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A GLOBAL EDUCATION TRANSITION: COMPUTER SIMULATION OF  
ALTERNATIVE PATHS TO UNIVERSAL BASIC EDUCATION

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A Dissertation

Presented to

the Josef Korbel School of International Studies

University of Denver

---

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy

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by

Mohammod T. Irfan

November 2008

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OF ALTERNATIVE PATHS TO UNIVERSAL BASIC EDUCATION  
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### **Abstract**

As an acknowledgment of the critical role of education in realizing other development targets, the Millennium Development Goals (MDG) of the United Nations include education in a framework of development targets. The MDG targets for education include achieving universal primary education and gender parities in all levels of education by 2015.

Recent global campaigns have added to the momentum of the rapid progress of educational expansion, which began in roughly the 1960s. Countries with universal or near universal participation and completion in elementary education have started to look beyond primary, towards free and compulsory basic education- education up to lower secondary- for all their citizens.

This dissertation will explore the progress towards, and viability of, meeting current and potential global targets at various stages of basic education. It will answer questions such as: What path is the world on in terms of meeting the MDG goal of universal primary education? Which regions and countries are at risk of falling short of that target? How will lower-secondary education unfold in different regions of the world? Will there be any disparity between boys and girls as the countries expand their primary and lower-secondary education? What needs to be done to meet the current MDG for universal primary education and to move the global system towards universal lower secondary at the global, regional, and country level?

To find the answers, we developed a long-term educational forecasting model that represents the student and financial flows through the different levels of a formal educational system from primary to tertiary. The model is integrated within the broader International Futures model and represents the economic and demographic forces shaping the supply and demand of education. The broader International Futures system models the impacts of education on societal variables like fertility, productivity, and income, thus creating a feedback loop.

According to our analyses, most of the developing countries will continue their educational expansion at a speed faster than the speed that the developed countries showed when they were at a comparable stage of development. However, some of the developing regions will still be far away from universal participation or gender parity in primary and lower secondary, largely due to the low initial condition in these regions.

Forecasts from the base case of our educational model show the pace of progress will not be sufficient to meet the education MDGs. Two of the world regions, sub-Saharan Africa and South and West Asia, might not be able to enroll all their children in elementary schools by 2015. These two and one other UNESCO region, the Arab States, do not see universal lower secondary education in the horizon even at 2020. In the base case, all UNESCO regions but two will reach or be close to gender parity in primary education by 2015. While the Arab States will be close to parity by 2030, the sub-Saharan African index will not reach parity until mid-century. Latin America and the Caribbean, on the other hand, might experience a reverse gender bias favored towards girls by 2015, but will re-approach parity later.

Lowering population growth will lessen the demand pressure in these countries and thus help them achieve better rates of participation in basic education. A better economy will help them spend more on education and thus get better results. Exploration of the recent growth patterns in access to and progress in education convinced us that there is room for some acceleration of the progress in these areas. We have combined these findings to develop an aggressive but realistic normative scenario, where growth targets in educational flow rates, rather than an absolute coverage, are pursued.

Even with the improved results from the normative scenario, the world is unlikely to meet the 2015 MDG targets. However, the sub-Saharan African region, as a whole, would be sufficiently close to the target of universal primary education by 2020. All other regions meet the MDG of universal primary under the normative scenario, with South and West Asia just barely making it. Under the normative scenario, all but one world region, sub-Saharan Africa, reach 95 percent or higher gross participation rate in lower secondary by 2020. It is almost mid-century by the time sub-Saharan Africa reaches close to universal lower secondary.

Substantial progress in terms of gender parity will occur under the normative scenario despite the goal being explicitly pursued under the normative scenario. As girls in developing regions catch up with boys these regions reach close to gender parity in primary education around 2015. By 2020, exact parity is obtained in all regions. While the reverse gender parity extant in regions like Latin America and the Caribbean will start

to slide back starting in the 2020s, a similar reverse parity starts to show up in sub-Saharan Africa around that time.

The transition to universal basic education is important for human development. It will take considerable time and efforts to complete the transition. While it is useful to coordinate the global efforts in making the transition, it is also important to take into account the differences across regions and nations in setting realistic targets and goalposts.

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# **1 Introduction to the Topic: Questions and Goals**

## **1.1 Education for Human Development**

Education facilitates the realization of potential in every individual. The United Nations' Universal Declaration of Human Rights of 1948 states that access to a minimum level of education is the basic right of every human being. Ensuring this fundamental right is an important part of creating a just global community.

Education is also important for prosperity. It creates opportunities for individuals to seek better livelihoods and healthier lives. Today's most developed countries generate wealth from the increased productivity of their highly educated labor force (Easterlin, 1981). Although some debate surrounds the direction and extent of the links between education and economic growth, there is no doubt that inadequate education is a powerful indicator of poverty and income inequality. At the dawn of the new millennium, almost all the children of elementary age in the rich OECD economies went to school, whereas about one out of every five children in the developing world was deprived from schooling.

The dual importance of education as a fundamental human right, valuable in and of itself, and as a tool to improve quality of life and generate prosperity, determines its priority on both national and global development agendas.

That the benefits of education go mostly unrealized in a large part of the world makes one wonder about the broader socioeconomic context of the education system (UN

Millennium Project 2005, 27). The failure of low-income countries to materialize the more education and faster growth virtuosities has been attributed both to the weaknesses of the education sector and to the deficiencies in extra-sector fundamentals like macro-economic instability, market failures, and to social unrest (Pritchett 2001). It is thus necessary to be informed about the socio-economic context of any given education system and integrate it in analyses thereof.

Standardization in education has reached the point (Meyer, Ramirez, and Soysal, 1992) that educational processes worldwide can be described with a single isomorphic schema (Ramirez and Ventresca 1992, 47–59) known as *national education systems*. This global standardization in the organization of curricula, students, teachers, and resources makes possible a comparative cross-national study.

The stages of formal education are now well defined and similarly sequenced. In most countries, secondary schooling follows primary education, after which some graduates attend tertiary institutions. It is possible to study these stages individually or in combination. The focus of study would vary depending on the angle of research. For example, tertiary education is more relevant than is elementary schooling for those studying the emergence of knowledge societies, which are characterized by well-funded infrastructures that provide substantial research and development opportunities for their well-educated personnel. On the other hand, those studying developing economies—where the struggle to break free of the poverty trap is ongoing and the education system is generally defined by low participation and low expenditure—are likely to start on the lower rungs of the educational ladder and look for the way up. Mass access to a minimum level of basic education—primary followed by partial secondary—is something that

needs to be pursued for the sake of development at the individual and social levels of such economies.

The consensus on the importance of basic education for reducing poverty has mobilized global commitment. In the 1990 World Conference on Education for All in Jomtien, Thailand, representatives from 155 countries and 150 organizations pledged to provide quality primary education for all children by the year 2000 (UNESCO 2007, 14). The Jomtien conference was followed by the World Education Forum in Dakar in April 2000. Since then, education has become increasingly central to global strategies for the elimination or reduction of poverty. At the United Nations Millennium Summit in September 2000, world leaders set a goal to achieve universal primary education by 2015. Other targets of the Millennium Development Goals (MDG), as they are collectively known, include the elimination of gender disparities at all levels of education by 2015 and the same at the level of primary and secondary by 2005. National education goals meanwhile have been incorporated into country level Poverty Reduction Strategy Papers (PRSP) prepared under the guidelines of the international agencies.

The global campaigns have added momentum to the postwar progress of mass education; because of this new emphasis on education, a large number of countries have succeeded in enrolling most children of the appropriate age in elementary school. Many countries have already started thinking beyond primary. Basic education now encompasses lower secondary schooling in addition to primary. Countries consider making it compulsory and providing it free. A global transition from low- to high-basic education, like that from high to low fertility, is well on the horizon.

The global educational movement faces challenges, however. As countries get closer and closer to universal access, they must contend with the increasing marginalization of segments of their student populations, requiring more effort and more resources. Factors like rapid urbanization, the high cost of education for the rural poor, and the negative impact of the HIV/AIDS pandemic on teacher availability have thwarted progress in many areas of the world. Two regions in particular, sub-Saharan Africa (SSA) and south Asia, are seriously off track for achieving the education MDG by 2015.

## **1.2 What Would We Like to Know?**

The global community is past the halfway point on the education-MDG timeline. Efforts to meet its goals at the local, regional and international level are being closely monitored by multilateral agencies like the United Nations, the World Bank, the International Monetary Fund, UNESCO, UNICEF, and others. The results are mixed. Some countries have made impressive progress, while others lag abysmally. Even some of the high achievers are likely to meet the 2015 deadline for universal enrollment, because they started with a very low initial value. The disparity in the pace of regions and countries to reach the goals has also raised doubts about the appropriateness of the goals' universality as opposed to that of region- or nation-specific objectives.

A substantial number of countries have already missed the 2005 goal of gender parity in primary and secondary education. For some countries, most of which are in sub-Saharan Africa, the possibility of reaching universal primary by 2015 is very remote under a business-as-usual scenario. On the other hand, countries like Burkina Faso, Ethiopia and India are showing rapid progress towards both of these education MDGs.

For them, it will be necessary to plan early for handling the demand pressure at the next level of education, the lower secondary.

This study will explore the viability and progress of potential and current global targets for the primary and lower secondary stages of education. We shall start with an exploration of the processes of basic education at the national, regional, and global levels and attempt to place them in a comprehensive framework along with other components of human society, namely demography and economy that are inextricably linked to education. The time-bound and quantified MDG targets give us convenient signposts to organize our questions. We list the questions hereafter.

1. What path is the world taking to meet the MDG goal of universal primary education? We shall study participation and parity in primary education and identify the regions and countries at risk.
2. How will lower secondary education likely unfold around the world? We shall look at participation and gender parity at this level of education and classify the regions and countries in question according to their performance.
3. What needs to be done to meet the current MDG for universal primary education and to move the global system toward universal lower secondary at the global, regional, and even national levels? When would we be able to complete this global transition to universal basic education?

At least one of these questions, the first, has been asked several times in the recent past. The answer was negative with respect to success at the global level, mostly because

of a wide consensus about the inability of two world regions—sub-Saharan Africa and South Asia—to achieve universal primary education (UPE) by 2015 (UNESCO 2007). Although there is not much debate about the validity of that answer, the literature largely fails to deepen and extend the analysis further in time. For example, one analysis (Clemens 2004) finds that the speed with which sub-Saharan countries like Burkina Faso are expanding their elementary education programs is quite impressive compared to the rates of growth in the Japan or United States of the nineteenth century. Yet the study concludes that the MDGs are too optimistic, even “utopian,” (Clemens 2004, 31) and it ends without identifying feasible policy alternatives or projecting a potential timeline by which every individual in SSA would have access to the education so needed for the development of the region.

The second question has not yet been explored with the kind of specificity that we intend to add. Some researchers have looked at secondary as a whole, examining the trends (Clemens 2004; Wils, Carrol, and Barrow 2005; Wils 2007) and estimating the costs (Binder 2006; Cohen, Bloom, and Malin, 2006). Secondary education in the contemporary period is generally divided into two stages, lower secondary and upper secondary. The objective of lower secondary is to extend the rudimentary skills obtained in primary so that they are generally applicable to future occupations and to nourish the qualities characteristic of able citizens, who can respond to social and national needs (Okuda and Hishimura 1983). Upper secondary, in turn, expands the knowledge obtained in lower secondary, developing professional skills and “provid[ing]e for the determination of a career according to one’s personal characteristics,” among other things (Okuda and Hishimura 1983, 572–573). It is thus necessary to decouple lower secondary



from upper secondary and examine each individually; no such global study has yet been done.

The third question involves the global educational future. The global community has made impressive progress in primary education in recent decades. Now that universal primary is on the horizon for all but a couple of regions, we should be preparing ourselves for the next target. UNESCO's ISCED, or International Standard Classification of Education identifies primary and lower secondary as the two stages of basic education that need to be made compulsory (UNESCO 2006). Countries are responding accordingly, making universal basic education the next target (UNESCO 2007, 58). Because of the indispensability of basic education as a foundation for lifelong learning and a means of fostering human development at the individual and collective levels, it is very important to estimate the effort required not only to bring the remainder of the world's children into primary schools but also to facilitate their transition to lower secondary. In charting a course for the steady or even, if possible, accelerated transition to universal basic education, we must do more than identify trends; we must also single out the drivers that influence those trends, calculate the magnitude and direction of the causal relationships between them, and use those relationships to determine the amount of time and type of resources that will be required to complete the global transition to universal basic education—riding or reversing the identified trends as necessary. That is what we intend to do in this research.

In their explorations of these issues, most experts have rightfully extended their forecasts until at least 2015 if not beyond. Given that at least some sub-Saharan countries

will still be a long way from achieving universal primary education in 2015, we have likewise deemed it necessary to extend our analyses beyond 2015. Since we are also considering lower secondary in our analyses, we have extended our analyses up until the mid-century.

One important step that we have taken in our research involves an endogenous analysis of education in relation to other sectors. Although forecasts on student flows and educational costs can be driven by independent forecasts on relevant demographic and economic variables, we might in so doing miss some of the interactions among education, economy and demography. For example, decreases in fertility can result from increases in education among women; gains in economic productivity can accompany gains in education. We have aimed to reduce such omissions by endogenizing the education model we have used into a broader socioeconomic model, namely the International Futures with Pardee global model.

### **1.3 Discussion of the Topic**

Humans have always used education in one form or another to pass to the next generation the skills, knowledge, values, and traditions necessary for survival and the continuation of the species. However, a systematic approach to bringing formal education to the masses has started only in the early modern period. Recent discourse has established education as a key component of social progress, one that interacts complexly and bidirectionally with other societal systems like economy, demography, and politics.

### 1.3.1 Education System

Over the last few hundred years, approaches to education have evolved from classical models, which were informal, private, and parochial, to the formal, public, and secular schemas of modernity. The most common educational stages children traverse sequentially are primary (also called elementary in some part of the world), secondary, and tertiary. Primary and the early grades of secondary equip individuals with basic literacy and numeracy as well as the skills required to live a healthy life. Upper secondary and tertiary furnish pupils with the more advanced and specialized knowledge that, in most cases, makes them professionals in their field.

Formal education correlates strongly with underlying demographics and incurs costs that would be borne by consumers (i.e., households) under a working market mechanism. However, there is convincing evidence of imperfections in the market that affect the initial levels of education. Figure 1.1 shows the relationships between education sectors and their underlying demographics and economies in simplified fashion. The limitations of a private market for education (Vandenberghe 1999), combined with the obvious appeal of education's societal returns, makes a convincing case for public spending in education.

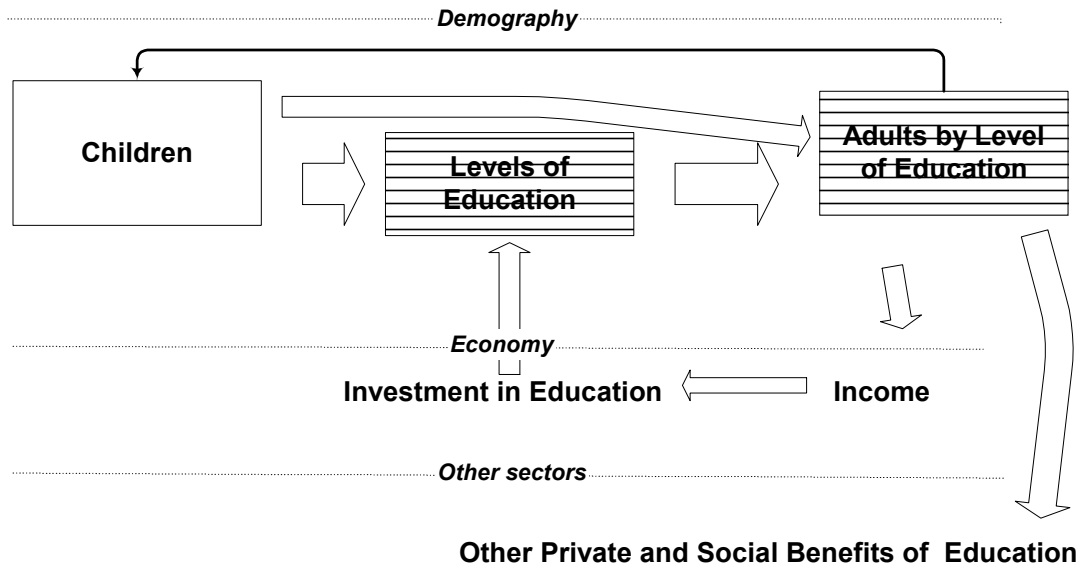


Figure 1.1. Education Sector in the Broader Society

### 1.3.2 Educational Levels and Human Development

Some analysts have found evidence (Schultz 1975, cited in UN Millennium Project 2005, 27) for education’s complementarities with other human-development goals like health, sustainable lifestyles, and better standards of living in the Mincerian sense, whereby wages increase with level of education. Higher education has also proved central to knowledge-based societies, in which considerable research and development activities result in substantially higher productivity. However, education at the lower levels— elementary and some secondary—proved to be more important for developing economies. In fact, for nations in the early stages of development, elementary and lower secondary education generates higher returns at the individual as well as societal level. Considering these facts, we focused our research on the initial levels of education, keeping underlying demographics and economic scenarios in mind.

### 1.3.3 Basic Education: The Next Impetus

As a post-UPE goal, universal secondary (Binder 2006) naturally comes to mind. However, as we have indicated, secondary is not as coherent as primary, consisting of two stages, lower and upper. Accordingly, in its 1997 ISCED, UNESCO established separate criteria for lower and upper secondary, which it named ISCED 2 and ISCED 3 respectively. ISCED 2 more closely resembles the preceding level of elementary. Upper secondary, equivalent to high school in the United States, starts preparing students for college-level educations. Realizing that elementary education is inadequate for equipping individuals with the tools to improve their standards of living, many countries have started to make lower secondary the minimum level of education required for all citizens. The term that they use to indicate their commitment to this mandate is *compulsory education*.

Basic education means roughly the same thing as compulsory education. However, less political and pedagogical, the term *basic education* might also be ambiguous. In the days before a strict classification system like the ISCED, it was used to mean the aforementioned combination of rudimentary literacy and numeracy with life skills, imparted either in a formal setting to school-age youth or in a nonformal setting to illiterate adults. More recently, international development organizations and national education authorities have started using the term to refer to the formal educational levels of primary and lower secondary combined. According to an analysis of 113 countries done for the Education For All Global Monitoring Report (EFAGMR) 2008 (UNESCO 2007) two-thirds of the countries use the term in this manner. The remaining countries

use the term to mean primary education only, primary plus some pre-primary, or primary plus total secondary education.

#### 1.3.4 Education Goals

Because of coordinated efforts to achieve the MDG, the global figures for primary enrollment have improved. The global gross-enrollment ratio for primary education has jumped a huge 13 percent, from 84 percent to 97 percent (as determined by an IFs calculation with population-weighted average), within a short period of five years, from 2000 to 2005. According to the EFA GMR 2008, the number of children not attending school worldwide decreased from 96 million to 72 million between 1999 and 2005, an impressive achievement. However, it is diminished somewhat if we unpack it across the demographics of age, sex, and location. The global net-enrollment rate—that is, the percentage of primary-age children who are in school—has increased a mere 4 percent, going from 84 percent to 88 percent in the same five years. Although the girls made twice as much progress as the boys, they are still more than 2.5 percent behind the boys, who are at about an 87-percent net-enrollment rate. According to the aforementioned report, 59 countries have achieved gender parity in primary and secondary education by 2005, only three of them doing so in between the years of 1999 and 2005, while 122 of the 181 countries studied have yet to meet that target. Although most geographical regions were close to reaching UPE by 2005, there are at least three regions that were not: the Arab states, sub-Saharan Africa, and South and West Asia, according to EFA GMR 2008 (UNESCO 2007). As we have noted, at least two of these regions are off track for reaching UPE by the MDG deadline; although some countries within them have

succeeded or are on their way to succeeding, others very clearly will not. This picture turns even bleaker if we consider the quality of primary education worldwide, the importance of which was rightly stressed in the 1990 EFA goals.

Given the likelihood that the MDG of UPE by 2015 will not be reached, we should ask ourselves whether we should just reschedule the deadline and continue to mobilize all our efforts toward an easy-to-express single global target or bring further sophistication to this process. The variations in progress across the globe raise some serious doubts about a global education-sector goal. Level of achievement is not the only source of variation; levels of expenditure and efficiency also show wide variation, since different countries are at different levels of economic development and therefore cannot commit the same sorts of resources to education. Without substantial international aid, some countries may never be able to get out of the vicious cycle of low education and low income.

Any serious effort to develop a global education-sector strategy must consider these variations. It might be necessary to divide countries into groups according to their capacity for meeting the education MDG on time. For countries that are most unlikely to meet the education MDG, we should attempt to set a more feasible timeline, identifying potential problems and ways to minimize them. For all other countries, we need to move on towards the next educational goal.

#### **1.4 Education Model: Computer Simulation of 182 National Education Systems**

Given our stated goals—understanding the global transition in basic education, identifying the drivers that cause such transitions, and designing policy levers that can boost the transition—we need a tool that can emulate the whole enterprise of basic education, showing the individual and resource flows both within and exogenous to the system. The tool has to have enough flexibility to be able to chart alternate courses under alternative scenario inputs. A computer application with dynamic simulation capabilities would serve this purpose best. In the remainder of this section, we shall discuss the first steps to developing such a model.

An examination of the historical progress of basic education around the world will help us understand its trends, pace, and potential. The knowledge will be valuable for setting education sector-goals around the world. We need to do several things before beginning such an examination, however. We need to gather a time series of education-sector variables. We also need to compile a database of demographic and economic variables, which are important for determining demand for and supply of educational activities. What's more, we must determine the formal relationship among variables both within and beyond the education sector. We then need to synthesize the system components: —for instance, demographic projections of school-age children with economic growth, government collection and allocation in different sectors, and the cost of different levels of education—to forecast the progress of basic education across countries and regions.



To address all these needs, we gathered international data on education from sources like UNESCO, analyzed the data, and developed a computer-based simulation model representing the education sectors of countries around the world. For linking education to demographic, economic, and other potential social variables, our education model sits within a broader model that represents societies beyond their national education systems. This broader model, called the International Futures System (IFs), is a structure-based, agent-class-driven, dynamic modeling system. The current version represents demographic, economic, energy, agricultural, sociopolitical, and environmental subsystems for 182 countries within the global system.

Figure 1.2 illustrates the relationship between the education model and other modules of the International Futures System. The education model encompasses the national education systems of all the 182 IFs countries claiming populations of over 100,000—and thus captures the variety of political, social, economic, and cultural contexts around the world. The model has the capability to project intake, participation, and progression rates at various levels of education along a timeline that goes well past the MDG deadline. The model is also able to forecast relevant financial indicators, such as per-student expenditures at various levels of education. While the demographic and economic projections are beyond its scope and are covered instead by the broader IFs model, the education model does balance the financial budget across different levels of education, using an incremental budgeting process unique to such education forecasts.

