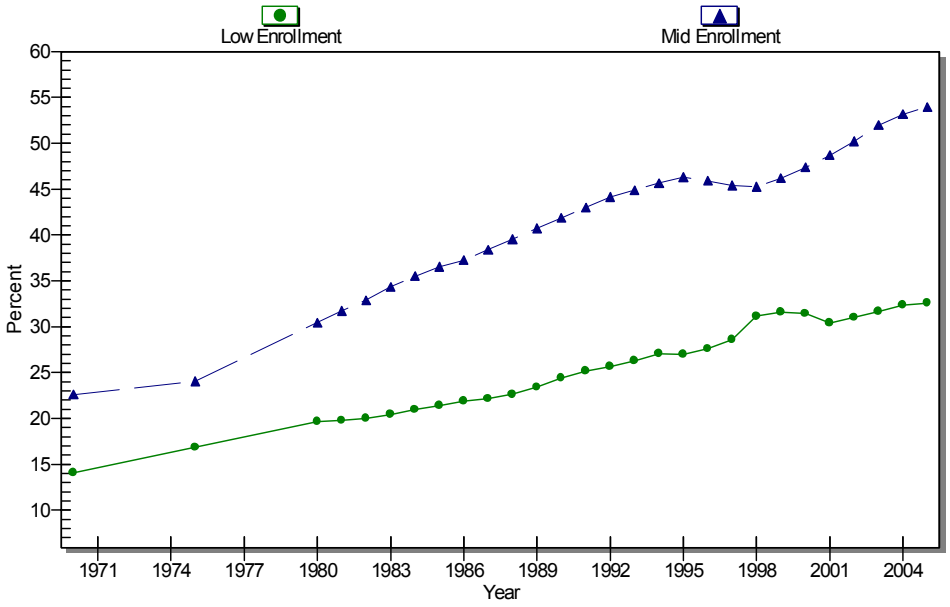

Figure 4.4 Gross secondary enrollment rates in non-African, low and mid-enrollment clusters
Source: IFs Version 6.01, using UNESCO.
Note: Used 5-year moving average.

Returning to the relationship of educational advance with demographics, the fertility rate of non-African countries with middle levels of gross secondary enrollment (and quite high primary rates) has fallen so that it is now mid-way between that of the high-primary enrollment Africans and the Europeans. The fertility rates of non-African countries with low levels of gross secondary education are now quite similar to those of African countries with high primary enrollment.

Commenting on the tertiary level, Table 4.1 showed that enrollment rate growth in the last 15 years has continued in all regions and that an upper limit is not clear. Gross enrollment rates at the tertiary level in the United States (not shown) are near 80 percent, and whether or not they are stabilizing is by no means clear. Chapter 6 (see Figure 6.x) returns to this issue and shows that a number of countries are now pushing up toward 100 percent gross enrollment, again without obvious saturation effects. Among the problems in understanding those rates is the fact that some individuals earn multiple advanced degrees across a lifetime and also that in many societies older adults return to earn an advanced degree in the typical "catch-up" mode that helps drives gross enrollments above net ones and all levels when expansion is rapid. In contrast, lower-income regions, only the transition countries of Central and Eastern Europe, with very well-developed tertiary systems from the communist era, exceed 35 percent.

4.1.4 Gender balance: pursuing parity

The transition to gender parity (often seen as ratios of the enrollment rates of girls and boys between .0.97 and 1.03) is also moving at substantial speed.[83] Table 4.2 shows patterns for primary, secondary and tertiary enrollment across the standard UNESCO regional groupings (except for the division of East Asia and the Pacific into two subgroups). By 2005 the world had mostly achieved gender parity in primary net and gross enrollment (see also Lewis and Lockheed 2006 with data beginning in 1960). Even at the secondary level, the progress toward parity since 1970 has been truly remarkable, most dramatic in the Arab States. Central Asia is still some distance from parity, sub-Saharan Africa is a considerable distance, and both appear to have stalled in progress since 1990.

At the tertiary level, South and West Asia joins Africa in being furthest from having completed the transition to parity, in spite of quite dramatic improvements in both regions since 1970. Significantly, the richer countries of East Asia and the Pacific are also some distance from parity; Japan explains most of the gap, which is computed on a population-weighted basis.

A significant reverse gender gap has now emerged at the tertiary level in North America and Europe, as well as in Central and Eastern Europe and in Latin America. Perhaps most surprisingly, a significant reverse gender gap also has appeared in Arab States, although part of the explanation is likely that many males study abroad. The gap in the Arab States is especially striking because that region's female share of the labor force is still below 30 percent. Chapter 8 will turn to the relationship between education and other social change.

[83] Hill and King 1993 explored many aspects of the gender gap, not just in student numbers at all levels, but also teachers and much else. They also investigated the forces that perpetuate gender disparities and the broader socioeconomic implications of them.

	Net Primary Parity			Gross Primary Parity		
	1970	1990	2004	1970	1990	2005
Arab States	0.58	0.85	0.95	0.59	0.84	0.92
Central & Eastern Europe	1.00	1.00	0.99	0.91	0.99	0.99
Central Asia			0.96	0.76	0.97	0.97
East Asia & Pacific (Poor)	0.98	0.96	0.99	0.92	0.94	0.98
Latin America & Caribbean	0.98	0.99	1.00	0.98	0.98	0.98
South and West Asia	0.65	0.88	0.94	0.62	0.75	0.97
Sub-Saharan Africa	0.91	0.88	0.93	0.72	0.83	0.89
North America and Europe	1.01	1.01	0.98	1.00	0.99	0.99
East Asia & Pacific (Rich)	1.00	1.00	1.00	1.00	1.00	0.99
World	0.82	0.97	0.99	0.81	0.90	0.96

	Gross Secondary Parity			GrossTertiary Parity		
	1970	1990	2001	1970	1990	2005
Arab States	0.43	0.69	0.93	0.26	0.67	1.15
Central & Eastern Europe	0.81	1.00	0.95	0.73	1.14	1.26
Central Asia	0.45	0.87	0.87	0.24	0.89	0.91
East Asia & Pacific (Poor)	0.66	0.82	0.97	0.52	0.70	0.89
Latin America & Caribbean	0.95	1.11	1.08	0.54	0.96	1.07
South and West Asia	0.43	0.60	0.91	0.29	0.51	0.74
Sub-Saharan Africa	0.43	0.79	0.79	0.20	0.48	0.78
North America and Europe	0.94	1.02	1.02	0.65	1.13	1.35
East Asia & Pacific (Rich)	0.98	1.02	1.00	0.41	0.72	0.84
World	0.69	0.86	0.96	0.57	0.95	1.11

Table 4.2 Gender parity indices
Source: IFs Version 5.45, using UNESCO data.

In another study, with a focus on girls, Lewis and Lockheed (2006: 35-45) [Janet, need citation] explored the complications around a number of subpopulations, including Mayans in Guatemala and Mexico, Laos rural minorities, scheduled castes or tribes in India, the Roma in Eastern Europe, and various tribal minorities in Benin, Ghana, and Malawi. The UNESCO Education Policy and Data Center (2007) also reached beyond the gender balance, with special attention to the rural/urban attendance ratio. They find that the gap has been declining.

4.2 Adult populations: educational attainment

Students in school become adults in the workforce and society more broadly. Educational levels of the adult population fundamentally shape social change. For instance, the educational level of women in their child-bearing years affects fertility rates; education of those in the work force affects economic productivity; and education of voters of all ages has important implications for the stability of democracy. Hence understanding of educational attainment has great importance for us.

4.2.1 Years of education

One of the most common measures of educational attainment is the average years of education completed by those aged 25 or more (who are thus almost certainly through the formal years of education and into the work force) or, alternatively, of those aged 15 or more (in developing countries perhaps a better cut-off on both counts).[84] Barro and Lee (2000, 2001) and Cohen and Soto (2001) have compiled such information, most often using surveys of and therefore self-reports of educational attainment or completion.[85] One very useful advantage of such methods for mapping a society's education is that they provide information also by age and sex, allowing the building of age-sex-education distributions.

Figure 4.5 shows the growth of average years of education completed by those 15 years or older across the UNESCO groupings with extrapolative forecasting by Cohen and Soto (2001) through 2010. The figure suggests three distinct sets of regions. First, North America and Europe, as well as More Developed East Asia and Pacific, clearly stand well apart from all other regions, maintaining over time their absolute educational lead in years. It is actually quite phenomenal that the More Developed East Asia and Pacific region had an educational stock level similar to North America and Europe already in 1960, early in the development surge of Japan and ahead of those for the Republic of Korea, Singapore, and Taiwan. Second, Sub-Saharan Africa and South and West Asia stand out as the regions with the fewest years of education, overtaken before 1990 by the Arab States and consistently below all other regions. Overall, regions have advanced roughly in parallel, although the Arab States have, as indicated, been in a rapid "catch-up" mode and progressed most rapidly. Looking across groupings at ratios of years of education, there has been some clear relative convergence over time across this broad set of country groupings. The seeming slowing of growth in North America and Western Europe suggests the likelihood of absolute convergence in future years.

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[84] Analysts sometimes define educational attainment in terms of education level undertaken but not necessarily completed. Here we focus on completed activity.

[85] They use administrative data on enrollment primarily to fill holes. Barro and Lee (2000: 2) have at least one point for each of 142 countries and complete sets since 1960 for 109 countries. Cohen and Soto include 95 (Bloom 2006: 38). Cohen and Soto also provide forecasts to 2010. Bloom (2006) has extensively analyzed the datasets. IFs uses a cross-sectional function to estimate initial values for countries that neither set includes.

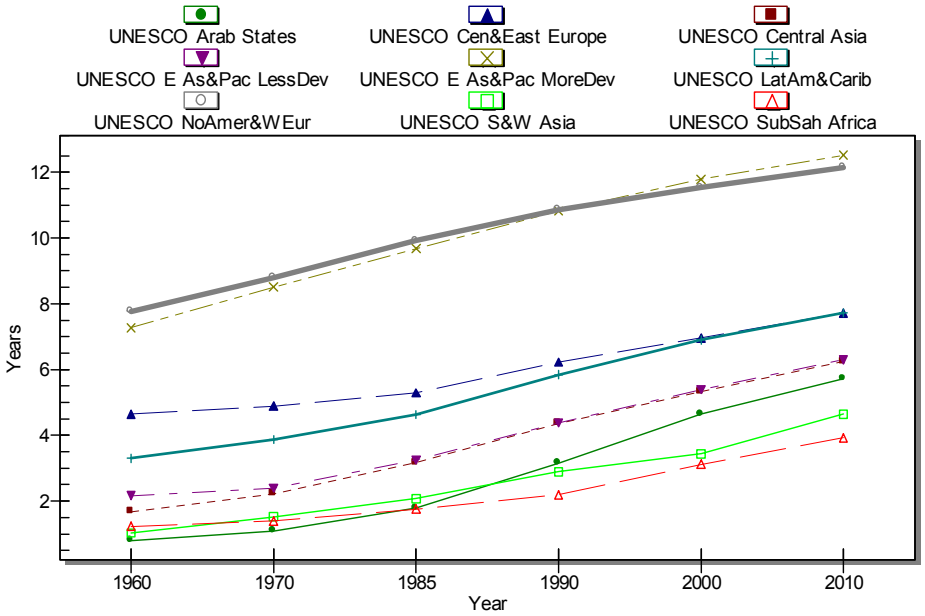

Figure 4.5 Average years of education completed at age 15 and above.
Source: IFs Version 6.01 using data from Cohen and Soto (2001).

4.2.2 Adult education by level

Another important dimension of education in the adult population is its distribution across levels of education. Table 4.3 shows those levels for the UNESCO groupings (separating low and high income countries in East Asia and the Pacific). Most fundamentally, the progress in nearly all regions at all levels is impressive. Based on the patterns of the table, it would not require hyperbole to speak of a global educational revolution, not simply a transition. Yet it is also striking that at the beginning of the twenty-first century 50 percent or fewer of adults in Arab States, Latin America, South and West Asia, and Sub-Saharan Africa had a primary education, that 20 percent or fewer had completed a secondary education, and that 5 percent or fewer had completed a tertiary education. Although change nearly everywhere is rapid, the educational revolution for adult populations is in remarkably early stages.

	Primary			Secondary			Tertiary		
	1960	1980	2000	1960	1980	2000	1960	1980	2000
Arab States	6.4	20.5	42.2	0.9	5.7	15.2	0.1	1.2	3.3
Central & Eastern Europe	60.3	76.1	84.1	12.9	17.0	28.8	1.8	3.9	8.7
Central Asia	26.7	45.4	72.1	1.9	6.8	14.0	0.1	1.2	3.0
East Asia & Pacific (Poor)	24.4	44.1	59.3	3.2	10.5	17.9	0.7	0.8	2.5
Latin America & Caribbean	27.4	37.7	49.9	5.7	11.0	19.5	0.9	2.0	4.8
South and West Asia	10.6	24.6	37.2	0.8	7.4	11.2	0.1	0.7	2.0
Sub-Saharan Africa	14.3	18.0	27.1	1.8	1.9	4.4	0.2	0.3	0.9
North America and Europe	73.3	82.0	85.5	18.1	24.0	50.5	3.6	7.5	15.1
East Asia & Pacific (Rich)	67.4	78.0	86.2	26.6	31.2	44.2	2.5	7.1	11.5
World	38.9	46.4	55.8	9.0	112.0	21.0	1.2	2.4	4.8

Table 4.3 Educational completion at 15 and older, percent of adults
Source: IFs Version 6.01 using data from Barro and Lee (2000).

4.2.3 Gender balance of adult educational attainment

The gender balance transition is essentially complete in the more developed countries so we can focus on developing regions.[86] Figure 4.6 shows that even across their entire adult populations, the developing countries of Central and Eastern Europe and of Latin America and the Caribbean are now close to achieving gender parity. After some movement away from gender parity up to about 1980, both Sub-Saharan Africa and East Asia and the Pacific have moved steadily toward it. South and West Asia, Central Asia, and the Arab States have made the most absolute progress, albeit from the lowest bases.

[86] King and Hill 1993 undertook a substantial study of women's education in developing countries.

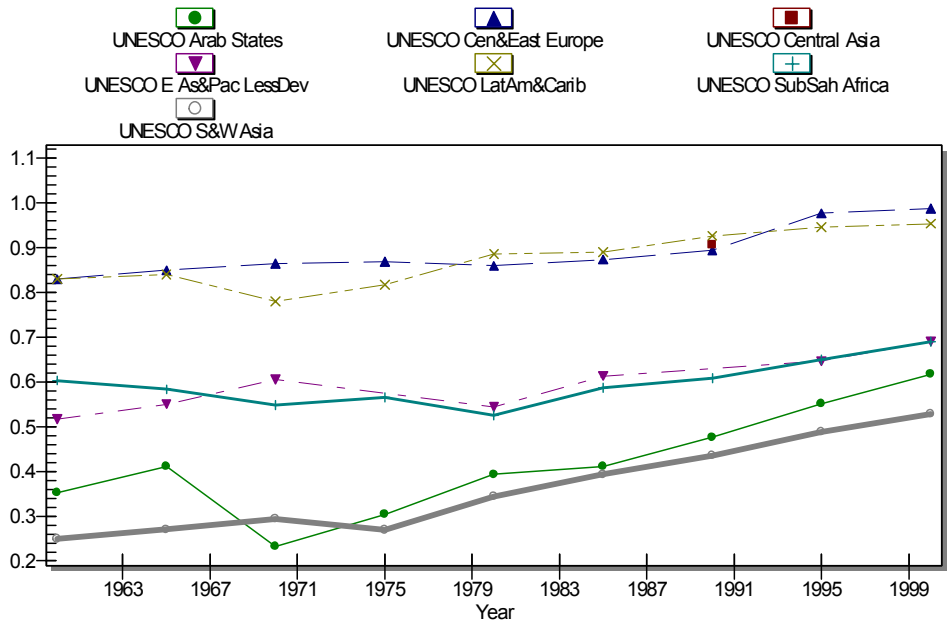

Figure 4.6 Gender parity index of education in adult populations (25+).
Source: IFs Version 6.01, using data from Barro and Lee (2000).
Note: Removed 1975 and 1991 from East Asia and Pacific, Less Developed and used 5-year moving average.

The differences between the gender balance patterns among adults in Figure 4.6 and those in current student populations in Table 4.2 are striking. The gender ratio for years of education in South and West Asia among those 25 and older was only 0.56 in 2005 compared to values above 0.90 for primary and secondary levels of enrollment and 0.74 (with rapid rise in recent years) at the tertiary level. Education among adults in the transitional 15-24 age category is therefore also now quite quickly moving towards gender parity. It will still, however, take at least three generations for the ratios in the full adult population to make the transition.

While Figure 4.6 shows changes in gender parity indices across time in developing regions, Figure 4.7 shows how that relationship looks across countries in recent years and how it relates to the total level of education in a population. Overall, it appears that the gender balance for education in the adult population begins to reach equality when that population has about 8-10 years of education. The substantial contemporary movement towards gender parity in enrollments should, however, steadily reduce that level and shift upward the left-hand tail of the curve in Figure 4.7. The current patterns of adult education levels are, in essence, legacies of generations of imbalance in access to school.

Beyond the general analysis, the sample countries shown by name in Figure 4.7 indicate how frequently countries in Latin America and the Caribbean display a considerably better gender balance than might be expected given the overall pattern represented by the regression line. Conversely, many of the countries below the line are Asian. Obviously, this is not an isolated phenomenon concerning attitudes with respect to women—almost all analyses of "missing women" resulting from child preferences focus on Asia (Sen

1992 calculated the number of women expected on the basis of normal birth ratios and compared that to numbers in the population and found about 60 million globally).

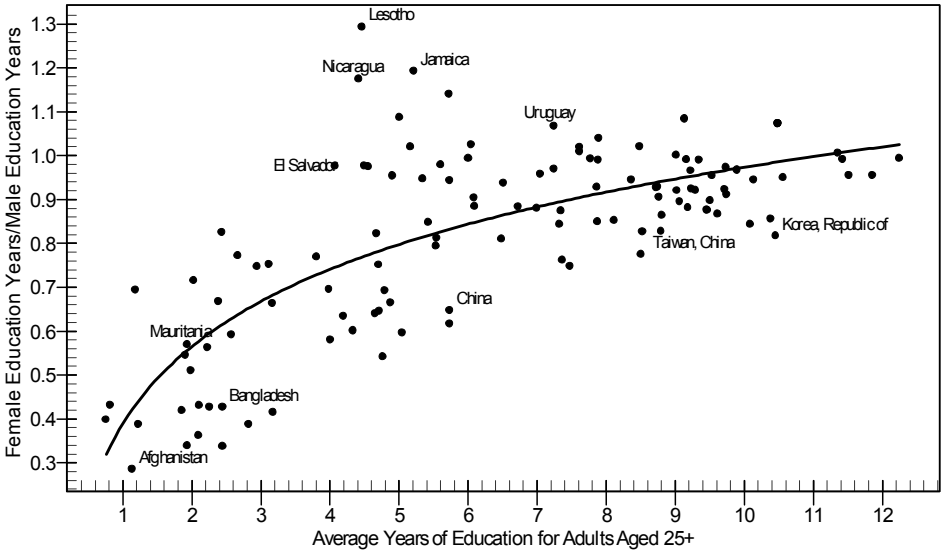

Figure 4.7 Relationship of gender ratio to average education years
Source: IFs Version 6.01, using data from Barro and Lee (1960)
Note: R-squared of 0.55 using logarithmic formulation; patterned after Goujon and Wils (1996: 6)

4.2.4 Literacy

Although more specialized, the best-known measure of educational attainment level is literacy rate. The importance attached to literacy led to inclusion of the literacy rate of 15-24 year olds as one of the three official indicators for universal primary education in the Millennium Development Goals. Similarly, the Dakar Framework called for "achieving a 50 per cent improvement in levels of adult literacy by 2015, especially for women …"

Global literacy is advancing rapidly. Literacy in the developing world grew from 25 to 75 percent during the twentieth century (Cohen, Bloom, Malin, and Curry 2006: 2). By the time an adult population on average reaches 8-9 years of education, it will generally have a literacy rate over 90 percent.[87] Societies vary greatly, of course, and cross-country and cross-region differences have a long history. For instance, Dollar (2007: 7) reported that 21 percent of adults in China were already literate in 1870, above the 15 percent in Latin America and the levels of approximately 3 percent in both South Asia and Africa.

The literacy measure, like others, has its complications. The standard definition is the portion of the population "who can, with understanding, read and write a short, simple statement on their everyday life"(UNESCO 2007b: 233). Literacy can be acquired from

[87] The relationship between years of education and literacy rates, which is generally logarithmic, has an R-squared of over 0.8.

schooling, of course, but there is no clear 1-to-1 match between schooling level and literacy, because of differences in educational quality and learner ability, and also because it is possible to acquire literacy outside of formal education. Therefore the assessments that are generally now considered most reliable have relied on self reporting in household surveys.[88] Through approximately 2004 the UIS produced annual literacy data from 1970 to the current year for about 120 countries, relying in part on countries to report literacy based on educational attainment levels. They then judged the methodology to be flawed, significantly abandoned the earlier data, and have begun reporting much more intermittent entirely survey-based data.[89] In order to get a general sense of the progression of literacy over time, however, we have blended the two series, adjusting the earlier one to be compatible with values from the more recent.[90]

Figure 4.8 shows the resultant progression of adult literacy for UNESCO's standard set of developing countries (with our standard Asian division). In addition to the transition region of Central and Eastern Europe, three developing regions, namely Central Asia, Latin America and the Caribbean, and the developing portions of East Asia and the Pacific (demographically dominated by China) have moved relatively close to universal literacy. The remaining three developing regions, Sub-Saharan Africa, South and West Asia, and the Arab States have much lower literacy rates, but have progressed almost linearly to higher levels, in each case near or above 50 percent. Differences across groupings of countries have narrowed since 1970.

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[88] Because of the intermittent character of such surveys, however, various methods have been used to fill in the holes, including interpolation. Additionally, UNESCO UIS has relied on modeling from IIASA for estimation of future values.

[89] We much appreciate the explanations of this in personal communications from Jose Pessoa of the UIS.

[90] Specifically, we have used the ratio of values from the newer series to the older one (in the same year when possible or as extrapolated from the older data when necessary) to adjust all country-years of the older data when new and old values differ by more than 2 percent.

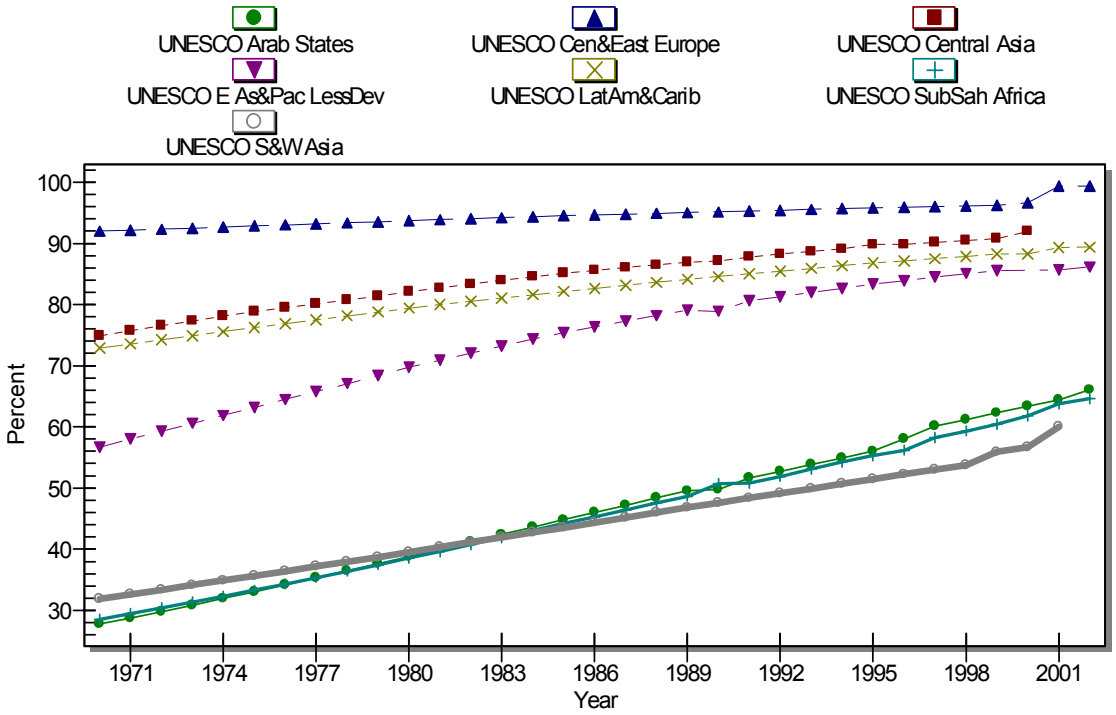

Figure 4.8 Adult (15+) literacy rates
Source: IFs Version 5.48, using World Bank, World Development Indicators. [change when update]
Note: Removed East Asia 2000, South and West Asia 2002, Central Asia 2001 and 2002 because incomplete data causes transients. [as soon as the blended series is available, report it]

Literacy rates in the youngest adult populations, those less than 24, are much higher than those in the full adult populations of most countries. In 2005 there were only about 40 countries remaining in the world where illiteracy of those aged 15-24 was less than 80 percent.

The achievement of gender balance in literacy rates again follows the pattern that we see repeatedly in variables concerning education levels of the adult population (see again Figure 4.3). Specifically, at low levels of education, the imbalance can be substantial. At the lowest levels of literacy, female rates can be 50-70 percent those of males. By the time the literacy rate of young adult populations reaches 80 percent, the female/male ratio is almost always 0.9 or higher.

One of the most interesting aspects of global educational transition is going to be the relationship between the rapid transformation of education levels and human development systems more generally. Although the promise of more educated populations is very great, there will be challenges as well, including possible conflicts between more educated younger generations and older, less educated generations, as well as difficulties, especially for very poor countries in taking advantage of higher levels of

education in economic and socio-political systems (Wils 2007: 6-7). Chapter 8 returns to the "forward linkages" or implications of education.[91]

4.3 Educational spending

Educational analyses emphasize repeatedly that expenditures do not assure quantitative advances in education, much less its quality. At the same time, analyses also emphasize the importance of well-trained and well-paid teachers, adequate infrastructure for education (school rooms and transportation systems that bring students to them), sufficient instructional materials and more. In short, expenditure can be and often is inefficient, but it is essential.

4.3.1 Public spending: global patterns

Two measures of educational spending frame the discussion of total public spending levels: public spending as a percent of GDP and public spending as a percent of total government spending. UNESCO (2007: 11-14) discusses the two measures and their relationship. Public education spending as a portion of GDP puts that spending in the context of all societal resources and for that reason is the main focus of the analysis that follows. In general, education spending as a portion of GDP rises with GDP per capita; in economic terms, education is a superior good and individuals, most often through their governments, spend greater portions of income on it as they become more well to do. Educational funding as a portion of total government spending is also a useful measure of societal commitment. It tends to become a smaller portion of total government spending as societies become richer, however, because total government spending, especially on transfer payments and health, rises even faster than that on education.

Globally, governments spent approximately $1.5 trillion on formal education in 2005, of which non-OECD countries spent about $300 billion. Worldwide we spend about 5 percent of GDP on education.[92] Figure 4.9 shows that there is tremendous variation in that rate by country, but with some tendency for it to increase with GDP per capita.

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[91] It is, of course, important in forecasting completion levels to handle the accounting correctly, that is to advance populations by year and to decrement populations by deaths. Ideally, population forecasting systems would distinguish mortality by educational level, because those who are more educated have longer life expectancies. IFs and other forecasting systems do not do that [does IIASA?], and therefore they will slightly underestimate future educational attainment levels. Most importantly, however, it is essential to feed calculations of completion levels with reasonable forecasts of educational acquisition.

[92] UNESCO (2007: 8) estimated 4.4 percent. See also Cohen, Bloom, Malin and Curry (2006: 2) on spending levels and patterns.

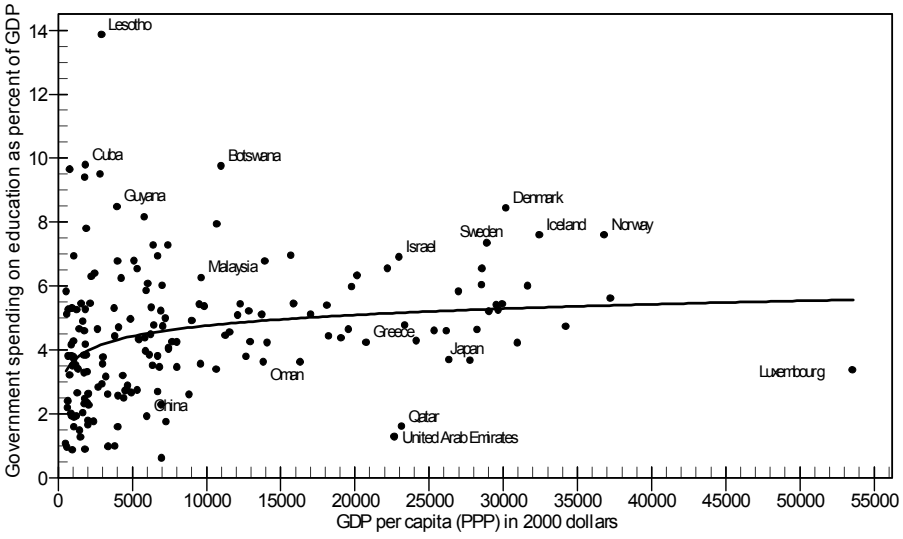

Figure 4.9 Public spending on education as function of GDP per capita (PPP)
Source: IFs Version 6.01, using World Bank, World Development Indicators.
Note: R-squared=0.07 using logarithmic formulation

Figure 4.10 shows that the global push for greater proportions of populations to attend and complete school, regardless of national income levels, coupled with focus on enhancing the quality of education has driven increases in spending levels as a portion of GDP nearly everywhere. It shows the growth over time of education spending as a portion of GDP for countries in four different income categories of the World Bank. Coombs (1985: 139-143) pointed out that the real growth in spending globally was overwhelmingly in the 1960s and to 1974, but that increase did include the low-income countries, for which was growth in spending rate continued fairly steadily through end of the century.

The timing of the big upward shift in most income categories after 1960 is interesting.[93] It was at least in part due to the pressures of the Cold War for investment in human abilities. In the United States and Europe, as well as in Latin America, the period following the Soviet launch of Sputnik coincided with a very large push to improve education. The break-down of colonial empires by the early 1960s also contributed to substantial increase of spending rates in Africa and in South and West Asia. The upward shift presumably also reflected the peak of global population growth rates during that decade, adding demand-side pressure to education for that and at least the next two decades. And not least, the setting of global goals for increased education helped push up spending.

[93] Because data on education spending in 1960 are so much sparser than those by 1970, and because their quality may not be as good, we should we wary about reading too much into the shift of the 1960s. In any case, it appears to have been a one-time event, with typical spending rates not increasing much after that time.

Interestingly, we can also in Figure 4.10 see some downtown in spending for the middle-income countries in the late 1970s and especially in the 1980s, finally reversing in the mid 1990s. That pattern, as well as stabilizing spending for the upper middle income countries through the mid-1980s reflects in part the global debt crisis and the constraints it placed on spending.

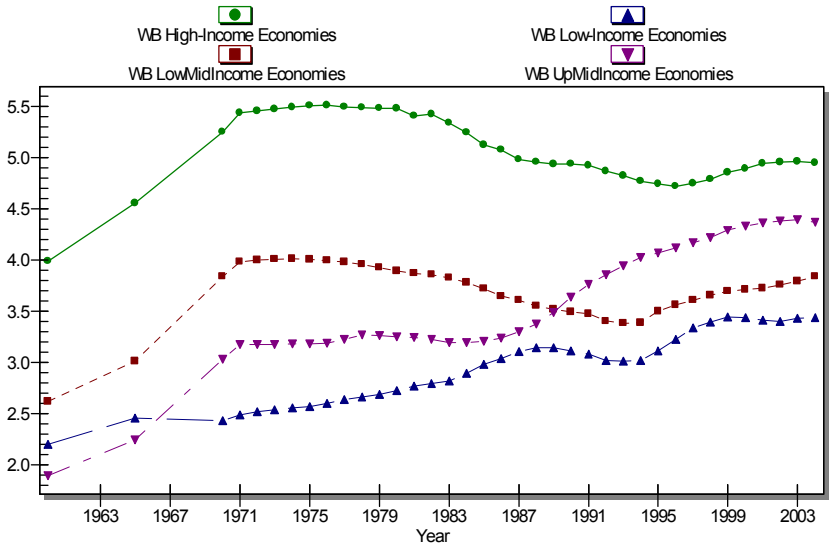

Figure 4.10 Educational spending over time as portion of GDP per capita (PPP), by income category.
Source: IFs Version 6.01, using World Bank, World Development Indicators.
Note: 10-year moving average used to smooth points.

Near the end of the century, spending stabilized or climbed again in all income groups. Many expected an economic dividend from the end of the Cold War, which resulted in a decline between 1990 and 2000 of more than one percent in GDP directed to the military in poor countries and something closer to 2-3 percent for the richest. That may account for part of the increase. Another portion almost certainly reflects somewhat faster economic growth around the world relative to the 1980s and some success in resolving the spending constraints associated with the debt crises following the oil shocks of the 1970s (the aftermath of the 1997 financial crisis is not at all obvious). Most likely the increasingly obvious emergence of the global knowledge economy also helps explain the upward movement after the mid-1990s. Interestingly, the gap between currently upper-middle income countries and high income countries, which was a full 2 percent of GDP in 1960, has now all but closed.

Around 5 percent of global public education expenditures are at the pre-primary level, 30 percent are at the primary level, 35-40 percent are at the secondary level (split fairly equally between lower and upper secondary levels) and the remaining 20-25 percent are at the tertiary level. The high share of tertiary reflects both the relatively higher per student cost of tertiary education and the fact that tertiary students are disproportionately in rich countries of the world.

4.3.2 Public spending: regional patterns

Table 4.4 helps us see the very considerable regional divergence that lies below the patterns tied to income levels. Taking advantage of oil revenues, spending on education was already relatively high in the Arab States in the 1970s and continued to grow thereafter. Most other developing regions, including South and West Asia, moved up the share of GDP going to education by 0.5-2.0 percentage points in the last four decades of the twentieth century, bringing most into the range of 4-5 percent of GDP, similar to spending of high-income countries. A somewhat surprising laggard in such increase has been the poorer subset of East Asia and the Pacific, dominated by China. In recent years China has, however, also announced a plan to significantly increase the portion of its economy committed to education. The major exception to increase in developing regions is Central Asia, where expenditures have fallen dramatically in the post-communist era, not boding well for future development of human potential.

	Public Education Spending as Percent of GDP			
	1960	1970	1990	2004
Arab States	4.20	3.61	4.86	5.47
Central & Eastern Europe	3.55	3.61	3.87	4.33
Central Asia		8.27	7.69	2.98
East Asia & Pacific (Poor)	2.30	2.10	2.07	3.89
Latin America & Caribbean	1.81	3.19	3.37	4.46
South and West Asia	1.71	3.09	3.32	3.72
Sub-Saharan Africa	2.13	3.24	4.64	4.17
North America and Europe	4.06	6.02	5.02	5.46
East Asia & Pacific (Rich)	3.73	3.33	4.12	3.84
World	3.83	5.06	4.55	4.96

Table 4.4 Government spending on education as a percentage of GDP
Source: IFs Version 6.01, using World Bank WDI data, originally UNESCO.
Note: Using 5-year regional averages weighted by country population.
Note: 2004 value for East Asia & Caribbean (Poor) does not include China [redo when available]

The Dakar Framework for Action, agreed upon at the World Education Forum in 2000, declared that "no country shall be thwarted from meeting the [Education for All] goals due to a lack of resources" (UNESCO 2007: 3). It seems highly improbable that expenditures of GDP in the 1-3 percent range, which characterized about 30 countries in the 2000-2005 period are adequate for universal primary education, much less for good quality of it. The push in recent years for higher intake, enrollment and completion rates has strained the economic resources of low-income countries, and some have been unable to or have failed to respond with public support. For example, the groupings of African countries discussed earlier that have low and moderate rates of net primary enrollment spend on average somewhat less than 2.5% of their GDP on education, while the African countries with high primary enrollment average more than 4.5%.

4.3.3 Public spending per student

Turning from the aggregate level to spending per student, high-income countries spend about 20 percent of GDP per capita to educate each primary student (Chapter 6 explores in much more detail current patterns of spending per student at all levels across regions and countries of the world). Spending per student relative to GDP per capita is a useful comparative measure in part because on a global basis salaries, which vary by GDP per capita, make up 75 percent of total education spending across pre-primary through upper secondary levels. Other current spending is 15 percent of the total, and capital spending constitutes the balance.

Poorer countries, and necessarily those with higher population growth rates and young population proportions, often spend a considerably smaller portion of GDP per capita on each student.[94] On average, low-income countries spend about 10 percent of GDP per capita on each primary student. Figure 4.11 provides perspective on how expenditure patterns vary across low- and middle-income areas of the world and have been changing in those areas. It suggests some degree of global convergence in recent years (although especially sparse data before 1998 should temper that conclusion). For instance, there has been steady upward movement of spending per student in Latin America from very low levels, consistent with some diminution of demographic pressure and with more attention to education. In contrast, the breakdown of communism is apparent in the decreases of per capita spending in both Central and Eastern Europe and Central Asia.

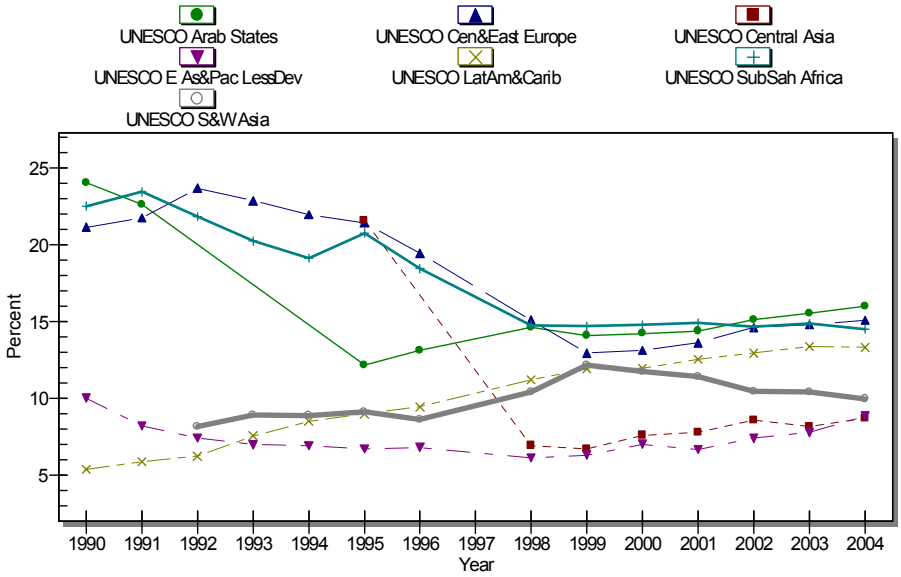

Figure 4.11 Education spending per primary student as percent of GDP
Source: IFs Version 6.01 using data from World Bank, *World Development Indicators*, originally UNESCO.
Note: Figure uses 5-year moving averages; data prior to 1998-1999 are sparse.

[94] All countries where those of primary school age constitute 12 percent or less of the total population have achieved universal primary education (UNESCO 2007: 29).

One of the more striking trends in Figure 4.11 is some erosion of spending per student in Africa. This has many drivers, including continued demographic pressures, expansion of primary enrollment, and the growth of enrollments above the primary level. There is almost certainly one additional factor of importance. In general, expense per student tends to be more expensive in the early phases of development of education at any level in any part of the world than in later expansion of educational systems (Chapter 6 returns to this issue). For instance, poorer countries with lower enrollment rates often spend higher portions of GDP per capita on each secondary and tertiary student that global average spending, in substantial part because the structural foundations for efficient and lower cost education are not in place. In countries with high secondary enrollment rates, secondary education seldom costs more than 1.5 times that of primary students (UNESCO 2007: 25). In some of the poorer countries that ratio is more than a factor of 2.0. In countries with high tertiary enrollments, the cost per student never exceeds 2.75 times that of primary students (UNESCO 2007: 25), but in low enrollment and generally poorer countries the cost per tertiary student can be 5-50 times that of a primary student.

4.3.4 Private spending

More than three-fourths of total global spending on education is public. Figure 4.12 shows the portion of GDP devoted to education from private funds, in total and by level (compare overall spending with public rates in Table 4.4). Overall, about 1.5 percent of global GDP is spent privately on education.[95] That number testifies strongly to the importance that citizens afford education and to the significant private benefits of it. Very few countries provide data on private spending, however, and measurement quality varies greatly. Moreover, public spending sometimes supports private schools and private tuition sometimes is paid to public schools, making separation of the two income and expenditure streams very difficult.

Clearly, tertiary education receives the bulk of private spending, consistent with the social value that governments place on lower levels and with the increasing private value that higher education has. Even citizens of lower and upper middle-income countries spend on average nearly 0.5 percent of GDP on private tertiary education. Citizens in Latin American countries average about 0.6 percent. Those in Central and Eastern Europe and in Central Asia are fairly close behind. In many countries of these regions, people believe that advanced private educations, in business or technical fields, offer more potential for advancement than do programs in public institutions.

[95] This figure may somewhat exaggerate the reality because it comes only from reporting countries. Countries that spend more may be more likely to report; and rich countries with high private tertiary expenditures, may be somewhat over-represented.

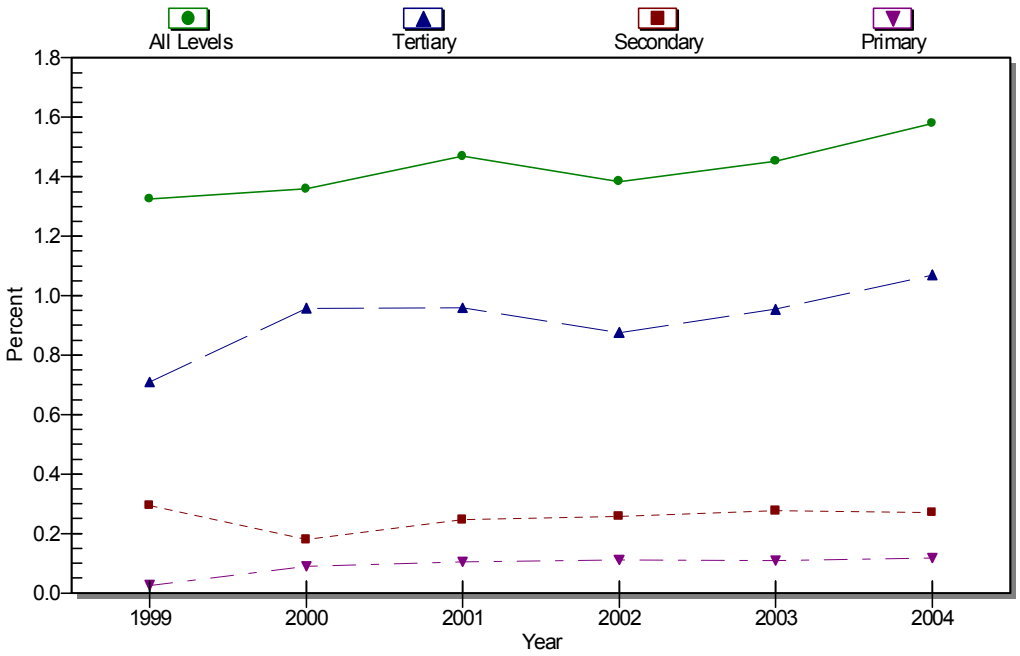

Figure 4.12 Private education spending as a percent of GDP
Source: IFs Version 6.01, using data from World Bank, *World Development Indicators*, ultimately UNESCO.

The data of Figure 4.12 suggest that using public spending as a proxy for total spending at lower levels of education is not unreasonable. As described in Chapter 3, the IFs modeling system does that because (1) the private share is normally small and (2) we simply do not have private data for many countries.

External assistance is another possible source of educational expenditure. Between 1999 and 2004, commitments of aid from donor countries more than doubled from $1.3 to $3.3 billion dollars (UNESCO 2007: 42). Although that amount is miniscule in the scope of global spending, it can be very significant for the very poorest countries[96] Chapter 6 returns to a discussion of both external spending on education and spending more generally in the context of developing a normative scenario for global educational expansion.

[96] Birdsall, Levine, and Ibrahim (2005: 34) indicate that bilateral official development assistance for education rose from about 1 percent of the GDP of developing countries in the 1970s to as much as 4-6 percent by the late 1990s. That seems improbable given that it would have required $3.6 billion simply to cover 4 percent of the GDP of Sub-Saharan Africa. The numbers probably refer to Least Developed Countries only, for which 4% of GDP in 2000 would have been a bit below $3 billion.

4.4 Conclusions

Educational change is a set of interrelated transitions. Contemporary focus is appropriately very heavily on increasing enrollment rates, especially at the primary and increasingly the lower secondary levels. Movements towards universality of flows through basic education take time, however, measured historically in many decades. That is especially true for the last sub-populations to enter the process of schooling. What may appear to be slow rates of change in recent years appear very rapid in longer historic context.

Patterns of change in recent decades and across countries and regions have been variable. The 1960s and 1970s were an especially rapid period of growth in student numbers and spending on education, while many countries struggled more during the 1980s and the first half of the 1990s. Increases in enrollment rates have been accelerating again in recent years.

Ultimately, the transition that perhaps matters most is in the level of educational attainment by the broad population—in what is often characterized as the stock of education or human capital. The transition of societies from low rates of enrollment and completion to universal primary and lower secondary education, to very nearly universal upper secondary education, and to very high rates of tertiary education, undergirds the transition to high levels of adult attainment. Average years of education that adults have acquired is an important measure of such attainment. Literacy is a more specific but critically important measure. Transformation of societies from low to high levels of educational attainment is a relatively slow process with at least a century-long scale, if only because of the human life span and the resultant slow diffusion of educational attainment increases across the age structure. By historic standards that transition is also very dramatically underway around the world.

Although equity demands that gender equity be achieved as well at lower rates and levels, high rates of flow through school and high levels of educational attainment in a society require movement to gender equity in education. This transition, too, has been progressing rapidly and has been significantly finished at lower levels of education in most of the world, but remains quite far from completion in many countries. Reverse gender gaps are appearing in tertiary education of high-income countries.

Most fundamentally for this volume, while all of these interacting educational transitions have been playing out at significant pace, there is obviously much more to come. Subsequent chapters explore how these transitions may continue to unfold and consider possible variations in their patterns.

5. What Path Are We On?

Building on the historic context, this chapter explores a base case forecast of the future of global education as it now appears to be unfolding. We want to consider the evolution of student enrollments and completion of education at all levels and to explore the implications of those patterns for adult educational attainment. It is, of not possible to isolate enrollment patterns from financial needs and availability of funds, so we consider that also.

The base case forecast of global education, while it rests on recent trends, is not a simple extrapolation. Instead the IFs system produces it using a dynamic representation of relationships between education and other components of human development systems, notably demographic, economic, and socio-political futures. For instance, the IFs base case forecasts of population, GDP per capita, and government spending interact closely with student numbers, adult educational attainment, and spending on education.[97] Because forecasts of such key interacting systems can vary considerably, we look in the second section of the chapter at alternative forecasts for those key variables and consider how they might affect our base forecast of educational futures.

We know, of course, that all forecasts are flawed and uncertain. Comparing the IFs forecasts with those of others, the objective of the final section, will help us discuss the confidence that we have in the IFs forecasts and those of educational forecasting more generally. To a very considerable degree, however, human leverage with respect to educational transitions will occur within the general range of our base case and the alternatives considered in this chapter, a subject to which Chapter 6 will then turn.

5.1 The IFs base case forecast

Many forces, not least significant economic advance in combination with public and international political will, have pushed global education forward in recent years. In spite of historically rapid and accelerating progress in global education over the last 50 years (and some shorter-term acceleration since the mid 1990s following earlier disruptions), there are certainly many countries and educational levels where educational progress could accelerate further. It is important to emphasize also, however, that there are some brakes on and even limits to such expansion. Among them are:

- Demographic transitions tend to precede educational ones, in part because very rapid population growth greatly strains educational resources; global demographic transitions to low fertility rates, especially in Africa, have far to go and the current high fertility adds much to strain on educational systems.

[97] Other documents provide information on the base case of IFs. See especially in this series Chapter 5 of the first volume on *Reducing Global Poverty*.

- More prosaically, increases in completion at lower levels must precede increases at higher levels.

- There are also financial constraints, and we have seen that higher-income societies have not significantly increased the share of GDP that they devote to education for several decades; most low and middle-income countries have raised the share of GDP spending close to that of high income countries, limiting the likelihood of further rise.

- In addition, although not yet addressed there certainly also are constraints that arise from the demand side of the process; not everyone in poorer, heavily agriculture-based societies wants or needs higher education.

Where the historic trends take us depends on the interaction of the forces that accelerate and those that brake change. The educational forecasts of IFs are, as emphasized repeatedly, not simple extrapolations of past patterns. Instead, the flow of students through various levels is responsive to both demand-side and supply-side forces, both the changing desire and economic need for education and the changing ability of countries to provide it.

Again, it is student flow through the educational system that ultimately determines the long-term future of education in a population. We therefore start with base case forecasts of those flows and then move to analysis of the resultant educational levels in the broader population.

5.1.1 Student population flows: acquisition of education

Rates of enrollment at all levels of education are advancing around the world. Gross primary enrollment rates globally now exceed 100 percent and attention is appropriately on net primary enrollment, which is rapidly approaching 90 percent. (In this study we recognize 97 percent to be a good cut-off for universal enrollment, but because of structural constraints in both the real world and the model on obtaining even that level, we pay much attention to 90 percent as "nearing universal enrollment."[98]) Figure 5.1 shows that push upward, as well as those for gross lower secondary (rapidly approaching 80 percent and rising in tandem with primary),[99] gross upper secondary, and gross tertiary. By mid-century both gross lower and upper secondary will likely be near 90 percent, a remarkable achievement.

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[98] Much attention in this study to 90 percent enrollment recognizes that the level is nearing universality but falls below it. Because of the great difficulty of enrolling the last 10 percent, in fact the near impossibility of enrolling the last 2-3 percent, universal enrollment is not generally interpreted as meaning 100 percent. Even in high-income countries, values in 2005 fell below that level: Denmark (95.8), France (98.6), Japan (99.8), Switzerland (89.9), and the United States (91.6). Hence, the *EFA Global Monitoring Report* (UNESCO 2007b: 180) categorized country prospects for universality in 2015 based on a 97 percent net enrollment rate.

[99] The forecasts here above the primary level emphasize gross enrollments because of stronger data in most cases and the structuring of the model around gross enrollments.

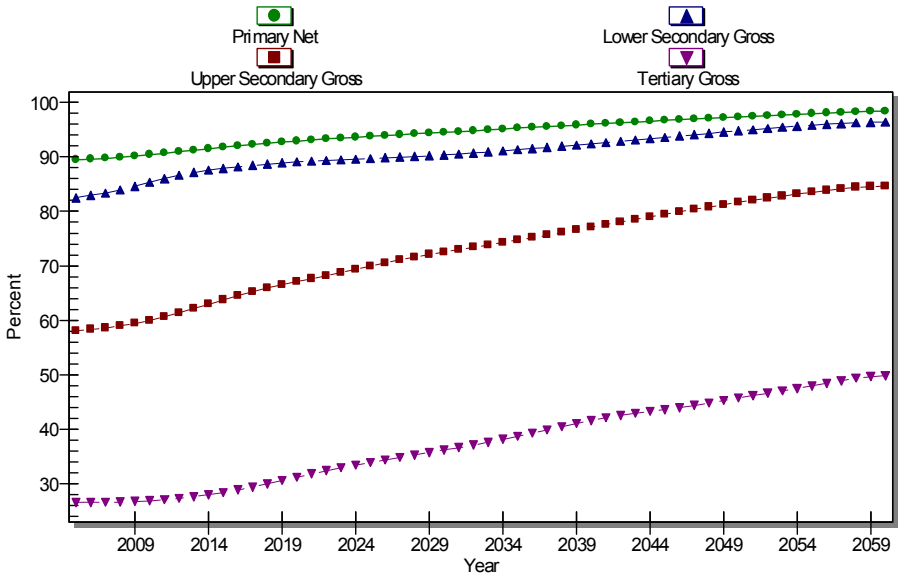

Figure 5.1 Global educational enrollments by level
Source: IFs 6.01.

The 89 percent global net primary education rate of Figure 5.1 for 2005 concealed, of course, significant regional variation. Table 5.1 reiterates that variation as well as showing forecasts of all of the series that Table 4.1 presented historically.[100] Although the IFs base case clearly does not anticipate universal primary education by 2015, Table 5.1 shows that even the regions with the current difficulties now (and nearly all countries within them) will likely have reached that goal by 2060.

Thus between now and mid-century, the attention of the globe will have shifted to universal lower secondary education and even higher levels. Gross enrollment rates overestimate the progress to universal education, but the quite high rates at the lower secondary level in 2060, even in sub-Saharan Africa, suggest that before mid-century most focus will be on completing basic education and more.

[100] The values for 2005 in Tables 4.1 and 5.1are not identical because values in the latter include IFs estimations for 182 countries, not all of which provide data, and also include IFs adjustments made to reconcile all of the initial enrollment data for the model.

	Net Primary				Gross Primary			
	2005	2015	2030	2060	2005	2015	2030	2060
Arab States	84	88	93	99	97	100	101	102
Central & Eastern Europe	91	97	100	100	110	118	110	100
Central Asia	85	92	100	100	101	111	106	100
East Asia & Pacific (Poor)	97	99	99	100	108	107	101	100
Latin America & Caribbean	94	97	99	100	120	115	106	100
South and West Asia	85	89	94	98	110	112	107	102
Sub-Saharan Africa	68	70	78	95	92	96	101	106
North America and Europe	94	98	100	100	103	104	101	100
East Asia & Pacific (Rich)	98	99	100	100	101	101	100	100
World	89	92	95	99	107	107	103	102

	Gross Lower Secondary				Gross Upper Secondary			
	2005	2015	2030	2060	2005	2015	2030	2060
Arab States	80	89	94	102	56	65	76	93
Central & Eastern Europe	91	107	107	100	89	103	108	103
Central Asia	93	103	106	100	79	88	101	100
East Asia & Pacific (Poor)	92	100	97	99	54	64	77	92
Latin America & Caribbean	101	106	104	102	74	81	86	93
South and West Asia	66	75	88	97	38	45	63	84
Sub-Saharan Africa	41	46	55	86	23	26	33	58
North America and Europe	103	103	102	101	98	100	101	98
East Asia & Pacific (Rich)	101	102	101	102	102	104	104	103
World	82	88	90	97	58	64	73	85

	GrossTertiary			
	2005	2015	2030	2060
Arab States	18	21	28	52
Central & Eastern Europe	57	56	63	778
Central Asia	28	29	41	53
East Asia & Pacific (Poor)	21	25	37	57
Latin America & Caribbean	30	31	41	6862
South and West Asia	10	13	22	42
Sub-Saharan Africa	5	5	8	15
North America and Europe	69	72	83	98
East Asia & Pacific (Rich)	64	68	80	97
World	27	28	36	50

Table 5.1 Enrollment rates across time and levels
Source: IFs 6.01.
Note: Net primary enrollment is adjusted and contains one year over and under age students. Compare with Table 4.1.

The historic review of Chapter 4 noted that, except for Afghanistan, all countries with net primary enrollment rates below 50 percent in 2000 were in Africa. And, in fact, all but four countries with net primary enrollment between 50-70 percent were in Africa. Figure 5.2 therefore extends the historic pattern (see again Figure 4.2) for three sets of African

countries with the forecast of the IFs base case. The focus of this volume through 2060 proves long enough to capture the anticipated movement of primary enrollment rates to universality in the set of African countries with mid-range enrollment rates currently, but not quite long enough for those with the lowest enrollment rates.

