5

What Path Are We On?

This chapter explores a dynamic base case forecast of the next fifty years of global education as it now appears to be unfolding.

It has been fifty years since the large wave of independence from colonialism washed across Africa and around the world. Intensified efforts to boost levels of education followed quickly in lower-income countries. The competition of the Cold War and the emerging focus on knowledge foundations of economies had similarly energizing effects in middle- and upper-income countries. Chapter 3, using data that have become increasingly available over the past five decades, sketched the rapidly unfolding and, in fact, accelerating transition in global education.

Building on that historical context and using the IFs forecasting system, this chapter will explore a base case forecast of the next fifty years of global education as it now appears to be developing. We will consider the possible evolution of student enrollment rates and persistence at all levels of education, as well as of public education funding, and examine the implications of these patterns for the future of adult educational attainment. Unfortunately, of course, all forecasts are flawed and uncertain. Comparing the IFs forecasts with forecasts from other models will help us discuss the confidence that we have in the IFs forecasts and those of education forecasting more generally.

The base case forecast of global education, though it rests on recent trends, is not a simple extrapolation. Instead, the IFs system produces the base case using a dynamic representation of many interactions between education and other components of human development systems, notably, demographic, economic, and sociopolitical futures. For instance, the IFs base case forecasts of population, GDP per capita, and government spending interact closely with enrollment patterns and with adult educational attainment.[1] Because forecasts of such key interacting systems themselves can vary considerably, we will look in the final section of the chapter at alternative forecasts for key driving variables and consider how they might affect our base forecast of education futures.

The IFs Base Case Forecast

Many forces, not least of which is a significant economic advance in combination with public and international political will, have pushed global education forward in recent years. As we saw in Chapter 3, in spite of historically rapid and accelerating progress in global education over the last fifty years (and some shorter-term acceleration since the mid-1990s following earlier disruptions), there are certainly many countries and education levels where educational progress might accelerate further. It is important to emphasize also, however, that there are some brakes on and even limits to such expansion. For example:

- Demographic transitions tend to accompany and even to precede educational ones, in part because very rapid population growth greatly strains education resources; global demographic transitions to low fertility rates, especially in Africa, have far to go, and high birth rates will continue to challenge education systems for decades.
- More prosaically, increases in completion at lower levels must precede increases at higher levels, and the human resources needed for expansion at lower levels often come from higher ones, making the interactions across levels important constraints on each other.
- There are also financial constraints. We have seen that higher-income societies have not significantly increased the share of GDP that they devote to education for several decades (in fact, they have decreased it modestly); most low- and middle-income countries have raised the share of GDP spent on education close to that of the high-income countries, limiting the likelihood of a further increase from domestic resources.
- Constraints also arise from the demand side of the process; for instance, not everyone in poorer, heavily agriculture-based societies wants or needs higher education. In addition, social exclusion and identity issues limit demand from some population groups.

Where the historical trends take us in coming decades depends on the interaction of the forces that accelerate change and those that constrain it.

Student population flows: Expansion of education

As we have seen, rates of enrollment at all levels of education are rising around the world. Primary gross enrollment rates globally now exceed 105 percent and are likely to decline somewhat as the enrollment rates of of-age children continue to increase and those of overage children decline. Figure 5.1 shows this decline as well as the ongoing push upward for lower secondary (rapidly approaching 80 percent), upper secondary, and tertiary gross enrollment rates. By midcentury, the global lower secondary gross enrollment rate will likely be near or slightly above 90 percent, a remarkable achievement, and the upper secondary gross rate will likely be near 80 percent.

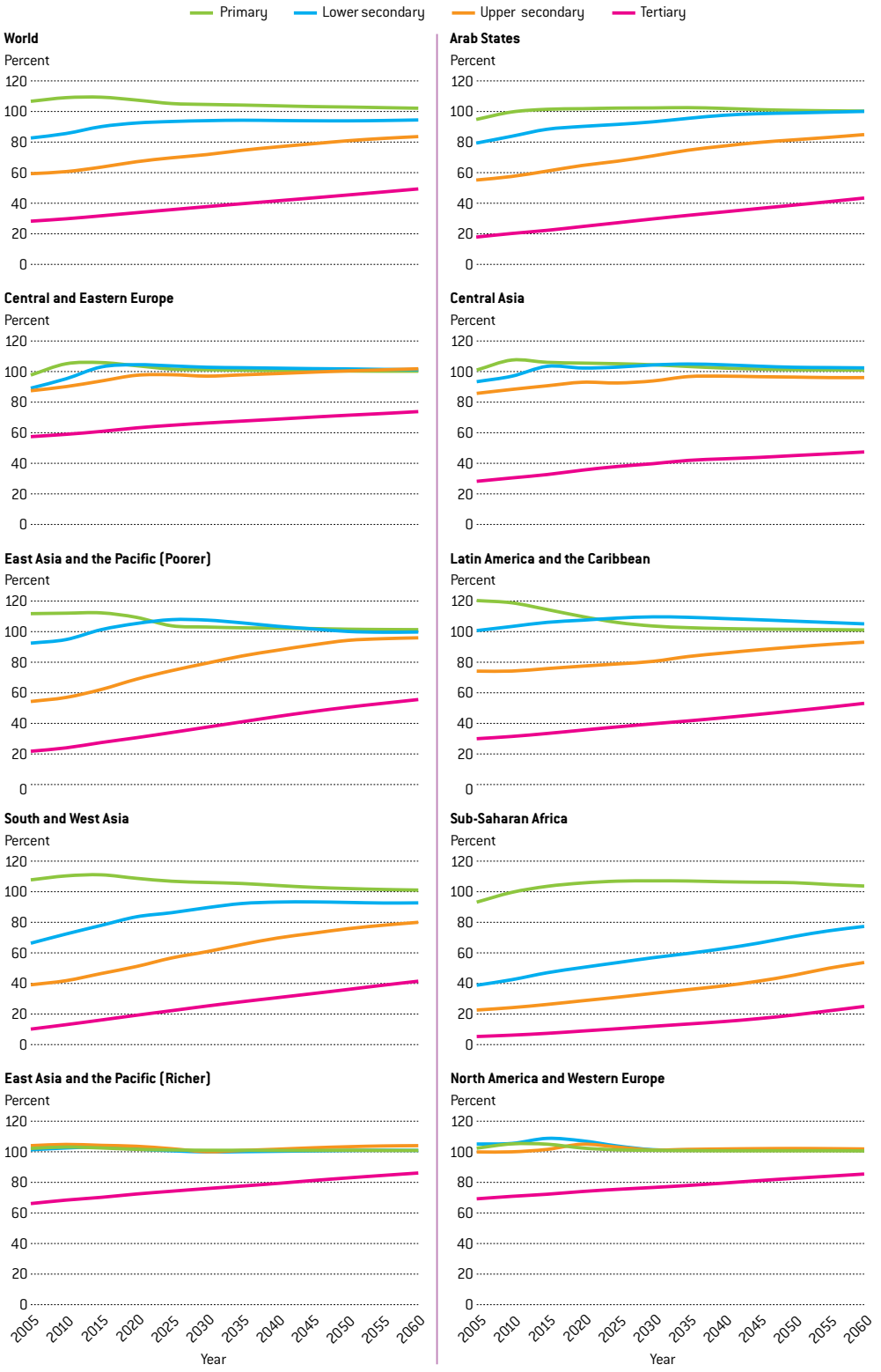
One of the reasons why rates will be able to increase so significantly is that demographic pressures on education systems are now waning almost everywhere. On a global basis, the number of students enrolled in primary programs will actually peak around 2022 and begin declining, in spite of continuing enrollment rate increases. In the IFs base case, primary student numbers fall from 675 million in 2005 to 653 million by 2060. At the lower secondary level, the peak numbers may occur around 2055, but the total number of students globally in 2060 (about 334 million) is likely to only slightly exceed that in 2005 (298 million) in spite of the movement to near-universal enrollment. This is a critical reason why our forecasts can show rapid enrollment rate increases. The large increases in absolute numbers will come at the upper secondary and tertiary levels.

Figure 5.1 explores regional variation as well, showing forecasts of the series that Figure 3.1 presented historically. Although we did not have the data needed to differentiate lower and upper secondary enrollment rates over a long historical period, we do differentiate them in our forecasts.[2] Gross enrollment rates overestimate the progress to universal education. Yet the quite high rates forecast at the lower secondary level in 2060, even in sub-Saharan Africa, suggest that well before midcentury the attention of the globe will have shifted to universal lower secondary education and to setting goals at higher levels.

The future of education's advance will be determined by the interaction of forces accelerating it and forces constraining it.

The further spread of education will be helped by changing demography; demographic pressures on education are waning almost everywhere.

Figure 5.1 Gross enrollment rates by region and education level



Note: The figure does not include historical values because of much missing data; see the regional historical values of relatively data-rich countries in Chapter 3.

Source: IFs Version 6.12 base case forecast.

Table 5.1 presents forecasts for primary and secondary net enrollment rates. The IFs base case clearly does not anticipate that the world will have reached universal primary education by 2015,[3] but Table 5.1 shows that all regions except sub-Saharan Africa will likely have reached or passed the 90 percent "nearing universal enrollment" marker by 2030 and that sub-Saharan Africa will essentially do so by 2045 (although in both cases, some individual countries may not yet have done so).

Student flows: Targeted country sets

The historical review of Chapter 3 noted that, except for Djibouti (and almost certainly Afghanistan, for which recent data are not available), all countries with primary net enrollment rates below 50 percent in 2005 were in sub-Saharan Africa. And in fact, all but three countries with primary net enrollment rates between 50 and 70 percent were in that region. Figure 5.2 therefore extends the historical pattern (see, again, Figure 3.8) for three sets of sub-Saharan African countries with the forecast of the IFs base case.[4] The 2060 horizon of this volume proves long enough to capture the anticipated movement of primary net enrollment rates to or near to universality in the sets of African countries with midrange and higher enrollment rates

The base case shows a continuation of the historically rapid transition of recent decades.

Even so, reaching the MDG of universal primary education by 2015 is not, and never was, a reasonable goal for all countries.

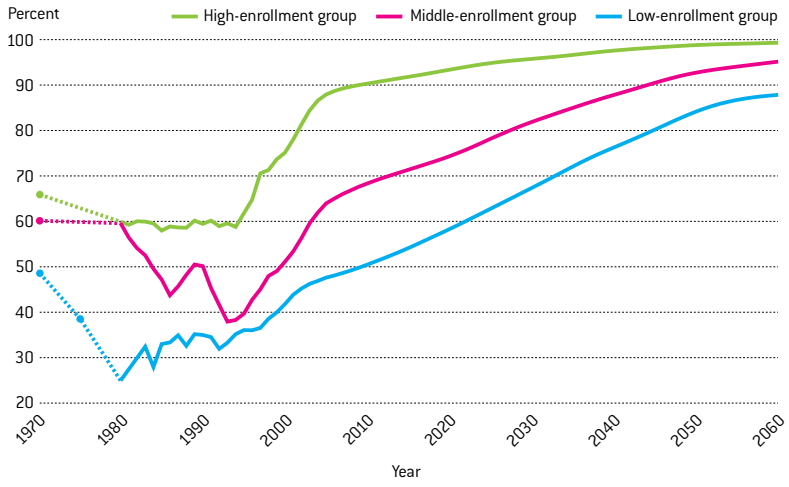
Table 5.1 Primary and secondary net enrollment rates by region

	Primary net enrollment				
	2005	2015	2030	2045	2060
Arab States	81.9	88.1	95.0	98.2	99.6
Central and Eastern Europe	89.9	98.8	100.0	100.0	100.0
Central Asia	84.4	91.8	98.5	100.0	100.0
East Asia and the Pacific (Poorer)	88.0	95.6	99.4	99.8	100.0
Latin America and the Caribbean	93.7	96.8	99.0	99.5	99.7
South and West Asia	85.5	88.3	94.0	97.9	98.6
Sub-Saharan Africa	67.7	72.2	81.4	89.3	93.8
East Asia and the Pacific (Richer)	97.7	100.0	100.0	100.0	100.0
North America and Western Europe	95.2	99.9	100.0	100.0	100.0
World	86.6	91.3	95.1	97.3	98.3
	Secondary net enrollment				
	2005	2015	2030	2045	2060
Arab States	58.7	65.7	73.7	82.3	86.7
Central and Eastern Europe	78.1	85.8	93.0	96.3	98.4
Central Asia	82.3	87.8	92.1	95.2	96.5
East Asia and the Pacific (Poorer)	63.9	71.3	83.7	89.8	93.3
Latin America and the Caribbean	68.7	77.4	85.1	89.3	93.1
South and West Asia	45.3	53.0	64.4	72.2	77.2
Sub-Saharan Africa	23.3	30.4	39.9	47.7	57.8
East Asia and the Pacific (Richer)	95.1	97.0	98.3	99.4	99.8
North America and Western Europe	90.9	93.5	97.3	99.1	99.6
World	60.4	66.2	74.0	78.5	82.1

Note: Compare with Table 3.1.