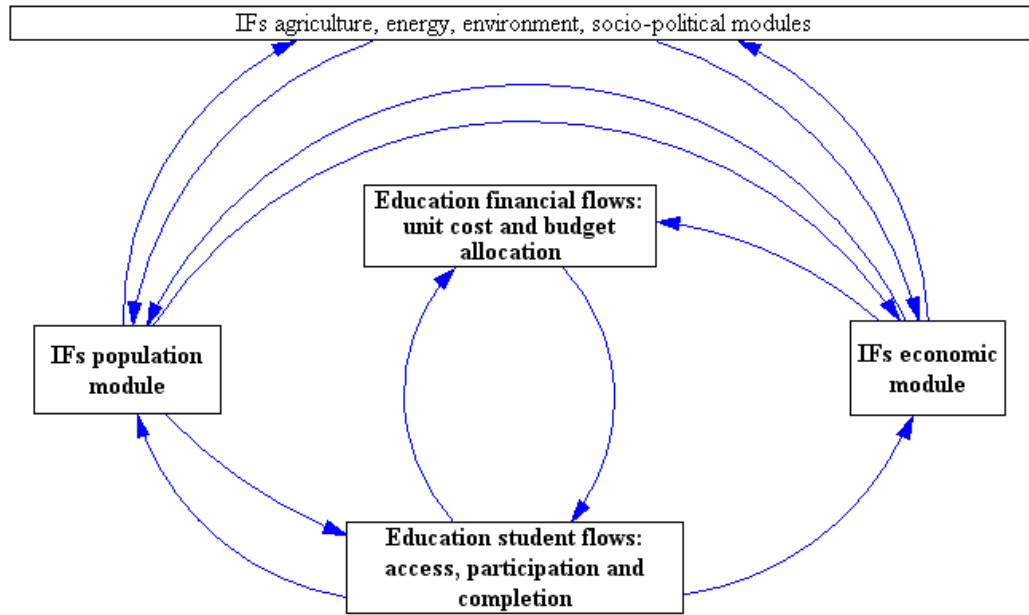


Figure 1.2. Education Model inside International Futures System

Though the education model includes all levels of formal education, from primary to tertiary, our research concerned the primary and lower secondary levels only.

### 1.5 Organization of the Dissertation

Chapter 2 of this study reviews the existing literature on the importance, organization, and expansion of formal education. It also examines the causes of educational expansion as well as the data and tools used to examine educational trends and forecast educational futures. In Chapter 3, we chart the development of the education model used to perform the analyses in this study. We follow the explanation of our methodology with an elaboration on the results of our analyses, with one chapter devoted to historical progress and reference case forecasts of basic education and the next one,

chapter 5, on the interventions necessary to obtain desired progress in basic education in the coming years. The final chapter contains the general conclusions from this research.

## **2 Literature Review**

The long-term advancement of education is necessary for achieving the goals of broader human development of which it is an intrinsic component. In order to develop a model that explores the potentialities, pitfalls, and policies characterizing the transition to universal basic education, it is necessary to study different approaches to educational policymaking, identify the trends in educational progress with the help of a common conceptual framework, and examine the trends under that theoretical lens with a view to singling out the variables driving them.

### **2.1 Formation of Education Sector**

Human beings, from the very early periods of civilization, have used education for acquiring and transmitting the knowledge necessary to thrive as individuals and to advance society. Education policy has always been an important social issue. In ancient Greece, education was viewed as a means to create virtuous citizens (Aristotle, trans. Rackham, 1944). The instrumental view prevailed in the medieval period, although the definition of virtuousness was more church-based and studies concerned divinity above all. Instruction and learning in these early periods generally took place informally within the household or community, as formal education was usually limited to the privileged few, hailing from or useful to the nobility or the clergy.

With the rise of industrial society during the latter half of the eighteenth century, education started to democratize and standardize. As Durkheim described the collective objective underlying the expansion of education (Durkheim 1956, 71), “for each society education is the means by which it secures in the children the essential conditions of its own existence.” This expansion entailed formalization and systematization. Mass schooling has since evolved into a worldwide institution, reflecting both a normative principle and an organizational reality (Meyer, Ramirez, and Soysal 1992). Educational activities, handled at the level of the nation-state, each with its own education sector, became similar in content and organization.

The growing resemblance of national-education sectors prompted comparative studies as early as the nineteenth century (see Limage 2001, 26–30 for a list of such studies). Often they focused on educational systems foreign to their authors or sponsors with a view to rejecting, making suggestions for, or borrowing from them (Limage 2001, 26). While most were limited in their geographic scope, at least some of them, particularly the European ones, established rankings, recorded changes, and attempted to anticipate future developments (Limage 2001, 29).

## **2.2 Educational Planning for Development**

After the Second World War, development studies emerged as a new field suitable for studying the patterns of economic growth and social modernization born of European reconstruction and Afro-Asian decolonization. Because of the perceived significance of education to these processes (Little 2003, 245-246), educational planning

emerged during the 1950s and 1960s as a “‘strategic subfield’ focused on identifying optimal national investments on education” (Limage 2001, 33). At that time, modernization theory emphasized the need for increased economic growth through high savings and investment as well as a strong labor force. Economists attempted to deal with the interdependence of occupational structures and education systems, and manpower planning became quite popular (Woodhall 1967). Socialist governments, by comparison, made education key to their central planning. Meanwhile, during the 1960s, the developed global North also started to show interest in the development of the global South through educational research and planning. As one author (Farrell 1997) has pointed out, the establishment of centers like the Center for the Study of Education and Development at Harvard University, the Center for Development Education at Syracuse University, the Comparative Education Center at the University of Chicago, and the Stanford International and Development Education Center at Stanford University bring an applied dimension to the field of comparative education.

### **2.3 Recent Approaches to Education Policy: The Human Dimension**

Economists took the education-development linkage further in the 1960s and 1970s. However, the early growth theories of the postwar era, because of their focus on the role of physical capital and the growth of average income (GDP per capita), began to be viewed as too reliant on collectivization and centralization, ignoring the individual on whom development has its greatest impact. In reaction to this inadequacy, the concept of *human capital* (Schultz 1961; Becker 1975) arose to emphasize the human inputs, namely skills and education, in economic production. Human-capital theorists advocated a cost-

benefit approach (Woodhall 2004) to educational investment, at both the individual and societal levels, supported by micro- and macro-analyses of the educational rate of return (Psacharopoulos 1994). Starting in the mid-1970s, critics of the human-capital theory itself deemed it too instrumentalist and limited with respect to the intrinsic values of education. Development economists (for example, Frances Stewart, Amartya Sen, Alejandro Ramirez, and Mahbub ul Haq) forwarded the concept of *basic needs* (see Allen and Anzalone 1981, for a history of this approach). This human-needs approach resonated quite well with the call for the provision of education as a fundamental *human right*, declared thus by the 1948 UN Declaration. Human-needs approaches, according to a section of these theorists, among whom Amartya Sen and Martha Nussbaum are the two most notable ones, had their own limitation of being concerned more with evaluating the condition of poverty than with considering the agency of the poor in freeing themselves from poverty in an enabling environment. The emphasis on empowerment (see, e.g., Sen 1992; Sen 1999) came to be known popularly as the *human capability* approach. Capability combined with the protective notion of rights, to reshape the age-old political concept of state-centered security into a political-economic concept of *human security* (UNDP 1994). These human-centered approaches dominated the development discourse of the 1990s, as their advocates cautioned about the inadequacy of explaining poverty in terms of material output and asked that non-income-related factors be considered as both means to and ends of well-being. Several authors have identified these new approaches as belonging to a new development paradigm, called the-*human*

*development paradigm* in the United Nations Development Program's (UNDP) annual Human Development Reports (HDRs),<sup>1</sup> the first of which came out in 1990.

In the following section, we shall discuss three of the dominant models of contemporary education-policy analysis: the human-capital theory, the human-rights perspective, and the human-capability approach (following Robeyns 2006). We shall then discuss the notion of human development, which synthesizes these three models and which we have found to be more practical for strategic policy analysis. Implicit in our analysis is the assumption that educational endeavors, undertaken with adequate planning and in proper sequence, yield positive results only.

### 2.3.1 Human-Capital Theory

Human-capital theory, advanced by a group of University of Chicago economists in the early 1960s (Schultz 1963; Becker 1975), conceptualizes education as a form of capital manifested in the individual, which can be invested in a manner similar to physical capital. In the *Encyclopedia of Economics* (Behrman and Taubman 1982, 474), human capital is defined as “the stock of economically productive human capabilities.” According to a World Bank report (World Bank 2006, 89), “human capital can be increased through education expenditure, on-the-job training, and investments in health and nutrition.” The accumulated human capital increases an individual's productivity and, ultimately, wages (Mincer 1974). At the macro level, education helps economic growth both by increasing the productivity of the labor force and by fostering

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<sup>1</sup> Fukuda-Parr (2002, Chapter 1.9) cautions that the HDRs and the widely-used Human Development Index (HDI) fail to fully capture the concept of human development.



technological progress (Solow 1956), as knowledge accumulates over longer periods (Romer 1990). The human-capital theory helped economists view educational investments from a cost-benefit perspective (Woodhall 2004). Several types of educational-return models—ranging from rate-of-return models at the private and social levels (Psacharopoulos and Partinos 2002) to various kinds of growth-regression models—(Barro and Sala-i-Martin 1999), emerged.

Despite the carefully limited economic scope, intuitively sound hypothesis, and easy measurability of this approach,<sup>3</sup> proponents have nonetheless failed to achieve consensus on the direction and magnitude of the education-economy relationship (see Pritchett 1996, for a discussion). Some researchers (see, e.g., Hanushek and Wößmann 2007) blame the disagreements partly on the underrepresentation of quality of education in the growth regressions. The economic outlook of this approach, they say (see, e.g., Robeyns 2006), misses the intrinsic values of education and thus is inadequate for justifying policies like those that would provide more education for women in developing countries—which are clearly justifiable from the standpoints of personal growth and family health but, women being less likely to join the work force, appear less rational from an economic point of view. Taking the instrumentalist point of view, critics (see Wigley and Akkoyunlu-Wigley 2005; UNMP 2005) also point to the fact that, in environments without well-functioning markets, credit agencies, or stable political systems, it is difficult to parlay education and skills into material well-being. Even within the instrumentalist school, some argue that education serves mainly as a piece of signal (Spence 1973; Arrow 1973) in the job market, narrowing some of the ‘information

asymmetry' (Stiglitz 1975) between the employer and the employee rather than indicating the real productive capacity of the employee. Screening or sorting theories of education concern the likelihood of the *sheepskin effect* (also called *credentialism*), whereby wages are skewed disproportionately upward toward degree- or diploma-holding workers (Hungerford and Solon 1987). These admittedly inadequate and perplexingly opposed roles education plays in generating economic growth have recently been reconciled in endogenous-growth theories, which conclude that the human-capital stock, upon reaching a threshold level, produces increasing returns and leads to faster growth by augmenting total productivity (Romer 1986; Romer 1990).

### 2.3.2 Human-Rights Perspective

The human-rights perspective presupposes every individual's entitlement to an education, given the indispensability thereof to human development (UNICEF/UNESCO 2007). Although they employ a similar instrumentalist tone, proponents of the rights-based approach differ from the human-capital theorists in their emphasis on the intrinsic and non-economic values of education, such as its facilitation of healthy and wholesome living at the individual and societal levels. Viewing education as a basic right regardless of its market value, societal forces mobilize to ensure access thereto. The success of such mobilization in expanding mass education by making it compulsory throughout the developed world during the prewar period (Lleras-Muney 2002) encouraged the inclusion of education in the 1948 UN Declaration of Human Rights. As Article 26 states, "Everyone has the right to education. ... Education shall be directed to the full

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<sup>3</sup> Birdsall (1999) has called education the most easily measured form of human capital.

development of human personality and to the strengthening of respect for human rights and fundamental freedoms.”

In the postwar period, the agendas of international organizations like UNESCO and UNICEF focused on more specific rights, such as that of access to education for all children as spelled out in the articles 28 and 29 of the United Nations Convention on the Rights of the Child, 1989, (UNICEF/UNESCO 2007). Global coalition like the Education for All (EFA) was formed to advance the quantity and quality of education throughout the world. The EFA declarations, which are still being pursued aggressively, were followed by the MDG, whereby the global community committed to providing primary education to all children by the year 2015 (UNMP 2005). The rights discourse, though quite helpful for the quick formulation of policy and its translation into action, has its own limitations. The propensity of national governments to interpret declarations of rights as mere rhetoric (Unterhalter 2003a, 8) seriously undermines their enforcement. Moreover, without implementation, they are nothing but meaningless promises (United Nations 2005). On the other extreme are those authorities that take the responsibilities created by the declarations as burdens, even at the point of fabricating results (PROBE Team 1999, 91). The rights approach usually generates top-down educational policies whose generalization obscures the extent of under-education among the disadvantaged.

### 2.3.3 Human-Capability Approach

Amartya Sen, Martha Nussbaum,<sup>2</sup> and a group of other notable development economists attempting to resolve the limitations of the econo-centric models in

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<sup>2</sup> Sen's approaches are somewhat different from Nussbaum's and are more relevant in the context of the developing world,

accounting for the conditions of the disadvantaged developed the capability approach. Starting from the basic-needs approaches of the mid-1970s, (Stewart 1985; Sen 1980), these theorists made gradual progress in clarifying the non-economic dimensions of poverty and suggesting possible solutions to its ills (Sen 1999). In the normative framework of the capability approach, the flourishing of the individual is contingent upon being educated, an important “functioning”, that, in turn, depends on the “capability” or the opportunity to get that education. The capability approach helped bridge the gap between the intrinsic and the instrumental (Drèze and Sen 2002; Unterhalter 2003b) rationales for education and balanced the undue emphasis on the utility of education (Anand and Sen 1994).

Despite its theoretical clarity, this approach has proven difficult for applied policy research. The multiple dimensions that it adds to the indicators of achievement (Alkire, 2002) warrant a new kind of formalism and a substantial amount of data not easily available at this point. Another criticism of the capability approach, coming from its own advocates, blames it for being too individualistic and underplaying group responsibility (Robeyns, 2005). In response, the capability theorists say that their individualism is more ethical than methodological or ontological (Robeyns, 2005).

The strengths and limitations of the three education-policy approaches we have just discussed can be summarized within a framework of multiple dichotomies— intrinsic-instrumentalist, individual-collective, and economic–non-economic—as shown in Table 2.1.

Table 2.1. Education Policy Approaches

Level	Purpose		
	Intrinsic	Instrumental	
		Economic	Wider
Individual	Human rights, Human capability	Human capital, Human capability	Human capability
Collective	Human rights, Human capability	Human capital, Human capability	Human capability

#### 2.3.4 Human-Development Synthesis<sup>3</sup>

The capability approach (Sen 1999) and its antecedents were formulated in response to the definitions and measurements of development dominant in the early postwar period, which were based solely on economic indicators like income and utility. They added richness to development studies by emphasizing sociological concepts like agency and reshaping political ones, like those of rights and security. Many scholars have identified them collectively (Fukuda-Parr and Kumar 2003; Haq 1995) as an indicator of a new paradigm (Kuhn1970) in development theory. This new paradigm is more inclusive, human-centered, and interdisciplinary than were its predecessors.

The interconnected nature of these education-policy approaches is quite evident from Table 2.1. There is, however, some confusion about the position of at least one of

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<sup>3</sup> In the discussion in this section I'll be drawing upon some of the work that was done for a paper prepared for the 2007 conference of the Human Development and Capability Association (Hughes, Dickson, and Irfan 2007). In that paper, the sections relevant to the conceptualization of the human development framework was written primarily by Janet Dickson.

these —namely human capital—in the human-development paradigm. Human capital, a mostly economic concept, would seem to make a poor fit for a paradigm characterized by its opposition to purely economic theories. Nevertheless, the pioneers of the paradigm emphasize its holistic nature (Haq 1995, 19) and point out that they object to a reliance on monetary indicators like income not because such indicators are unnecessary but because they are insufficient. One of the three measures used in developing the Human Development Index (HDI) is indeed income (UNDP 1990). In elaborating the concept of human development, the 1995 Human Development Report (HDR) (UNDP 1995, 12) puts productivity first on a list of four essential components of human development (the other three are equity, sustainability, and empowerment, the 1996 HDR added two more, cooperation and security). Attempting to clear up any remaining confusion, Sen (1997, 1959-1961) has highlighted the relationship between human capital and human capability by noting that, “both are concerned with the role of human beings and, in particular, with the actual abilities that they achieve and acquire.” That said, the measure of human capital is not easily reconciled with any monetary measure. The most basic calculation of human capital involves the average number of years of education a population or labor force receives (World Bank 2006, 89); the HDI, meanwhile, gauges literacy.

In his aforementioned work, Sen looks as far back as the philosophies of Adam Smith to justify the need for taking an integrated approach to economic and social development. Our discussion thus far suggests that the synthesis of human capital, human rights, and human capability affected by the human-development paradigm represents a logical first step toward such integration. The conceptual formulations of human development have, in the past couple of decades, been strengthened by substantial empirical investigation.

As mentioned in the preceding section, the UNDP has developed a Human Development Index, which is a composite measure of income, education, and health, and ranks nations annually according to their HDIs. While the ability of these rankings to capture the multiplicity and dynamics of human choices (UNDP 1990) is modest, they successfully illustrate the fact that economic prosperity and social development are not inextricably linked; for instance, contrast Sri Lanka with Saudi Arabia, which has a much higher income but a lower HDI. The World Bank (1995; 2006) has made repeated attempts to measure human capital against other forms of capital —physical, natural, social —at a global level.<sup>4</sup> The results have been very helpful in evaluating human development in a holistic way. For the purpose of strategic policymaking, it is further necessary to conduct an integrated study of the various development indicators with a view to understanding and measuring the dynamic interactions among them and their drivers across multiple subsectors of demography, economy, and society.

Education, in a human-development synthesis, should be viewed within a broad, complex developmental context. There is bidirectional linkage between human development and economic development, both at the private (personal or micro-) and public (social or macro-) levels, although the direction and magnitude of the relationship can vary (Ranis, Stewart, and Ramirez 2000, 198). . In such a synthesis, education's strengths and weaknesses—for example, its role in endowing the individual with wealth, health, and other components of human well-being versus its inability to do so alone—have to be intuitively understood and discussed with equal emphasis.

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<sup>4</sup> The World Bank's measures suggest that human capital and the value of institutions (as measured by the rule of law) constitute the largest share of wealth in virtually all countries (World Bank, 2006).

Meanwhile, considerations of the structure and level of development of a country's economy, as well as the impact of its public-sector expenditures on the education of its people, are also incorporated into the human development discourse, as are discussions of the availability or shortage of education as a reflection of national resources. These supply-side analyses dominate the recent literature on global-education goals (Bruns, Mingat, and Rakotomalala 2003; Delamonica, Mehrotra, and Vandemoortele 2001; Devarajan, Miller, and Swanson 2002). However, a country's level of economic development also determines participation in the educational system, entailing the need for demand-side analyses. While there is strong research on the wage-related returns of education (Mincer 1974), parents must be convinced that there will be sufficient benefits to offset the costs incurred by the enrollment of their children in school. In a paper prepared for the Millennium Project Task Force on Education and Gender Equality, Michael Clemens refers to a "take-off" point in primary enrollment, reached when per capita GDP approaches a level signaling likely returns for education (2004:18). There are only a few discussions of demand (OECD, 2006) in the education- and development-policy literature. An additional factor that comes into play on the demand side is the availability of further education. Because many parents perceive some secondary education as necessary for participating in and benefiting from a growing economy, they may decide to send their children to primary school based on the opportunity to pursue the next level of education (UNMP 2005, 65).

Demography is also closely intertwined with education and development. Demographic disasters and advancements have significant implications for future demand for education (Gehring et al. 1981; Hildernik 2000). Conversely, educational



expansion helps decrease fertility rates as women gain employment and child mortality rates likewise decrease (Lutz and Goujon 2001; Hill and King 1993). Lower fertility, in turn, means lower educational demand, such that more resources may be dedicated to educational quality.

Figure 2.1 illustrates the connections among the aforementioned variables, namely education supply and demand, critical economic and financial variables, population, and the level of education attained by the population.

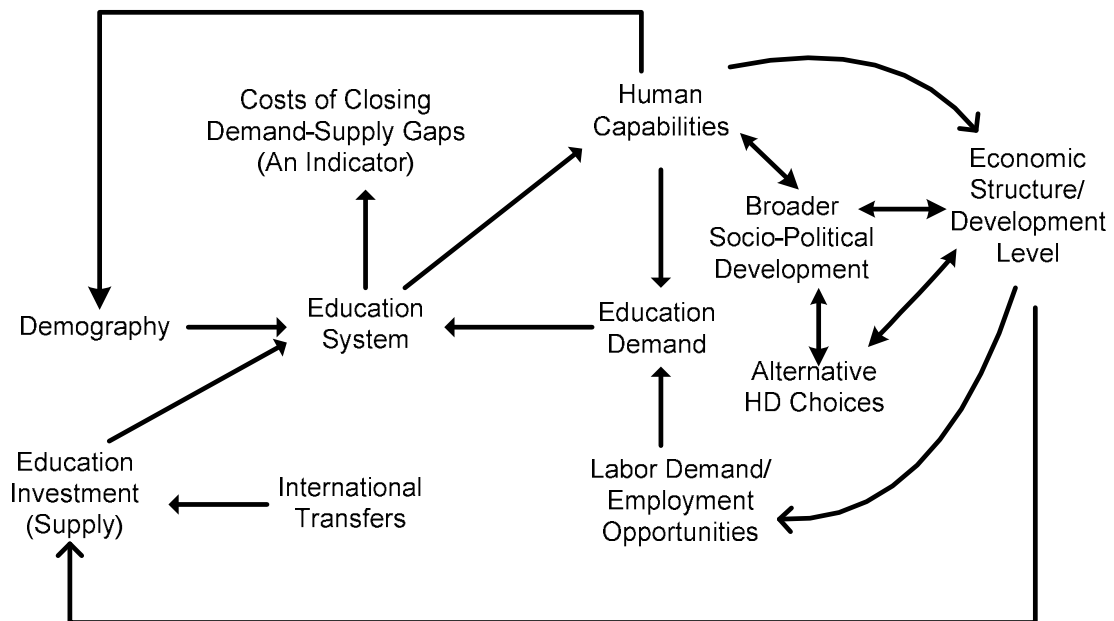


Figure 2.1. Education and the Human Development System  
*Source:* Dickson, Irfan, and Hughes 2007, 11.

## 2.4 Conceptual Framework: Understanding Educational Systems

Mass schooling programs around the world have shown some basic organizational similarities since their inception (Meyer, Ramirez, and Soysal 1992). Schools, students, teachers, curricula, and the associated flows of individuals and resources are common characteristics of national formal-education systems. They diverge, however, with respect

to the duration, sequence, and hierarchy of their educational stages and the terminology used to describe such variables.

#### 2.4.1 Standardization of the Levels of Education

A conceptual framework that standardizes classifications and terms is necessary for comparing education systems. As a recent historical study has noted (Smyth 2008), comparative educationists were recommending the adoption of an “artificial terminology” as early as 1933 (Hans 1933). UNESCO started the standardization process after the Second World War (UNESCO 1958, cited in Smyth 2008) and finalized it in 1997, when the final revision of ISCED was adopted. ISCED is a universal classification system covering the sequential stages of education along the central axis of curriculum content as well as subsidiary axes such as commencement, duration, graduation, and instructor designation.