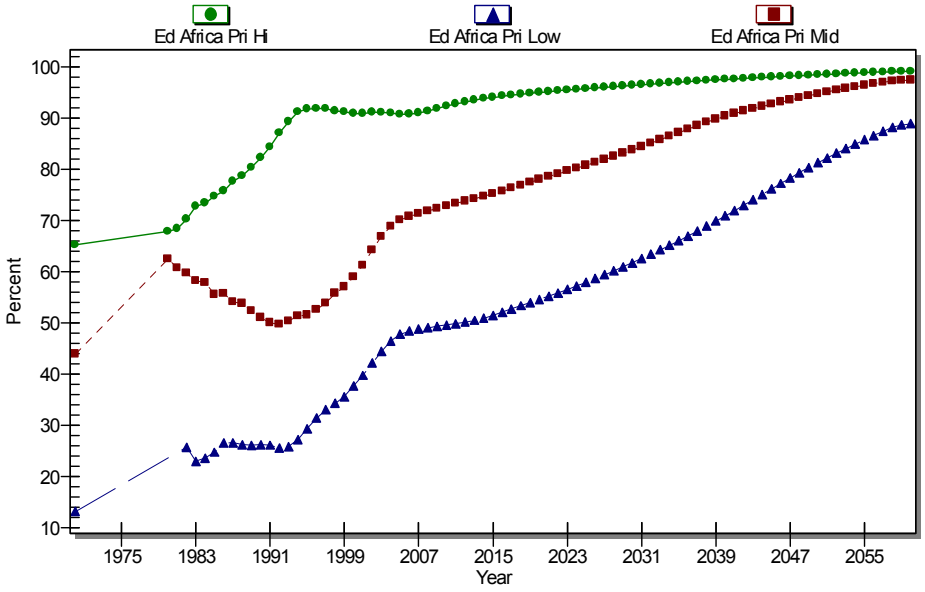

Figure 5.2 Net primary enrollment in three African country groupings (history and forecast)
Source: IFs 6.01, with data from UNESCO.
Note: Used 5-year moving average after removing 1975 for high- and middle-enrollment groupings and 1981-1982 for the low-enrollment grouping. Historical data through 2004.

On the basis of pure extrapolation, one would challenge that late-achievement forecast for the low-enrollment group. Continuation of the acceleration of growth in enrollments that began for its members in the mid-1990s would bring the group to universal net primary enrollment by about 2025. There are, however, many reasons to believe that such extrapolation would be in error:

- The low-enrollment group had a period of flat growth in the 1980s. Were one to trust the 1970 values and extrapolate all historic growth between then and 2004, the group would achieve universal net primary enrollment by 2055.

- The historic experience of the mid-enrollment grouping has demonstrated that reversal of gains is also quite possible, particularly in periods of "bust" in commodity price cycles or financial crises.

- Included in this group of countries are many that have had and/or are currently having significant political turmoil. In fact, in 2008 the Fund for Peace and *Foreign Policy* placed six of the 10 countries in the group on their failed-state list

at the "critical" level.[101] From the most problematic end of that list, those six are Somalia and Sudan (in the top two positions), followed by Guinea, Ethiopia, Niger, and Guinea-Bissau.

As has been emphasized by all forecasts of educational flows, reaching the MDG of universal primary education by 2015 was never a reasonable goal for all countries. The base case shows a continuation of the historically rapid transition of recent decades, but also indicates that much time is likely still required to meet the goals that the global community has already set. Subsequent analysis (Chapters 6 and 7) will consider whether, in a more aggressive scenario, a more rapid transition than that of the base case might be possible.

One aim of this study is to help consider reasonable goals for primary and secondary education across country sets and even for individual countries, as the world looks beyond 2015. Although most countries will have achieved universal primary education by that time, the IFs base case forecast identifies 60 that may not achieve that level (Table 5.2). In fact, 41 of those may not achieve it by 2030. By 2060 nearly all are likely to do so.

Looking beyond the current Millennium Development Goal for education must, however, involve elements beyond the temporal. Increasingly, attention is moving to basic education, combining lower secondary years with primary ones. (Chapter 2 discussed the importance of lower secondary education in the broader human development transition, particularly for women.) Table 5.2 therefore also shows all countries that may not yet have reached 90 percent lower gross enrollment by 2015, and the subsets of them that may not reach that goal by 2030 and 2060.[102] The two columns of Table 5.2 together indicate the very significant challenge that the world faces as it seeks to move to universal basic education. Given the difficulty of enrolling that last 7-10 percent (97 percent is often used to indicate universal enrollment), the challenge is even somewhat greater than the table indicates.

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[101] See www.fundforpeace.org for the most recent listing.

[102] Among the surprising entries in Table5.2 is Singapore, one of the economically most competitive countries in the world on nearly every list. Yet the UIS data show decreases since 2000 in both net primary enrollment and gross lower secondary enrollment, bringing recent values down to or just below 80 percent.

Unlikely to achieve 90% net primary enrollment by 2015	Unlikely to achieve 90% gross lower secondary enrollment by 2015
Afghanistan, **Angola**, **Benin**, Bhutan, Bosnia, **Burkina Faso**, **Burundi**, **Cameroon**, ***Central African Republic***, ***Chad***, **Comoros**, **Democratic Republic of the Congo**, **Republic of the Congo**, **Cote d'Ivoire**, ***Djibouti***, Dominican Republic, ***Eritrea***, **Ethiopia**, *Gambia*, **Ghana**, **Guinea**, ***Guinea Bissau***, **Haiti**, Kenya, **Democratic Republic of Korea**, Kyrgyzstan, Laos, Lebanon, Lesotho, **Liberia**, Madagascar, Malawi, **Mali**, **Mauritania**, **Mozambique**, Namibia, **Nepal**, Nicaragua, ***Niger***, **Nigeria**, **Oman**, **Pakistan**, **Palestine**, **Papau New Guinea**, **Rwanda**, Sao Tome and Principe, **Saudi Arabia**, **Senegal**, Singapore, ***Sierra Leone***, **Solomon Islands**, ***Somalia***, **Sudan**, Swaziland, **Timor**, **Togo**, Uganda, Uzbekistan, **Yemen**, Zimbabwe	***Afghanistan***, **Angola**, **Bangladesh**, ***Benin***, **Bhutan**, **Burkina Faso**, ***Burundi***, **Cambodia**, ***Cameroon***, ***Central African Republic***, ***Chad***, **Comoros**, ***Democratic Republic of the Congo***, **Republic of Congo**, **Cote d'Ivoire**, **Djibouti**, **Dominican Republic,** Ecuador**, El Salvador,** Equatorial Guinea**, Eritrea**, ***Ethiopia***, **Gabon**, **Gambia**, **Ghana**, ***Guinea***, ***Guinea Bissau***, **Haiti**, **Honduras**, India, **Indonesia**, **Iraq**, **North Korea**, **Laos**, Lesotho, ***Liberia***, ***Madagascar***, ***Malawi***, **Mali**, ***Mauritania***, Morocco, **Mozambique**, **Myanmar**, Namibia, **Nepal**, Nicaragua, ***Niger***, **Nigeria**, **Pakistan**, **Papau New Guinea**, **Paraguay**, Philippines, ***Rwanda***, ***Sao Tome and Principe***, **Senegal**, ***Sierra Leone***, **Singapore**, **Solomon Islands**, ***Somalia***, **Sudan**, **Swaziland**, ***Tanzania***, **Timor**, ***Togo***, **Uganda**, **Vanuatu**, **Yemen**, ***Zambia,*** **Zimbabwe**

Table 5.2 Countries with low enrollment forecasts
Source: IFs 6.01.
Note: Bold face indicates countries unlikely to reach indicated target by 2030 and italics indicates countries that may not reach target by 2060.

The challenge of reaching universal primary enrollment faces not only Africa—18 countries outside of Africa are unlikely to reach 90 percent net enrollment by 2015. The challenge of reaching universal lower secondary education is even much more clearly a global one. Figure 5.3 helps us understand better the pattern that non-African countries with low rates of lower secondary enrollment may follow through mid century. The figure restricts its focus to the 13 countries outside of Africa with gross secondary enrollment below 60 percent in 2005 (see Chapter 4 for this set). Most of those countries already have high levels of gross primary enrollment and significant levels of net primary enrollment; the IFs base case forecast is that they will reach the 90 percent rate by 2045. They may approach 90 percent gross lower secondary enrollment by 2060 and reach about 60 percent higher secondary enrollment in the same year.

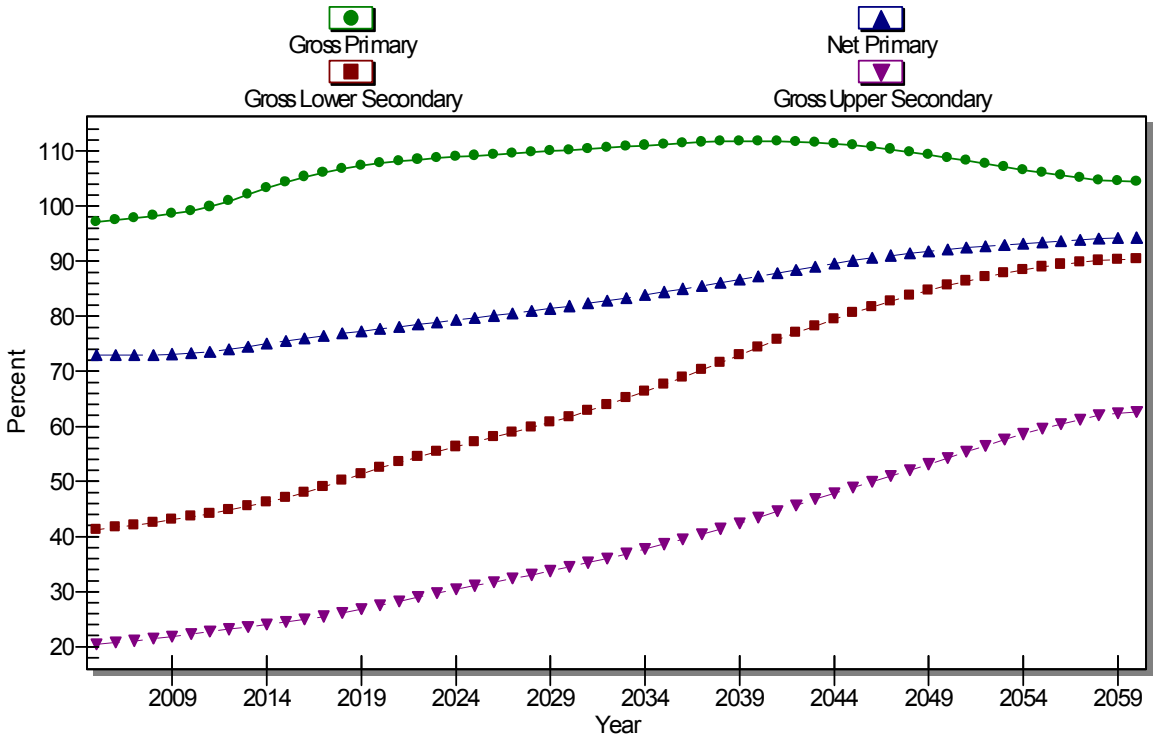

Figure 5.3 Education forecasts for non-African countries with gross lower secondary enrollments below 60 percent
Source: IFs 6.01 base case.
Note: Used 5-year moving average; assessment of lower secondary enrollments in 2005 or most recent year of data.

Turning to forecasts of gender balance, high income countries have reached gender parity for females at all levels of education, and, in fact, have a reverse gender gap at the tertiary level where the enrollment ratio is nearly 1.2. Figure 5.4 shows that gender parity ratios for low and middle income countries (using non-OECD countries as a proxy) have increased rapidly in the last three decades. There remain many countries below the 97 percent ratio that is often used as an indicator of parity, however, and the forecast of the IFs base case suggests that many will still likely fall below that level by 2015. Those include Afghanistan, Angola, Benin, Brazil, Burkina Faso, Burundi, Cameroon, Central African Republic, and Chad. The forecast tables at the end of this volume provide detail also on this variable.

Ironically, given the continuing gender imbalances at lower levels, the sparse data available (not shown in Figure 5.4) indicate that a reverse gender gap has already developed for these countries in the aggregate at the tertiary level. In addition to important remaining issues around gender gaps for many countries at the primary and secondary level, one of the great uncertainties in forecasting through mid-century is whether reverse gender gaps will continue to grow in high income countries and increasingly climb also in the developing world.

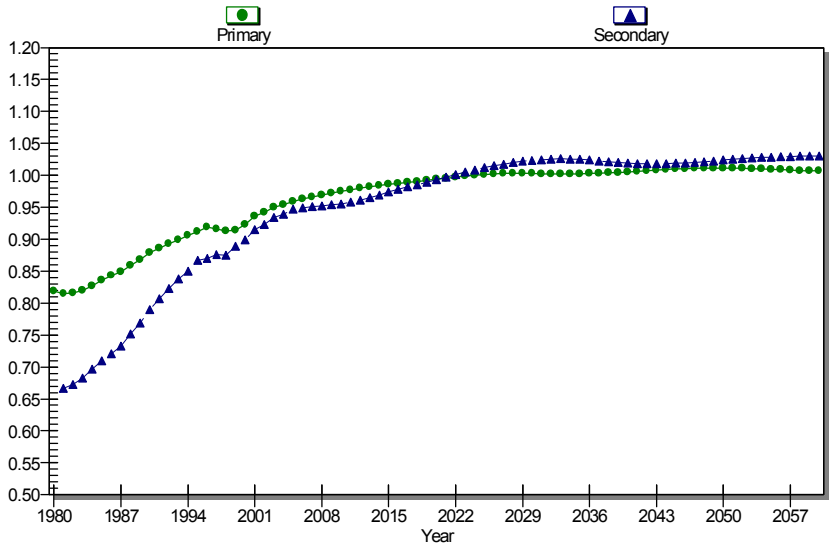

Figure 5.4 Gender parity indices of low and middle-income countries
Source: IFs 6.01, using UNESCO data.
Note: Used 5-year moving average after removing 1980 value at the secondary level.

Overall, the base case of IFs suggests that the multiple global educational transitions will continue to progress steadily and even rapidly around the world. Yet there are, as indicated earlier, many constraints on the progress of those transitions and many countries in which they are not moving smoothly.

5.1.2 Educational attainment of adults

Even those who may joke that education is about getting the kids out of the house and into schools know it to be about a great deal more. It is about enhancing human capabilities. Societies seek to educate children in order to have educated adults. Figure 5.5 shows the pattern of adult education, measured in terms of average years of education, in the IFs base case forecast, as an extension of historical data (compare with Figure 4.5). The forecast, which anticipates that adults in all regions of the world will have 6 years or more of education by mid-century, looks almost like an extrapolation of past growth patterns.

There are, however, some slowly occurring but important changes beneath the surface of roughly parallel lines. First, the absolute gaps between regions may be staying fairly constant, but the relative adult educational levels are narrowing. For instance, in 1960 Africa's 1.5 years of average adult education was only 21 percent as much as the 7 years in North America and Western Europe. In the base case forecast, Africa's 7 years in 2060 (in addition to being fundamentally the same educational level as the highest income countries in the world had in 1960) would be approaching 50 percent of the 14.5 years in North America and Western Europe.

Second, there are some small relative changes in regional position over time. Sub-Saharan Africa is at risk of falling increasingly behind the "pack." And Eastern and Central Europe look likely to fall away from and behind the system leaders, a pattern that is even more evident for adults 25 and older. Other regions as a whole are very slowly closing the absolute gap with the system leaders. In particular, the progress of the Arab states and of South and West Asia is notable. One of the few surprises in the IFs base case might be the substantial closing of the gap between Europe and North America by mid-century (not shown in Figure 5.5). That closure reflects in part a continued expansion of tertiary educational opportunities in Europe.

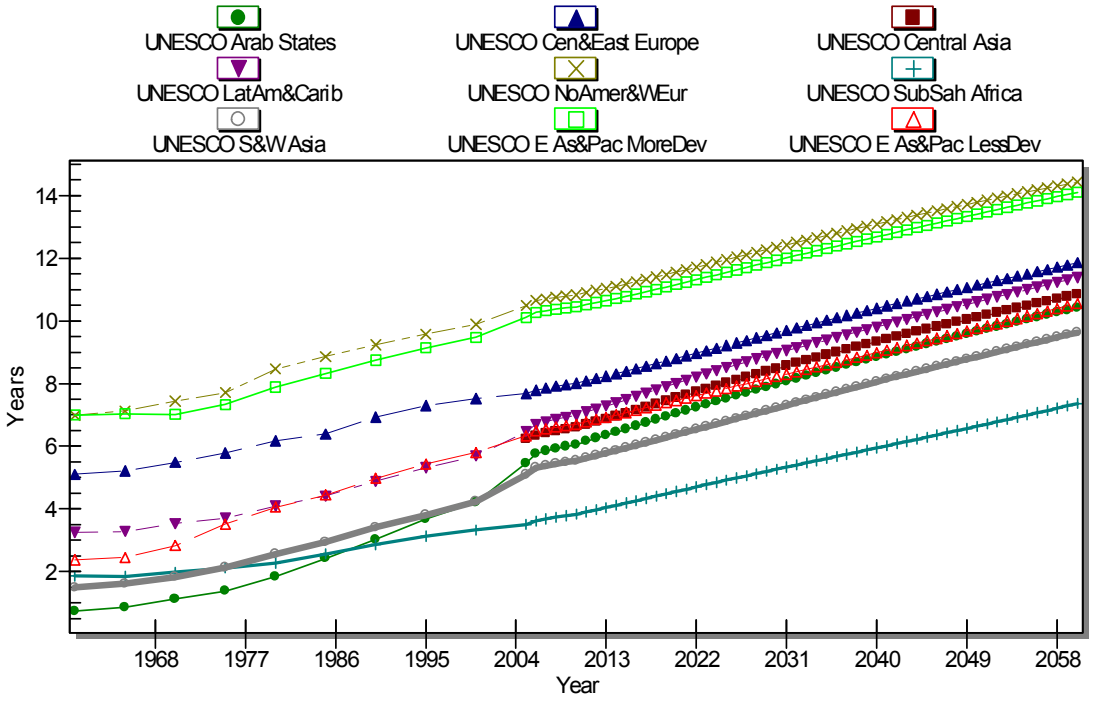

Figure 5.5 Years of education of adults, 15 years and older, history and forecast.
Source: IFs 6.01, using data from Barro and Lee (2000).
Note: Used 10-year moving average.

Throughout the continued unfolding of growing levels of adult education, there will, of course, continue to be somewhat higher levels of education among younger adults than among those who are older. Today the pattern in many developing countries is one of numerous, increasingly well-educated young adults in combination with older adults, especially females, with very few years of education. In Figure 5.6 the upper-left educational pyramid for India in 2005 shows such a pattern. For those aged 45 and more, tertiary education is rare among men and even completed secondary education is rare among females.

In contrast, however, by 2060 both demographic and educational structures of the Indian population will most likely be dramatically different. In the upper-right of the figure one can see that for those aged 30 or younger, primary education will be essentially universal. In fact, those with secondary and tertiary educations will each likely exceed those with primary education only. Significant levels of secondary and tertiary education will characterize all cohorts through a working life-time. The largest population cohorts will still be in, if nearing the end of the prime years of their careers, boding well for continued economic dynamism through the first half of this century.

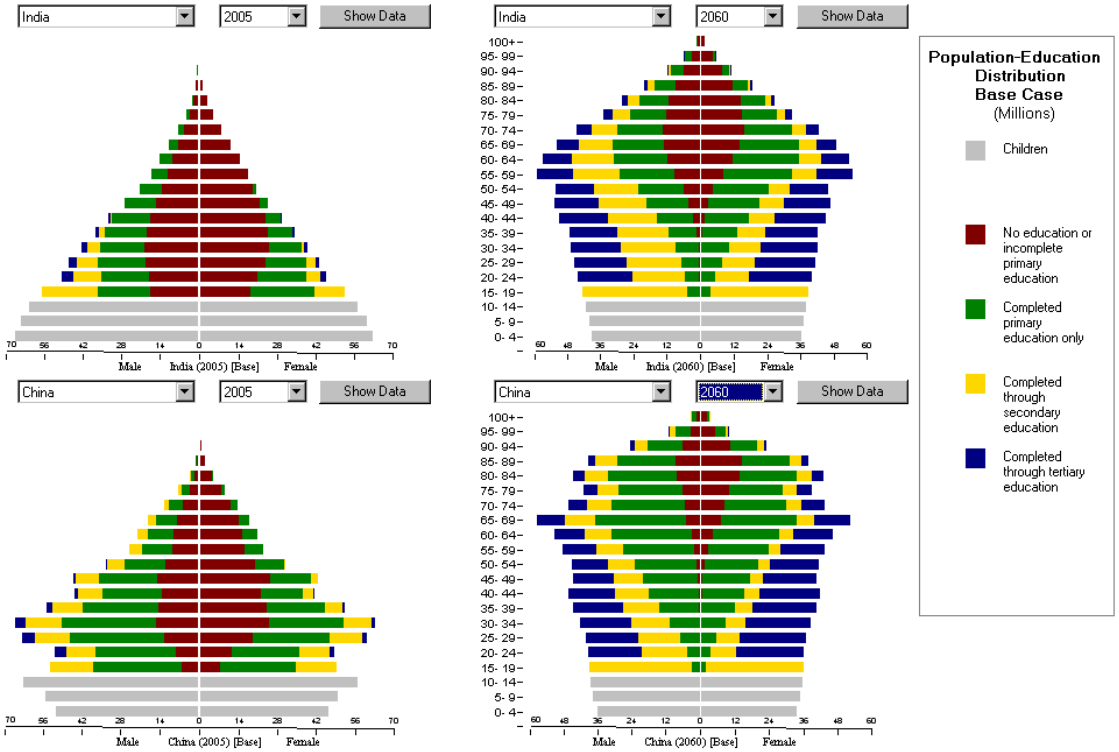

Figure 5.6 Education by age, sex, and level completed
Source: IFs 6.01.

In China the educational patterns will evolve in much the same manner. By 2060 very few Chinese without at least a primary education will remain in the work force. The greatest difference between China and India is already apparent in the shape of the age-sex distribution of China in 2005, a pattern that looks more like that of Greece, Portugal or Spain than it does of India. By 2060, the distributional shape of the Chinese age structure will look more like that of Japan or Italy in the coming two decades than that of India. Most notable, the largest population cohort that China is likely ever to have will have already reached retirement age.

Completed Primary Education (Percent)				Total	Females
	1960	2000	2030	2060	2060
Arab States	6.4	42.2	69.1	84.4	82.2
Central & Eastern Europe	60.3	84.1	84.5	91.9	90.4
Central Asia	26.7	72.1	82.4	91.5	90.9
East Asia & Pacific (Poor)	24.4	59.3	77.2	89.5	87.6
Latin America & Caribbean	27.4	49.9	72.4	86.9	86.2
South and West Asia	10.6	37.2	63.0	80.0	78.7
Sub-Saharan Africa	14.3	27.1	48.4	69.5	68.4
North America and Europe	73.3	85.5	89.7	95.8	95.7
East Asia & Pacific (Rich)	67.4	86.2	91.8	96.4	95.5
World	38.9	55.8	70.7	83.5	82.2

Completed Secondary Education (Percent)				Total	Females
	1960	2000	2030	2060	2060
Arab States	0.9	15.2	37.4	55.0	56.1
Central & Eastern Europe	12.9	28.8	51.9	72.4	71.8
Central Asia	1.9	14.0	53.1	74.5	73.4
East Asia & Pacific (Poor)	3.2	17.9	31.5	51.5	51.7
Latin America & Caribbean	5.7	19.5	42.4	61.1	63.5
South and West Asia	0.8	11.2	24.8	42.0	38.0
Sub-Saharan Africa	1.8	4.4	12.0	23.5	23.9
North America and Europe	18.1	50.5	65.6	79.0	82.4
East Asia & Pacific (Rich)	26.6	44.2	65.9	84.2	83.0
World	9.0	21.0	33.9	48.9	48.5

Completed Tertiary Education (Percent)				Total	Females
	1960	2000	2030	2060	2060
Arab States	0.1	3.3	12.1	25.4	27.3
Central & Eastern Europe	1.8	8.7	21.1	36.5	38.0
Central Asia	0.1	3.0	14.6	28.8	31.4
East Asia & Pacific (Poor)	0.7	2.5	11.7	24.2	27.5
Latin America & Caribbean	0.9	4.8	14.2	26.6	29.4
South and West Asia	0.1	2.0	8.6	19.5	20.7
Sub-Saharan Africa	0.2	0.9	2.9	7.6	8.2
North America and Europe	3.6	15.1	33.0	52.8	56.0
East Asia & Pacific (Rich)	2.5	11.5	26.4	45.2	46.0
World	1.2	4.8	13.0	23.6	25.6

Table 5.3 Percentage completion by education level for adults aged 15 and older
Source: IFs 6.01, using historical data from Barro and Lee (2000, 2001).

The patterns of educational advance will vary considerably across regions. Table 5.3 shows the portions of the adult populations aged 15 or more who had completed primary, secondary and tertiary education in 1960 and 2000, combined with forecasts from the IFs base case for 2030 and 2060 (compare also with Table 4.3). Recognizing the high error

level of such forecasts, there are still a number of insights that we might draw from the table:

- With respect to primary education, earlier discussion indicated that the transformation to universal enrollment and completion will be largely complete globally, even in the least developed countries of today. The transition to universal completed primary education in the adult population will, however still be very much underway. In fact, IFs base case forecasts suggest that the least developed countries and therefore also sub-Saharan Africa will be near to finishing that second transition (a 90 percent full primary attainment level among adults) only by about the end of the century. Yet on the remarkably positive side, only three regions, Arab states, sub-Saharan Africa and South and West Asia will likely have adult populations with lower primary attainment rates than North America and Europe had in 2000. Moreover, the Arab states and South and West Asia will be rapidly approaching that level.

- With respect to secondary education, earlier discussion pointed out that the transition to universal lower secondary completion in sub-Saharan Africa is likely to be only about 2/3 finished by mid-century and the transition to universal upper secondary completion may be only 1/3 done. Hence it is no surprise that not many more than 1/5 of the region's adults will have attained a full secondary education. Similarly, although nearly 90 percent of secondary-aged students in South Asia may be graduating from the lower secondary level, and nearly 70 percent may be completing upper secondary education, not even 50 percent of adults will have attained a full secondary education. Again very much on the positive side, it is likely that only sub-Saharan Africa and South and West Asia will have lower secondary attainment rates than North America and Europe had in 2000, with South and West Asia again not far behind.

- With respect to tertiary education, the adult attainment levels once again will, of course, fall in 2060 much below completion rates by adults in such programs. Yet is quite possible at this level that only sub-Saharan Africa will have not reached levels of adult attainment comparable to North America and Europe in 2000. And even their forecasted rate of 7.6 percent would be more than double that of the high-income region a century earlier.

- With respect to gender balance, it may well be too early to declare complete success, even in 2060, because there will still be countries and even regions (such as South and West Asia at the primary level), where the ratio of female to male rates will fall below 97 percent. But clearly the base case suggests that the battle could be all but over. Global attainment rates for females are forecast to be 98 percent of males at the primary level, 99 percent at the secondary level, and 108 percent at the tertiary level. It will be very interesting to see when and how the reverse gender gaps at the tertiary level becomes politicized.

Figure 5.7 turns our attention to one of the major milestones with respect to the level of a society's education, its literacy rate. Because literacy is generally attained in the course

of a basic education, it is not surprising that all major regions of the world are moving towards 100 percent literacy by mid-century.

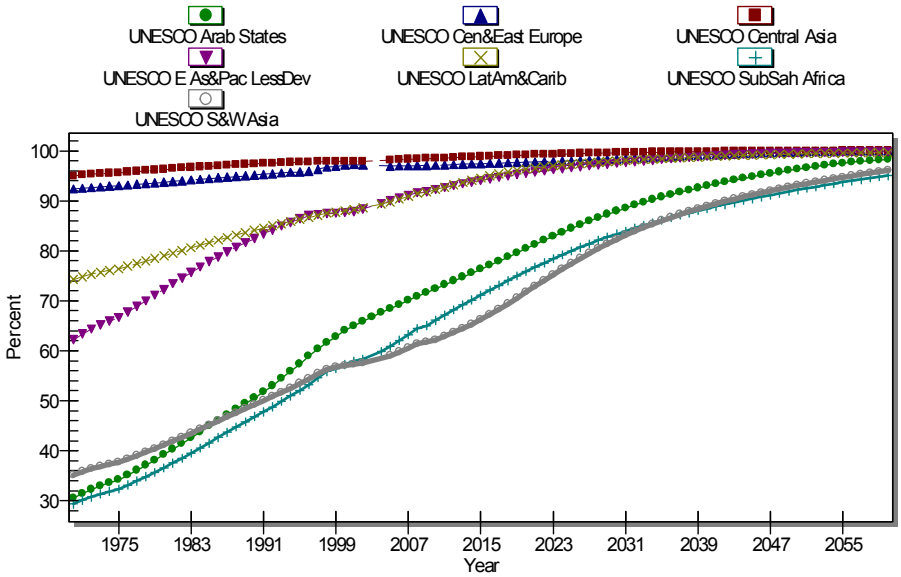

Figure 5.7 Adult literacy rate, history and forecast
Source: IFs 6.01, using WDI/UNESCO data.
Note: Used 10-year moving average after removing 2003 from Latin America and the Caribbean, sub-Saharan Africa, and East Asia and Pacific low income, as well as 2004 for Central and Eastern Europe. Literacy data values after 2002 are sparse and not fully consistent with earlier ones. Historical data come from a blended file of WDI/UNESCO literacy data before and after a change of methods in 2005-2007.

Education is, of course, spread unequally across populations, within and between countries. It is possible to use Gini coefficients not only to understand the distribution of income and wealth in a society, but to understand the distribution of any resource, including years of schooling. Lewis and Lockheed (2006: 33-34) computed the educational Ginis of a large number of countries at three points in time and explored the relationship between those coefficients and the average years of education in a society. Intuitively we would expect societies with higher average years of education to also have more equal distributions of it, as captured by lower Gini coefficients. In fact, the relationship is remarkably strong.

In addition to looking at the Gini distribution within societies, it is possible to compute a global Gini coefficient across societies. Figure 5.8 shows the Lorenz curve for that calculation. In 2005 the global population-weighted country Gini of literacy was 0.125, a considerably more egalitarian distribution than that for global income.[103] In fact, almost

[103] Milanovic (2005) clarified the distinctions between Gini calculated across countries without weighting, across countries using population weighting (as in Figure 5.8), and on the basis of individuals. Hughes and others (2008) explored forecasts for poverty using the second and third approaches.

all quality of life measures are distributed more equally globally than is income. For instance, the global Gini for life expectancy is about 0.07. Moreover, developing countries are closing the gaps with developed countries on nearly all such measures. Gini for literacy declines in the IFs base case to 0.051 in 2030, and Gini for years of education at age 25 (the least egalitarian of the education attainment measures) declines from 0.229 in 2005 to 0.165 in 2060.

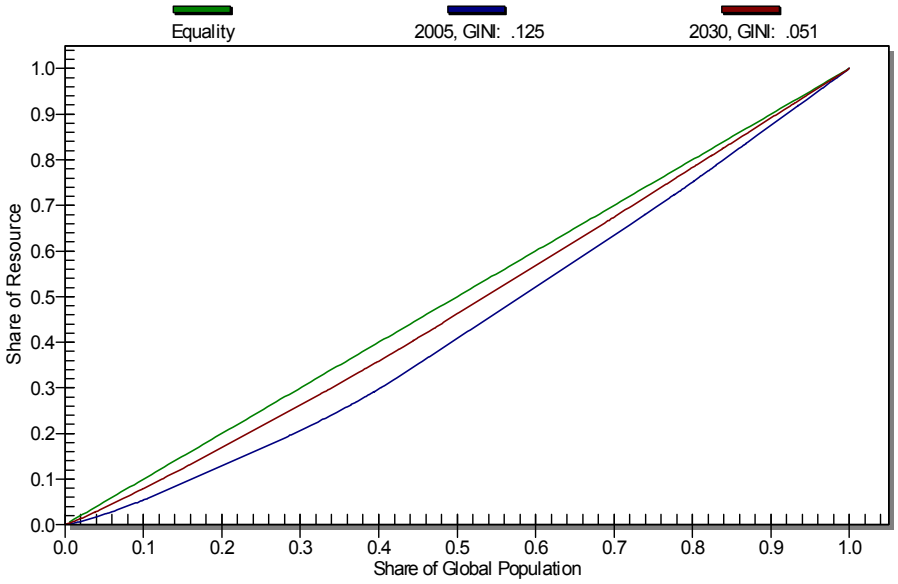

Figure 5.8 Global Gini of literacy rataes
Source: IFs 6.01.

5.1.3 Educational expenditures

Educational enrollment transitions are matched by very understandable transitions in educational spending patterns. Total public educational spending as a share of GDP in low and middle income regions is still generally below that of North America and Europe (see again Table 4.4). Therefore we would expect to see some continued rise in that spending share over time. Figure 5.9 shows a possible evolution of those expenditures across developing regions of the world. Globally, spending may only rise from about 4.6 percent of GDP in 2005 to 4.85 percent in 2060, but that aggregate forecast conceals considerable composition change.[104] Yet by mid-century expenditures of low income countries may rise from 3.3 percent of their GDPs to about 4.6 percent, the current global

[104] Because lower-income regions spend less of GDP on education than do higher-income ones, as the global GDP shares of developing countries rise, their lower (but rising) expenditure percentages weigh more heavily in the global average and slow global growth.

rate. Expenditures of upper middle income countries could climb from 4.2 to 5.1 percent of GDP .[105]

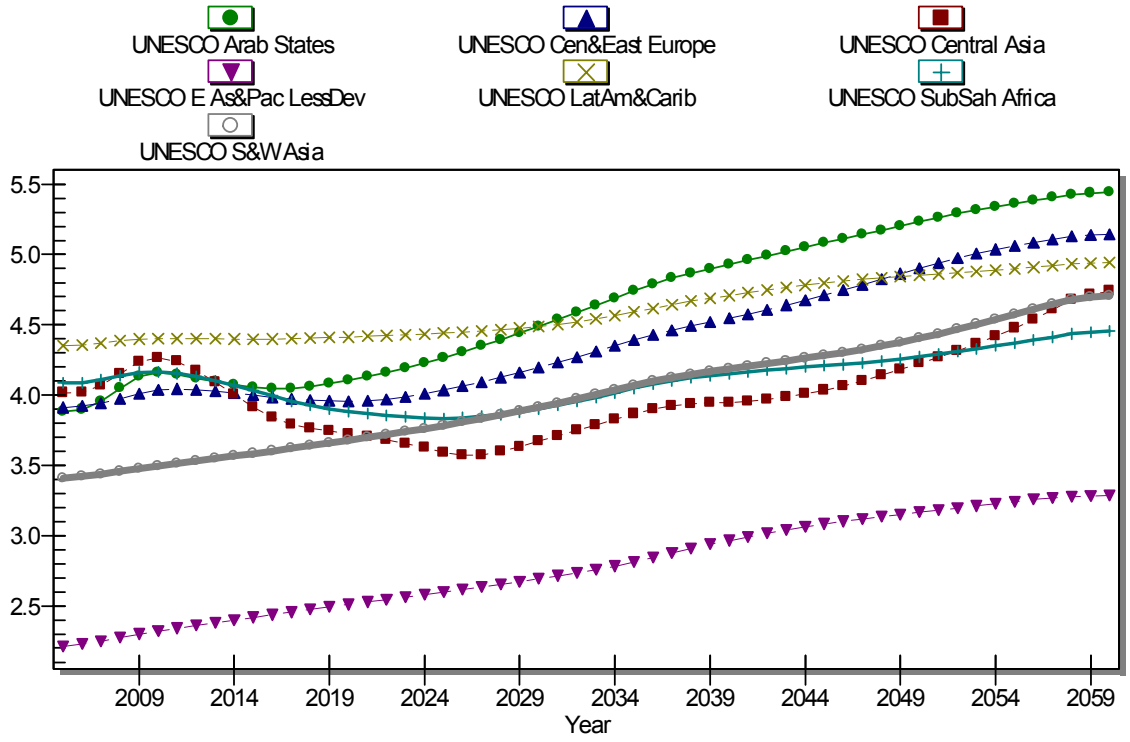

Figure 5.9 Government spending on education as percent of GDP
Source: IFs 6.01 base case.
Note: The temporary early-century rise for some groupings result from rapid increase in governmental revenues as a result of high energy and materials prices. The low values for East Asia and the Pacific lower income countries reflects in part missing data for China in recent years; the last reported value was 1.9 percent in 1999.

Globally (and for both OECD and non-OECD groups as a whole), the primary share of total educational spending generally will be pushed down because the numbers of students at other levels are growing faster than those at the primary level. This relative decline in student numbers more than offsets the fact that spending per primary student as a portion of GDP tends to rise as societies become wealthier, which somewhat holds up the overall share of primary spending in the total global budget. In contrast, secondary student numbers are rising as a share of the total global student population and tertiary numbers, while low, are rising even more rapidly. Costs per student relative to GDP per capita tend to be fairly stable at the secondary level and to fall with income increases at the tertiary level (Chapter x will explore this in considerably more detail). Figure 5.10

[105] In 2006 the Chinese Minster of Education announced plans to raise China's spending on education from 2.8 percent of GDP to 4.0 percent over five years (*The China Daily* March 1, 2006). Available at http://www.chinadaily.com.cn/english/doc/2006-03/01/content_524886.htm

shows the IFs Base Case global forecast of spending shares by level that results from these interacting patterns of student numbers and costs per student.

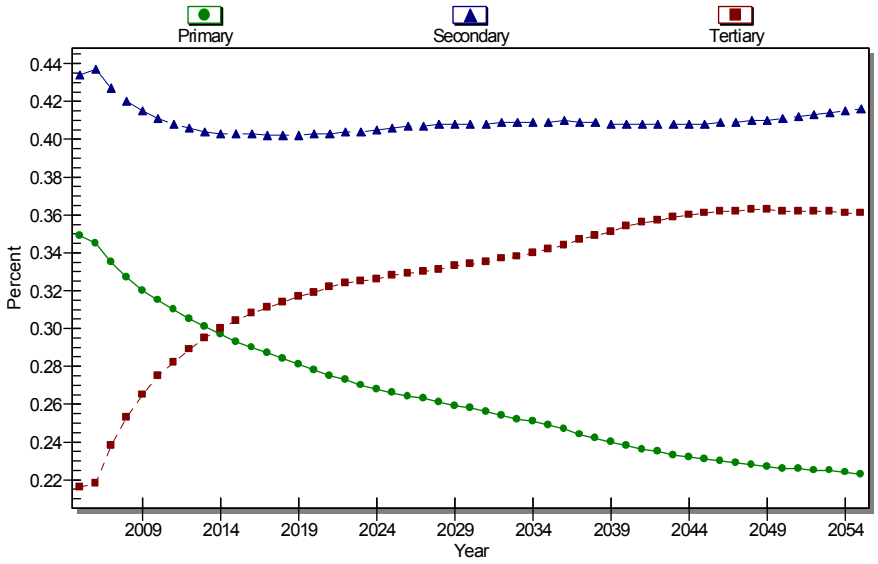

Figure 5.10 Global education spending, shares by level
Source: UNESCO and IFs 6.001.
Note: The rise of the tertiary share in early years appear unlikely rapid and probably reflects a model formulation that causes tertiary spending per student to rise for the high income countries (this will be revisited and fixed).

Very different spending patterns now characterize, and will continue to characterize countries at early stages of educational transitions. In African countries with net primary enrollment below 50 percent, primary spending takes between 40-45 percent of the total government education budget and will continue to do so through mid-century. At the same time, the secondary share will likely decrease slowly but remain in the 30 percent range by 2060. Tertiary spending will likely rise to about 25 percent of the total, even for these societies focused heavily on reaching universal primary education.

In non-African countries with gross secondary enrollment rates below 50 percent, spending on primary education now accounts for over 50 percent of the total. Obviously, these countries have been heavily focused in general on attaining near universal primary enrollment. The primary share is likely to fall fairly sharply by 2060. For these countries as well, tertiary spending is likely to rise steadily.

Levels and patterns of spending on education are therefore significantly driven by the character of the educational transitions underway. Yet funding levels in particular have their own dynamics, separate from the demand side of the educational picture. Governments have limited access to revenues and many claims upon expenditures. The next section will explore some of the implications of different supply-side spending patterns, as well as looking at other elements of forecasting uncertainty. Subsequent chapters will return to the financial side of educational forecasting in the context of development and exploration of a normative educational scenario.

5.2 Comparison with other forecasts

So far this chapter has put the IFs base case forecasts for global education in the context of historic trends. It is also important, however, to consider them in the context of other forecasts, to determine whether the results are comparable, and to consider the bases for differences when they exist. For instance, most other forecasting has been extrapolative (often non-linear but still univariate) whereas IFs uses a considerably more extensive and integrated modeling system for its forecasts.

5.2.1 Have early forecasts been successful?

Little forecasting has been undertaken for education until very recent years. Nonetheless, earlier forecasts by UNESCO have proven reasonably good. For instance, in 1984 UNESCO used extrapolative techniques to forecast gross enrollment rates for its regions through 2000.[106] Table 5.4 compares those forecasts with contemporary UNESCO data values through 2000. One notable feature of the table is that the values for 1980 in current UNESCO data (as compiled within the IFs database and aggregated to regional totals with population weighting) are often significantly different than those of 1980 at the time of the forecasts. That places a retrospective handicap on the UNESCO forecasting, because in 1982 they did not build from what are now considered accurate values.

	UNESCO Data and Forecasts from 1982			UNESCO Contemporary Data		
	First Level	Second Level	Third Level	First Level	Second Level	Third Level
Developed						
1980	107	78	30	103	81	32
2000	105	87	38	102	101	53
Developing						
1980	86	31	7	96	41	8
2000	96	49	12	98	60	13
Africa						
1980	78	21	3	81	16	2
2000	93	43	6	86	38	5
Latin America						
1980	104	44	14	105	43	13
2000	109	67	26	125	85	23
South Asia						
1980	83	31	7	78	31	6
2000	93	47	10	91	53	11

[106] The extrapolations by UNESCO have typically used logistic or S-shaped curves and have been made at the country and sex-specific level (UNESCO Division of Statistics 1993: 2).

Table 5.4 Gross enrollment rate forecasts made in 1982, compared with data in 2000
Sources: UNESCO, Trends and Projections of Enrollments 1960-2000, as presented by Coombs (1985: 64); contemporary UNESCO data via IFs 5.45.
Note: UNESCO used First, Second, and Third levels to mean primary, secondary, and higher education.

In spite of subsequent data re-evaluations, the forecasts for 2000 proved remarkably good at the primary level, somewhat overestimating African progress and underestimating that of Latin America. Across levels of education, the major weakness proved to be significant underestimation of secondary education enrollments almost everywhere except Africa, where they were again overestimated. At the tertiary level, the only really striking discrepancy is for the developed world, which added both secondary and tertiary students much faster than UNESCO anticipated (the European push in higher education has certainly been one reason).

UNESCO again made forecasts in 1994, this time for literacy rates and with an extended horizon to 2010. Table 5.5 compares the forecasts for 2000 with more recent UNESCO data and with IFs forecasts for 2010. As in 1994, the basic methodology of UNESCO was extrapolative projection. In this case, they significantly underestimated progress on literacy for the Arab States and South Asia by 2000 and therefore likely will have underestimated by 2010. They again overestimated progress in sub-Saharan Africa already in 1990, as well as in 2000, therefore also overestimating it for 2010.

	UNESCO Data and Forecasts from 1994			IFs Data and Forecasts from 2008		
	1990	2000	2010	1990	2000	2010
Developing	67.2	73.4	76.9	67.4	77.1	79.9
Least Developed	44.8	52.7	60.6	44.1	51.4	59.4
Arab States	51.7	61.5	70.0	51.9	67.3	76.4
Sub-Saharan Africa	51.3	62.0	71.4	50.6	61.7	67.4
Latin America	84.9	88.2	90.9	84.6	88.3	93.5
South Asia	46.6	53.7	60.6	49.0	58.2	62.0

Table 5.5 Literacy rate forecasts made in 1994, Compared with data in 2000 and IFs forecast for 2010.
Source: UNESCO (1994:3) and IFs 6.01 using contemporary UNESCO data.
Note: Historical IFs data come from a blended file of WDI/UNESCO literacy data before and after a change of methods in 2005-2007.

UNESCO made other forecasts prior to the turn of the century including the enrollment forecasts for 2025 in Table 5.6. It is clear, looking at those forecasts made just four years apart in 1989 and 1993 that the enterprise of educational forecasting was at an early stage and the UNESCO Division of Statistics (1993: 2) appropriately urged that the forecasts for 2025 "*be used with the utmost caution*" (italics theirs). Even primary forecasts varied significantly between the studies, especially those for Sub-Saharan Africa. The 1993 study brought down the anticipated number for 2025 because of changing understanding of the demographic prospects of the region and especially because it had come to be understood that the early expansion of enrollment had faltered. At the secondary and

tertiary levels there was even greater uncertainty about prospects and they study slashed the forecast for secondary enrollment in sub-Saharan Africa relative to that of 1989.

Most often the contemporary IFs forecasts fall between the two early forecasts of UNESCO. One significant exception is at the tertiary level, where IFs forecasts for developing regions tend to be higher than either UNESCO set. Also, however, IFs forecasts at the primary level are on the low side of the UNESCO pair, primarily because global population growth forecasts have been revised downward substantially since 1993.

	UNESCO Forecasts made 1989			UNESCO Forecasts made 1993		
	Primary	Secondary	Tertiary	Primary	Secondary	Tertiary
World	807	572	126	747	448	100
Developed	107	99	43	116	106	47
Developing	700	473	83	631	342	54
Sub-Saharan Africa	201	106	10	133	28	2
Arab States	57	45	9	53	33	6
Latin America & Caribbean	100	51	20	81	33	12
East Asia	398	314	52	185	117	15
South Asia				173	124	16

	IFs Forecasts made 2008		
	Primary	Secondary	Tertiary
World	734	549	134
Developed	83	91	43
Developing	652	458	91
Sub-Saharan Africa	175	56	5
Arab States	50	48	7
Latin America & Caribbean	61	60	13
East Asia & Pacific (LMInc)	160	136	36
South and West Asia	197	144	25

Table 5.6 UNESCO forecasts of student enrollment numbers in 2025 (millions)
Source: UNESCO Division of Statistics (1989: 7; 1993: 7) and IFs 6.01.
Note: In 1989 UNESCO combined East and South Asia into Asia & Pacific; shown in table as East Asia

Lessons to be drawn from these historic forecasts might be that (1) short-term extrapolative forecasts have been reasonably accurate, although they have clearly shifted with the mood and understanding of the times; (2) the forecasts of these earlier studies are not significantly different from those of IFs made 15-20 years later.

5.2.2 More recent enrollment forecasts

How do the results from the IFs Base Case compare with those from other, more contemporary forecasting efforts?[107] There are a number of significant projects and forecast sets that we consider more or less chronologically.

[107] In addition to the more extensive forecasting projects considered here, there are other important educational analyses that make more limited forecasts. For instance, Cohen, Bloom, Malin and Curry (2006: 1) forecast that "An estimated 299 million school-aged children will be missing primary or secondary school in 2015; of these, an estimated 114 million will be missing primary school." Our

Clemens (2004) did an extensive analysis of rates of change in enrollment within historic data, more important to us here than his forecasts of regional enrollment rates to 2015. He mapped net primary enrollment for more than 100 countries at five-year intervals from 1960-2000 and analyzed the speeds at which they moved between benchmark enrollment rates (such as from 50 percent to 70 percent or from 90 percent to 99 percent). In his analysis of those rates, he affirmed that increases in enrollment rates have indeed followed an S-shaped pattern of growth (see the graphic of Clemens 2004: 42), in which the most rapid change is around 50 percent enrollment and incremental change is slower when enrollment rates are very low or very high (thereby creating the S-shape).[108]

Table 5.7 summarizes what he learned about the transition speeds across different intervals. The 15 percent rise from 75-90 percent enrollment has taken an average of 28 years, obviously demonstrating, consistent with the S-shaped pattern, slower progress than the 22.3 years normally needed to progress from 50-70 percent. There is, of course, significant variation across countries and time. At something of an extreme, Kenya took about 60 years to move from 50 to 70 percent enrollment. Table 5.7 also shows the transition speeds calculated within IFs in forecasting between 2000 and 2015. On the whole, the speeds in IFs were faster when, as in the table, the budget constraint was not applied. That is, driven by the demand side of IFs only, transition speeds are faster. Clemens (2004: 52) used his S-curve approach to forecast enrollment rates of global regions in 2015 from a 2000 base.

Transition in Net Enrollment Rate	Clemens' transition time	IFs transition time (average)
50%-70%	22.3 years	20.3 years
50%-80%	36.4 years	29.8 years
50%-90%	57.7 years	40.5 years
75%-90%	28 years	18.1 years
90%-99%	-	19.8 years

Table 5.7 Comparing the speed of transition in primary net enrollment
Source: Clemens (2004:15-16); IFs 5.40
Note: Mohammod will redo this table for the most recent IFs version, with the budget constraint on.

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forecasts are 209 million students at the two levels, of which 53 million will be at the primary level (in IFs EDPRITOT/EDPRIENRN gives the total number of potential students, minus EDPRITOT gives the missing students). Bloom(2006: 32) indicates that the current numbers not enrolled are equivalent to 15 and 30 percent of school-aged children at the primary and secondary levels (we show 14% and 34% in 2000) and forecasts the numbers to be 17% and 24% in 2015 (we forecast 8% and 25%). He says deterioration at the primary level by 2015 "probably results from offsetting factors such as rapid population growth in countries that are off track to meet education goals." We see enrollment rates in even the most rapidly growing countries going up too rapidly overall for that to happen.

[108] Meyers et al. (1977, 1992) previously identified such sigmoidal patterns of diffusion of mass education throughout the world for a very long period of 1870-1980.

A comparison of the base case forecasts for IFs in 2015 with those of Clemens, using the complete, budget-constrained system of IFs, found differences that did not exceed 2 percent in forecasts for South Asia, Latin America and the Caribbean, Eastern Europe and Central Asia, East Asia and the Pacific, and high-income OECD countries.[109] The significant differences appeared for forecasts of Sub-Saharan Africa in 2015 (70.4 percent in IFs versus 79.6 percent in Clemens) and the Middle East and North Africa (95.2 and 88 percent, respectively). What might account for these substantially different forecasts over a fairly short period? A primary element of explanation is that the education forecasting in IFs is tied to full demographic, economic, and government budgeting sub-modules (in fact, also to energy and other modules as discussed in Chapter 3). As subsequent discussion will elaborate, those modules tend to impose constraints on African countries in coming years, while the energy revenues and economic growth of North Africa and the Middle East provide some wind in the sails of education growth.

Wils, Carrol, and Barrow (2005) of the Education Policy and Data Center (EPDC) also used a fundamentally extrapolative methodology (with logistic or S-shaped curves) to forecast the years in which 70 poor countries would likely reach universal primary education entry and completion (displaying results graphically through 2050 but extrapolating even further for some countries). They tapped data from Demographic and Health Surveys (DHS) and Multiple Indicators Cluster Surveys (MICS)[110] survey data on current educational attainment of different adult age cohorts to reconstruct past educational flow rates like entry or completion. These rates represent the proportion of any single-year age cohort that entered (or completed) primary school, either at an appropriate age or later.[111] While this definition sounds close to the gross enrollment rates defined by UNESCO, they cannot exceed one hundred percent by definition and, thus, are not exactly the gross intake or completion rates. The flow rates used by Wils, Carrol, and Barrow are thus quite different from the similarly titled rates that Clemens and IFs use and forecast.

Although forecasts by Wils, Carrol, and Barrow (2005) are not directly comparable with those from IFs, we can again analyze the speeds of transition between rates and compare those with the forecasts of IFs. Because of country-specific analysis, Wils, Carrol, and Barrow (2005), unlike Clemens (2004), reported a range of transition speeds rather than a typical speed. For the purpose of comparison with IFs we calculated an average of the

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[109] We must be somewhat cautious in the comparisons because Clemens (2004) used administrative data on net enrollment rate from the pre-2003 data revision of UNESCO and IFs data uses post-2003 revision data.

[110] The US Agency for International Development (USAID) sponsors the DHS and the United Nations Children Fund (UNICEF) sponsors the MICS.

[111] Wils, Carrol and Barrow (2005) included entrance up to the age of 14 and completion up to the age of 19 in their entry and completion rate calculations. While this definition sounds close to the gross enrollment rates defined by UNESCO, they cannot exceed one hundred percent by definition and thus are not exactly the gross intake or completion rates. The flow rates used by Wils, Carrol, and Barrow are thus quite different from the similarly titled rates used and forecast by Clemens and IFs.

transition speeds reported by Wils, Carrol, and Barrow (2005) for 80%-90% and 90% - 95% transitions in primary completion rates.[112] The figures in Table 5.8 compared Wils, Carrol, and Barrow completion transitions with that for the same set of countries from IFs. Keeping in mind the differences between the ways these two models define the completion rate, the results are comparable.

Transition in Completion Rate	Wils, Carrol and Barrow transition time	IFs transition time (average)
80%-90%	14.68 years	13.63 years
90%-95%	13.2 years	11.3 years

Table 5.8 Comparing the speed of transition in primary enrollment
Source: Wils, Carrol, and Barrow (2005:22); IFs 5.40.

A recent report from the Education Policy and Data Center (2007b) gives us an opportunity to more directly compare forecasts made using extrapolative methods with those from a cohort-based methodology and those from the integrated and structural forecasting system of IFs. In support of the Education for All Global Monitoring Report 2008 the EPDC prepared three different sets of forecasts of primary and secondary enrollment in 2015 and 2025.[113] The first two used S-curve extrapolations of enrollment rate trends from data since 1991 and 1999 and the third used a cohort flow method on which planning models for individual countries more typically draw. That cohort methodology has features in common with the annual student flow approach of the educational module of IFs. Table 5.9 summarizes the forecasts for net primary enrollment rates in 2025 from all four methods.

[112] We estimated the data visually from bar graph showing 80%, 90% and 95% completion dates (Wils, Carrol and Barrow 2005: 22, Figure 3b).

[113] A fourth set of custom forecasts covered only a small set of countries.

	Data since 1991	Data since 1999	Cohort-method	IFs
Burkina Faso	64.8	74.3	100.0	53.1
Burundi	73.8	95.0	95.0	63.4
Djibouti	38.7	54.3	74.6	39.5
Eritrea	89.5	81.0	40.8	51.1
Ethiopia	96.7	99.2	66.7	70.0
Ghana	81.7	88.0	81.9	69.7
Guinea	95.3	98.3	99.4	74.8
Kenya	96.5	98.2	79.8	90.5
Lesotho	97.5	99.8	83.3	90.8
Mauritius	95.6	99.6	99.1	100.0
Mozambique	96.5	99.5	58.7	83.9
Namibia	45.9	65.0	86.4	94.5
Niger	71.6	92.0	89.3	44.4
Senegal	90.3	96.4	66.7	77.9
Tanazania	100.0	100.0	87.7	95.1
Togo	92.5	78.1	70.7	82.4
Zambia	97.4	100.0	99.2	95.2

Table 5.9 Comparing forecasts of net primary enrollment in 2025
Source: Education Policy and Data Center 2007; IFs 6.01.

Although there are a number of countries in Table 5.9 for which the forecasts are similar, notably those with high enrollment rates already, the striking aspect of the forecast comparison is the significant range of variation across them, even for as relatively near-term a horizon as 2025 (a 20-year forecast). The differences between the extrapolations based on data available since 1991 and 1999 clearly reflect whether or not there has been acceleration or de-acceleration of enrollment gains in recent years. Acceleration is the case for countries including Burkina Faso, Burundi, Djibouti and selected others, especially Namibia and Niger. Reduction in the speed of gains has characterized fewer countries, and those include Eritrea and especially Togo. Although it is not a universal rule, the cohort methodology appears to somewhat amplify such turns. Burkina Faso and Namibia are examples on the upward side, and Togo illustrates it on the downward side.

The forecasts of IFs prove be within the range of the others in many cases, but tend more often than not to be at the low end of the forecasts of Table 5.9 or below the range of the other forecasts. Burkina Faso and Niger are the clearest examples. In order to understand why that might be the case, and to better understand the differences of the alternative methodologies, it can be useful to explore in some detail the case of Burkina Faso.

Educationally, the net primary intake rate of Burkina Faso grew from 19.1 percent in 1999 to 29.5 in 2005. Its adjusted net intake rate (including children one year over and under age) grew from 40 percent to 68.7 percent in same period (between 2000 and 2005, the adjusted net intake rate of the country therefore grew by an average 5.5 percentage points each year, an extraordinary rate). The country's primary survival rate has averaged just below 70 percent with a very slight downward trend. Collectively, these changes led to a growth in net primary enrollment from 34.7 percent in 1999 to 44.1 percent in 2005 with an especially large jump between 2004 and 2005. On a purely extrapolative basis, forecasts for 2025 in the 65-75 percent range do not seem unreasonable.

The IFs model, however, ties change in intake, survival/completion and therefore enrollment to forces on both the demand and supply sides of the educational system. On the demand side, the per capita income level of Burkina Faso is sufficient to be consistent with considerably higher enrollment rates than it has. At similar levels of income, adjusted net enrollment of Rwanda is just under 75 percent and Kenya is just over that level. In fact, on the basis of cross-sectional analysis of countries around the world, the "typical" country with a GDP per capita of its level would have net primary enrollment approaching 75 percent.

In short, the demand-side specifications of the education model of IFs would not necessarily lead to a forecast that differs from that of the extrapolative analysis. The constraint in the enrollment forecast of IFs is rooted instead on the supply side. It lies in assessment of the ability of the country to support the kind of enrollment growth that it has experienced in recent years and that extrapolative forecasts implicitly presume will continue.