Source: IFs Version 6.12 base case forecast.

Figure 5.2 Primary net enrollment rates in sub-Saharan African country clusters: History and forecast



Note: Used 5-year moving averages after removing 1975 for high- and middle-enrollment groupings and 1981–1982 for the low-enrollment grouping.

Source: IFs Version 6.12 base case with UIS data.

Reaching universal lower secondary education will be challenging for many countries.

Table 5.2 indicates the difficult undertaking the world faces as it seeks to achieve universal basic education.

currently but not long enough for those with the lowest enrollment rates.

On the basis of pure extrapolation from very recent patterns, one could challenge our late-achievement forecast for the low-enrollment group and also expect more rapid achievement of universality for the other two groups. Continuation of the acceleration of growth in enrollment rates that began for its members in the early to mid-1990s would bring even the low-enrollment group to universal enrollment by about 2025. There are, however, reasons to believe that such an extrapolation would be in error:

- The low-enrollment group had a period of flat enrollment rate growth in the 1980s. Were one to trust the 1970 values and extrapolate all historical growth between then and 2004, the group would demonstrate only slow, if any, growth in enrollment rates over that extended period.
- The historical experience of the middle-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 the low-enrollment group of countries are many that have had and/or are currently experiencing significant political turmoil. In fact, in 2008, the Fund for Peace and *Foreign Policy* placed eight of the fourteen countries in the group on their failed-state list at the "critical" level. From the most problematic end of that list,[5] those eight are Somalia (in the top position), the Democratic Republic of Congo, Côte d'Ivoire, Central African Republic, Niger, Burundi, Republic of Congo, and Guinea-Bissau.

As nearly all forecasts of education flows have concluded, 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 it also indicates that much time is likely still required to meet the goals that the global community has already set. Subsequent analysis (in Chapters 6 and 7) will consider whether, in a more aggressive scenario, a faster transition than that of the base case might be possible.

The challenge of reaching universal primary enrollment faces not only sub-Saharan Africa but other regions as well—indeed, eleven countries outside sub-Saharan Africa are unlikely to reach 90 percent primary net enrollment by 2015 (see Table 5.2). And the challenge of reaching universal lower secondary education is far more clearly a global one. Figure 5.3 helps us understand better the pattern that may be followed through midcentury by countries outside sub-Saharan Africa with low rates of lower secondary enrollment. The figure focuses on the fifteen countries outside sub-Saharan Africa that had lower secondary gross enrollment rates below 60 percent in 2005 (see Table 3.5 for this set). Most of these countries already have high levels of primary gross enrollment and significant levels of primary net enrollment; the IFs base case forecast is that they will reach the 90 percent primary net rate by about 2036. They may approach 80 percent lower secondary gross enrollment and 60 percent upper secondary gross enrollment by 2060.

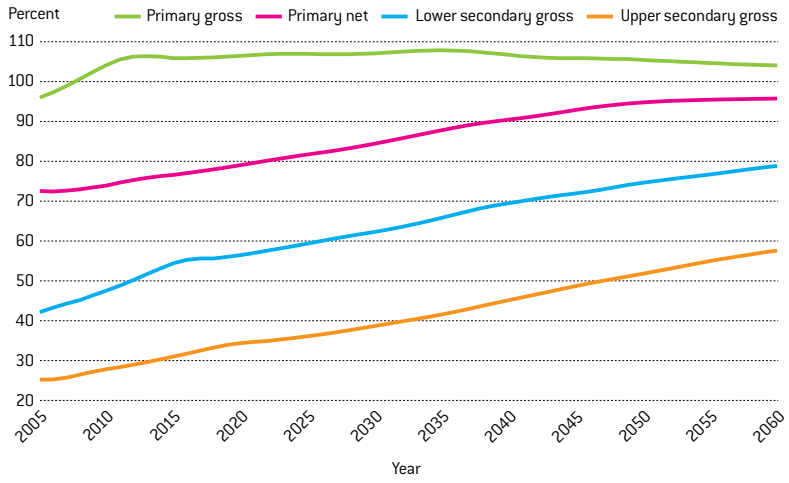
Student flows: Missing current goals

One aim of this study is to help consider reasonable goals for primary and secondary education enrollment rates for individual countries and across country sets as the world looks beyond 2015. Although most countries

will have achieved at least a 90 percent primary net enrollment rate by 2015, the IFs base case forecast identifies thirty-seven that may not reach that level (Table 5.2).[6] In fact, twenty-seven of those may not reach 90 percent by 2030, including some whose recent gains have been so rapid that we question whether they can be sustained. Nearly all countries are likely to reach the 90 percent level by 2060.

Looking beyond the current Millennium Development Goal for education must, however, involve elements other than the temporal. Increasingly, as we have noted, attention is moving to basic education, combining lower secondary years with primary ones. Table 5.2 therefore also identifies countries that may not have reached 90 percent lower secondary gross enrollment by 2015, 2030, 2045, and 2060. The two columns of Table 5.2 together indicate the extremely difficult undertaking that the world faces as it seeks to move to universal basic education.

Figure 5.3 Enrollment rates for countries outside sub-Saharan Africa with low lower secondary enrollment rates in 2005



Source: IFs Version 6.12 base case forecast.

Gender parity

Chapter 3 discussed the rapid movement toward parity in recent decades. Figure 5.4 shows again that gender enrollment ratios at all levels of education have, in the global aggregate, reached the 0.97 ratio that is often used as an indicator of parity. Yet many regions remain below that level, and the forecasts of the IFs base case suggest that many countries will remain below that level in 2015. Regionally, the gender parity ratios in sub-Saharan Africa are the lowest—in 2005, the IFs-calculated ratio exceeded 0.90 only for primary net enrollment (where it was 0.92), and progressively higher levels of education had progressively worse ratios. The regional value for primary gross gender parity was slightly lower than the primary net parity ratio—but only because males tend to repeat grades more often or otherwise enroll overage, suggesting an enrollment advantage for males that is really a disadvantage educationally. Hence, Figure 5.4 shows the net ratio at the primary level.

The base case forecast suggests slow but continued progress in reducing female disadvantage in sub-Saharan Africa, and by about 2030, the primary net gender parity ratio could reach 0.97. But even though the region

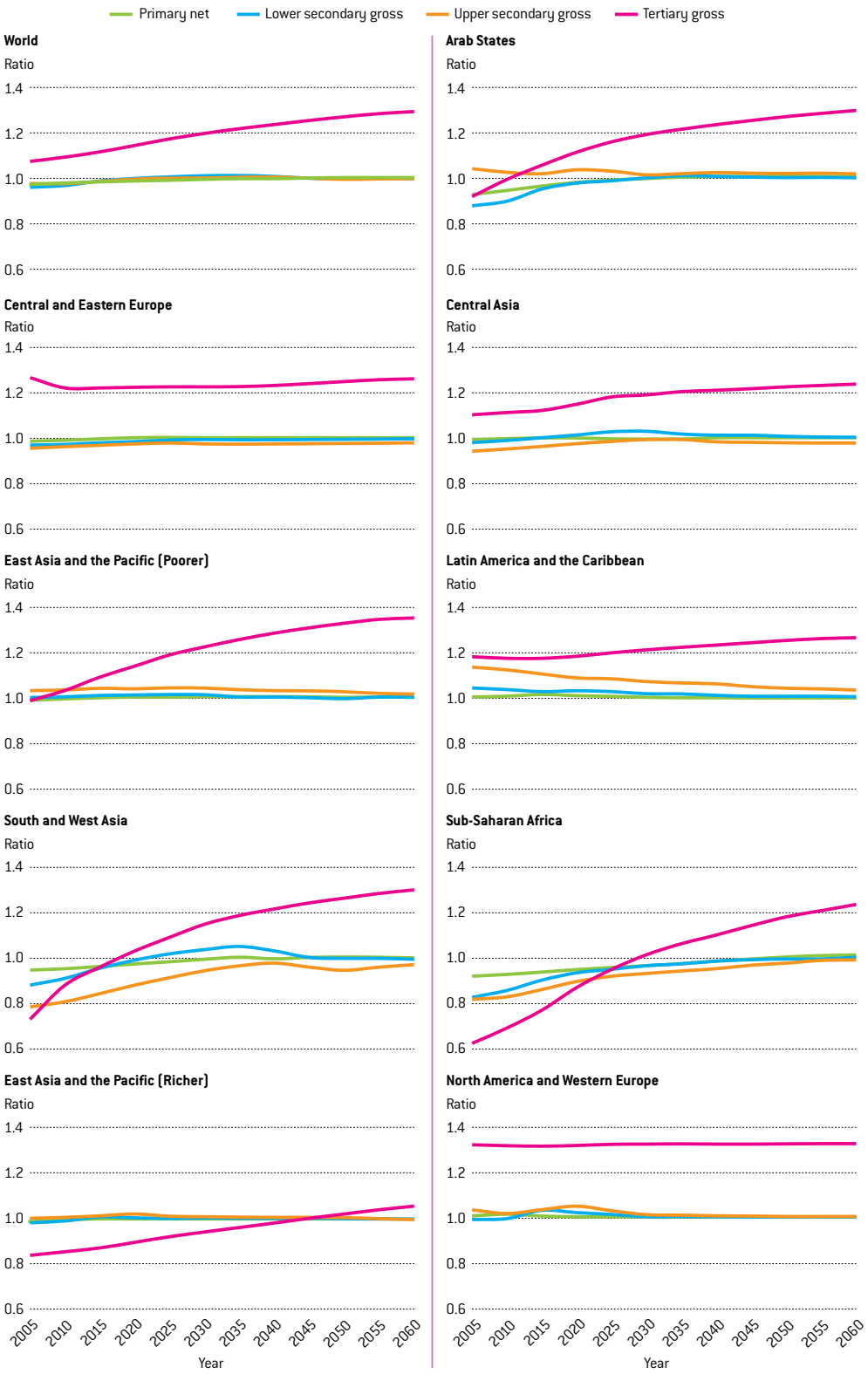
Despite much progress, the IFs base case suggests many countries will lack gender parity in one or more levels of education in 2015.