There are seven ISCED levels, beginning with level zero for pre-primary and ending with level 6 for advanced tertiary; Table 2.2 illustrates primary or level 1, lower secondary or level 2, and level 3 of upper secondary. The primary level is considered the first stage of basic, compulsory education. The ISCED classification has disaggregated secondary into lower and upper divisions of mostly equal length. Its objectives being somewhat similar to those of elementary, lower secondary completely prepares pupils for low-skilled occupations, possibly for the long term. It adds to the rudimentary skills of primary by imparting sufficient foreign-language knowledge to comprehend foreign technologies. It also hones the life skills and civic lessons obtained in primary, which shape pupils into responsible household members and citizens. Upper secondary, by

comparison, resembles the higher levels of education. It generally prepares pupils for tertiary education; indeed, students may not be able to fully realize its benefits if they do not use it for entry into tertiary.

As described in the classification, then, primary and secondary are more similar than are the two levels of secondary themselves. Thus, it is suggested that levels 1 and 2 be made compulsory as the stages of basic education. They provide the learning foundational to further levels of education as well as the skills necessary for human development at the individual and societal levels.

Table 2.2. UNESCO ISCED Levels 1, 2, and 3

How to Determine the Level of a Program		Name of the Level	Code	Complementary Dimensions
Proxy Criteria for Contents				
Main Criteria	Subsidiary Criteria			
Beginning of systematic apprenticeship of reading, writing, and mathematics	Entry into nationally designated primary institutions or programs  Start of compulsory education	Primary education  First stage of basic education	1	None
Subject presentation  Full implementation of basic skills and foundation for lifelong learning	Entry after some six years of primary education  End of the cycle after nine years since the beginning of primary education  End of compulsory education  Classes conducted by several teachers in student's field of specialization	Lower secondary education  Second stage of basic education	2	Type of subsequent education or destination-program orientation
Typical entrance qualification  Minimum entrance requirement		(Upper-) secondary education	3	Type of subsequent education or destination-program orientation  Cumulative duration

Source: UNESCO 2006.

#### 2.4.1.1 Basic Education in ISCED

Basic education, from primary through lower secondary,<sup>5</sup> is explicitly defined in the UNESCO ISCED (UNESCO 2006, 19). As we mentioned before, at the policy level, there is an emerging trend (UNESCO 2007, 58) toward establishing them collectively as the minimum level of education necessary to realize individual potential.

In recent years, universal primary education has been the foremost national and international education target, mainly due to the global consensus on the importance of primary education for reducing poverty by ensuring higher agricultural and economic productivity as well as healthier, more responsible living (Kadzamira and Rose 2003, 501). As we have noted, attempts to set new educational goals to be met once universal primary education is achieved are already being made (see, e.g., King, McGrath, and Rose 2007). Some analysts argued for paying increased attention to postelementary by pointing to the positive changes in its returns (Tilak 2007), reversing the traditional rate-of-return analyses (Psacharopoulos 1985), whereby elementary is shown to have the highest returns. Analyzing the relationship between poverty and different levels of educational attainment in the states of India, Jandhyala Tilak (2007, 440) concludes that while illiteracy and poverty go hand in hand, the “mere literacy” obtained in primary is not enough to reverse the relationship between education and poverty. It is at the level of

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<sup>5</sup> While UNESCO has classified pre-primary education as level 0, preceding level 1 or primary, we haven't included pre-primary in our analyses, since pre-primary education starts to expand only after countries develop and acquire wealth.

middle school, or upper primary,<sup>6</sup> that we start to see an inversion in that relationship (Tilak 2007, 440). On the private level, as more and more children complete primary school, the wage gains could shrink because of supply pushes. Unless there is access to postprimary education, the perception about this falling economic returns is likely to affect the demand for primary and might start to reverse the rise in primary participation could offset (UNMP 2005). Furthermore, although the primary curriculum fosters the literacy and numeracy necessary for reading, writing, and doing simple math, the “full implementation of basic skills” that provide a “foundation for lifelong learning” can be obtained only through lower secondary education (UNESCO 2006, 19). Thus the “full development of the human personality” championed by the UN Declaration of Human Rights, can only be ensured via the expansion of education to at least lower secondary. Moreover, from a structural point of view, those that will meet the MDG of UPE on time will be contending with a demand push on the next level of education, lower secondary. Even those countries that are sure to miss the UPE by 2015 could benefit from a serious analysis of lower secondary in other countries, which would examine claims that a lack of postprimary opportunities depresses demands at the elementary level.

#### 2.4.2 Student-Flow Indicators

UNESCO’s standardization of educational levels made the tracking of students flowing in and out of those levels simple and comparable, furthering an understanding of the educational flows. For example, taken together, gross and net enrollment rates (which will be explained later) reveal sufficient information about the participation and progress

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<sup>6</sup> In some places in India, the country of analysis in Tilak (2007), there are what are called middle/upper

at any given ISCED level even in the absence of details like age-enrollment profiles. We shall explain the flow rates via the example of the level of primary, though the explanation applies to the level of lower secondary as well.

Though UNESCO's seven-level ISCED97 classifies primary education as level 1, coming after the pre-primary level 0, it is the first phase of formal education in many countries that do not have pre-primary. Children around the world start primary school between the ages of five to seven, stay there for a duration ranging from three to seven years, and then graduate to the next level. Access to and coverage in primary-education systems are expressed by statistical indicators of intake and enrollment, which represent the proportion of children entering and staying in school, respectively. In the ideal situation, the extent and efficiency of a national primary-education system could be sufficiently expressed with a single rate each for intake, enrollment, and graduation (the final step in the educational flow at each level). In reality, however, children within a single system may enter school at different ages and stay for varying durations. In developing regions, parents are not always able to send their children to school at the appropriate age. Once in school, not all of them progress through the system at the desired pace. Owing to various reasons, including poverty levels and the quality of the school system, children might repeat one or more grades or drop out of school altogether.

To capture these age-grade inconsistencies, primary-student flows are reported using two different types of indicators, *gross' rates* and *net rates*. The gross- or apparent-intake rate reflects the number of students entering schools, irrespective of their age, divided by the total number of entrance-age children. In contrast, net-intake rate is the

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primary schools for classes between six to eight grades.

sum of the number of entrance-age school entrants divided by the total number of entrance-age children. Similarly, there are gross- and net-enrollment ratios for the whole span of primary education. Gross-enrollment ratio is the total number of children in primary schools, irrespective of age, divided by the population of primary-school-age kids, whereas net enrollment is the number of school-age enrollees divided by the entire population of that age. Though the denominators are the same in both cases, the numerators differ and are always higher or equal in the case of gross rates. Both gross and net statistics are expressed in percentages; by definition, the gross enrollment can go above 100 percent. UNESCO maintains the most comprehensive database on gross and net enrollments and the indicators compiled (or, in a few cases, estimated) annually (UNESCO Institute for Statistics 2004) with data from the education ministries of national governments.

In addition to enrollment and intake, there are official data on the percentages of repeaters and dropouts. However, the usual approach is to use a single indicator, called the survival (or persistence) rate, which is theoretically defined as the proportion of students of an entering class who reach the final grade with or without repetition along the way. Survival, expressed as a percentage bound by 100, by definition excludes the dropouts and is helpful in charting the progress of the learners as well as the efficiency of the system. Survival rate is conceptually different from completion rate. Survival to grade four or 5 originated as a proxy measure for the minimum level of education necessary for sustainable literacy, but it monitors progression only for those students who have entered the system. Completion rate measures the number of primary graduates as a proportion of



the total population of graduating age; they can (and do) exceed 100 percent for countries nearing the transition to universal primary.

Disaggregation of flow rates along further axes of uneven development—for example gender, ethnicity, urbanization, or location—allows us to evaluate and monitor progress in educational parity across variables. Gender parity in particular is closely observed by those national and international agencies that monitor progress toward the MDG.

Differences in enrollment, intake, and survival, as well as differences between the net and gross rates of the first two, help us understand the structure of the education system in any given country at any particular point in time.

#### 2.4.3 Financial-Flow Indicators

The allocation of resources to cover the costs of education varies across countries and along the timeline of educational stages. A comparative understanding of these financial flows is possible only with the use of relative real indicators, rather than absolute nominal ones. The standard practice is to express the costs and allocations as proportions of per capita and national income respectively. For example, the public expenditure (data on the private expenditure for education are scarce) in primary education in developed countries converged to a value of about 20 percent of national income (UNESCO Institute for Statistics/OECD 2005). An average OECD country spends between 5 and 6 percent of its GDP on education as a whole (UNESCO Institute for Statistics 2007).

#### 2.4.4 Indicators Appropriate for Monitoring Educational Goals

Reaching UPE is a complex process. It requires both universal intake into the system at the front end of the process (access) and persistence to the point of completion some years later. This complexity has generated some debate about which indicators most accurately gauge progress toward UPE. The United Nations Statistics Division has listed net primary enrollment as the prime indicator, with a target of 100 percent net enrollment by 2015. Those opposed to the use of this indicator point to the appearance of the phrase “universal primary completion” in the text of the MDG, noting that not everybody in school in 2015 will necessarily graduate. Accordingly, they name the (gross) completion rate as their indicator of choice (see, e.g., Bruns, Mingat, and Rakotomalala 2003), and the target of 100 percent completion is implicitly combined with an intermediate target of 100 percent of net intake by the year 2010. A careful analysis of the structural patterns of primary-education systems (to come later in this work) shows that high achievement in net intake is followed by higher survival and high completion. It also shows that gross enrollment is a misleading indicator, because low survival in underdeveloped countries can result in low net enrollment even when gross enrollment and intake reach 100 percent. Acknowledging the time lag from access or entry to survival or completion, UNESCO decided to use multiple indicators. It suggests the use of four to track progress toward universal primary education: (1) the *net-enrollment ratio* in primary education (a flow indicator); (2) the *survival rate*, or the proportion of pupils starting grade 1 who reach grade 5 (a measure of education-system efficiency); (3) the *primary completion rate* (variously regarded as an indicator of efficiency, quality, and capital-stock formation); and (4) the *literacy rate of fifteen- to*

*twenty-four-year-olds* (a quality indicator). Of the four indicators adopted to track progress toward gender parity, two specifically relate to education: (1) the *ratio of girls to boys in primary, secondary, and tertiary education*; and (2) the *ratio of literate women to men, fifteen to twenty-four years old*.

#### 2.4.5 A Note on the Disambiguation of Terminology

We would like to explain two of the terms that appear in the title of this study to make sure there is no confusion about the senses in which we employ them. There is some ambiguity<sup>7</sup> surrounding the use of the term *basic education*. Some experts use it to mean the combination of basic literacy, numeracy, and life skills that is imparted to a child in a formal or nonformal setting or to a previously uneducated adult in a nonformal setting. For example, a World Bank report on education in sub-Saharan Africa (World Bank, 1988) used the term to mean nonformal basic education for youth or adults. However, it is now often being employed as a synonym for *compulsory education*, (UNESCO 2007, 58) generally defined as the minimum amount of education citizens should be provided by the state, usually the equivalent of primary plus lower secondary. . As a World Bank sector report (World Bank 1995) points out, basic education typically requires eight years of schooling and is the top priority in almost all countries. It demands particular attention from educational policymakers in any developing country.

By basic education, we mean the “fundamental stages” of education necessary for the “full development of the human potential,”<sup>8</sup> including the formal levels of primary

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<sup>7</sup> I have discussed this ambiguity in several places above, as deemed relevant. However, I believe that the issue demands its own space.

<sup>8</sup> We quote here the UN Declaration of Human Rights, Article 26.

and lower secondary, which serve as the foundation for lifelong learning and human development upon which further levels and types of education and training may be built.

We use the word *transition* to describe the passage from one state of education and literacy to another—for example, from low to high—rather than in the more technical sense of education-policy experts, whereby it refers to the passage of students from one level of education to another.

## **2.5 Global Trends in Education**

The impressive (albeit uneven) progress in education many countries have made over the past several decades has made a profound impact that has in turn brought education to the forefront of the global-development agenda (King 2007). In the past couple of decades, the global community repeatedly vowed to speed up the transition to worldwide education (UNMP 2005). Understanding the variations in the education-sector trends and identifying the drivers that affect those trends are important not only for evaluating the global goals for education but also for suggesting modifications and extensions that will accelerate the transition, ensuring that it happens within the foreseeable future.

### 2.5.1 Early History of Education

The history of education is as old as the history of the civilization. Two-and-a-half millennia ago, Aristotle declared education was the means to a “good life” (Aristotle, trans. Rackham, 1944, 637). With the rise of modern schooling in the West, an event that roughly paralleled the Industrial Revolution came the democratization of education. The formal-education system broke the medieval monopoly held by professional scribes and

their patrons in the religious establishment (Leon 1985, 66). Education has gradually been transforming into a secular and public activity ever since (Tyack, James, and Benavot 1987), democratizing and spread among the masses. Aaron Benavot and Phyllis Riddle (1988) have analyzed the period from 1870 to 1940 and shown that the growth in mass primary education worldwide has varied. Using their dataset, John Meyer, Francisco Ramirez, and Yasemin Nuhoglu Soysal (1992) have identified a slow but steady sigmoid diffusion of global mass education for the same period.

### 2.5.2 Expansion in Mass Education

In the postwar period, the pace of educational achievement across the world seemed to increase; though researchers disagreed about the precise velocity, they reported consistent worldwide growth. John Meyer, Francisco Ramirez, Richard Rubinson, and John Boli-Bennett (1977) were among the most optimistic about both the speed and the extent of global-educational expansion, viewing the “rapid” changes of the 1950s and 1960s as proof of a “world-education revolution.” Later, with Ramirez and Soysal, Meyer extended his analysis on mass primary enrollment up until the 1980s and came to the same conclusion about rapid progress, this time with respect to a prewar period of eighty years, 1870–1940 (1992, 133). Julian Simon and Rebecca Boggs (1997) have illustrated the “exciting and heartening” trend in the increases in the education of youth around the globe. According to their pictorial essay, the trend started “in the nineteenth century in the advanced countries” and is “continuing and speeding in the twentieth century in all the world” (Simon and Boggs 1997, 69). Annababette Wills and Anne Goujon (1998, 361) have shown that school enrollment increased significantly in all the major regions of

the world from 1960 to 1990. Michael Clemens (2004) has shown that, since 1960, the average country has sped up the time it took to go from a 75 percent to a 90 percent primary net enrollment by nearly a third of that in the prewar period. According to an international study published by the US National Center for Education Statistics (US Department of Education, National Center for Education Statistics 1996, 13), educational participation among five- to twenty-four-year-olds increased in most countries between 1985 and 1991.

### 2.5.3 Universal Basic Education: Emerging Global Transition

The rapid postwar spread of mass education has resulted in a substantial improvement in adult literacy. Youth literacy and elementary enrollment moved even faster, making most analysts quite hopeful about their universality by the 2015.

The percentage of illiterate adults (aged fifteen and up) worldwide nearly halved from 36 percent to 20 percent from 1970 to 2000 (UNESCO Institute for Statistics 2002). In the same thirty-year period, the rate of illiteracy among young adults aged fifteen to twenty-four, decreased by exactly half, reaching the low teens by the end of the century (UNESCO Institute for Statistics 2002). The progress looks even more impressive as we examine the current flows at the lower levels of education, specifically primary and lower secondary. According to our calculations using the latest data published on the UNESCO Institute for Statistics (UIS) website (UNESCO Institute for Statistics n.d.a), just over 88 percent of primary-age children worldwide—almost nine out of ten— were attending school by the year 2005. Doing the same kind of weighted average for 1970 we get a

much lower number—just over 70 percent global primary net enrollment (although the comparison is not precise due to missing data for 1970).

At the level of lower secondary—for which global coordination in statistics gathering is comparatively new—the global participation ratio has improved an impressive 7 percent within a short six-year period, from 1999 to 2005 (UNESCO 2007, 59). The sequence of educational expansion gives rise to the possibility of multiple sequential stages of educational transition—for example, the completion of universal primary education followed by universal basic education and so on. Annababette Wils suggested in a 2002 paper<sup>9</sup> “most countries in the world are either in the process of an education transition to full literacy, and perhaps to universal full primary and secondary education achievements for all adults, or have finished this transition.” In an unpublished working manuscript, Barry Hughes contrasted this educational transition from low to high enrollment with the much better-known demographic transition from high to low fertility (Dickson, Hughes, and Irfan 2008, 69). The latter has largely been completed in developed countries and thus maps the route likely to be followed by less-developed ones, albeit more rapidly. The educational transition, at least at the higher levels, is still occurring even in developed countries, making the path elsewhere in the world less certain.

#### 2.5.4 Uneven Progress: Uncertain Transition?

The postwar expansion failed to level the educational playing field across the dimensions of gender and geography. According to the Delors Commission Report

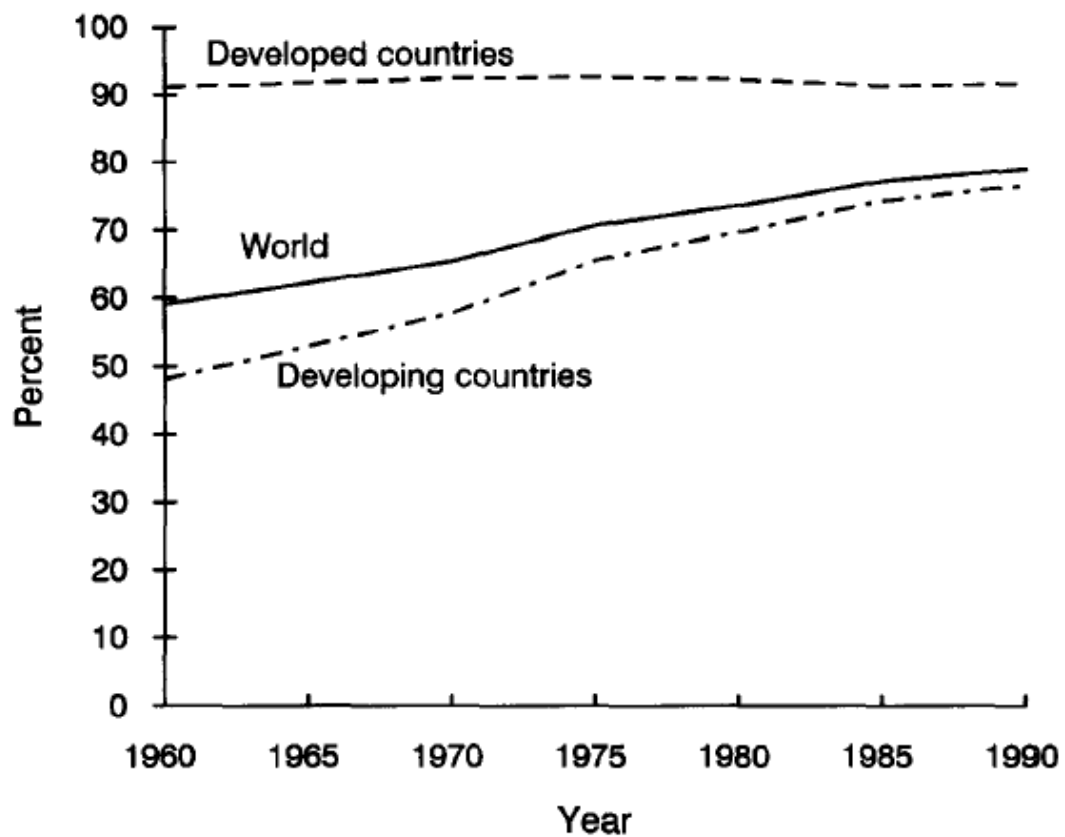
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<sup>9</sup> The quote that follows is from the unpaginated abstract of the paper.

(Delors 1996, 117), “The record of the twentieth century in expanding educational opportunities is a source both of pride and of shame”

At the primary level, while the high-income, developed countries continued their progress in the late twentieth century, the developing world failed to catch up, as is visible in Figure 2.2.

Figure 2.2. Proportion of World’s Children Aged Six to Eleven Enrolled in School, 1960–1990



Source: UNESCO, 1991, 2–31.<sup>10</sup>

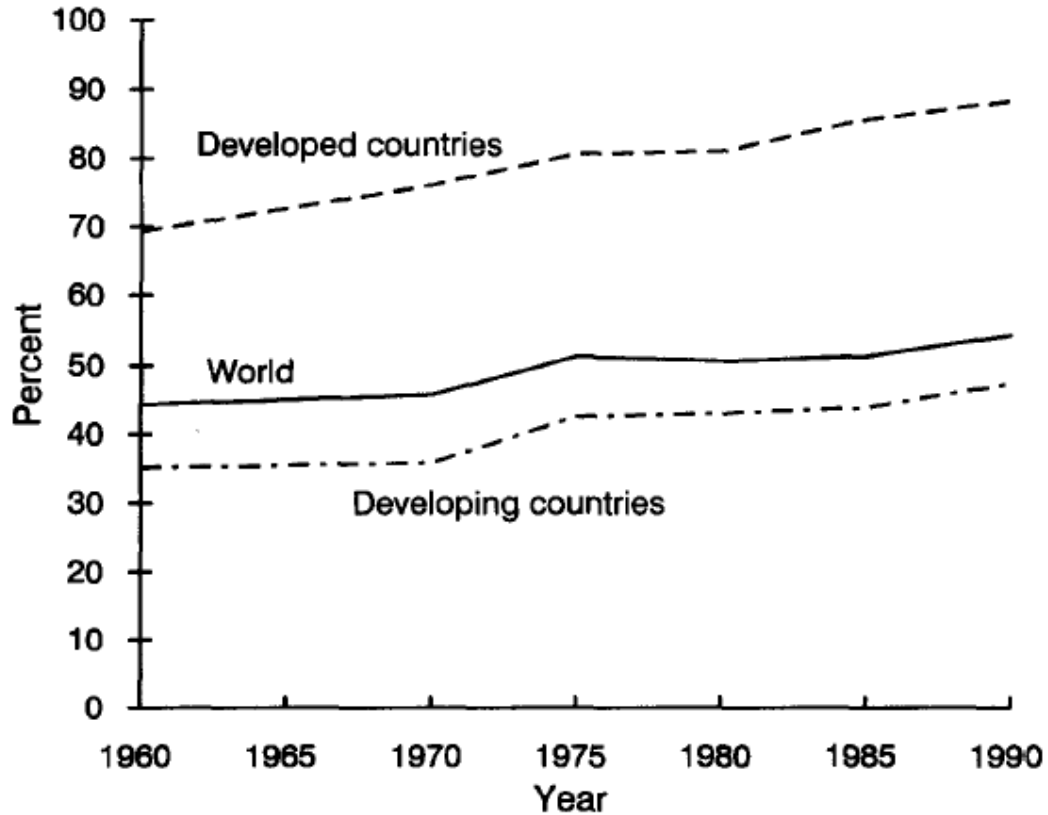
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<sup>10</sup> Reprinted from *Economics of Education Review*, Vol 16, no. 1, Simon, Julian L., and Rebecca Boggs, *The quantities of education: A pictorial essay*, Pages 69-80, Copyright (1997), with permission from Elsevier.