Burkina Faso is a land-locked, resource-poor African country in a region of north-western Africa that overall suffers from high population densities and major environmental problems, especially water availability. Demographically the country suffers a total fertility rate of about 6.2 children per mother and a population growth rate of nearly 3 percent. An Education Policy and Data Center (2005: 62-63) analysis put Burkina Faso on a list 6 countries where education growth was likely to be overwhelmed by population growth. About 48 percent of its total population is 15 years of age or younger, a remarkable and challenging youth bulge. Subsistence agriculture occupies nearly 90 percent of its population.[114] Economically, its GDP per capita in 2005 at PPP (2000 dollars) was only $1,080, but growing reasonably well until higher oil and food import costs affected it in recent years. The IFs base case anticipates a value of $1,440 in 2025.

[114] Information given on Burkina Faso comes primarily from the World Bank's World Development Indicators 2007-2008 and the CIA's World Factbook (on-line).

Several important factors limit the country's ability to mobilize resources for continuing expansion of education and to meet the growing demand of a growing young population. It has an international debt of about 60 percent of GDP, about twice the rate of indebtedness in 1990. Its deficit on current account in 2007 was nearly $700 million or about 4 percent of GDP. Its government budget was similarly in deficit by about $450 million. Household finances are also under pressure. Significant portions of the male population seek employment in neighboring countries, and unrest in Cote d'Ivoire and Ghana has disrupted flows. Governmental financial constraints have helped maintain school fees, typically suppressing household ability to send children to school (UNESCO 2007b: 112).

On the positive side, Burkina Faso received a Millennium Challenge Account grant to improve girl's education at the primary level and may receive more external funding for other purposes. Yet the country is already dependent on aid from the outside for about $650 million annually and the potential for growth from such levels in coming years is not great. In fact, high-income countries have reduced aid as portions of their GDP in recent decades and the growth of low-income countries has spread the amounts more thinly.

Not only does the country face financial constraints, but the demand for educational spending has, of course, grown significantly. One of the complications of extrapolative forecasting is that growth can be its own undoing if there is overshoot, as in part the rapid growth of enrollments in Africa during the 1960s and 1970s proved to be. That is true in many domains, of course, and is one of the reasons for the success of contrarian perspectives in financial markets.

In the case of education, the rapid increases of enrollment have increased the financial burden of schooling on the government, recently enough so that the full effect of the increase has not yet been felt. Moreover, such growing burden at the primary level will increasingly be compounded by growing pressure for secondary education of new primary graduates. In Burkina Faso the transition rate to lower secondary education rose from 38 percent in 1999 to 46 percent in 2004, just as primary enrollments rose sharply. It is partly for this reason that the forecast of the IFs base case for growth in secondary enrollment in Burkina Faso also differs from extrapolative ones made by the EDPC. Specifically, using post-1991 and post-1999 data, the EDPC (2007b: 92) forecast growth for net secondary enrollment from 11.2 percent in 2005 to 22.6 and 21.7 percent in 2025, respectively. The IFs base case forecasts growth in gross secondary enrollment from 13.8 percent in 2005 to 19.2 percent in 2025, a significantly slower rate of increase.

Burkina Faso is likely to obtain some financial help from more efficient use of its education spending. It now spends about 30 percent of GDP per capita on each primary student, about 10-15 percent more than the typical low-income country (Chapter 6 returns to this issue). The IFs base case forecast does, however, already build in a reduction of per-student spending to 20 percent of GDP per capita in 2025 and nonetheless sees growing fiscal constraint.

We certainly do not wish misfortune on Burkina Faso with respect to future enrollments so as to support our arguments for the merits of an integrated forecasting approach. Yet it is important to explain why the forecasts of IFs in Table 5.9 tend to suggest slower enrollment growth than do some important existing forecasts and to indicate bases for some conservatism of expectations.

5.2.3 Forecasts of educational attainment

In addition to forecasting enrollments, various projects have also forecast adult educational attainment. The objective has, of course, been the same as ours, namely to understand changes in human capital levels and the broader societal implications of them. The Education Policy and Data Center (2005), in projects under the leadership of Annababette Wils (EPDC 2005) and the International Institute for Applied Systems Analysis (IIASA), in work led by Wolfgang Lutz (Lutz, Goujon and Wils 2005), have used a population cohort-based methodology called multi-state projection. That approach carries years of education forward in the model over time as part of (one of the states of) aging population cohorts, fundamentally as the IFs model does.

The EPDC (2005) forecast through at least 2025 not just the levels of educational attainment by youths and adults in 83 developing countries, but also those of sub-national regions in four countries with significant inter-regional variation (Kenya, Nepal, Madagascar, and Nigeria). Lutz and colleagues have used the approach variously for 13 world regions and a variety of specific countries. At this point, we are unaware of any published numbers that allow comparison of adult educational attainment measured by years of education across forecast efforts. The IFs project has, however, published for 182 countries forecasts in 2030 and 2055 of the years of education attained by adult populations 15 and 25 years of age and older (Hughes and others 2008). Hopefully, that report and the current one (see the end tables of this volume), as well as the on-line availability of continually evolving forecasts from IFs, will make such comparative analysis possible.

With respect to a different measure of attainment, UNESCO UIS (2007b) has published country-specific and regional forecasts of adult literacy in 2015. Table 5.10 compares those forecasts with those of the IFs base case. The methods of the two forecasts again vary. The UNESCO forecasts use the UIS Global Age-Specific Literacy Projections model (2007b: 258), which is based on the work of Lutz.[115] The IFs model uses the cohort methodology to forecast the percentage of adults who have completed primary education and then uses a function and algorithm around that percentage to estimate literacy. The 2015 forecast horizon is so near that one would not expect great differences between the two forecasts in any case, and there are not.

[115] The Lutz methodology used the 5-year age cohorts from 15-29 to estimate transition rates to literacy over time, extrapolated the growth in those rates, and built full age-sex pyramids of literate and illiterate populations through 2015 (

	EFA 2008	IFs
World	86	85
Transition	100	99
Developed	99	99
Developing	83	82
Arab States	78	77
Cental and East Europe	98	98
Central Asia	99	99
East Asia & Pacific	95	95
Latin America & Caribbean	93	95
North America/Western Europe	99	100
South and West Asia	70	66
Sub-Saharan Africa	70	72

Table 5.10 Comparing forecasts of adult literacy in 2015
Source: Education Policy and Data Center 2007; IFs 6.01.

Comparing base case forecasts of IFs with other reference cases helps us understand the implications of different methodologies. As an enterprise, however, forecasting typically compares alternative forecasts or scenarios, either exploratory ones tied to alternative understandings or normative ones linked to alternative interventions. It is to that we turn.

5.3 Uncertainties in forecasting

Neither developers nor users of forecasts should ever forget Forecasting Rule 1: never trust a forecast. Nor should they ever believe that it is possible to put realistic confidence intervals around forecasts of complex systems.[116] What is possible, however, is to explore some of the sources of uncertainty in forecasts and thereby to build a basic mental map of the extent of uncertainty.

The greatest sources of uncertainty lie in the specification of the model itself, both its structure and its parameterization. The preceding section explored the IFs base case relative to a limited number of alternative forecasts, some of which use quite different and mostly extrapolative procedures. That analysis has given us some very rough sense of the magnitude of formulation-based uncertainty.

Much of the uncertainty about the future of global education lies, however, with assumptions about key drivers of the variables of interest to us, namely the flows of students through the educational process and into adult years. We can identify at least three key driver sets for those flows: the size and age-composition of school-age populations, the size and structure of the economy, and the level and character of spending on education. This section explores the possible affect on educational futures of

[116] Modelers can calculate and use onfidence intervals with small, econometrically estimated models. Such intervals are not meaningful in large-scale models with significant structural components and algorithmic elements (such as budgeting rules).

key elements within each set individually and together. In each case we consider a reasonable range of uncertainty in the driver and then explore how variation across that range might affect educational patterns.

The first volume in this series on Patterns of Potential Human Progress explored the future of global poverty (Hughes and others 2008). In doing it so it explained the base case of the IFs with respect to demographics, economics, and socio-political systems in much more detail than does this volume, extensively comparing and contrasting IFs forecasts of population and economics with other forecasts; we direct those with deeper interest to that volume.

5.3.1 Demographic futures

In its bi-annual series on World Population Prospects, the United Nations regularly updates forecasts of population growth by country. It develops four scenarios or what it calls variants: low, medium, high, and constant fertility rates. Because global fertility rates have been dropping steadily for nearly 40 years, the constant fertility variant is only a reference point, not a reasonable forecast.

Figure 5.11 shows approximately the same scenarios using the IFs model. The IFs Base Case is very close to the UN medium variant and the other two cases in IFs similarly largely match the high and low UN variants.

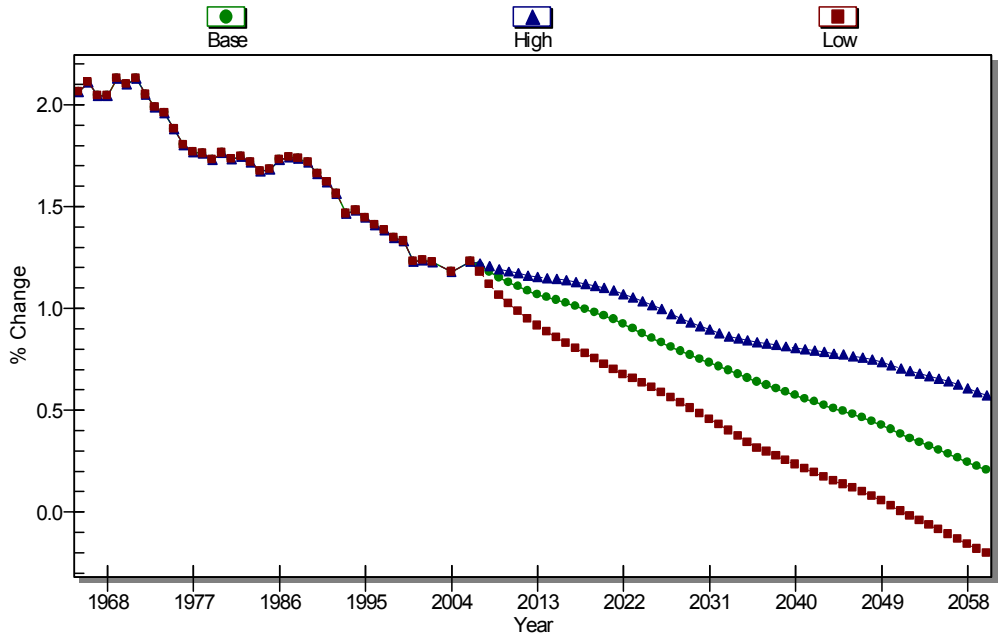

Figure 5.11 Global population growth rate scenarios
Source: IFs 6.02.
Note: Removed bad data from 2004 and 2006.

Population growth or decline will affect student flows most directly simply by changing the number of potential students of traditional age with respect to each educational level. For instance, were of-age children to decline in number without a drop in older population numbers or income levels, societal resources would potentially be available to support either larger portions through school or to devote more resources to each student. Governments and households could, of course, also choose to divert spending from education to other purposes.

Table 5.11 shows the calculations by IFs of the enrollment rate effects across the scenarios. Lower populations do indeed tend to produce higher enrollment rates, especially when initial rates are well below universal enrollment and when population growth rates are high, so that the demographic variation across scenarios is greater. Thus the effects are considerably greater in sub-Saharan Africa than in South and West Asia. In the high population scenario, total fertility rates in sub-Saharan Africa decline from 5.4 in 2005 to 3.8 in 2060; in the low population scenario rates drop to 1.7 (in the base case they decline to 2.6).

The differences in enrollment rates across the three population scenarios would be quite substantial. At the higher end of such differences, the rate of lower secondary enrollment in sub-Saharan Africa in 2060 could be 12 percentage points higher in the low population scenario than in the high population scenario and upper secondary enrollment could be 16 percentage points greater. For the world as a whole, the low population scenario allows the attainment in 2060 of universal enrollment at the lower secondary level (98.9 percent), 4.5 percent above that of the high population scenario.

Below the rates of Table 5.11, the differences in student numbers are considerably more dramatic across the three scenarios. In sub-Saharan Africa, there were nearly 18 million students enrolled in lower secondary programs in 2005. In the high population scenario there would 47.5 million enrolled in 2030 and 132 million in 2060. In the low population scenario there would be 40 million in 2030 and 49 million in 2060. In other words there would be 80 million fewer students at that level in 2060 in spite of the increase of enrollment rate from 81 percent in the high population scenario to 93 percent in the low population scenario. The students would also be better funded with lower population growth. In the low population scenario, expenditures per lower secondary student would rise from 20.2 percent of GDP per capita to 22.8 percent, whereas in the high population scenario they would fall to 17.7 percent of GDP per capita. IFs further estimates that the GDP per capita for the region could be $7,200 in the low population scenario versus $5,251 in the high population scenario.

		Alternative Population Framing Scenarios					
		Low Population		Base Case		High Population	
	2005	2030	2060	2030	2055	2030	2060
Enrollment (%)							
World							
Primary	89.4	95.0	99.1	94.5	98.5	94.1	97.9
Lower Secondary	81.9	92.3	98.9	90.3	96.6	88.7	94.4
Upper Secondary	57.8	74.7	89.5	72.6	85.0	70.9	81.0
Tertiary	26.6	38.0	55.8	36.2	50.4	35.1	46.4
Sub-Saharan Africa							
Primary	68.1	78.3	96.2	77.6	95.1	77.1	94.0
Lower Secondary	40.9	57.3	92.8	54.6	85.5	52.9	81.1
Upper Secondary	22.5	34.2	68.3	32.6	57.9	31.5	52.4
Tertiary	4.8	8.4	20.8	7.7	14.9	7.2	12.2
South and West Asia							
Primary	85.4	94.5	98.9	93.9	98.3	93.4	97.7
Lower Secondary	65.9	91.6	98.9	88.4	97.0	85.4	95.3
Upper Secondary	38.0	65.8	88.4	62.7	84.3	59.7	80.6
Tertiary	10.1	24.4	45.0	21.7	41.7	20.3	38.9

Table 5.11 Enrollment rates by level of education across population scenarios
Source: IFs 6.02.
Note: Primary enrollment is net; others are gross.

This analysis of differences across population scenarios suggests both a constraint on countries struggling to enhance their prospects of advancing educational opportunities and a policy option for such enhancement, namely reduction of high fertility rates. Figure 5.12 explores the relationship further by looking at it cross-sectionally. As a general rule, it appears that countries with fertility rates of 4 or higher are unlikely to have achieved near universal primary enrollment. That does not, of course, demonstrate causality as opposed to correlation, because low-income generally contributes to both high fertility and lower enrollment. Yet, the analysis of the three population scenarios in IFs does suggest at least some element of causal connection as well, via the path of available resources. It should not surprise us that many of the countries who have high fertility and especially those that fall below the line with respect to enrollment rate appear frequently on lists of failed or struggling states (for instance, in the annual analysis of the Fund for Peace and *Foreign Policy*).

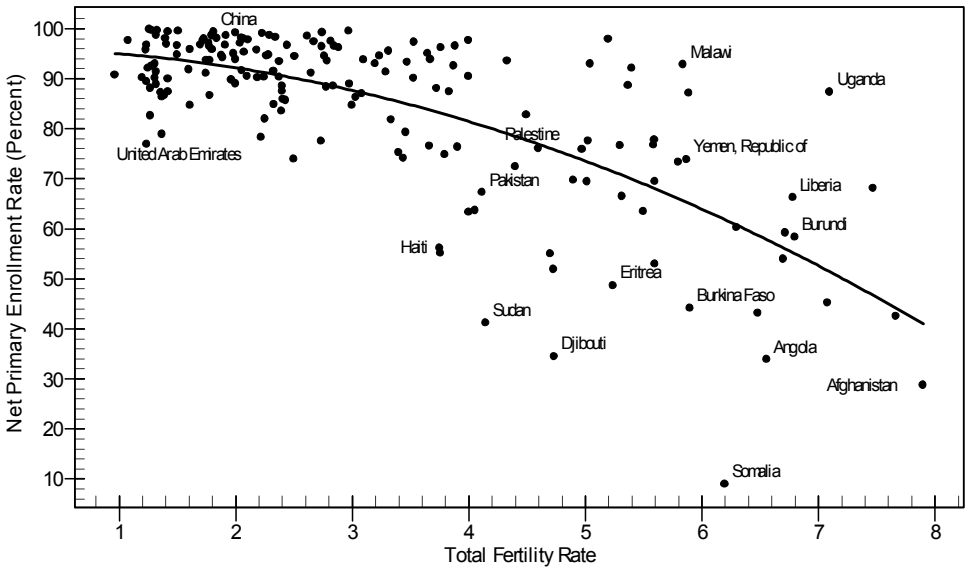

Figure 5.12 Net primary enrollment rate as a function of total fertility rate
Source: IFs 6.02 (2005/most recent data).
Note: R-squared=0.52; function is second-order polynomial.

The implications for education years at age 25 and older (or 15 and older) are, however, not terribly great regionally or globally because of the long lags in changing educational attainment levels of adult populations. Figure 5.13 shows that global educational attainment in 2060 varies only about 0.5 years across the three scenarios by 2060 (and it varies slightly less in Africa). We should not, however, disparage that impact. Not only does one half year account for about 5 percent of the total average years of education across global adults in 2060, the impact of the different population scenarios continues to grow over time.

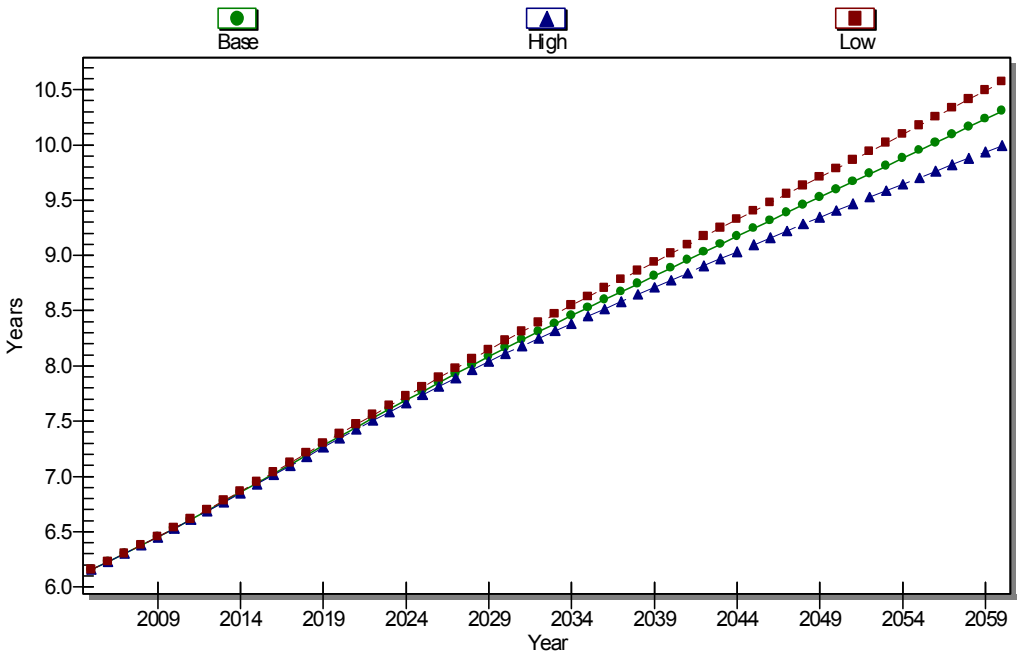

Figure 5.13 Years of global adult education (age 25+) across population scenarios
Source: IFs 6.02.

5.3.2 Economic Futures

In spite of their importance on almost every issue of public policy, there are few long-term forecasts of economic growth for the world or for multiple countries or global regions. Hughes and others (2008: Chapter 5) discussed at some length the economic forecast of the IFs base case, comparing it with the few existing others, namely those of the World Bank, Global Insight, and the International Energy Agency (World Bank 2007: 3; United States Department of Energy 2006: 12; IEA 2007), as well as placing the scenario in the context of historic growth. Figure 5.14 shows again the historic context for the economic growth of the IFs base case and also indicates global growth patterns in two alternative scenarios.

The interventions made to create the high and low economic forecasts were scaled so as to create something close to rates of GDP growth 1 percent faster or slower than those of the base case. Because of greater uncertainty and somewhat higher bases, we increased or decreased the rates of growth in Sub-Saharan Africa, South Asia, and Latin America by about 1.5 percent. Because the historic pattern of economic growth, to which the base case is tied, has been so high for China, we increased its high case by only 0.5% and decreased its low case by 2.0%. Although IFs produces forecasts for GDP at both purchasing power parity (used in most education model calculations) and market prices, Figure 5.14 shows market prices because they are used in most comparative forecasts.

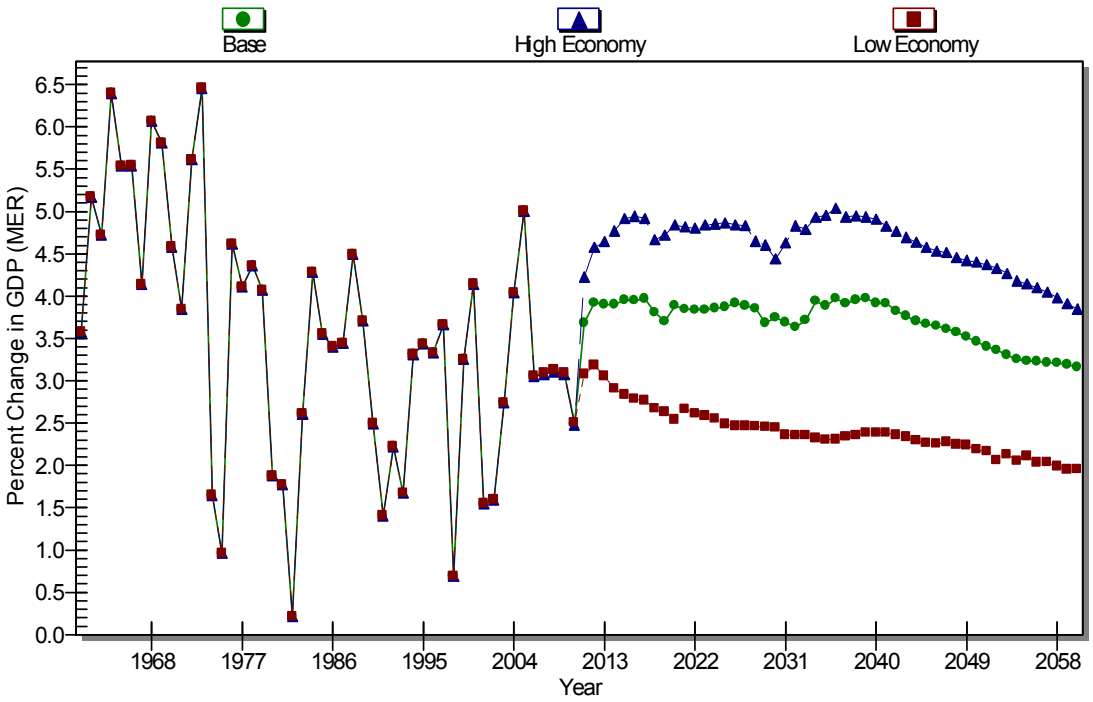

Figure 5.14 Global economic growth rate and scenarios
Source: IFs 6.02.
Note: Variation in economic forecasts reflects, in part, the impact of energy transition; slowing growth reflects population growth slowing.

Economic growth will affect student flows on both the demand and supply side. It will change the demand for education because of changing economic structures and because of changing economic capabilities and educational-benefit analyses within families.[117] Chapter 4 discussed the manner in which changes in GDP per capita (at PPP) tend to shape educational patterns. Already in 2030, in the fast growth economic scenario GDP per capita in Sub-Saharan Africa is 43 percent higher than in the low growth scenario; by 2060 the difference is nearly 300 percent. For South Asia the differences are 51 and 260 percent and globally they are 41 and 157 percent. The differences are so large because of the power of compounding growth rate differentials over 55 years.

On the supply side, higher economic growth will enhance societal resources at least proportionately. In fact, government revenues actually tend to rise faster than GDP when average income is rising. Further, we have already seen that spending on education as a portion of GDP also rises with income levels. Somewhat offsetting these changes that function to increase educational support and thus enrollments, the costs per student will rise with GDP per capita. Thus only a relatively small portion of the increased funding brought by higher GDP will be available to fund the higher enrollments desired from the demand side.

[117] IFs represents only the affect of the GDP per capita in the aggregate.

Overall, Table 5.12 shows quite significant potential differences in enrollment rates across the three economic scenarios. At the highest end of the impacts, tertiary enrollments in Sub-Saharan Africa could be 21 percent in 2055, nearly 2 times higher in the high economic growth scenario than in the low growth scenario. Similarly, in South and West Asia, tertiary enrollments could be 1.7 times higher than with low growth. More generally, whereas different demographic scenarios have greatest impact at the secondary level, the economic scenarios have proportionately somewhat greater impact at the tertiary level. Higher GDP and GDP per capita very significantly affect demand for tertiary education.

Still, in absolute terms the greatest percentage shifts would be at the secondary level. Lower secondary enrollments in Africa could be 74 percent in the low growth scenario in 2060, but 91 percent in the high growth scenario. The framing scenarios are, of course, chosen to be extreme. Nonetheless, the scenarios help us see the potential uncertainties in educational futures.

		Alternative Economic Growth Framing Scenarios					
		Low Growth		Base Case		High Growth	
	2005	2030	2060	2030	2060	2030	2060
Enrollment (%)							
World							
Primary	89.4	94.1	96.8	94.5	98.5	94.9	98.8
Lower Secondary	81.9	89.1	93.4	90.3	96.6	91.3	97.9
Upper Secondary	57.8	70.7	80.0	72.6	85.0	74.0	88.2
Tertiary	26.6	33.4	39.6	36.2	50.4	38.2	59.0
Sub-Saharan Africa							
Primary	68.1	76.7	88.0	77.6	95.1	78.6	95.8
Lower Secondary	40.9	53.5	74.1	54.6	85.5	56.0	90.6
Upper Secondary	22.5	32.1	48.7	32.6	57.9	33.3	65.9
Tertiary	4.8	6.7	11.2	7.7	14.9	8.6	21.4
South and West Asia							
Primary	85.4	93.1	97.7	93.8	98.3	94.7	98.6
Lower Secondary	65.9	85.8	94.7	88.4	97.0	90.5	98.0
Upper Secondary	38.0	60.2	77.0	62.7	84.3	65.6	88.3
Tertiary	10.1	19.1	32.2	21.7	41.7	24.7	55.1

Table 5.12 Enrollment rates by level of education across economic scenarios.
Source: IFs 6.001.
Note: Primary enrollment is net; others are gross.

Given the significant difference in educational flows of the three economic scenarios, however, a look at adult educational attainment re-emphasizes the degree to which education is a very long-term investment for societies. Average years of education for adults 25 and older differ globally in 2060 by only 0.3 years across the three scenarios; in Sub-Saharan Africa the difference is 0.4 years. Relative to an average of 7.5 years in the base case in 2050, that shift within Africa is certainly important, even if disappointingly small in absolute terms.

5.3.3 Educational Spending Futures

A third variable of great importance for educational forecasts is the rate of spending on education. Much forecasting around education is normative and has looked at the costs of education to reach specific educational goals (for example Bruns, Mingat, and Rakotomalala. 2003; for comparative discussion see Gurria and Gershberg undated). We know of no forecasts that explore the impact of alternative spending levels on educational outcomes.

Absence of spending/outcomes forecasts is partly because additional spending can influence educational forecasts in three different ways. It can increase enrollment levels, increase quality of the education of students (for example, via better teachers or school facilities or through improved materials), or increase expenditures per student without increasing quality. It is very difficult to know in any given situation how the impact of expenditure will split across these three categories. In this analysis we build on an algorithm for balancing demand for expenditures and supply of them that provides some additional funding to each category. Chapter 3 explained the budgetary algorithm of the model, meant to capture some of the elements of the incremental and bureaucratic decision-making processes. In Chapter 6 we will explore more carefully the possibility of a normative scenario that combines higher spending levels with spending per student at benchmark levels, thus minimizing the diversion of extra funding to inefficient expenditures.

Given that educational spending averages just below 4.5 percent of global GDP, a shift upward or downward by 0.6 percent is considerable and provides a reasonable range across which to look at the possible reactivity of educational futures. Table 5.13 shows the impact of such change on enrollment.

		Alternative Education Spending Framing Scenarios					
		Low Spending		Base Case		High Spending	
	2005	2030	2060	2030	2060	2030	2060
Enrollment (%)							
World							
Primary	89.4	93.9	98.2	94.5	98.5	95.0	98.7
Lower Secondary	81.9	88.3	95.8	90.3	96.6	91.6	97.2
Upper Secondary	57.8	68.9	83.2	72.6	85.0	74.5	86.4
Tertiary	26.6	32.7	46.6	36.2	50.4	38.7	53.1
Sub-Saharan Africa							
Primary	68.1	76.0	94.4	77.6	95.1	79.0	95.6
Lower Secondary	40.9	51.5	83.4	54.6	85.5	57.6	87.4
Upper Secondary	22.5	29.3	54.4	32.6	57.9	35.6	61.1
Tertiary	4.8	6.6	13.0	7.7	14.9	8.7	16.8
South and West Asia							
Primary	85.4	93.0	98.1	93.9	98.3	94.7	98.5
Lower Secondary	65.9	84.0	96.5	88.4	97.0	90.9	97.4
Upper Secondary	38.0	56.7	82.5	62.7	84.3	65.7	85.8
Tertiary	10.1	18.8	39.0	21.7	41.7	25.7	44.0

Table 5.13 Enrollment rates by level of education across education spending scenarios
Source: IFs 6.02.

The impact on enrollment is significant, but not as large as might be expected. That is partly because a considerable portion of the increased spending does go in a "spending push" scenario to greater spending per student. At the world level, spending per primary student rises in the base case from 18.6 percent of GDP per capita in 2005 to 23 percent in 2060. The high spending scenario pushes it to 25.9 percent and the low spending scenario holds it back to 20 percent. A normative scenario for enrollment increase would not simply "push on the noodle" of spending increases (wet noodles tend not to go where you want when you push the base of them), but also focus on the efficiency of expenditure use, an issue to which Chapter 6 returns.

At least as important a reason, however, that enrollment does not increase very significantly in the high spending scenario is that the achievement of educational goals such as universal basic education, even by 2060, will require more interim spending rise in sub-Saharan Africa and many parts of South and West Asia than this simple scenario has posited. In addition, the temporal profile of that spending increase will be complex. Chapter 7 returns to those issues.

The scenarios of spending increase do, of course, also affect adult educational attainment. In 2060 the high spending scenario adds 0.5 years of average education for global adults 25 years and older, relative to the low spending scenario. In Africa the increment is the same, and in South and West Asia it rises to 0.6 years.

5.3.4 Framing a broad range of uncertainty

The three sets of framing scenarios have begun to provide some insight into the uncertainty that we face in forecasting changing educational futures. In each case the variation in the driving variables was specified so as to be large, but not unreasonable. Table 5.14 puts together then three sets of scenarios so as to give us some sense of the most extreme range of uncertainty that faces us with respect to these driving variables. The variation across the combined scenarios is greatest in absolute terms with respect to secondary education in sub-Saharan Africa. In the very pessimistic scenario gross lower secondary enrollment would be about 67 percent in 2060; in the very optimistic scenario it would be about 98 percent, effectively completing the transition to universal basic education. With respect to adult educational attainment, the difference in average years of education for global adults in 2060 between the extreme scenarios would be 1.3 years; in Africa it would be 1.2 years (about 16 percent of the level in the base case) and in South and West Asia it would be 1.5 years.

This exploration helps us understand the forces that buffet the educational transitions globally, very often totally outside of the control of those who seek to set and reach educational goals. The importance of policy around population growth, for instance, could be as great as the leverage we might expect to exercise strictly within the educational system. Thus this analysis should provide some perspective and humility as

we move forward to consider a normative scenario that focuses on changes largely within the educational system.

		Alternative Education Spending Framing Scenarios					
		Very Pessimistic		Base Case		Very Optimistic	
	2005	2030	2060	2030	2060	2030	2060
Enrollment (%)							
World							
Primary	89.4	93.0	94.9	94.5	98.5	95.8	99.3
Lower Secondary	81.9	85.2	88.8	90.3	96.6	93.9	99.9
Upper Secondary	57.8	65.3	72.4	72.6	85.0	77.1	92.3
Tertiary	26.6	29.0	32.5	36.2	50.4	42.3	66.8
Sub-Saharan Africa							
Primary	68.1	74.6	84.8	77.6	95.1	80.5	97.3
Lower Secondary	40.9	48.7	66.7	54.6	85.5	61.5	97.6
Upper Secondary	22.5	27.8	40.2	32.6	57.9	38.0	77.8
Tertiary	4.8	5.4	7.6	7.7	14.9	10.4	31.3
South and West Asia							
Primary	85.4	91.5	95.9	93.9	98.3	95.8	99.2
Lower Secondary	65.9	78.2	90.2	88.4	97.0	94.0	99.6
Upper Secondary	38.0	51.2	69.3	62.7	84.3	69.6	92.3
Tertiary	10.1	15.9	27.8	21.7	41.7	32.2	61.0

Table 5.14 Enrollment rates across a broad uncertainty range
Source: IFs 6.02.

5.4 Conclusion

This chapter explored the educational forecasts of the IFs base case, putting them in the context of historic patterns and other forecasts. It also considered their sensitivity to alternative framing forecasts of population growth, economic growth, and educational spending, in order to begin exploring the range of variation that may be possible in educational futures. The next chapter will consider further the issue of possible variation in educational futures, and the influence that our choices might have in bringing about more desirable ones. To do so it will develop a normative scenario for global education that attempts to be aggressive but reasonable in accelerating educational advance.

6. Enhancing Educational Futures

Chapter 5 provided a base case forecast of educational futures that outlined the path we appear to be on for the first half of this century, and explored some of the uncertainties around that path. This chapter explores the possibility of improvement in educational futures relative to the base case. Its purpose is to lead us to a normative scenario, focused on enhancing educational futures, for comparison with the exploratory base case.

It has historically been common to set educational goals across countries (at the regional and often the global level, like the Millennium Development Goals), without taking into account the great differences in the starting points of those countries. That practice has reflected both the considerable weakness of data for specific countries, especially those with the least advanced educational systems, and inadequate knowledge (or inadequate attention to existing knowledge) concerning desirable yet realistic improvements over time.

Our goal is to develop, as an alternative to the base case reviewed in the preceding chapter, and as an alternative to selected universal quantitative goals, a normative global educational scenario that advances quantity and quality in an aggressive but realistic manner. The elaboration of the alternative scenario will first explore patterns of change in student numbers and flow patterns across primary, secondary and tertiary levels and then look at spending per student to assure that financial resource considerations are a realistic foundation of the scenario.[118]

A normative modeling scenario of human development, to be most useful, combines two characteristics. The first is that it involves a stretch towards a meaningful goal or goals. The second is that it should seek to be realistic, not arbitrary in its goal setting. Educational goals should be attentive to desirable patterns of transition across all levels of education, not simply primary. They should consider the specific elements of change most needed at each level, such as enhanced intake or completion rates, not just change in the overall enrollment rates that result from those. They should take resource needs of increased education in combination and the ability of societies to generate or acquire those. And they must recognize the different initial positions in which various global regions and countries find themselves, including demographic foundations.

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[118] Such an effort to develop a realistic normative scenario is in the tradition, for example, of the International Energy Agency's (IEA) Alternative Policy Scenario for global energy futures. Each year the IEA's *World Energy Outlook* (e.g. IEA 2007) refines that scenario, taking into account new data, new understanding of the global energy system and its demographic and economic drivers, changes in the actual policy environment, and insights concerning the types of policies that might achieve superior energy futures.

6.1 Existing descriptions of enhanced global educational futures

The World Education Forum, at a meeting in Dakar in April 2000, drafted and adopted an Education for All Framework for Action that expresses a vision of enhanced global futures in education.[119] The Framework articulates six global goals for meeting the basic learning needs of all people. The goals are: (1) expanding and improving comprehensive early childhood care and education, especially for the most vulnerable and disadvantaged children; (2) ensuring that by 2015 all children, particularly girls, children in difficult circumstances and those belonging to ethnic minorities, have access to and complete free and compulsory primary education of good quality; (3) ensuring that the learning needs of all young people and adults are met through equitable access to appropriate learning and life skills programs; (4) achieving a 50 per cent improvement in levels of adult literacy by 2015, especially for women, and equitable access to basic and continuing education for all adults; (5) eliminating gender disparities in primary and secondary education by 2005, and achieving gender equality in education by 2015, with a focus on ensuring girls' full and equal access to and achievement in basic education of good quality; (6) improving all aspects of the quality of education and ensuring excellence of all so that recognized and measurable learning outcomes are achieved by all, especially in literacy, numeracy, and essential life skills.[120]

Some important elements stand out in the Dakar Framework. It targets learning and learners at all ages, from early childhood through adult, and in so doing recognizes the importance of both formal and non-formal education. It sets specific and measurable targets, including time-frames, for some goals (access to and completion of free and compulsory primary education, gender parity in access to primary and secondary education, and improvements in adult literacy rates) and not for others. And finally, its focus is explicitly on basic education.

In combination the six Dakar Framework goals are a powerful, albeit incomplete,[121] statement of global goals across a broad landscape of educational futures. They serve as a reference point for domestic and international commitments to increasing education access and quality. We turn next to how they are advancing educational futures specifically vis-á-vis access to and quality of formal education.

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[119] King (2007) reviewed the full history of creating a global agenda on education and the integration of educational goals into broader developmental initiatives.

[120] The Dakar Framework for Action is available on the web at http://www.unesco.org/education/efa/ed_for_all/framework.shtml. See pages 1-2.

[121] The Dakar Framework for Action never mentions tertiary education and sets no targets for secondary education.

6.1.1 Targeting quantity

In September of 2000, the Millennium Summit of UN members issued the Millennium Declaration, a pledge signed by over 180 heads of state and other participants to "do our utmost to free our fellow men, women and children from abject and dehumanizing conditions of extreme poverty." The Millennium Declaration elaborated eight Millennium Development Goals (MDGs) in areas related to poverty reduction, education, gender equality, health, environmental sustainability, and a global partnership for development. Concrete targets by 2015 substantiate each goal, as do quantifiable indicators for all but MDG 8 (global partnership).

Primary education targets

The second Millennium Development Goal (MDG), drawn from the Dakar Education for All Framework, is universal primary education by 2015 for "children everywhere, boys and girls alike." The third MDG, the promotion of gender equality and the empowerment of women, places heavy emphasis on education by including gender parity in primary and secondary education, preferably by 2005, and at all levels by 2015 (again drawn directly from the Dakar Framework).

The official indicators for the second goal are the net enrollment ratio in primary education, the proportion of pupils who start grade 1 and reach grade 5 (the survival rate), and the literacy rate of 15-24 year-olds. The official indicators of the education component of the third MDG are the ratio of girls to boys in primary, secondary, and tertiary education, and the ratio of literate women to men, 15-24 years old.

These are appropriate and important goals. They manifest several important human values. One very strong foundational value is equity. In general terms, systems without universal participation are inherently unequal, because some children will be disadvantaged throughout their lives. The goals also reflect the value of equity in more specific terms. Even before universality of education may be possible, and at levels of education such as tertiary where it may never even be desirable, unequal participation rates across genders, rural/urban residence, ethnicity/religion or other important social dimensions—disparities that in many places are in fact greater than those by sex—should be eliminated. These factors combine so that poor girls who belong to an ethnic minority, and live in rural areas, are at special risk for being out-of-school. Other high at-risk populations include children in conflict and post-conflict countries and children with disabilities (Birdsall, Levine, and Ibrahim 2005: 36-39). Allowing such specific inequities to continue is inherently unfair and additionally puts the cohesion of the society at risk. The existing goals target such specific equity issues only by sex, but in practice, societies should and often do target additional specific inequities.

The indicators selected for charting progress toward global education goals place value on efficiency as well as equity. Efficiency is expressed by targeting both age-appropriate entry into, and progress through, primary education, as measured by (1) the net or "of-age" enrollment ratio, and (2) survival to the last grade of primary education. Whatever the intake pattern with which they are associated, high drop-out and/or grade repetition

rates result in and reflect a costly and inefficient use of system resources. A major—and some might argue the major—policy problem at the primary level is low survival rates.

Figure 6.1 shows the global relationship of survival rate to intake rate. The countries below 70-80 percent survival suffer such inefficiency (which can also reflect social inequalities). Different groupings of countries in the figure illustrate different challenges to educational systems. Countries in the lower right-hand quadrant, such as Equatorial Guinea, Madagascar, Rwanda, and Uganda, bring most of-age students into the system but advance relatively few of them to graduation.[122]

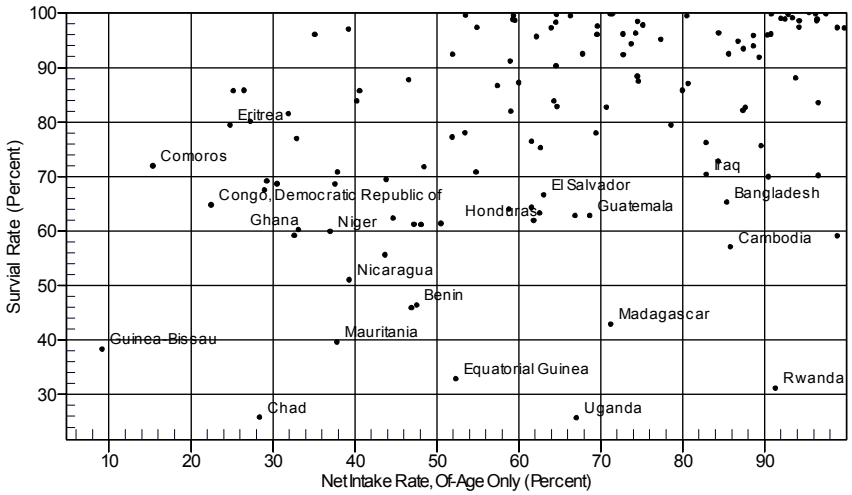

Figure 6.1 Inefficiency: survival rate across levels of of-age intake rate (primary)
Source: IFs version 5.45.
Note: Using data from 2004-2005

A second set of countries in Figure 6.1, including the Comoros, Eritrea, the Democratic Republic of the Congo, Ghana, and Niger, illustrate a different kind of educational system challenge. Those countries have moderately high survival rates, but the intake rates are far from universal. The challenge they face is participation, and low participation rates are inherently inequitable. In the lower left-hand quadrant, countries like Guinea-Bissau, Chad, Mauritania, Benin and Nicaragua struggle with a double burden, low intake and survival rates. This third set of countries needs to address both low participation and low efficiency.

Indeed, one question that emerges from this analysis is how developing countries deal with the twin and interacting challenges of equity and efficiency as they move toward universal primary education. Do they tend to deal with both challenges simultaneously or is there a pattern of emphasizing first one target and then the other? What are the circumstances and consequences associated with the differing patterns, and are there

[122] In some cases, of course, like that of Chad or Uganda, political disruption can help explain the failure of many students to complete their education and the resultant inefficiency.

implications for best practice? This is a topic we will explore further as we develop the normative scenario.

Secondary education targets

So far we have discussed quantitative targets and issues relative to primary education, and, in fact, it is only for primary education that the UN has articulated and adopted measurable global numerical goals in the MDG set, and for which monitoring and reporting of progress is globally mandated (gender parity is, of course, a goal at all levels). Clearly this has resulted in an emphasis on primary education, an emphasis whose rationale includes a commitment to providing, despite resource constraints, some level of education to all children. The sequential reality that children need to be educated at the primary level before secondary and higher education has also served to make primary education the first emphasis. The result in many countries, however, is that increasing numbers and percentages of children are completing primary education in environments that are not prepared to handle increasing demand at secondary or tertiary levels.

This does not mean that "after primary" is receiving no attention. The report of the UN Millennium Project Task Force on Education and Gender Equality, for example, speaks specifically to the need for post-primary education (Birdsall, Levine, and Ibrahim 2005: 5-6, 65, 161-163) and includes the recommendation that current investments in primary education be balanced with selective support to post-primary education (especially opportunities for girls and young women) and that planning for the expansion of post-primary education take place along with planning for the achievement of universal primary education (Birdsall, Levine, and Ibrahim 2005: 66). Perhaps the strongest call and depth of analytic support for moving globally beyond primary education has come from the UBASE (Universal Basic and Secondary Education) Project at the American Academy of Arts and Sciences. Begun in 2001, the focus of the UBASE project has been the extension of education to all children from age 6 to 16 worldwide (Cohen, Bloom, and Malin 2006).[123]

Discussions and policies are moving increasingly toward clarifying and/or reinforcing distinctions between two levels of secondary education—lower and upper. Analysts view lower secondary as the completion of a basic education (including preparation for informed citizenship) and upper secondary as more advanced and more specialized preparation for work and/or tertiary education. While lower secondary education has yet to be adopted as a global goal, a UBASE publication interestingly notes that many who

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[123] An important facet of the emerging focus on post-primary education is exploration of the role of secondary education in developing countries in an environment of universal or near-universal primary education. We see this in an International Institute for Educational Planning/UNESCO 2000 report entitled "Positioning secondary school education in developing countries," an Academy for Educational Development/World Bank 2003 joint report entitled "Beyond Basic Education: Secondary Education in the Developing World," the World Bank's first policy statement on secondary education in 2005 ("Expanding Opportunities and Building Competencies for Young People: A New Agenda for Secondary Education"), and in regional study and policy oriented groups such as the 2002-2005 Secondary Education in Africa (SEIA) initiative.

were involved in creating the Dakar Framework believed "primary education" was a proxy for "basic education," which the authors describe as "usually defined as eight years of schooling" in distinction from the five or six years typically labeled primary education in our part of the world (Sperling 2006: xii). In other words, many thought they were endorsing primary and lower secondary (or substantial portions of lower secondary) education for all children. Interesting also is that of the 197 countries for which the UNESCO Institute for Statistics provided 2005 data on years of compulsory schooling translated into education levels, 73 percent had compulsory education statutes or policies (although not necessarily legally enforced) that extend through the lower secondary level.[124] In distinction, only 12 percent of the 197 countries had compulsory upper secondary statutes in 2005 (same source). Table 6.1 shows the lower secondary gross enrollment ratios for the countries with compulsory lower secondary education.

	Income Level		
	Low	Middle	High
Compulsory lower secondary			
Non-compulsory lower secondary			

Table 6.1 Lower secondary gross enrollment rates by country income level and compulsory status
Source: Compiled by authors.
Note: Table to be developed.

While there is a growing consensus that universal lower secondary education should be a global goal, there is less thrust toward compulsory or universally available upper secondary education.[125] Lively discussions occur about the desired extent, role, curricula, organization, and financing of upper secondary education, with an emphasis on the need for reform arising from two circumstances. The first is that upper secondary education in developing countries frequently is still modeled on systems established during the colonial periods in these countries—systems that were open only to a small proportion of carefully selected youth, with the specific goal of preparing them for positions of support in the colonial bureaucracies. These systems have become spectacularly ineffective—if indeed they were ever effective—given the type of educated skilled work force that is necessary if developing countries are to prosper as partners in a global knowledge based society. What exactly should be offered instead (including the appropriate extent and role of vocational education) often occurs in the context of a debate about how to assure quality while expanding access. In addition, significant differences of opinion still exist about the role of public financing of upper secondary education, related in part to

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[124] By region, countries' rates of at least nominal compulsory lower secondary education vary widely. From lowest to highest, they are: Sub Saharan Africa (31 percent); South and West Asia (44 percent); East Asia and the Pacific (74 percent); Latin America and the Caribbean (83 percent); Arab States (85 percent); Central and Eastern Europe (95 percent); North America and Western Europe (96 percent); and Central Asia (100 percent). From UIS On-line Data Center, at http://stats.uis.unesco.org/unesco/TableViewer/document.aspx?ReportId=143&IF_Language=eng.

[125] Even the emphasis of the UBASE project on education for all children ages 6 to 16 does not encompass all years of secondary education in all systems.

differing perceptions as to whether the individual or society benefits most from education at this level.

A related set of issues arises when developing countries, in the face of constrained resources, have to make decisions about the relative balance between strategies to increase access to primary education and strategies to increase access to lower and upper secondary education. Increased numbers of primary graduates place great pressure on secondary systems, perhaps even resulting in a reduction of transition rates to lower and upper secondary levels (although that may not mean a reduction in enrollments). Should developing countries focus on completing the transition to universal primary education before focusing on expanding access to secondary education? What values, goals, and sets of circumstances should guide their decisions?

In fact, the balance of emphasis on primary and secondary education, and on lower and upper levels within secondary, varies considerably across countries. Figure 6.2 shows the global pattern of relationship between enrollments at the primary and secondary levels. It identifies some of the countries that deviate considerably from the general pattern. For instance, one set of countries, those well below the line, have secondary enrollments quite a bit lower than would be expected at their level of primary enrollments. Note that Uganda and Tanzania both have gross lower secondary enrollments near or below 20 percent in spite of net primary enrollments near 90 percent.

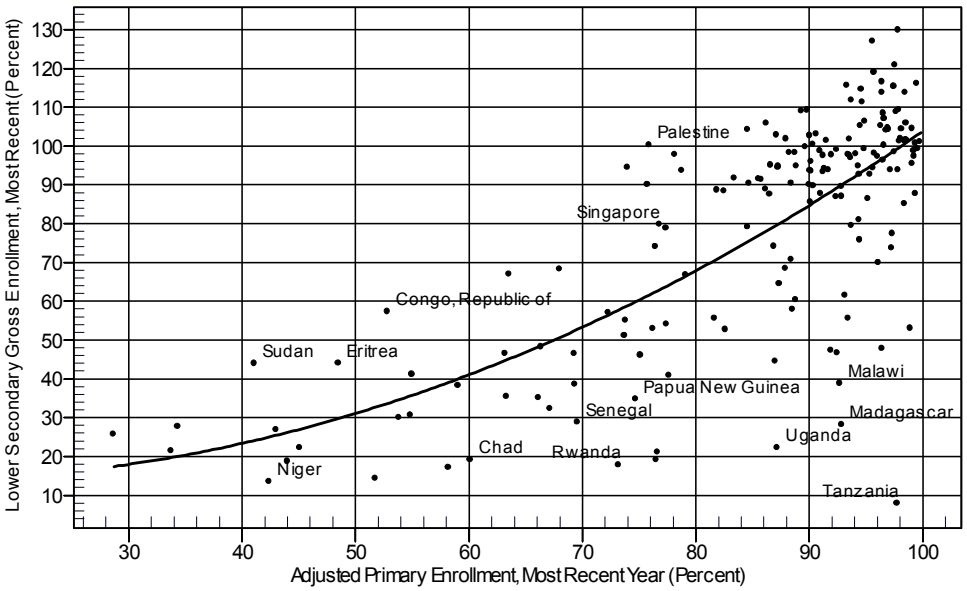

Figure 6.2 Balance: relationship of gross lower secondary to adjusted net primary enrollment
Source: IFs version 5.45.
Note: R-squared=0.54; the functional form is quadratic.

The issues are complicated on both equity and efficiency grounds. One could argue for the pattern of Uganda and Tanzania on the grounds of equity, emphasizing primary for

all, rather than providing a path for a smaller number to achieve both primary and secondary education, leaving many citizens behind (as the Sudan and the Republic of the Congo could be said from Figure 6.2 to be doing). It is, however, important to recognize that moving toward universal primary enrollment without building a significant secondary system as well can again be inefficient. For instance, good training for teachers and therefore high quality of education requires at least a secondary education. It is not a coincidence that many of the countries below the line in Figure 6.2 were also in the lower right-hand and more inefficient quadrant of Figure 6.1, characterized by low survival rates relative to intake rates. Students and their families may not continue the educational process if the quality of it does not provide benefits greater than the opportunity costs of the pursuit.

Quantity goals overall

Overall, then, the existing images of enhanced global futures for education tend to share a number of elements. Universal primary education tends to be central, but universal basic education, incorporating lower secondary education as well, is increasingly prominent. Acceleration of movement towards gender parity is of high importance. There tends to be much less emphasis on upper secondary education and little at the level of the global community with respect to tertiary education, where high-income countries place much emphasis. There is considerable attention to both equity and efficiency. And there is much recognition that high survival rates are an important indicator of the health of educational systems.

6.1.2 Improving quality

The final goal of the Dakar Framework reminds us explicitly that extending the quantity of education, while essential, is not sufficient. In addition, advancing global education requires a focus on "improving all aspects of the quality of education and ensuring excellence of all so that recognized and measurable learning outcomes are achieved by all, especially in literacy, numeracy, and essential life skills. " (Dakar Framework for Action, page 2) In order to improve quality it is necessary first to develop measures of it, second to apply those measures and assess performance, and finally to analyze approaches to enhancing quality.

Measuring quality

While many developed countries now participate in international learning assessments that focus specifically on literacy, numeracy and/or essential life skills, far from all middle income countries and very few low income countries participate. Because of the historic scarcity of internationally reported learning assessments for developing countries, more widely available proxy measures are often used as comparative indicators of quality. The most frequently used is one of the official indicators for MDG 2, namely the survival rate of an entering primary cohort to the beginning of fifth (or final) grade. The use of the survival rate as a quality proxy is based on recognition that schools, in general, will not retain large proportions of students to the final grade unless the educational experience has quality.

Testifying further to its importance, the survival rate is used as the quality component in an Education Development Index (EDI) developed to measure overall progress toward a number of the goals in the Dakar Framework (UNESCO 2007b: 198-205). In some sense, the EDI itself is a composite proxy measure of quality. Its components are (1) the primary net enrollment rate (a measure of the proportion of children of defined school age who are enrolled); (2) the adult literacy rate; (3) the survival rate; and (4) the gender-specific EFA index (a composite of the gender parity indices in primary and secondary education and the gender parity index for adult literacy).[126] The 2008 EFA Global Monitoring Report charts progress on the EDI between 1999 and 2005 for the 44 countries that included values for all four components in both years. The report notes that while primary net enrollment was the component showing most improvement during that period, "In most countries that saw low improvement or decline in the EDI, the weak point was the survival rate . . ." (UNESCO 2007b: 95).

Although survival rates and other measures of educational involvement and outcome are fundamentally important to gauging the quality of educational systems, countries have placed increasing emphasis in recent years on direct assessment of learning. Many developing countries participate in regional and country-specific assessments of learning outcomes that, although not necessarily comparable or widely disseminated, contribute to understanding of quality outcomes. The EFA Global Monitoring Report 2008 notes that 50 percent of developing countries and 17 percent of transitional countries conducted at least one national learning assessment between 2000 and 2006, compared to 28 percent and 0 percent between 1995 and 1999 (UNESCO 2007b: 68-69).

[126] While serving in some sense as a quality proxy, the EDI also includes a proxy, as the proportion of the adult population with completed primary education is used as a measure for the adult literacy rate. In IFs, change in the percentage of adults with primary education drives change in literacy rate.

Box 6.1 The development of international educational assessment

The International Association for the Evaluation of Educational Achievement (IEA) and the OECD are both involved in significant efforts to measure educational quality across countries, and both focus on direct assessment of student learning outcomes rather than on proxy measures. IEA, now headquartered in Amsterdam, grew out of a meeting of researchers convened by UNESCO in 1958, and became a legal entity in 1967. Since that time a variety of studies have been conducted under its auspices, only some of which have evolved into regularly-recurring assessments.

The two primary IEA assessments, conducted in conjunction with the International Study Center at Boston College's Lynch School of Education, are TIMSS (Trends in Math and Science Study) and PIRLS (Progress in International Reading Literacy Study). TIMSS was conducted in 1995, 1999, 2003, and 2007; 8th grade students were included in all four assessments, while 4th grade students were included in all but the 1999 assessment. In addition, students in the final grade of secondary school were included in the 1995 assessment. PIRLS, on the other hand, was conducted in 2001 and 2006, both times with 4th grade students only. TIMSS and PIRLS report each country's performance relative to an international mean score across all participating countries. They also report the percentage of students in each country who perform at various percentile levels of achievement relative to defined competency levels or targets.

While the TIMSS and PIRLS assessments have focused on students in 4th as well as 8th grade, the PISA assessment program—under the auspices of the Organization of Economic Cooperation and Development (OECD)—focuses on 15 year-olds. PISA—the Programme for International Student Assessment—includes timed tests in reading, mathematics and science literacy. Its intent is the assessment of students' ability to apply knowledge and learning at the "typical" end of compulsory education. PISA was conducted in 2000, 2003, and 2006. Performance scores are expressed as country-level means and standard errors, and include percentile distributions. Since in a large number of developing countries, many (and not infrequently, most) students who have completed primary school are no longer in the educational system by age 15, PISA is not able to provide as broad or direct an assessment of the quality of primary education as are TIMSS and PIRLS. However, it makes a significant contribution by focusing on students' preparation for assuming the roles and responsibilities of work, citizenship, and/or advanced study for those who are completing lower secondary education.