Table 5.2 Countries with primary and lower secondary enrollment rate forecasts below 90 percent in 2015

	Primary net	Lower secondary gross
May not reach 90% until between 2015 and 2029	Bhutan, Dominican Republic, Kenya, Lesotho, Nepal, Oman, Palestine, Rwanda, Swaziland, Yemen	Dominican Republic, Ecuador, Equatorial Guinea, Gabon, India, Indonesia, Israel, Morocco, Namibia
May not reach 90% until between 2030 and 2044	Benin, Côte d'Ivoire, Ethiopia, Ghana, Mauritania, Mozambique, Pakistan, Senegal, Togo	Bhutan, Honduras, Iraq, Lao PDR, Paraguay, Sudan, Swaziland, Yemen
May not reach 90% until between 2045 and 2059	Burkina Faso, Burundi, Rep. of Congo, Djibouti, Eritrea, Guinea, Mali, Niger, Nigeria, Solomon Islands, Sudan, Timor-Leste	Bangladesh, Cambodia, Comoros, Rep. of Congo, Djibouti, Ecuador, Eritrea, Ghana, Guatemala, Lesotho, Mali, Mozambique, Myanmar, Nepal, São Tomé and Principe, Senegal, Timor-Leste, Uganda, Vanuatu, Zimbabwe
May not reach 90% until 2060 or later	Central African Republic, Chad, Gambia, Guinea-Bissau, Liberia	Angola, Benin, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Dem. Rep. of Congo, Côte d'Ivoire, Ethiopia, Gambia, Guinea, Guinea-Bissau, Liberia, Madagascar, Malawi, Mauritania, Niger, Nigeria, Pakistan, Rwanda, Sierra Leone, Solomon Islands, Togo, Zambia

Source: IFs Version 6.12 base case.

Figure 5.4 Gender parity enrollment rate ratios by region and education level



Note: Primary is based on net enrollment rates and secondary and tertiary are based on gross enrollment rates.

Source: IFs Version 6.12 base case forecast.

may thus quite belatedly reach the global goal set for 2015, many countries will lag behind. By 2040, a dozen countries in the continent, including Chad, Guinea-Bissau, Somalia, Togo, Eritrea, and the Democratic Republic of Congo, may still fall short of the 0.97 goal.

South and West Asia is better positioned in terms of attaining gender parity. By 2005, it already had a primary net gender parity ratio of 0.95 and a lower secondary gross ratio of 0.89. By 2015, both of those ratios could near 0.97. Two of the forces beneath the forecast of rapidly improving ratios for many regions at the secondary level are survival rates that are often already higher for females and transition rates that are more nearly equal than enrollment rates. For instance, in South and West Asia as a whole, about 87 percent of girls who begin lower secondary education persist to the last grade, compared to about 83 percent of boys. And 81 percent of both girls and boys who recently completed primary school went on to general programs at the lower secondary level.

In Latin America, girls have advantages both in transition and especially in survival at the lower secondary level and even more pronounced ones in general programs at the upper secondary level. As systems continue to move toward universal primary education, substantially increasing the number of girls who complete primary education, these transition and survival patterns could well accelerate the movement toward female gender parity (and also increasing male parity gaps) at the lower secondary level. It is also possible, however, that increased participation of females at lower levels could eliminate their current advantage in those rates and slow down movement to parity (a dynamic that the model does not capture).

At the tertiary level, a reverse gender gap ratio of 1.08 has already appeared globally, and reverse gaps exist in several regions, including Latin America and the Caribbean. Our forecasts show reverse gender gaps at the tertiary level increasing around the world, in part again because gender gaps at lower levels are decreasing and are thus making steadily more females eligible for tertiary education. Tertiary forecasts are, however, among our least certain.

Education expenditures

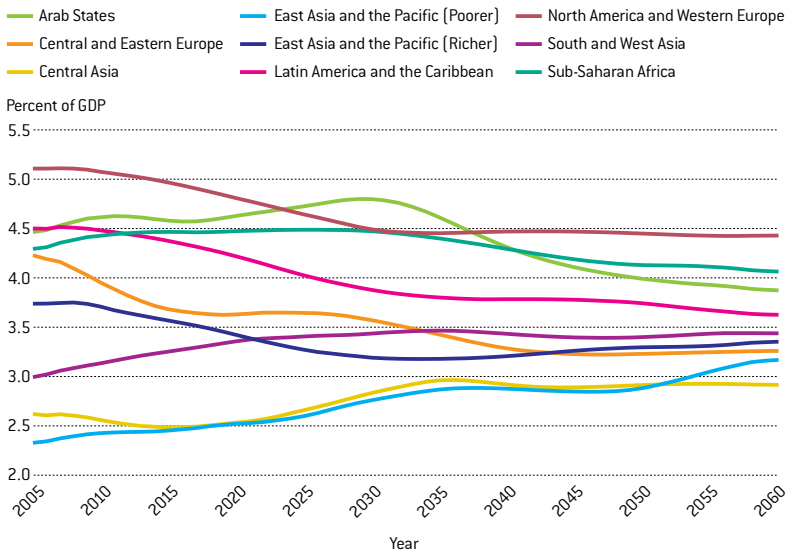
Expansions of education enrollment rates generally require expansions of education spending. Total public education spending as a share of GDP in low- and middle-income regions is still generally a little below that of high-income countries (see, again, Figure 3.13 and Table 3.6). Therefore, we would expect to see some continued rise in those spending shares over time. Figure 5.5 shows a possible evolution of education expenditures across developing regions of the world. Globally, spending may decline from about 4.5 percent of GDP in 2005 to 3.7 percent in 2060, heavily influenced by decreasing demographic burdens of younger populations and increasing demand from aging populations.[7] The declines will likely be overwhelmingly in North America and Western Europe, the richer countries of East Asia and the Pacific, and Central and Eastern Europe. The base case also anticipates, however, some decline in the Arab States and in Latin America and the Caribbean.

In contrast, low-income countries as a whole are likely to see expenditures rise from 2.7 to 3.5 percent of GDP, whereas spending in lower middle-income countries could rise from 2.7 to 3.3 percent of GDP. As in high-income countries, spending in upper middle-income ones may decline.

Girls often have lower primary entry rates than boys but higher survival rates and equal or higher transition rates to subsequent education levels.

Education spending will change over time in quite complex ways in response to multiple interacting forces.

Figure 5.5 Government spending on education as percent of GDP



Note: Used 5-year moving averages.

Source: IFs Version 6.12 base case forecast.

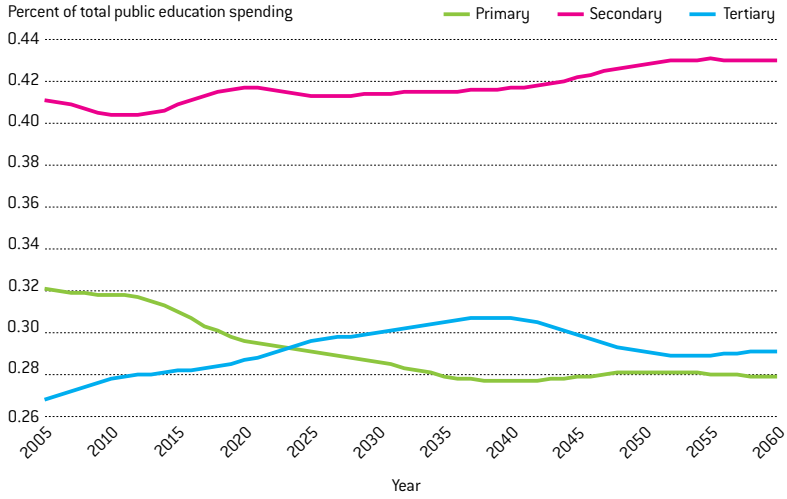
Spending patterns that characterize countries at earlier stages of education transitions will continue to differ from more typical global patterns.

The IFs base case anticipates that by 2060, adults globally will have completed, on average, ten years of education.

Rapid increases in government revenues as a result of high energy and materials prices cause temporary early-century rises for some groupings, especially the Arab States. The initial low values for the poorer East Asia and the Pacific countries heavily reflect China's spending in recent years and are uncertain—China's last reported value was 1.9 percent in 1999.[8]

Globally (and for countries in all income categories), the share of total education spending going to the primary level generally will decrease because the numbers of students at other levels are growing faster than those at the primary level. In contrast, secondary student numbers are rising as a share of the total global student population, and tertiary numbers, though low, are climbing even more rapidly. With increases in income, costs per student relative to GDP per capita tend to rise slightly at the primary level, to be fairly stable at the secondary level, and to fall at the tertiary level (Chapter 6 will explore this in more detail). Figure 5.6 shows the IFs base case global forecast of spending shares by level that results from these interacting patterns of changes in student numbers and changes in costs per student. The forecasts of increasing share for tertiary and declining share for primary expenditures suggest that total global tertiary expenditures will exceed primary expenditures within two decades.

Figure 5.6 Global education spending shares by education level



Note: Used 5-year moving averages.

Source: IFs Version 6.12 base case forecast.

Spending patterns that characterize and will continue to characterize countries at earlier stages in education transition differ significantly from the global patterns. For instance, in sub-Saharan Africa, more than half of the spending is now directed at the primary level. Yet the tertiary spending share will rise sharply because of the high cost of tertiary education per student in developing countries, not just because of rising student numbers. By 2060, sub-Saharan African countries are likely to direct roughly equal shares of their spending to each level of education.

Although the character of the education transitions under way significantly drives levels and patterns of spending on education, funding levels definitely have their own dynamics, quite separate from the demand side of the education picture. Governments have limited access to revenues and many claims upon those revenues for expenditures. The final section of this chapter will explore further the implications of different supply-side spending patterns, as well as look at other elements of forecasting uncertainty. Subsequent chapters will return to the financial side of education forecasting in the context of development and exploration of a normative education scenario.

Education attainment of adults

Education is about enhancing human capabilities. Although progressions to high levels of enrollment are important elements of the global education transition, the transition is ultimately about adults being able to live their lives as educated members of society. That element of the transition obviously lags the expansion of enrollment by many years. Figure 5.7 shows the pattern of adults' educational attainment, measured in terms of average years of education, in the IFs base case forecast as an extension of historical data. The forecast, which anticipates that adults in all regions of the world will have, on average, 7.3 years or more of education by midcentury, 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, relative gaps in adult education levels are narrowing. For instance, in 1960, sub-Saharan Africa's 1.9 average years of education among those fifteen

and older was only 28 percent of the 7 years in North America and Western Europe. In the base case forecast, sub-Saharan Africa's 7.3 years in 2060 (in addition to slightly exceeding the education levels in the highest income region of the world in 1960) would be 50 percent of the 14.7 years forecast for North America and Western Europe.

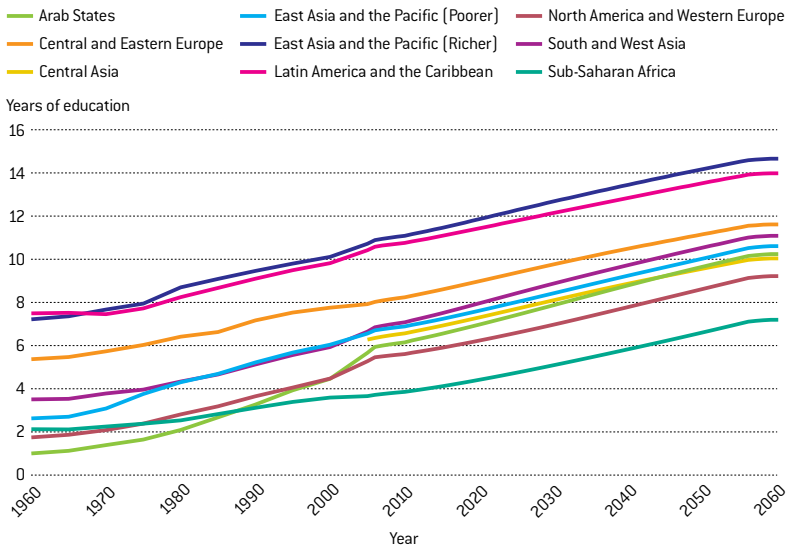
Second, there are some small but important relative changes in regional position over time. Sub-Saharan Africa is at risk in absolute terms of falling increasingly behind the "pack." In terms of the absolute difference in years of education between sub-Saharan Africa and North America and Western Europe, the gap increased from 5 years in 1960 to 7 in 2005, and it could be 7.5 years by 2060. This does not bode well for the competitiveness of the region in the global economy. In addition, Central and Eastern Europe looks likely to fall away from and behind the system leaders. Other regions are very slowly closing the absolute gap with those system leaders. In particular, the anticipated progress of the Arab States is notable. There is also likely to be a substantial closing of the gap between Western Europe and North America by midcentury (not shown in Figure 5.7 where the UNESCO region combines the two subregions), reflecting in part a continued expansion of tertiary education opportunities in Europe.