The sequencing of multiple educational transitions becomes quite evident if we contrast Figure 2.2 with Figure 2.3, which compares the postwar evolution of enrollment in the developing and developed regions for the next age group of pupils.

Figure 2.3. Proportion of World's Children Aged Twelve to Seventeen Enrolled in School, 1960-1990

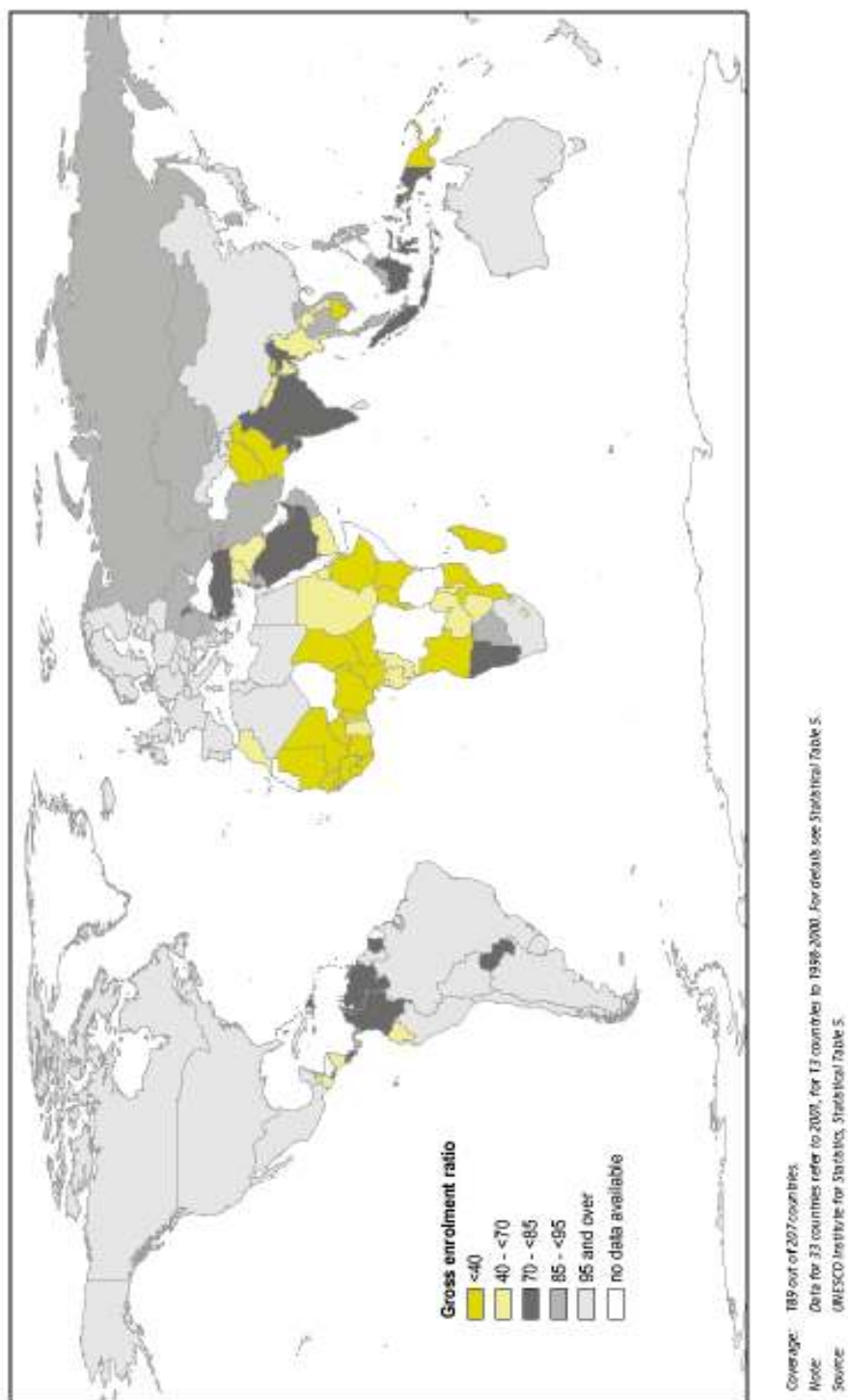


Source: UNESCO, 1991: 2-31<sup>11</sup>.

Variations across geographic regions are also large. Figure 2.4 shows a map of the global lower secondary participation rate and indicates the contrast between Europe, where the participation rate is mostly above 95 percent, and Africa, where the participation rate is below 40 percent for about half of the continent.

<sup>11</sup> Reprinted from *Economics of Education Review*, Vol 16, no. 1, Simon, Julian L., and Rebecca Boggs, *The quantities of education: A pictorial essay*, Pages 69-80, Copyright (1997), with permission from Elsevier.

Figure 2.4. How Do Countries Compare in Terms of Participation in Lower Secondary?<sup>12</sup>



Source: UNESCO Institute for Statistics 2005, 10.

<sup>12</sup> Reprinted with permission from UNESCO Institute for Statistics.

Countries are not making the transition in the same manner. For instance, most countries have gross enrollments, which include over-aged repeaters and regulars, in primary that are no more than 20 percent higher than their net enrollments (of appropriately aged, on-track students). Some, however, find themselves in primary catch-up mode. In 2005, Afghanistan had a gross enrollment of just over 100 percent and a net enrollment of just under 30 percent, a contrast that vividly reflects both the state of education under the Taliban and the determination of Afghani families since the end of its rule to return their children to school. Similarly, Gabon had a gross enrollment of about 150 percent but a net enrollment of under 80 percent. Other countries in catch-up mode in 2005 included Comoros, Ethiopia, Haiti, Nigeria, Rwanda, Saudi Arabia, and, to a lesser extent, Angola. Although playing educational catch-up may not be very efficient, many disrupted societies find it necessary.

Boys and girls do not share achievements in the global education sector equally, though gender parity has improved. UNESCO's EFA monitoring report of 2003 and 2004 (UNESCO 2003, 265) notes "a strong global move toward greater gender parity, particularly at [the] primary level, where the proportion of girls to boys enrolled has improved from 88 percent to 94 percent over the past decade." However, the report also points to the fact that three-fifths of the 128 countries analyzed were sure to miss the MDG goal of gender parity in primary and secondary education by the year 2005 (266). Its pessimism continues as it finds that two-fifths of the analyzed countries will not be able to make this goal even by 2015. Most of the at-risk countries are in sub-Saharan Africa, but exceptions include China and India, each of which has one of the largest student populations in the world.

## **2.6 Understanding the Trends: Drivers of Transition**

Experts give several reasons for the fluctuations in educational expansion worldwide. These range from a given nation's initial condition to the underlying patterns of its demography, health, urbanization, migration, and economy.

Bruce Fuller and Richard Rubinson (1992, 8–9) developed a four-stage model of school expansion putting the stages of demand, supply, school expansion and effects in the sequence they are listed here. Educational expansion, as per their model, is a result of the demand determined educational supplies while the economic, political, and social returns from education feed back to both the supply and the demand of education. In the following section, we shall discuss the variables that may have led to the expansion of education or its lack thereof in different parts of the world. We use a subset of these causal variables to develop our education model, as we will elaborate in the methodology section.

### 2.6.1 Economy as a Driver

Theoretically, the perception that increases in income are proportional to more education (Mincer 1974; Psacharopoulos 2002), should prompt people to get more education. However, since the market mechanisms do not work well (Arrow 1973), the outcome depends more on the availability of public resources available and their allocation toward educational activities, at least with respect to the lower levels of education. The process has a feedback mechanism (Dickson, Irfan, and Hughes 2007) whereby sustained economic growth, as a result of the increased productivity born of increased education (McMahon 1999; Barro and Sala-i-Martin 1995), ensures the

availability of more resources for educational investment, at both the government and household levels (UNESCO 2007, 19).

#### 2.6.1.1 Demand Side: Perceived Returns Increase Educational Demand

The returns of education at the individual level have long been researched. On the other hand, the literature on the macro impact of education on economic growth is more recent and, in most cases, focus on empirical evidence of regressing individual educational variables against economic growth (Barro and Sala-i-Martin, 1995) or on some quality-of-life variable (McMahon, 1999). Researchers have reached opposing conclusions regarding not only the significance of the explanatory powers of the variables but also their regressions (for example, Lant Pritchett found negative impacts of education on aggregate growth (1996)). George Psacharopoulos (2002) points to the major gap in research on the links between the micro- and macro-evidence of returns on education. Whereas it has been established beyond any reasonable doubt that there are tangible and measurable returns to investment in education at the micro level, the evidence is not as consistent or forthcoming at the macro level.

#### 2.6.1.2 Supply Side: Investment in Education

Several studies have sought to identify the circumstances favorable to educational expansion in any given nation. The studies summarized in the UNESCO Global Education Digest (GED) 2007 repeatedly stress the importance of ensuring a sufficient and stable source of funding for education (Colclough and Lewin 1993; Bruns, Mingat, and Rakotomalala 2003). According to the GED 2007, we should look at not only the total expenditure but also the per-student share to capture the underlying demographic

needs and the capacity of the system to meet them: “Countries with relatively high primary gross-enrollment ratios and primary completion rates generally devote a greater share of national income or government budgets to public primary education. In addition, expenditure per primary pupil also tends to be in the middle of the range (relative to GDP per capita)” (UNESCO Institute for Statistics 2007, 7).

### 2.6.1.3 Level of Financing/Expenditure

Extensive effort has been made- mainly by UNESCO- to measure the absolute and proportional amounts of the expenditure by various governments for various levels of education. The most extensive analyses of expenditure patterns can be found in a joint UNESCO/OECD report (UNESCO Institute for Statistics/OECD 2005) on the World Education Indicator (WEI) countries, a set of nineteen countries in different geographic locations, with diverse socioeconomic backgrounds. WEI countries<sup>13</sup> include both poor and middle-income countries but not OECD countries. The second chapter of the report (which we will call WEI 2005 from here on out) discusses the trends of expenditure in the WEI countries for an eight-year period, 1995—2003, and compares them with those in the OECD countries.

According to WEI 2005, by 2002, overall public spending on education in WEI countries was proportionally similar to that in OECD countries, with WEI countries spending an average of 3.9 percent of their GDP on primary, secondary, and postsecondary nontertiary education, plus an additional 1.3 percent on tertiary education,

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<sup>13</sup> Namely, Argentina, Brazil, Chile, China, India, Indonesia, Jordan, Malaysia, the Philippines, the Russian Federation, Thailand, Egypt, Jamaica, Paraguay, Peru, Sri Lanka, Tunisia, Uruguay, and Zimbabwe.

compared with 3.8 and 1.4 percent, respectively, in OECD countries. In middle-income WEI countries like Chile, Jamaica, Malaysia, and Jordan—and even in low-income Paraguay and Tunisia—expenditure on primary, secondary, and postsecondary nontertiary was significantly higher than in OECD countries. Chile, Jamaica, and Malaysia also spent significantly more than OECD countries at the tertiary level of education relative to their level of wealth.

There is also a longitudinal increase in public expenditure in WEI countries, where, since 1995, expenditure on educational institutions has increased at the primary, secondary and postsecondary nontertiary levels of education, from an average of 3.1 to 3.9 percent of GDP. The increase at these levels of education was larger for Chile, India, Jamaica, Malaysia, and Paraguay but smaller for Brazil. Uruguay and Tunisia, by contrast, have seen a decrease in the share of GDP spent on education at the levels below tertiary. At the tertiary level, Malaysia has seen a dramatic rise in public expenditure, more than doubling relative to GDP since 1995.

### 2.6.2 Non-Economic (Wider) Drivers

Tom Schuller (2004) and others have identified several non-economic benefits of education for individual health, family life, and society in general, which they call *wider benefits*. These drive education in turn. For example, demographic issues heavily determine educational outcomes in low-income countries, from the size of student population to the availability of trained teachers in the midst of an international brain drain (UNESCO 2007). In many parts of these countries, HIV/AIDS is taking a heavy toll

on teacher retention and there are calls for special allocations to cover those additional costs (Bruns, Mingat, and Rakotomalala 2003)

### 2.6.3 Initial Condition

In any movement toward a social target, those lagging behind usually proceed at greater speed than those near the target. Educational transition poses no exception (Meyer, Ramirez, and Soysal 1992; Clemens 2004; Wils 2002). However, a huge initial gap can make it difficult for the late starters to catch up even at their relatively high speed (Clemens 2004). Though it took the United States a full century and a quarter, starting from the time of its independence, to go from 50 percent white and 0 percent black enrollment to reach UPE, it did so by 1900 (CGD n.d.). By contrast, Ethiopia was sending only one-third of its primary-age children to school by 2000 (UNESCO Institute for Statistics 2006).

In its most recent global-monitoring report on the Education for All global goals (2007, 195–198), UNESCO has already expressed some caution about making the transition to universal primary education<sup>14</sup> by the MDG deadline of 2015.

If the 2008 climb in food and energy prices continues (Economist, 2008), developing countries and their international donors will find it increasingly difficult to muster the resources sufficient for expediting educational transition. Some countries in sub-Saharan Africa and south Asia will struggle the most.

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<sup>14</sup> There is controversy as to whether either of the two types of enrollment rates—gross or net—or the completion rate will be used as the indicator for universal primary.



## **2.7 Measurement of Educational Progress: Data and Tools**

In recent decades, we have seen the increasing development and use of statistical indicators to measure the condition of national-education systems throughout the world (Smith and Baker 2001). Since the global goals for education were set, UNESCO has led efforts to coordinate at the global level the results of research that has itself accelerated and improved at the local level. Global-education–flow-time series are now available online thanks to the UNESCO Institute for Statistics, founded in 1999. Although the availability and quality of the data are not always satisfactory, researchers have nonetheless been developing extensive policy models to analyze the costs of attaining the global goals. In this section, we shall discuss education data and models.

### **2.7.1 Global Data on Education**

There are two major sources of comparable international data. The first is UNESCO, the UN body charged with defining, standardizing, collecting, and maintaining education-related data for countries around the world. The second one is the United States Agency for International Development (USAID).

UNESCO collects educational statistics for nations around the globe. It has published those data annually since 1966. More recently, it has made them available in electronic format. Its efforts are heavily concentrated on flow indicators within the education sector, and it mostly collects data through its field offices, using centrally coordinated school surveys and school registers as its primary data sources. UNESCO published these data in printed statistical yearbooks until 1999, when it began publishing annual Global Education Digests or GEDs. The most recent editions of the GED cover as

many as 200 countries and contain data on access to, participation in, and progress through the various levels of formal-education systems by country and sex. UNESCO also compiles information from human-capital surveys conducted around the world, reporting the distribution of educational attainment in populations stratified by age and sex. However, the coverage of these data is skimpy. Robert J. Barro and Jong-Wah Lee (1993) have used the human capital data from UNESCO and other sources to construct a more extensive educational attainment time series, using lagged enrollment ratios, age structure and a perpetual inventory method. Daniel Cohen and Marcelo Soto in a 2001 paper presented another human capital data set for ninety-five countries.

USAID, meanwhile, started collecting education-related data later than did UNESCO, incorporating flow as well as very detailed human-capital-stock–measurement questions in its most recent Demographic and Household Surveys (DHS), which it conducted globally with the cooperation of academic partners like Johns Hopkins University.

There are other international sources of data; some of them, such as the World Bank’s World Development Indicators, offering global coverage and others, like the OECD’s UNESCO/OECD/EUROSTAT (UOE) database, offering only partial coverage. However, these sources mostly collect their data from UNESCO.

Some developed countries have their own data clearinghouses, compiling disaggregated national data as well as some international data for the sake of comparison. One such example is NCES, the aforementioned US federal agency that collects and maintains educational statistics.

### 2.7.2 Tools: Global-Education Models

Empirical models that illustrate educational trends and processes depend on the availability of necessary data. Because of their lead in data gathering, developed economies have been the pioneers in this respect, employing mostly statistical models to aid in educational planning as early as the mid-1960s (OECD 1967 cited in Vaizey et al. 1972, 80). These econometric models of enrollment and expenditure projection are much mentioned in the literature ( Vaizey et al. 1972 ) alongside two other types of analytic economic models, namely those calculating demands for (Stone 1965, cited in Vaizey et al. 1972, 80–84) and returns from (Psacharopoulos 1985) education in the form of labor market requirements and wages, respectively. What was missing—and is still missing to some extent, as will soon be clear—is an integrated model of educational systems that captures not only the students and financial flows within them, but also the reciprocal links between education and other components in the societal, economic, and broader human systems.

As previously mentioned, one of the limitations of the early postwar education models was their failure to compare and contrast education systems worldwide. UNESCO's statistics division completed one of the first educational projections with comprehensive global coverage in 1993 (UNESCO 1993); it has, in its repository, historical data for all levels of education for the maximum number of countries. In recent times, the increased inflow of data and the formulation of global goals have inspired progress in the field of comprehensive modeling for education systems worldwide.

Education forecasts in the past decade or so have focused on either of two types of dependent variables. The first predict short-term education-sector flows like the entry and progress of students and the allocation and expenditure of resources. The second study longer-term accumulation of human capital in a given society as a result of its population's educational attainment over time. Each of these forecast models could also be differentiated by their approach to education as a separate sector or one integrated with other social sectors.

Student-flow and costing models are the only ones relevant to our study. Of all the flow models that we have found in the literature, none has endogenized education into other sectors, though some have incorporated independent forecasts for other sector variables relevant to education-sector flows. In recent years, various attempts have been made to project student enrollments and the associated resources required to meet the global-education goals. In the section to follow, we shall discuss the purposes (i.e., the major dependent variables), techniques, and data sources of some of these models.

#### 2.7.2.1 Purpose of Student-Flow and Costing Models

Enrollment forecasting is quite common in educational planning. Some models attempt to forecast the participation rates of students in primary education following trends of the recent or comparable past. In this group are the models developed by Michael Clemens (2004) and Annababette Wils (Wils, Carrol, and Barrow 2005). Clemens analyzed the speed of expanding net-enrollment rate in primary education for over 100 countries from 1960 to 2000.<sup>15</sup> He has also studied the achievement of gender

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<sup>15</sup> Clemens (2004) also estimated educational transition for a smaller sample, using an adjusted net-enrollment rate, for the period of 1865–1914.

parity in primary and secondary education. Annababette Wils, Bidemi Carrol, and Karima Barrow (2005) used primary entry and completion rates as their dependent variables and analyzed the transition speed of those variables for seventy mostly poor International Development Assistance countries from 1950 to 2000. In a later study (2007), Wils also projected educational participation rates in both primary and secondary for a period of twenty years, beginning in 2005 and ending in 2025, using a sample of eighty-three countries.

Costing models attempt to calculate the resources necessary for meeting various national-, regional-, or global-education goals, extrapolating a normative path for flow rates toward the goal. In 2006, Melissa Binder developed a costing model attempting to calculate the costs of universal secondary education (USE). There is at least one hybrid model (Bruns, Mingat, and Rakotomalala 2003) that has forecast both student flows and educational costs, with future flow rates being determined by normative goal seeking, as in the average cost models.

#### 2.7.2.2 Data Sources for Flow and Costing Models

The creators of these education models needed data on population and enrollment rates as well as various economic data, such as the per-unit cost of education, national income, and the allocation of resources to education. All these models used population data (and projections) from the United Nations Population Division. To determine flow rates—that is, net or gross enrollment, intake or survival—the models used one of two sources. Michael Clemens (2004), Barbara Bruns, Alain Mingat, and Ramahatra Rakotomalala (2003), and Enrique Delamonica, Santosh Mehrotra, and Jan Vandemoortele (2001) all used administrative data compiled by UNESCO's field offices

from school registers. UNESCO has made tremendous efforts to collect administrative data from education systems around the world and to make them as comparable as possible. The evolving ISCED scheme and ongoing consistency checks require UNESCO to revise their estimates on certain occasions. Even when two models— both use UNESCO as their data source, the enrollment rates they rely on may differ; Clemens (2004), for instance, uses an unrevised, pre-2003 dataset, whereas the IFs education model uses data revised after 2003.

By comparison, Wils, both in her 2007 work and the 2005 work she coauthored with Carrol and Barrow, has used survey data collected by USAID in its DHS. DHS collect, among others, data on educational attainments of individuals by age and sex. Thanks to their associated age profiles, these data can be used to back-calculate the entry, completion, or transition rates required to reach the current level of attainment. For example, Wils and her coauthors (2005) have used the percentage of sixty-four-year-olds with some primary education at the time of data collection as the primary entry rate fifty years prior (allowing for the possibility of late entry up to the age of fourteen).

### 2.7.2.3 Methodology of Flow and Costing Models

The student-flow models, in a nutshell, identify trends of student-flow rates from historical data and project those trends into the future. Both Clemens and Wils chose to fit their historic data to a sigmoid path characteristic of social innovation (Hagerstrand 1967, mentioned in Wils, Carrol, and Barrow 2005). However, Clemens (2004, 41) used the complete panel of historical data (for 129 countries over forty years, encompassing 529 data points in total) to calculate the s-curve parameters (one of which he calls the *transition speed*) common to all the countries. Wils' (2005) team, by contrast, used

country-wise longitudinal regression to estimate and extrapolate national trends for each of their two variables. Both groups use the s-curve parameters to simulate the flow rates in successive years, starting from the year after that with the most recent data availability—2000 in both cases. In her more recent study, Wils uses a combination (2007, 13) of the standard cohort-population projection and the multistate demographic-projection method developed at International Institute for Applied Systems Analysis (IIASA) in the 1970s (2007, 28). The multistate projection method initializes the model with data on educational attainment by age-cohort and sex and then uses transition rates among different educational-attainment groups to forecast the future educational distribution of the age-sex cohorts.

Costing models generally use an average cost method (Devarajan, Miller, and Swanson 2002, 15), with a constant projection for relative unit cost and a linear goal path for enrollment rate. There are two major components of the cost calculation: the total enrollment and the per-student cost. Costing models start with the simple normative scenario of a linear progression from the most recent annual enrollment rate (e.g., for the year 2000) toward the 2015 MDG target rate. They then calculate the annual additional enrollment necessary to meet the goal as the difference of the number of students that need to be enrolled to reflect an accelerated rate and the number that would be enrolled if the 2000 enrollment rate held steady until 2015. These differentials, estimated by country, are then multiplied by a country-specific per-student cost according to the latest available data (in this case, the data for 2000) to yield a final estimate of additional resources necessary per country per year. An average cost over the whole period, aggregated to regional level as necessary, is then calculated by dividing the sum of costs

over the period (in this case, 2000–2015) by the total number of years in the period. We will now consider the details of one such model, which was developed by Delamonica, Mehrotra, and Vandemoortele (2001).