Box 6.1 briefly describes the major standardized tests for educational assessment of learning outcomes—TIMSS, PIRLS, and PISA. Table 6.2 shows the scope of country participation by World Bank income categories in at least one component of TIMSS, PIRLS, and PISA between 1995 and 2007.[127] The region with the smallest percentage of

[127] Participants in one or more TIMSS, PIRLS, and PISA assessments, 1995-2007:
Low-income countries: Ghana, Kyrgyzstan, Mongolia, Palestine, and Yemen
Lower-middle income countries: Albania, Algeria, Armenia, Azerbaijan, Bosnia/Herzegovina, Colombia, Dominican Republic, Egypt, El Salvador, Georgia, Guatemala, Indonesia, Iran, Jordan, Macedonia, Moldova, Morocco, Paraguay, Peru, Philippines, Syria, Thailand, Tunisia, and Ukraine

its countries included is Sub Saharan Africa, with just Botswana, Ghana, and South Africa participating.[128]

	TIMSS 1995	TIMSS 1999	TIMSS 2003	TIMSS 2007	PIRLS 2001	PIRLS 2006	PISA 2000	PISA 2003	PISA 2006
Low Income Countries (n=53)	0	0	3	4	0	0	0	0	1
Lower-Middle Income Countries (n=55)	5	9	11	16	5	6	5	3	6
Upper-Middle Income Countries (n=41)	10	11	14	14	10	9	10	10	17
High Income Countries (n=60)	30	18	23	30	20	26	28	28	33
	45	38	51	64	35	41	43	41	57

Table compiled by authors by categorizing lists of participating countries into World Bank income categories
Countries are included if they participated in any component of the assessments for a given year (e.g., 4th or 8th grade or both) if the assessment included more than one possible population.

Table 6.2 Countries in global assessment programs by income level
Source: Compiled by authors by categorizing IEA and OECD lists of country participants by country income status.

Quality measures and cross-country differences

One of the most remarkable aspects of the various tests is their ability to show consistent cross-country differences, regardless of the assessment instrument and subject area (TIMMS, PIRLS or PISA) and even independent of sex and age. Cross-country relationships of examination results across all of these categories are remarkably strong. Table 6.3 shows the relationships across all dimensions other than sex. The lowest r-squared, a very respectable 0.48, links the TIMMS math test for 4th graders with the PISA reading test for 15 year-olds. The persistent tendency for low- and middle-income countries to report much lower scores than do high-income countries increased the magnitude of the R-squared coefficients and suggests a relationship between income and scores.

Upper-middle income countries: Argentina, Belize, Botswana, Brazil, Bulgaria, Chile, Croatia, Hungary, Kazakhstan, Latvia, Lebanon, Lithuania, Malaysia, Mexico, Montenegro, Oman, Poland, Romania, Russian Federation, Serbia, Slovak Republic, South Africa, Turkey, and Uruguay
High-income countries: Australia, Austria, Bahrain, Belgium, Canada, Chinese Taipei, Cyprus, Czech Republic, Denmark, England, Estonia, Finland, France, Germany, Greece, Hong Kong, Iceland, Ireland, Israel, Italy, Japan, Republic of Korea, Kuwait, Liechtenstein, Luxembourg, Macao, Malta, Netherlands, New Zealand, Northern Ireland, Norway, Portugal, Qatar, Saudi Arabia, Scotland, Singapore, Slovenia, Spain, Sweden, Switzerland, Trinidad and Tobago, United Arab Emirates, United Kingdom, and United States.

[128] IEA has one other recently completed international assessment, and two more underway, in which a number of low and medium income countries are participating. SITES (Information on Technology in Education) 2006 included Chile, Chinese Taipei, Estonia, Lithuania, Russian Federation, Slovak Republic, Slovenia, South Africa, and Thailand. TEDS (Teacher Education and Development in Mathematics) 2008 includes Botswana, Chile, Chinese Taipei, Georgia, Mexico, Oman, Philippines, Poland, and Syria. ICCS (International Civic and Citizenship Education Study) 2009 includes Bulgaria, Chile, Chinese Taipei, Columbia, Dominican Republic, Estonia, Guatemala, Indonesia, Republic of Korea, Latvia, Lithuania, Mexico, Paraguay, Poland, Russian Federation, Slovak Republic, Slovenia, and Thailand.

	Test (see rows for identification)						
TIMMS	1	2	3	4	5	6	7
1. Math 4th grade							
2. Science 4th grade	0.92						
3. Math 8th grade	0.86	0.76					
4. Science 8th grade	0.81	0.86	0.91				
PIRLS							
5. Reading 4th grade	0.80	0.94	0.77	0.81			
PISA							
6. Reading 15 year-olds	0.48	0.59	0.58	0.62	0.61		
7. Science 15 year-olds	0.62	0.59	0.68	0.67	0.67	0.94	
8. Math 15 year-olds	0.66	0.67	0.77	0.64	0.65	0.87	0.92

Table 6.3 r-squared of countries across quality tests
Source: Compiled by authors using the most recent test results in each case (years vary).

Test scores like those in Table 6.3 are not the only attempts to assess the relative quality of educational programs. The World Economic Forum (WEF) uses a survey approach to scoring and ranking most countries on educational quality (WEF 2007). The 2004 ranking on this more reputational approach to quality assessment had an r-squared of only 0.26 with the PIRLS reading test. Clearly, that measure is picking up something different than are the examinations, perhaps even some broader disappointment with the performance of public institutions by survey respondents. For instance, Georgia, Germany, Italy, Poland, and Russia all score more highly on the PIRLS examination than they do on the WEF measure.

Countries have come to take their relative position on the PISA and other examinations quite seriously.[129] For instance, Germany was very surprised that its relative position on the first PISA exam was not higher, which more detailed exploration suggested was in large part attributable to lower scores in its Turkish community than in the ethnically German population. That finding spurred a variety of initiatives to improve the education of the large minority population.[130]

Turning to the gender dimension, Figure 6.4 shows the relationship between male and female scores for the PISA reading examination across countries. It allows two conclusions. First, there is an extremely high relationship between male and female scores across countries; Peru falls a bit off the line but most countries are nearly on it. The correlations of male and female scores across countries for science and math (not shown) are equally remarkable, with r-squared values of 0.97 and 0.98, respectively. Second, the figure shows some quite consistent gender differences on reading examinations across countries. Females around the world tend to score 30-40 points

[129] Students from countries such as Korea, Japan, and Singapore consistently produce very high average scores on tests. This has led some analysts to conclude that educational systems emphasizing rote learning produce students who do well on such examinations but may not always produce students who have the individualism and creativity that modern knowledge economies need. Such pedagogical debates are beyond the scope of this report.

[130] *The Economist*, April 5, 2008: 31.

higher than males on reading (except in Peru). On mathematics (not shown) males outscore females by about 20 points on average. Gender differences on the science exams (also not shown) are essentially non-existent.

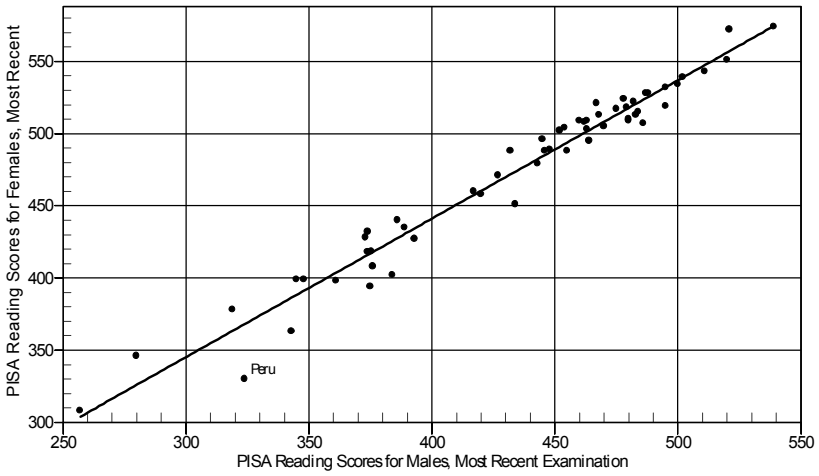

Figure 6.4 Gender score patterns on PISA reading exam
Source: IFs Version 5.45.
Note: r-squared=0.96

The high cross-country correlations across exams, topic areas, levels of education, sex, and age suggest two more general conclusions. First, the tests probably are capturing some underlying dimensions of educational quality (test-taking ability, if nothing else) quite well and consistently. It suggests significant validity of the tests. Second, cross-country differences are substantial and require our attention. Exploring them may help us identify some of the drivers or markers of quality differences in education around the world.

The determinants of quality across countries.

What helps countries achieve higher scores on these examinations and, hopefully, thereby structure stronger educational systems? The answer to that question may help us structure a normative scenario. Although it is not possible for us to forecast test scores as a proxy for quality, it is possible for us to forecast some of the apparent correlates of quality. A great many factors almost certainly relate to the substantial and quite consistent differences in test scores across countries:

- Studies within countries often stress the importance of parental educational levels, especially that of mothers, to the success of students (Birdsall, Levine, and Ibrahim 2005: 26).

- Spending levels per student might also contribute generally, if not invariably, to quality.

- The structure of educational systems, including the attention paid to helping students complete their years of primary or higher education (the survival rate) could also be important. (Survival rate could also be a proxy for other qualities of educational system, including aspects as diverse as teacher quality, class size, transportation and other infrastructure systems, and cultural commitment of education.)

- Governance effectivness and quality, including the absence of corruption, also may spill over into educational quality. A common focus in many studies is corruption level, as measured by Transparency International and the World Bank's Governance Matters project (Kaufmann, Kraay, and Mastruzzi 2007). An even more powerful measure proves, however, to be the World Bank's measure of government effectiveness. The measure is intended to capture the "quality of public service delivery," so correlation with quality of education should not be surprising.

- Not surprisingly, the income of countries, as either a proxy for some of these other factors or as a determinant in itself, is a strong candidate for helping explain higher test scores. So, too, is income distribution.

Examining these factors individually and in combination will help up begin to understand the foundations and markers of quality. In the case of per-student levels, survival rates, and governance, the analyses may also suggest policy interventions to improve quality. In exploring each factor we use the PIRLS reading score as the summary measure. That test is administered at the fourth grade allowing quite extensive participation of middle-income countries. A reading test, with its obvious tie to literacy, is perhaps a more globally general measure of education than are mathematics and science examinations. And the country set participating in PIRLS is reasonably extensive and growing (see again Table 6.2).

Table 6.4 summaries the relationships of the various factors with the level of PIRLS reading scores across countries. For instance, earlier discussion emphasized the importance of survival rate as a surrogate measure for quality of primary education. In fact, the survival rate has the highest bivariate relationship with test scores of all the variables considered.

Interestingly, GDP per capita does not prove to have a terribly high relationship to PIRLS test scores. It is important to stress again, however, that such relationships can vary considerably as a result of only a few outliers or other changes to the country set. A correlation of GDP per capita to PISA test scores, for example, climbs from the 0.19 in Table 6.4 to 0.60. Considerably more middle-income countries take the PISA examination.

	Relationship to PIRLS reading score		
	Bivariate	Multivariate with GDP per capita	Multivariate with GDP per capita, Gini
Female secondary education	0.28	0.25	0.25
Spending per student	0.15	0.16	0.16
Survival rate	0.31	0.30	0.65
Government effectiveness	0.23	0.30	0.46
Gini coefficient	0.29	0.47	
GDP per capita	0.19		

Table 6.4 R-squared of possible determinants of quality with PIRLS reading scores
Source: Compiled by authors using the most recent test results in each case (years vary)

Our analysis also looked at a wide range of multivariate relationships with test scores. The most powerful combination of variables proved to be survival rate, GDP per capita, and the income Gini coefficient. This outcome reinforces the importance of attention to survival rate as a key factor in improving educational quality (and/or reflects the manner in which quality affects survival rate), reinforcing our attention to it in the process of elaborating a normative scenario throughout this chapter. Somewhat in contrast, the apparently low level of relationship of per-student spending to quality outcomes reinforces two conclusions that appear in much of the educational literature: first, educational spending is obviously necessary, but many countries do not get clear return from higher spending levels; second, quality is possible even at modest spending levels. These are important insights to take into a subsequent discussion on appropriate spending levels. Still the demonstrated instability of all of the relationships of possible drivers with test scores must make us very cautious about drawing conclusions.

In summary, educational quality measurements themselves tend to be quite highly but imperfectly correlated. International test scores themselves are remarkably closely associated across countries, sex, age, and even subject matter. A number of contextual variables relate well to them, not least survival rates.

6.2 Foundations for enhancing education: flow patterns

This analysis has stressed that it is unrealistically simple to call for universal enrollment at the primary or any other level of education by a particular time in the future. It is important instead to consider aggressive but realistic targets for advance. Moreover, we cannot focus only on enrollment. It is critical to look at the intake of students and their process through the educational system, including completion of each level of education. The question that guides our consideration of enhancing student flow patterns (see again Chapter 3 for the conceptual structure of flow patterns) is how fast can various rates (especially intake and survival/completion) realistically grow?

6.2.1 Primary

Growth in net enrollment. Even in the highest-income countries, net primary enrollment generally falls somewhat short of 100 percent. Thus 97 percent is sometimes used as the threshold definition of universal enrollment. A level of 90 percent enrollment

is a good indicator that countries are nearing universal enrollment, even though bringing that next 7-10 percent of school-aged children into the system may take many years. Chapter 5 identified a total of 62 mostly African countries that in the IFs base case will likely not reach the goal of 90 percent enrollment by 2015 (see Table 5.2); a very small number will find it difficult to reach the goal by 2060.

In a normative, accelerated scenario, how fast might we expect countries to increase their net enrollment rates? Average performance in the past provides some initial insight (see again Tables 5.7 and 5.8). Clemens (2004: 15-16) found that in the last half of the 20th century countries on the average moved from 50 percent net enrollment rates to 70 percent in 22.3 years, increasing enrollment rates by nearly 1 percentage point each year; movement from 75-90 percent enrollment rate took 28 years on average, at a rate of approximately 0.5 percent each year. Similarly, Wils, Carrol, and Barrow (2005:22) found that movement from 80-90 percent required 14.7 years, a gain of about 0.7 percent each year.

Considering four relatively data-rich countries that experienced rapid historical growth offers further insight into potentially aggressive net enrollment growth rates. Botswana appeared successful after 1970 in raising rates from 46 to 76 percent in a bit more than 10 years, an annual increase of nearly 3 percentage points. Those numbers may, however, have been overly ambitious or inaccurate and then corrected; over a full 35 years, the annual increase was only about 1 percent. Similarly, although Bangladesh appeared to have surged from 50 to 90 percent in 28 years (adding an average of 1.4 percent annually), but over a full 35 years the annual increase averaged 1.1 percent. With a different overall pattern, Moroccan rates climbed from 39 to 72 percent in 25 years, a bit more than 1 percent annually, but then surged and averaged 1.4 percent gain over 35 years. Similarly, Saudi Arabia, with both a late start on primary expansion given its income level and substantial resources to support growth, increased rates from 32 to 87 percent in 35 years, a rise of 1.6 percent each year. The experience of these four historically aggressive countries suggest that increasing enrollment rates by even 1.5 percentage points annually over a prolonged period is very challenging.

Moving analysis up to the regional level, Latin America had already reached average enrollments of nearly 80 percent by 1970 and the regional growth has only been 17 percent (about 0.5 percent each year) since then. Over 34 years the low enrollment set of African countries also demonstrated collectively a pattern very much like that described by Clemens, climbing from 13 to 47 percent for an annual increase rate of 1 percent.

In the period of the 1990s and the first few years to the 21st century, however, growth in net enrollment rates accelerated. Between 1990 and 2004, a period of especially great attention to enrollment increase, the annual percentage gain in the low enrollment African countries accelerated to 1.6 percent. Similarly, annual percentage point increase for the middle-enrollment set of African countries averaged nearly 1.5 percent during that period.

Thus the broader literature and the patterns in these country and regional suggest that something close to 1.5-2 percentage points gain each year might be at the upper end of

realistic sustainable annual increases. It may be feasible for some countries to surpass 2 and move towards 3 percentage points for short periods of time, but such rates appear generally unsustainable.

Growth in intake. Although universal primary net enrollment (UPE) is a major target/goal, accomplishing it requires universalizing both student intake and survival to and completion of the final grade. Along with minimizing repetition (or maximizing successful grade completion), intake and survival/completion are the true points of policy leverage. Unfortunately, there is little administrative data on net primary intake until 1999 at which time the UNESCO Institute of Statistics (UIS) began to gather them. Similarly UIS data on survival are now presented on-line only for 1991 and 1999 forward and on completion since 1999.[131]

Table 6.5 shows gross intake rates in order to provide a longer series. It also shows separately the periods from 1970-1999 and 1999-2005 because of the acceleration of growth in recent years. Table 6.5 and subsequent tables and figures in the discussion of primary level education focus on Africa because it is significantly further from UPE than any other region; the secondary education discussion will broaden perspective again.

	1970	1999	Annual Percent Growth
Low Education Africa	33	66	1.1
Middle Education Africa	71	92	0.7
High Eduation Africa	79	107	1.0

	1999	2005	Annual Percent Growth
Low Education Africa	66	81 (2004)	2.5
Middle Education Africa	92	113	3.5
High Eduation Africa	107	118	1.8

Table 6.5 Growth in gross primary intake rates
Source: Compiled by authors from IFs version 6.01.
Note: Low education Africa value is for 2004.

There has, of course, been in recent years a big push to increase intake across Africa, with domestic desire and will reinforced via the global community's elaboration of goals through Education for All and the Millennium Summit. Focusing on a few countries with relatively extensive data and especially fast adjusted net intake growth, the rates between 2000 and 2005 for Burkina Faso (see the discussion of forecasts for Burkina Faso in Chapter 5), Burundi, Guinea, Mozambique, Niger and Zambia were 5.5, 2.3, 4.6, 6.8, 3.0, and 4.4, respectively. Unfortunately for analysis, that growth included some seemingly improbable increases in several instances (including a 17 percentage point jump in

[131] The IFs database also includes data on survival back to 1970 and on completion back to 1999, collected from earlier editions (2004 and 2005) of the World Bank's World Development Indicators (WDI). These are not necessarily consistent with data reported in more recent years.

Mozambique between 2002 and 2004).[132] It is important to understand, however, that such annual average changes in intake rates are truly exceptional. Only a very few counties experienced increases of more than 2 percentage points each year.

In many countries large numbers of children one year below or above official age enter and the adjusted net intake of the IFs project includes those children. At one extreme, in Indonesia about 60 percent of children one year below the official age enter every year, a higher entrance rate than for children of-age. Yet the growth rates for intake of strictly of-age students are not terribly different from those of adjusted net intake, except for a small number of countries.[133]

Overall, the analysis in this discussion, both of other literature and of data, suggests that a normative target for annual percentage rise in adjusted intake rates for countries with current rates somewhat near 50 percent could perhaps be as much as 3 percent, but that 2 percent is probably a more realistic value. Overly rapid increases in intake would also risk putting pressures on school systems that increase drop-out and repetition rates. Interestingly, and with implications for the discussion below of survival rates, a normative intake growth rate of about 2 percent is comparable to the normative target for increase in net enrollment rates discussed earlier.

Growth in primary survival/completion. Universal survival to the final grade (it would be better called persistence because "survival" makes it sound as if the educational experience is life-threatening) joins universal net enrollment as the second key indicator of universal primary education in most goal sets. It is also, along with intake, the second key driver of primary enrollment levels.

Survival to the final grade of those who enter primary school makes possible completion of that grade and thus of primary schooling. Bruns, Mingat, and Rakotomalala (2003) found that the 20 highest performing low-income countries during the 1990s achieved, on average, a 2.38 percent annual increase in completion rates.[134] Completion rates climb as roughly the sum of increase in intake rates and survival rates. Thus if intake increased roughly 1.5-2.0 percent annually in the highest performing countries (as the previous section suggests), the implicit gain in survival rates for these 20 countries would have been about .38-.88 points, no more than 1 percentage point annual increase.

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[132] The annual increases of the figure and subsequent ones in this discussion are simple (rather than compound) averages, that is the difference between values at the end and beginning of the period divided by the number of years in the period. The data series shown in the figure is EdPriNIRTotal%.

[133] For example the annual change in of-age net intake rate for Mauritius is 4 percent, compared to less than 1 percent in Figure 6.5 for adjusted intake. Mauritius regularized enrollment patterns over time, decreasing the intake rate of children one year above age from 24 percent in 2000 to 11 percent in 2005, while increasing the intake rate for of-age children from 71 to 91 percent. Even with such regularization, however, relatively few countries were able to increase of-age net intake rates by more than 2 percent each year between 2000 and 2005. Only 10 countries with adequate data to allow assessment did so, and growth exceeded 3 percent in only six of those.

[134] The median was 1.96 percent per year and the range was 1.39 to 7.63 percent.

In fact, the relatively limited data we have on survival rates over time suggests that 1 percent growth is a fairly aggressive target, especially on top of growing intake rates. Fitting trend lines to the very sparse and irregular data on survival for the three different enrollment-level groupings of sub-Saharan Africa (low, medium and high) over the 1970 to 2005 period shows essentially flat patterns on average.[135] Looking only at data from 1999-2005, reporting countries were more likely than not to show some increase in survival rates, but only 7 countries showed annual gains of more than 2 percent, and only 9 others gained more than 1 percent. There appears some tendency for gains in survival to occur mostly after intake rates reach at least 45 percent and for gains to slow after intake reaches 70 percent.

Figure 6.5 is largely consistent with that analysis. It shows the completion rates for the three educational sub-regions of the continent. (South and West Asia, not shown, has very sparse data but rates relatively closer to the high-education African grouping.) It is obvious from the figure that completion rates changed relatively slowly over a 16-year period from 1988-2004. For the low, medium, and high-education groups, respectively, the annual points gained averaged 0.3, 1.5, and 1.0 percent. Patterns are sufficiently irregular, with different countries reporting over time, that these calculations are highly uncertain, but the overall conclusion that these rates have risen slowly is inescapable.

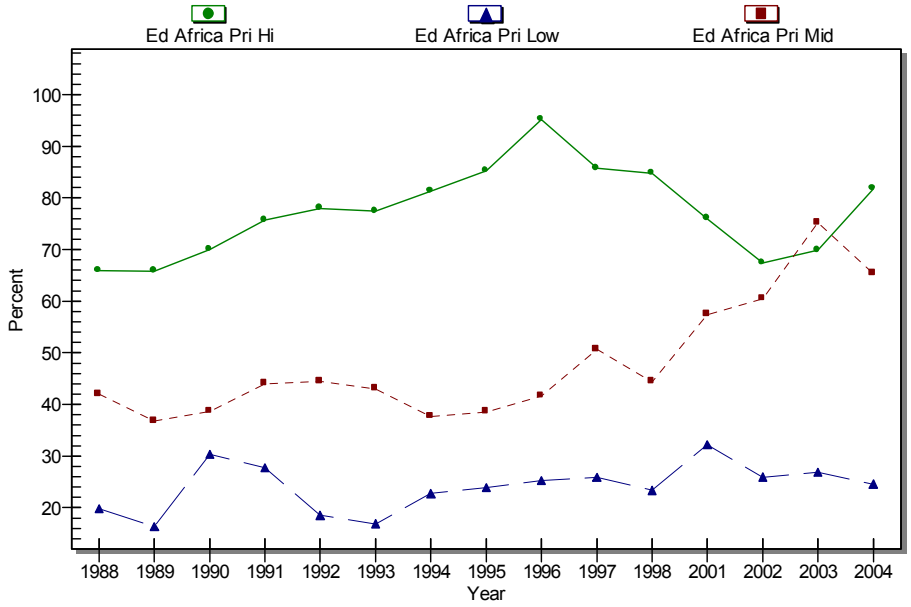

Figure 6.5 Completion rates across African primary enrollment groupings
Source: IFs Version 5.46.

Because the growth in completion rates (Figure 6.5) is roughly comparable to growth in intake (Table 6.5), it suggests that the rate of survival for those who enter must be fairly stable, consistent with direct examination of the more sparse survival data. The only

[135] The survival data set for the analysis blended earlier data from the World Bank's World Development Indicators with more recent UIS on-line data.

truly clear-cut increase in completion rates, and therefore probably for survival, was for the middle enrollment group.

The experience of countries attempting to accelerate educational advance is that it may be easier to increase intake rates than survival or completion rates. Both the literature and our own data analysis suggest that gains in completion tend not much to exceed those for intake and survival rates have been growing very slowly. In general, gains of even 1 percent in survival rate (especially when intake is rising significantly, as in the normative scenario) are very aggressive. Yet, in the case of sub-Saharan Africa, particularly the low and medium primary enrollment countries where survival rates now average 65-70 percent, the normative scenario needs to truly aggressive. We have seen that survival is highly related to quality as well, of course, to achieving UPE. Thus the normative scenario will include that 1 percent increase rate.

6.2.2 Lower secondary

Increasingly, experts advocate universal completion of basic education, the combination of primary and lower secondary education. That target will almost certainly become a goal for the global system in the relatively near future. Again, however, a normative scenario for pursuit of such a goal must give attention to reasonable rates of increase and to the balance of intake and survival as enrollment rates rise. We should not automatically apply the same assumptions about aggressive but reasonable rates of increase to lower secondary education that we apply to primary education.

Growth in secondary enrollment. To begin putting the analysis of universal lower secondary enrollment in broader context, Figure 6.6 shows the historic growth of total secondary education since 1960 across economically-developing global regions; the high-income countries have largely reached universal gross secondary enrollment. In sub-Saharan Africa and South and West Asia, total secondary enrollment rates since 1960 have increased just a bit more than 0.7 percent annually. The most rapid increases have been in Latin America and the Caribbean, at 1.6 percent. The Arab States and the developing countries of East Asia and the Pacific have fallen in between with annual increases of 1.3 percent. As a general rule, growth rates have been higher in countries with higher enrollment at the primary level.

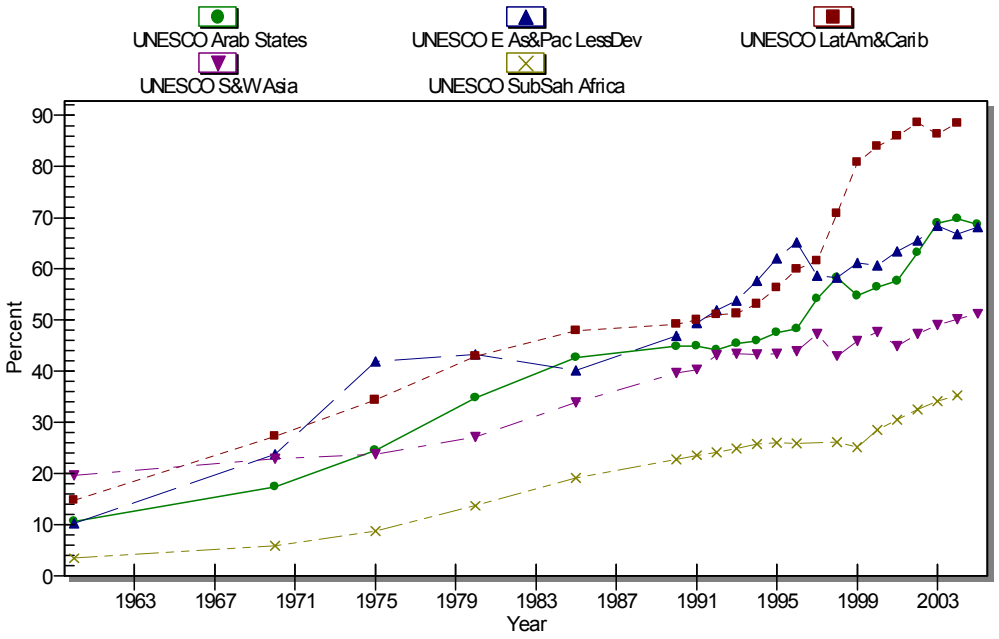

Figure 6.6 Growth in gross secondary enrollment rate across continents
Source: IFs Version 6.003.
Note: Eliminated 1997 transient for Africa; 2005 for Africa and Latin American countries.

Unfortunately, data series for lower secondary enrollment are shorter. The level in both high-income and upper-middle income countries has now reached 100 percent, and that in lower middle income countries is about 85 percent. In sub-Saharan Africa (see Table 6.6) lower secondary rates have reached 43 percent. Growth in annual enrollment rates over a 34-year period has been roughly 1-2 percent across regions. There has been acceleration in recent years; the lower secondary gross enrollment rate in sub-Saharan Africa increased 2.2 percent annually 1999-2004.

	Lower Secondary Enrollment Rate		Annual Percentage Point Change
	1970	2004	
Arab States	37.5	81.5	1.3
East Asia and Pacific (low-income)	21.9	79.8	1.7
Latin America and Caribbean	30.7	101.1	2.1
South and West Asia	27.7	64.4	1.1
Sub-Saharan Africa	8.2	43.2	1.0

Table 6.6 Lower secondary gross enrollment rate and average annual growth
Source: IFs version 6.01.
Note: 2005 data are available, but are less complete and many of our tables use 2004.

Understanding the pattern of lower secondary growth relative to that at the primary level can help us identify aggressive but reasonable rates of progress. Figure 6.2 showed the relationship between net primary and gross lower secondary enrollment. Three elements of the relationship in that figure shed light on the relationship between any given level of education and the one that precedes it:

- Enrollment at the primary level clearly provides a basis for a "pass through" to the lower secondary level across the entire range of primary enrollment rates. This is an obvious result of the need for there to be graduates at a lower educational level to provide candidates for a higher one.

- There is an upward slope to the curve relating the two enrollments suggesting that the pass-through accelerates as primary enrollment rises. Cuadra and Moreno (2005) explored the implications of the reality that global rates of growth at the secondary level exceed those at the primary level. Fewer seem aware that annual percentage-point growth in global enrollments at the tertiary level are now about the same as those at the aggregate secondary level and are likely to surpass them in a few more years.

- There is, in fact, a threshold effect related to the base building for pass-through. Specifically, there tends to be accelerated take-off in gross lower secondary enrollment when adjusted net primary enrollment exceeds about 80 percent. Below that threshold, gross lower secondary enrollment rates tend to be 10-15 percent less than those at the primary level. Above that point, growth of secondary enrollment rates rapidly accelerates in many countries.

With respect to the last point, we would expect countries with more than 80 percent adjusted primary enrollment and less than 40 per lower secondary enrollment (Tanzania, Madagascar, Malawi, and Uganda) to experience rapid future growth at the secondary level. More generally, however, Lewin (2004: 23) concluded that "primary enrolment rates at the secondary level in SSA are substantially independent of primary enrolment levels…" and instead reflect policy preferences. Clearly the pressures of EFA and MDGs for universal primary enrollment are channeling especially large contemporary efforts to primary education and at least in some countries therefore starving secondary education. Mingat (2004: 7) emphasized that the anticipated growth in number of those completing primary school from 7.8 million in 2001 to 20.7 million in 2015 would create great bottom-up pressure for growth at the secondary level.

Growth in lower secondary transition rate. How fast might such lower secondary enrollment levels grow in an accelerated scenario? It is again entrance and persistence to and through the final year that shape the size of enrollments. On the entrance or intake side, a key variable is the transition rate, the percent of those completing primary education that continues into lower secondary. Figure 6.7 shows transition rates in recent years for five of UNESCO's groupings of lower income countries.[136] Transition rates have been mostly high and relatively stable for four of those groupings. The rate in the Arab states has increased about 1 percent each year.

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[136] Transition rates represent only progression into general lower secondary education and omit those moving directly from primary to vocational education. Vocational education is, however, much less common at the lower secondary than at the higher secondary level. Only in Latin America among UNESCO regions does it reach 5 percent at the lower secondary level, and elsewhere it averages less than 3 percent.

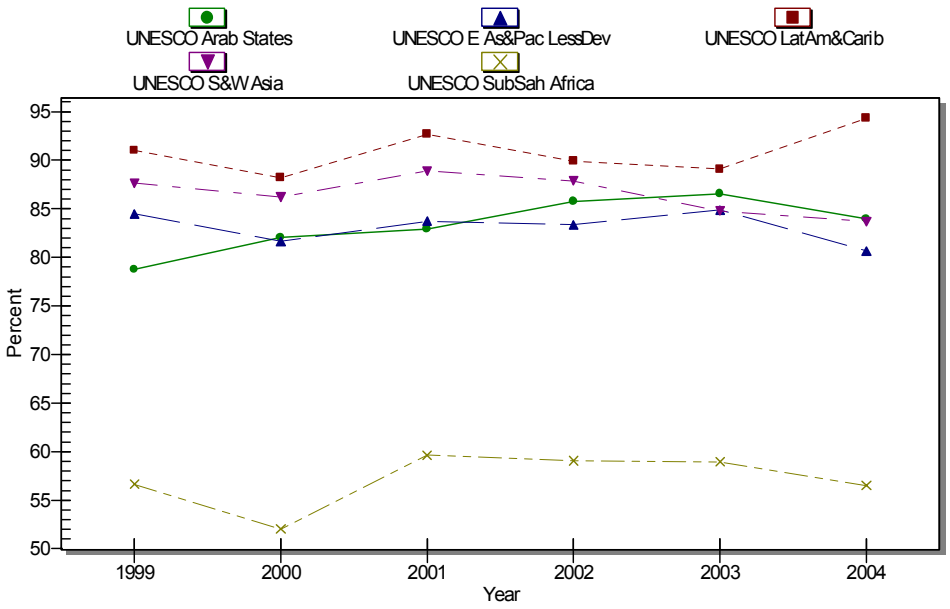

Figure 6.7 Primary to lower secondary transition rates, selected regions
Source: IFs Version 5.46.
Note: Selected values are available for 2005, but inadequate coverage for graphing.

In Sub-Saharan Africa transition rates to lower secondary education have been only a bit above 50 percent. Most of the countries in that region with increases have been in the low primary enrollment group of countries, where transition rates, somewhat surprisingly, are higher than in the mid primary enrollment group. This provides a slightly different perspective on those two country sets, returning us to the earlier discussion of focus on universality at one level as opposed to advance for smaller numbers across several. In the low primary enrollment group, relatively few children complete primary school but over 70 percent of those who do so go on to secondary school. Moreover, the transition rate rose about 1.5 percent annually in the 1999-2004 period. In the mid primary enrollment group, many more children complete primary school and enrollments have been pushed up sharply in recent years; but fewer than 50 percent go on to lower secondary.

An examination of change in transition rates on a country-by-country basis between 1999 and 2004 shows that of 74 countries for which we have adequate data, annual increases exceeded 3 percent for only seven countries and exceeded 2 percent for only 11 others. Annual increases for most countries fell below 1.5 percent, and, in fact, below 1 percent.

The recent patterns in transition rates for most regions, sub-regions, and countries suggest that annual percentage increases of 1.5 percent are quite high. Recognizing that in an integrated normative scenario the high rates of increase for intake and survival at the primary level will substantially raise the rate of increase the population available for transition to secondary, 1 percent is almost certainly a better aggressive, but realistic transition rate.

Growth in lower secondary survival rate. We found at the primary level that survival rates tend to grow rather slowly until intake rates are quite high. In fact, they do not climb significantly until adjusted net intake rates reach about 85 percent. Growth in lower secondary survival rates is similarly related to transition rates into lower secondary education. Figure 6.7 showed that most low and middle income regions of the world already have transition rates into lower secondary education of 80 percent or higher; thus we might expect by analogy that the survival rates in those regions would be rising. Table 6.7 shows that, indeed, those same regions generally demonstrate a recent pattern of increase in survival rates. In contrast, transition rates into lower secondary education for sub-Saharan Africa were near 50 percent between 1999 and 2004, and it is the only region in Table 6.7 that did not demonstrate growth in lower secondary survival during the same period.

	Lower Secondary Survival Rate		Annual Percentage Point Change
	1999	2004	
Arab States	72.1	87.6	3.1
East Asia and Pacific (low-income)	81.7	81.8	0.0
Latin America and Caribbean	78.8	84.2	1.1
South and West Asia	82.6	88.6	1.2
Sub-Saharan Africa	80.5	76.0	-0.9
Developing Economies Total	81.2	85.2	0.8

Table 6.7 Lower secondary survival rates, selected regions
Source: IFs Version 6.01.
Note: The developing economies region is the World Bank classification..

The heavy emphasis of the region on primary education has potentially important consequences for survival rates. Rapidly increasing primary graduates in Africa push more students into the secondary level, even if transition rates are stable. That mathematical reality has, in turn, substantive implications. Rapid growth in lower secondary intake has financial costs and can dilute resources and attention across growing student bodies. Looking at another example of that phenomenon on a different continent, Costa Rica, with very strong governance and emphasis on education, has been increasing enrollments at the lower secondary level by more than 5 percent a year in the early 2000s. It has, however, seen a significant decline in survival rates during that same period.

Overall, the developing economies in Table 6.7 averaged growth in lower secondary survival rates of 0.8 percent across the short period for which we have significant data. For the normative scenario, the global and regional patterns, with the remarkable exception of recent growth in Arab states, suggest that increases in survival of 1 percent are significant and that 1.5 percentage point annual gains would be very high, most likely occurring when transition and enrollment rates have become quite high.

6.2.3 Upper secondary

Growth in upper secondary gross enrollment rate. Table 6.8 shows the very short time period for which we have data on upper secondary enrollment rates. There has been quite rapid growth in recent years nearly everywhere, but especially in middle and upper-middle income regions.

	Upper Secondary Enrollment Rate		Annual Percentage Point Change
	1999	2004	
Arab States	42.8	57.4	2.9
East Asia and Pacific (low-income)	39.3	51.1	2.4
Latin America and Caribbean	62.7	73.5	2.2
South and West Asia	32.7	38.1	1.1
Sub-Saharan Africa	19.7	26.4	1.3

Table 6.8 Growth in upper secondary gross enrollment rates, selected regions
Source: IFs Version 6.01.

Figure 6.8 shows the global relationship between gross enrollment at the lower and upper secondary levels. It is generally similar to Figure 6.2, which portrays the relationship of enrollment at the primary and lower secondary levels, in that an upward-bending curve best fits the cross-sectional data. As in Figure 6.2, and as noted in other elements of the progressive expansion of educational flows, there appears to be a rough threshold of about 80 percent in lower secondary enrollment at which point growth in upper secondary enrollment takes off.[137] The threshold pattern is, however, less marked than in lower secondary education's relationship to primary enrollment. One of the results of this less-pronounced threshold is that the fit of the curve in Figure 6.8 to the data points is considerably stronger than that in Figure 6.2 (with an r-squared of 0.69 versus 0.54)

Moreover, the curve has a less steep slope than did Figure 6.2. These differences collectively suggest that, as lower secondary enrollment increases, there is more a gradual and consistent acceleration in enrollment rates at the higher secondary level (pass through from the lower level) than any pronounced increase at a threshold.

[137] In Figure 6.8, it is visually obvious that a line fit to the points only below 80 percent lower secondary enrollment would have a lower slope that a line fit to the points above 70 percent.

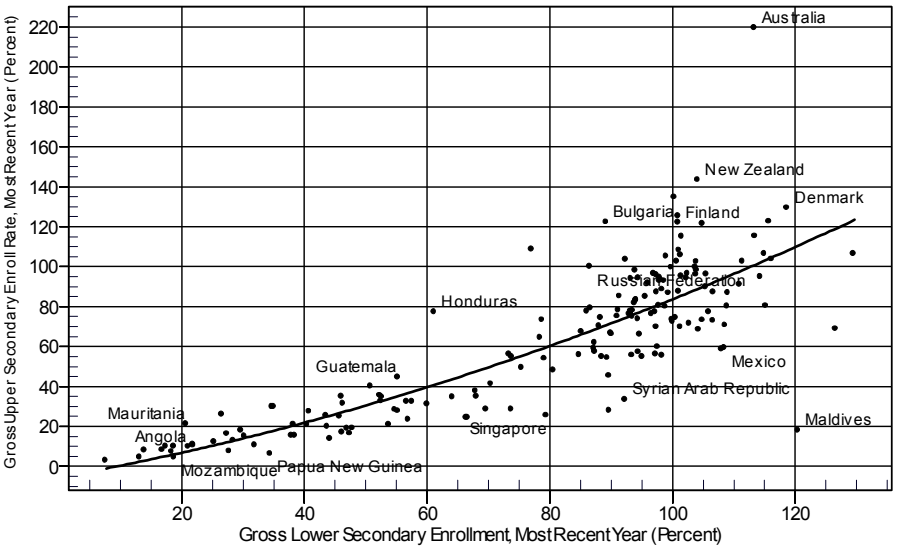

Figure 6.8 Gross upper secondary enrollment as function of gross lower secondary enrollment
Source: IFs Version 5.46.
Note: The functional form is quadratic; the R-squared is 0.69

One further important characteristic of the relationship between lower and secondary enrollments is that the rate of general pass through of lower to upper secondary quite consistently shows that about 20-25 percent fewer enrollments occur at the upper secondary level. Even when gross lower secondary enrollment reaches 100 percent, gross upper secondary enrollment reaches an average of only about 80 percent. The enrollment numbers at both levels include both general and vocational education. Because vocational educational is a much larger share of upper secondary education than of lower secondary schooling, the numerical differences between the two levels for general education alone would be larger. On a global, population-weighted basis, vocational enrollments at the upper secondary level are about 22 percent of total enrollments, compared to less than 2 percent at the lower secondary level. Thus differences in general education across the two levels are probably closer to 40 percent.[138]

Growth in upper secondary transition rate. Still again, however, it is entrance into programs and persistence to and through the final year that shape the size of enrollments. Figure 6.9 shows recent transition rates from lower to upper secondary education for five of UNESCO's groupings of developing countries. On the whole there is no clear pattern of change. It appears that transition rates have actually fallen in East Asia and the Pacific, and that could be related to a long and rather steep climb in enrollment rates at

[138] At the upper secondary level vocational students make up about 40 percent of total enrollment in Central and Eastern Europe, and about 30 percent in East Asia and the Pacific, as well as in North America and Western Europe. In most low and middle income regions, it averages between 15 to 25 percent, except for South and West Asia where it is less than 3 percent.

the lower secondary level. As more students complete lower secondary education, it puts some downward pressure on transition rates to upper secondary.

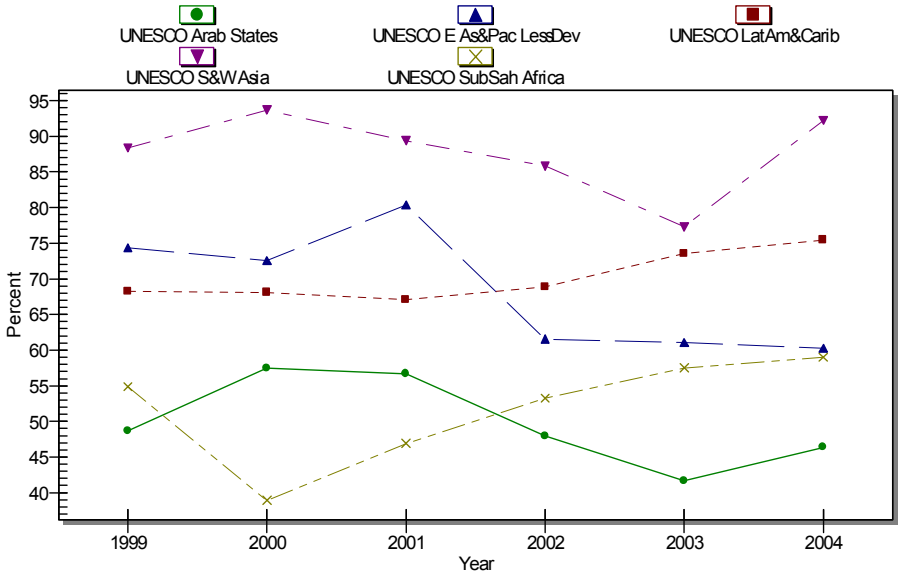

Figure 6.9 Lower to upper secondary transition rates: selected regions
Source: IFs Version 5.46.

For the normative scenario, it appears that an aggressive but reasonable annual increase in transition rate from lower to upper secondary is probably closer to 0.5 percent than 1 percent. There are several reasons. First, of course, even constant transition rates automatically pass through increased completion from lower secondary education and the normative scenario is already being structured to be aggressive at that level. Second, we have seen that the slope of the cross-sectional relationship between enrollments at the lower and upper secondary levels is less steep than the one we saw between enrollments at the primary and lower secondary levels. Third, the recent data suggest little or no empirical increase in that transition rate.

Growth in upper secondary survival rates. We found at the primary level that survival rates tend to grow very slowly until intake rates are quite high. In fact, primary survival does not climb significantly until adjusted net intake rates reach about 85 percent. We found at the lower secondary level that empirically there is generally a slow ramping up of survival rates as transition rates from primary completion rise, with no real growth below 30 percent transition rates, perhaps a maximum of 0.5 percent by 40 percent and 1.5 percent by 70 percent.

The pattern at the upper secondary level appears different. Figure 6.10 suggests that for most regions, including sub-Saharan Africa, the survival rates are quite high. In fact, the global cross-sectional correlation between GDP per capita and survival at the upper secondary level is very low, contrary to the pattern at lower levels of education. Almost around the world, those who make it to upper secondary education have already been selected for or are self-selected for relatively greater success than at lower levels.

It is South and West Asia that stands out with very low and decreasing levels. Not too much, however, should be made of the values for South and West Asia—India and Pakistan do not report, so Bangladesh alone dominates the pattern. Bangladesh and India enroll only about one-third of potential students (rates are lower for Pakistan), not much more than does sub-Saharan Africa where survival rates are much higher. Moreover, enrollment growth rates are very low for the region. Thus it is not pressure from recent enrollment growth that has led to low survival. Collectively, these numbers point to a major challenge for the region; clearly it has emphasized lower secondary and therefore basic education, but has given much less attention to upper secondary.

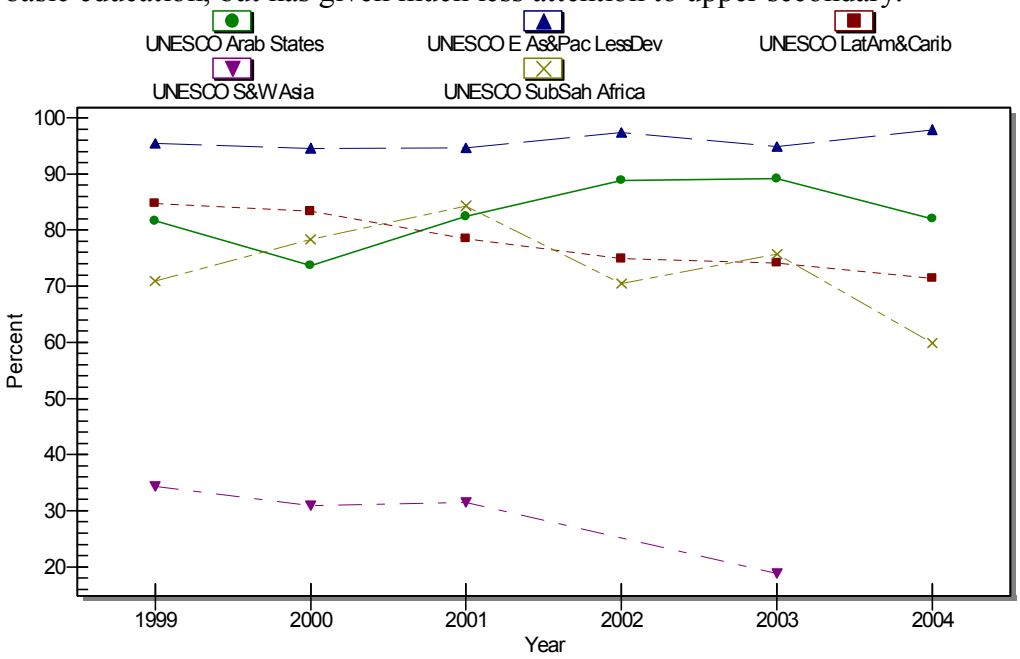

Figure 6.10 Survival rates for upper secondary education: selected regions
Source: IFs Version 5.46.

Overall in this section, we have seen that growth in upper secondary enrollment generally proceeds in parallel with that in lower secondary enrollment rather than building on a threshold foundation level of it. There is, nonetheless, a slight tendency for accelerated growth at the upper secondary level as lower secondary enrollment rises and some degree of sharpening in the rise when gross lower secondary enrollment exceeds 80 percent. Upper secondary transition and survival rates have not been fast growing and, in fact, have been under considerable pressure from the pass-through of incoming students from lower levels. For the normative scenario, transition rate rise of 0.5 percent is quite aggressive. Because of the importance of gains in survival to quality and efficiency, the normative scenario should include 1 percent annual gains.

6.2.4 Tertiary

Analysts do not typically study tertiary enrollment in terms of transition from the secondary level and in terms of survival rates. Data on intake rates are available, but many analysts and much available data (and hence the forecasting of tertiary study within IFs) focus directly on gross enrollments. Future refinements for forecasting are both possible and desirable, particularly a distinction between levels A and B within tertiary education (see Chapter 2) and between science/technical and other education. (Volume 4 in this series will return to elaboration of higher education and knowledge systems in a larger discussion of infrastructure.)

To help understand historic patterns and the speed at which tertiary enrollments can reasonably increase, Figure 6.11 traces the historic patterns of total tertiary enrollments for five UNESCO developing regions. In the mid to late 1990s three regions obviously reached thresholds or turning points with much accelerated enrollment growth. In the sub-period form 1998 through 2004 the enrollment rate in Latin America and the Caribbean rose by nearly 2 percent annually. In that same sub-period, enrollments in developing Asia and the Pacific and in the Arab states rose nearly 2.5 percent annually. All of these regions had reached gross upper secondary enrollment rates of about 40 percent by the beginning of their recent rapid growth spurts (Latin America had reached 63 percent), reinforcing the pattern found at lower educational levels of the need to build a foundation prior to rapid gains at the next level. These levels are, however, lower than the 80 percent or so typically found in earlier analysis. It is possible that recognition of the importance of higher education for global knowledge economies and societies spread rapidly in the 1990s with accelerated globalization, giving an additional impetus to higher education everywhere.

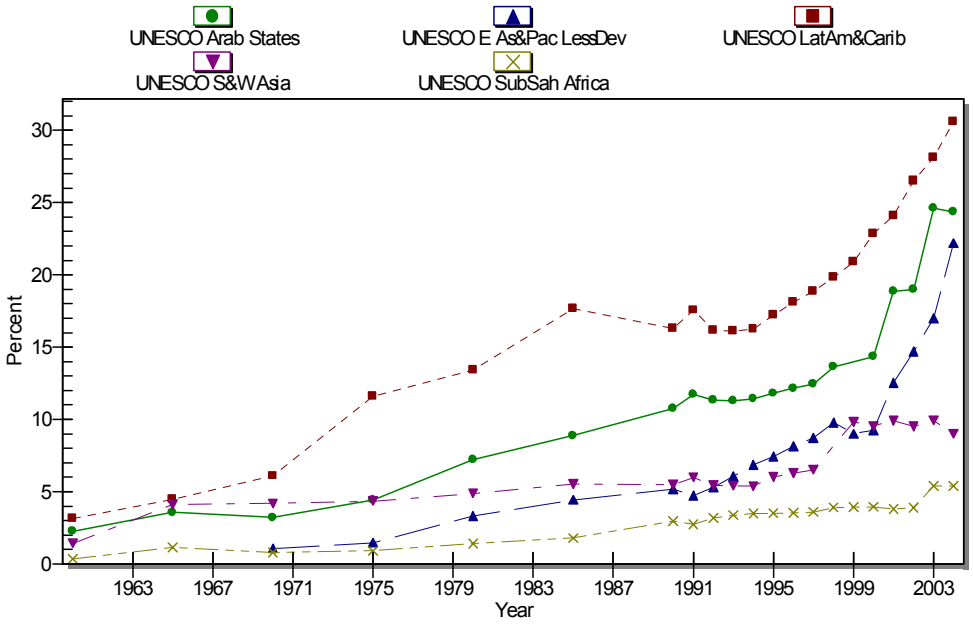

Figure 6.11 Gross tertiary enrollment, selected developing regions
Source: IFs Version 6.01.

Note: Because of transients in mixed country set, removed 1960, 1965 from East Asia; 1999 from Arab States; 1998 from South and West Asia; 2004 and 2005 from all regions.

Figure 6.12 turns to the relationship between gross upper secondary and gross tertiary enrollment in more detail. The relationship proves quite strong with the elements we have seen before across adjacent educational levels. Specifically, there is a pass-through element, although it is not very strong until gross upper secondary enrollment reaches about 40 percent. There is acceleration of that pass-through as secondary enrollment rises. And there is an apparent threshold of about 80 percent secondary enrollment at which point tertiary enrollment rises even more sharply. Gross tertiary enrollments of 30 percent or more are not typically reached until that threshold, suggesting that the three regions in Figure 6.11with rapidly accelerating tertiary enrollments may be breaking ground for new global patterns.

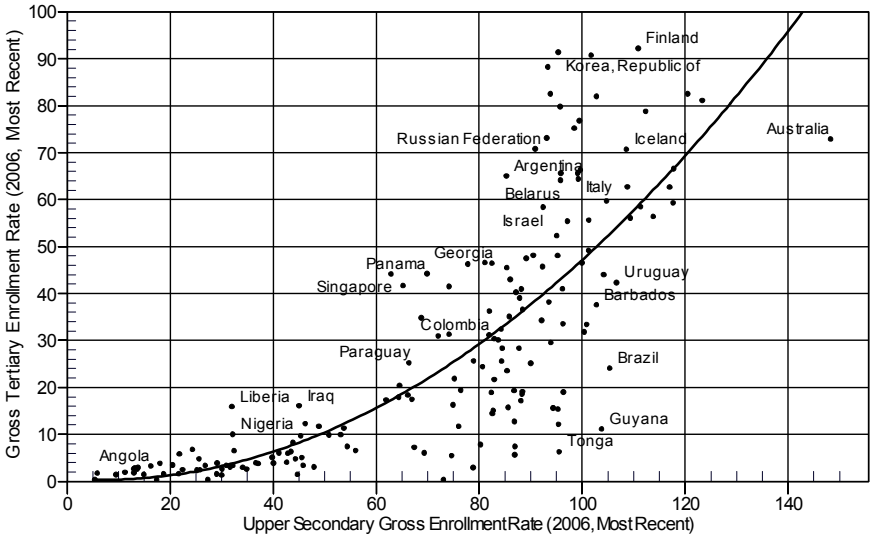

Figure 6.12 Gross tertiary enrollment as a function of gross upper secondary enrollment
Source: IFs Version 5.46.
Note: R-squared = 0.63

Figure 6.12 also suggests some of the countries with the potentially greatest opportunity for acceleration of tertiary enrollment. Countries with 70 percent or higher gross secondary enrollment but less than 20 percent gross tertiary enrollment would appear strong candidates for rises at the tertiary level. There are even six such countries where gross tertiary enrollment falls below 10 percent: Botswana, Belize, Samoa, St. Lucia, Sri Lanka, and Tonga. Many others fall between 10 and 20 percent tertiary enrollment: Albania, Azerbaijan, Brunei, Fiji, Guyana, Jamaica, Kuwait, Luxembourg, Mauritius, Oman, Qatar, South Africa, Suriname, Tajikistan, Trinidad and Tobago, and Uzbekistan.

In understanding global tertiary enrollment patterns, however, it will be important to recognize that some of these countries already achieve much higher tertiary enrollment than these numbers suggest by sending substantial number of students abroad. For many smaller countries, including those on South Sea islands such as Fiji, Samoa and Tonga (with just 117,000 people), those in the Caribbean such as St. Lucia, and even those of

rich city states such as Hong Kong, Singapore and, in effect, Luxembourg, it may not be realistic to develop a domestic university system capable of meeting all of their needs. Bahrain and Botswana send 4 percent of their tertiary student-aged population abroad, Tonga sends over 5 percent, Cape Verde, Mauritius, Hong Kong and Singapore each send more than 7 percent, the Bahamas and Iceland send about 10 percent, Luxembourg sends about 25 percent, and Cyprus sends over 30 percent (UIS on-line data).

Most oil-rich countries, surprisingly, have considerably lower levels of outbound students. Kuwait sends about 3 percent of the eligible population abroad, the United Arab Emirates send 1.5 percent, and the portion in Saudi Arabia is only about 0.5 percent.

Another issue for consideration in the normative scenario at the tertiary level, however, also did not appear at lower levels of education. It seems quite obvious from historic patterns that the movement is strongly not just to universal primary enrollment, but to universal gross lower secondary enrollment, and perhaps even to near universal gross higher secondary (already largely accomplished in the United States, Europe, and the high-income countries of Asia). A normative target for tertiary education is less clear.