As levels of education among adults rise in the years ahead, younger adults will continue to achieve higher levels of education than older adults. Today, the pattern in many developing countries is one of numerous, increasingly well-educated young adults in combination with older adults, especially females, who have very few years of education. Figure 5.8 shows two important countries that exemplify this pattern, India and China.

The education pyramid of India in 2005 (upper left) shows that tertiary education is rare among men forty-five or older; even completed secondary education is rare among females. By 2060, both demographic and educational structures of the Indian population will most likely be dramatically different than they are today. In the upper right of the figure, one can see that for those aged thirty or younger, primary education will be essentially universal. In fact, through age sixty, the number of individuals with secondary and tertiary educations will each likely exceed those with only primary education. Thus, significant levels of secondary and tertiary education will characterize all cohorts through a working lifetime. The largest population cohorts will still be in the prime years of their careers, albeit nearing the end of them, which bodes well for continued economic dynamism through the first half of this century.

In China, the population patterns will change considerably less, but the patterns of educational attainment will evolve in much the same manner. By 2060, very few Chinese without at least a primary education will remain in the workforce. The greatest difference between China and India is apparent in the shape of the age/sex distribution of China in 2005, a pattern that looks more like those of Western European countries rather than India. By 2060, the distributional shape of both the Chinese and the Indian age structures (and educational structures) will look more like each other, in both cases coming to resemble those that we anticipate for Japan and Italy in the coming two decades. The largest population cohort that China may ever see will have already reached retirement age, and the largest cohort of India will not be far behind.

Figure 5.7 Average years of education of adults 15 years and older: History and forecast

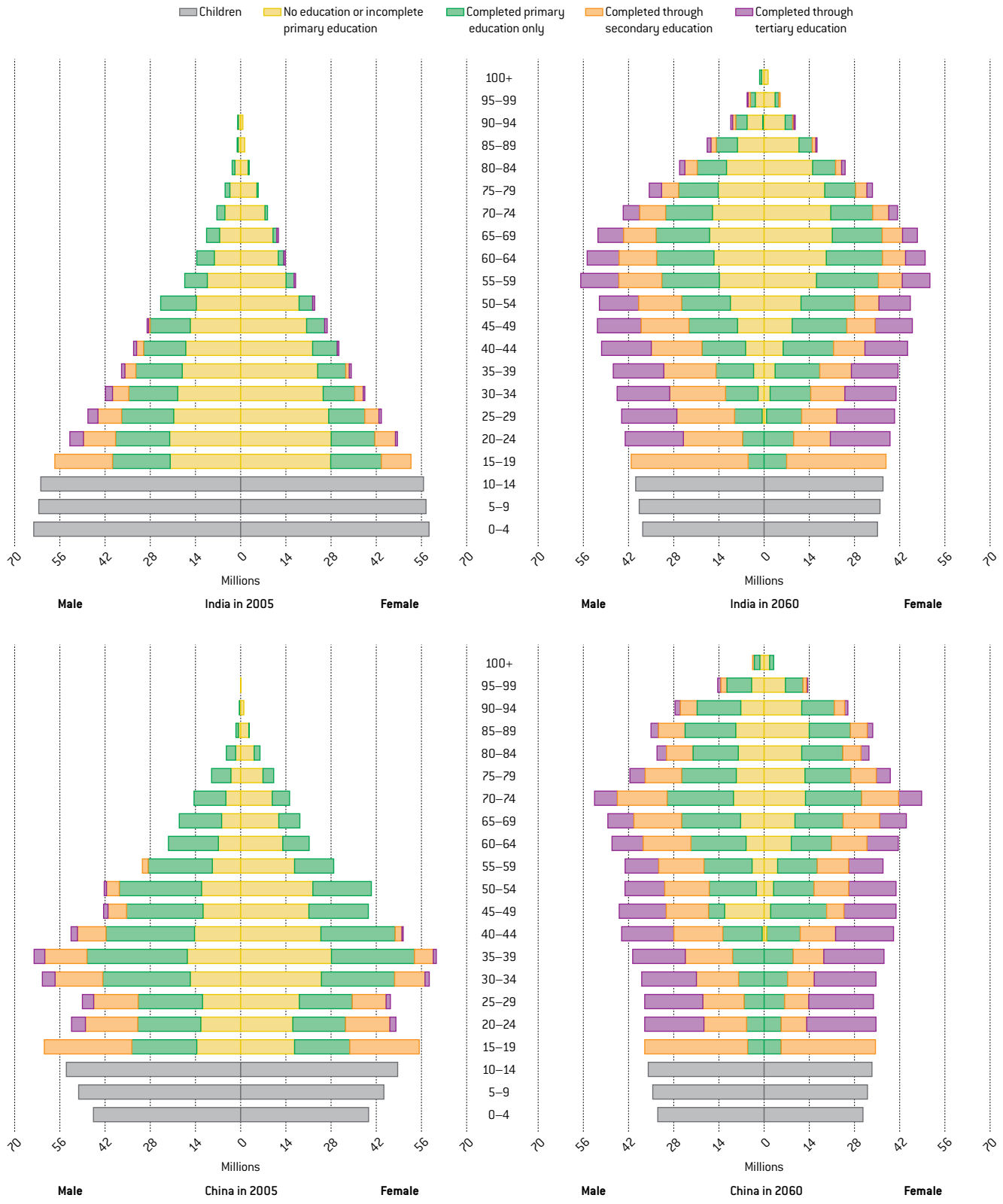


Note: Values are 5-year moving averages with 1990 for Central Asia removed for smoothing.

Source: IFs Version 6.12 base case with Barro and Lee (2001) data through 2000.

Relative gaps in adults' education levels are narrowing across all regions, but sub-Saharan Africa is at risk of falling further behind in absolute terms.

Figure 5.8 Population by age, sex, and level of completed education



Source: IFs Version 6.12 base case forecast.

Table 5.3 extends our look at the education levels of adults to the portions of various regional populations likely to have completed various levels of education in 2030 and 2060 in comparison with 1960 and 2000. We draw a number of insights from the table:

- With respect to primary education, the IFs base case suggests that for the least developed regions, the transition to universal primary education among adults will still be very much under way in 2060, reaching 90 percent only by about the end of the century (not shown). Yet it will also be quite far along even in the developing world. Only sub-Saharan Africa will likely have an adult population in 2060 with lower primary attainment rates than North America and Western Europe had in 1960.
- With respect to secondary education, not quite one-fourth of adults in sub-Saharan Africa and 40 percent of adults in South and West Asia will likely have attained a full secondary education in 2060. Yet it is also likely that only those two regions will have lower secondary attainment rates than North America and Western Europe had in 2000, and even that of sub-Saharan Africa will likely approximate that which the highest income regions experienced in 1960. However, a hundred-year lag is long, even when it reflects progress from a base of nearly nonexistent secondary education among adults across sub-Saharan Africa in 1960.
- With respect to tertiary education, it is quite possible that by 2060, only sub-Saharan Africa will not have reached levels of adult tertiary attainment comparable to those in North America and Western Europe in 2000. The advance of tertiary education globally is likely to be one of the most dramatic elements of education transition in the coming decades. Whereas in 1960, only 1.2 percent of adults globally had a tertiary education, that figure could potentially reach 25 percent by 2060.
- With respect to gender balance of education among adults, it will 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 secondary level) where the ratio of female-to-male adult attainment rates will fall somewhat below 97 percent. But clearly, the base case suggests that the battle for female parity, at least as reflected by education attainment rates, could be largely won. Global attainment rates for females are forecast to be 99 percent of males' rates at the primary level, 97 percent at the secondary level, and 104 percent at the tertiary level.

In coming decades, the global advance of tertiary education among adult populations is likely to be dramatic.

Because basic education generally confers literacy, it is not surprising that all major regions of the world will likely achieve almost 100 percent literacy by midcentury. The Gini coefficient is the most widely used measure of distribution for income and other quality-of-life measures. The smaller the Gini value, the more egalitarian a distribution is. In 2005, the IFs estimated global Gini of literacy was 0.116 (using population-weighted country data),[9] a considerably more egalitarian distribution than that for global income, which was 0.583.[10] Gini for literacy declines in the IFs base case to 0.062 in 2030, and with universal literacy, the value would be 0. The global Gini for years of education at age twenty-five (the least egalitarian of our education attainment measures) declines in the base case from 0.229 in 2005 to 0.172 in 2060. Such improvement in the global distribution of the ability to read and write and to participate in further education has considerable potential for increasing equality in other spheres.

The base case suggests that by 2060, the battle for female parity as reflected by the education attainment rates of adults will be largely won.

Comparison of Forecasts

So far, this chapter has put the IFs base case forecasts for global education in the context of historical trends. It is also important to consider them in the context of other forecasts, in order to determine whether results are comparable, and to consider the bases for differences when they exist.

Early forecasts

Before comparing IFs forecasts with others made quite recently, there is value in going back somewhat further and looking at UNESCO forecasts made across the years. Doing so helps us see whether forecasts have been successful more generally.

All major regions of the world will likely achieve almost 100 percent literacy by midcentury.

Table 5.3 Percentage of population age 15 and older completing various levels of education: History and forecast

	Completed primary education (percent)				
	1960	2000	2030	Total 2060	Females 2060
Arab States	6.4	42.2	64.6	82.3	81.1
Central and Eastern Europe	60.7	84.1	84.1	91.3	90.0
Central Asia			73.7	86.3	85.3
East Asia and the Pacific (Poorer)	24.4	59.3	74.1	86.8	84.7
Latin America and the Caribbean	27.4	49.9	70.0	84.9	84.4
South and West Asia	10.6	37.2	55.6	74.3	72.4
Sub-Saharan Africa	14.3	27.3	40.9	63.9	64.3
East Asia and the Pacific (Richer)	70.1	87.0	90.4	95.5	95.2
North America and Western Europe	73.3	85.5	92.4	97.3	97.2
World	39.0	55.9	66.2	79.6	78.5
	Completed secondary education (percent)				
	1960	2000	2030	Total 2060	Females 2060
Arab States	0.9	15.2	34.5	54.0	54.5
Central and Eastern Europe	13.0	28.8	49.3	66.8	66.9
Central Asia			46.1	64.0	63.7
East Asia and the Pacific (Poorer)	3.2	17.9	34.7	54.7	54.0
Latin America and the Caribbean	5.8	19.6	40.5	60.3	61.6
South and West Asia	0.8	11.2	22.9	40.5	36.2
Sub-Saharan Africa	1.8	4.5	10.9	23.5	22.4
East Asia and the Pacific (Richer)	28.2	44.8	62.6	77.9	78.0
North America and Western Europe	18.1	50.5	67.7	84.5	84.8
World	9.0	21.1	33.5	48.5	47.2
	Completed tertiary education (percent)				
	1960	2000	2030	Total 2060	Females 2060
Arab States	0.1	3.3	10.2	21.4	21.4
Central and Eastern Europe	1.8	8.7	24.2	39.3	40.0
Central Asia			13.9	24.0	25.7
East Asia and the Pacific (Poorer)	0.7	2.5	11.2	25.6	27.6
Latin America and the Caribbean	0.9	4.8	13.8	25.4	27.3
South and West Asia	0.1	2.0	8.0	18.7	18.2
Sub-Saharan Africa	0.2	0.9	3.5	10.0	10.2
East Asia and the Pacific (Richer)	2.6	12.0	29.7	49.7	46.4
North America and Western Europe	3.6	15.1	34.4	54.4	57.9
World	1.2	4.8	12.9	23.7	24.6

Source: IFs Version 6.12 base case with Barro and Lee (2001) data through 2000.