Delamonica's team (2001) calculated, country by country, the average additional amount that would have to be spent every year to build a sufficient number of school places by 2015 to ensure UPE. Their estimates are based on the most recent country-by-country data on budgetary expenditure, population and enrollment trends, and unit costs at the primary level. They used the most recent country-specific net-enrollment ratios (NER) at the primary level, based on UNESCO data, to estimate the number of enrolled children in 2000. For the years between 2000 and 2015, they computed the number of children in school by applying the latest NER to the projected number of children aged six to eleven (using interpolation from the UN Population Division data). This provided the baseline against which to compare the additional enrollment required for achieving UPE. Their next step was to estimate the annual number of enrolled children as the NER gradually approaches 100. They assumed that the NER would increase in a linear manner in every country every year beginning in 2000 to reach 100 by 2015. They then multiplied the NER by the projected number of children aged six to eleven in each corresponding year, which gave them the number of schoolchildren that need to be enrolled each year in order to gradually achieve UPE by 2015. After that, they calculated the number of additional schools places needed each year to reach the NER of 100 by 2015 by subtracting from the projected number of children aged six to eleven the number of those children that would be enrolled had the NER remained unchanged. Next, the number of additional children was multiplied by the country-specific unit cost to obtain



the additional cost relative to the expenditure level in the year 2000 (the data presented in the *UNESCO Statistical Yearbook*, 1994, 1997, and 1998, was used to approximate public expenditure). The unit cost of one year of primary education was expressed as a percentage of per capita income—<sup>16</sup> that is, it was determined by dividing the amount of public spending on primary education by the number of primary students and then by the GNP per capita. In the cases where no country-specific unit cost was available, the figure for a country in the same region or subregion with a comparable per capita income was used. The unit cost was assumed to remain constant for the fifteen-year period for which the cost estimates apply. Capital costs—for example, funds for building schools—were also calculated separately. However, the unit costs did not incorporate the cost of teacher training. Finally, the additional costs were added for each country and for each year and divided by fifteen to arrive at the average annual additional cost of achieving UPE at the regional and global levels. Devarajan, Miller, and Swanson (2002) adopted a very similar methodology in a World Bank–commissioned calculation of MDG costs.

Bruns, Mingat, and Rakotomalala (2003) have added some sophistication to this differential methodology by ramping up the flows that feed to enrollment rate—that is, the entry and completion rates—rather than the enrollment rate itself. They have also disaggregated the cost into its component current and capital costs. Current cost is further subdivided into teacher salary and non-salary costs. While they have assumed the same economic growth rate of 5 percent for all of the forty-seven developing countries in their

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<sup>16</sup> Relative costs are more meaningful than absolute ones because the principal cost item consists of teachers' salaries. That cost item is related to the level of economic development of the country (Carnoy and Welmond, 1997, cited in Delamonica, Mehrotra, and Vandemoortele, 2001).

study, the relative teacher salaries and the nonsalary costs (which are percentages of the former), expressed as a percentage of per capita income, stay the same throughout the run of the model after being initialized to the latest available data. In their benchmark scenarios, the researchers have let the unit costs rise or fall gradually toward the best practice costs in the region. They have also calculated a resource gap rather than the differential cost, as others have done. The financing gap, in their case, is the difference between the resources required to meet the goal and the available public resources, calculated according to various normative assumptions regarding national income growth, revenue collection, and education expenditure. All these cost models depend on the UN population projections for their underlying demographic projections. Some of the cost calculations have accounted for the HIV/AIDS epidemic. Bruns and her coauthors (2003), for example, incorporated a cost component reflecting teacher attrition from HIV/AIDS. In a variety of scenarios, the authors present estimates of incremental costs, including estimated gaps in domestic funding capacities.

Melissa Binder (2006) calculated the costs of universal secondary education (USE) using a methodology similar to that used by Delamonica, Mehrotra, and Vandemoortele (2001) as well as Devarajan, Miller, and Swanson (2002), holding the unit cost and enrollment rates constant while projecting the potential student population using standard UN population forecasts. In her calculations, unit cost is held constant over the projection period as the initial unit cost, calculated using secondary enrollment and expenditure data from UNESCO, or a best-practice cost reflecting the median of per-pupil spending by countries with better outcomes in secondary. She came up with a US\$34 billion-per-year figure with a fifteen-year USE target for the 144 developing

countries that she studied combined. With a twenty-five-year USE target, the per annum cost for the same group reduces by US\$6 billion, a more than 15 percent reduction with a ten-year extension in horizon. Further reductions in costs, ranging from 7 percent to 15 percent, occur in her efficiency scenarios of reduced repetition and best-practice cost.

#### 2.7.2.4 Results from Flow and Costing Models

Results from different models are not always comparable. Whereas Clemens (2004) projected the expansion of primary education by using net primary enrollment rate, Wils' team (2005) used the intake and completion rates to do the same. Projections might also be different in terms of the data they use to initialize their model. We have shown above how some models use administrative data, while others use the surveys and estimations based on those data. Despite the differences in data and methodology, the flow models generally point to the slow pace of transition. The slow expansion of education, like other social processes, casts some doubt on the achievement of universal primary education by 2015. We will elaborate upon these general conclusions in a later chapter, comparing them with the results from our education model.

The costing models were commissioned by international development organizations like World Bank and UNICEF with a view to calculating the development aid necessary for meeting the education goals. According to the findings of Delamonica's team (2001), the annual additional cost of achieving "education for all" in developing countries by 2015 is estimated at US\$9.1 billion (expressed in 1998 dollars). This represents less than one-third of one-tenth of 1 percent of world GNP (0.03 percent) or 0.14 percent of the combined GNP of developing countries. The global shortfall

represents about 11 percent of what developing countries currently spend on primary education. Delamonica's team concluded that UPE is affordable at the global level. The summary average annual incremental cost for forty-seven low-income countries plus Afghanistan—the subjects of the Bruns, Mingat, and Rakotomalala (2003) study, which used the best-practices framework—is recurring, plus classroom-expansion capital costs of US\$8.2 billion, infrastructure-rehabilitation costs of US\$0.8 billion, and infrastructure-expansion costs of US\$0.3 billion, for a total of US\$9.7 billion, for which the average annual domestic financing gap is estimated at US\$3.7 billion. Bruns' team further estimates average annual incremental costs for middle-income countries (though they were not the focus of the study) at an additional US\$23–28 billion, of which US\$1–3 billion is considered a domestic financing gap (2003,110–111).

#### 2.7.2.5 Limitations of the Flow and Costing Models

The authors of the recent education models made immense progress in studying the future of global education in a comprehensive fashion. They have gathered data, analyzed trends, measured the speed of educational progress, and calculated the costs of educational expansion at a global level. These are huge accomplishments within a short period of seven to eight years. However, as with the results from all such big tasks, they are not free of shortcomings.

Since global-educational efforts are concentrated around universal primary education, so are most of the flow and costing models. Even if some of them include secondary, they do not disaggregate secondary into lower and upper secondary in a manner that would be helpful for studying the achievement of universal basic education. Another general limitation of these education models is their failure to integrate and

interact with variables outside of but important to the education sector. Among these non-education sectors, the most important is the demographic sector. All of these models used UN population projections to determine school-age population. While the UN's is one of the most accepted demographic projections, the goal-seeking models fail to capture the feedback from increased education to demography, for example through the established channel of reduced fertility as a result of more education for girls.

Another important bidirectional linkage exists between education and economics. It is now established that the demand for education is closely linked with increased prosperity. As income rises, more families send their children to school. The goal-seeking models have generally ignored this reality by forecasting under the normative goal-seeking scenario, assuming that there are enough demands. The flow-rate projection models (Clemens, 2004; Wils, Carrol, and Barrow 2005) are also limited by their inability to capture affects from economic upturns or stagnation—which, according to Clemens (2004, 18) are major drivers influencing the transition speed of enrollment rates.

Bruns' team (2003) attempted to represent the supply side of the economics of education via a somewhat detailed representation of education-sector budgeting, starting from national income and going all the way to domestic-resource mobilization and allocation. However, their assumption of constant economic growth across countries and along the entire model horizon was too simplistic, at least for the set of countries they chose. Both Bruns (2003) and Delamonica (2001) made similar assumptions about the per-student costs. Although the data show a gradual increase in teacher salaries—the major component of the per-student cost—as countries get richer, both models assume constant relative costs along the model horizon.

Another major bidirectional link between education and economics involves increased productivity resulting from more education and the subsequent availability of more funds for education. The short-run goal-seeking models might not be affected by this link, as there is a time lag between youth education and worker productivity. However, it might be very important for determining long-term transition speeds, as outlined by Clemens (2004) and Wils' team (2005).

Another important problem for costing models concerns their use of net- instead of gross-enrollment rates. Although the net-enrollment rate, with its definitional limit of 100 percent, is the preferred indicator for universal primary, calculating costs using only net rates might result in underestimations for those developing countries where high numbers of repeaters and late entrants raise the gross-enrollment rate to a point much higher than that of the net-enrollment rate.

The education model developed for this research attempts to address some of these shortcomings by modeling the student and financial flows in both primary and lower secondary education over a horizon substantially longer than that of other models. We have also integrated the education model into a broader economic and social model allowing for bidirectional interactions between the modules. Though not all of them are used in this research, the IFs education model represents in detail all levels of formal education, from primary to tertiary, showing the coherent transition of students from one level to another.

### 3 Methodology

At the end of the previous chapter, we discussed some models developed for the purpose of analyzing the global educational futures. Any such analysis could be either exploratory—aimed at predicting the likelihood of educational progress—or normative, designed to determine the feasibility, costs, and benefits of reaching a desired educational target. In addition, models can vary in terms of the methodologies they use, as well as the issues that they cover and the temporal and geographic factors involved. The purpose, structure, and focus of the models are generally determined by the potential clients of the modeling enterprise.

Some of the models that we discussed were exploratory (e.g., Wils, Carrol, Barrow, 2005 and Clemens, 2004). Those models explored the pace, progress, and potential of global transition towards full literacy, or universal elementary (and sometimes secondary) education. Some other models (e.g., Bruns, Mingat, and Rakotomalala, 2003; Binder, 2006) estimated the feasibility and resource requirement for reaching a normative target like universal primary or secondary.

Some of the exploratory models used extrapolation (e.g., Clemens, 2004; Wils, Carrol, Barrow, 2005) of various kinds, mostly sigmoid, while others used a detailed structure with educational cohort flows (e.g., Wils, 2007). The normative models, by contrast, generally interpolated a goal path from a base educational level to a targeted increase and calculated the resources required to follow that path according to various

exogenous assumptions about educational costs, population growth, and economic development.

There is, however, another modeling technique, developed by Walter McMahon (1999), that we have not yet discussed because of its irrelevance for our modeling purposes. McMahon's model is driven by econometric estimation and structure and is more concerned with calculating the benefits of education. The models we have discussed extend their forecasts from ten to twenty-five years and are cross-national. However, they do not attempt to capture the dynamic interactions between education and other components of society and economy in a comprehensive fashion, either within or across nations.

Normative models are concerned merely with calculating the supply of funds needed to reach the desired targets; they do not take into account the demand side. The exploratory models, however, do not consider budget constraints that potentially limit educational expansion. We have attempted to address these shortcomings by developing an integrated education model that captures not only the agents' demands for education and the institutional mechanisms for meeting those demands but also various societal and economic factors that influence supply and demand.

The development of a comprehensive model for the study of educational futures involves the conceptualization of educational systems, the collection of relevant data to test and measure said conceptualization, and the determination of operational specifications based on the understanding of various relationships and their parameters. An integrated automated tool is helpful for accomplishing these steps. Such a tool not



only allows us to study the usual unfolding of education around the world but also enables us to explore the consequences of interventions in the education sector.

The continued improvement in the collection of education data and the availability of publications regarding education indicators with a wide country-coverage has made it possible to measure progress to date and forecast the direction thereof at a global level. As we look into the unfolding of basic education around the globe over a period of time from 1970 to 2005, we start with the understanding that educational expansion is driven by variables both within and outside the education sector. For example, enrollment is a result of access and retention, factors within this sector. Rates of entrance and retention, in turn, are influenced by the number of potential entrants, a demographic variable, and by the amount of available resources, a mostly economic variable. These demographic and economic inputs to education get some feedback from educational outputs as more education results in lower fertility and mortality as well as higher productivity. To make a reasonable forecast regarding the direction of global education, we need a tool capable of assessing both the education sector and related sectors beyond it—not just an extrapolative but an integrated model that can simulate the networks within and interconnections among the education, economic, and demographic systems. We have developed a simulation model of national education systems that is situated within a wider model representing the demographic, economic, energy, agricultural, sociopolitical, and environmental subsystems for 182 countries in the global system. In this chapter we shall describe our efforts in conceptualizing and developing the education model.

### 3.1 Conceptualization of the Education Systems

Schools are where people spend substantial amounts of time to become educated. Activities inside the schools require resources that must be paid for somehow. To determine the factors underlying the growth of education around the world as it was discussed in the previous chapter, we must find out why people go to school, under what conditions are they able to stay there and succeed, how much their education costs, and who appropriates those costs, as well as why and how they do so.

According to the anthropocentric framework we discussed in chapter 2, illustrating the four concepts of human capital, human rights, human capability, and human development, the motivation for getting education inheres in its intrinsic values as well as its instrumental ones: enhancing human capability and human capital. Thus the *demand for education*, as economists (Woodhall 1967; Checchi 2006) frequently and rightly describe it, should have been partially equilibrated by its supply in an independently working market of education. However, for reasons ranging from the impacts of economic externalities to imperfections in the financial sector, private markets do not serve individual demands for education very well (Banerjee 2004). These realities, combined with the recognition that education is a human right with intrinsic value for the individual, make it desirable for governments to ensure the provision of education for their citizenries irrespective of market conditions in the education sector. The rights-based approach is supported both by the traditional political rationale for education—that it produces good citizens (Aristotle, trans. Rackham, 1944)—and by the economic rationale that the public financing of education amounts to an investment in human capital that will yield economic growth (Jorgenson and Fraumeni 1992) and a “merit”

good (OECD 2006, 22), benefitting society as a whole (OECD 2001b). The result is the public funding of education, in most countries, with an insignificant private market, especially at the levels of elementary and secondary.<sup>17</sup> In the developed nations, excepting the welfare states, there is a somewhat stronger private market, especially at higher educational levels.

Though most of these countries have adopted the policy of free schooling, at least at the basic level, low enrollment and high dropout rates remain a common problem. Experts at international agencies are fashioning global models to calculate the funds necessary to help nations with less educated populations finance their compulsory and universal education projects. However, as a case study on Indonesia (Pearse, 1977: 265) suggests, “the desires of individual families for education for their children [are what] determine the actual level of utilization of the education supplied by government.” The cost calculation exercises, necessary as they are, do not always take into account the factors affecting the demand for education. While public choice policies can be adjusted to expand the supply of education, lack of individual demand<sup>18</sup> as a result of household budget constraints may thwart government efforts to attain education goals. The supply-side prescription fails to resolve issues like the hidden costs of education, the forgone earning as a result of being in school or the lowering of expectations about the returns of

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<sup>17</sup> Despite the success of the public provision of education up to the secondary level in Western capitalist societies, a growing number of experts are questioning such public provision. Some of these critics point to the inefficiencies of bureaucracies and propose more competition through quasi-market solutions like school vouchers (Friedman 1995). Interestingly, the late Milton Friedman ultimately reversed his early position (Friedman 1962) supporting government intervention in education on the grounds of positive externalities. Other critics raise more serious issues like the absence or insignificance of positive externalities in education (Acemoglu and Angrist 2000; Hall 2006). Henry M. Levin and Clive R. Belfield (2003) provides a review of this promarket position.

<sup>18</sup> Simon and Pilarski (1979) present a wonderful discussion of the demands and supplies of education, albeit in the context of the impacts of population growth on education.

education—all of which may affect families' decisions to send children to school. Even on the supply side, governments are constrained by rises in the cost of education and in the number of school-age children due to uncontrollable population growth as well as by the scarcity of resources, by the competition for those resources at varying levels of education, and by trade-offs with other public sectors, like those of health or defense.

Any conceptualization of a nation's education system thus presupposes consideration of the factors affecting the demand for education, the supply of education, and the mechanism by which both the demand for and supply of educational funds may be reconciled in a resource-constrained world. While the list of factors influencing or impacted by the demands for and supplies of education can be long, we attempt to identify the most significant among those.

### 3.1.1 What Drives the Demand for Education

The majority of the economics literature (e.g., Becker 1975; Mincer 1974; Psacharopoulos 1985) views the demand for education as the manifestation of the desire to invest in human capital, the investors' expectations being that the discounted returns would offset the present costs. Some experts (e.g., Kodde and Ritzen 1984), however, attempt instead to explain the demand for education as motivated by consumption. While economists struggle to find a satisfactory framework in which consumption and investment simultaneously determine the demands for education (Schaafsma 1976), the intrinsic value of education that the human capability–human development literature highlights provides a rationale for the consumption of education. As Daniele Checchi (2006, 15) very eloquently elaborates, using Amartya Sen's terminology: “Being able to read, calculate, and process information can be thought of as a *functioning* necessary for

conducting a normal social life (namely, appearing in public without shame).”<sup>19</sup> Thus, in a human-centered approach, the two dimensions of educational demand overlap with the aforementioned intrinsic-instrumental purposes of education, as illustrated in Table 3.1.

Table 3.1. Demand for Education: Consumption and Investment, Intrinsic and Instrumental

	Demand for Education	
	Consumption/Intrinsic	Investment/Instrumental
Individual	Human Development: education for the flourishing of the individual Human Capability: demand for education functioning	Human Capital: education for higher earning
Social	Human Development: education for virtuous citizens Human Rights: citizens’ right of education	Human Capital: productivity gains from educated labor Human Development: education for civic goods

Factors affecting the demands of education are discussed below. Figure 3.1 at the end of the following section highlights some of these factors in a combined demand-supply schematics.

### 3.1.1.1 Economic Drivers of the Demand for Education

Costs of education borne by households bear significantly on the demand for education. The investment motive will be determined by weighing the sum of out-of-pocket expenses and the income forgone<sup>20</sup> while at school against the present value of the future earnings resulting from the acquired education; by contrast, consumption decisions

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<sup>19</sup> Italics and parentheses follow from the original text.

<sup>20</sup> Some experts (for example, Todaro and Smith, 2006: 371) use the terms *direct costs* and *indirect costs* to identify these two.

at the same level of income and utility are affected more by current costs. The out-of-pocket costs of schooling include tuition, which most countries now subsidize fully at the lower levels, and complementary costs for uniforms, meals, and/or transportation—which are also increasingly being covered by the governments of developing countries. The opportunity cost—that is, the value of the time spent in school by someone who could already have been earning wages instead—is somewhat difficult to measure. When we think about opportunity costs, we usually envision the potential income lost by young adults who attend college rather than take a job after high school. However, Maureen Woodhall (2004, 34) reports a number of studies (Colclough and Lewin 1993; Colclough et al. 2003; UNESCO 2002a) showing that opportunity costs can drive down the demand in developing countries even at the elementary level. According to these studies, in the poorest households of South Asia and Africa, the value of unrealized earnings and/or unperformed domestic labor due to school attendance is much greater than the direct costs of schooling. In some developing countries, governments attempt to offset some of the opportunity costs by making direct payments to parents who send their children to school in what are commonly known as conditional cash transfer or CCT programs (UNESCO 2007, 153).

Future earnings from education are dependent upon businesses' willingness to not only hire educated workers but pay them wages higher than those of uneducated workers. Per capita income is a good proxy for the average wage in any given economy. In countries with high and increasing per capita income, households are more willing to send their children to school, as businesses are more likely to hire the skills learned there. In contrast, in poor countries, the demand for educated workers is limited; thus

government efforts to subsidize the costs may, as Michael Clemens (2004: 2) puts it very eloquently, help lead young people to the fountain of education but still can't make them drink.

It is evident from the prior discussion that the dependence of the demand for education on the direct costs, opportunity costs, and expected benefits does in translate into an income effect. In many of the low-income, developing countries, the relatively high cost of education, direct and indirect, combined with the bleak prospects for the general economy as well as for the job-seeking individual equipped with only some basic education, tend to lower the private demand for basic education.

In the aforementioned paper, Michael Clemens (2004: 4–6) surveys the large body of literature (Harbison and Myers 1965; Behrman, 1987; Psacharopoulos and Arriagada 1989; Canagarajah and Coulombe 1997; Brown and Park 2002; Binder, 1999) that empirically confirms that national and household income are the most significant drivers of the demand for education across various developing countries in Africa, Latin America, and Asia. Clemens' conclusion is worth repeating as is:

“Since most of these studies were designed to measure policy impact, they include variables representing school quality or availability, such as distance to school, as determinants of outcomes like school enrollment. While often statistically significant, they are nowhere near as economically significant as household income and parental education in explaining the variance of schooling choices in the large majority of these studies”.

#### 3.1.1.2 Non-Market Drivers of Educational Demand

Literature concerning the demand for education focuses on its market-determined values. However, the nonmarket components of the demand for education are no less important. Though it is difficult to quantify all of them, experts agree on the significance of some non-economic factors in affecting the household demand for education.

#### 3.1.1.2.1 Parental Education

Clemens (2004) cites several papers to establish parental education as the second most important determinant of the demand for schooling, the first being income. However, average years of education attained by the adult population in a given society (Barro and Lee 2000), a proxy for parental education, is highly correlated with per capita income. It is thus difficult to distinguish between the impacts of parental income and parental education on demand. However, over a longer period, the greater the parental education, the greater their children's educational progress (Psacharopoulos and Arriagada 1989, 70). This intergenerational impact might bear on the educational demand resulting from income effects.

#### 3.1.1.2.2 Culture

Certain aspects of the demand for education—for example its variability along gender lines—are considered by experts to reflect cultural issues. The EFA Global Monitoring Report for the years 2003 and 2004 (UNESCO 2003: 119) cites several studies (Momsen and Townsend 1987; Kabeer 2003; Sen 1990) to elaborate the point that gender inequalities in education are generally found in more traditional societies that confine women to the home, denying them the right to participate in the labor force. Such restrictions, the study concludes, “tend to be associated with other values and practices that further inhibit women's life chances, including patrilineal principles of inheritance and descent, where family line and property [are] transmitted through men [according to] patriarchal structures of authority.”

Some researchers, however, caution that what is seen as the impact of culture on demand might actually reflect the influence of noncultural factors. Nagat El Sanabary, in



a 1989 paper on the determinants of women's education in seven countries from Middle East and North Africa, finds that the level of economic development of a country and the distribution of income within it are much stronger determinants of educational access and achievement than are cultural Islamic values. To cite a similar example, the PROBE Report (1999, 14, 19-28) found that 98 percent of parents in India, hailing from the country's most educationally backward states, considered children's schooling important.

#### 3.1.1.2.3 Population Growth and Structure

The demand for education may also decrease as the number of children in a household increases. The more the children in a low-income household, the more severe the economic constraints on the demand for education. Persistently high rates of childbirth congest the supply channels, affecting both the quantity and the quality of education and thus, in turn, demand.

The overall educational attainment in the population influences the demand for education by affecting the availability of labor. For example, a country in the early stages of educational transition whose enrollment pressures are shifting from elementary to secondary might experience a shortage of teachers because its adult population has achieved relatively lower levels of education. While this demand for manpower more greatly affects the supply side, it no doubt also affect the social demand for education, for example by increasing teacher salary and hence the cost of schooling.