Figure 6.13 shows three countries that have now reached gross tertiary enrollment rates of 90 percent. A number of other countries have reached approximately 80 percent: Denmark, New Zealand, Norway, Slovenia, Sweden, and the United States.[139] The experience of these countries suggests that gross enrollment rates of 100 percent or more are quite possible and may become common in many countries well within our forecast horizon. There are, however, a number of reasons to be cautious about interpreting these trends and making forecasts. First, tertiary education has many different characters in countries, making comparative analysis perhaps even more difficult than at lower levels. Second, the trends show gross enrollment, which is subject to catch-up related overshoots of long-term steady states because it includes older students, a very common pattern at the tertiary level (this has perhaps been especially true of women in high-income countries). Third, and somewhat contradicting the implications of the second, increasing numbers of people around the world secure multiple degrees, including doctorates, and spend larger portions of their lives immersed in continued pursuit of credentials.

[139] Of all countries named, only the United States appears to have reached a plateau, having reached 80 percent in the early 1990s and not advanced further. The other countries do not even clearly show the slowing of growth that typically signals levelling off.

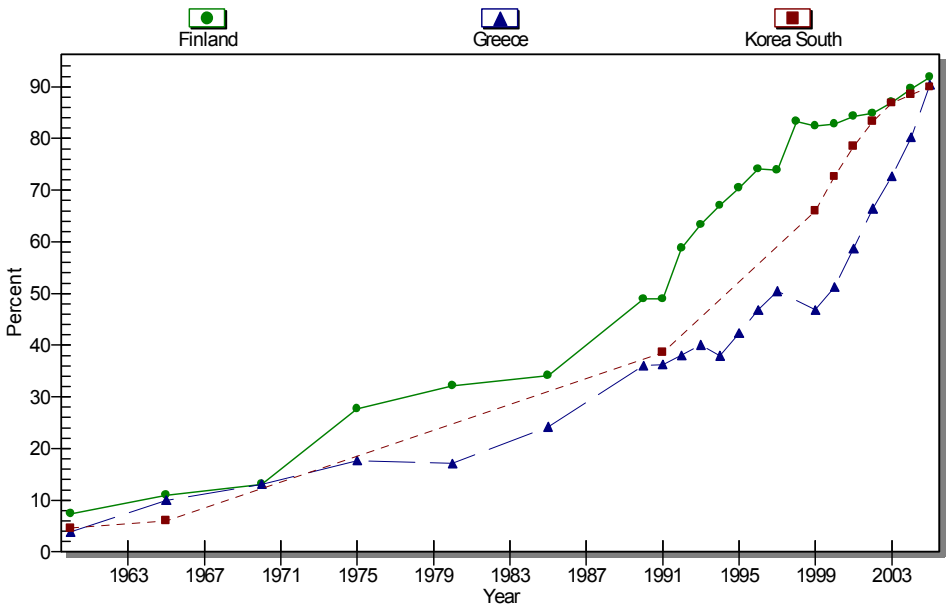

Figure 6.13 Highest gross tertiary enrollments
Source: IFs Version 5.46.

The rapidity of growth in rates for the three countries in Figure 6.13 is remarkable. Across a 45-year period, they increased tertiary enrollments by 1.8-2 percent annually, a reasonable target rate for the normative scenario. For the purposes of that scenario, however, it is important to reiterate that growth in tertiary enrollment generally proceeds in parallel with that in upper secondary enrollment, but tends to accelerate when upper secondary levels exceed 80 percent (and perhaps also now earlier at around 40 percent). It is not clear what a long-term target level for saturation of enrollments should be, but as countries move into the contemporary high-income range, it must be at least 80-90 percent.

Gender parity

Gender equity issues require attention across all levels of education in the normative scenario. Table 6.9 suggests the current situation across educational levels and also gives some insight into how patterns appear to be developing in the IFs base case. For instance, in 2005 at the primary level, the problem very much remained inequity at the expense of girls. The numbers in the table underestimate the extent of that inequity because the countries that fell below 0.97 tended to do so to a much greater degree than those who rose above 1.03.

Afghanistan is consistently among the very worst offenders, although it is likely that data for the country have not caught up with some of the improvements in the society since 2001. Setting it aside, other countries with gender parity below 0.8 were Somalia, Central African Republic, Chad, Guinea Bissau, Niger, Yemen, Pakistan, Liberia., Mali, and Burkina Faso. Additional countries below 0.9 were Cote d'Ivoire, Benin, Djibouti, Sudan, Guinea, Comoros, Eritrea, Togo, Iraq, Nigeria, Sierra Leone, Nepal, and the Democratic Republic of the Congo. Simply to name the lagging countries is to recognize

how difficult the process of change will be; many fall regularly on lists of conflict-ridden or failed states.

	Actual in Year 2005		Forecast in Year 2015	
	Below 0.97	Above 1.03	Below 0.97	Above 1.03
Primary	66	13	37	18
Lower Secondary	73	35	60	43
Upper Secondary	75	43	63	80
Tertiary	65	95	41*	91*

Table 6.9 Number of countries with gender imbalance by education level
Source: IFs Version 6.02.
Note: Ratios are female enrollment rates divided by male enrollment rates. Countries shown with * are numbers below 0.90 and above 1.10.

Table 6.9 suggests some other useful insights, however. First, the gender imbalance to the detriment of females tends to lessen at higher levels, and disappears at the tertiary level, even in 2005.

Second, the spread of gender ratios tends to widen at higher levels of education. Thus more and more countries in total fall below 0.97 or above 1.03 as we move up the educational ladder. This would be less surprising, however, if it were happening only for numbers of countries below 0.97, because we might expect women to be more disadvantaged the further countries fall from universal enrollment. Yet even though relatively few countries have reached universal upper secondary enrollment, the numbers of countries falling above 1.03 as well as below 0.97 are higher than at primary and lower secondary levels. On part of the explanation is that females have lower repetition rates and higher survival rates at all levels, so relatively more of them than males are available to move to the next level.

These patterns suggest that we may need to re-evaluate what gender equity means at higher levels. This is particularly true at the tertiary level. For the purpose of the table the values in the year 2015 are shown for countries below ratios of 0.90 and above values of 1.10.[140] Numbers are still strikingly high.

Table 6.10 turns attention to the closure of gender gaps. It shows countries that have demonstrated the most rapid reduction of gaps in the last 2-3 decades. It includes two countries that have rapidly brought down reverse gender gaps.[141] Overall it suggests that in exceptional circumstances, the ratios can be moved from initial conditions towards 1.0 at the rate of about 0.01-0.02 points per year. A target rate of about 0.015 points annually is probably reasonable for the normative scenario.

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[140] Twenty-eight were not computed because of 0 values in one or more historical years and many of those were likely also below 0.97 in 2005.

[141] The reverse gender gaps of 1980 for Botswana and Lesotho could have been related to large migrations to South Africa of males seeking work, even at quite young ages.

	1980	2005	Annual Change
Burkina Faso	0.59	0.80	0.008
Chad	.44 (1987)	.70 (2003)	0.016
Guinea	.49 (1983)	.71 (2001)	0.012
Guinea-Bissua	0.49	.71 (2001)	0.010
Nepal	.43 (1983)	.88 (2004)	0.020
Senegal	0.68	0.96	0.011
Togo	0.67	0.86	0.008
Botswana	1.15	1.00	-0.006
Lesotho	1.36	1.06	-0.012

Table 6.10 Examples of rapid closure of gender gaps in primary net enrollment
Source: IFs Version 6.02.

Conclusions for the normative scenario: student flows

Student enrollment and flow patterns vary greatly across countries. Model forecasts in the normative scenario, as well as the base case, recognize and build on those initial conditions. Before summarizing the specific elements of the normative scenario, two points help clarify how the model's structure and algorithms interact with normative specifications of growth patterns to forecast behavior consistent with historic patterns, but more aggressive:

- S-shaped curves of increase in enrollments, intake, and survival are common across levels. Rates of increase put into the model are targets and interact in model calculations with the full model dynamics including (when turned on) budget constraints that can limit those increases and saturation effects that can slow them down as levels approach ceilings. Thus effects of normative specification tend to be most pure in the lower and middle ranges of growth.

- We have seen in the data clear and understandable tendencies for levels of enrollment at lower levels to affect those at higher ones (with accelerations at higher levels occurring very often near or after a threshold point, sometimes about 70-80 percent at the lower level). Similarly survival increases commonly accelerate as intake and enrollment approach the upper end of ranges. In a reflection of these common patterns, when supply-side budgets in the model interact with intake and enrollment patterns, approaching saturation at one level creates increased opportunities for growth at others.

Given that structures of the model interact with normative specifications in these ways, the rates of increase in Table 6.11 summarize roughly the upper limits of reasonable increase in rates of increase of intake/transition rates and of survival/completion, but not precisely the patterns that the model will generate. The Appendix to this chapter specifies the actual rates used in the normative scenario.

	Intake/Transition	Survival/Completion
Primary	2% intake growth is aggressive (would normally occur near 50% enrollment, generating S-shaped pattern)	1% increase is aggressive; could specify 2% for specific countries or regions to represent catch-up needs, especially when intake has surpassed 85 percent
Secondary, Lower	1% transition growth is aggressive on top of aggressive primary growth (total secondary enrollment growth of 2-2.5% is aggressive result)	1% is aggressive; historically, survival tends to ramp up across range of transition/enrollment rates, but the scenario accelerates it for quality reasons
Secondary, Higher	0.5% transition growth is aggressive on top of primary and lower secondary interventions; historically would tend to ramp up with lower secondary enrollments	1% increases is aggressive; country or regional catch-up specifications could be as much as 2%; historically, survival ramps up at higher intake/enrollment
Tertiary	2% growth in gross enrollment would be aggressive	Not applicable: IFs forecasts only gross enrolllment rate

Table 6.11 Summary of target rates in the normative scenario
Source: Compiled by authors

6.3 Foundations for enhancing education: public finance

To establish a context for thinking about the financing of education, Table 6.12 shows how public spending per student varies around the world and by level of education. As UNESCO (2007:19) points out, "By expressing expenditure [per student] as a percentage of GDP per capita, education budgets can be compared in relation to national income level, which is a proxy for a country's ability to generate education financing."

At the primary and secondary levels, low-income and lower middle-income countries spend considerably less than upper middle- and high-income countries, as a percentage of GDP per capita. It may be reasonable to speculate that such levels for lower-income countries represent inadequate spending as a result of resource constraints and very high child dependency rates (population 0-14 as a portion of total population). In contrast, however, developing countries spend much more per student at the upper secondary and especially at the tertiary level than do richer countries. That almost certainly reflects the great difficulty that developing countries have in obtaining educated faculty and other professionals to staff that level of education, and may also represent the start-up costs of

developing facilities for universities and professional schools.[142] Also, education at the tertiary level is a more tradable good than education at lower levels (large numbers of students do study abroad), a fact that should lead to some degree of global convergence of actual costs and prices and therefore to continued great disparity in spending relative to GDP per capita.

	Country Income Level (World Bank Categoreis)			
Education Level	Low	Lower Middle	Upper Middle	High
Primary	10.1	10.2	14	20.5
Lower Secondary	10.5	11.7	15.4	23.6
Upper Secondary	30.7	14.2	16.5	25.9
Tertiary	152.3	34.7	30.7	29.2

Table 6.12 Public spending per student as percent of GDP per capita
Source: IFs Version 6.001
Note: The table uses data from the most recent year available, mostly 2000-2005.

There is, however, tremendous variation in spending rates per student across countries within the categories of Table 6.12, especially at lower incomes. In order to determine "reasonable" spending rates for a normative scenario, it would be very useful to determine benchmarks that represent spending consistent with the goals of both quality and efficiency.

Two approaches can help analysts estimate such benchmarks for aggregate per-student costs relative to GDP per capita, appropriate to the specific circumstances of each country and variable across levels of education. The first is bottom-up analysis of specific costs within developing countries that are demonstrating good practice in educational outcomes. The second, to which we return later, is an aggregate, top-down analysis, looking comparatively at total spending across countries around the world to understand how patterns relate to quantity and quality of performance.

6.3.1 Good practice: a bottom-up look

Many analyses of global education have identified, at least conceptually, the kinds of specific inputs that quantity expansion and quality improvement require, including well-trained teachers, sufficient teaching materials, safe and accessible schools, and supporting infrastructure. Costs of such inputs will, of course, vary greatly across countries, reflecting differing cost structures and expenditure capacities as well as historic paths and unique circumstances. Yet salaries, which constitute about 75 percent of total costs globally for pre-primary through upper secondary education,[143] correlate highly around the world with GDP per capita. Other costs also co-vary with GDP per capita, making per student expenditures as a percentage of GDP per capita a useful focus of analysis.

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[142] Coombs (1985:158) provided information on per student spending in 1976. Interestingly, the ratio of tertiary to primary spending per student in developed countries then was about 2-to-1, even higher than recently.

[143] Analysis from UIS data. The salary share is somewhat lower in Central and Eastern Europe and somewhat higher in Arab states, but cross-regional variation is not great.

Bruns, Mingat, and Rakotomalala (2003) conducted a landmark study that exemplifies useful bottom-up analysis at the primary level.[144] Their study grouped 47 of the low-income countries eligible to receive deeply-concessional funds from the World Bank's International Development Association (IDA) into four categories dependent on educational performance.

- Group 1 (Education for All successful). These ten countries had gross enrollment of at least 85 percent and completion rates of 70 percent or more. They also had "healthy spending; reasonable unit costs, teacher salaries, and class size; and low repetition" (p. 63).

- Group 2 (high inefficiency). These eight countries had gross enrollment of at least 80 percent but completion rates of 60 percent or less. The stylized description of their educational systems is "inadequate spending on quality and excessive repetition" (p. 64).

- Group 3 (low coverage). These seven had both gross enrollment and primary completion of 60 percent or less and were characterized by "low spending, high unit costs driven by extremely high teacher salaries, and relatively poor efficiency" (p. 64).

- Group 4 (outside these patterns).

By analyzing the system characteristics associated with success, notably in Group 1, Bruns, Mingat, and Rakotomalala (2003: 73) constructed stylized best practice benchmarks related to quality, efficiency and resource mobilization. Benchmarks include 40 pupils per teacher, 33.3 percent spending on inputs other than teachers, a 3.5 multiple of GDP per capita for average teacher salary, and a 10 percent repetition rate (reflected in a 110 percent target for gross enrollment rate).[145] These benchmarks, with an addition for instructional hours per year, were adopted as guidelines (the "Indicative Framework") for the first group of countries selected into the Fast Track Initiative.

Overall, the work of Bruns, Mingat, and Rakotomalala (2003) suggests that best practice spending is within about 2 percent of average spending levels of their Group 1 countries,

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[144] There have also been country-level studies, at all three levels of education, as part of the Fast Track Initiative. In addition, there is the Pole de Dakar report for Africa, which analyzes all three levels for each country.

[145] With respect to aggregate spending associated with these specifics, the authors recommended that government revenues be 14, 16, or 18 percent of GDP, depending on the country's income; that 20 percent of government revenues be committed to education for recurrent expenditures; and that 50 percent of the recurrent spending be directed to 6-year primary education programs (42 percent to 5-year programs).

namely 14 percent of GDP per capita versus the average of 11.8 percent in that group. That is an important insight as we move into looking top-down instead of bottom-up.[146]

6.3.2 Good practice: aggregate, top-down analysis

Aggregate, cross-sectional comparison frames top-down analysis. It can provide a more detailed picture of spending per student as it relates to income levels (see again the summary picture in Table 6.12). It can show the extent of variability in spending patterns and serve as a take-off point for exploration of that variability.

Primary level public spending. Figure 6.14 shows the global relationship for both developing and developed countries between GDP per capita and spending per student relative to GDP/capita. The range of spending practices around the central tendency in Figure 6.14 is dramatic for low-income countries, and subsequent sections will return to analysis of it. Some of the more extreme values are likely the result of data problems. Still, there are also many reasons for substantial spread. Cuba, for instance, prides itself on its public investments in human capital. Some other countries well above the line have high cost structures because of teacher shortages; Burkina Faso may be an example, and its high cost structure is almost certainly linked to the rapid enrollment growth that Chapter 5 discussed. Other countries suffer from the disappearance of funds into many hands between central authorities and local school officials; in fact, the addition of Transparency International's measure of corruption perception to the relationship in Figure 6.14 raises the adjusted R-squared to 0.17. Some of the countries well below the line rely heavily on private spending; about 0.5 percent of GDP in the Dominican Republic goes to private primary education. In general, developing countries are going up steep learning curves as they structure and institutionalize their educational systems.

The upward sloping line of Figure 6.14 captures the same tendency that Table 6.12 showed for higher income countries to spend a greater portion of GDP per capita on each student. There are, however, some differences. The central tendency of spending for countries with GDP per capita below $5,000 is in the general range of 13-14 percent, above the roughly 10 percent average for low- and lower-middle income countries.[147] Interestingly the line in Figure 6.14 thus fits the target values for benchmark that Bruns, Mingat, and Rakotomalala (2003) identified. These analytical elements together suggest that our normative scenario might productively target spending levels at about those of the relationship in Figure 6.14.

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[146] Their numbers are not strictly comparable to those in Table 6.10 for several reasons, among which is the inclusion in Table 6.10 of capital expenditures that add about 10 percent on average to the base of recurrent expenditures.

[147] The standard least-squares method of fitting a regression line to data weights variations from the line by the square of their size. Thus the low-income countries significantly above the regression line shift it upward relative to the simple averages of Table 6.9.

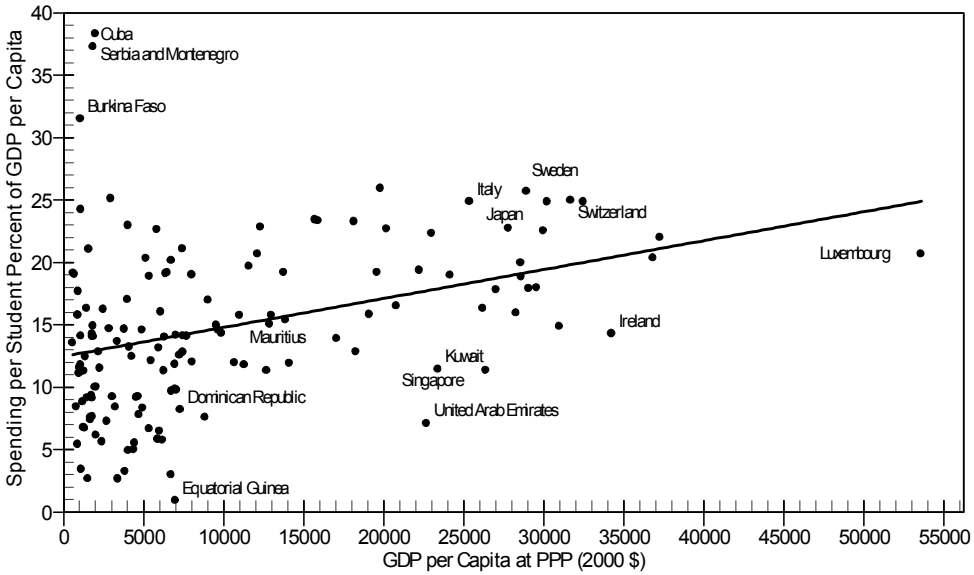

Figure 6.14 Primary spending per student as function of GDP per capita
Source: IFs Version 6.02.
Note: R-squared = 0.12. Data from the most recent year available, variously 2000-2006; excluded Djibouti (55 percent spending) as extreme outlier.

Secondary level public spending: total. Turning to spending at the secondary level, a similar cross-sectional analysis produces a central tendency for global spending of about 22 percent of GDP per capita. Cuadra and Moreno (2005: xxii) argued that successful secondary systems have been spending 1.4 times as much per secondary student as per primary student and 3 times as much per tertiary student. If good-practice spending at the primary level is in the range of 13-15 of GDP per capita, that would imply that secondary spending should be in the range of 18-21 percent, just slightly below the global average, a fact that reinforces our general approach of using global cross-sectional patterns as proxies for good practice.[148]

Binder (2006) considered the costs of good practice at the secondary level in an analysis of 144 developing countries. Somewhat surprisingly, using net enrollment rate as a measure of quality she found that "… the median high-performing country achieves better outcomes at a lower per unit cost than the average country" (Binder 2006: 473). We should certainly not interpret this result to mean that lower spending is always better, but it does suggest that some high-spending countries may be inefficient. Thus it again adds again some support to our attention to central tendencies of spending rather than values significantly above them.

[148] A Cuadra and Moreno table (2005: 142) shows per student spending in fast growing countries at 11, 18, and 55 percent, from primary through tertiary, but 11 percent at the primary level seems too low based on other evidence analyzed here.

Secondary level public spending: differentiating lower and upper. The main thrust of the distinction between lower and upper secondary education views lower secondary education as the completion of basic education, while upper secondary education provides more specific and specialized preparation for work or advanced study. Elaboration of this distinction usually makes the point that the cost structure for lower secondary education is, or could be, quite similar to that of primary education, especially if teachers and physical facilities are shared. Meanwhile, upper secondary education, because of its more specialized and diversified nature, is—or is likely to be—more expensive.

Table 6.12 showed the general tendency for spending per student at the lower secondary level to rise with income. The table also showed spending per student at the upper secondary level to be especially high for low-income countries, but otherwise to rise somewhat with GDP per capita. Cross-sectional analysis like that of Figure 6.14 reinforces those patterns. At the lower secondary level, the correlation of GDP per capita with per-student spending is nearly non-existent, but the pattern does have a slight upward slope with a central tendency globally of around 20 percent.

The relationship between GDP per capita and per-student spending at the upper secondary level is considerably more complex, and the curve fit to it in Figure 6.17 somewhat exaggerates the symmetry at the low- and high-income ends. Again, it reinforces the pattern of Table 6.12.

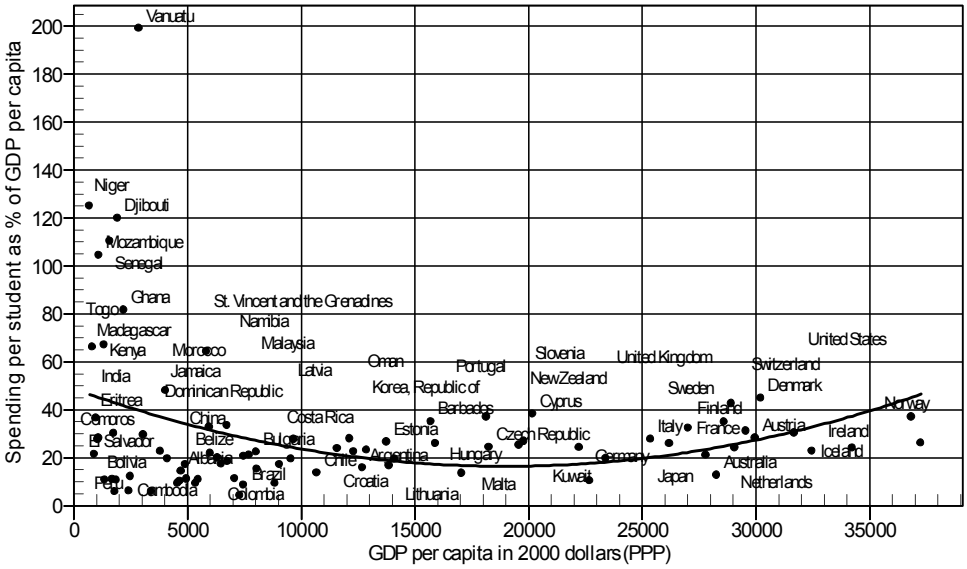

Figure 6.17 Upper secondary spending per student as a percentage of GDP per capita
Source: IFs Version 6.001
Note: R-squared = 0.10; the form is second-order polynomial

Tertiary level spending. Moving to spending at the tertiary level, Figure 6.18 shows that the range across developing countries of spending per student relative to GDP per

capita is still wider than at the secondary level.[149] Nonetheless, there is a somewhat tighter fit to what proves a strongly downward-sloping relationship. Clearly, tertiary education is extremely expensive for developing countries. One reason is that the labor costs for the very highly educated personnel needed to staff universities and other higher educational institutions is exceptional in very poor countries. And still again, corruption adds to costs; the adjusted R-squared rises when the variable is added.

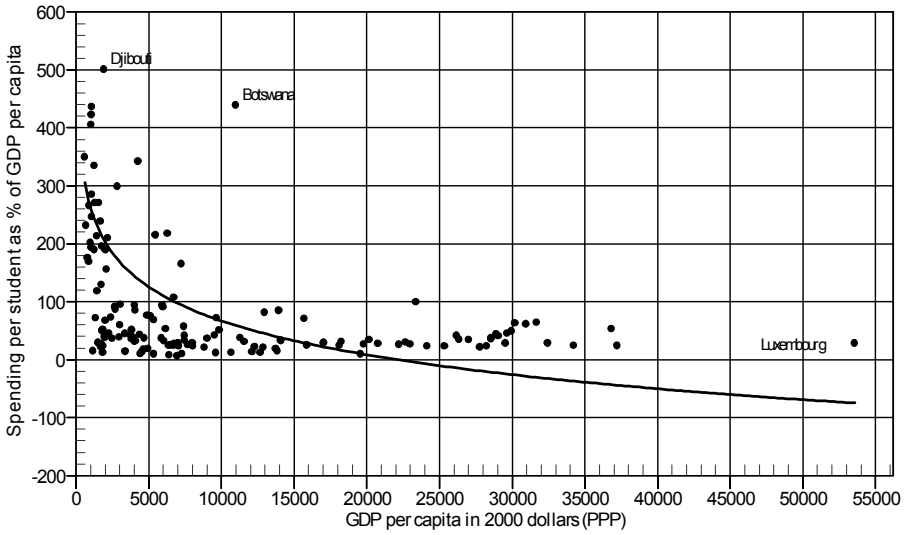

Figure 6.18 Tertiary spending per student as a percentage of GDP per capita
Source: IFs Version 6.001
Note: R-squared = 0.22

Given an absence of studies of good-practice spending at the tertiary level, it seems reasonable to carry forward the experience of more extensive analysis at the primary and secondary levels, namely that the average practice pattern, related to GDP per capita, is a reasonable target level. Clearly, however, the right-hand tail of the curve must be kept positive (that is, countries must spend more than 0 percent of GDP on each student); Table 6.12 showed that 30 percent of GDP per capita is the average for high-income countries and thus a realistic lower bound for the curve in Figure 6.18. Further, the high left-hand tail of the curve for the poorest countries, with expenditures per student at several hundred per of GDP per capita, also appears to suggest unreasonable levels for "best practice." Thus, to represent the relationship between per-student spending and GDP per capita, it makes sense to use a representation based on Table 6.12 rather than the pure analytic function.[150]

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[149] In fact, we removed Malawi, with per-student expenditures of about 1,500 percent of GDP per capita from the figure as an extreme outlier, as well as Ethiopia, Eritrea, and Lesotho, also with spending above 800 percent of GDP per capita.

[150] The breakpoints for the World Bank's income categories are $905 for the top of low income, $3,595 for the top of lower middle income, and $11,115 for the top of upper middle income (these values are actually for gross national income (GNI) in U.S. dollars at market exchange rates).

6.3.3 Exploring variation: non-income drivers of public per-student spending

Even though central tendencies can prove very useful as indicators of average patterns, we have seen at all levels of education that the relationships between per-student spending and GDP per capita are not at all strong. What explains such great inter-country variation? Analysis within the IFs project explored several possibilities.

- Dependency ratios. Higher ratios of student-aged to adult populations may create resource constraints and lower per-student spending. Analysis shows the expected downward-sloping relationship between higher youth dependency ratio and per student spending at the primary level, but the correlation is low. The addition of the factor to GDP per capita makes a negligible difference in r-squared, although the sign remains correct.

- Enrollment rates. Higher enrollment rates may help systems move up learning curves and perhaps create some economies of scale that could bring per-student costs down. Potentially even, higher enrollment rates could reduce the cost of teachers. Analysis does find this supported. Both GDP per capita and enrollment rates individually explain about 10 percent of the variation in per-student primary spending and together they explain about 20 percent. We also explored the relationship at the secondary and tertiary levels and found less clear-cut results. At the tertiary level the sign was reversed, but the relationship was not significant.

- Private/public balance. Greater private enrollments may reduce public spending per student. UIS data exist on private educational spending only for a relatively small set of countries. A statistically significant relationship was found with the expected sign at the primary level.

- Vocational/general balance. Extensive vocational education (in lower and upper secondary programs) relative to general, with its commonly higher costs, may boost total public spending per student. We found no found no relationship at the lower secondary, upper secondary, or combined secondary levels.

- Political economy orientations. More state-centric societies, particularly those with an emphasis on government spending generally, may spend more on human capital including education. The share of GDP devoted to government spending is quite highly correlated to per-student spending at the primary level, explaining 22 percent of the variation (adding GDP per capita brings the value to 26 percent). The power of government spending share decreases to the 6-7 percent range at the secondary and tertiary levels.

- Levels of corruption. More corrupt societies may suffer from higher costs as few or many hands siphon funds between central authorities and actual spending on students, tending to raise per-student spending. At the primary level Transparency International's measure on perception of corruption added 12 percent to the explanatory power of GDP per capita alone. At the secondary and tertiary levels the incremental contributions are about 6 and 10 percent, respectively.

In combination, GDP per capita, government consumption as a percentage of GDP, and corruption explain 30 percent of the variation in per-student primary spending. Interestingly, only the GDP per capita term fails to be statistically significant. In short, the political economy variables are very significant in explaining variation of spending levels around the central tendencies, variation that does not appear to correlate with quality of outcome.

6.3.4 Identifying financing variations: regions and countries

To what degree are there consistent regional variations from the global patterns of change in per-student spending as incomes rise? Table 6.13 shows spending across the UNESCO regions. One of the striking elements of the table is that per-student spending in sub-Saharan Africa is reasonably high across all levels of education, even primary. At the primary level, it is low-income East Asia and the Pacific (demographically dominated by China), and South and West Asia (predominantly India), that exhibit low levels of per-student spending.

	Primary	Lower Secondary	Upper Secondary	Tertiary
Arab States	15.0	16.1	19.5	65.2
Central & Eastern Europe	17.2	18.5	21.9	23.7
Central Asia	12.0	14.1	20.6	31.3
East Asia & Pacific (Poor)	6.5	8.4	20.1	72.7
Latin America & Caribbean	12.9	14.0	14.1	32.3
South and West Asia	9.1	9.9	26.2	92.8
Sub-Saharan Africa	14.9	23.2	59.4	370.7
North America and Europe	20.6	23.5	27.7	27.7
East Asia & Pacific (Rich)	21.0	23.9	20.8	20.8

Table 6.13 Public spending per student as percent of GDP per capita, by region
Source: IFs Version 6.001
Notes: The table uses data from the most recent year available, mostly 2000-2005. Regional averages are population-weighted.

Combined with earlier enrollment analysis, the patterns in Table 6.13 suggest that (1) African countries need to focus on efficiency of spending as well as increasing enrollment, which our normative scenario will do; (2) China needs higher per-student spending in coming years;[151] and (3) South and West Asia needs attention to raising both

[151] Because spending data do not include China in recent years and it has announcement plans to raise spending, this may already be well underway.

enrollments and per-student spending. Educational analysis tends to give overwhelming attention to Africa, but it is by no means the only region struggling with educational policy.

Country variation in primary spending per student. The discussion of benchmark analysis earlier in this chapter suggested that good practice typically requires about 13-15 percent of GDP per capita for each primary student in low- and middle-income countries. Table 6.14 shows countries that spend unusually high or low portions of GDP per capita on each enrolled primary student. There is reason to believe that most of those countries might benefit in terms of either quality or efficiency, and sometimes with respect to both, by moving spending levels closer to those of the benchmark.

Extent of Variation	Portion of GDP/Capita	Unusually Low Spending
Very Substantially	<5%	Armenia, Republic of Congo, Ecuador, Equatorial Guinea, Guatemala, Indonesia, Libya, Myanmar
Substantially	5-8%	Albania, Azerbaijan, Bangladesh, Brunei, Cambodia, Cameroon, Chad, China, Gabon, Gambia, Togo, United Arab Emirates, Uruguay, Venezuela, Vietnam, Zambia
Significantly	8-10%	Bhutan, Comoros, Dominican Republic, El Salvador, Haiti, India, Iran, Kazakhstan,Kyrgzstan, Laos, Lebanon, Madagascar, Mauritania, Nicaragua, Panama, Tajikistan
		Unusually High Spending
Substantially	25-30%	Lesotho, Slovenia, Sweden
Very Substantially	>30%	Cuba, Serbia and Montenegro

Table 6.14 Atypical public spending per primary student as percent of GDP per capita
Source: IFs Version 6.001
Notes: The table uses data from the most recent year available, mostly 2000-2005.

Some country deviations from typical levels merit special attention. For instance, the oil-rich countries of Libya, the United Arab Emirates (UAE), and Venezuela (whose data predate the period under Chavez) spend much less than would be expected per student. This could be because private spending supplements the public spending levels, which happens also in many countries of Latin America including the Dominican Republic and El Salvador. It could also be because their nominal GDPs per capita are considerably above the wage structures common in the country. For example, the UAE hosts a great many laborers from other countries and those employees, some of whom presumably help staff the school systems, receive wages well below those commensurate with GDP per capita. The apparent under-spending could also reflect historic inattention to education by some of these countries.

A number of former communist countries, namely Albania, Armenia, Azerbaijan, Kazakhstan, Kyrgyzstan, and Tajikistan, also spend less than would be expected, as do

some still communist countries, notably China and Vietnam. In these cases, quite strong central governments with considerable price control may have once set or still keep educational costs at levels that would be unusual in market economies (strong emphasis on increasing educational enrollments at higher levels could also generate abundant teachers and therefore lower salaries, even when markets begin to function). That pattern makes the cases of Cuba and of the Serbia and Montenegro portions of the former Yugoslavia, which spend more than two times the benchmark level per student, especially unusual cases at the other extreme. With strong movement towards market systems in almost all of these former communist countries, we can reasonably expect substantial convergence toward global patterns in coming years.

Given the large number of countries in Africa, their relative scarcity in the Table 6.14 is notable. That fact, and the presence of several high-population Asian countries among those who spend below global patterns, notably Bangladesh, China, India, Indonesia, reinforce the discussion around Table 6.13. Except for Cuba, high-population Caribbean countries, the Dominican Republic and Haiti, are among low-spending countries. Except for Costa Rica, so too are the Central American countries of the El Salvador, Guatemala, Nicaragua, and Panama. In the case of Central America, it may be that relative inattention to indigenous peoples has been a historic root of low-spending patterns.

Interestingly, it appears that many of the factors that likely underlie variations in Table 6.14 from global patterns may be weakening in importance. That reinforces the usefulness of the normative scenario developed in this study, positing significant convergence to global per-student spending patterns.

Regional and temporal variation in tertiary public spending per student. We have seen (Figure 6.20) how much more substantially per-student spending at the tertiary level varies across income levels than does spending at lower educational levels. Much of that great inter-country variation, with very high levels of spending in low-income countries, may result from the building of new tertiary educational systems in countries with limited human and physical resources for that development.

Table 6.15 reinforces that analysis by showing how spending per student has declined around the world at the tertiary level since 1970 in the UNESCO regions. In North America and Europe it has dropped from more than 50 percent of GDP per capita to just below 30 percent on average.[152] That is, reductions in per-student spending have occurred not just in low- and middle-income countries, but in high-income ones. In Latin America per-student spending has fallen from about 77 percent of GDP per capita to under 30 percent as well, and per-student costs for the developing countries of East Asia and the Pacific have dropped from levels well over 100 percent of GDP per capita to just below 20 percent. South and West Asian countries still have costs closer to 40 percent of GDP per capita and those in sub-Saharan Africa average nearly 200 percent.

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[152] In the United States, the increasing use of part-time adjunct instructors has taken advantage of a pool of willing and qualified personnel who work at much lower cost than full-time, tenured faculty.

	1970	1990	2000	2005
Arab States	176	76	98	81
Central & Eastern Europe	18	29	35	30
Central Asia		75	40	33*
East Asia & Pacific (Poor)	151	117	27	25
Latin America & Caribbean	77	30	46	21
South and West Asia	1129	85	87	41
Sub-Saharan Africa	979	349	222	184
North America and Europe	57	26	31	27*
East Asia & Pacific (Rich)	26	22	19	18*

Table 6.15 Tertiary public spending per student as percent of GDP per capita
Source: IFs Version 6.001
Note: *Values from 2004

Conclusions for the normative scenario: financial targets

Per-student cost structures at each level of education vary greatly over time and across countries, and model forecasts must reflect such changes. Based on the discussion of this section, we can identify values towards which countries will tend over time. In general, those values also represent "best practice," so that a normative scenario will accelerate that convergence process.

- Primary level. The analytic function of Figure 6.14, bound at the upper end by 21 percent provides a generally reasonable pattern of change over time as income levels change. A number of studies suggest that low-income countries generally need to spend about 13-15 percent of GDP per capita on each student to attain good practice levels. The regression line, with low-income levels somewhat above the low-income category average, provides such a target.

- Lower secondary level. An analytic function with slowly increasing expenditures as a portion of GDP per capita, bound at the upper end by 25 percent, is a reasonable pattern of change over time with income changes. Low- and middle-income countries need to spend about nearly 20 percent of GDP per capita to be near central tendency spending levels and presumptive good practice.

- Upper secondary level. The analytic function in Figure 6.17, bound at both ends by 30 percent is a reasonable pattern for change with income and target for best presumptive best practice. Low income countries may need to spend about 30 percent of GDP per capita on each student and often struggle to hold spending down to that level as they build upper secondary systems. Middle income countries probably need to spend about 15-20 percent on average.

- Tertiary level. The analytic function in Figure 6.16 is too steeply falling (in fact, it falls below 0 percent) to represent change over time or best practice. Instead, a functional representation based on the income-category average values of Table 6.12 can serve as such as guideline. We will bound the function at 100% of GDP

per capita at the very lowest levels of GDP per capita and eliminate further spending rate declines as incomes increase in the High-Income category.

Even in the base case forecasts of the model as described in Chapter 5, it was necessary to represent changing cost structures over time at each educational level. The general functions and guidelines above were used. In the normative scenario, we will move countries more rapidly towards the benchmark rates. (Chapter 3 described the process of convergence to cross-sectionally estimated functions.)

Overall spending levels within countries and regions often need to change in order to achieve these targets. The appendix to this chapter specifies the changes that were made for the normative scenario.

6.4 Conclusions

A normative scenario must strike a complicated balance among many factors. On the demand side of the equation are increases in enrollment and changes in desired spending per student. Even within the enrollment element, the scenario must pay attention to sub-elements, such as increasing intake versus enhancing survival and, of course, gender balance. Quality considerations influence a number of potential trade-offs, as do basic considerations of feasibility in terms of speed of ramp-up of enrollments.

On the supply side, expenditures on education compete with government expenditures in all other areas, including spending other than education that might enhance human well-being in the short run (including health) or that might increase economic growth and make future spending easier (such as infrastructure). Supplementing domestic spending with external resources is always a possibility, but the domestic demands for such external resources are no less numerous and the trade-offs are no less complex. Across the demand and supply sides, there are inevitably clashes between the perceptions of actors who view investments in education as the predominant or even only subject of interest and those who look at social and economic development more broadly (Chapter 3 discussed the algorithmic approach of the model to balancing demand- and supply-side pressures).

Hence any normative scenario for education is inevitably both complex and less than fully satisfying. Setting goals more abstractly has its appeal. This volume continues to argue, however, that the gradual elaboration of a more complete scenario for educational advance in a larger context does have value. The next two chapters turn to the exploration of the scenario discussed here (and summarized in the appendix to the chapter) for educational advance itself and for development more broadly.

6.5 Appendix: summary of interventions for the normative scenario

In scenario analysis we typically ramp in many parameter changes over time (using language below such as "by 2020"or "over 15 years") rather than introducing change in sudden jumps. Such ramping over time represents the incremental nature of political and social change; particularly around expenditures, sudden jumps are unusual. In the listing of parameter changes below, however, we typically set growth rate specifications across an entire forecasting horizon and the rates similarly lead to incremental changes in levels.

World as a whole, student flows:

Growth in primary intake rate at 2 percent annually (males, females, total); growth in primary survival rate at 1 percent annually (males, females, total); growth in transition rate from primary to lower secondary at 1 percent annually (males, females, total); growth in lower secondary survival rate at 1 percent annually (males, females, total); growth in transition rate from lower secondary to upper secondary at 0.5 percent annually (males, females, total); growth in upper secondary survival rate at 1 percent annually (males, females, total). There is no tertiary target built into the scenario.

There is no movement towards gender parity yet built into the normative scenario. This needs to be tested and added.

World as a whole, financial elements:[153]

Budget constraint turned off (educational model influences government spending rather than vice versa); convergence of spending per student to cross-sectional typical patterns in 20 years for primary, lower secondary and upper secondary spending. Convergence acceleration for tertiary must be added.

Developed countries: rise of foreign aid donations as a group to 0.3% of GDP over 55 years.

Africa

UNESCO Sub-Saharan Africa (excepting changes below): education spending increased 40% over 25 years (in 2030) and maintained, relative to the base case.

Kenya, South Africa: no change in spending.

Congo, Democratic Republic of: education spending doubled by 2060, relative to the base case.

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[153] The specifications here of increased spending are rough approximations of the spending needed to achieve the enrollment patterns that the intake/transition and survival rates plus the per-student expenditure patterns require. When the budget constraint is turned off in the model, the demand side requirements are forced onto the government budget model, making the need for specification of supply-side spending unnecessary.

Asia

UNESCO South and West Asia (excepting changes below): relative to base case, education spending increased 40 percent by 2020, maintained at that level until 2050, decreased to 10 percent in 2060.

China: relative to base case, education spending increased 30 percent by 2015, decreased to 20 percent by 2040, decreased to 10 percent by 2050 and maintained.

India: relative to base case, education spending increased 40 percent by 2020, maintained until 2035, then decreased to -10 percent by 2045.

Pakistan: relative to base case, education spending increased 60 percent by 2020 and maintained.

Bangladesh: relative to base case, education spending increased 60 percent by 2030 and maintained.

America

Central (excepting change below): Relative to base case, education spending increased by 20 percent by 2020, maintained until 2050, then decreased to 20 percent by 2060.

Costa Rica: no change in spending.

South (excepting change below): Relative to base case, education spending increased by 40 percent by 2020, then decreased to base by 2035.

Columbia: no change in spending.

7. Exploring an Alternative Educational Future

Although the general character of an aggressive but reasonable acceleration of advance in global education may be relatively clear, the merits of undertaking such a program are less so. As Chapter 2 discussed, in addition to the instrumental returns of education to individuals and the broader society, education carries its own intrinsic rewards in terms of the capabilities it builds in those who attain it and the freedom of action those capabilities confer. Thus cost-benefit analysis of investment in education, while certainly of use, cannot fully assess the returns to the investment.

This chapter explores the details of a normative scenario with acceleration of educational advancement in terms of its implications for enrollment patterns and educational attainment levels, in and of themselves. In addition the chapter calculates the costs of the normative scenario and considers where funding might be available. The next chapter considerably broadens the analysis of costs and benefits to consider a wide range of implications of aggressive educational advance.

7.1 Accelerating educational advance (if budget were no constraint)

Chapter 6 provided both the foundations for the development of a normative scenario and the details of that scenario in terms of intake/transition rates and survival/completion rates. How significantly different would the patterns of education advancement be for regions of the world (and specific countries) under the normative scenario, assuming cost were no object? This section explores that question using forecasts from the International Futures (IFs) system.

Cost is, of course, always an object. Chapter 6 also considered the patterns globally of public costs per student and explored what might constitute good practice. The following section will therefore look at the costs of the normative educational future, were countries to move toward good/standard practice. We again organize the discussion of regional patterns with the breakdown of the world used by UNESCO (see Appendix 1).[154]

[154] IFs can aggregate forecast as desired by the user. The end tables of this volume use a UN regionalization of the world that is more widely used across issue areas than is the UNESCO regionalization.

7.1.1 Sub-Saharan Africa

Africa is the region for which the normative scenario makes by far the most difference. Figure 7.1 shows the pattern for net primary enrollment and gross enrollment at the other levels. In the normative scenario, the continent surpasses 90 percent net primary enrollment in 2023 and 97 percent in 2040 (failing to meet the MDG for education even with the extra impetus of this scenario). Sub-Saharan Africa reaches 90 percent gross lower secondary enrollment in 2042 and 97 percent in 2056. Targets for enrollment at the upper secondary level do not exist. But in the normative scenario the continent reaches 80 percent gross upper secondary enrollment in 2055. Tertiary enrollment builds to 22 percent in 2060, also a remarkable advance on the 5 percent level of 2005, bringing the region to about the level of Central America today.

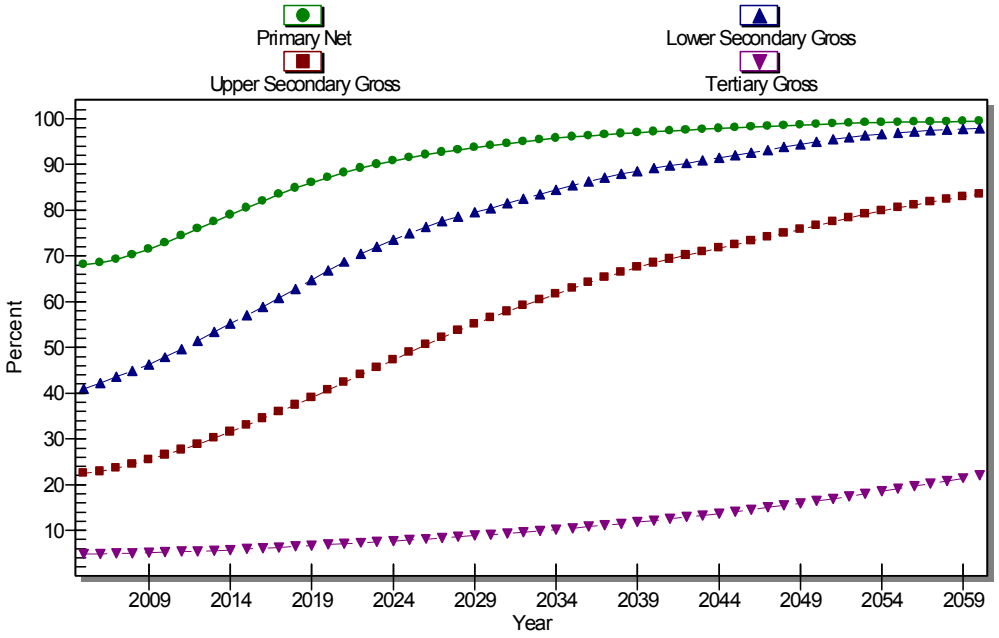


Figure 7.1 Enrollment at all levels in sub-Saharan Africa in the normative scenario
Source: IFs version 6.02

The difference between the pattern of the normative scenario and that of the base case is quite striking. Table 7.1 compares the two scenarios directly. Although differences at the primary level are considerable, it is those at the secondary level, both at the lower and upper secondary levels, that prove most significant. The normative scenario greatly accelerates the movement towards near universal basic education (90 percent), achieving it more than 20 years earlier than in the base case.[155] Moreover, the normative scenario brings upper secondary enrollment of Africa up to levels of current upper middle income countries by 2060 (the GDP per capita at PPP of upper middle income countries is now just over $9,000, and Africa would achieve the same upper secondary rate at about $7,300 in the normative scenario).

[155] Gross lower secondary enrollment of 100 percent often does not, of course, mean universal education at that level because large numbers of above-age students or repeaters can boost gross well above net.

	Net Primary	Lower Gross Secondary	Upper Gross Secondary	Gross Tertiary
2005	68.1	40.9	22.5	4.8
2020				
Base	72.7	48.8	27.8	6.1
Normative	87.1	66.8	40.7	6.9
2040				
Base	83.8	64.6	39.5	9.7
Normative	97.1	89.2	68.5	12.2
2060				
Base	95.1	85.5	57.9	14.9
Normative	99.5	97.9	83.5	22.1

Table 7.1 Comparison of normative scenario and base case, sub-Saharan Africa
Source: IFs version 6.005.

The group of low-education African countries needs until near the end of the forecast horizon to reach the 90 percent lower end of the universal primary enrollment category in the base case, and is able to do it more than 20 years earlier in the normative scenario (see Table 7.2). Moreover, that group of countries can also reach 100 percent lower gross secondary enrollment levels by 2040, well above the expectation for the base case.

	Net Primary	Lower Gross Secondary	Upper Gross Secondary	Gross Tertiary
2005	49.5	35.6	15.6	3.0
2020				
Base	54.7	45.5	21.4	4.2
Normative	74.2	68.3	36.3	5.4
2040				
Base	70.9	67.5	35.9	6.3
Normative	94.3	101.1	73.7	10.7
2060				
Base	89.9	90.6	58.2	10.2
Normative	99.3	102.5	88.0	20.0

Table 7.2 Comparison of normative scenario and base case, low-education countries of sub-Saharan Africa
Source: IFs version 6.02.
Note: Gross secondary enrollment can exceed net primary enrollment because of students who repeat grades re-enter at an older age or—as in some Western European countries in particular—return for a second or third vocationally related program.

As a general rule, countries that are furthest from universal primary have the greatest gender enrollment imbalances. Thus it is not surprising that sub-Saharan Africa, the region furthest from universal primary enrollment, is also the furthest from gender parity. Interestingly given popular images, gender imbalances in the education systems of Arab countries are not as great as in Africa and Asia, and imbalances of enrollment have been closing in those states most rapidly of all regions (see again Chapter 4 and Table 4.2). In Latin America imbalances are, on average, largely gone.

Figure 7.2 shows the ratio historically for countries of sub-Saharan African in the base case and normative scenario, distinguishing low and high enrollment country sets. Consistent with the general rule, the low enrollment countries are further from parity, with a primary gender parity ratio in 2005 of only 0.84, compared to 0.96 (just below the parity threshold) in the high enrollment countries of the continent. In the base case, the high enrollment countries reach parity nearly immediately and overshoot with a very small reverse gender gap; the normative scenario dampens that small overshoot. In the base case the low enrollment countries reach parity only in 2025, consistent with the slowing, S-shaped pattern that occurs in so much end-stage enrollment change. The normative scenario pushes their movement to parity considerably more aggressively, but still only achieves it in 2017. In short, although we obviously want to see parity achieved more rapidly, that horizon appears to be a reasonable expectation in an aggressive scenario.

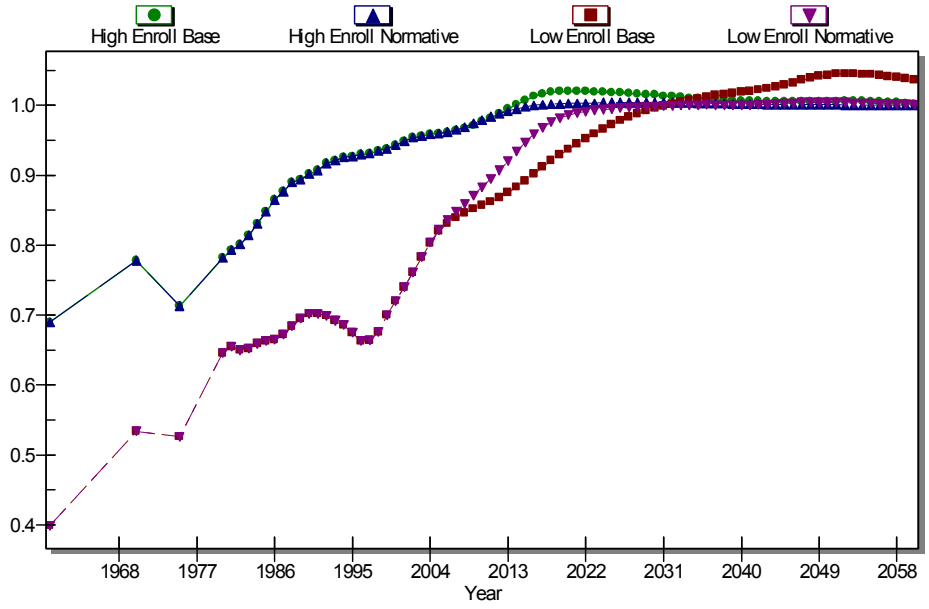


Figure 7.2 Primary gender parity ratio in sub-Saharan Africa, history and forecasts
Source: IFs version 6.02.
Note: Using 5-year moving averages.

Much of the uncertainty about educational futures in Africa is tied to developments in several of the demographic giants of the continent: Nigeria, Ethiopia, and the Democratic Republic of the Congo (DRC). In the case of the DRC a long history of internal conflict and elite kleptocracy since decolonization has greatly retarded advance

socio-politically as well as economically; in fact, in each of these countries disruptions have frequently reversed earlier gains.

The reality is, therefore, that forecasts of educational advance to mid-century for these countries are highly uncertain even in the base case. Nonetheless, Table 7.3 presents forecasts of DRC's educational enrollment patterns for the base case and normative scenario. They are dramatically different, exhibiting among the most extreme gaps for the continent. The normative scenario presents the possibility of the DRC not only catching up with the rest of Africa, but of substantially closing gaps with the rest of the world. The scenario clearly would have substantial economic costs relative to the base case and subsequent discussion will return to the issue of whether those costs might reasonably be paid. The normative scenario would also require, however, a resolution of the cycles of conflict that continue to plague the country. Ending such cycles would, in different ways, be potentially even more expensive and even more helpful for the future. Such resolution is not something we can forecast with any confidence and unfortunately even the base case for the DRC looks like a substantial challenge.

	Net Primary	Lower Gross Secondary	Upper Gross Secondary	Gross Tertiary
2005	57.0	29.8	17.6	0.4
2020				
Base	55.9	30.6	16.8	0.2
Normative	85.4	60.5	36.0	0.7
2040				
Base	69.3	41.6	20.2	0.4
Normative	99.6	95.3	71.6	1.4
2060				
Base	94.5	73.3	32.5	1.4
Normative	99.7	102.8	86.9	6.7

Table 7.3 Comparison of normative scenario and base case, Democratic Republic of the Congo
Source: IFs version 6.02.
Note: Gross secondary enrollment can exceed net primary enrollment because of students who repeat grades or re-enter at an older age.

The tables at the end of this volume provide forecasts from the base case of many educational variables across 182 countries, both enrollments and student flow patterns on one hand, and adult educational attainment on the other. Those who wish to explore the normative scenario in detail can see a parallel set of forecasts at www.ifs.du.edu. (Those will be prepared and displayed at the time of volume publication.)

7.1.2 South and West Asia

The UNESCO region of South and West Asia contains India, Bangladesh, and Pakistan, three large South Asian countries, combining them with Iran and with generally smaller countries of the region (Afghanistan, Bhutan, the Maldives, Nepal, and Sri Lanka). Enrollments at all levels in this grouping of countries exceed those of sub-Saharan Africa. For instance, primary net enrollment is already close to 90 percent and should reach that level by 2020. In fact, lower secondary enrollments are already at 66 percent and climbing strongly, compared to only 51 percent in sub-Saharan Africa. As Figure 7.2 shows, from the perspective of the early years of this century the next frontiers of education in South and West Asia as a whole are in upper secondary and tertiary education, both of which advance substantially even in the IFs base case (not shown, but available by country in the end tables of this volume). The normative of the scenario of Figure 7.3 shows the possibility of near universal gross higher secondary education (90 percent) before 2045.

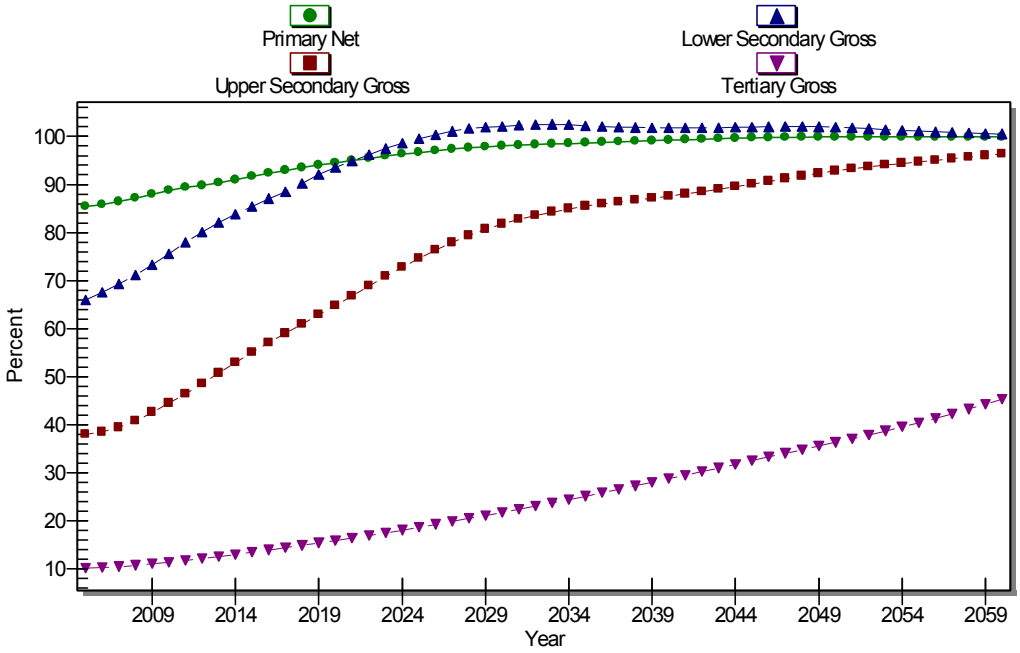


Figure 7.3 Enrollment at all levels in South and West Asia in the normative scenario
Source: IFs version 6.02

Table 7.4 shows the rapid advance in secondary education, particularly upper secondary, relative to the base case. Again it should be pointed out, however, that South and West Asia appears poised for remarkable educational advance, even in the base case.