For instance, in 1983, UNESCO used extrapolative techniques to forecast gross enrollment rates at all education levels for countries and regions through 2000.[11] The UNESCO forecasts proved remarkably good at the primary level, although they somewhat overestimated African progress and underestimated that of Latin America. Across levels of education, the major weakness proved to be a significant underestimation of secondary education enrollment rates almost everywhere except Africa, where they again overestimated enrollment rates. At the tertiary level, the striking discrepancy was for the developed world, where enrollment rates for both secondary and tertiary students increased much faster than UNESCO anticipated.

In 1994, UNESCO made forecasts for literacy rates in 2000, with an extended horizon to 2010. These forecasts significantly underestimated progress on literacy for the Arab States and South Asia by 2000. They again overestimated progress in sub-Saharan Africa (in fact, even the base year data they used for 1990 subsequently proved to be too high).

Looking further ahead, UNESCO made other forecasts in both 1989 and 1993 for 2025, including the enrollment headcount forecasts shown in Table 5.4. Looking at those forecasts made just four years apart, it is clear that the enterprise of longer-term education 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 in the original). Even primary enrollment forecasts varied significantly between the studies, especially those for sub-Saharan Africa. The 1993 study brought down the anticipated number for 2025 because of a changing understanding of the demographic prospects of the region and especially because it had come to be understood that the earlier expansion of enrollment rates had faltered. At the secondary and tertiary levels, there was even greater uncertainty about prospects, and the 1993 study significantly reduced the forecast for secondary enrollment in sub-Saharan Africa relative to that of 1989.

It is important to consider the IFs base case forecasts of education's continued advance with those of other researchers and forecasters.

Table 5.4 UNESCO and IFs forecasts of student enrollment numbers in 2025 (millions)

	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 and the Caribbean	100	51	20	81	33	12
East Asia	398	314	52	185	117	15
South Asia				173	124	16

	IFs forecasts made 2009		
	Primary	Secondary	Tertiary
World	703	573	182
Developed	78	87	50
Developing	626	485	132
Sub-Saharan Africa	185	63	11
Arab States	50	39	10
Latin America and the Caribbean	55	60	20
East Asia and the Pacific (Poorer)	152	148	45
South and West Asia	176	152	36

Note: In 1989, all of Asia was combined in a single UNESCO region, whereas by 1993, it was represented as two regions—East Asia and South Asia. In this table, "East Asia" in 1989 includes both East Asia and South Asia.

Source: UNESCO Division of Statistics (1989: 7; 1993: 7) and IFs Version 6.12 base case.

Early extrapolative forecasts appear to have underestimated the acceleration of enrollment growth at secondary and tertiary levels.

Except for sub-Saharan Africa, the current IFs forecasts in Table 5.4 for enrollment headcounts in 2025 at the primary level are lower than both UNESCO forecasts; African enrollment rate increases have accelerated in recent years, whereas more recent population forecasts have revised expected school-age populations substantially downward elsewhere. In contrast, at the secondary level, most IFs forecasts, again excepting sub-Saharan Africa, are closer to the higher 1989 UNESCO forecasts than to those of 1994. The major difference between IFs and UNESCO forecasts, however, is at the tertiary level, where IFs forecasts for developing regions are clearly higher than either UNESCO set.

Two lessons that might be drawn from these historical forecasts suggest (1) that short-term extrapolative forecasts have been reasonably accurate, although they have clearly shifted with the mood and understanding of the times; and (2) that extrapolative methods appear to have underestimated the ongoing acceleration of enrollment growth at secondary and tertiary levels.

More recent enrollment forecasts

How do the results from the IFs base case compare with those from other, more contemporary forecasting efforts?[12] There are a number of significant projects and forecast sets that we will consider more or less chronologically.

As stated previously, Clemens (2004) completed an extensive historical analysis of rates of enrollment change. He mapped primary net enrollment rates for more than 100 countries at five-year intervals from 1960 to 2000 and analyzed the speeds at which countries moved between benchmark enrollment rates (such as from 50 percent to 70 percent or from 90 percent to 97 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 in Clemens 2004: 42), in which the most rapid change occurs around a 50 percent enrollment rate and incremental change is slower when enrollment rates are very low or very high (thereby creating the S-shape).[13]

Table 5.5 summarizes what Clemens learned about transition speeds in primary enrollment rates across different intervals. Increases from a 75 percent to a 90 percent enrollment rate (15 percentage points) have taken an average of 28 years, demonstrating (consistent with the S-shaped pattern) slower progress than the 22.3 years typically needed to progress from a 50 percent to a 70 percent enrollment rate. Table 5.5 also shows the transition speeds calculated from IFs forecasts. On the whole, the speeds in the base case of IFs are faster.

Clemens (2004: 52) also used his S-curve approach to forecast primary enrollment rates for global regions in 2015 from a 2000 base. A comparison of the base case forecasts from IFs in 2015 with those developed by Clemens, using the complete, budget-constrained system of IFs, found differences that did not exceed 2 percentage points between now and 2015 (except for sub-Saharan Africa),[14] despite the faster transition speeds of IFs in Table 5.5.

Wils, Carrol, and Barrow (2005), of the Education Policy and Data Center, also used a fundamentally extrapolative methodology (with logistic or S-shaped curves) to forecast the years in which seventy 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 household survey data from Demographic and Health Surveys and the Multiple Indicator Cluster Survey[15] that included questions about current education attainment levels of different adult age cohorts

Table 5.5 Comparing the speed of transition in primary net enrollment rates

	Time needed for the growth interval (in years)	
Primary net enrollment rate growth interval	Clemens	IFs
50%–70%	22.3	19.8
50%–80%	36.4	30.8
50%–90%	57.7	43.3
75%–90%	28.0	20.3
90%–97%	not reported	12.3

Note: IFs speeds were calculated across all countries and entire forecast horizon in the base case.

Source: Clemens (2004: 15–16); IFs Version 6.12 base case forecast.

to reconstruct past education flow rates such as 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.

Although the forecasts made 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. Wils, Carrol, and Barrow, 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 speeds they reported for the transitions from 80 to 90 percent and from 90 to 95 percent in primary completion rates.[16] The figures in Table 5.6 compare their completion transition speeds with those for the same set of countries from IFs. Keeping in mind the differences between the ways these two models measure the completion rate,[17] the results are more similar than they might appear.

A recent report from the Education Policy and Data Center (EPDC 2007b) gives us an opportunity to more directly compare forecasts made using extrapolative methods with those from a cohort-based methodology and with those from the integrated and structural forecasting system of IFs. In support of the *Education for All 2008 Global Monitoring Report,* UNESCO and the EPDC prepared three different sets of forecasts of primary and secondary enrollment in 2015 and 2025.[18] The first two used S-curve extrapolations of enrollment rate trends from data since 1991 and 1999. The third used a cohort flow methodology that has some features in common with the annual student flow approach of the IFs education model. Table 5.7 summarizes the forecasts of primary net enrollment rates in 2025 for the sub-Saharan African countries for which all four methods provided forecasts.

The striking aspect of the forecast comparison in Table 5.7 is the significant range of variation across the methodologies, even for a horizon as relatively close as 2025. The differences between the extrapolations based on data available since 1991 compared to those based on data available since 1999 clearly reflect whether or not a country has experienced acceleration or deacceleration of enrollment gains in recent years. Acceleration is the case for countries including Burkina Faso, Burundi, and selected others, especially Namibia and Niger. Reduction in the speed of gains has characterized fewer countries, namely, Eritrea and especially Togo. In general, the cohort methodology, which was based on recent patterns, appears to somewhat amplify such turns. Burkina Faso and Namibia are examples on the upward side, and Togo illustrates the situation on the downward side.

The forecasts of IFs prove to be within the range of the others in many cases, but they tend more often than not to be at the

Table 5.6 Comparing the speed of transition in primary completion rates

Transition in completion rate	Wils, Carrol, and Barrow transition time	IFs transition time (average)
80%–90%	22.3	19.8
90%–95%	36.4	30.8

Source: Wils, Carrol, and Barrow (2005: 22); IFs Version 6.12 base case forecast.

The IFs base case forecasts a somewhat more rapid transition in primary enrollment rates than some other contemporary models and reports.

Table 5.7 Comparing forecasts of primary net enrollment rates for selected sub-Saharan African countries in 2025

	Trend from post-1991 data	Trend from post-1999 data	ProEnrol cohort method	IFs
Burkina Faso	64.8	74.3	100.0	61.5
Burundi	73.8	95.0	95.0	67.6
Eritrea	89.5	81.0	40.8	63.5
Ethiopia	96.7	99.2	66.7	74.8
Ghana	81.7	88.0	81.9	77.1
Guinea	95.3	98.3	99.4	76.3
Kenya	98.5	98.2	79.8	88.3
Lesotho	97.5	99.8	83.3	91.3
Mauritius	95.6	99.6	99.1	100.0
Mozambique	96.5	99.5	58.7	85.5
Namibia	45.9	65.0	86.4	97.7
Niger	71.6	92.0	89.3	57.3
Senegal	90.3	96.4	66.7	81.3
Tanzania	100.0	100.0	87.7	93.4
Togo	92.5	78.1	70.7	84.6
Zambia	97.4	100.0	99.2	91.4

Note: These countries are the subset of sub-Saharan African countries with results from each of the four forecast methods.

Source: Education Policy and Data Center (2007b: 84–87); IFs Version 6.12 base case.

However, IFs frequently generates more conservative forecasts than those that rely solely on extrapolations from very recent time periods.

low end or below the range of the other forecasts of Table 5.7. Burkina Faso and Niger offer the clearest examples. To understand why that might be the case, and to better understand the differences of the alternative methodologies, it is useful to explore in some detail the case of Burkina Faso.

Educationally, the strictly of-age primary net 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 overage and one year underage) grew from 40 percent to 68.7 percent in the same period (the adjusted net intake rate of the country therefore grew by an average 5.5 percentage points each year between 2000 and 2005, 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 primary net enrollment from 34.7 percent in 1999 to 44.1 percent in 2005, with an especially large jump from 2004 to 2005. On a purely extrapolative basis, forecasts for 2025 in the 65–75 percent range do not seem unreasonable.

However, as stated previously, the IFs model ties change in intake and survival (and therefore enrollment) to forces on both the demand and the supply sides of the education 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 very similar levels of income, the net enrollment rate of Rwanda is just under 79 percent, and Kenya's falls just below that level. In fact, on the basis of cross-sectional analysis of countries around the world, the "typical" country with a GDP per capita at the level of Burkina Faso would have a primary net enrollment rate 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 the assessment of the ability of the country to support in the future the kind of enrollment growth that it has experienced in recent years and that extrapolative forecasts implicitly presume will continue.

To provide some background,[19] Burkina Faso is a landlocked, resource-poor country in a region of northwestern Africa that overall suffers from high population densities and major environmental problems, especially a lack of available water. Demographically, the country has a total fertility rate of about 6.1 children per mother and a population growth rate of just over 3 percent. An Education Policy and Data Center analysis (EPDC 2005: 62–63) put Burkina Faso on a list of six countries where educational growth was likely to be overwhelmed by population growth. About 46 percent of its total population is fifteen years of age or younger, an extremely challenging child dependency ratio. Subsistence agriculture occupies nearly 90 percent of its population.[20] Economically, its GDP per capita in 2005 at PPP (2005 dollars) was only $1,079, but it was growing reasonably well until higher oil and food import costs affected the national economy in more recent years. The IFs base case anticipates a value of $1,438 in 2025.

Several important factors limit the country's ability to mobilize resources for a continuing expansion of education and to meet the growing demand of an increasing young population. In 2007, Burkina Faso had an international debt of about 21 percent of GDP and 165 percent of exports. Its deficit on current accounts in 2007 was nearly $700 million, or about 11 percent of GDP. Without foreign aid, its government budget deficit was about 7 percent of GDP. Household finances are also under pressure. Significant portions of the male population seek employment in neighboring countries, and unrest in Côte 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 girls' education at the primary level, and it may receive more external funding for other purposes. Yet the country is already dependent on aid from the outside for about $500 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.