#### 3.1.1.2.4 Marginalization

The educational gender gap in developing economies is generally the result of parents' unwillingness to send female children to school under the social and economic

conditions that make their education more costly and less economically fruitful than that of male children (Hill and King, 1995). Thus, though the factors that affect the schooling of boys and girls are the same, the magnitudes of their impact differ. That said, both sexes may be affected depending on the educational variable in question. While social taboos may make it harder to get girls into school, once inside they persist longer (UNESCO 2002b, 6). Thus, any trend in educational flow rates has to be considered in light of gender.

Demand for schooling also varies across other dimensions of social stratification: rural versus urban populations, ethnic and racial demographics, and so on. However, unlike gender differences, whereby family earnings affect children of both genders equally, a major portion of the other dimensions of educational exclusion can be explained by income differences.

### 3.1.2 Demand for Educational Spending

Funds are needed to meet the demand for education. Total cost of education can be expressed by the cost function shown in the following equation:

$$\text{Cost, } C = C(Q,P) \text{ ----- (0)}$$

Here, Q is the quantity of schooling demanded as discussed earlier and P is the price of education—the unit costs or resources required for each student. We shall now discuss the components of educational cost—the standard ways of representing both the per-student and the aggregate demands for educational expenditure.

#### 3.1.2.1 Cost of Education

One way of classifying the costs of education is categorizing them as current or capital. The capital expenditures consist mostly of the expansion of educational facilities

and usually constitute a one-time outlay. The composition of current educational expenditures, however, is quite similar across countries. The components of current expenditure are the salaries of teaching and administrative personnel, the cost of learning materials, and the cost of maintaining educational facilities. The largest component of current cost is teacher salary, which is generally two-thirds and “often much more” of the recurrent cost (UNESCO 2005, 164, 362–369). In the absence of comparable data on teacher salaries, per capita income—a close proxy for the wages of most occupations—comes to mind once more as the major determinant of cost per student. Economic development levels, which we have seen playing an important role in determining the demand for schooling, also affect the major determinant of demand for resources. In the absence of an independent price measure in a well-functioning market, per capita income determines both the demand for schooling and the resources required to meet those demands.

#### 3.1.2.2 Per-Student Cost

No doubt, the disaggregation of costs into their various components equips educational planners with more information. However, it would be quite complex to project all those components for all countries at all levels of education over a long period. Costs expressed on a per-student basis and on relative terms like a percentage of income per capita serve well, if not perfectly, for demonstrating educational resource requirements and their economic ramifications. These costs vary among countries and across different levels of education within the same country. For example, in 2005, both the median and the mean expenditures per primary student—a good proxy for public cost per student, as most of the expenditure at this level is incurred by the government—were

around 15 percent of GDP per capita around the world.<sup>21</sup> However, the range of variation in these costs is wide; while in low-income countries like Guatemala, Democratic Republic of the Congo, and Zambia the relative costs were as low as 3 to 5 percent, in at least two low-income sub-Saharan African countries—Burkina Faso and Niger—the costs exceeded 30 percent of per capita income. Both of these are French-speaking countries where teacher salary is usually high because of the low supply of teachers proficient in French, the language of instruction per colonial legacy (Lambert 2004).

#### 3.1.2.1 Total Demand for Educational Funds

Total demand for educational funds can be calculated as the product of the total demand for enrollment and the cost per student. Accordingly, to forecast the total demand for funds, one needs to project both the enrollment demand and the per-student costs.

#### 3.1.3 Supply of Educational Funds

The supply of education should come as a response to the demand for education. In a market system, supply and demand balance each other unless there are deficiencies in the market for education—which happens to be the case, as we shall now discuss.

In a properly working market, agents would buy education at a market-determined price, using their income, wealth, or credit to pay the cost. However, because of both the existence of costs and benefits of education external to the market and the absence or inadequacies of a market for financing education, education would be underprovided, especially to the poor, if left to markets entirely (Checchi 2006, 114).<sup>22</sup>

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<sup>21</sup> Author's calculation from UIS (n.d. c) data.

<sup>22</sup> Some authors use the term *public good* to justify public funding of education. However, while the benefits of more education in a given society satisfy the “non-rivalry” and “non-excludability” properties of public good, as Daniele Checchi (2006: 15–16) points out, educational activities themselves do not satisfy

The positive externalities of education frame a strong case for the public funding of schooling, especially at the basic levels, where the net of the social gains is comparatively higher than the net of the private gains (Todaro and Smith 2006, 383–386). There are some concerns about the efficiency of complete “nationalization” of education (Friedman 1962) even at the lower levels, and many rich, developed countries are trying out solutions like instituting a quasi-market system of education through school vouchers or the encouragement of competition by decentralizing public school systems. However, in almost all countries, rich or poor (with a few exceptions like Guatemala and Nicaragua), most of the education at the elementary and lower secondary levels is funded by the government. The private sector is more visible at the upper levels of education. In many developing countries, nonprofit nongovernmental organizations are taking on a larger role in providing education to both illiterate adults and, more recently, unenrolled children from poor families, mostly in nonformal settings. For example, Bangladesh Rural Advancement Committee (BRAC) runs an extensive nonformal primary education (NFPE) program that enrolled over a million pupils in some 34,000 schools as of 2006 (Todaro and Smith 2006, 563).

Governments’ willingness to fund education is limited by their ability to do so.

Some of the factors affecting the public funding of education will now be discussed.

#### 3.1.3.1 Resource Constraints

With more available resources, a nation can spend more for education. In 2004, the world as a whole spent about 2.5 trillion of purchasing power parity (PPP) dollars (i.e., about US\$2 trillion), constituting about 4.5 percent of global income, on education

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either of these criteria. As the number of students in a classroom goes up, each student starts receiving less attention from the teacher. When schools charge tuition and fees, anyone who cannot afford them can be

(UIS 2007, 4). However, more than half (55.1 percent) of those resources were spent on the students in the rich economies of North America and Europe (UIS 2007, 9). In fact, the education budget of any one high-income country—the United States, France, Germany, or Italy, for instance—surpasses the education expenditure in the entire sub-Saharan African region (UIS 2007, 4).

Governments' ability to collect public revenue is an important determinant of resources available for education. Rich economies enjoy the dual benefits of higher income and hence higher public revenue, thanks to the efficiency of their tax legislation and enforcement mechanisms. Rich European economies like France, Germany, Belgium, and Austria spend close to half of their GDP in the public sector, and about one-tenth of that expenditure goes to education (UIS 2007, 12–13). According to a calculation by Theodore W. Schultz (1960, 577), growth in the investment in education was three-and-a-half-times as much as the growth in the investment in physical capital in the United States between 1900 and 1956.

Understandably, the availability of resources has to be supplemented by a given government's commitment to investing those resources in education. According to the 2007 Global Education Digest published by the UNESCO Institute for Statistics, countries in Northern America and Western Europe, where educational participation is at the maximum, invest the highest shares of national resources in education, amounting to 5.6 percent of the regional GDP (UIS 2007, 4). All of the other UNESCO regions spend less than 5 percent of their GDP on education, with Central Asia and East Asia and the Pacific allocating as little as 2.8 percent. Sub-Saharan Africa is apparently one of the

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excluded.

more committed regions, with an educational outlay equaling 4.5 percent of income. However, we should keep in mind that the base of that relatively high aggregate spending, the regional domestic product for this region, is quite low, while the number of potential beneficiaries in the region is quite high, and that the high regional average is partly due to inefficiencies in some countries where the per unit cost, as discussed previously, is high. As the aforementioned report shows, five of the eleven countries that spend 2 percent or less of their domestic product on education are in sub-Saharan Africa (UIS 2007, 10).

#### 3.1.3.2 Responsiveness of Demand to Supply

Educational resource allocation, even when expressed in relative terms, does not always reveal the limits of public financing for education. For one thing, the supply of public funds in a given country should adjust according to demand as it is shaped by demographic, social, and political circumstances. For example, the aforementioned, high relative allocation of funds to education in SSA amounts to only 2.4 percent of the world's education resources and goes to 15 percent of the world's school-age children that live in the region. In developed economies, the youth population is shrinking in conjunction with fertility rates, thanks to the increased education of women (Cochrane, 1979). Countries in which youths make up less than 12 percent of the population are generally able to meet the demand for primary education (UIS 2007, 29). However, some researchers have shown that the sizeable elderly populations negatively influence governments' willingness to spend money on education, the plausible explanation being that elderly voters support health and social security expenditures more (Grob and Wolter 2007).

In sharp contrast, four out of five births worldwide happen in developing countries (UNESCO 2007, 17), and the average annual rate of population growth in the least developed countries will be more than two-and-a-half times that of the others until the mid-twenty-first century. The IFs reference case forecasts that the youth bulge in the SSA will not start to reverse till the 2040s; until then, the region must cope with a moving educational target. By comparison, some developing countries, for instance Bangladesh, have reached high primary enrollment ratios just as their school-age populations have started to decline. These countries will be able to shift their budgets toward improving the quality of education and increasing participation at the higher levels of education.

As we have discussed, universal basic education is increasingly being promoted by the international community as a human right due to its intrinsic value. There is, consequently, mounting political pressure in developing countries to supply basic levels of education irrespective of economic demand. Concern for the inability of low-income countries to gather adequate funds to meet resources requirements has prompted international development agencies to lobby for more and more aid for education (UNESCO 2007, 154). In the year 2005, the net disbursement of overseas development aid (ODA) for education reached US\$106 billion (UNESCO 2007, 154). In low-income countries, about 60 percent of the committed aid went to basic education (UNESCO 2007, 159).

### 3.1.3.3 Political Economy of Educational Spending

The ideologies, philosophies, and organizational structure of a given government influences its collection and allocation of public funding for education and other social expenditures. The social-welfare states of the Scandinavian region and the heavily



centralized governments of Western nations like France, Germany, and Canada spend more on education than the OECD average. These countries also raise more public revenue via higher taxation, thus raising the Lindahl price<sup>23</sup> of education even for that part of the population whose households contain no school-going members. Compared to their European counterparts, wealthy countries with more liberal economic policies like the United States and New Zealand, collect relatively less revenue but allocate a larger portion thereof to education. Even among the less well-off countries and provinces, those with left-leaning governments, like Cuba and the Indian state of Kerala, spend more on education than countries with similar economic profiles do. However, as may be observed in some of the transition economies, higher spending does not always result in better education systems.

Most of the cross-national variation in public education spending is observed at the level of tertiary. In rich capitalist economies, 50 percent or more of tertiary education spending comes from the private sources, as Table 3.2 indicates. However, even among the richer group, political economy is a decisive factor in overall educational spending. As the table also shows, the social welfare economies of the Scandinavian region allocate more funds to higher education more than do their more capitalistic counterparts.

Table 3.2. Public and Private Expenditure in Tertiary Education: Selected Countries

Percentage GDP Spent in Tertiary by Sources			
Country	Total	Public	Private
Australia	1.536299	0.734314	0.801985
Japan	1.420732	0.478904	0.941828
Sweden	1.679537	1.430828	0.190535
Finland	1.752421	1.684602	0.067819
United States	3.028226	1.051783	1.976442

Source: UIS Online Education Database (UIS n.d. a.)

<sup>23</sup> The *Lindahl price* is the tax share an individual must pay per unit of public good, named after Erik Lindahl (1958/1919).

Some of the developing countries—for example, several South Asian countries—continue to subsidize public education even at the level of tertiary. The public universities in these countries provide nearly free tertiary education, but only to a few, because of its high cost. However, the fear of political backlash has prevented the governments in these countries to expand higher education by raising the costs.

#### 3.1.3.4 Funding Authority

Public funding for education can be handled at the central or local level. In rich Western economies, most educational funding is raised locally. For example, in the United States,<sup>24</sup> a major portion of the education budget is handled by county administrations through the property taxes they collect. This gives individual communities more control over their educational futures. It also breeds competition in the quasi-market of public education, as families may move to where the schools and tax rates suit them, in accordance with the so-called Tiebout choice (Tiebout 1956). By contrast, local governments in low-income countries lack the resources to fund education for all—partly because of economic inadequacies and partly because of the poor condition of the tax infrastructures—and thus have to depend on central sources.

#### 3.1.3.5 Funding Leakage

Public education funding is also affected by corruption. In a cross-national study of more than 100 countries, Paolo Mauro has found evidence of a “negative, significant, and robust relationship between corruption and government expenditure on education”

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<sup>24</sup> The US constitution took the burden of educational funding off the federal government and put it on individual states.

(1998, 277), which he thinks might be a result of the relative unattractiveness of education spending to the rent seekers.

### 3.1.4 Balancing the Education Budget

Governments have to balance demand and supply of educational funds with other expenditures and transfers. Further, the total allocated funds must be distributed among the different levels of education. Budgeting this allocation annually is a complex and lengthy process. It is planned and executed by the executive branch and closely examined by the legislature.

#### 3.1.4.1 Theory of Budgeting

Much controversy has surrounded the theories and philosophies driving the budgeting process. As early as 1940 (1138), V. O. Key drew attention to the problem with an aptly titled article, “The Lack of a Budgetary Theory”, in which he claimed, “The absorption of energies in the mechanical foundations for budgeting has diverted attention from the basic budgeting problem (on the expenditure side), namely: on what basis shall it be decided to allocate  $x$  dollars to activity A instead of activity B?” Later experts in the field of public finance, for example Aaron Wildavsky (1964, 1988), identified *incrementalism* as the dominant paradigm in budgeting. The concept of incrementalism in political decision making was formally put forward by Charles E. Lindblom (1959, 81), who argued that political decisions are based on “successive limited comparisons” rather than formal scientific comparisons of possible alternatives. In the incremental process of budgeting, heads of government departments devise the annual budget depending on departmental estimates, and only the increments from a well-defined base are scrutinized by the legislature. In a 1967 paper on simulating municipal budgets, John P. Crecine lists

the sequences involved in the budgeting procedure as “departmental requests, mayor’s executive budget, and final council appropriations” (Crecine 1967, 786). While suggesting automation in representing the structural form of the decision process and the functional form of the individual decision rules and parameters, Crecine does indicate that “the mayor perceives this year’s budget problem as basically similar to last year’s with a slight change in resources available (new revenue estimates) for dealing with a continuing set of municipal problems” (1967, 789)—making the budget process, in essence, an informed incremental process. However, as he (1967, 789–790) points out, budget theorists like himself and Aaron Wildavsky see “government by precedent” more as an “aid to calculation” rather than as the “rational” strategy defended by Charles Lindblom.

Based on his interviews with actual decisionmakers, Crecine goes on to point out that they do not view the problem as that of optimizing resources for achieving certain goals (1967, 787–788) but rather as a balancing exercise that starts with departmental budget requests calculated from an estimate of the initial demands, which are in turn based on the assumption that the current situation will continue. The department heads making the requests resist cutbacks below their requested sum and attempt to grab a reasonable share of any increase in the total resources so that they can enhance the departmental program. Public outlays for education are thus contingent upon requests for educational funds and the ability to balance the available funds taking into account the trade-offs with various other sectors.

### 3.1.4.2 Balancing the Educational Budget

Demand and supply of any commodity or service are balanced by the price determined in a free private market. However, because of the public provision of education supported by the rationale just discussed, the market price of education is unknown. Faced with the task of estimating educational budgets, government officials use their best guesses regarding educational needs and the prices of educational inputs to estimate the demand for funds.

The demand for education in an individual household is contingent upon several factors, including income, which is determined by the workings of a free market in most countries. The prices of some educational inputs are determined in the private markets of those inputs. For example, the labor market determines teacher salary, which accounts for the major portion of the funds the government h need. Education sector, thus, works somewhat like a quasi-market<sup>25</sup>, where the government's attempt to balance the demand for funds with a constrained supply. The allocations resulting from that balancing process impact the educational outcomes and decide the final amount that the government spend per pupil, which in turn serves as a proxy for the market price of education.

In an incremental budgeting process, allocation is usually based on the allocations of the previous year and doesn't change drastically. However, given the total education budget, the standard operating procedure of the government ministry or department in charge of education is to distribute that budget among the levels as per the projected demand of funds for each. While there might be a host of line-item projections depending

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<sup>25</sup> The term *quasi-market* is sometimes used specifically to define publicly funded but privately managed activities like the semi-privatization of the national health system in England or the school voucher program in the United States, an objective of which is to enhance the efficiency of the public sector by putting it in competition with the private sector,

on the coverage of the budget, they can be summarized into the product of two components, total number of students and per-student cost.

#### 3.1.4.3 Trade-offs Faced by Education Budgeters

Governments must make trade-offs when allocating funds among different sectors. In low-income countries, resource constraints are greater and the trade-offs are more visible. The trade-offs among sectors like education, health, defense, and government transfers are negative in many cases (Russett 1982; Yildirim and Sezgin 2002<sup>26</sup>). In most countries, large portions of government spending are transfers to households in the form of welfare or pensions, which can squeeze the budgets of education sectors. In Brazil, about 11 percent of GDP is absorbed by social security and public welfare programs, while only 3 percent goes to education (Vélez and Foster 1999, 46). In low-income countries, defense spending is more likely to take a toll on other social expenditures (Deger 1985).

In developing countries where the resource base is already low, competition is intense not only among social-service sectors but also within the education sector itself among different levels of education. For example, when the government of Malawi undertook an extensive primary-education expansion program in the 1990s, its secondary-education system and teacher training programs experienced massive cuts in real terms (Al-Samarrai 2003, xiv).

There is another kind of trade-off that occurs at each level of education: quality versus quantity. As teacher's salary constitutes the bulk of educational costs, attempts to

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<sup>26</sup> This paper has a tabular summary of trade-offs at page 570.

improve the quality of education by reducing class size and thus increasing the ratio of teachers to pupils can increase the costs greatly.

Abundance of resources, especially natural resources, can also have a negative impact on educational spending. Nations with a sense of complacency about their natural wealth may spend less on the growth of human capital. For example, in 1997, high-income OPEC countries spent, on average, less than 4 percent of their GNP on education, less than the global average (Gylfason 2000, 3). An exception is the resource-rich sub-Saharan economy of Botswana, the educational expenditures and achievements of which continue to be among the highest in the world.

### 3.1.5 Interaction Between Education and Broader Socioeconomic Issues

We have so far discussed societal and economic factors that affect education in what is known as *backward linkage*. However, as we have noted repeatedly in this paper, the economic and social benefits of education are numerous. In this section, we shall close the loop of interaction between educational and broader societal concerns with one more brief discussion on the benefits of education, followed by an outline of the feedback from society and economy to education, as we have shown in Figure 3.1.

#### 3.1.5.1 Benefits of Education: The Forward Linkage

Robert Haveman and Barbara Wolfe (1984, 383-384) tabulated the research on various market and nonmarket benefits of education at the individual and aggregate levels.

There have been extensive studies, both theoretical (e.g., Lucas 1988; Romer 1990) and empirical (Barro 1999c; McMahon 1999), on education's ability to foster economic growth by improving the skills of labor forces and creating networks of

knowledge conducive to higher productivity. In his research on Uganda, Simon Appleton (1995) has found that each year of primary education of a male adult is associated with a 2 percent increase in household consumption per capita, *ceteris paribus*. Barry Hughes (Hughes 2005, 39) summarized the education-growth linkage observed by Robert Barro and his colleagues thus: “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[b]: 19–20) reported that one extra year of male upper-level education raised growth by 1.2 percent per year.”

Education, especially the education of women, helps curb unwanted population growth. Several researchers (e.g., Breierova and Duflo 2003) have found that the education of girls reduces fertility rates, providing them in womanhood with more economically valuable skills as well as the knowledge that helps curb child mortality.

Education allows individuals to participate more actively in civic life. Researchers have shown that education at both the individual and social levels is an important predictor of political and social engagement (Helliwell and Putnam 1999) and democracy (Barro 1999a).

#### 3.1.5.2 Feedback from Socioeconomy to Education

Gains in household income stemming from education in turn boost the demand for education. Growth in the national economy, meanwhile, ensures the availability of more resources for education. The reduction in fertility rates that results from women’s schooling can reduce some of the pressure on educational budgets for subsequent



generations. Figure 3.1 illustrates the links among educational demand and supply and broader socioeconomic factors that we have discussed so far.

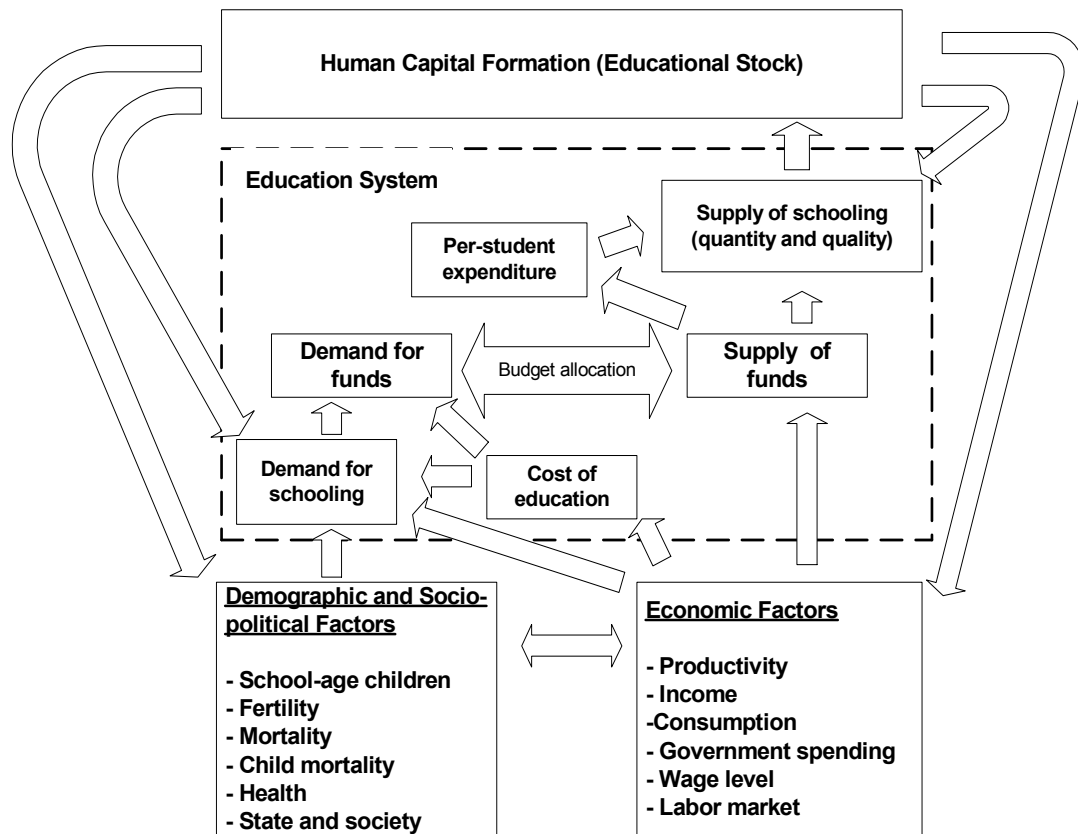


Figure 3.1. Conceptualization of the Links among Education, Economy, and Society

### 3.1.6 Structure of the Educational System

As we discussed in the previous chapter, UNESCO has developed a standard classification system for national education systems. That classification scheme uses a numbering system to identify the sequential levels of educational systems—namely, pre-primary, primary, lower secondary, upper secondary, and tertiary—which are characterized by curricula of increasing difficulty and specialization. Within educational institutions at each level, students move through a succession of single-year grades. A certain percentage of pupils from each grade are promoted to the next grade at the end of

each academic year, a certain percentage repeats the same grade, and a certain percentage drops out before completing the school year. The quantitative and qualitative progress of an education system can be identified by indicators expressing the rates of the constituent flows—that is, the intake, promotion, repetition, and dropout rates. While enrollment rate<sup>27</sup> is widely used to gauge the success of a national education system, it doesn't have an independent dynamic. Changes in enrollment rate actually reflect a combination of the movements in other educational flows, such as the entry and retention of students in the school system. The dynamics of the enrollment rate can thus only be understood by analyzing the dynamics of the intake and survival rates. Figure 3.2 demonstrates the main student flows within the educational system, including all details for the primary level while collapsing similar details for the next level.