	Net Primary	Lower Gross Secondary	Upper Gross Secondary	Gross Tertiary
2005	85.4	65.9	38.0	10.1
2020				
Base	90.7	80.4	50.4	15.5
Normative	94.5	93.5	64.8	15.9
2040				
Base	96.2	92.7	71.0	31.6
Normative	99.2	101.8	87.6	28.7
2060				
Base	98.3	97.0	84.3	41.7
Normative	99.9	100.5	96.3	45.3

Table 7.4 Comparison of normative scenario and base case, South and West Asia
Source: IFs version 6.02.

The emphasis on the importance of the normative scenario for secondary education in South and West Asia should, not, however, detract from the need to complete an agenda with respect to primary education. A key element of that remaining agenda is the need to bring primary survival rates up substantially. Most of the South Asian countries and a number of other countries in Asia more generally (including Cambodia, Laos, Myanmar, Papua New Guinea, and the Philippines) have survival rates below 80 percent and these need to rise to near 100 percent for the achievement of universal primary education. Figure 7.4 shows the values of net primary enrollment for those countries in the base case and normative scenario.

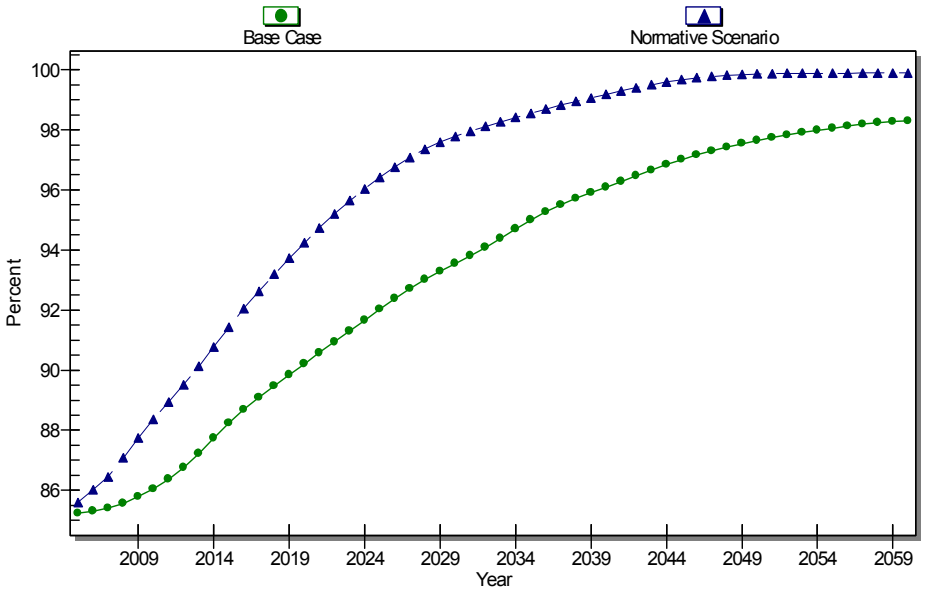


Figure 7.4 Net primary enrollment in Asian low survival group, base case and normative scenario
Source: IFs version 6.02.
Note: Used 5-year moving average.

And of fundamental importance, of course, attention to regional aggregations cannot divert our attention from the specific issues of particular countries. Figure 7.5 shows how far Pakistan is from universal net primary education, much less universal basic education and how long it may take to move to those goals even in the normative scenario. Afghanistan finds itself in a similar situation, complicated at least in the short run by the need to catch up with education missed during the years of rule by the Taliban. Again, the end tables of this volume provide country detail.

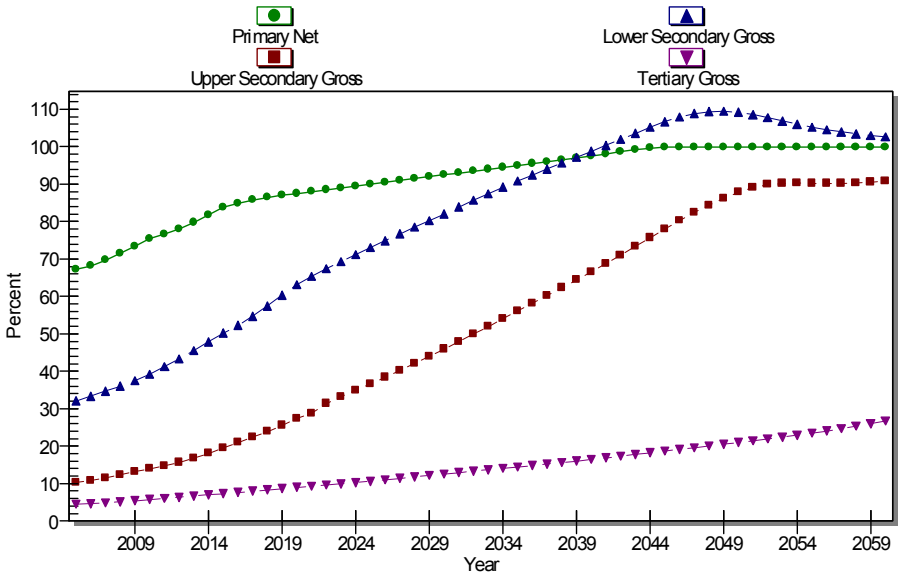


Figure 7.5 Enrollment at all levels in Pakistan in the normative scenario
Source: IFs version 6.02

East Asia and the Pacific, less developed

The UNESCO region of East Asia and the Pacific includes both very high-income countries such as Japan and Australia, as well as low- and middle-income countries. For that reason this volume has divided the two sets and this discussion focuses on the less developed countries of East Asia. China dominates the lower-income set demographically, but the grouping also includes the heavily populated countries of Southeast Asia and the Philippines.

Figure 7.6 shows that the region as a whole has largely completed the transition to universal primary and lower secondary education. Strikingly, the region has obviously given much more attention to lower secondary and hence to basic education than to upper secondary education. The contemporary gaps in enrollment between lower and upper secondary education are considerably greater than those that earlier figures showed for sub-Saharan Africa or South and West Asia (closer to 40 percent than to the 20-25 percent differentials in the other regions). This has resulted from a huge push with respect to lower secondary education over the last half-century. Although data must be treated warily, gross lower secondary enrollment in Thailand is reported to have increased from 22.5 percent in 1970 to 96 percent in 2005. Less dramatically, but significantly, the rate in the Philippines climbed from 49.8 percent to 86.7 percent over the same period. China had already reached the range of 60-70 percent by the 1980s. Graduation rates of the region at the lower secondary level also reflect the progress made and are near 90 percent.

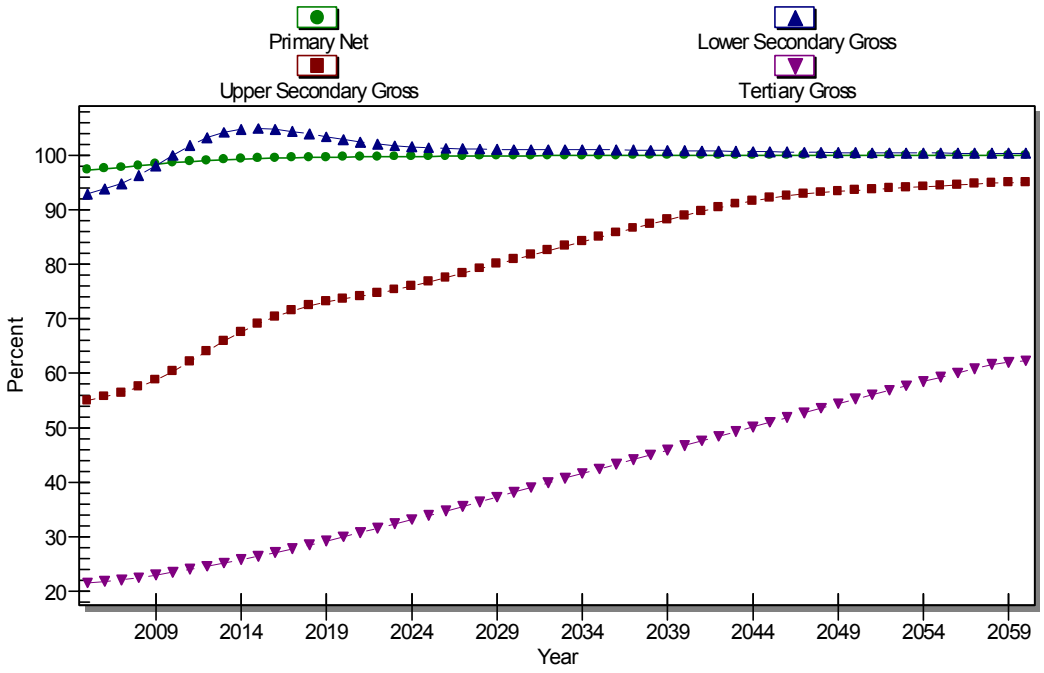


Figure 7.6 Enrollment at all levels in the developing countries of East Asia and the Pacific in the normative scenario
Source: IFs version 6.03.
Note: Using 5-year moving averages.

The demographic dominance of China in East Asia should not lead us to believe that basic education has been universalized more broadly throughout the region. Although the rate in the Philippines is near 90 percent, lower secondary gross enrollment in Southeast Asia as a whole is still in the low 80 percent range.

Nonetheless, it is obvious that the region will be focused much more heavily on upper secondary and tertiary education in the coming years, and most of the growth in both the base case and the normative scenario is at those levels. Figure 7.7 compares the upper secondary gross enrollment rates in the two scenarios. Even in the base case the region is likely to be nearing universal enrollment by 2060, but the normative scenario leads to rates that are 3-5 percent higher across most of the forecast horizon.

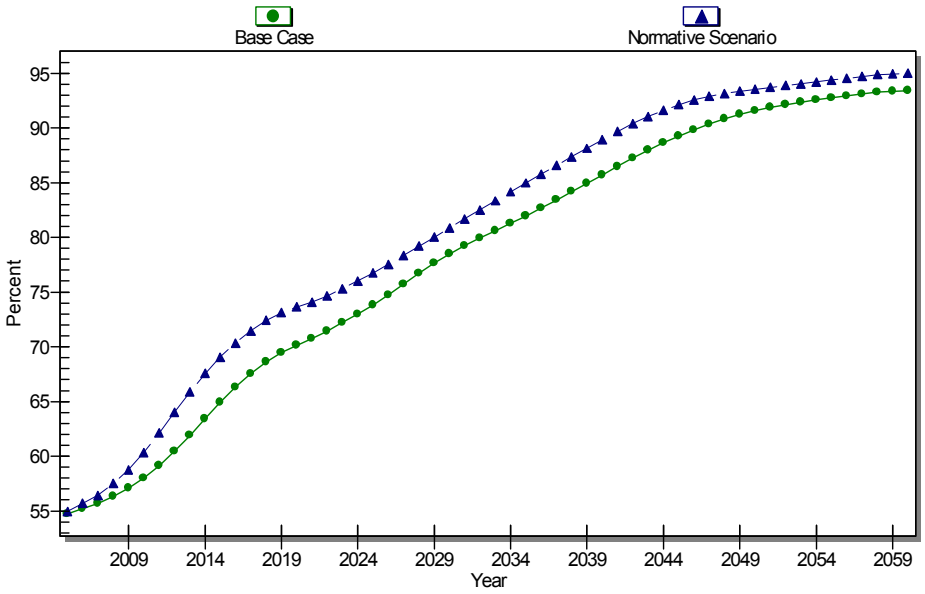


Figure 7.7 Upper secondary gross enrollment in the developing countries of East Asia and the Pacific in the normative scenario
Source: IFs version 6.03.
Note: Using 5-year moving averages.

With respect to tertiary enrollment, the normative scenario would move the developing countries of East Asia to about 63 percent by 2060. That would put them near the level of Southern Europe today. Is such rapid growth possible? In 1970 the gross tertiary enrollment rates in Southern Europe were only about 13 percent, lower than the 22 percent of developing East Asia today and not much above the level of South Central Asia. Tremendous educational change can and almost certainly will occur in 40-50 years.

As in every region, there are societies in which the forecasts are more uncertain and the initial starting positions less propitious. Cambodia is such a country in East Asia. Although primary education is universal, only about 50 percent of the potential student body attends lower secondary schools and fewer than 20 percent attend upper secondary institutions. Even by 2060 in the normative scenario universal basic education would be uncertain, but the scenario would anticipate it shortly after 2050.

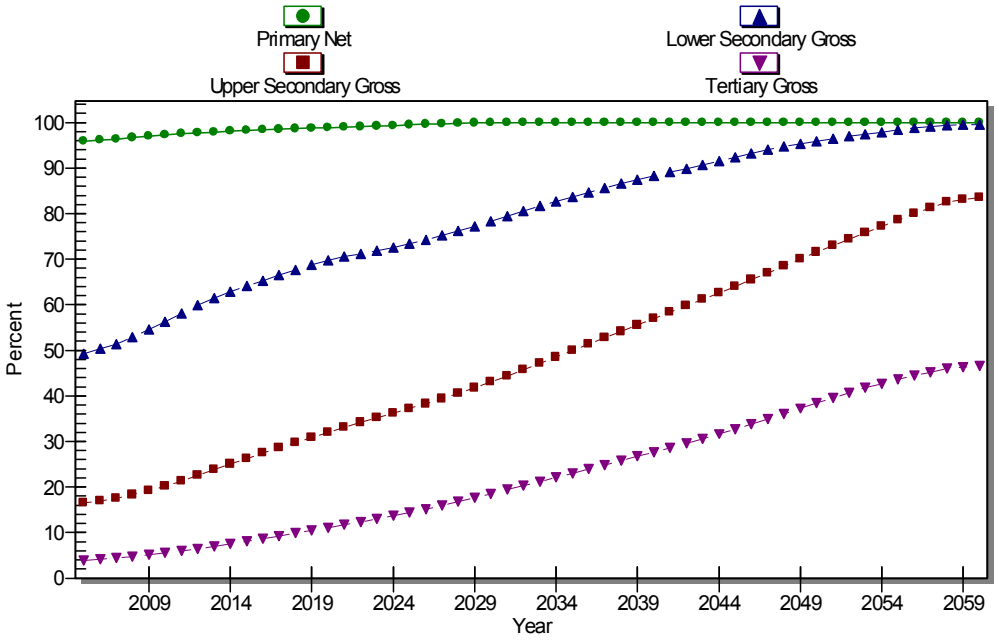


Figure 7.5 Enrollment at all levels in Cambodia in the normative scenario
Source: IFs version 6.03
Note: Using 5-year moving averages.

Latin America and the Caribbean

The UNESCO region of Latin American and the Caribbean includes Mexico and all of Central America. Like the developing portion of East Asia, the continent has all but reached universal primary enrollment, although there certainly are pockets of population who do not yet receive schooling at that level. Figure 7.6 shows the current status of enrollment at four levels and the possibilities of the normative scenario. There are, however, across Latin America as well as within countries, huge inequalities. In contrast to Figure 7.6, the net primary enrollment rate in Haiti and Guatemala is only about 60 percent. In Nicaragua, net primary enrollment is about 85 percent and gross secondary enrollment about 75 percent. At the other extreme in Cuba, gross upper secondary enrollment is already 86 percent and gross tertiary enrollment is over 60 percent.

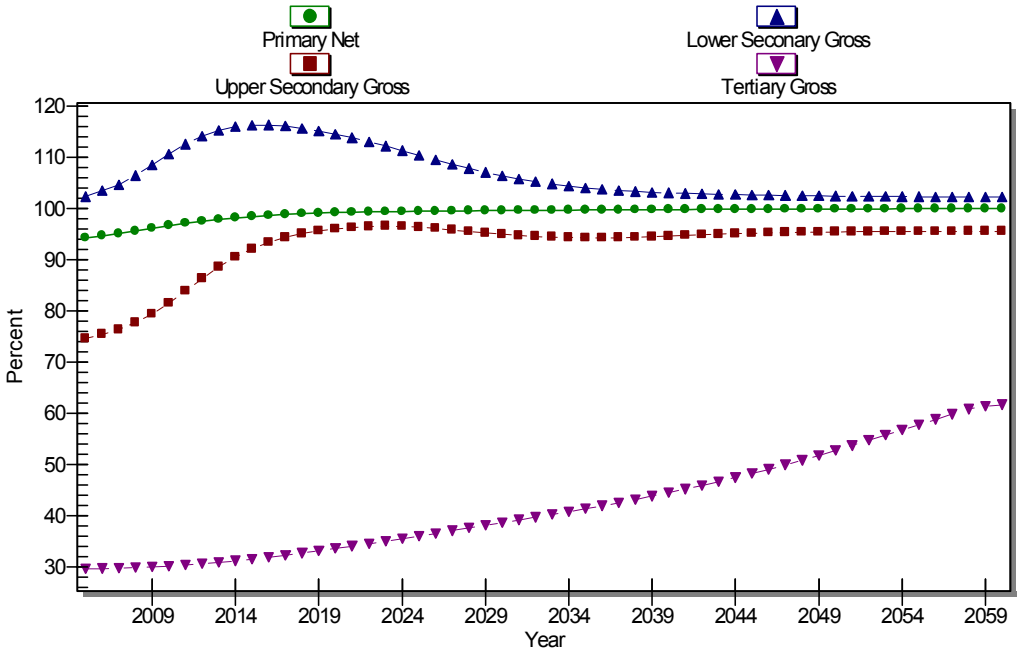


Figure 7.6 Enrollment at all levels in Latin America and the Caribbean in the normative scenario
Source: IFs version 6.03
Note: Using 5-year moving averages.

In spite of the negative exceptions, the region as a whole is also quite well positioned with respect to basic education. The focus in the coming decades will be mostly on upper secondary and tertiary education. And the greatest uncertainty in forecasting is therefore also at those levels. Figure 7.7 shows the difference between the base case and the normative scenario with respect to gross upper secondary enrollment. Although the movement from about 75 percent to over 90 percent in 20 years is aggressive, it is quite possible. The region as a whole moved from 63 to 73 percent in just the 5 years between 1999 and 2004. In fact, the base case may appear too conservative, but it reflects both budgetary constraints and slowing rise in demand as rates become higher.

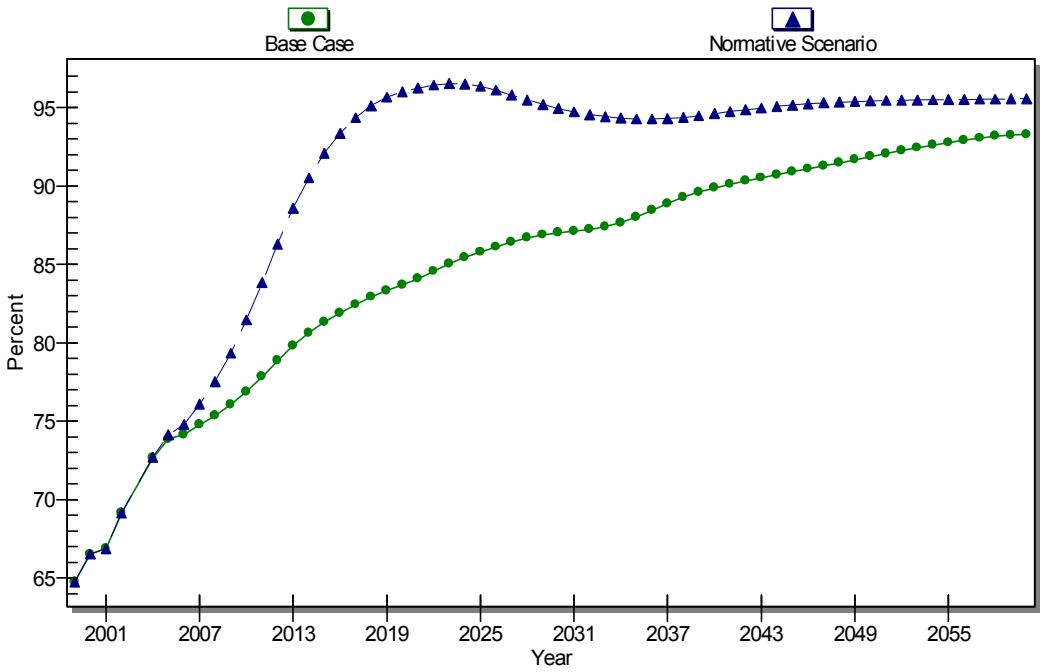


Figure 7.7 Gross upper secondary enrollment in Latin America and the Caribbean in the base case and normative scenario (with history since 1999)
Source: IFs version 6.03
Note: Using 5-year moving averages after removing 2003.

Brazil is the demographic giant of Latin America. With a population of nearly 200 million, it is almost twice the size of Mexico, which in turn is about twice the size of third-ranked Colombia. Brazil is also one of the Goldman-Sachs BRICs (Brazil, Russia, India, and China). Thus its educational future is of considerable importance not just to the region, but with also respect to the concept of continuing global emergence of large, middle-income countries. Figure 7.8 shows the prospects in the normative scenario. The overshoots in gross enrollment at both secondary levels are common as countries rapidly increase their education at those levels and address the entry of older populations and ongoing issues around repetition rates (which tend to decline with improved quality of schooling and the development of norms for enrollment and persistence).

Perhaps the two most interesting aspects of the forecasts for Brazil are (1) the starting conditions, with nearly universal education through upper gross secondary education already in place and (2) the movement by 2060 to about 60 percent tertiary enrollment, as in the forecast for developing East Asia. It appears more generally that the educational future in 2060 of today's middle income countries could look much like that of Southern Europe today. Indeed, tertiary enrollment is only marginally higher today in Northern Europe.

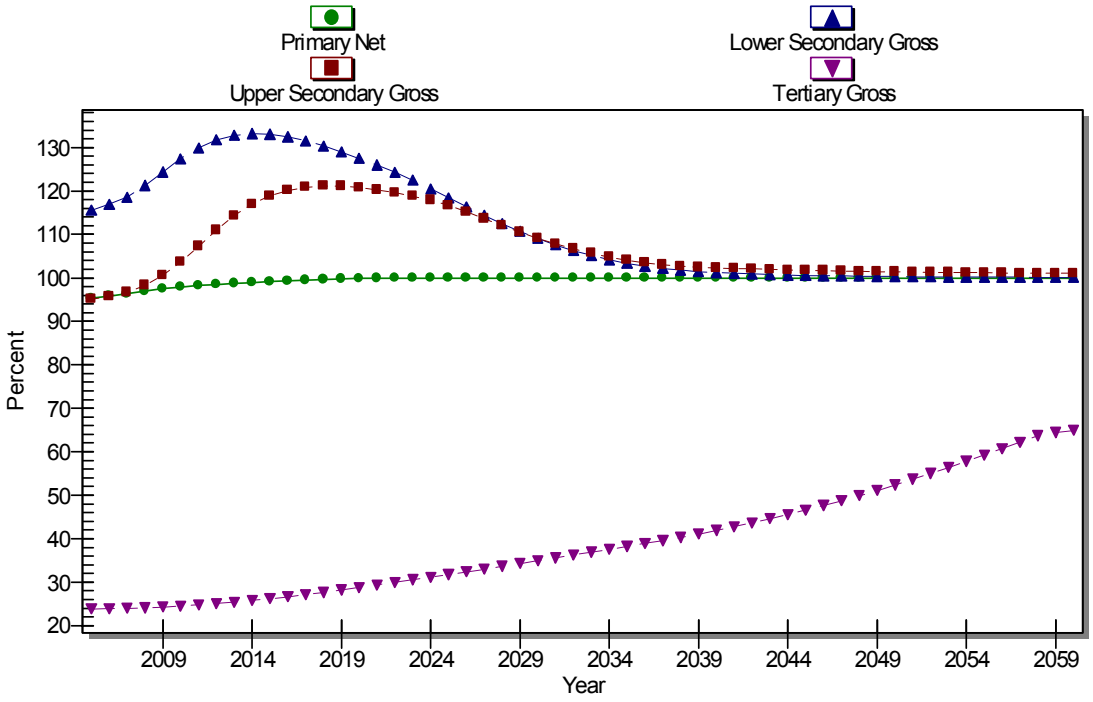


Figure 7.8 Enrollment at all levels in Brazil in the normative scenario
Source: IFs version 6.03
Note: Using 5-year moving averages.

Arab States

The UNESCO Arab state region spans the whole of North Africa (including the Sudan) and the Arabian Peninsula. At a bit more than 300 million its population is, however, not much more than half that of Latin America, which is in turn considerably smaller than the other world regions of this review. The largest country is Egypt at 74 million. Algeria, Iraq, Morocco, Saudi Arabia and the Sudan are all somewhat less than half that size.

The Arab States (see Chapter 4) have experienced a rapid expansion of education in recent decades. Still, Figure 7.9 shows that, relative to Latin America and even East Asia, there is unfinished business for the Arab states even at the primary level and more at the lower secondary level, in addition to relatively modest rates of enrollment at the upper secondary level for such a generally rich region. Although we have seen a rapid closure of the region's gender gap in recent years, the rate of enrollment of males at the primary level is still about five percent higher than that of females, and the gap at the lower secondary level is over eight percent. Women now have parity only at the upper secondary and tertiary levels.

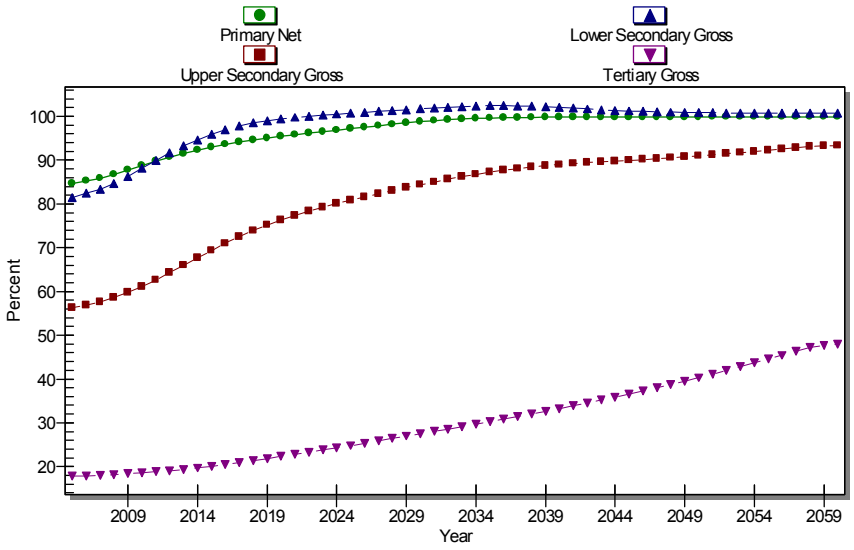


Figure 7.9 Enrollment at all levels in the Arab states in the normative scenario
Source: IFs version 6.03
Note: Using 5-year moving averages.

The Sudan by itself accounts for most of the region's missing students at the level of basic education. Net primary enrollment and gross lower secondary enrollment are both below 50 percent and upper secondary enrollment is about 25 percent. Morocco, too, trails the regional pattern, with net primary enrollment below 90 percent and gross lower secondary at about 65 percent. On the whole, the energy rich states have near universal basic education, as does Egypt, a country that has long placed considerable emphasis on education. Thus the region clearly has a mutli-tiered structure in which various states look more like Africa (the Sudan), South and West Asia (Morocco) or Latin America (the bulk of the region).

Although all countries of the region are important, the educational future of Saudi Arabia is perhaps of special interest. It currently produces and largely exports about 14 percent of the world's oil (the production also accounts for about the same percentage of all energy in interstate trade, including coal and natural gas). Its governance structure is increasingly at odds with its current educational patterns, much less those that we might anticipate as the century proceeds even in the base case. And it definitely has the economic resources, particularly in a very high-priced energy environment, to pursue normative scenarios in education and much else. Figure 7.10 shows the history and normative forecast of education in the region, replacing the differentiated attention to lower and upper secondary education with total gross secondary education because of the lack of differentiated historic data.

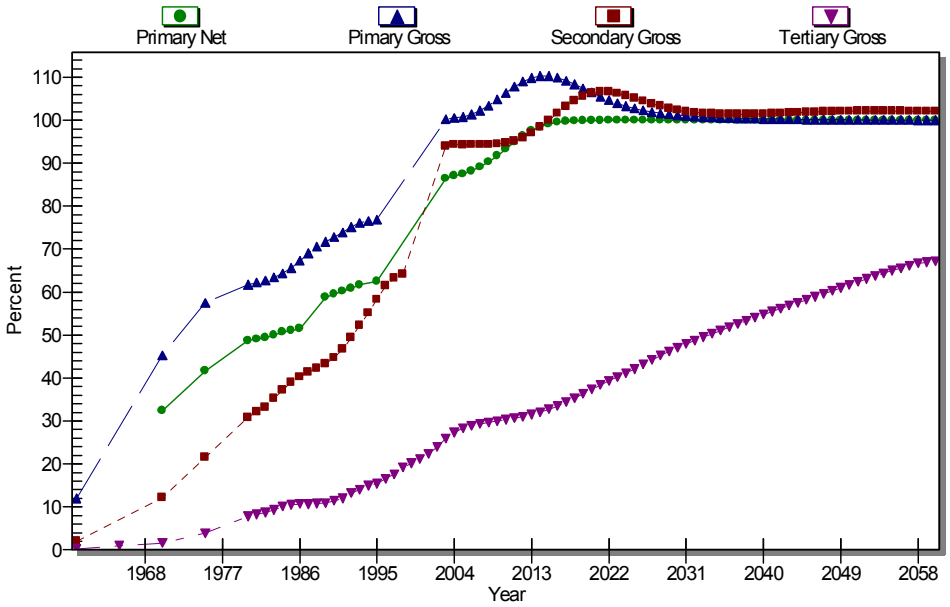


Figure 7.10 Enrollment at all levels in Saudi Arabia in the normative scenario
Source: IFs version 6.03
Note: Using 5-year moving average, after removing 1996-1998 for net and gross primary education because they are not consistent with series (show temporary declines).

Historic growth in education at all levels in Saudi Arabia since 1960 has been truly remarkable. Even gross upper secondary education (not shown) now exceeds 90 percent. The normative scenario is not significantly different from the base case, because the kingdom is already increasing enrollments at about the rates posited in the normative scenario and has nearly reached universal education through upper secondary.

The historic growth and contemporary educational patterns are rapidly reshaping the regional profile of attained education among adults. Figure 7.11 shows level of education among adults in Kuwait in the normative scenario (now about that of Europe in 1975), contrasting it with Sudan at the other extreme for the region. Interestingly, the gender imbalance among adults in Kuwait (not just among current students) is reversing rapidly. That pattern is, however, rather exceptional. In the Sudan, educational levels are much lower and the gender gap is large. In Egypt (not shown), the educational attainment level of females older than 15 is only five, versus seven for males; the gender gap may not close significantly over our forecast horizon

Although the region is struggling with many educational issues, not the least of which is gender equity, growth in adult educational levels is rapid. Even in the base case, adult attainment levels of Arab states will, on average, reach those of Europe today by 2035 and could reach those of Northern Europe today by 2060. The normative scenario would add at least 0.5 years of education to the forecasts of the base case. Chapter 8 will return to the issue of the broader socio-political implications of such transitions in educational attainment.

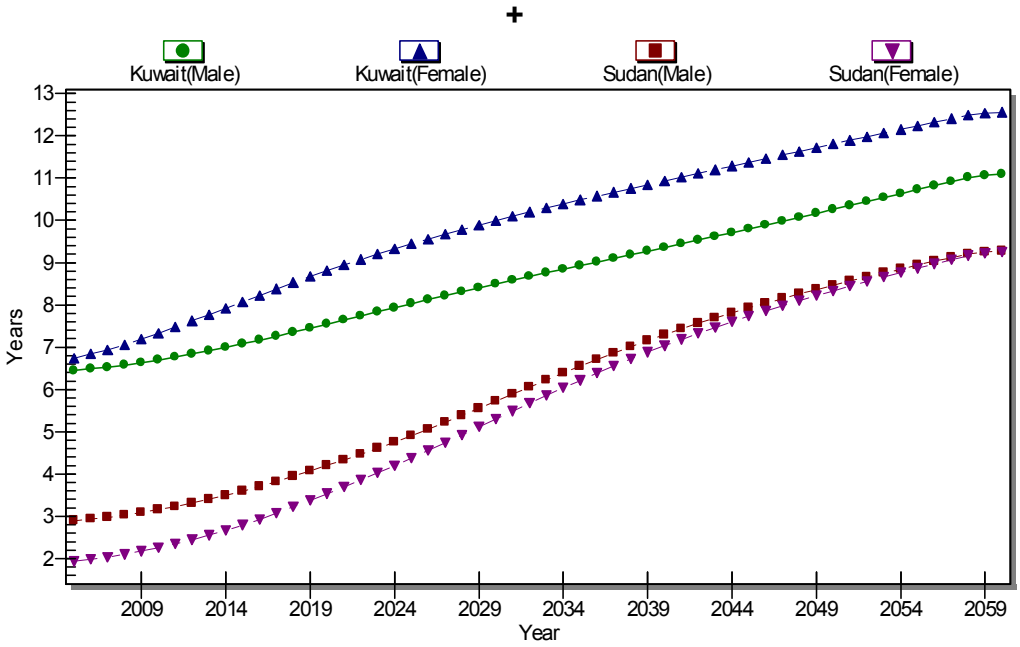


Figure 7.11 Average years of education of adults 15 years and older in Saudi Arabia and Sudan in the normative scenario
Source: IFs version 6.03
Note: Using 5-year moving averages.

Central Asia

The UNESCO region of Central Asia consists of Armenia, Azerbaijan, and Georgia (collectively the Caucasus), Mongolia and the Turkish republics of Central Asia (sometimes referred to as the "-stans" or "lands of"). The entire region has a population of less than 80 million and Kazakhstan is the largest country by population at only 15 million as well as by physical size (it is the largest land-locked country in the world).

Figure 7.12 shows that the region has an educational pattern somewhat like that of the Arab states. That is, that the transitions to universal education remain unfinished at the primary and lower secondary level, but enrollment levels are reasonably high. In contrast to the Arab states as a general category, the level of gross upper secondary enrollment in Central Asia is quite high, in part a legacy of the Soviet era. Most of the countries of the region have a fairly similar pattern to the region as whole.

In addition to completing the extension of lower levels of education, the region's major challenge in coming years is likely to be the extension of tertiary education. The oil rich countries are busy building universities. In spite of their resource wealth, however, the economies and governance structures of many of the countries in the region are somewhat fragile, a key reason that the forecast for tertiary extension is not terribly high.

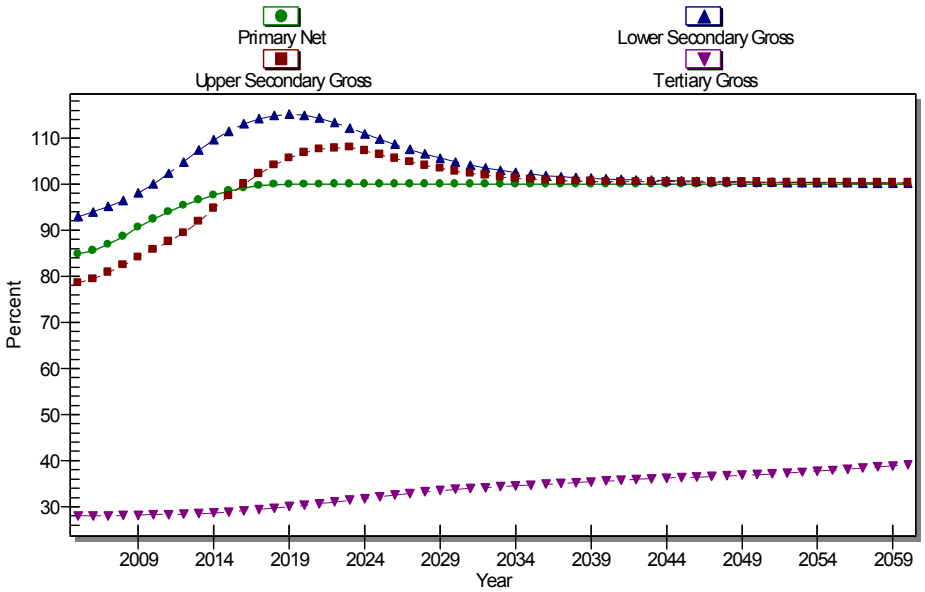


Figure 7.12 Enrollment at all levels in Central Asia in the normative scenario
Source: IFs version 6.03
Note: Using 5-year moving averages

Central and Eastern Europe

UNESCO's Central and Eastern Europe includes Russia, which therefore dominates it demographically, but also Turkey, at about half the size of Russia. Most of the countries were part of the former Soviet Union and have similar patterns of high enrollment rates across all levels of education. Most striking are two elements in the initial conditions of the normative forecast in Figure 7.13. First, the initial levels of net primary and lower secondary education are somewhat low considering the high levels of upper secondary and especially of tertiary enrollment. This aggregate pattern can also be seen individually in both Russia and the Ukraine. One part of the explanation is a decline of lower level enrollments, even in Russia, after the fall of communism. That is already being reversed. The pattern also almost certainly reflects the presence of large numbers of minority groups, some of whom, such as the Roma, do not participate even at lower levels.

Second, the levels of tertiary enrollment are remarkably high given the levels of GDP per capita that the region members now have. This reflects the legacy of the emphasis that communism put on education overall, including higher education. Also, the current market exchange rates result in values for GDP per capita of Russia and some neighboring countries that fall considerably below values at purchasing power parity, the better measure of their economic condition.

The pattern for Turkey is somewhat of an outlier for the region. It has high primary and lower secondary enrollments, but the upper secondary rate falls to 70 percent and the tertiary rate to 30 percent. Clearly, its historic pattern is very different than members of the former Soviet Union.

With respect to the normative (and base case) forecasts, one of the striking elements is relatively flat tertiary enrollments. In fact, after beginning at 70 percent, there is even some dip in the rate for the Ukraine. Russia also begins at 70 percent and remains relatively flat. This result is tied to the use of a demand function in the forecasting model, rooted in turn in levels of GDP per capita (PPP), which holds back the growth in tertiary education that we have seen in the forecasts of most regions. We would expect some convergence of educational patterns for the countries in the region towards the patterns of long-term market-based economies.

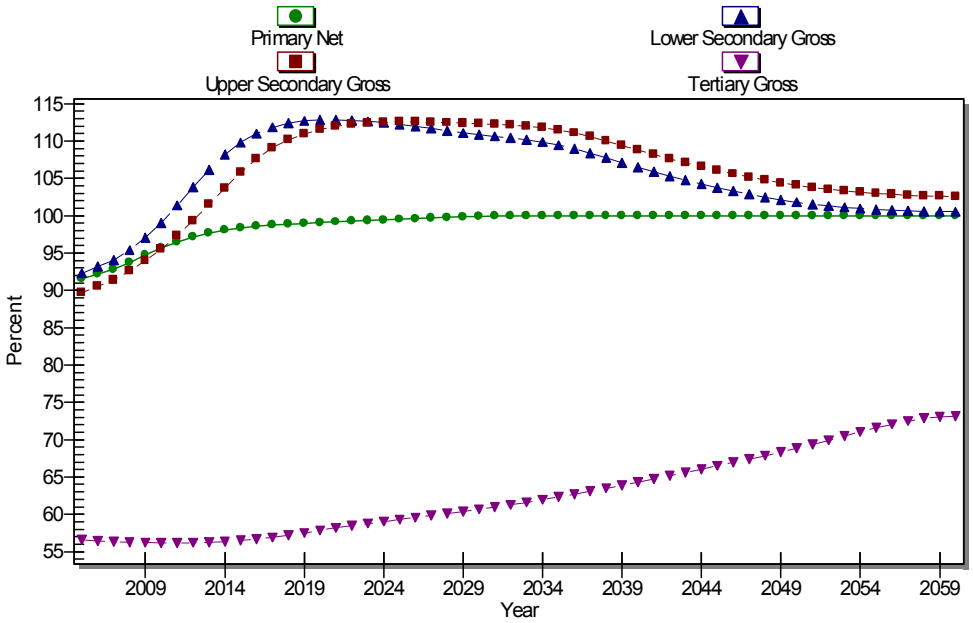


Figure 7.13 Enrollment at all levels in Central and Eastern Europe in the normative scenario
Source: IFs version 6.03
Note: Using 5-year moving averages.

High-income regions

The UNESCO division of the world contains one region that consists essentially only of high-income countries, namely North America and Western Europe. For the purposes of this volume and its analysis, we have split UNESCO's East Asia and the Pacific into two sub-regions, one of which also contains only high-income countries. We will consider both regions in turn.

Not surprisingly, Figure 7.14 shows that North America and Western Europe have largely attained universal education through the upper secondary level. The fact that the net primary enrollment rate is consistently around 95 percent and therefore below the 97 percent definition of universal may be somewhat surprising, but even in the richest countries some subpopulations may not participate in or complete primary education. The United States has by far the largest population of countries in the region, and has

somewhat lower primary and secondary enrollment rates than the average: 92 percent net primary and only 87 percent gross upper secondary.

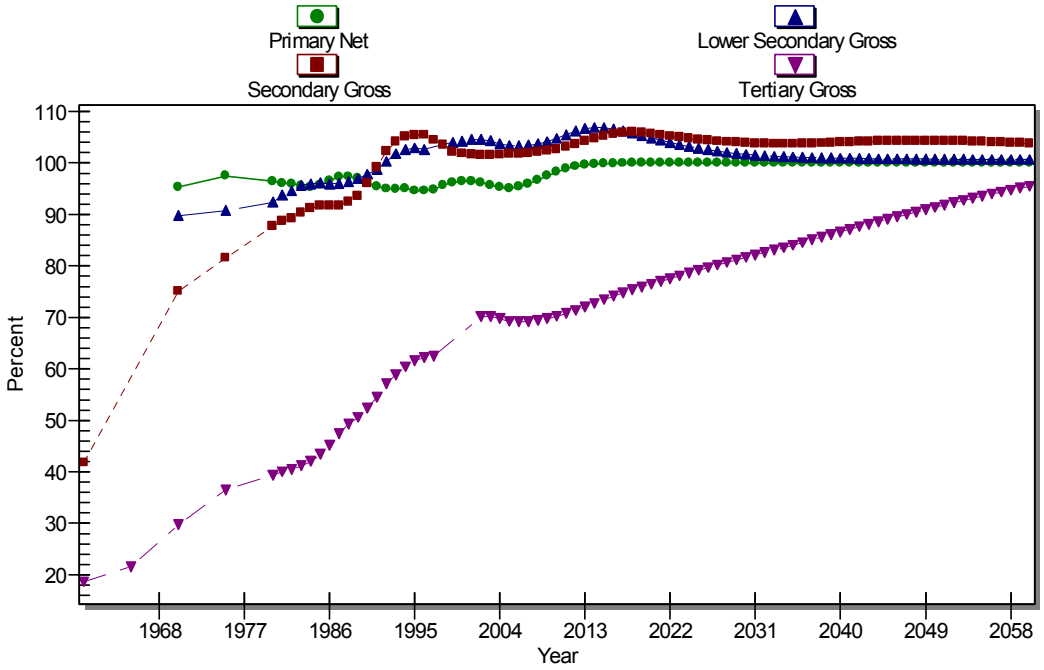


Figure 7.14 Enrollment at all levels in North America and Western Europe in the normative scenario, history and forecast
Source: IFs version 6.03
Note: Using 5-year moving averages after removal of years 1998-2001 from tertiary history because data were not consistent. Historical numbers are often irregular because of changes in country set reporting. Total secondary was substituted for upper secondary because we lack historic data.

The historic data in Figure 7.14 allow us to look at patterns in these high-income countries 40-50 years ago. Even forty years ago the countries of North America and Western Europe had very nearly attained universal basic education. Strikingly, however, total secondary enrollment was probably in the 50-60 percent range, which means that upper secondary enrollment even lower.[156] At the tertiary level gross enrollment was 19 percent, even including the United States at 32 percent. The rate in Western Europe was only 8 percent.

Comparing the North American and Western European region of 1960 with contemporary regions of the world, it would fall below the educational enrollment levels of Latin America (where the upper secondary rate is 75 percent and tertiary is 30 percent) and remarkably close to that of the developing countries of East Asia. The GDP per capita (PPP) of the high-income countries in 1960 was $10,800, compared with the

[156] The figure shows 42 percent but contains no data from the United States or the United Kingdom in 1960. In that year, total gross secondary enrollment in France was 46 percent, Sweden was 55 percent, and the Netherlands was 58 percent. Growth by 1970 in all three countries was substantial.

$7,500 today of Latin America and $5,400 of developing East Asia. Emphasis on education at all levels has increased over those decades around the world.

Today high-income countries still pay much attention to their educational patterns and their competitiveness in the modern knowledge economy. Because of the importance of tertiary education, the growth of enrollment at that level has been especially rapid. A major unknown in the coming half century is the degree to which gross tertiary rates that have now reached 70 percent can continue to grow. Is a rate like 90 percent in 2060 really reasonable? Gross enrollments include people throughout their life span, many of whom may acquire multiple degrees, seek career retraining across their life-span, or simply enroll to satisfy personal interests, thus making such rates at least theoretically possible. The fourth volume in this series will return to higher education in the context of discussing modern knowledge systems.

Figure 7.15 turns to the high-income countries of East Asia and the Pacific. That region consists of Australia, Japan, the Republic of Korea, New Zealand, Singapore and Taiwan. Japan has the largest population and is twice the size of Korea. The remarkable aspect of the educational history in that region is that it is very similar to that of North America and Western Europe, in spite of the fact that the GDP per capita (PPP) of the countries in 1960 was only $4,700, a bit less than the developing countries of East Asia and the Pacific today. One difference is that the region has been somewhat more egalitarian. Secondary enrollments were above those of North America and Western Europe in 1960 and 1970, while tertiary enrollments were lower. The rapid economic and educational growth of the high-income Asian countries over the last 50 years gives added weight to forecasts of similar patterns in the culturally similar low-income Asian countries over the next 50 years (see again Figure 7.6).

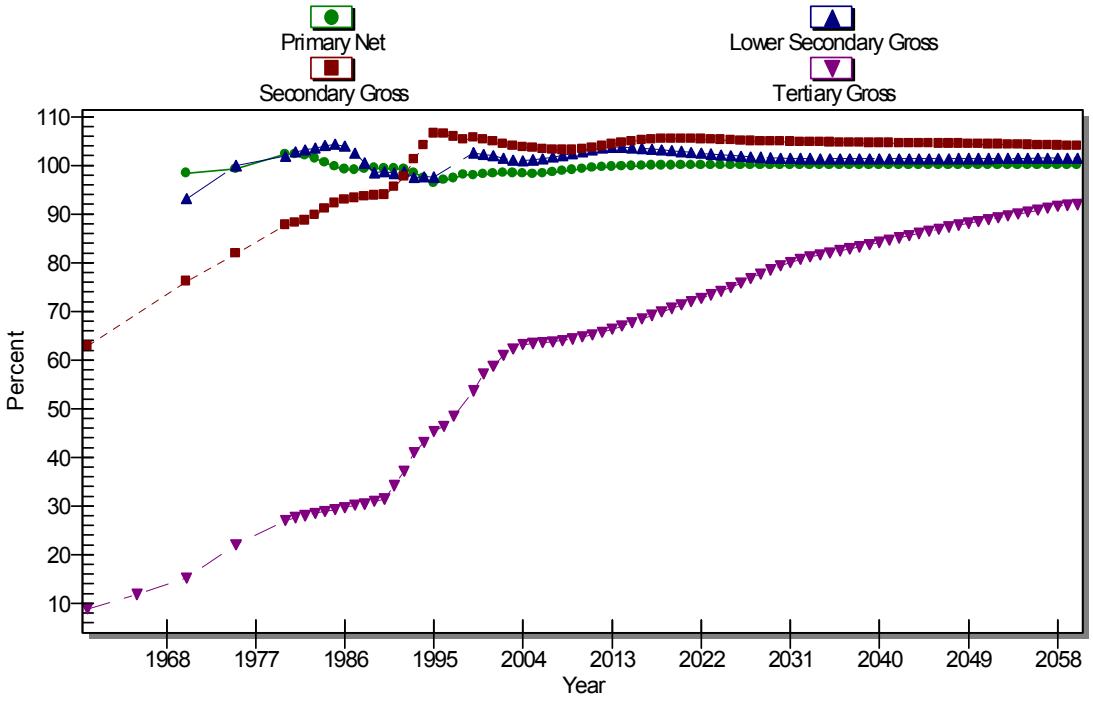


Figure 7.15 Enrollment at all levels in high-income East Asia and the Pacific in the normative scenario, history plus forecast
Source: IFs version 6.03
Note: Using 5-year moving averages, after removal of years 1996-1997 from lower secondary and 1998 from tertiary because data were not consistent.

Implications for future educational targets

One of the arguments of this volume is that, when it comes to educational targets, one size does not fit all. Most of the world will reach universal primary enrollment (if defined as 90 percent enrollment rather than 100 percent) before 2015, but East, West, and Middle Africa are unlikely to reach it before about 2025, even in our normative educational scenario (see Table 7.5). When defined by the stricter target of 97 percent, the sub-regions in Africa, except for South Africa, are unlikely to meet the target until 2025-2045. With the stricter target, the Caribbean, Central America, and South Central Asia reach it, even in the normative scenario, only after 2020.

A very similar global disparity exists with respect to lower secondary education and thus basic education in total. Most of the world again will reach universal levels (defined as 90 percent gross enrollment, an easier target than 90 percent net enrollment) by 2015. Three African regions will be unlikely to meet the goal before 2035 and, in the case of East Africa, 2055.

As the global community begins to look beyond basic education to universal upper secondary, the pursuit of even 80 percent gross enrollment will, of course, take longer and many regions of the world, including most of Asia, will be hard-pressed to reach it before 2020-2025. Central America may need until 2031, while West and Middle Africa

will perhaps reach it before 2040-2050. Unfortunately, East Africa may not reach that goal within our forecast horizon, largely because of Ethiopia, which is now below 20 percent.

At the tertiary level, it is difficult to imagine a global goal of 90 percent, but not impossible that many regions could pursue 60 percent within our time horizon, a level that has been reached by almost the entire high-income world. Only East Asia, West Asia, and South America are likely to attain it.

	Net Primary (97% target)	Net Primary (90% target)	Lower Gross Secondary (90% target)	Upper Gross Secondary (80% target)	Gross Tertiary (60% target)
Africa					
East	2044	2022	2055	2060+	2060+
Middle	2038	2023	2042	2048	2060+
North	2026	2014	2010	2027	2060+
South	2016	2009	NA	NA	2060+
West	2031	2020	2037	2043	2060+
Americas					
Caribbean	2037	2013	2011	2015	2060+
Central	2022	NA	2017	2031	2060+
North	2010	NA	NA	NA	NA
South	2010	NA	NA	NA	2055
Asia					
East	NA	NA	NA	2029	2045
South Central	2022	2012	2017	2027	2060+
Southeast	2010	NA	2011	2021	2060+
West	2014	2008	2011	2016	2058
Europe					
East	2012	NA	NA	NA	NA
North	NA	NA	NA	NA	NA
South	NA	NA	NA	NA	NA
West	NA	NA	NA	NA	2022
Oceania	2013	NA	NA	NA	2019

Table 7.5 Years that global regions attain IFs educational targets in the normative scenario
Source: IFs version 6.03.
Note: This table uses the standard UN world regionalization, not that of UNESCO.

7.2 Paying for educational acceleration: costs and possible sources

7.2.1 What the normative scenario would cost and why

Both the demand for education and the supply of funding provided by the government heavily influence our base case forecast of educational futures. Yet as we saw in Chapter 4, educational funding patterns tend to be fairly consistent portions of GDP around the world, significantly independent of the financial needs as reflected by underlying demographic patterns and efforts to push educational enrollments forward aggressively. In those circumstances, expenditures for students often are squeezed (but sometimes also are very generous by global standards).

In order to assess the costs of the normative scenario, this analysis simultaneously removed the normal budgetary constraint from government spending and also moved countries quite rapidly (over 20 years) to the benchmark patterns of spending that Chapter 6 discussed. This allows us to see clearly the difference between the desired spending of the normative scenario and the forecast spending of the base case.

Figure 7.16 shows the resultant financial gap for sub-Saharan Africa. The figure portrays that gap as a portion of GDP to put it in broader context. The cumulative sum of the extra costs through 2060 would be $1.6 trillion 2000 dollars.

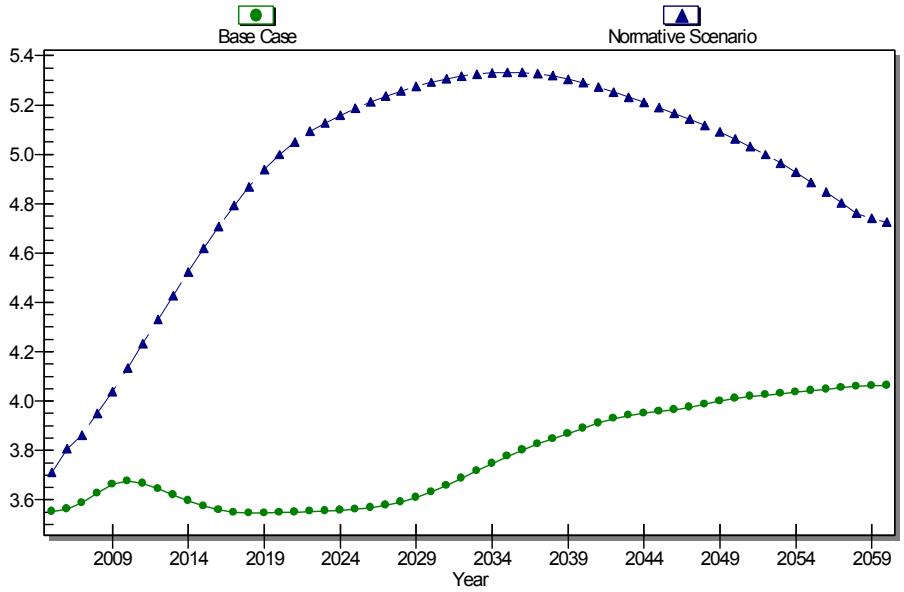


Figure 7.16 Educational costs as percent of GDP, sub-Saharan Africa in the base case and normative scenario
Source: IFs version 6.03
Note: Using 5-year moving averages. The up-tick in the early years of the base case represents the pass through of higher government resources of oil-rich countries benefiting from high oil prices.

One of the important aspects of Figure 7.16 is the very uneven incremental needs over time. Among the three primary reasons for the bulge in expenditure needs is the demographic bulge in school-aged population. Another is the need, on average across Africa, to raise per student spending to benchmark levels, faster in the normative scenario than in the base case. And a third, of course, is the acceleration of enrollment rate increases relative to the base case. In fact, the figure makes clear that, given the financial constraints obvious in the base case, neither the increases in student spending nor the acceleration of enrollment rate increases of the normative scenario could likely happen without identification of significant incremental resources—the budgetary constraints are simply too great.

It has been relatively common to calculate additional resources required to meet specific educational goals over a fairly short horizon. For instance, a broad purpose of the Bruns, Mingat, and Rakotomalala (2003) study was to estimate the financing gap between the cost of efficiently educating students at the target levels they explored for 2015 (95 percent primary completion) and the reasonable mobilization of domestic spending given the benchmarks they provide. Scaling up their analysis for rehabilitation of inadequate facilities, system expansion for new students, and extension of the analysis to all low-income and middle-income countries, they find that the annual average incremental cost of achieving the second MDG would be $33-38 billion, with the need for $5-7 billion from external resources (Bruns, Mingat, and Rakotomalala 2003: 111, Table 4.15).

If, however, the requirements for meeting long-term goals are rather irregular over time, a pattern that we will see for other global regions also, the mobilization of resources becomes an even greater problem. The next section will return to that issue.

As noted above, the high incremental costs of the normative scenario for sub-Saharan Africa, which in relative terms is the region of greatest incremental needs, and the pattern for them over time, has three major bases. The first is demographics. A very large portion of the population of the region, nearly 45 percent, is 15 years of age or younger. Figure 7.17 compares that school-aged population across all of the low-income UNESCO regions. The Arab states also have high fertility rates and have the second largest demographic burden, while countries of South and West Asia are third. Many of the Arab states obviously have greater resources, and the percentage of school-aged population in Africa is nearly 10 percent higher than in South and West Asia. By 2060 the portion of the population in Africa less than 15 years of age will likely drop sharply. In fact, the decline in the normative scenario is about 5 percent greater than that in the base case, a result of education and growth's feedback impact on fertility (which Chapter 8 will discuss). The decline helps significantly ease the differential financial needs of the normative scenario relative to what it would cost with the same fertility as those of the base case.