In addition to facing financial constraints, the country must cope with a demand for education spending that has grown significantly. One of the complications of extrapolative forecasting is that growth can be its own undoing if there is overshoot (that is, unsustainable increase), as in part the rapid growth of enrollments in sub-Saharan 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.

With respect to complications for extrapolation of change in education participation rates, the rapid increases in intake have been recent enough that the government has not yet felt the full financial burden of the ongoing enrollment levels that will result from them. Moreover, growing pressure for secondary education of new primary graduates will increasingly compound the mounting burden at the primary level. In Burkina Faso, the transition rate to lower secondary education rose from 38 percent in 1999 to 44 percent in 2005, just as primary enrollments rose sharply.

Burkina Faso is likely to obtain some financial help from a more efficient use of its education spending. It now spends about 35 percent of GDP per capita on each primary student, almost 20 percentage points more than the typical low-income country. The IFs base case forecast does build in a reduction of per-student spending to 20 percent of GDP per capita in 2025 but nonetheless sees growing fiscal constraint.

We certainly do not wish misfortune on Burkina Faso with respect to future enrollment patterns 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 5.7 tend to suggest slower enrollment growth than do some important existing forecasts and to indicate bases for some conservatism of expectations.

Forecasts of educational attainment

In addition to forecasting enrollment rates and numbers, 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, in projects under the leadership of Wils (EPDC 2005), and the International Institute for Applied Systems Analysis, in work led by Lutz (Lutz, Goujon, and Wils 2005), have used a population cohort–based methodology called multistate 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 but with one key difference. The EPDC and IIASA models count (and forecast) anyone who has attended any portion of a level of education in the attainment data for that level. The IFs model, in distinction, counts and forecasts in attainment data only those who have completed a level.

The EPDC (2005) forecasted through at least 2025 the levels of educational attainment not just by youths and adults in eighty-three developing countries but also by subnational regions in four countries with significant interregional variation (Kenya, Madagascar, Nepal, and Nigeria). Lutz and colleagues have used the approach variously for 13 world regions and 120 countries. However, we do not compare our forecasts with theirs because of the significant differences in methodology as to what constitutes attainment. The IFs forecasts for 183 countries are included in the end tables in this volume, and earlier IFs forecasts were in the end tables of the first volume in the Patterns of Potential Human Progress series (Hughes et al. 2008).

With respect to a different measure of attainment, UNESCO (2007b) has published country-specific and regional forecasts of adult literacy in 2015. Table 5.8 compares those forecasts with ones of the IFs base case. Again, the methods of the two forecasts vary. The UNESCO forecasts use the UIS Global Age-Specific Literacy Projections model (UNESCO 2007b: 258), which is based on the work of Lutz;[21] the IFs model, by contrast, 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 (correctly) not expect great differences between the two forecasts in any case.

UNESCO and IFs forecasts of adult literacy in 2015 are all but identical.

Table 5.8 Comparing forecasts of adult literacy rates in 2015

	UNESCO	IFs
World	86	85
Transition	100	99
Developed	99	99
Developing	83	82
Arab States	78	77
Central and Eastern Europe	98	98
Central Asia	99	98
East Asia and the Pacific	95	95
Latin America and the Caribbean	93	95
North America and Western Europe	99	100
South and West Asia	70	67
Sub-Saharan Africa	70	70

Source: UNESCO (2007b); IFs Version 6.12 base case.

By exploring some of the uncertainty in our base case, we can develop a sense of the extent of that uncertainty.

We look at uncertainty with respect to demography, economy, and education spending and explore their possible effects on future education patterns.

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, often incorporating sensitivity analysis with respect to uncertainties. It is to that we now turn.

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.[22] 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 a very rough sense of the magnitude of formulation-based uncertainty.

Much of the uncertainty about the future of global education relates to assumptions about key drivers of the variables of interest to us, namely, the flows of students through the education 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 effects on education futures of 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 education patterns.

Mapping the range of uncertainty

Population

In its biannual World Population Prospects series, 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.[23] Analysis with the IFs model replicates the general differences of these UN scenarios through the introduction of multipliers on fertility rates. Overall, the IFs low-population scenario gradually, over a period of thirty years, reduces total fertility rates (TFRs) in developing countries by roughly 30 percent relative to the base case (subject to a minimum TFR of 1.6), and the high-population scenario increases fertility rates globally over fifty years by roughly 40 percent relative to the base case.

Figure 5.9 shows the resulting global population growth rates using the IFs model, as well as historical data. The IFs base case is very close to the UN medium variant, and the other two cases in IFs largely match the high and low UN variants. The resultant global populations in 2060 are 7.7 billion in the low-population scenario, 9.4 billion in the base case, and 11.3 billion in the high scenario. In the high-population scenario, total fertility rates in sub-Saharan Africa decline from 5.3 in 2005 to 3.7 in 2060; in the low-population scenario, rates drop to 1.6, whereas in the base case, they decline to 2.6. As a result, in sub-Saharan Africa, the population ranges from 1.4 to 2.6 billion across the scenarios; in South and West Asia, it ranges from 1.9 to 2.8 billion.

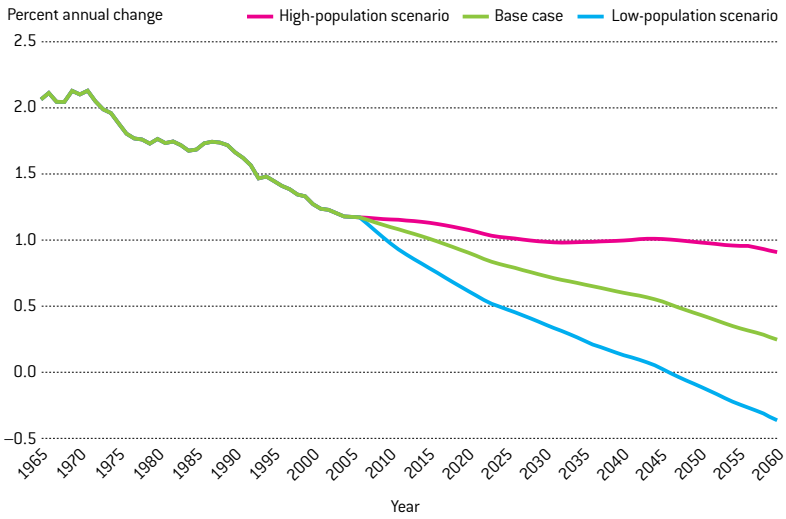
Economic growth

In spite of their importance in regard to 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 et al. (2008: chap. 5) discussed the economic forecast of the IFs base case, comparing it with a number of the others that do exist—namely, those of the World Bank, Global Insight, and the International Energy Agency (World Bank 2007a: 3; United States Department of Energy 2006: 12; IEA 2007)—as well as evaluating the forecast in the context of historical growth. Figure 5.10 shows again the historical context for the economic growth of the IFs base case and also indicates global growth patterns in two alternative scenarios.

The interventions made in IFs to create the high and low economic forecasts for use in forecasting education futures were largely variants in assumptions concerning productivity growth. The interventions were scaled 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 growth in the base case, we increased or decreased the rates of growth in sub-Saharan Africa, South and West Asia, and Latin America and the Caribbean by about 1.5 percent. And because the historical pattern of economic growth (to which the base case is tied) has been so high for China, we increased China's high case by only 0.5 percent and decreased its low case by 2.0 percent. IFs produces forecasts for GDP at both purchasing power parity and market exchange rates (MERs). GDP at purchasing power parity is used in most education model calculations. However, Figure 5.10 shows GDP at market exchange rates because they are used in most comparative forecasts.

Some readers may argue that the low-growth scenario should be the base case and that other scenarios should be adjusted downward accordingly. The global financial crisis beginning in 2008 and the subsequent global downturn give weight to such an argument. So, too, does the general downward trend in global GDP growth since the "golden era" of the 1960s, a trend that Figure 5.10 shows. Nonetheless, the shorter upward trend from the late 1980s through 2007, related to the spread of new productivity-enhancing information and communications technology and to the accelerated growth of China, India, and other large emerging market countries, provides a basis for the argument that a higher-growth future could reemerge. (IFs is available for readers to create and explore alternative scenario sets.)

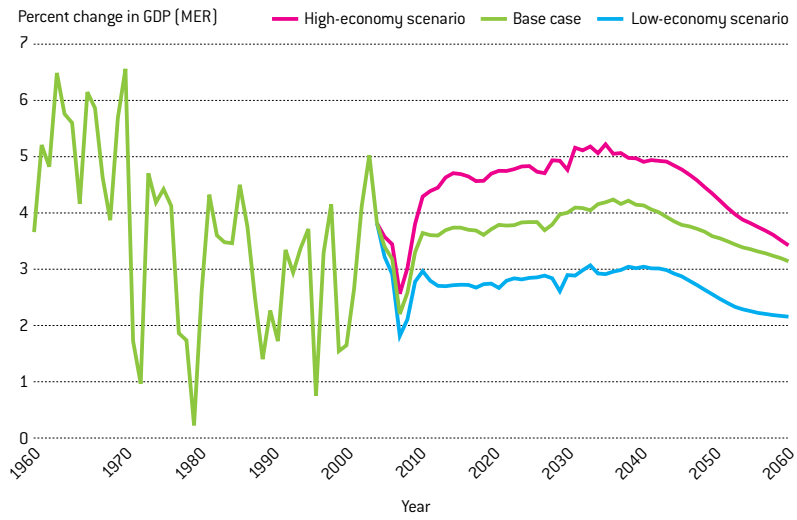
Figure 5.9 Global population growth rate scenarios: History and forecasts



Note: Removed apparently inconsistent data from 2003 and 2005.

Source: IFs Version 6.12 base case forecast and high- and low-population scenarios with WDI data through 2005.

Figure 5.10 Global economic growth rate scenarios: History and forecasts



Note: Irregularities in the economic forecasts reflect, in part, the impact of energy transition; slowing growth reflects decreasing population growth.

Source: IFs Version 6.12 base case forecast and high- and low-economy scenarios with WDI data through 2005.

The impact of the alternative population scenarios is, in the long run, greater than that of the alternative economic or education spending scenarios.

Public spending on education

A third variable of great importance for forecasts of education participation is the rate of spending on education. Much forecasting around education is normative and has looked at the costs of education to reach specific education goals (see, for example, Bruns, Mingat, and Rakotomalala 2003; for comparative discussion, see Gurria and Gershberg undated), and some analyses have explored relationships between varying levels of public spending and education participation levels (again, see Bruns, Mingat, and Rakotomalala 2003 and also Cuadra and Moreno 2005 and Binder 2006). We know, however, of no forecasts that explore the impact of alternative spending levels on education outcomes.

Given that public spending on education averages just below 4.5 percent of global GDP, a total variation of about 0.5 around the base case forecast provides a reasonable range across which to look at the possible reactivity of education futures. We introduced that magnitude of variation into IFs gradually over ten years, using upward and downward multipliers on endogenously generated spending.

Although it is often not true that all good things (or all bad things, for that matter) go together, it is possible to imagine a "highly optimistic" world of low population growth, high economic growth, and high education spending or to imagine a "highly pessimistic" world based on the reverse assumptions. We considered the impact of such extremes as well.

For the world as a whole, the low-population scenario allows near-universal enrollment at the lower secondary level by 2060.

Exploring uncertainty by driver

Figure 5.11 shows the separate impact of each set of alternative scenarios on gross enrollment rates at the lower secondary level. The impact at the primary level, which the next section will discuss, is considerably smaller because there is less "headroom" remaining there for upward movement when drivers vary.[24] And we show only sub-Saharan Africa and South and West Asia, again because those regions have the greatest room for potential upward movement at the lower secondary level.