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<sup>27</sup> Chapter 2 has a section defining these rates.

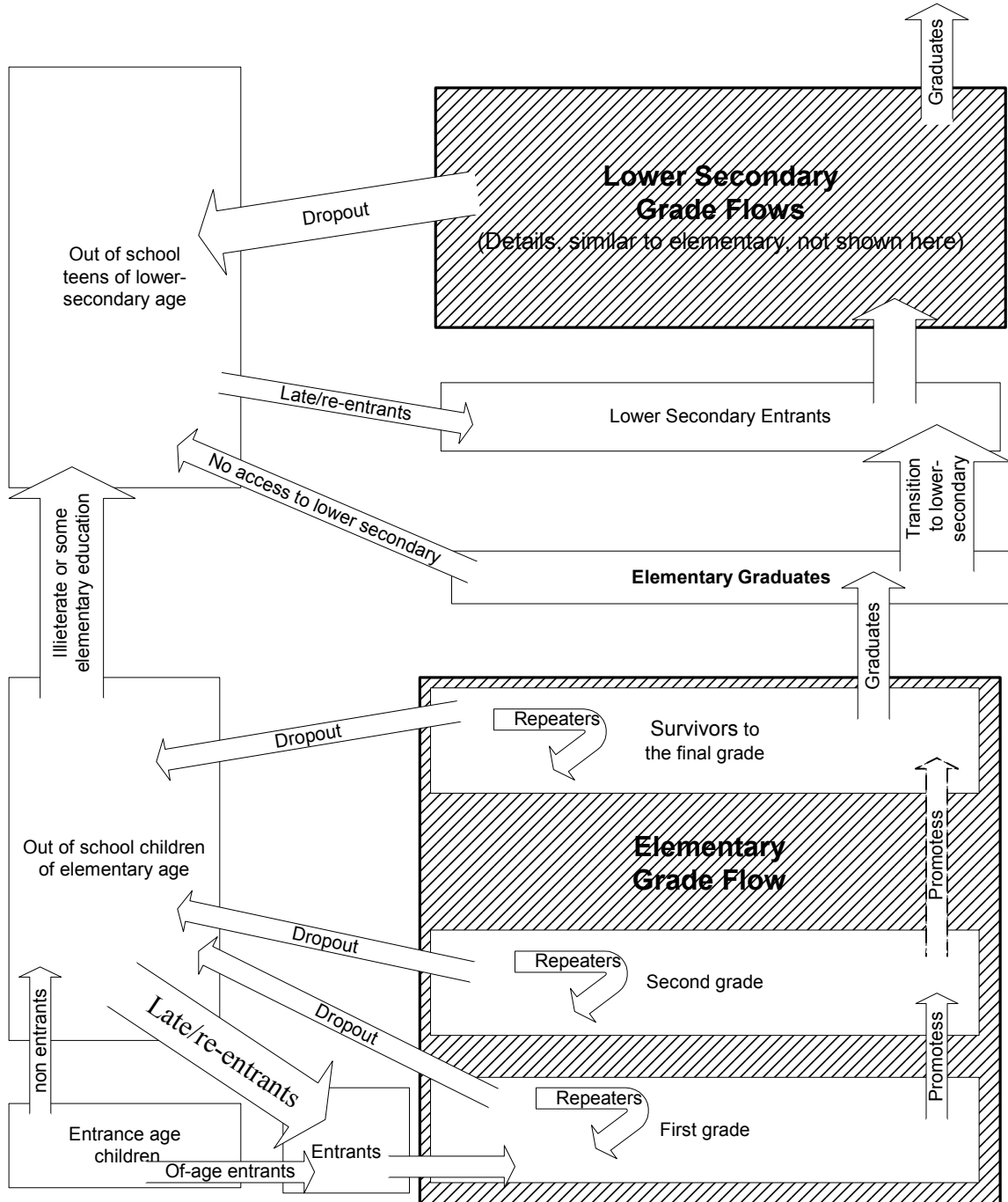


Figure 3.2. Student Flows

## 3.2 Global-Education Data

<sup>28</sup> Once we understand how the education system works, we need to gather data on the variables of interest, which in our case are the access, progress, and participation rates for primary and lower secondary education systems in different parts of the world. We have collected historical data and stored them in a computerized database. We shall describe the data-gathering procedure in this section.

### 3.2.1 Sources of Education Data

There are only a few primary sources of comparable international data. The first is UNESCO, the UN body charged with defining, collecting, standardizing, and maintaining education-related data worldwide. The second is USAID, which collects education data as a part of its Demographic and Household Surveys. OECD also collects data on various educational measures. Though its efforts are concentrated mostly on its member countries, it sometimes includes nonmember countries representing various stages of economic development.

UNESCO is the biggest repository of educational data. Its field offices coordinate with national governments in collecting data at national levels, mostly through administrative school surveys. UNESCO's statistics division, which was recently turned into the UNESCO Institute for Statistics (UIS), has been publishing yearbooks of global-educational statistics (UNESCO 1994, 1997, and 1998) since the early 1960s. Starting in 2004, these annual publications have been titled the *Global Educational Digest* (GED) and include data regarding access, participation, persistence, progress and the costs of

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<sup>28</sup> There is a very similar section on data availability in Chapter 2, albeit in a different context.

and allocations for education at every ISCED level for both boys and girls in more than 200 countries. GEDs (e.g., UIS 2007) are the most extensive global-educational databases available for free, in both print and electronic format. UIS also put its database up on the Internet, updating it regularly and allowing anyone to download the data using an easy to use interface.

USAID has started collecting education-related data by incorporating schooling flow rates as well as very detail educational attainment measurement into its latest Demographic and Household Survey (DHS), conducted globally with cooperation from its partners in academia, such as Johns Hopkins University. Like UNESCO, USAID makes its database available online (USAID 2008).

As mentioned earlier, OECD focuses on gathering data for its member countries as well as for a few nonmembers. Besides collecting its own data, it collaborates with UNESCO on the UNESCO/OECD/EUROSTAT (UOE) database and the UNESCO/OECD World Education Indicators (WEI), which include some middle-income countries. Like the UIS, OECD's Centre for Educational Research and Innovation publishes the indicators annually in a volume titled *Education At a Glance* (EAG). However, unlike the GEDs, EAGs (OECD 2007) contain more analyses and fewer data.

Other international agencies constitute secondary sources of international data. For instance, the World Bank's annual *World Development Indicators* or WDI (World Bank 2006b) and UNICEF's annual *The State of the World's Children* (UNICEF 2007) contain education data collected from UNESCO sources.

Researchers and research agencies focusing on global education sometimes collect and compile their own databases. The Education Policy and Data Center in Washington, D.C., is one such organization, which has collected data from UNESCO and USAID sources and performed its own calculations to build a global dataset that it publish on the Internet with a search interface (EPDC 2008). Over the last few years, the IFs tea has collected education data from UNESCO sources to develop an educational database with substantial coverage. The IFs educational database is also online as part of the complete IFs online model.

Robert Barro and Jong Wha Lee (1993) have published their estimates of human capital stock (i.e., the educational attainment of adults) at the website of the Center for International Development of Harvard University. In 2001, Daniel Cohen and Marcelo Soto presented a paper providing another human capital dataset for a total of ninety-five countries.

Some of the developed countries have their own data clearinghouses, compiling disaggregated national data as well as some international data for the sake of comparison. One such example is NCES, a US federal agency that collects and maintains educational statistics.

Such data gathering mostly concerns the quantitative aspects of education. While data series like persistence or survival rates represent the quality of a given educational system in some way, the comparative quality of learning around the world can only be determined by the results of internationally administered tests. Though there are concerns about the comparability and compatibility of these tests, especially since not many countries are yet administering them, data on test results are growing fast thanks to the

efforts of the International Association for the Evaluation of Educational Achievement (IEA) and OECD, which conduct comparable tests like PISA and TIMSS (Hanushek and Kimko 2000). We have recently included some of these datasets in the IFs database.

### 3.2.2 Indicators

UNESCO has developed a set of indicators representing various aspects of the student and resource flows at different levels of education in countries around the world. UIS calculates these indicators at both the national and regional levels, using the raw data it collects from school registers and school surveys. It is no doubt a huge task to make such calculations for all the countries in the world. Despite UIS's tremendous efforts, the quantity and quality of indicators available differ markedly across countries. Also, the higher the level of education one is examining, the fewer the indicators available. We describe some of these indicators below.

#### 3.2.2.1 Student Flow Data: Primary

Primary education data is most extensive conceptually, geographically, and temporally. There are data on indicators of gross and net access and participation rates for primary. There are also data on internal efficiency (survival rates) and wastage (repetition rates). These data are generally obtained (in a gender-disaggregated, country-level, time-series format) from the latest series available in UNESCO's online database (UIS n.d. a).

##### 3.2.2.1.1 Adjusted Net Intake Rate in Primary

We have taken all the primary level data from the UIS online database except the net intake rate. UIS publishes three net intake rates, one for the entrance age and two others for ages one year above and one year below the entrance age. We add these three

rates and bound it at 100 to calculate an adjusted net intake rate for primary. Our rationale is that whoever enters school one year ahead of the appropriate time will ultimately be not available for entry when her turn for entry comes. Let us now look at the one year overage entrants. If an almost fixed proportion of children continue to enter school a year late, we can count them as if they are entering on time, without losing much mathematical precision in our flow calculation. We shall, however, continue to use the term net intake rate.

### 3.2.2.2 Student Flow Data: Lower Secondary

UNESCO reports enrollment data on lower secondary. Though UIS disaggregates enrollment rates by gender and curriculum (general and vocational), the dataset reports gross enrollment rates only and for a limited period of time, 1999–2005. When contacted, UIS provided a link to a web-based repository of historic data, including the number of students in each grade of secondary and the total population of secondary-age boys and girls. We used these data to estimate historic gross enrollment rates for lower secondary.

#### 3.2.2.2.1 Calculation of Lower Secondary Survival Rates

UIS does not have survival rates for lower secondary either. We have used UIS's suggested reconstructed-cohort method, to be described later, to calculate survival rates in lower secondary using the grade-wise enrollment and repeater counts<sup>29</sup> for two consecutive years.

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<sup>29</sup> For students following general nontechnical curriculum only



### 3.2.2.3 Financial Data

Total and per-student expenditures (expressed as percentage data) are obtained from the UIS website. That source has data on both private and public sources of expenditure. Public expenditures per student at the primary, secondary, and tertiary levels of education, relative to GDP per capita, are published in the UIS web database (UIS n.d.a). UIS does not report the per-student expenditures at the lower-secondary and upper-secondary levels directly. However, using its reported data on total educational expenditure as a percentage of GDP, on the shares of that expenditure that go to various levels of education, on enrollment totals for lower and upper secondary, and on the IFs-collected data on GDP and population, we were able to calculate the relative per-student expenditures for lower and upper secondary.

### 3.2.2.4 Educational Attainment Data

For educational-attainment data, the IFs education model uses the Barro-Lee education dataset (Barro and Lee 2000) to initialize the age-sex structure of country-specific populations for four different levels of educational attainment of the adults (no education, primary graduates, secondary graduates, and tertiary graduates). Robert J. Barro and Jong-Wha Lee have estimated that historical time series going back to 1950.

We used a spread algorithm<sup>30</sup> to distribute the levels of educational attainment from the single combined age group of twenty-five and older (and fifteen and older) represented in the Barro-Lee dataset into five-year cohorts.

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<sup>30</sup> Explained in the section on data initialization and the pre-processor.

### 3.3 Operationalization of the Education Model

To develop a formal (mathematical) model according to the conceptualization that we outlined earlier, we have analyzed the global-education data using the cross-sectional and longitudinal data-analysis tools provided by the IFs software. In particular, we have identified the trends of educational flows and detected other variables, for example income, that drive those trends. Based on the data analysis, we have developed the algorithms for our education model. Our model represents all the tiers of a typical national education system, namely primary, lower secondary, upper secondary, and tertiary. The model forecasts the access, participation, and progress of pupils according to their gender for each of these levels of education. It can also forecast the resource requirements for each level of education. In addition to forecasting the flows of students and resources, it also forecasts the accumulation of education for working-age populations.

A summary of our model is provided in Figure 3.3. GDP per capita (or income per capita), as forecast by the IFs economic model, is the principal driver of educational demand. Conceptually speaking, a more appropriate driver would be the educational requirement of the labor force according to the sectors where they work and the perceived returns from those employments. Our model does not yet have that detail of specification. Nor does it currently include the greater demand that increasingly educated segments of the population, particularly women, have for their children to attend school. The model does, however, represent a force that we call *systemic shift*: an observable global increase in educational demand independent of income but related to a variety of factors, including the trend toward knowledge economies and the increasing education of adult

populations. That systemic shift is currently something of a proxy for factors not captured by income per capita.

The base case of the model is a continuation of the present realities and trends. It does not include any special education policy intervention, by the government or by any other actor, to strengthen the educational outcomes. Instead, the resource allocation, in the base case, responds only to the demand side following the usual budget mechanism. The larger IFs model does, however, represent growth in production and revenue collection as well as international aid flows. Thus the augmentation of governmental revenues so as to support investment in education is present.

Our model, however, has the capability to test normative scenarios under alternative assumptions about the pace, progress, and sequence of the educational flows. What's more, our modeling tool allows policy interventions in educational investment, across all or particular levels of education.

We have operationalized the linkage from education to demography through a linkage of educational levels to fertility rates in the population. Human capital stock calculated in the education model feeds economic productivity in the broader IFs model. Some other sociopolitical variables in the broader IFs model, like political stability, are also affected by level of education.

In short, the causal structure of the current model increasingly represents our concept of a system that we believe will strongly support the analysis of education and human development. There is, of course, always more that can be done. Figure 3.3 shows the existing IFs implementation of the education system conceptualized in Figure 3.1.

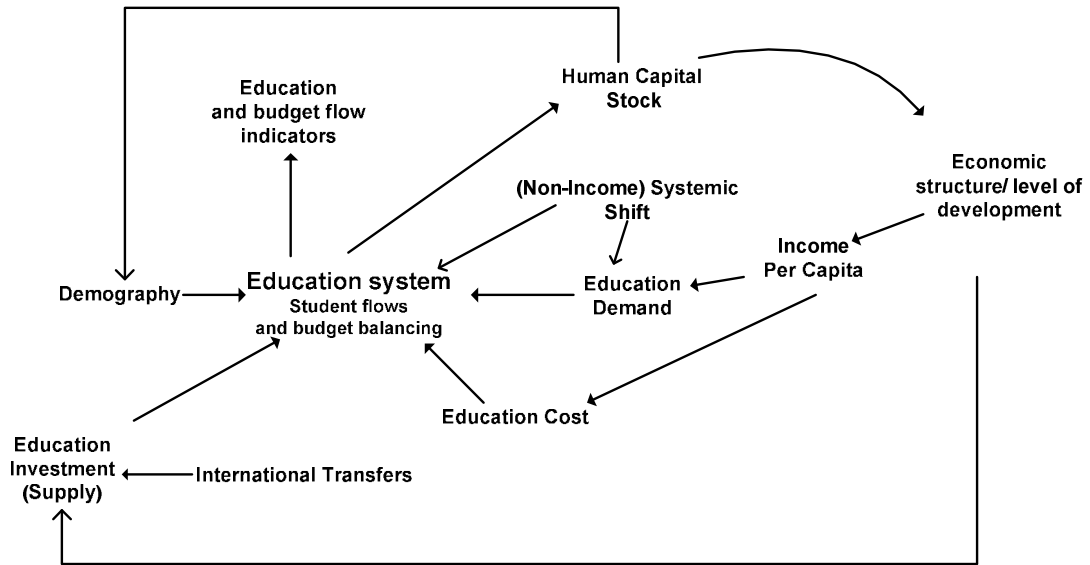


Figure 3.3. Causal Structure of the Current IFs Educational Module

### 3.3.1 Education Model: Embedded in the Broader IFs Model

To capture the linkage between education and other areas of broader society, the education model is embedded within a broader global model, titled, as we have seen, the International Futures System or IFs (Hughes and Hillebrand 2006; Hughes 2004a). IFs is a structure-based, agent-class-driven, dynamic modeling system representing demographic, economic, energy, agricultural, sociopolitical, and environmental subsystems for all the major countries interacting in the global system.<sup>31</sup> The demographic module uses a standard cohort-component representation. The six-sector economic-module structure is general equilibrium. The sociopolitical module represents life conditions, traces basic values and cultural information, and portrays various elements of formal and informal sociopolitical structures and processes. IFs was conceived and developed originally by Barry Hughes, who now leads a team of

<sup>31</sup> That is, countries with a population of over 100,000.

developers continuing to enrich the model at the Frederick S. Pardee Center for International Futures at the University of Denver. The education model runs synchronously with other IFs modules, simulating the bidirectional linkages between education and other components of the economic, social, and demographic system. Figure 3.4 below illustrates the linkages of the IFs educational model to the other modules of the IFs modeling system.

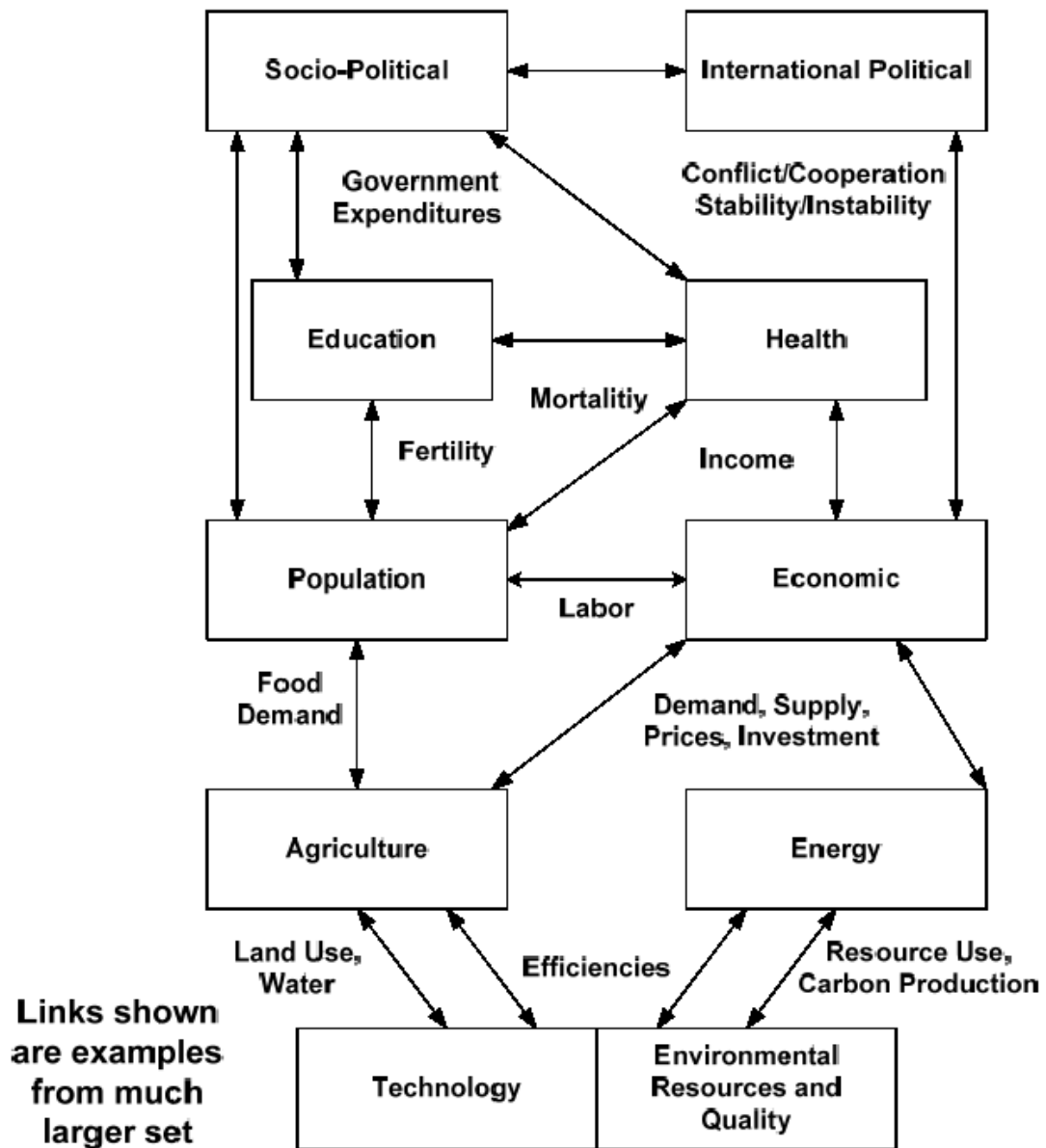


Figure 3.4. Detail of the Education Model Inside International Futures

Source: Hughes et al. (2008)

### 3.3.2 Education Model Basics

The education module of IFs simulates the educational flows and resultant human capital stock in 182 countries over a long time horizon under alternative assumptions

about uncertainties and interventions. Its purpose is to serve as a generalized thinking and analysis tool for educational futures within broader developmental contexts.

The model structurally represents a multilevel formal education system that starts at primary and ends at tertiary. Student entry into and progression through the system are determined by forecasts on intake and persistence (or survival) rates superimposed on the population of the corresponding age cohort. Students at all levels are differentiated by gender. Secondary students are further divided into lower and upper secondary, and then further into general and vocational according to the curricula that they follow. Though the model has been developed for all levels of education, we have here only used primary and lower secondary, which we have combined into the category of basic education.

The major agents represented in the education system of the model are households,—represented by the parents who decide which of their boys and girls will go to school—and governments that direct resources into and across the educational system. The major flows within the model are student and budgetary, while the major stock is that of educational attainment embedded in a population. Other than the budgetary variables, all the flows and stocks are gender disaggregated.

The level of the economic development of a country is a major underlying driver that affects but does not wholly determine either the supply of education or the demand for it. On the supply side, the level of GDP per capita significantly shapes the access of governments to resources. Furthermore, there are typical global patterns of fund allocations across various demands (education, health care, the military, and others) that provide a context for the actions of particular governments. On the demand side, a society's level of economic development significantly influences its sectoral structures

and labor markets in ways that affect the demand for education by its households. In addition, economic development levels affect teacher salaries and other expenses that collectively determine costs per student in a relationship with GDP per capita that is fairly strong across countries. At this stage in the model's development, the relationships between economic development level and educational supply and demand are fully represented. Other factors that influence demand in the long term—for instance, parental educational attainment as a driver of student retention and progress—are modeled as long-term systemic shifts in the demand function.