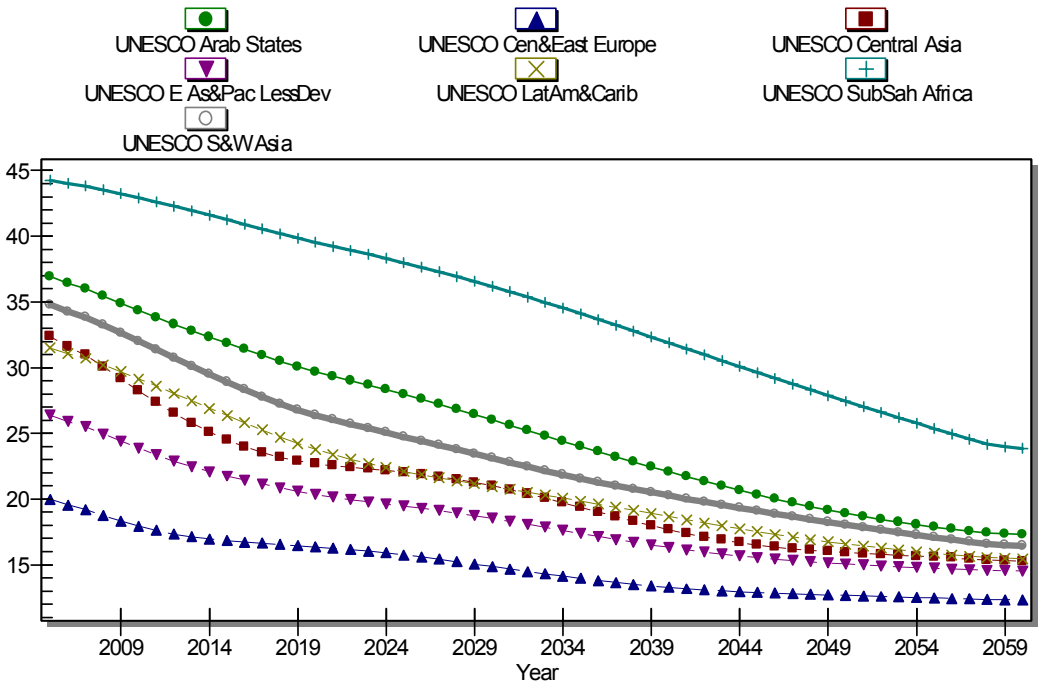


Figure 7.17 Population percentage aged 15 or younger, normative scenario
Source: IFs version 6.03
Note: Using 5-year moving averages.

The second source of incremental costs in the normative scenario, per-student spending, has a close relationship to the first. Figure 7.18 shows primary spending per student as a percent of GDP per capita, in the base case and normative scenario. It is obvious in the base case that expenditures per student are held very low, well below the benchmark level of roughly 15-16 percent (see Chapter 6 for details) for low-income countries. A combination of constrained resources from the government and large numbers of potential students hold down expenditure levels and student numbers in the base case—a pattern seen at all levels of education in sub-Saharan Africa. In the normative scenario those expenditures gradually rise to the benchmark level (they actually overshoot somewhat by 2060 in the base case as student pressures decline but government budgets remain in place).

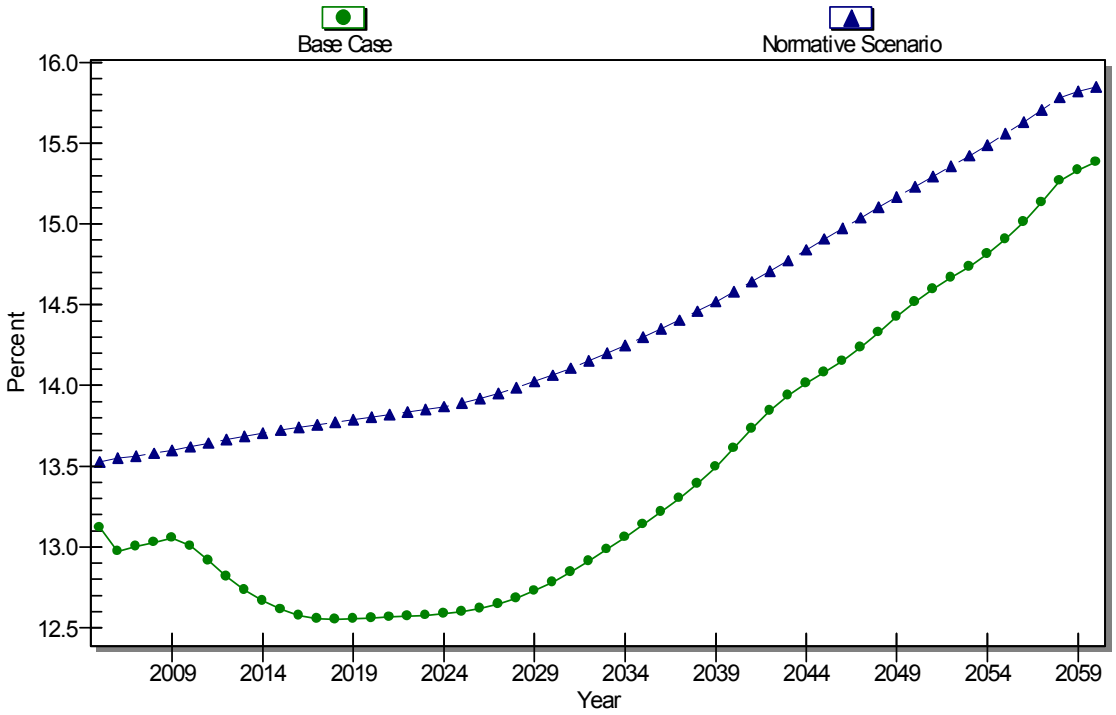


Figure 7.18 Percent of GDP per capita spent per primary student, sub-Saharan Africa, base case and normative scenario.
Source: IFs version 6.03.
Note: Using 5-year moving averages. The up-tick in the early years of the base case represents the pass through of higher government resources of oil-rich countries benefiting from high oil prices.

The third source of large incremental spending in the normative scenario is the aggressive intake/transition and survival increases of the scenario, especially at the secondary level. Costs per student at the secondary level are about double those at the primary level, compounding the upward pressure on total costs of the scenario (see also Cuadra and Moreno 2005: 128; Binder 2004: 30). Again, this is an inevitably growing problem, one could almost say "train wreck" for sub-Saharan Africa as many governments work hard to push primary enrollments upward but do not adequately prepare for the increased pressures that will appear at the secondary level.

Thus at its peak these pressures push up desired educational spending in the normative scenario by nearly 2 percent of GDP relative to the base case. The trade off is between such spending and the loss of roughly two generations (40 years) in attaining universal education at the secondary level.

The other UNESCO region with a similar profile is South and West Asia (see Figure 7.19). For that region the force of the three pressures is less great, but still very considerable (cumulative incremental costs through 2060 are 2.1 trillion 2000 dollars).[157]

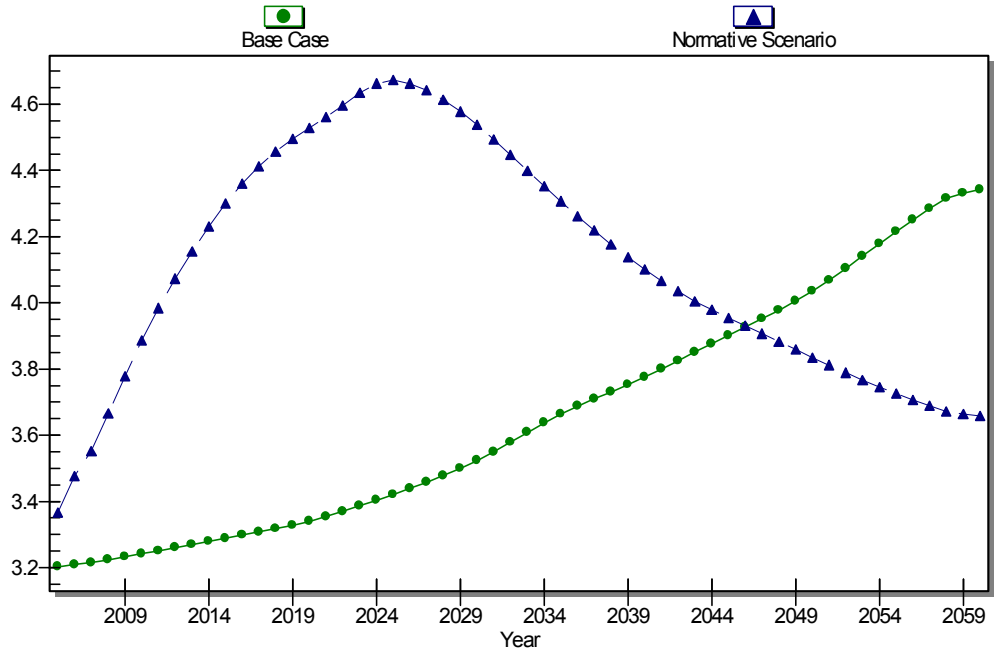


Figure 7.19 Educational costs as percent of GDP, South and West Asia in the base case and normative scenario
Source: IFs version 6.03
Note: Using 5-year moving averages

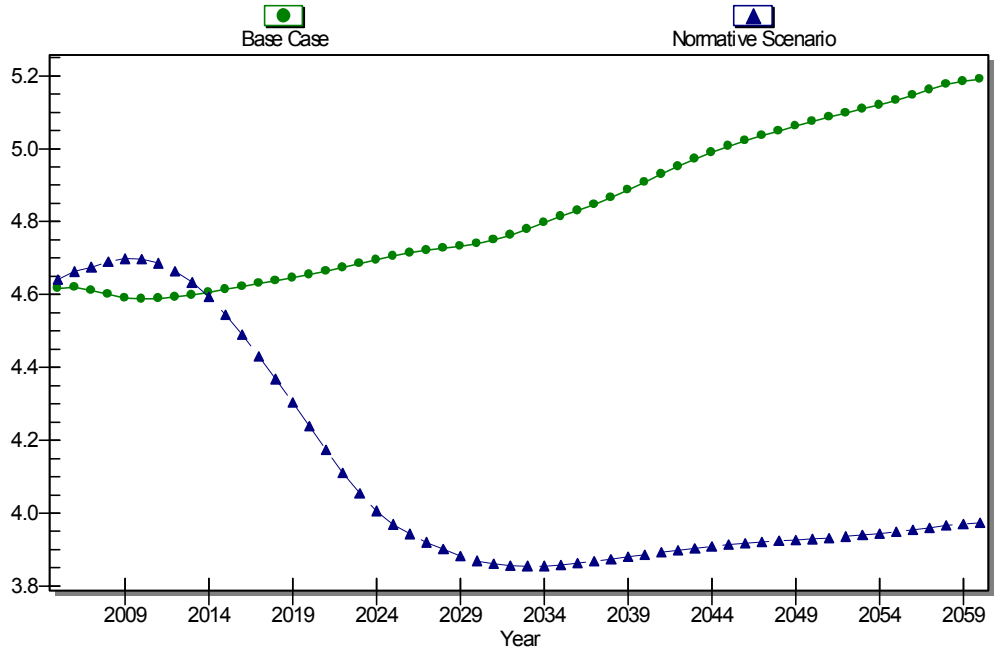
The low-income countries of East Asia and the Pacific would also face spending about 1 percent more of GDP on education in the peak period of the normative scenario (about 2025). The total incremental costs would be about 5.3 trillion 2000 dollars, but on the base of a much higher GDP. The most important difference for that region relative to Africa and South and West Asia is that educational spending as a portion of GDP is currently very low, only about 3 percent of GDP. The incremental spending of the normative scenario never pushes the region about 4 percent of GDP. In Latin America and the Caribbean, the increment needed for the normative scenario only reaches 0.6 percent of GDP and peaks early, about 2015. Lower fertility rates quickly bring the costs of the normative scenario down to and then below the base case. Although cumulative incremental spending reaches $450 billion by 2030, spending reductions actually produce a cumulative saving of $2.1 trillion by 2060.

The possibility of spending savings in the normative scenario for some regions merits more discussion. The extreme example of possible savings is in North America and

[157] Incremental costs peak at about $2.5 trillion dollars, but some savings in later years reduce the increment. The savings occur because the normative scenario avoids the slow catch-up and then overshoot in expenditures of the base case.

Western Europe. Figure 7.20 again contrasts the spending needs of the base case and normative scenario. Although the normative scenario produces a short period of incremental costs relative to the base case, the demographic trends in the region are such that possible savings of nearly 1 percent of GDP materialize fairly soon. The normative scenario takes advantage of such savings and reduces the portion of the GDP spent on education by government

Why do such reductions not occur in the base case? Because the theoretical foundations built into public spending on education in the base case are those of incremental decision-making and bureaucratic politics, rather than those of purely rational actors.[158] Pressures from a strong educational community and the recognition of the importance of knowledge in the modern era (and some international competition with respect to developing knowledge societies) could quite easily contribute considerable inertia to spending patterns, perhaps continuation of a past pattern of slow growth as a portion of GDP, even though demographic pressures for spending were waning. In contrast, the normative scenario represents the possibility of being able to shift about 1 percent of GDP towards other priorities, such as the rapidly growing medical and pension needs of aging populations, even after allowing for considerable continued expansion at the tertiary level (see again Figure 7.14).



[158] Simon (1957) presented the classic model of "satisficing" rather than optimizing and Lindblom (1959) provided foundations for understanding incrementalism in private and public behavior. Allison (1971) laid out three archetypical models of decision-making: incremental, bureaucratic-politics, and rational actor. Cecine (1969) laid out the resultant model of such foundations specifically for governmental budget development. The IFs system does not assume rational actor decision-making, but something much closer to incrementalism and bureaucratic-politics.

Figure 7.20 Educational costs as percent of GDP, North America and Western Europe in the base case and normative scenario
Source: IFs version 6.03.
Note: Using 5-year moving averages.

In the Arab State region as a whole there are no significant budgetary constraints on meeting the normative scenario. Obviously there are major exceptions, and Mauritania would need another 3 percent of GDP to meet its needs in the normative scenario. In contrast, however, Egypt has been spending a rather generous 5.5 percent of GDP on education and it might actually find some savings in the normative scenario. For similar demographic reasons, Central Asia would not face needs for budgetary expansion to pursue the enrollment increases of the normative scenario. Nor would Central and Eastern Europe. Again, high levels of spending on education historically and relatively declining populations of young people might allow educational spending reductions across many countries in coming years.

7.2.2 Domestic sources

As regions, it is thus sub-Saharan Africa and South and West Asia that would need to mobilize substantially greater resources were they to pursue the normative educational future. In the case of sub-Saharan Africa, as much as 1.5 percent of GDP would be needed at the peak of the difference in spending between the base case and the normative scenario. For South and West Asia the peak would be 1.2 percent of GDP, albeit for a shorter time. That analysis raises two questions: (1) Can such resources be mobilized? (2) Does mobilizing them have value (and not just monetary return) that rather definitively outweighs the costs of doing so? The remaining portion of this chapter explores the first question and Chapter 8 focuses on the second.

Calls for greater educational funding abound in rich and poor countries alike. The UN's Millennium Project (2005), under the leadership of Jeffrey Sachs, issued one of the strongest calls in recent years. As that study emphasized, it makes great sense to look for such additional funding first from domestic public sources. One of the key arguments for spending more on education, health or infrastructure is that the spending generates, at least in part, public goods (goods like knowledge to which access is not easily restricted and that individuals can benefit from without diminishing benefits to others). That is, spending on education generates positive externalities (such as the creation of new knowledge flowing from tertiary education) that individuals, spending on their own education, cannot fully capture. Chapter 8 will return to this issue (see also Chapter 2, which introduced the discussion). Typically, the value of public goods is not fully recognized by society collectively and individuals prefer to free ride on the provision of such goods by others. Thus societies almost invariably under-provide public goods (Weimer and Vining 2004).

The Commission on Macroeconomics and Health (CMH), also directed by Jeffrey Sachs, did an analysis around increased spending (a normative scenario) on health (CMH 2001: 60). In their analysis the authors posited that low-income countries could increase spending on health by 1 percent of GNP within 6 years (by 2007) and 2 percent with 14 years (by 2015). They also explored efficiency savings and concluded that they were unlikely to be more than 20 percent of current spending. Further, they considered the complications of exploring increased government spending in an area where there is a mix of public and private spending. With respect to health, they found that

> …the proportion of total health outlays coming through the budget is also relatively low (55 percent), much lower than in the high-income countries (71 percent). Since public-sector spending on health is needed to provide critical public goods (such as epidemic disease control) and to ensure enough resources for the poor to gain access to health services, the meager size of public outlays exacerbates the problem of overall insufficiency of resources (CMH 2001: 60).

In summary, the study concluded that low-income countries should increase health spending by $57 billion in 2007 and $94 in 2015, $35 and $63 billion in those years respectively from the countries themselves and $22 and $31 billion from external donors, about 0.1 percent of donor GNP (CMH 2001: 11 and 109). Africa had the largest needs for external help.

The Commission extended the analysis to benefits as well as costs. They concluded that a very conservative estimate of the economic savings in 2015 from the scaling up of health spending would be $186 (CHM 2001: 103). In short, it would more than pay for itself in a quite short period of time.

The incremental costs of this normative education scenario are not terribly different from the normative scenario of the CHM and, in fact, less in the early years (see Figure 7.21). Looking as the Commission on Macroeconomics and Health primarily did at low-income countries, the incremental educational spending for the World Bank low-income grouping would be $15 billion in 2015, $83 billion in 2030, $108 billion in 2045, and a net savings of $46 billion in 2060. The next chapter will consider estimates of the return to such an investment.

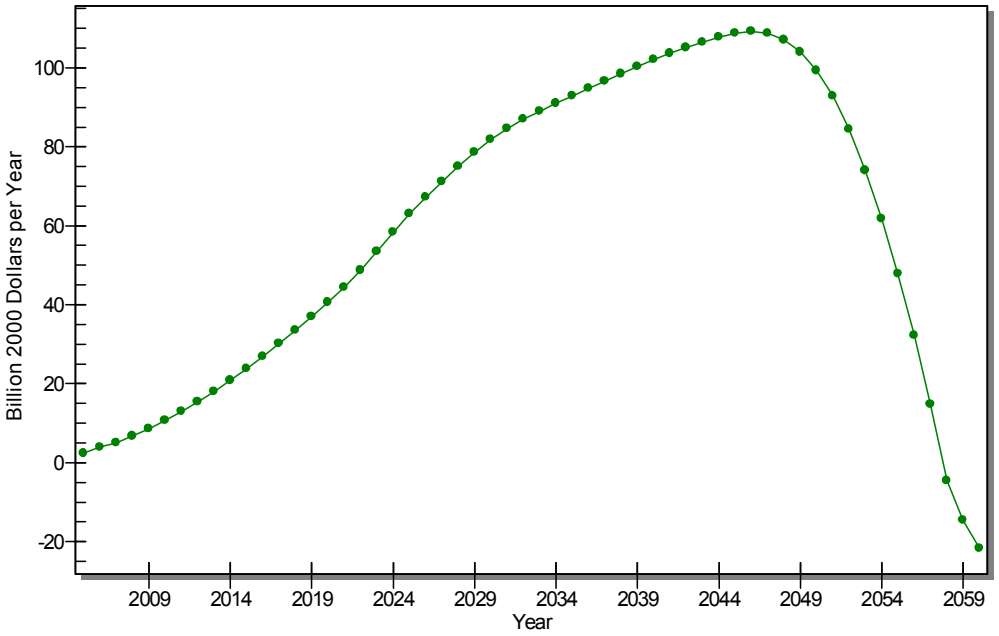


Figure 7.21 Annual incremental costs for low-income countries of the normative scenario
Source: IFs version 6.03.
Note: Using 5-year moving averages.

Earlier figures showed a maximum gap of about 1.5 percent between educational spending as a percentage of GDP in the normative scenario and the base case for sub-Saharan Africa and 1.2 percent for South and West Asia. The logic of the CMH would suggest that these regions in aggregate (although not, of course, every country in them) could bear the entire cost of such increments, especially with the considerably longer ramp-up period indicated by our analysis than in the shorter-term analysis of the CMH. The problem with such logic is that these countries face competing needs, not limited just to health and education, but including much more, such as infrastructure, energy, and the environment.

In addition, low-income and least developed countries face special problems with respect to revenue mobilization. Figure 7.22 shows that low-income countries mobilize only about 12-13 percent of GDP for all government consumption (military, health, education, and other), compared to about 18 percent in high-income countries. Even that level of resource mobilization is currently supported by foreign aid equivalent to about 2.5 percent of the GDP of low-income countries and about 5.5 percent of the GDP in sub-Saharan Africa. Many low-income countries have very weak domestic taxing and revenue-raising capability.

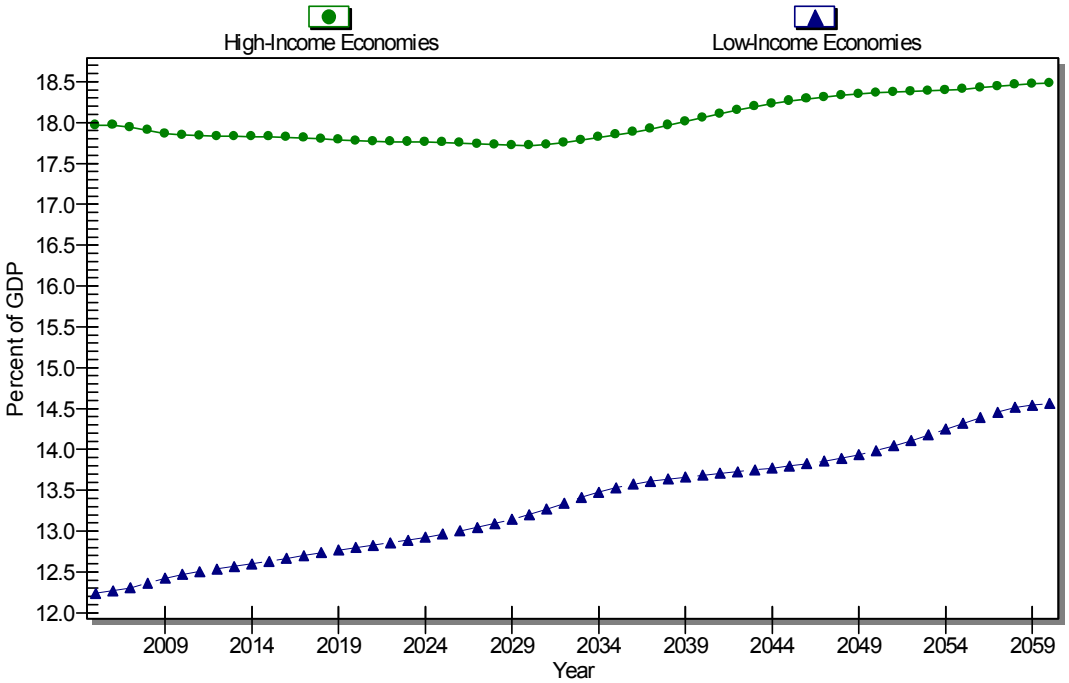


Figure 7.22 Government consumption as a portion of GDP in the normative scenario
Source: IFs version 6.03.
Note: Using 5-year moving averages.

To better explore the potential for increases in domestic spending as a step between the base case and the normative scenario, we created a third scenario around high domestic-spending. The purpose of it was to increase domestic spending by an aggressive, but reasonable amount and to look at the gap between that heightened domestic spending and the needs of the normative scenario. That allows us to estimate the rough magnitude of need in the normative scenario unmet by domestic (and current foreign) resources before looking at possible external sources to close the gap.

In light of the earlier discussion of domestic spending capability, the high domestic-spending scenario restricted additional spending on education to about 1 percent of GDP at the peak of increment needs in the normative scenario, but with variations by region of the world and even by country. For instance, within sub-Saharan Africa the countries of South Africa and Kenya are already spending quite generously on education (7 percent of GDP in the case of Kenya) and the normative scenario did not augment those levels. In extremely sharp contrast, the Democratic Republic of the Congo (DRC) is spending only about 1 percent of GDP on education and has huge unmet needs for education that the normative scenario has identified. The DRC has relatively limited prospects for much increase in spending level in the near term, but considerable potential in the longer term. For the high domestic-spending scenario, we tripled its spending rate to 3 percent of GDP gradually across the entire scenario horizon. In the aggregate, the increases of domestic spending for the continent raised domestic spending from about 3.5 to 4.5 percent of GDP over the forecast horizon, enough to cover, on average, almost all of the incremental spending demands of the normative scenario. The increase would not, however, cover

the specific needs of all countries, particularly the least developed, an issue to which we will return.

The high domestic-spending scenario also limited incremental spending increases in South and West Asia to about 1 percent of GDP at the limit. There, too, such increase would hardly be easy to mobilize. And it would not always be adequate to meet the needs of the normative scenario. For instance, spending in India should ramp up by about 40 percent over 15 years and then could be relaxed somewhat over time (see again Figure 7.19). The pattern in Pakistan, subject to more intense demographic pressures (40 percent of its population is under 15, compared to 33 percent in India), is more like that of sub-Saharan Africa, requiring even a great ramp-up. In Latin America, Central America has the greatest needs with a higher, longer bulge in near- and mid-term spending needs than most of South America. Costa Rica is a distinct sub-regional exception. Within 10 years it may be able to start relaxing spending in light of currently significant levels and waning demographic pressure. Most other areas of the world have the resources to undertake the normative scenario with considerably less than 1 percent of additional GDP devoted to the sector.

In short, ramping up domestic spending by no more than 1 percent of GDP in most developing countries, and considerably less in many, would be enough to domestically support the increased needs of the normative scenario. But it would not do so for all countries.

7.2.3 International transfers

It is neither the purpose of this volume to become very specific with respect to where funds for the normative scenario might be obtained, nor to plea for an international commitment of assistance. Instead, the objective is to map the general character and expense of accelerated advancement of global education, and to explore the implications of its pursuit.

The World Bank defines a category of Least Developed Countries (LDCs). Those countries are by definition of the set least able to be able to close the gap between increased spending from their own resources and the estimated expense of the normative scenario. Most of the countries are in sub-Saharan Africa. Bangladesh, Bhutan, Cambodia, Haiti, Laos, Mauritania, Myanmar, Samoa, Sao Tome and Principe, the Solomon Islands, Timor-Leste, and Vanuatu supplement the membership from that region. Three criteria collectively put countries on the list: GDP per capita below $900, human resource weakness such as inadequate nutritional levels or low life expectancy, and economic vulnerability, such as instability of agricultural production.

Table 7.6 shows the educational spending of that least-developed country set in the base case and in the high-domestic-spending scenario, next to the educational spending level of the normative scenario. The final column identifies the minimum domestically (again with existing international assistance) unmet need, that is the gap between the high domestic spending scenario and the normative scenario. That gap is certainly a conservative estimate of unmet demand for funds in the normative scenario, because

many of the least-developed countries could not realistically redirect an additional 1 percent of GDP to education.

Year	Base	High Domestic Spending	Normative	Minimum Unmet Need
2005	7.7	7.7	7.7	0.0
2010	9.9	10.2	11.6	1.4
2015	12.8	13.8	17.1	3.3
2020	17.0	19.0	24.8	5.8
2025	23.2	26.8	35.9	9.1
2030	32.2	38.5	53.0	14.5
2035	45.2	54.5	76.1	21.6
2040	63.2	76.9	106.7	29.8
2045	88.9	108.6	147.3	38.7
2050	123.0	150.7	199.6	48.9
2055	168.7	207.1	267.2	60.1
2060	236.0	291.9	368.0	76.1

Table 7.6 Educational spending in the Least Developed Countries: base case, high domestic-spending, and normative scenarios
Source: IFs version 6.03.

The conservative estimate of need is fairly low by standards of international assistance efforts and pledges. Total official foreign assistance is now about $65 billion annually and in the base case, assuming constant rates of giving as portions of donor GDP, it would rise to $240 billion in 2060. For some additional context, at the G-8 meeting at Gleneagles in 2005, leaders of the G-8 agreed to basically double annual assistance flows, increasing aid to developing countries as a whole by $50 billion per year in 2010, including increased flows to Africa of at least $25 billion (the commitments also included debt relief for the least developed countries and other supportive actions).[159] It appears nearly certain that the G-8 will fall very considerably short of that pledge, but the annual funds of the pledge would obviously have more than covered the unmet need that Table 7.6 identifies through 2050. Foreign assistance given by all OECD countries constitutes only a bit more than 0.2 percent of their GDP. Increase to somewhat more than 0.3 percent would very comfortably fill the gap identified in Table 7.6 for the entire horizon of the normative scenario.

Again, it is important to emphasize that this study is not comparing the needs in education against those in health, infrastructure, or elsewhere in low-income countries. Thus this analysis would not support making an argument for such an increase in external assistance focused solely on education. Nonetheless, the existence of such level of need in education alone buttresses more general arguments in favor of increased external help.

The argument for either increase in domestic commitment to education or external help with increasing expenditures rests, of course, on the potential benefits of accelerating

[159] For further context, UNESCO (2007: 42) reported that the actual level of support via foreign assistance for education by the OECD and other international organizations doubled from $1.3 to $3.3 billion (in constant 2004 currency) between 1999 and 2004.

educational advance. Those benefits could be economic or non-economic, they could accrue only to the target countries or to the broader international community. For instance, enhanced domestic stability of low-income countries and lower spillover of threats to the international community could potentially constitute a partially non-economic benefit to the normative scenario for the global community. It is to a broad consideration of such benefits that Chapter 8 turns.

7.3 Conclusion

Educational advance is already remarkably rapid around the world. It might be that the emphasis placed on increasing the education of humans, the pace of which clearly now in low-income countries is much greater than it was in high-income countries at similar levels of income, is very adequate. Perhaps global attention should focus on tracking and recognizing—on welcoming—such advance. Yet a large community of analysts clearly believes that more rapid educational advance carries many rewards. The statement of global goals for universal primary completion and gender parity at all levels of education repeatedly demonstrates that belief.

This chapter has considered a normative scenario for educational advance globally, with special attention to low-income countries, that is simultaneously aggressive and solidly within the range of historic patterns. Such a future would cut more than a generation off the period that the peoples in Africa and also South and West Asia are otherwise likely to need in order to move to universal basic education and to high levels of upper secondary education (as well as accelerating it significantly in Central America and much of the rest of the developing world).

Achieving such acceleration in educational advance would, however, be expensive, costing more than 1 percent of GDP for the average country in those regions. Domestic resources could almost certainly support much or most of the acceleration, but the bubble-like patterns of funding need, tied to the passing through the system of demographic bubbles as well as to increases in rates of intake and completion, suggest a pace of ramping up that would also require significant external help, especially in least developed countries.

Chapter 2 emphasized that those who support acceleration of educational advance do so not only because of the economic returns that accrue to individuals and societies from it, but because of the capabilities it builds for the living of richer, freer, and more satisfying lives. The next chapter explores both types of returns.

8. The Broader Impact of Education

Rising educational levels provide many private and social benefits.[160] Analysis of policy choices that affect the speed of increase in educational attainment necessarily pays special attention to the aggregate social benefits (and should be concerned also with the distribution of private ones). Some social benefits, especially increased economic productivity, growth, and tax revenues, could potentially repay public investment in education over time, theoretically making possible a rather traditional cost-benefit analysis.[161]

Education, however, provides a combination of purely economic returns (and potentially of costs) and broader social impacts that different observers may assess in quite different ways. The fertility reduction that generally accompanies education of women is such a result of education. Most analysts would point positively to the direct economic returns that can accompany lower youth dependency ratios, higher portions of the population in the work force (the economic dividend of declining fertility) and therefore higher economic growth. Similarly, lower fertility rates generally allow women to enter the work force much more easily. Positively inclined observers would further note the ability of parents and society to better educate fewer children and therefore potentially to enhance economic productivity. Moving beyond strictly economic benefits of reduced fertility, they would point to the greater ability of women to control their own lives and of a smaller and more educated youth to provide greater social stability and would identify 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. There are, of course, other perspectives in societies on the same changes. For instance, we should not underestimate the challenge that such changes pose to the traditional dominance of men and therefore to cultural patterns of millennia; even those, like the authors of this volume, who see benefit in educationally-related cultural change cannot deny its disruptive impact on many lives. Nor should we fail to recognize that many environmental consequences of fewer, but considerably richer people could be negative.

Given the breadth and complexity of the impacts of education, and the differential valuation of such impacts, satisfactory monetization of the full range of costs and benefits of educational advance is simply not possible. Nonetheless, an analysis that combines attention to the economic and non-economic implications of educational advance, and to its less and more contentious impacts, is possible. The approach of this chapter will be to compare a wide range of the different socio-economic implications of the base case and

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[160] Hannum and Buchman (2003) surveyed various benefits and literature on them for the project on Universal Basic and Secondary Education (UBASE) and this chapter uses a similar typology. See also United Nations Population Division (2003). McMahon (1999) also cast a wide net. The Highlights of UNESCO (2007a: 23-24) offer a very brief introduction to the literature.

[161] 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.

the normative scenario, comparing some of the measurable economic consequences to the incremental costs of the normative scenario, but exploring more broadly the implications of accelerated educational advance.

8.1 Educational attainment in the normative scenario

Chapter 7 identified the most direct benefits of the normative scenario in terms of increased participation in all levels of education across the developing world. And it presented a calculation of the economic costs of aggressive increases in intake/transition rates and in survival rates. The wider benefits of education are not, however, related to educational intake, enrollment or completion of those currently in school. They are a function of the resultant pattern of educational attainment across the society.

Several standard measures provide insight into patterns of educational attainment, and each has its own strengths and weaknesses. Literacy rate is perhaps best known. It taps one of the clearly most important elements of educational attainment, the ability of a person to "read or write with understanding a simple statement related to his/her daily life."[162] Assessment of the ability to read and write is, however, non-trivial. The Institute for Statistics of the United Nations Educational, Scientific, and Cultural Organization (UNESCO) collects the most widely-used data, using surveys of self-reports.

Figure 8.1 shows forecasts of literacy in the base case and the normative scenario, as an extension of historical patterns, using the World Bank's reporting of the literacy data.[163] The figure focuses on Sub-Saharan Africa because the greatest potential gains in the normative scenario are there. In fact, at the peak, literacy rates in the normative scenario run 7-8 percent higher than in the base case (with compression of that advantage as rates approach 100 percent). In 2060 the normative scenario produces a literacy rate of 99 percent, 5 points higher than the base case.[164]

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[162] From the on-line Glossary of educational terms of the UNESCO Institute of Statistics.

[163] The World Bank has drawn on UNESCO UIS data, historically using its own processing to create more complete series. In World Bank provision of literacy data, a break occurred between the 2005 WDI CD, which had an extensive series from 1970 through 2002, and the 2006 WDI CD, which reported new data only for 2004 (subsequent CDs have expanded the series but it remains much less extensive than earlier). The Bank explains that a change in the International Standard Classification of Education from ISCED76 to ISCED97 occurred between 1997 and 1998, and it indicates that recent data are provisional. There are significant transients for some countries between the older and newer series; for instance, the earlier series put adult literacy in Chad in 2002 at 46 percent and the more recent one reports the 2006 value as 26 percent. Nonetheless, in order to create a long series the IFs project has blended old and new series, privileging the new values and either removing or adjusting old ones.

[164] The IFs model drives its literacy forecast with changes in the average educational years of population 15 years of age and older. Experimentation with adult completion of primary and/or lower secondary education seem theoretically stronger but provided weaker results. Because many people attain literacy outside of formal education, the educational model of IFs does not represent well the full dynamics of change in literacy.

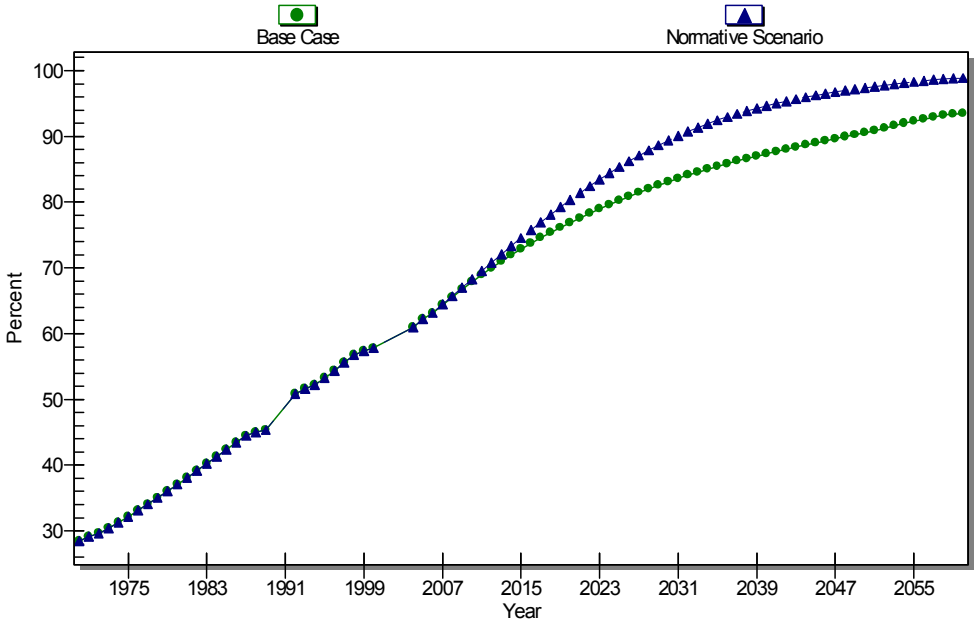

Figure 8.1 Adult literacy in sub-Saharan Africa, history and forecast
Source: IFs version 6.03
Note: Used 5-year moving averages after removing years 1990-1991 and 2001-2003.

There are at least two reasons that the differences between the scenarios may not be as great as one would expect. First, rapid historic growth patterns have taken global rates above 80 percent and even those of sub-Saharan Africa above 60 percent. Thus there is increasing saturation of literacy levels around the world and slowing progress in reducing pockets of remaining illiteracy. Second, populations that had fewer educational opportunities remain in the adult count for several generations, even when younger adults become almost universally literate.

This second reason takes on special significance as we move more deeply into consideration of changing educational attainment patterns for changing economic, demographic, and social ones. In many cases it is the younger populations that affect the greatest change in these various systems. Young adults moving into the workplace change patterns and productivity; young adults choosing to have or not have children change fertility patterns. Thus it is desirable to track young adults separately from the total adult population. Data on youth literacy (15-24 year olds) are available. Subsequent discussion will return to the importance of considering young populations more generally.

As important as acceleration of gains in literacy are, however, Chapter 7 documented that in the normative scenario even greater relative increases of education come at the secondary level. In fact, as the world nears universal primary education, almost all increase in enrollment will be at higher levels. Although lower basic education also contributes significantly to the attainment of literacy (in fact, some argue that it is essential for fully functional literacy), upper secondary and tertiary education convey

additional skill sets. To help us explore the broader impact of education on the economy and society, we therefore need other measures of adult attainment.

An alternative approach is to track the educational benchmarks that adults have reached in the educational system. For instance, it is common to consider the percentage of the population that completed primary, secondary, or tertiary education. Figure 8.2 uses such measures, representing them also by age-sex cohort, to map what are effectively two different worlds in 2005 and 2060. The world of 2005, for both sub-Saharan Africa and South and West Asia, is a world of young populations and rapid population growth. It is a world of low educational attainment levels; the majority adult population in both regions does not have even primary education. Gender imbalances in both regions are obvious, especially in South and West Asia. The world of 2060, again for both regions, is a world of quite rapidly slowing population growth and aging populations. In base case also, but even somewhat more in the normative scenario shown, it is a world of universal primary education for the youngest cohorts and a rapidly shrinking population of those without primary level education. Large numbers have acquired secondary and tertiary education.[165] Gender gaps are barely visible.

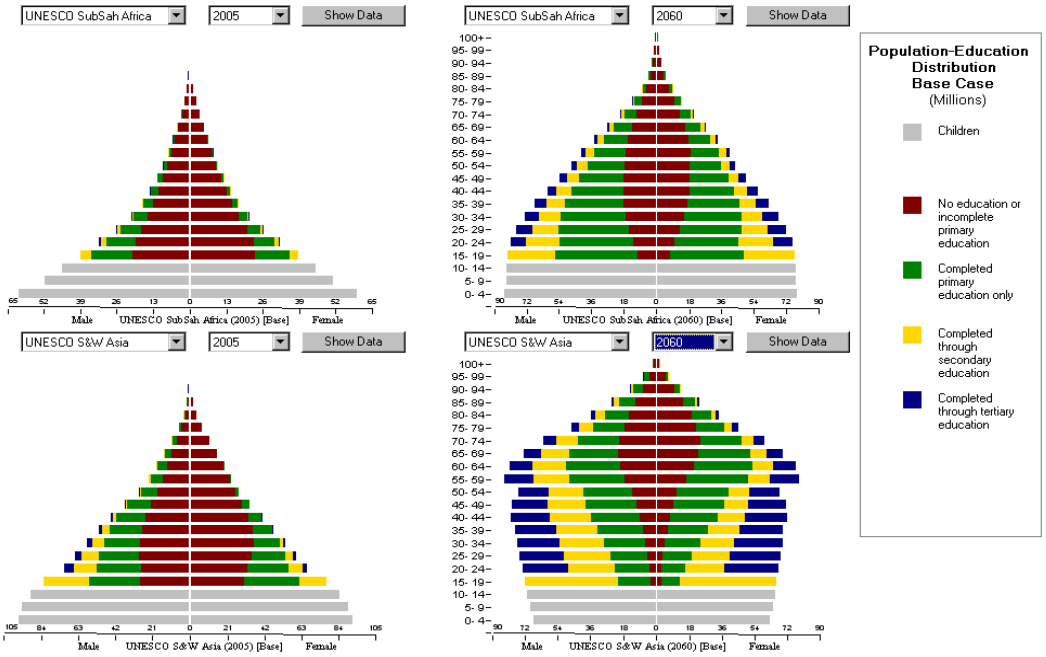

Figure 8.2 Educational attainment structure in sub-Saharan Africa and South and West Asia, normative scenario
Source: IFs version 6.03.

As useful as understanding and forecasting adult completion of educational levels may be, such measures of adult educational attainment suffer at least one important limitation.

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[165] An error in the display is not showing secondary completion only for higher age groups in 2060; the next revision of this chapter will provide a corrected display.

They omit the educational attainment of those who complete some or even most of any level of education; they only record those who have completed an entire level. Moreover, they don't satisfy the desire of much research for a single aggregate indicator of educational attainment by country.

The third type of attainment measure addresses those weaknesses by averaging the number of years of education in adult populations, regardless of level or completion of degree programs. The average years of adult education, whether measured from thresholds of 15 or 25 years of age, is a single measure that is quite widely used to consider forward linkages to other human systems, especially economic productivity and growth. Such aggregation can, of course, also conceal important differences in the level of education attained (at a country level, a society in which half of the population has completed tertiary education may look very much like one in which all of the population has completed lower secondary education). Thus it is often used in addition to measures that report completion of education at the primary or secondary levels.

The Barro and Lee (2001) data set on years of educational attainment (and they also report educational attainment by level) has been very widely used in looking at economic and social impact of education. More recent, Cohen and Soto (2001, substantially revised 2007) have compiled a similar data set, making use of information on educational attainment on age (see also Chapter 3 on both data sets). The Cohen and Soto approach allows refined representation of period-to-period differences (first differences) historically. They argue that the smoothing of such differences in the Barro and Lee data have contributed to estimation of lower impact of growth in educational attainment on economic growth. Using a Mincerian formulation that analyzes the log of human capital as a function of years of education),[166] Cohen and Soto (2007: 71) find that an extra year of schooling in a country adds slightly more than 12 percent to income in the long-term.

Figure 8.3 shows the average years of education of those who are 15 and older in low-income countries. That has been increasing steadily, rising from just 1.4 years in 1960 to 4.2 years in 2000.[167] Progression to about 8.7 years appears likely even in the base case (the dynamics of the full IFs educational and broader model lie behind the forecast in Figure 3, even though it may appear to be a simple extrapolation). The normative scenario adds nearly 1.5 year of education to the entire adult population of the developing world in 2060. In sub-Saharan Africa the scenario adds about 2.4 years on a somewhat lower base. In South and West Asia it adds 1 year.

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[166] Carstensen, Gundlach, and Hartmann (2008) provide a useful explication of the widely used Mincerian approach.

[167] Historic data do not include all of the 182 countries of IFs and primarily exclude some of the poorest and least well-educated. Thus the values through 2000 somewhat exaggerate attainment levels in aggregate. The forecast values fill the holes with estimates based on cross-sectional analysis and thus reduce the 2005 value slightly relative to the historic trend line.

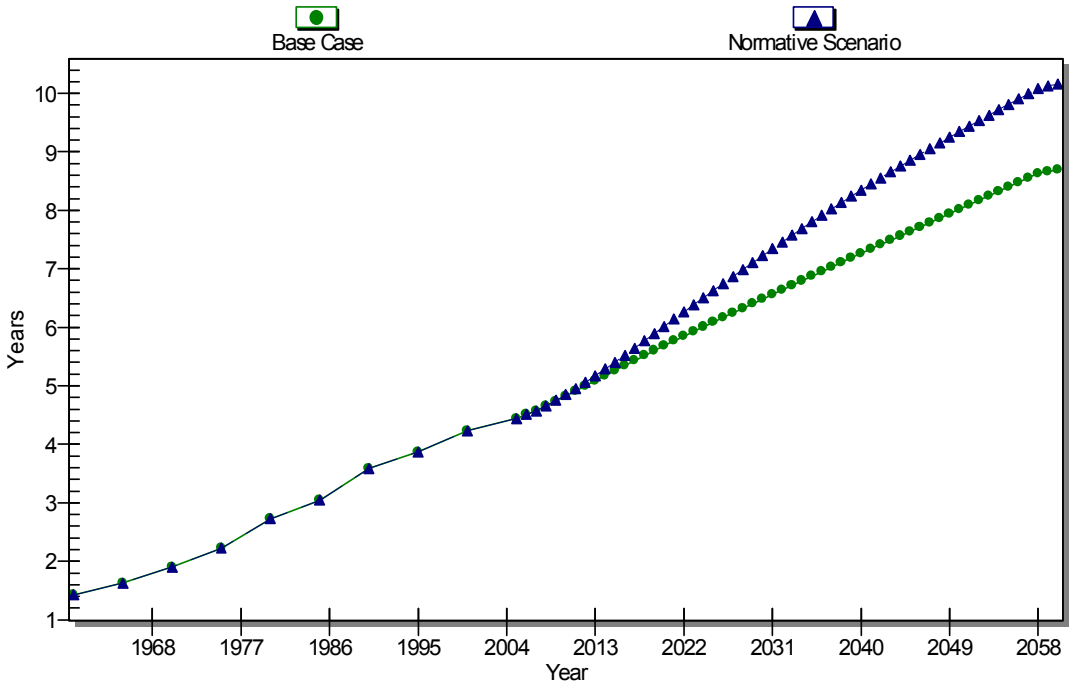

Figure 8.3 Average years of education completion of those 15 and older in low-income countries, history and forecast
Source: IFs version 6.03
Note: Using 5-year moving averages; a slight transient in 2005 results from the addition in IFs of primarily African countries, estimated cross-sectional for 2005 and not in the historic data

In summary, the normative scenario clearly adds to the educational attainment of adult populations over time. Although not shown, it increases attainment levels for young adult populations even more rapidly. The process is, of course, a gradual one as the scenario first increases intake and survival rates leading to higher enrollments, only increasing graduates rather slowly. The progression of those graduates into adult years, especially when the educational advance is at the primary and lower secondary levels, takes additional time. And the impact that those graduates will have on their countries takes still longer to unfold. It is to that impact that we turn next.

8.2 Education and economic development

8.2.1 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). Agreement characterizes the literature with respect to the micro returns to education; individuals who have more education earn more (UIS 2002: 34). The preponderance of literature also supports the proposition that greater educational attainment and/or educational expenditure also has social benefits and contributes to higher economic growth (Durlauf, Johnson, and Temple 2005). Some literature has begun to consider the differential impact for economic growth of investment in various levels of formal education (Psacharopoulos and Patrinos 2002).[168] There is, however, much uncertainty about the magnitude and character of that relationship. Easterly (2001) questioned whether special efforts to push education forward have any positive impact on growth and Pritchett (1996) found no significant benefit; 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 growth.[169] Illustratively,

- Barro and Sala-i-Martin (1999: 431) reported that a 1 standard deviation increase in male secondary education raised economic growth by 1.1 percent per year, and a 1 standard deviation increase in male higher education raised it by 0.5 percent. Barro (1999: 19-20) reported that one extra year of male upper-level education raised growth by 1.2 percent per year.

- The UNESCO Institute of Statistics (2002:8) found that each additional year of education in its World Education Indictors (WEI) country set raises long-term economic growth by 3.7 percent. It also found that the impact might have a threshold character in which higher levels of education, notably upper secondary, were especially powerful.

- Chen and Dahlman (2004: 1) concluded that a rise of 20 percent in average years of schooling raises annual growth by 0.15 percent and that an increase in average years by one year raises growth by 0.11 percent.

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[168] Even earlier, Mingat and Tan (1996) argued that primary education does tend 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) similarly suggest differential impact of investment in education depending on the society's overall current attainment level. Specifically, they suggest that an inverted U-shaped curve structures that relationship, with the greatest impact of increments appearing when current levels of average adult education are near 7.5 years.

[169] Jamison, Jamison and Hanuschek (2006) find a relationship between the quality of education and income growth, primarily via the path of technological progress.

- Jamison, Lau, and Wang (2003: 4) used the Barro-Lee measure of average years of school for males between 15 and 60, but concluded that the "effect was small."

- Bosworth and Collins (2003: 17) argued that each year of additional education adds about 0.3 percent to annual growth.

- The OECD (2003:76-78) found that one additional year of education (about a 10% rise in human capital in the countries of their analysis) raised GDP/capita in the long run by 4-7 percent.

- 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 percent.

- Baldacci, Clements, Gupta, and Cui (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. In exploring the path of the impact, they found (2004: 22) 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." Sub-Saharan African countries and low-income countries benefit the most.

- Cohen and Soto (2007: 71) find that an extra year of schooling in a country adds slightly more than 12 percent to income in the long-term.

Given the significant range of outcomes of research on the subject, it is difficult to know exactly how to represent and parameterize the relationship between educational advance and economic growth. For this analysis, we used relatively conservative parameters to link educational spending and years of educational attainment to the economic productivity term in the production function of the IFs model.[170] (The model is available for others to explore the implications of alternative parameters.

The aggregate impact of the normative scenario on economic well-being. Figure 8.4 compares GDP per capita in Sub-Saharan Africa in the normative scenario with that of the base case. The normative scenario results in GDP per capita nearly $1,200 higher in 2060 than that of the base case ($7,620 versus $6,450). Such results move well beyond the strictly economic impact of the normative scenario because the normative scenario affects population and other socio-political forecasts (as we shall see later in this chapter). Thus, importantly, Figure 8.4 also reflects the effects of the normative scenario on fertility rates and population size.

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[170] For detail on the specification within the IFs model system of linkages between educational spending and attainment, on one hand, and economic productivity, on the other see Hughes (2005 and 2007). The model formulations for this analysis have parameters of 0.2 linking both extra years of average education and additional percentages of educational spending to economic productivity. We used conservative values from the empirical literature in part because we represented both paths.

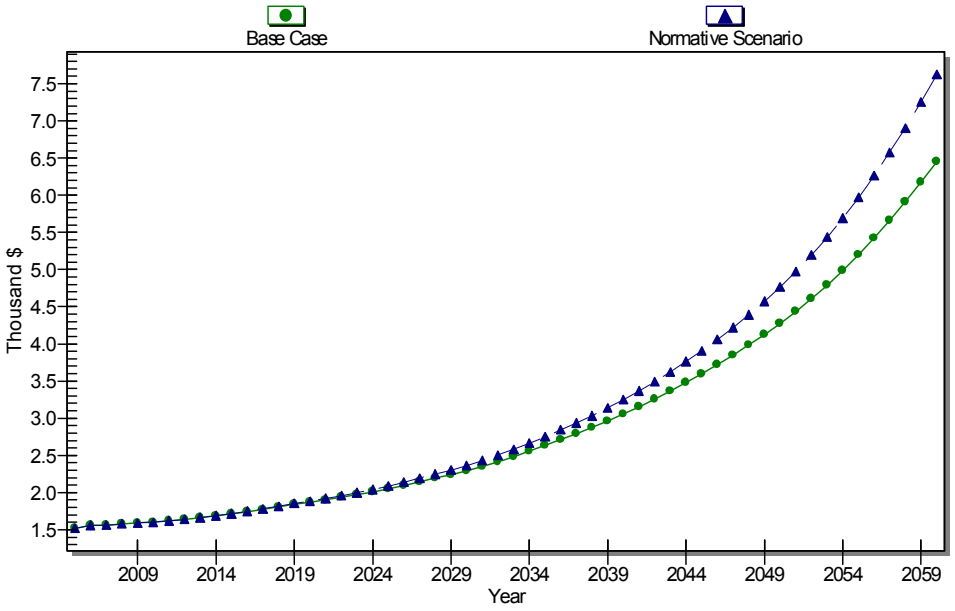

Figure 8.4 GDP per capita (PPP) of sub-Saharan Africa in the normative scenario relative to the base case
Source: IFs version 6.03.

The returns for other developing regions vary. In absolute terms, the GDP per capita (PPP) in South and West Asia is $1,700 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. Table 8.1 shows the impact of the normative scenario in all UNESCO regions. Those vary greatly across regions with by far the biggest impact on Sub-Saharan Africa, followed by South and West Asia. The normative scenario actually has net costs with respect to GDP per capita in East Asia and the Pacific and in Central and Eastern Europe. It is important to remember that the normative 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.

	Normative Scenario Relative to Base Case	
	2030	2060
Arab States	0.5%	0.3%
Central & Eastern Europe	-0.3%	-1.2%
Central Asia	0.3%	0.1%
East Asia & Pacific (Poor)	0.2%	-1.5%
Latin America & Caribbean	1.3%	2.0%
South and West Asia	3.4%	8.4%
Sub-Saharan Africa	3.1%	18.1%
North America and Europe	0.1%	1.2%
East Asia & Pacific (Rich)	-0.6%	-1.0%
World	0.9%	3.7%

Table 8.1 GDP per capita (PPP) in the normative scenario relative to base case
Source: IFs version 6.03

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 analysis of historical cross-national data. By 2030 the normative scenario adds 1 year of education to the average of those 15 and older, relative to the base case; by 2060 it adds 2 years of education. The increment to economic growth rate in the normative scenario between 2030 and 2060 is only 0.2 percent, well within the range of the studies cited earlier. For South and West Asia, the normative scenario adds an average of 0.55 years of education for those 15 and above; by 2060 it adds very nearly 1 year. The increment to economic growth for the region in the normative scenario is 0.18 percent (the normative scenario's impact on GDP per capita for Africa in Table 8.1 is so much greater than the impact for South and West Asia because of the greater reduction in fertility that the normative scenario generates in Africa, not because the impact on GDP is so much greater).

Comparing economic costs and benefits. This report cannot do 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 be a poor idea), but also monetizing change in fertility patterns, opportunities for women, and much more. It is, however, possible to examine the strictly economic streams of increased spending and increased GDP in the normative scenario.

The cumulative stream of additional spending on education in the normative scenario would be $125 billion by 2030 and $860 billion by 2060 for sub-Saharan Africa, very large sums. The cumulative increment in GDP in the normative scenario relative to the base case would be $195 billion by 2030 and $8.5 trillion by 2060 for sub-Saharan Africa, clearly even much larger sums. 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. Cumulative increments in GDP exceed those of cumulative expenditure on education by 2022.

Because African countries would pay for additional education quite a few years before the benefits of significantly higher GDP appear, it is appropriate not just to compare absolute streams of each, but streams discounted by the potential value of alternative opportunities of such investment. Using a typical discount rate of 3 percent on both costs and benefits, the benefits begin to outweigh the costs only five years later, in 2027 (a 5 percent discount rate delays break-even two more years).

For South and West Asia cumulative incremental expenditures (with an aggregate economy nearly 2.5 times as large as that of Africa) would be $750 billion by 2030, but the normative scenario actually generates a cumulative savings relative to the base case of $900 billion by 2060. The savings come from both reductions of student numbers with reduced fertility (a later section of the discussion will return to that) and from lower per-student spending in the late years of the normative scenario as it moves per-student spending toward benchmark levels (in the base case scenarios, per-student spending rises

above benchmark levels as growth in student numbers begin to ease towards mid-century). As in the case of Africa, the cumulative incremental GDP of the normative scenario by 2030 ($1.6 trillion) exceeds the cumulative incremental investment in education.

Uncertainties in analysis. Such cost-benefit analysis is, of course, sensitive not just to discount rates, but even more to parametric assumptions concerning the linkages between educational advance and economic growth. The discussion of literature made clear the extent of debates about those linkages.