Interestingly, the impact of the alternative population scenarios is, in the long run, greater than that of the alternative economic or budget scenarios. Upon reflection, this is not surprising when one considers that the population difference in 2060 across the low and high scenarios for sub-Saharan Africa is nearly a factor of two. The dependency ratio in 2060 for sub-Saharan Africa is 18.1 in the low-population scenario rather than 34.7 in the high-population case, and in South and West Asia, it is 12.0 rather than 23.4. Such differences have a huge impact on the ability to educate more students at higher levels. In contrast, much of higher GDP simply flows quite directly to higher spending per student, although it, too, has a significant impact on enrollment rates in the longer term.

It takes quite a while to accumulate significant differences in population or GDP across the scenarios because the underlying processes are related to stocks—of population, of capital, and of technology. Once set in motion, however, the impact of such changes tends to grow, in part because increasing education further reduces fertility and increases GDP in a positive feedback cycle. In contrast, diversion of government spending to or from education is a flow and has a quite immediate impact on enrollment. In the longer run, however, its impact does not grow.

The paths of population impact

Population growth or decline affects student flows most directly by changing the number of potential students of traditional age at each education level and the proportion of the total population they represent. For instance, were of-age children to decline in number without a drop in adult population numbers or income levels, societal resources would potentially be available either to support larger portions through school or to devote more resources to each student.

The differences in enrollment rates across the 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 11 percentage points higher in the low-population scenario than in the high-population scenario, and upper secondary enrollment could be 13 percentage points greater. For the world as a whole, the low-population scenario allows near-universal enrollment at the lower

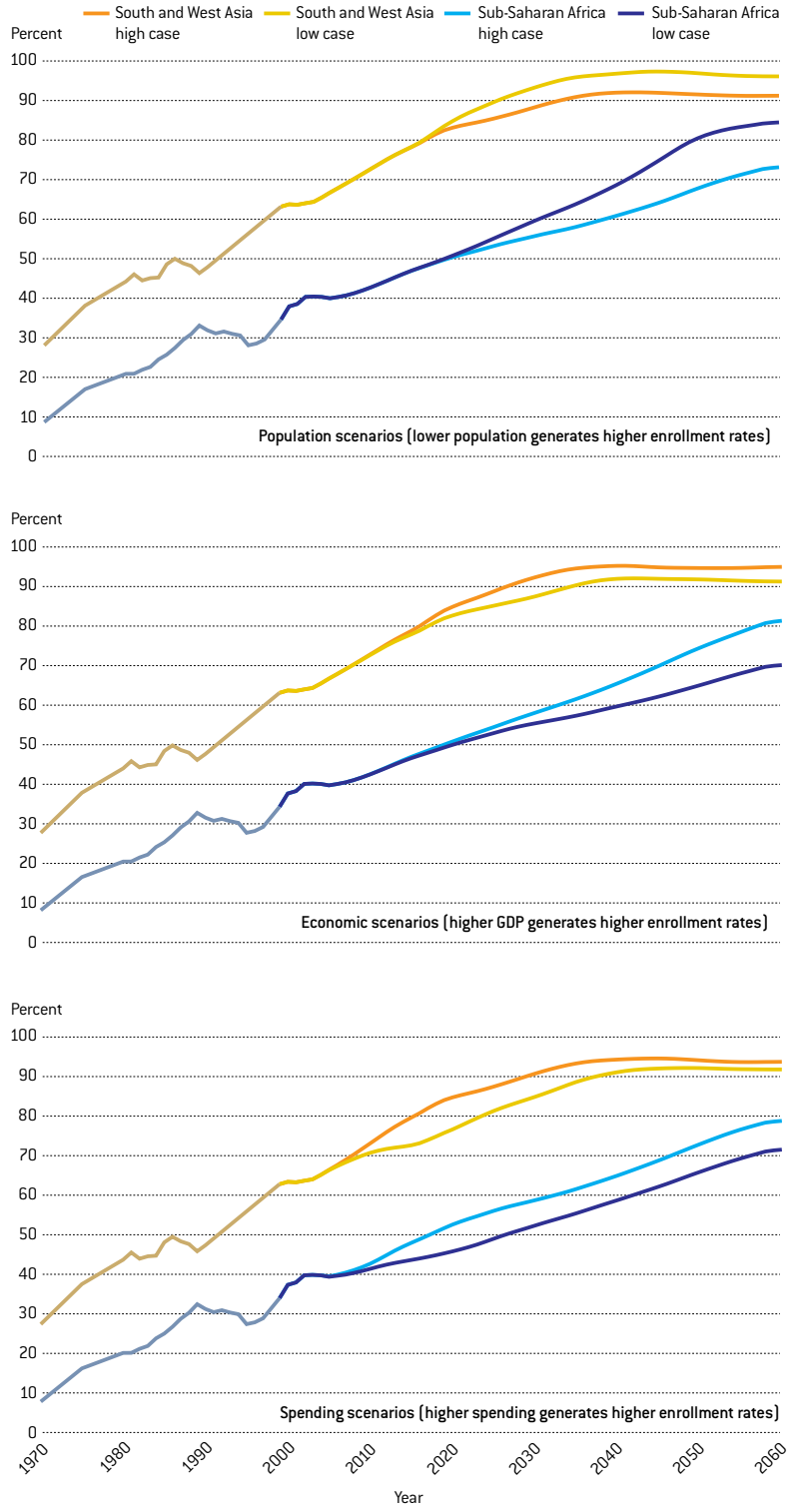
secondary level (a 96.8 percent gross enrollment rate) by 2060, 5.5 percent above that of the high-population scenario. Analysis of differences across population scenarios suggests both a constraint on countries struggling to enhance their prospects of advancing educational opportunities and a policy option for such enhancement, namely, the reduction of high fertility rates.

The differences in student numbers are even more dramatic across the scenarios than are enrollment rates. In sub-Saharan Africa, there were about 19 million students enrolled in lower secondary programs in 2005. In the high-population scenario, there would be 52 million enrolled in 2030 and 127 million in 2060. In the low-population scenario, there would be 44 million in 2030 and 49 million in 2060. In other words, there would be 78 million fewer students at that level in 2060 in spite of the increase of the gross enrollment rate from 74 percent in the high-population scenario to 85 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 17.2 percent of GDP per capita to 18.2 percent, whereas in the high-population scenario, they would drop to 16.5 percent of GDP per capita. IFs further estimates that the GDP per capita for the region could be $7,149 in the low-population scenario, versus $5,577 in the high-population scenario.

The paths of GDP impact

Figure 5.11 also shows the implications of different assumptions about economic growth on lower secondary enrollment. Different GDP per capita levels affect student flows on both the demand side and the supply side. They change the demand for education because of changing economic structures and because of changing economic capabilities and educational benefit analyses within families. In 2030 in the fast-growth economic scenario, GDP per capita in sub-Saharan Africa is 31 percent higher than in the low-growth scenario; by 2060, the difference is over 260 percent. For South and West Asia, the differences are similar—36 percent in 2030 and 260 percent in 2060—and globally, they are 39 and 232 percent. The differences are so large because of the power of compounding growth

Figure 5.11 Impact of framing scenarios on lower secondary gross enrollment rates in South and West Asia and sub-Saharan Africa: History and forecasts



Notes: Used 5-year moving averages after removing 1991–1996 historical values for South and West Asia.

Source: IFs Version 6.12 base case with alternate framing scenarios with UIS and WDI data through 2005.

Different GDP per capita levels affect both the demand for education and its supply.

Different demographic scenarios have the greatest impact at the secondary level, whereas different economic scenarios have a greater impact at the tertiary level.

The impact of government spending on enrollment is significant but not as large as might be expected.

Figure 5.12 shows the impact in South and West Asia and sub-Saharan Africa of the range of uncertainties combined into highly optimistic and pessimistic scenarios.

rate differentials over fifty-five years, enhanced by positive feedback loops.

On the supply side, higher economic growth would 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 tends to rise with income levels. Significantly offsetting these changes that function to increase education support (and thus enrollments), the costs per student will rise with GDP per capita (although in the poorest countries, spending per student as a portion of GDP per capita generally falls at the upper secondary and tertiary levels as GDP per capita rises). 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. Chapter 6 will, however, document that higher GDP per capita tends to correlate with higher quality of education as assessed with international testing.

At the highest end of the impacts, the tertiary gross enrollment rate (not shown in Figure 5.11) in sub-Saharan Africa could be 30 percent in 2060, or 1.7 times higher in the high-growth economic scenario than in the low-growth scenario. Similarly, in South and West Asia, tertiary enrollments could be 1.4 times higher than with low economic growth. More generally, whereas different demographic scenarios have the greatest impact at the secondary level, the economic scenarios have a proportionately somewhat greater impact at the tertiary level. Higher GDP and GDP per capita very significantly affect demand for tertiary education.

The paths of government spending impact

The impact of government spending on enrollment is significant, but it is not as large as might be expected. That is partly because additional spending can influence education forecasts in three different ways. It can increase enrollment levels, increase the quality of the education students receive (for example, via better teachers or school facilities or through improved materials), or increase expenditures per student without increasing quality. It is extremely difficult to know in any given situation how the impact of additional public expenditure might split across these categories. The education model of IFs contains an algorithm for balancing demand for expenditures and their supply in ways that reflect some additional funding going to each of these categories. In addition, the IFs model does not, except in the normative scenario, allow the government to push funds into education beyond those required by the demand side of the model; thus, the primary impact of our increased spending intervention here is felt in supply-side constrained regions such as sub-Saharan Africa. For the world as a whole, the supply-side constraint lowers enrollments, but supply push does not significantly change them.

It is well-known in policy analysis that higher spending often is like "pushing on a string," not always bringing the intended results. In Chapter 6, we will explore the possibility of a normative scenario that combines higher enrollment growth expectations and a commensurate expenditure increase with constraints that move spending per student to benchmark levels, thereby minimizing the diversion of extra funding to inefficient expenditures.

Exploring combined uncertainty by level of education

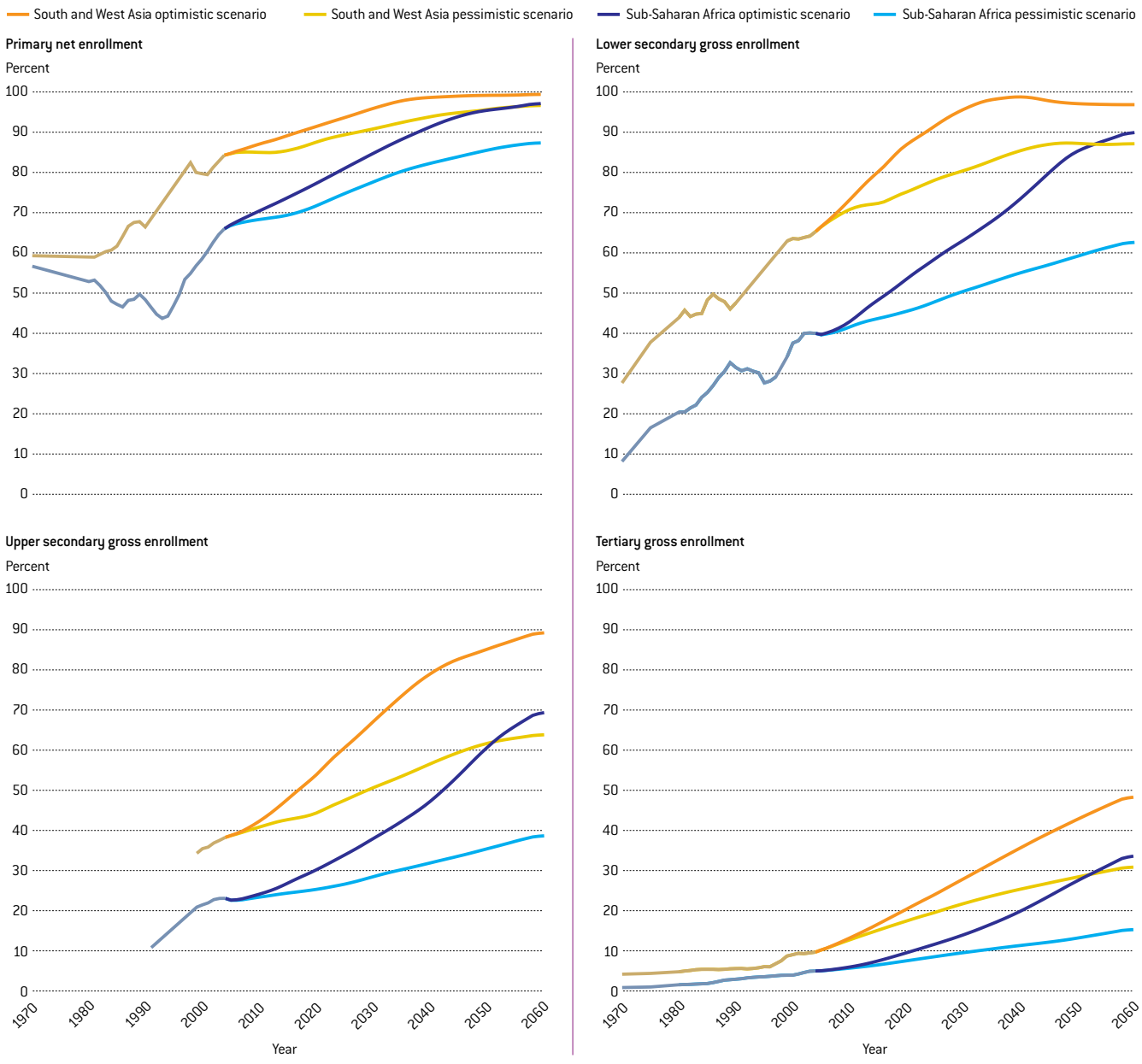
Figure 5.12 shows the impact on each level of education of the full range of uncertainties, combined into uniformly and therefore highly optimistic and pessimistic scenarios. The uncertainty increases by level of education. Upon reflection, this is not surprising because the lower levels of education have less headroom for expansion. At the extreme, South and West Asia could reach over 90 percent upper secondary enrollment (at the gross, not the net, level) by 2060 in the highly optimistic scenario, versus about 66 percent in the pessimistic scenario. The difference would be even greater for sub-Saharan Africa, 80 percent versus 40 percent.

Uncertainty in educational attainment

The variations between even the highly pessimistic and highly optimistic scenarios for education years at age fifteen and older are not especially great regionally or globally in 2060 because of the long lags in changing

the educational attainment levels of adult populations. The global educational attainment level varies only about 1 year between the scenarios by 2060—it varies about the same amount in South and West Asia and about 1.3 years in sub-Saharan Africa (as shown in Figure 5.13). Yet we should by no means disparage that impact. One year accounts for about 10 percent of the total average years of education across global adults in 2060 (and 1.3 years accounts for about 18 percent in sub-Saharan Africa), and furthermore, the impact of the different scenarios continues to grow over time.

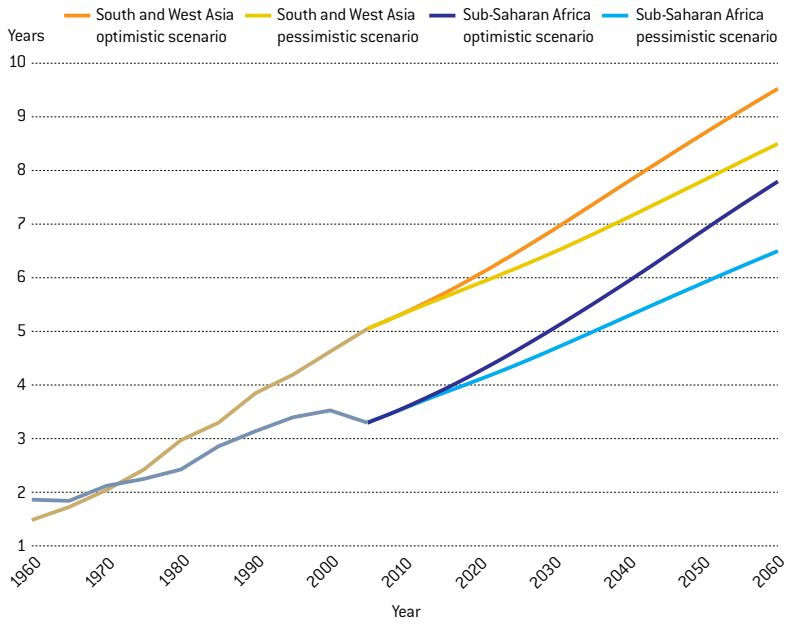
Figure 5.12 Highly optimistic and pessimistic framing scenarios for enrollment rates: History and forecasts



Note: Used 5-year moving averages after removing (1) 1980, 1982, 1991–1996 primary net historical values for South and West Asia and 1975 for sub-Saharan Africa, and (2) 1991–1996 lower secondary historical values for South and West Asia. UIS did not provide lower or upper secondary gross enrollment data until 1999; Irfan (2008) calculated estimated historical values for lower secondary enrollment rates for earlier years.

Source: IFs Version 6.12 base case with combined alternate framing scenarios with UIS data through 2005.

Figure 5.13 Education years of adults age 15 and older in South and West Asia and sub-Saharan Africa across optimistic and pessimistic framing scenarios



Note: The transient for sub-Saharan Africa reflects missing historical data mostly for low-education countries, so when missing country values are estimated by IFs, the average drops.

Source: IFs Version 6.12 framing scenarios with Barro and Lee (2001) data through 2000.

The IFs base case and alternative framing scenarios portray continued significant advance in education at all levels and across all regions.

A large portion of the uncertainty about education futures lies in alternative demographic and economic futures.

Conclusion

This chapter has explored the education forecasts of the IFs base case, putting them in the context of historical patterns and other forecasts. The IFs base case supports the likelihood of continued significant advance in education at all levels and across all regions, forecasts that appear generally quite reasonable in the historical context and relative to the forecasts of others. One interesting result with respect to the analysis of early forecasts by others is the tendency that extrapolative analysis has had to overestimate the progress of primary education in sub-Saharan Africa and to underestimate the progress of higher levels of education in many parts of the world. Both should serve as warnings to us.

This chapter has also considered the sensitivity of the IFs base case to alternative framing forecasts of population growth, economic growth, and education spending, in order to begin exploring the range of variation that may be possible in education futures. That analysis suggests some rather clear conclusions. First, it appears highly probable that education's advance will continue around the world. We see a significant advance in all the cases explored here, even the highly pessimistic scenario. There is great momentum behind the education transition. Second, the differences across varying driver assumptions may not be dramatic, but they are significant. Third, it appears that a very large portion of the uncertainty about education futures lies not in education policy and decisionmaking but rather in alternative demographic and economic futures. That conclusion has import for the analysis in subsequent chapters because it reinforces the consideration of normative-based policy in education within a broader human development context. It also has import, of course, for policy makers. For many countries, the surest routes to long-term education advance may be by attending to maternal health and family planning. We will proceed nonetheless to explore in the next three chapters the leverage that may exist within education policy, both because of the importance of education in and of itself and because of the contributions education makes to broader human development, which we will also consider.

1 Other documents provide information on the base case approach of IFs. See, for example, Chapter 5 of the first volume in the Patterns of Potential Human Progress series, *Reducing Global Poverty*.

2 The values for 2005 in Figures 3.1 and 5.1 are not identical and the series are not fully comparable because Figure 3.1 represents only those countries with extensive historical series. In contrast, the values in Figure 5.1 build on IFs estimations of values in 2005 for countries that do not report data, and they also include IFs adjustments made to reconcile inconsistencies in the enrollment data used to initialize the model.

3 As discussed in Chapter 3, we describe a 90 percent primary net enrollment rate as "nearing universal enrollment," and we treat a 97 percent primary net enrollment rate as the measure of universal enrollment. See the *Education for All 2008 Global Monitoring Report* (UNESCO 2007b: 180), which categorized country prospects for universality in 2015 based on a 97 percent rate.

4 Table 3.4 lists the member countries of the groups according to their primary net enrollment rates in 2005.

5 See www.fundforpeace.org for the most recent listing.

6 Thirteen other countries appear to be at risk with respect to primary net enrollment levels, but they are not listed in Table 5.2 because they lack recent data. The same is true of seven countries at the lower secondary level. Some of these are countries with the world's most seriously compromised education systems (such as Afghanistan, the Democratic Republic of Congo, Haiti, and Somalia), and they also appear to be at risk of not attaining 90 percent primary enrollment rates even by 2060.

7 Again, values for 2005 in IFs forecasts can differ from those for 2005 in historical analysis because the model estimates initial values for countries with missing data. In the case of education expenditures as a percentage of GDP, Chapter 3 reported a global historical value for 2005 of 4.8 percent, but the forecast value is 4.5 percent because nonreporting countries likely spend less. The disparity for sub-Saharan Africa is even greater (5.1 percent versus 4.3 percent).

8 In 2006, the Chinese minister of education announced plans to raise China's spending on education from 2.8 percent of GDP to 4.0 percent over five years; see *China Daily*, March 1, 2006, available at http://www.chinadaily.com.cn/english/doc/2006-03/01/content_524886.htm.

9 Milanovic (2005) clarified the distinctions between Gini calculated across countries without weighting, across countries using population weighting, and on the basis of individuals.

10 In fact, almost all quality-of-life measures are distributed more equally globally than is income. Moreover, developing countries are closing the gaps with developed countries on nearly all such measures. For instance, the global Gini for life expectancy was about 0.07 in 2005.

11 The extrapolations by UNESCO typically used logistic or S-shaped curves (UNESCO Division of Statistics 1993: 2). UNESCO subsequently revised data from 1980 used in the forecasts of 1983, complicating the evaluation of how well the forecasts did for 2000.

12 In addition to the more extensive forecasting projects considered here, other important education analyses make more limited forecasts. For instance, Cohen, Bloom, Malin, and Curry (2006: 1) forecasted 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 forecasts for missing school-age children at the two levels in 2015 are 337 million worldwide, of which 66 million will be at the primary level.

13 Meyer et al. (1977) and Meyer, Ramirez, and Soysal (1992) previously identified such sigmoidal or S-shaped patterns of diffusion of mass education throughout the world for the extended period from 1870 to 1980.

14 IFs forecasted a 72.2 percent primary net enrollment rate for sub-Saharan Africa, whereas Clemens forecasted a 79.6 percent rate.

15 The U.S. Agency for International Development sponsors the DHS, and the United Nations International Children's Emergency Fund sponsors the MICS.

16 We estimated the data visually from bar graphs showing 80 percent, 90 percent, and 95 percent completion rates (see Wils, Carrol, and Barrow 2005: 22, fig. 3b).

17 Wils, Carrol, and Barrow (2005) included entrance up to the age of fourteen and completion up to the age of nineteen in their entry and completion rate calculations. Although this definition sounds close to the gross enrollment rates defined by UNESCO, the flow rates used by Wils, Carrol, and Barrow cannot exceed 100 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 forecasted by Clemens and IFs. Because IFs completion rates are gross rates, they can advance much more rapidly in the 90–95 percent range.

18 A fourth set of custom forecasts covered only a small set of countries.

19 IFs does not factor all the background information provided here into its forecasts for Burkina Faso, but it does represent the major demographic, economic, and financial variables.

20 Information given on Burkina Faso came primarily from the World Bank's World Development Indicators and the CIA's *World Factbook* (online).

21 The Lutz methodology used the five-year age cohorts from fifteen to twenty-nine 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.

22 Modelers can calculate and use confidence 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).

23 Because global fertility rates have been dropping steadily for nearly forty years, and because there are many good reasons to believe they will continue to fall in most of the world, the UN constant fertility variant (based on fertility rates well above current ones) is only a reference point, not a reasonable forecast.

24 We do not display the base case in order to simplify the graphs; it would fall quite close to the middle of the alternative scenarios except in regard to education spending, where the base case would fall closer to the high-spending case.