For instance, this analysis could underestimate the delays in returns to educational investment, and somewhat exaggerate them, because the model formulations link both current educational expenditures and average years of education to productivity advance. In spite of the empirical analysis, it is not clear that there should be an early return to educational spending independently of the very long-term path through accumulation of educational attainment by adults. One argument for such a return presumes that educational spending also enhances the knowledge base of a society, not just the individual capabilities of students in their working lives.[171] That argument may be most appropriate for high-income countries in which educational spending, especially at the tertiary level, contributes to the advancement of both fundamental knowledge and applied technology. Although such logic may be less strong for low-income societies, it could operate there also at the secondary level and in applied institutions of higher education (such as agricultural institutes). Educational spending could also improve economic performance fairly quickly by targeting life-long learning, an element of educational attainment not always captured in the average years of education and not represented explicitly at all in this analysis.

Reducing by half the parameter linking educational spending to economic productivity does considerably change the analysis. In sub-Saharan Africa, the discounted stream of increments to GDP does not exceed the discounted stream of incremental expenditures until 2037. That is, of course, a very long time to wait for a payback on any social investment. The payback does, of course, continue to accumulate. By 2060, a discounted incremental investment of $213 billion generates incremental increases in GDP of over $1 trillion. That is true even though the incremental growth rate of the African economy between 2030 and 2060 is only 0.14 percent, a very conservative rate in the context of the historic empirical analysis.

One of the important conclusions from this analysis lies in the temporal relationship between expenditure and revenue streams. Although payback may be delayed for a generation or more, the investment in that generation and succeeding ones results in returns that continue to accumulate for decades, well-beyond the horizon of this analysis.

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[171] In terms of the production function, this would probably mean that it operated directly on technological advance, not on the quality of labor.

Broader impact of the normative scenario. Another question that the delayed return of the normative scenario raises is what the other interim costs of the accelerated investment in education might be. 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, where the greatest needs are in the normative scenario, the governments of the continent already officially spend about 4.1 percent of GDP on education, as much as on the military (1.6 percent) and health (2.5 percent) combined for a total of just over 8 percent of GDP. Somewhat more than another 8 percent goes to other consumption and administrative expenses.

These numbers, and the security needs of African countries, make clear that any suggestion of taking the funds from the military would be, of course, too simplistic. The Costa Rican model of spending 0.5 percent or less of GDP on the military certainly has many attractions and has contributed substantially to the country's investment in its human capital, but socio-political and geopolitical conditions are very different throughout most of Africa. 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 expense cannot be argued to be a generally practical approach.

For the purposes of the analysis here, incremental educational costs were taken proportionately from all other categories, including health. Doing so offers an opportunity to make clear that almost any diversion of funds has costs as well as benefits. What might be the health implications of such sharing in additional educational funding? The analysis with IFs suggests that, even with outside donors paying for part of the increase, it could cost on average across the continent about one-half year of life expectancy by 2020-2025, definitely a significant and unacceptable cost.[172] That reduction, however, almost certainly overstates the impact of fund diversion because education itself has a significant impact on health improvement that this strictly economic assessment does not include. A later section will correct this estimate by adding that direct beneficial impact of education for health into the analysis.

8.2.2 Distribution

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 Buckmann 2006: 507-517). Logically, that impact depends heavily on the distribution of educational attainment in the society as a whole. Perversely, raising educational attainment could simply open new levels of education for an elite and further concentrate opportunities for economic advancement.

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[172] Modeling of such relationships between spending on health and health outcomes is, however, exceptionally uncertain in IFs and more generally. The numbers provided here must be understood to be very rough estimates.

In reality, the expansion of education, particularly movement towards universal basic education, tends to spread educational attainment across society and increases inequality of it (leaving aside whether or not advances in educational equality automatically improve social equality).[173] There is a quite steeply downward sloping curve cross-nationally that brings down the Gini coefficient of education in societies, higher values being less egalitarian, as average years of education increase (World Bank 2000: 60). Longitudinal analysis of select countries also shows decreases over time with educational expansion. Thus we can reasonably expect that, in almost all cases, the normative scenario will enhance the distribution of education relative to the base case.

Does the distribution of education affect the distribution of income? Figure 8.5 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.[174] As one might expect, inequality declines most clearly with the approach of universality.

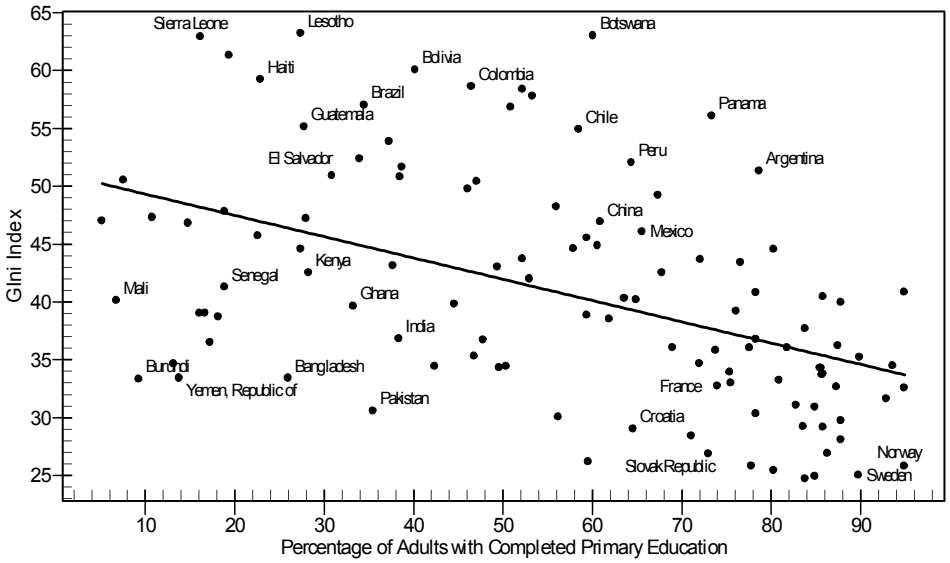

Figure 8.5 Relationship between extent of primary education and Gini
Source: IFs version 6.03
Note: R-squared is 0.233

Because we know that GDP per capita is highly correlated with both extent of primary education and income inequality, it might be argued that the relationship in Figure 8.5 is spurious and that income determines both. Yet the direct correlation between GDP per

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[173] It is also reasonable to assume that from extremely low levels of education, providing some to what are then a select few actually increases inequality of it. Only after a threshold, probably about 50 percent primary education, does further expansion decrease inequality again (a Kuznets curve-like phenomenon).

[174] The relationship of primary completion among adults with income Gini is slightly higher than that for education years of adults 15 or older and of adults 25 and older.

capita and Gini is only 0.155 and when both income and primary education extent are put into the equation the significance of education is much higher than that of GDP per capita. The correlation between extent of secondary education among adults and Gini is also higher than that of GDP per capita, although a bit less than that of primary education.

If greater education in a population helps lessen income inequality, it may also contribute to many other social enhancements. 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 explains the differential. Taking the analysis still further, Woolf and Johnson (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. In short, the path between improved education and health, long recognized to be quite powerful, may run in part through the distribution of income.

Educational advance affects not only domestic distribution of income, but global distribution, because of the relatively greater improvement it makes in GDP per capita of low-income regions. Figure 8.6 shows for the base case the steady decline of global inequality that is associated with any forecast of continued rapid growth in China, India, and other large emerging countries. The normative scenario reduces it in 2060 by a further 0.015 points on the 0-1 scale used in Figure 8.6.

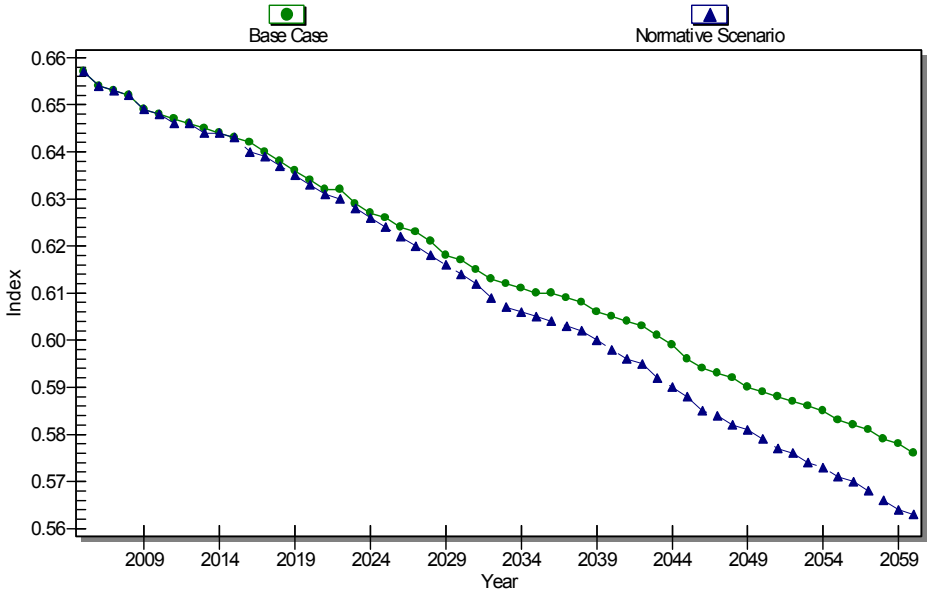

Figure 8.6 Global Gini index in base case and normative scenario.
Source: IFs version 6.03
Note: The Gini displayed is across peoples, not countries. The country-based global Gini shows a similar pattern with a 0.02 point incremental decline.

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 stays very wide until near mid-century. Figure 8.7 shows that in the normative scenario that ratio could begin to decline by about 2020, a significant achievement for humanity, if it proved possible. That pattern again reflects the approximate 1-2 generational time difference in many aspects of the base case and normative scenario, because the normative scenario advances the educational transition by that considerable amount of time.

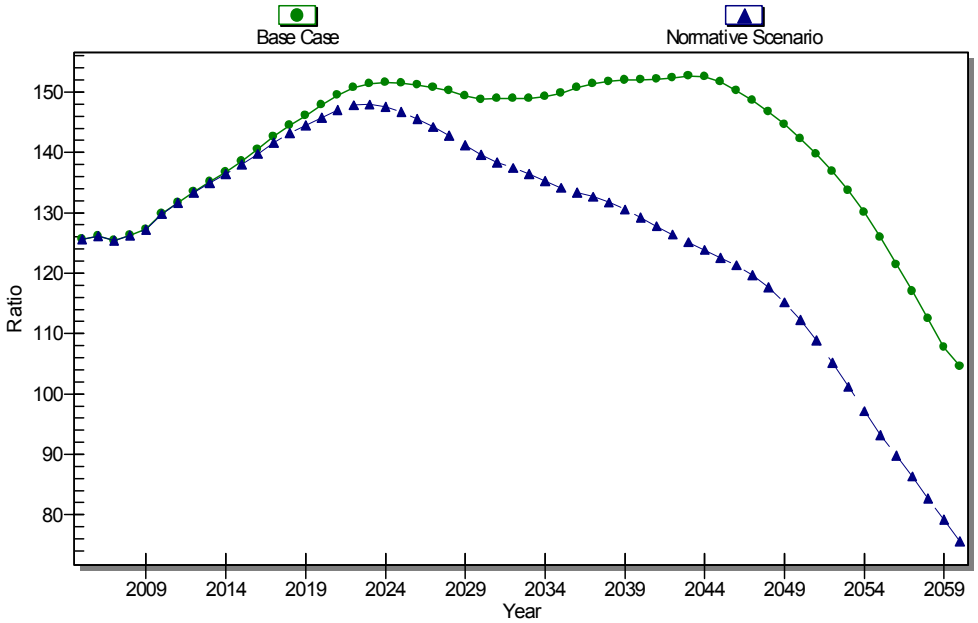

Figure 8.7 Income ratio globally of the richest 10 percent and poorest 10 percent
Source: IFs version 6.03

8.2.3 Poverty

The first volume in this series (Hughes, Irfan, Khan, Kumar, Rothman and Solórzano 2008)) explored the future of global poverty in detail. It found that education could influence its progression. Figure 8.8 compares the number of poor across the World Bank's set of Least Developed Countries (LDCs) in the base case and normative scenarios. In 2060 of the normative scenario 50 million fewer people than in the base case suffer extreme poverty of income less than $1 per day. The tables supporting this volume provide much more information on the future of poverty by region and country.

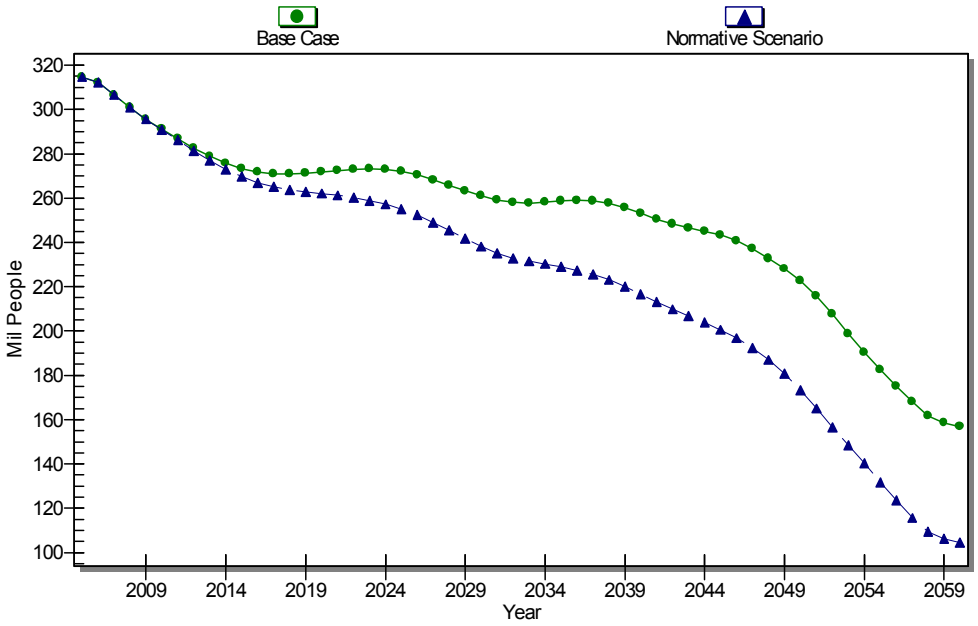

Figure 8.8 People living on less than $1 per day in the base case and normative scenario
Source: IFs version 6.03
Note: Using 5-year moving averages

Figure 8.9 compares the United Nations Development Program's (UNDP) Human Development Index (HDI) across the two scenarios. That measure of human capabilities combines attention to 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.

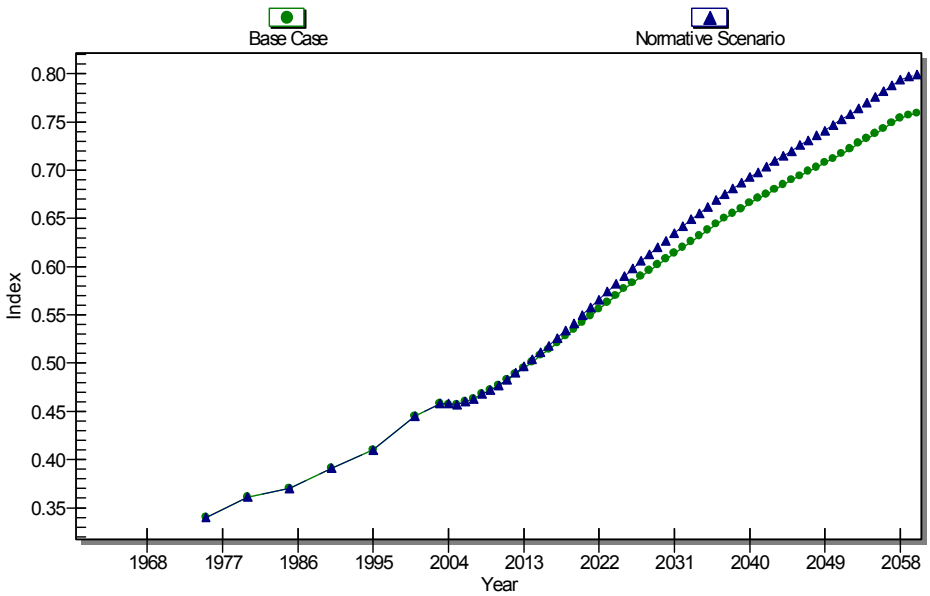

Figure 8.9 Human Development Index in the base case and normative scenario
Source: IFs version 6.03
Note: Using 5-year moving averages; the small transient between history and forecast represents slightly different index components in the IFs forecast calculation, notably the omission of a gross enrollment index from the IFs formulation.

8.3 Education and demographics

8.3.1 Fertility

The existence of a strong relationship between increasing education, particularly of women, and lower fertility is incontrovertible. The cross-sectional and longitudinal evidence is overwhelming and the theoretical logic (macro and especially micro) of the relationship is clear.

It is useful to juxtapose analysis of the relationship with the one that the previous section considered between education and economic growth. Economic growth changes in volatile fashion over time in response to a wide range of short- and mid-range phenomena, not just with long-term factors such as educational advance. Therefore clearly seeing in the data the relationship of economic growth with any its longer-term drivers, not just educational advance, is difficult.

In contrast, fertility rate, like education, changes in a relatively smooth pattern over time. The correlations with fertility reduction of fundamentally all forms and levels of advance in educational enrollment or attainment are strong. Correlations between variables with steady growth or decline over time are nearly always quite high, however, and analysts cannot uncritically accept such correlations as indicating causality. There are, however, strong macro theoretical reasons to believe that there are causal patterns behind the correlations of educational advance and fertility decline. The elaboration of them goes

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, helping give rise to the notion that in development "all good things go together."

At the same time, however, and in fact because of the broader development syndrome in which the interplay of education and fertility reduction occurs, the exact nature of that relationship and the patterns of causality are very 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. 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 difficult. Fertility transitions can, for example, begin at different levels of GDP per capita and unfold with different speeds (if they begin at higher levels of GDP per capita, they are normally faster; and those that have begun in more recent years have also tended to be faster). Patterns of relationship between specific levels of education and fertility vary significantly. Overall, Bledsoe, Johnson-Kuhn, and Haaga (1999: 2) reasonably conclude that

> Understanding the nature and strength of the relationship between education and fertility remains a central challenge both for scholars seeking to explain demographic and social change and for policy makers who must decide on the allocation of scarce public resources.

Strongly trending variables make it difficult to know whether correlations are spurious, that is a result of the influence of one or more third variables instead of showing the impact of education on fertility. That can also be a problem in data across cases rather than time. For instance, Case (2006:459) pointed out:

> Girls in developing countries who are educated beyond primary school may be a highly motivated, very select group, who may have lower total fertility for other reasons. It may not be women's education per se that causes fertility to decline, but that educated women are more likely to marry educated men, and these men may have strong preferences for lower fertility. Young women who have had children may find it difficult to return to school—both because of the demands placed on them at home, but also because many schools discriminate against young mothers returning to school. All of these would lead us to find a connection between women's education and fertility, but not one that was causal.

Reinforcing the statistical evidence on causality, however, the fundamental logic of educational advance and fertility reduction at the micro level seems powerful (a la Easterlin 1961 and Becker 1973 and 1974). 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.

Hannum and Buchmann (2003: 13-16) reviewed some of they elements of the dynamic processes than link education advance and fertility reduction. They include the encouragement of marriage at a later age; the creation of opportunities for employment and income and thus of opportunity costs for childbearing and childrearing; the enhancement of women's status in the family as well as broader society with concomitant increase in decision-making authority; and changing opportunities for the survival and life prospects of children, further influencing parental decisions concerning desired numbers of them. Martín and Juárez (1994) summarized the micro level elements in terms of changes as a result of education in (1) knowledge, (2) opportunities, and (3) world views and values.

A variety of proximate variables help explain reductions in fertility. These include increased a desire for fewer children, use of modern contraceptives (and their availability through family planning and health services), and delay in marriage age.[175] Education, as a distal or "deep" driver, helps explain change in many of these proximate drivers. There is, for example, a strong relationship between education and contraceptive use (Cleland 2002: 190) Clearly, many of these proximate drivers and the more general micro logic of fertility change reinforce the already obvious central role of women and their education in fertility rate change.

What can be said more precisely 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 UN Population Division 2002) has teased out some insights. Among these are:

- Secondary education seems particularly important. Hannum and Buchmann (2003: 13) find "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 UN Population Division (2003: 21) reports that in some countries, early age of marriage, sexual activity and first birth have been higher in populations with 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 that some primary education might actually increase fertility no longer hold up well.

- Breadth of education, the development of mass education, is important. Caldwell (1980: 249) found that breadth is more important than depth. Even the advent of universal education requirements seems to begin a process of change as a result of

[175] The reduction of duration for breast-feeding that often comes with higher education in developing countries works in the other direction by potentially increasing fertility rates.

cultural change. The UN Population Division (2002b: 143) finds that, even when at a macro level higher education is related to lower fertility, in many countries fertility "declined fastest among women with no education." Related to this, male education is important as well as female education (Martín and Juárez 1994).

Figure 8.10 shows the cross-sectional relationship between the average years of education of adult female populations (15 years of age or older) and fertility rate. As indicated above, other measures of educational attainment, including the portion of women or men who have completed primary education or secondary education, also correlate strongly with reductions in fertility–the relationships involve a complex pattern of variables around education and development more broadly (including the relative roles of primary and secondary education), not just average years of female education. 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.

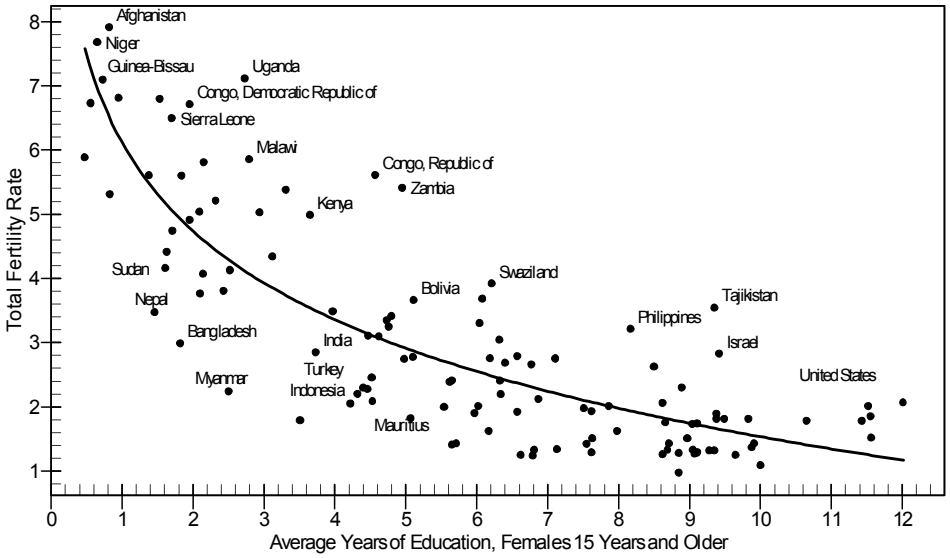

Figure 8.10 Total fertility rate as a function of average adult female education years
Source: IFs version 6.03
Note: R-squared=0.71

Figure 8.10 also suggests one of the complications of forecasting based on such a relationship. It is obvious that a significant number of African countries, including Uganda, Sierra Leone, Kenya, Rwanda and the two Congos, populate the upper left-hand corner of the distribution, falling above the regression line. It may be that cultural reasons have retarded the pace of the fertility reduction transition relative to what educational levels would suggest. Or it may be that the onset of rapid fertility change has been slightly delayed (their infant mortality levels, an important determinant of onset, are all still relative high, from 79 to 165 in 2005), as has been the case in many other countries that subsequently experienced especially rapid decline. The forecasting

formulation, as in the general pattern in the IFs model, protects the initial conditions, but assumes that there will be some convergence of such countries towards the general tendency over time.

Many other variables clearly affect fertility. In formulating the relationship for IFs, it was found that GDP per capita (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 contribution and raise the overall adjusted R-squared to 0.77. Because the literature also suggests the importance of the availability and use of modern contraceptive techniques among proximate factors, the IFs formulation includes it. Research also found that the relationship of fertility with both GDP per capita (PPP) and educational attainment has changed over time, with reductions in fertility occurring globally across levels of income. The spread of efforts to (and an ideational desire to) control population growth, along with improved technology for doing so, have reduced fertility. An additional term assumes some continuation, but slowing of that pattern.

Figure 8.11 shows the resultant forecasts of total fertility rates in the three educational sub-groupings 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 women 15-40 would somewhat accelerate onset of decline and would have common-sense basis (female enrollment rate could also be useful). Except for the low educational grouping, the apparent difference across the scenarios is not great. In the other two groupings, the pattern of decline is already stronger.

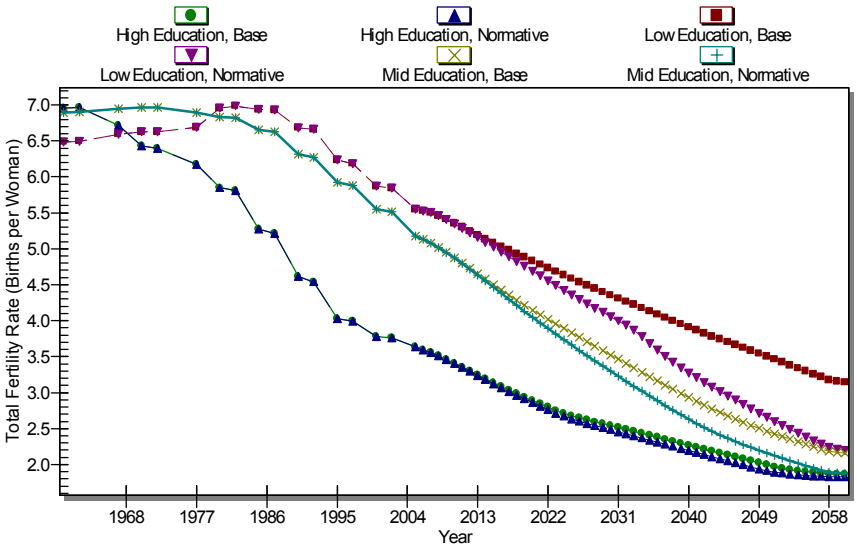

Figure 8.11 Fertility in sub-Saharan Africa educational groups across base and normative scenarios
Source: IFs version 6.03
Note: Using 5-year moving averages

The population of all sub-Saharan Africa is 163 million lower in 2060 in the normative scenario, about 9 percent relative to the base case. The reduction in the low education grouping is 63 million, 12 percent of the base case; the mid education country set has larger population and it would be 54 million lower. The portion of the African population under the age of 15 would be 23.2 percent, compared to 26.3 percent in the base case. In other words, fertility reduction itself would also begin to facilitate the process of educating African youth. As suggested earlier, different observers will value these implications of the normative scenario in different ways.

8.3.2 Health and mortality

Mortality reduction is the other half of the demographic transition, complementing and, in fact, preceding fertility reduction. Morbidity reduction would be another potential focal point in consideration of the positive health implications of education. Attention to disability-adjusted life years (DALYs) and other measures of morbidity 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. We restrict the discussion here to mortality.

Elaborating the process of mortality reduction, Omran (2001) developed the original explication of the epidemiological transition in 1971. 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 strongly emphasized the importance of educational attainment in reducing mortality or increasing life expectancy. Caldwell (1989) identified a range of micro evidence that individual parental education, especially of the mother, reduces infant and child mortality and macro evidence on the impact of education on mortality more generally.

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 developed countries, there is more attention to "psycho-social factors such as level of personal control, sense of agency, self-concept, and stress" (Hannum and Buchmann 2003: 12). In high-income countries generally, educational differentials seem particularly important with respect to cardio-vascular disease (United Nations Population Division 2003: 36).

Case (2006:455-457) reported findings that "each additional year of schooling for men in the U.S. is associated with an 8 percent 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 35 by as much as 1.7 years." Similarly, Shkolnikov and others (1998) found that each year of additional education in Russia reduced male adult mortality by 9 percent and female mortality by 7 percent (alcohol plays a key role and educational impact widened after the fall of the Soviet Union). Case

also emphasized, however, that there are many determinants of both education and health that can lead to a spurious correlation of them.[176]

In developing countries, the focus of attention has been overwhelmingly on the impact of education on maternal and child mortality (Hannum and Buchmann 2003: 13). Omran (2001: 165) emphasized already in 1971 that maternal and child mortality was central to the epidemiological transition. Caldwell (1989: 103) made the very strong statement 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." Caldwell (1990) further argued that education usually has more impact on mortality than does access to medical services, income, or nutritional levels. And Caldwell (1993: 128) cited a UN study that found that after controlling for other variables, an additional year of education for a mother reduces child mortality by 3.4 percent.

Other analysis has also generally found a clear relationship between education and mortality, but qualified the conclusions. Barrera (1990) and Chandola, Clarke, Morris and Blaine (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.

To complicate understanding of the relationship even further, there are not only direct linkages of education to health (such as mothers being able to read informational materials and improve behavioral choices), but important indirect ones via economic growth, which also affects income and health. Bloom and Canning (2005:2) note 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 point to a large literature on the positive impact of health on economic productivity and growth. Jamison, Jamison and Hanushek (2006: 21) noted 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 focuses on the importance of R&D to technological advance, and that suggests still another path via which education could affect economic growth and therefore health, namely the relationship between tertiary education in particular and the advance of knowledge.

[176] In a study based on a large Dutch survey, Groot and van den Brink (2007:186) concluded that "the implied health returns to education are 1.3-5.8 percent."

Given this research, it is not surprising that three key distal or indirect factors drive the forecasting model of the 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, while understanding that proximate or immediate factors, such as infection by a virus 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.[177]

The IFs project has developed the initial implementation of a health submodel that replicates the GDB approach and that will be used, after considerable further work on elaborating the proximate drivers of mortality, for the third volume in this series. Because of the linkage of education to health in that formulation, the IFs model can already estimate the mortality reduction or life expectancy expansion associated with the normative educational scenario.

Figure 8.12 shows comparative forecasts of life expectancy in South and West Asia across the base case and normative scenario.[178] The incremental life expectancy in the normative scenario is about 0.5 years already by 2030 and maintains that differential through 2060, for a regional population that would grow from 2.2 billion to 2.4 billion over the same period. A rough and estimate of life-years saved over that 30 years is 250 million.[179] Following common practice and valuing those life years at an embarrassingly low value of $6,000 (approximately the likely GDP per capita at PPP in 2030) yields a monetary value of $1.5 trillion. The cumulative incremental spending of the region on education in the normative scenario was $750 billion (as discussed earlier, by 2060 the cumulative spending of the region in the normative scenario is actually lower). Thus the investment in education for mortality alone (not even including morbidity in the health calculation) would seem to be very a very good investment.

The numbers are similar for sub-Saharan Africa. The incremental life expectancy there is 0.8 years by 2030 and 2.5 years by 2060. The region's population in 2030 is forecast to be about half that of South and West Asia, as is its GDP per capita. Overall, the estimate of value of life saved in the normative scenario is fairly comparable to that in Asia, for an

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

[178] The life expectancy calculation from the new health model has not yet been fully integrated with the larger IFs model. It is driven by the variables of that model, but is currently a satellite variable, without further forward linkages of its own.

[179] The estimate is an integration of regional deaths over the 30 years (about 500 million) times 0.5 years of foregone life per death.

increment of educational spending totaling $125 billion through 2030 and $860 billion through 2060.

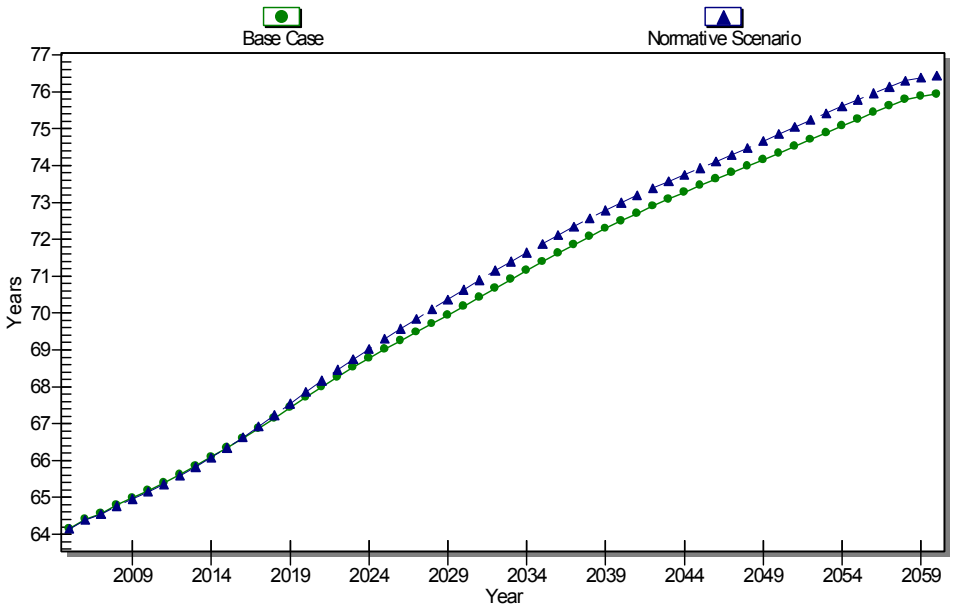

Figure 8.12 Life expectancy in South and West Asia across base and normative scenarios
Source: IFs version 6.03
Note: Using 5-year moving average

8.3.3 Population effects in combination

The fertility and mortality effects of educational advance in the normative scenario relative to the base case affect total population in different directions, but the population-reducing effects of fertility change overshadow the population-increasing effects of mortality change.[180] Figure 8.13 shows the resultant forecasts. As usual the implications of the normative scenario are the greatest in sub-Saharan Africa and less in South and West Asia. They are not significant in other regions.

[180] The life expectancy calculation of the new health module is not yet linked back to this population calculation.

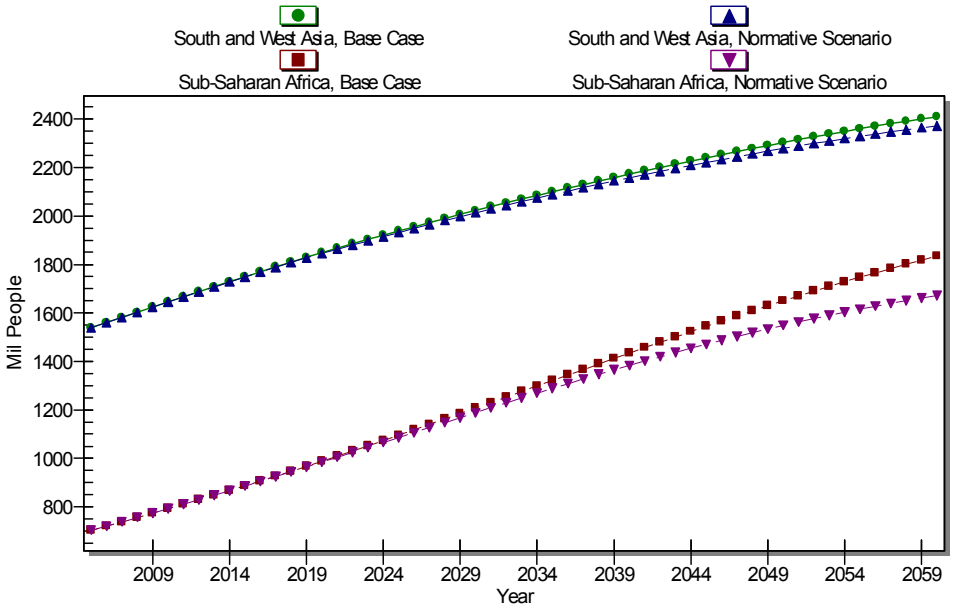

Figure 8.13 Population in sub-Saharan Africa across base and normative scenarios
Source: IFs version 6.005.

As noted earlier, the normative scenario also affects the age distribution of the population. In sub-Saharan Africa, the portion of the population under 15 falls even in the base case from 44 percent in 2005 to 26.3 percent in 2060, a decline that will effectively move the continent past this period of especially great challenge to educational systems. The acceleration of education in the normative scenario reduces that another 3 percentage points of 2060, a positive feedback loop that somewhat assists the transition.

Figure 8.14 shows a slightly different way of looking at dependency burdens. The threshold for a youth bulge has various definitions, but a common one is a portion of the population between 15 and 29 years of age in excess of 40 percent (Cincotta, Engelman, and Anastasion 2003: 43). Such high proportions of young people can create many social problems, including difficulty creating 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 century. South and West Asia has one that is likely to disappear formally by about 2020, followed by rapid drop in that category of population through the forecast horizon. The normative scenario would likely eliminate the youth bulge of sub-Saharan Africa only very marginally faster than does the base case. Still, by 2060 the scenario could reduce the portion of the population in that age group by almost 2.5 percent (the portion of the population over 65 in both regions would grow by less than 1 percent relative to the base case, providing for Africa at least some "demographic dividend" in terms of a proportionately larger working-aged population).

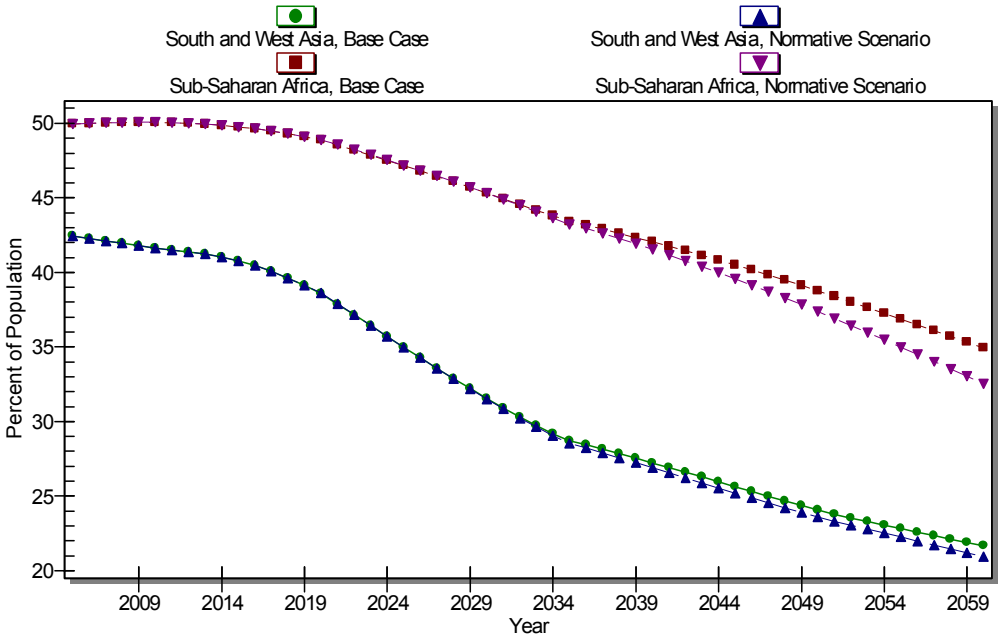

Figure 8.14 Youth bulge in sub-Saharan Africa across base and normative scenarios
Source: IFs version 6.03

8.4 Education and socio-political change

The changing course of the youth bulge indicates one of the many ways that education can affect societies, namely via its impact on demographics and the implications, in turn, of demographic change for socio-political change. Similarly, the effects of educational advance on economic growth and development will pass through to a wide range of aspects of society. Level of income (with GDP per capita as a widely used proxy for income) is strongly correlated with nearly all aspects of social change (Hughes 2001).

Yet such indirect effects of education on socio-political systems may substantially underestimate its broader and more direct effects. Education shapes understanding of the world, affects values, and therefore alters human behavior. Such impacts cannot but dramatically affect the ways in which humans interact with each other and organize their social institutions. Culture involves ideas, beliefs and values; social practices and relationships; and most broadly even the informal and formal institutions that build upon and perpetuate these. Thus education fundamentally shapes culture.

In much of the high-income, Western world, shaping can mean the maintenance and transmission of relatively slowing evolving cultures. In much of the developing world, however, it can mean fundamental rebuilding of them. Caldwell (1980) argued that the adoption of Western mass education throughout the world transforms cultures, beginning (when children are sent outside of 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 morality.

In this discussion we will not be able to describe the depth and breadth of such transformative processes. And our focus is, in any case, more on the marginal implications of the normative educational scenario, not on the massive change already associated with the base case. We therefore consider a select few manifestations of the impact of education, including processes of democratization and other aspects of governance.

8.4.1 Democratization

Social scientists who have looked at the influence of education on socio-political systems have paid special attention to its role in support of democratization since at least the time of John Dewey (1916) who wrote *Democracy and Education: An Introduction to the Philosophy of Education*. In another classic statement of the important relationship, Seymour Martin Lipset (1959: 80) wrote that "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."[181]

Once again, however, the existence of a very strong cross-sectional relationship between educational attainment of societies and 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.[182]

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[181] Both Hannum and Buchmann (2003) and Acemoglu, Johnson, Robinson, and Yared (2004) provide useful reviews of the literature.

[182] At the same time, Castelló-Climent (2006) argued that a more egalitarian distribution of education is supportive of democracy.

More contemporary analysis tends to take an institutional perspective in which education is seen as an integral part of the broader "social and political construction of society" (Hannum and Buchmann 2003: 18), but an element that has complicated relationships to the others. For instance, the manner in which educated elites are brought into the political system, or not incorporated, can vary and affect their support for existing systems. Glaeser, Ponzetto, and Shleifer (2007: 3-4) pointed to the important 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 Peron 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 strongly in the street during 2007-2008 impressed peoples around the world with the power of an educated, at least potential elite.

Just as the perspectives of general publics with primary or lower secondary education are not always democratic, such elite activism is, of course, not always supportive of democracy, and the empirical work of Acemoglu, Johnson, Robinson, and Yared (2004) questioned 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 greater understanding of the virtues of majority rule and of the protection of minorities.

Understanding the complications of cross-sectional analysis, the IFs project looked not just to levels of educational attainment in societies as a driver of change in democracy level, but also to GDP per capita (PPP), because that variable serves as a proxy for many types of general developmental change including, of course, income level. GDP per capita by itself has a logarithmic relationship (R-squared of 0.29) with a measure of freedom/democracy built from the sum of the two individual measures of Freedom House (Gwartney, Lawson, Sobel, and Leeson 2007).[183] The variable for education years at age 15 has a linear relationship (R-squared of 0.33). The two drivers together are both significant and raise the R-squared to 0.40.[184]

Figure 8.15 shows not so much a forecast of freedom in the base case and normative scenario using the resultant formulation within IFs, but a crude general tendency. The inclusion of the historical series is important to convey the great fluctuations in level of democratization over time in the two sets of countries represented in the figure, African countries with low primary education levels and non-African countries with low

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[183] The relationship using the Polity project's measure of democracy is nearly identical. Details on that project and measure, under the direction of Monty G. Marshall, are at http://www.systemicpeace.org/polity/polity4.htm.

[184] There is much evidence that the relationship between income level and democracy is non-linear and complex, involving an interim range of income across which democracy is often unstable or unconsolidated (Przeworski, Alvarez, Cheibub, and Limongi 1996).

secondary education levels.[185] Countries with historically high political instability populate both of these country sets. In addition they, like other countries, experience regional and global waves of democratization (Huntington 1991); the recent wave of democratization in Africa is apparent in the 1990s.

Thus one cannot pretend to be able to forecast the level of democracy in these countries, especially. Yet upward movement of democracy is likely on average with continued educational advance and income growth. The model formulations suggest that in 2060 the African set of countries could on average be about 0.5 points more democratic in the normative scenario than in the base case (on a 14-point scale), and the non-African countries could be about 0.3 points more democratic. Such potential gains may be small, but they have real value—democracies, much else being equal, tend to be more peaceful and less likely to abuse their own citizenry (Oneal and Russett 1999).

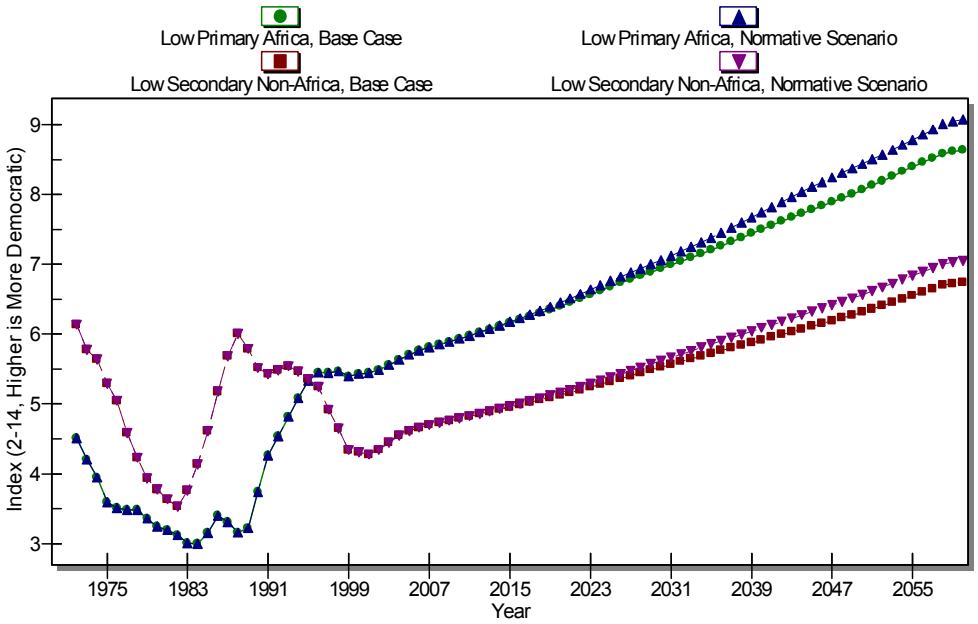

Figure 8.15 Freedom across base and normative scenarios, history and forecast
Source: IFs version 6.03

[185] The latter set consists of Afghanistan, Bhutan, Cambodia, Guatemala, Haiti, Laos, Myanmar, Pakistan, Papua New Guinea, Solomon Islands, Vanuata, and Yemen.

8.4.2 Government effectiveness

The World Bank's Governance Matters Project (Kaufmann, Kraay and Mastruzzi 2007) emphasizes the richness of variation in governance, something that is difficult to capture in single aggregate measures of democracy.[186] Governance Matters organizes data on six indices/dimensions:

- voice and accountability (similar to the measures of democracy and autocracy from the Polity project and the measure of freedom from Freedom House)
- political instability and violence
- government effectiveness
- regulatory quality
- rule of law
- control of corruption (similar to the corruption perceptions index of Transparency International (TI), to be discussed later

All of these dimensions are of interest and educational attainment is quite strongly correlated with each. Moreover, the relationships persist after controlling for GDP per capita. One of the strongest relationships of educational attainment is with governance effectiveness. The advance of education should logically influence it. As individuals become more educated they should 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 bi-directional—more effective governments will provide education and health care.

Work within the IF project has explored the relationship between the World Bank's measure of effectiveness and other variables including economic growth and found it to be strong. Whereas level of democracy (using measures such as voice and accountability or freedom) does not clearly correlate in most studies or our own analysis with economic growth, governance effectiveness has a very significant relationship with growth over decade-long periods (Hughes 2005 Part II: 11). Thus its relationship with education is of interest. Figure 8.16 explores the relationship between educational attainment and governance effectiveness and does, indeed, find it to be quite strong.

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

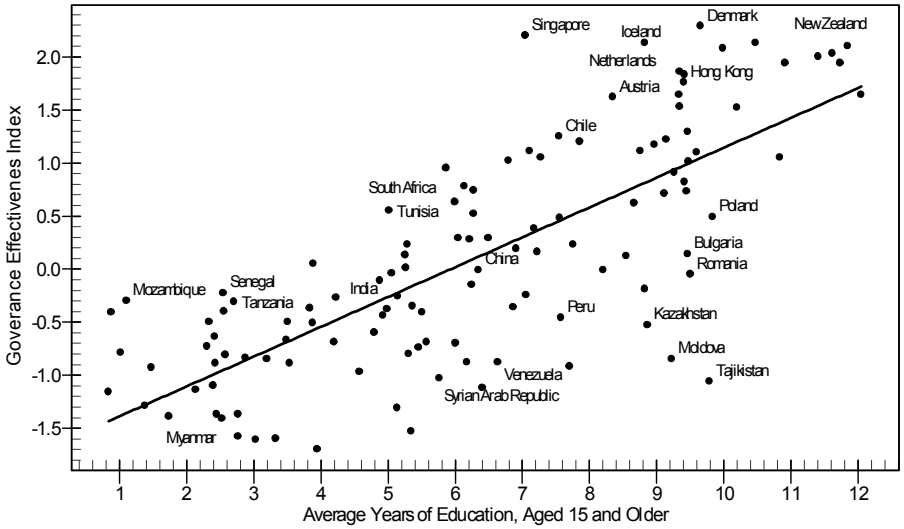

Figure 8.16 Governance effectiveness as a function of years of educational attainment
Source: IFs version 6.03
Note: R-squared = 0.58

The formulation in IFs for forecasting governance effectiveness relies upon both GDP per capita (PPP) and years of educational attainment of those 15 years and older. The combined r-squared for that relationship is a remarkable 0.78. Using the formulation and comparing the values of governance effectiveness in sub-Saharan Africa in the base case and the normative education scenario, the aggregate difference for the region by 2060 is about 0.3 points on a 5-point scale. The increase for South and West Asia is 0.2 points and in Latin America it is 0.05 points. Again this is a significant impact of accelerated education in the normative scenario, the full value of which is nearly impossible to monetize.

8.4.3 Corruption

Although the World Bank includes a measure of corruption in its set of governance indicators, the corruption perceptions index (CPI) of Transparency International has become very well known and widely used (Lambsdorff 2003). Again educational attainment is very highly correlated with reduction in corruption (R-squared of 0.51). But the correlation with GDP per capita (PPP) is exceptionally high (R-squared of 0.82) and the combination of the two drivers add minimal additional explained variation (R-squared of 0.84). Thus the IFs formulation relies only on GDP per capita.

Figure 8.17 traces the forecasts in the base case and the normative educational scenario and shows that by 2060 the normative scenario adds about 0.2 points on a 10 point scale to values for sub-Saharan Africa and about 0.4 points for South and West Asia. In addition it adds about 0.1 point for Latin America and 0.04 for the developing countries of East Asia and the Pacific. The forecasts suggest the power of the indirect linkage of education to governance quality via its impact on economic growth. In fact, across the

arena of social change, the advance of incomes with GDP per capita proves to be a powerful, if not the most powerful variable in the IFs formulations. Again, the exact path of education's impact remains uncertain, even while its importance is widely understood.

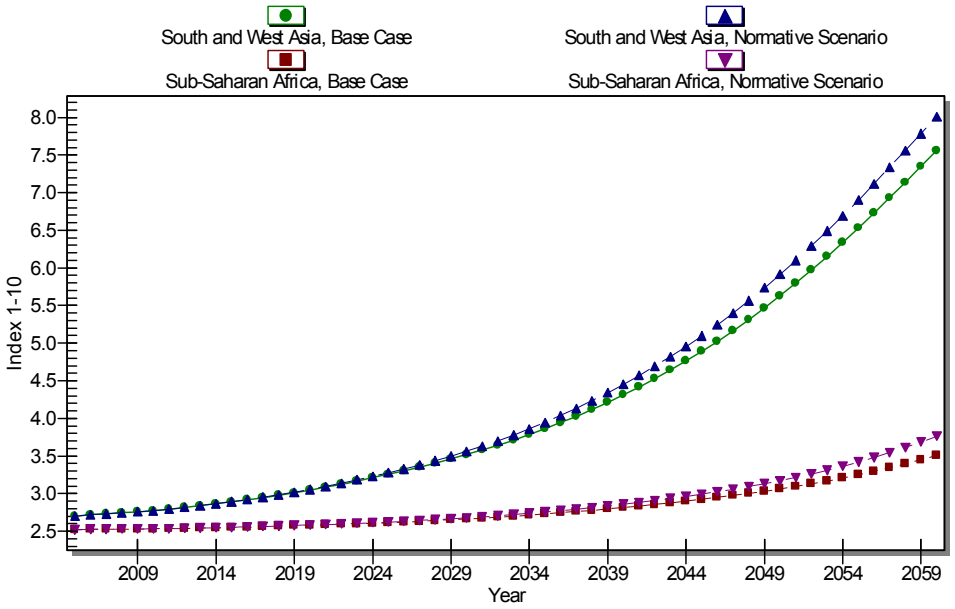

Figure 8.17 Corruption perception index across base and normative scenarios
Source: IFs version 6.03
Note: Higher values are more transparent and therefore less corrupt

8.4.4 State failure

Foreign Policy magazine and the Fund for Peace define a failed state index in terms of vulnerability to violent internal conflict and societal deterioration (a measure that overlaps with the World Bank's dimension of political instability and violence).[187] The index builds on 12 social, economic, political, and military indicators. A computerized Conflict Assessment System Tool (CAST) indexes and scans hundreds of thousands of articles and reports for data on the indicators by country.[188]

Figure 8.18 shows the strong negative relationship between educational attainment of societies and position on the index. Although the R-squared 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, suggesting a likely independent contribution of educational attainment.

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[187] The 2008 overview of the methods and findings was at http://www.foreignpolicy.com/story/cms.php?story_id=4350

[188] 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

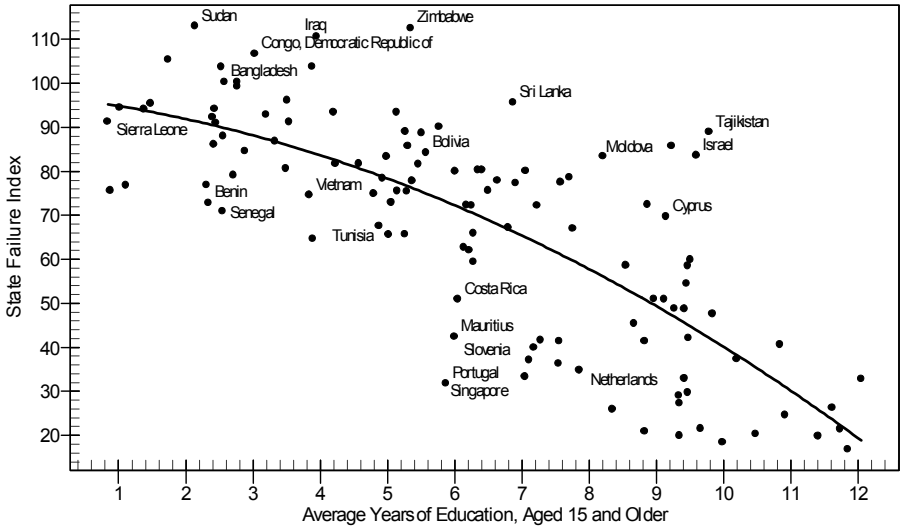

Figure 8.18 State failure as a function of educational attainment
Source: IFs version 6.03
Note: R-squared=0.59; formulation is second order polynomial

Interestingly, the outliers in Figure 8.18 tend to be very much the same countries that were outliers in Figure 8.16. Clearly there are historic path dependencies, reflecting strong elements such as local cultural patterns, ethnicity distributions and relationships, or simply historic events, that shape socio-political patterns in countries and that may make those patterns resistant to change driven by income, education, or other variables. Yet the cross-sectional relationships tend to be so strong that they suggest that key dynamic drivers, including education, probably push along even outliers over time, with those countries perhaps simply remaining in a more-or-less constant position relative to the general pattern. Note that outliers below the line in Figure 8.18 at low levels of education are about the same distance below the line as outliers at high levels of education. It seems highly likely that continued advance in education will contribute even to a reduction in the rate of state failure.

8.4.5 Still broader impacts of education

Education potentially affects a vast range of other socio-political and even broader phenomena. For instance, it almost certainly has some impact on environmental quality.[189] Smaller but richer populations in the normative scenario could potentially consume more of many commodities, including energy, water, and food, intensifying stress on the environment. In the IFs forecasts, global energy demand is 0.7 percent higher in 2060 in the normative scenario than in the base case. As usual, the biggest impacts are in sub-Saharan Africa (up 4.7 percent) and South and West Asia (up 5.3 percent). The increased energy use has proportional impact on carbon emissions. The

[189] McMahon (1999: 125-140) explored some of the complexity of that set of relationships

normative scenario does not significantly change the forecast of forest area relative to the base case (a smaller population largely cancels out the affects of improved diets of a richer population).

More generally, 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). Yet the costs and benefits of educational advance in the environmental arena alone would be very difficult to assess systematically.

8.6 Conclusions

Levels of educational attainment in societies correlate strongly with a vast array of important variables in the human development process. It is often difficult to know the extent to which those correlations indicate causality, but in very many cases good logical or theoretical reasons suggest that some significant part of the correlation does reflect causality.

We must clearly admit that the complexity of the human development process makes understanding, much less modeling the syndrome of relationships a very uncertain process. Yet the analysis in this chapter suggests that investment in accelerating educational advance to the rate of the normative scenario would provide economic returns that by 2060 return the investment and more, perhaps considerably more. The implications of educational advance for economic growth and for life expectancy could potentially each pay the incremental investment costs themselves. In addition, there are implications of educational attainment for fertility reduction and for socio-political change that most observers would judge to be positive and significant.

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