The relationship between education and the economy shown in the model is bidirectional. The availability of human capital and educational spending trends are among the forces of change in economic productivity via a model formulation that endogenizes the forecasting of multifactor productivity.

The education module also interacts bidirectionally with the demographic module in IFs. During each year of simulation, the cohort-specific demographic model provides the school-age population for the education module. The demographic and education modules maintain single-year cohorts for calculation and five-year cohorts for display. In turn, the education submodel feeds its calculations of educational attainment into the population module's computations of women's fertility.<sup>32</sup>

Although not used in this research, there are additional linkages of the educational module to the representations in IFs of the broader sociopolitical system. For instance, the stability of societies relies upon the stock of human capital therein. As the educational module develops further, such linkages will allow increasingly sophisticated



considerations of the costs and benefits associated with investment in education. Table 3.3 summarizes the key dynamics and the dominant relationships in our education model.

Table 3.3. Key Dynamics, Dominant Relationships, and the Underlying Accounting Flows in the Education Model

<b>Education Sector</b>	Student Flows and Financial Flows
Key Dynamics	<ul style="list-style-type: none"> <li>- intake rate</li> <li>- survival rate</li> <li>- transition rate</li> <li>- per-student cost</li> <li>- systemic shift</li> </ul>
Dominant Relationships	<ul style="list-style-type: none"> <li>- demand for intake positively correlated with household income</li> <li>- survival rate/dropout rate positively/negatively correlated with income</li> <li>- per-student cost correlated with per capita income</li> <li>- supply of education constrained by budget availability</li> <li>- intake and survival together determines enrollment</li> <li>- graduates feed into the human capital stock</li> </ul>
Accounting System: Stocks and Flows	<ul style="list-style-type: none"> <li>- flows of students through the grades determining total enrollment rate and the completion rate</li> <li>- flows of public spending into education system</li> <li>- stocks of adults with different levels of educational attainment</li> </ul>

### 3.3.3 Education Model Core: The Major Blocks

The education submodel has two major components:

1. The flows component simulates the circulation of pupils and resources throughout the entire education system of a country. It forecasts the rates for entry into,

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<sup>32</sup> In the emerging health module, educational stock is a key driver of mortality from eleven specific causes. These specific mortality calculations are not currently tied to forecasts of total mortality.

progression through, and completion of one educational level as well as the transition to the next. The costs incurred, funds demanded, and resources made available to sustain the student flows are also calculated in this component.

2. The stock component models the formation of human capital in a given society as a result of the educational activities simulated in the flow model.

These components are illustrated in Figure 3.5. The figure is divided into four sections (a, b, c, and d), the first three showing the three stages of the flows component outlined below and the last section showing the stock component.

#### 3.3.3.1 The Flows Model

The flows part of the education model is simulated in three stages. The first stage, the initial-demand estimation, forecasts the initial demand for schooling and the associated costs for different levels of education given the income, the strength of economy, and other conditions prevailing in the society in a country. The second stage, budget balancing, determines the budget allowances as per the demand of funds at different levels of education. The third stage, final educational projection, calculates the final educational flows in a society given its demands for education and its government's ability to meet them.

The model is first initialized with the most recent historic data (2005 at the time of this writing in 2008). The simulation of the first stage involves estimating the initial demand for school places at each level in a particular country in a particular year as well as the cost involved in providing each of those places. These estimates are multiplied together to calculate the need for funds. Three things are forecast at each level of education: (1) the number of new school places demanded by boys and girls (manifested

by intake<sup>33</sup> rates by gender); (2) the efficiency of the schools in retaining the boys and girls (or survival rates by gender); (3) per student cost or price of education. All three are driven by per capita income, which works as a proxy to household income, economic development, and wage level in the first, second, and third cases, respectively. Intake rate gives the number of entrants. Survival rate and the duration of the schooling cycle are then used to calculate an average dropout rate, while a *grade-flow simulation algorithm* (to be described) is used to calculate enrollment rate, grade by grade and cyclewide. The flow simulation works somewhat like a conveyor belt, carrying forward the persisting students from grade to grade, year by year. The per grade enrollment rates, obtained from the flow simulation, are applied to the forecasts of single year age-sex cohorts obtained from the IFs demographic module, to calculate an initial total enrollment number for each level of education. The enrollment demands are then multiplied by the level-specific unit cost forecasts to estimate demands for resources at each level of education for a particular country in a particular year.

The second stage of the flows model involves balancing the demand and supply of educational funds. The IFs main model has a detailed algorithm for forecasting government revenues and expenditures as well as their allocation toward different areas like education, health care, defense, and more. The education model takes the total government allocation toward education and distributes it *demand proportionally*<sup>34</sup> to the different levels of education. Each year, one or more levels of education may experience a shortfall or surplus in the budget, because of fluctuations in the overall government

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<sup>33</sup> Levels of lower and upper secondary use the rates of transition from the level below to calculate intake.

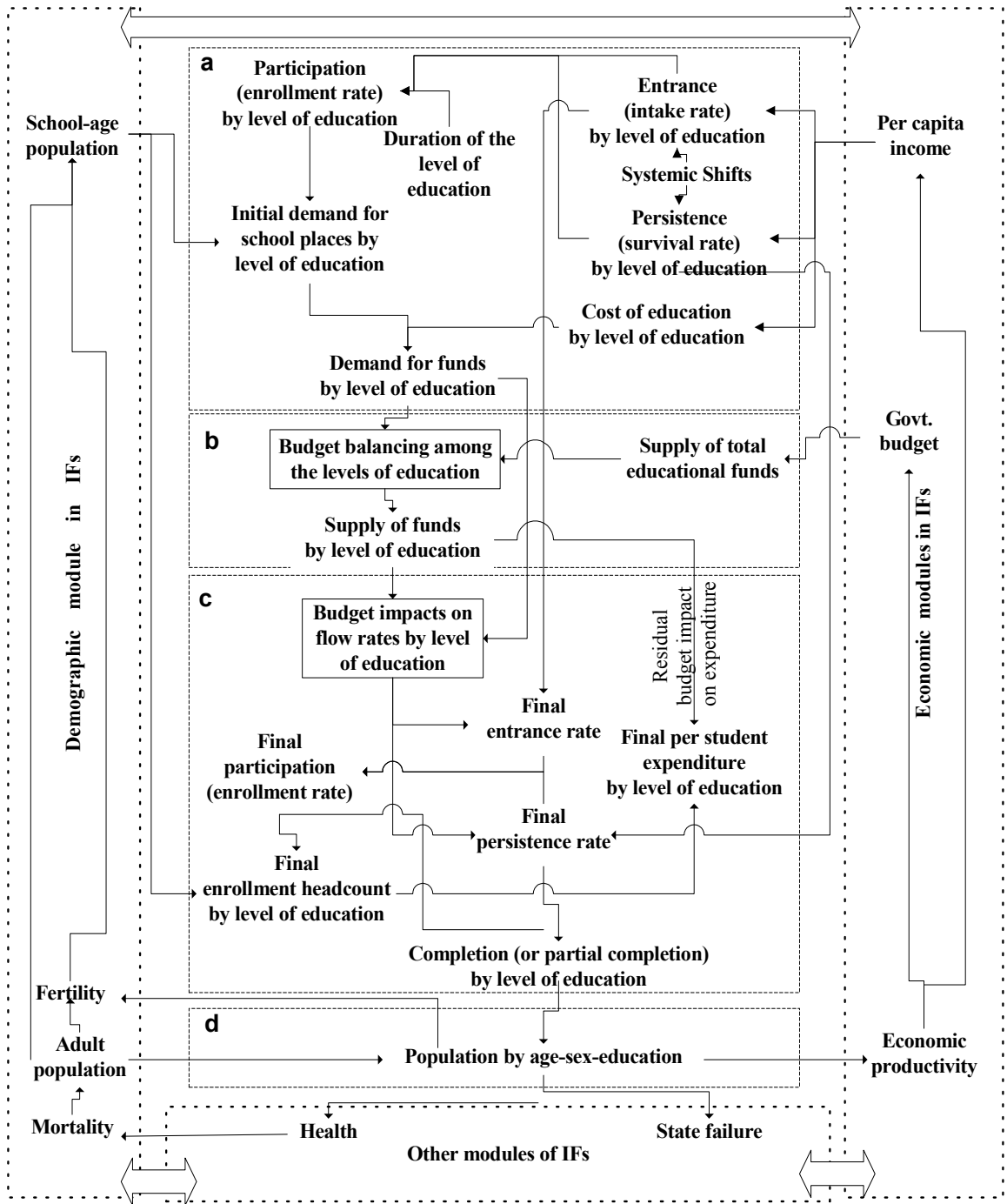
<sup>34</sup> Each level gets as big a share of total education budget as its proportion in the total demand for funds for all levels of education combined.

budget, constraint or leverage in the total educational budget, and/or the trade-off among the demands for funds at different levels of education.

The third stage of the flows model calculates the impact of government expenditure on student entrance into and persistence through school by raising the initial rates, calculated in the first stage to indicate a budget surplus and lowering them, somewhat gradually, to indicate a deficit budget. The budget-adjusted intake and survival rates are used to calculate the final forecast for enrollment rates, enrollment numbers, and the number of students who will complete each level of education. Final student projections and the supply of funds at each level are used to calculate the final value of the per-student expenditures. This residual calculation reflects the impact of resource constraints on per-student expenditure, which measures to a limited extent the quality of the educational institutions in question.

#### 3.3.3.2 The Stock Model

The stock part of the education model tracks the accumulation of education in a society as a consequence of the outcomes of the educational flows therein. Populations aged fifteen years and older are put into five-year cohorts divided by gender and categorized by four types of educational attainment: no schooling, primary, secondary, or tertiary. Each year, graduates at each level of education adjust the educational profile of the cohort to which they belong. The educational attribute of the cohorts changes with the aging of the population according to a cohort-advancement algorithm similar to the one used in the IFs demographic module. Both completed and uncompleted (dropout) grades at different levels of education are then aggregated by gender to calculate the average years of education for adult men and women.



**Legend for Parts of Education Model**

- a** Flow Component Stage 1: Initial Demand
- b** Flow Component Stage 2: Budget Balancing
- c** Flow Component Stage 3: Final Projection
- d** Stock Component

Figure 3.5. IFs Education Model: The Flows Component and the Stock Component

### 3.3.4 Education Model: Levels of Education

Our education model represents the levels of primary, lower secondary, upper secondary, and tertiary education. Figure 3.6 represents the flows of students through the system.

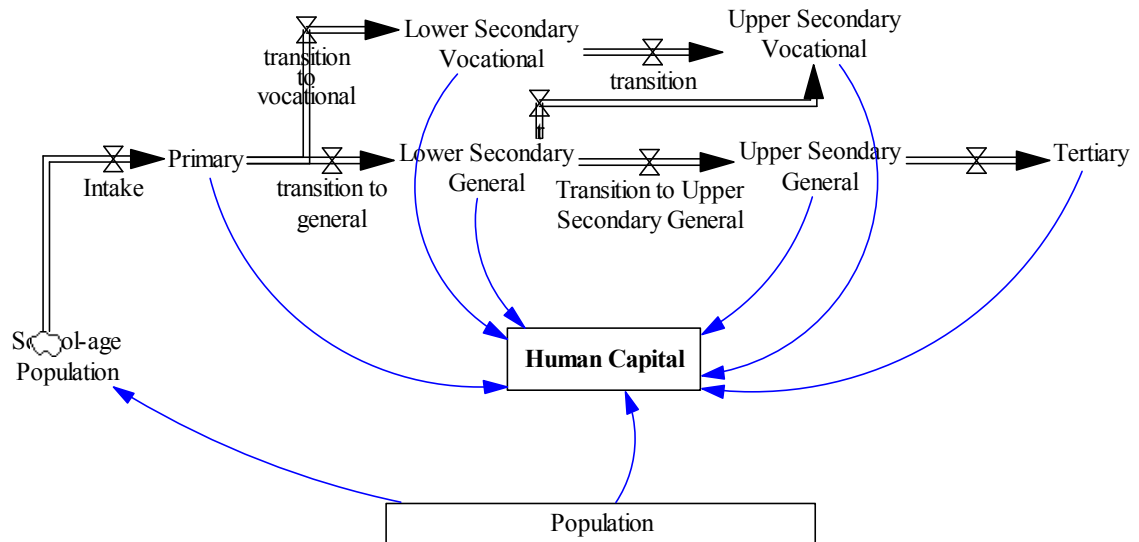


Figure 3.6. IFs Education Model: Levels of Education

Students enter a certain level of education and proceed from one grade to the next until they have completed the education level. We forecast important student flow rates<sup>35</sup> like enrollment, intake, survival, and graduation at each level for both males and females as well as for both genders combined.

Because of early or late entry and repetition, some students may be younger or older than their classmates. To account for this potentiality, the modeling of primary flow rates differentiates between gross and net enrollment ratios, tracking overage and age-appropriate students separately. In the primary-education representation of the IFs

education module, gross rates gradually converge toward the net as schools become more efficient and the pool of potential late entrants is exhausted.

For lower and upper secondary, we do not have any net rates. Thus, at those levels our grade-flow structure represents gross rates only. Meanwhile, secondary education is categorized in some countries as general versus technical or vocational education. Whenever applicable, we forecast enrollment rates for each of these categories.

Tertiary programs vary in type and duration even within a given country, while their potential applicants may defer entry until after gaining some work experience. Such contingencies make gross flow rates the only meaningful ones for tertiary education. Thus we have modeled and forecast only gross rates for tertiary.

One of the strengths of our model is that it provides an exact representation of entrance age and cycle duration for each country. These data better our approximation of the resources needed for education as well as the average number of years spent on education.

### 3.3.5 Education Model Initialization: The Pre-Processor

Educational flow data gathered into IFs' historical database are used to initialize the IFs education model. The initialization is performed by a special module of the model code called the model pre-processor. The pre-processor initialization is a multistep process. First, data for the model start year are read from the historical database. Any missing value is estimated using data from a sufficiently close time period or by estimating functions. The data gathered on various flow rates are then reconciled to make them consistent with their definition.

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<sup>35</sup> As appropriate to the level

### 3.3.5.1 Filling the Base Year Values from Data or Estimation

The data pre-processor in the education module populates the model data file with the initial year values of various flow rates obtained from UNESCO or WDI sources. If the datum for a country for the specific year that the IFs pre-processor requires is not available, we use several data imputation techniques. These techniques, normally used in the order in which they are listed below, are:

1. using the most recent and temporally proximate data point for the country;
2. longitudinally estimating from the available data points for the country through a temporal regression or
3. extrapolating the data variable using a driver variable with which it has a reasonable and significant relationship and for which data is available. The relationship is determined by plotting a cross-sectional function using the data from all the countries for which they are available at a particular point in time. Figure 3.7 illustrates one such cross-sectional relationship, namely the relationship between GDP per capita and net primary enrollment rate (such relationships are also used in the dynamics of the model).

More generally, the pre-processor is an important tool for filling holes and also for reconciling flow data that are incompatible (via a variety of algorithms for data cleaning).



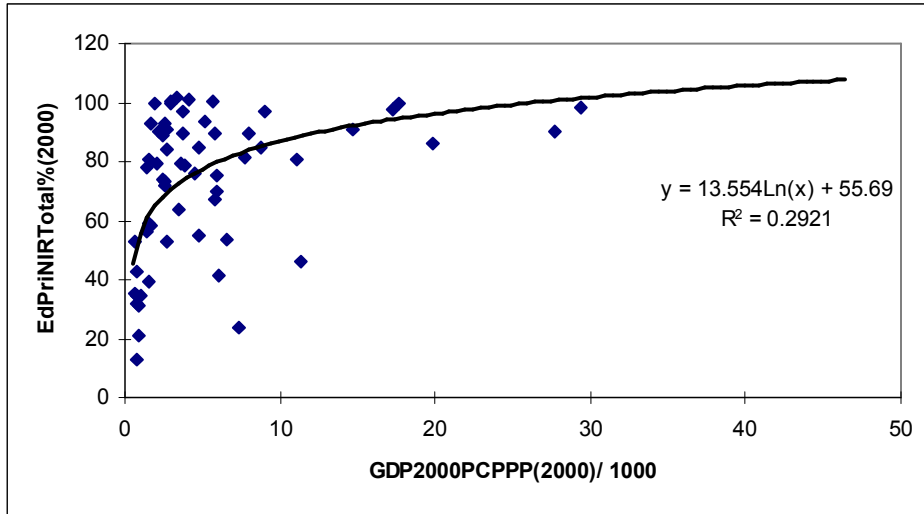


Figure 3.7. Cross-Sectional Function of Net Primary Intake Rate Against GDP Per Capita at PPP

*Note:* GDP per capita is expressed in 1000 PPP dollars. Data is from the year 2000.

### 3.3.5.2 Cleaning Up the Data

Before we start using the data or estimated values, we have to make sure that those initial values are congruent with the grade-flow structure that we'll be using for our forecast. An incongruent initialization could easily result in inconsistent forecasts. There are two sources of possible incongruence in the flow rates: disconnected cross-sectional estimations and inconsistent values from the database. We use a sequence of algorithms to reconcile this initial incongruence. The reconciliation algorithms first attempt to identify the incongruence. In the cases where incongruence is found, the algorithms keep some of the initial flow rates and compute the values for the other flow rates to maintain consistency with the retained values. The decision whether to retain or recalculate the values is guided by an ordering of both the quality and coverage of the data series and the estimation function.

We attempt first to do the reconciliation within each of the levels, then across them. This ensures that the number of pupils entering the higher level is consistent with the number of graduates from the level below who have decided to pursue further education.

#### 3.3.5.2.1 Cleaning Up the Data: Primary

At the primary level, the reconciliation mechanism works to find an enrollment rate congruent with both the intake rate and the survival rate. The enrollment rate is comparatively simple to obtain and has the most extensive coverage. The reconciliation algorithm is designed to retain these data as much as possible and compute either of the other two flow rates—intake or survival—consistent with the enrollment rate at a given level. Because of the definitional simplicity, intake rate data are more reliable. The intake rate series, at the primary level, also have fewer missing values than do the survival rate series. We thus try to use the intake rate whenever available and compute a survival rate congruent with both it and the enrollment data, if available<sup>36</sup>. In a situation where some of the values have been obtained from data and others from estimates, the data values are valued more by the reconciliation algorithm. In a situation where all three rates—enrollment, intake and survival—are estimates, the estimation functions using more data are given priority over those using fewer data. For example, in the case of primary, enrollment rate function is considered to be the most solid estimation. Intake rate estimation function is counted as the next best.

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<sup>36</sup> The ordering between the acceptance of intake rate and that of survival rate changes in some cases, for example, in situations when a low intake rate needs to be reconciled with a higher enrollment rate value, an anomaly in a schooling system with a less than one hundred percent survival rate.

Once the gross flow is reconciled, the gross rates are checked for consistency with their net counterparts and adjustments are made as required.

#### 3.3.5.2.2 Cleaning Up Data: Lower Secondary

In the lower secondary level, we have time series (with some missing data) on secondary gross enrollment rates, primary-to-secondary transition rates, and secondary survival rates. All these data are disaggregated by sex. However, though the gross enrollment rates are further disaggregated into general and vocational education, the transition and survival are for lower secondary education systems with general curricula only. We use the enrollment rates and the transition rates as published by UNESCO. However, the lower secondary survival rate is not reported by UNESCO. We use the grade by grade enrollment number and repeater number data from UNESCO to calculate the survival rate via UNESCO's reconstructed-cohort method.

Since not all vocational shares are available for the flow rates in lower secondary, we reconcile secondary by separating out the general share of the total lower-secondary enrollment and attempting to make this general enrollment rate consistent with the general secondary intake rate and survival rate. After reconciliation, vocational percentage is applied to the reconciled general lower-secondary enrollment rate, thus ensuring the consistency of the total flows.

The data and estimated values for lower secondary are weighted against each other for the same reasons as they are for primary. Here again, the gross enrollment data are valued most for their coverage and simplicity. Between the transition rate and the survival rate, the former are better for their wider coverage and greater reliability. The

ordering among the estimated functions is the same as it is among their data counterparts. As with the case of primary, data are valued more than estimation.

### 3.3.5.2.3 Reconciling Lower Secondary and Primary

The calculation of general lower-secondary intake rate involves applying the rate of transition from primary to secondary on the enrollment rate of the final grade of primary. So the reconciliation of lower secondary cannot be performed in isolation from primary.

We reconcile lower secondary in two stages. In the first stage, we find out a lower-secondary intake rate required to match the general lower-secondary enrollment rate and lower-secondary survival rate. We then calculate the lower-secondary intake rate using the data or estimation regarding the transition rate from primary to lower secondary and the enrollment rate in the last grade of primary according to the previously reconciled primary flows. Then we find out the gap—let us call it the *intake gap*—between the required intake rate and the calculated intake rate.

In the second stage of lower-secondary reconciliation, we try to close this gap first by adjusting lower-secondary survival and then by adjusting primary-to-secondary transition rate, within reasonable limits. The procedure for merging the remainder of the intake gap, if any, depends on whether the lower-secondary enrollment rate has been obtained from data or by estimation. If lower-secondary enrollment is gauged from data, the gap is narrowed by changing the enrollment rates for the last grade of primary. This will need a reworking of primary, as will be described. When gross enrollment rate for lower secondary is estimated, the remaining gap, if any, is closed by changing the general lower-secondary enrollment to a rate computed from the values of the general lower-

secondary survival rate and the calculated lower-secondary intake rate after the latest adjustments. If there is vocational enrollment, total lower-secondary enrollment is adjusted accordingly.

The last step in the final stage of lower-secondary reconciliation—that is, shifting the enrollment rate for the last grade of primary— might require a return visit to the previously reconciled primary flows.

For those few countries for which the lower-secondary enrollment rates are estimated, we apply the aforementioned last step on the lower-secondary enrollment rates and keep the primary reconciliation intact.

#### 3.3.5.3 Spread Algorithm

Two of the human capital variables that our education model forecasts are the average number of years of education completed and the distribution of educational qualification across five-year age cohorts of adult men and women. The variables are forecast by moving the recent graduates towards the bottom of the adult population to an appropriate cohort and by advancing the aging adults from one cohort to the next along with their acquired education.

Before we put the dynamics of the model into motion we needed to initialize the data. The data that are available do not provide a cohort-specific picture of human capital. All we have is the average number of years of education and the proportions of different levels of completed education for all the adults aged fifteen and older (or all the adults aged twenty-five and older). We have used an algorithm to spread these aggregate figures over five-year cohorts using an algorithm<sup>37</sup> that we call *spread algorithm*.

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<sup>37</sup> Weishang Qu at the Millennium Institute helped us with this.

The spread algorithm starts with two pieces of data:

1. The percentage of all the adults with a certain level of education.
2. The current graduation rate at that level of education.

The graduation rate is assumed to be the rate of education for all the people in the cohort that contains the people of graduating age. Since the rate of education is higher among younger people than their elders in any society—owing mainly to the gradual diffusion of education in the past several decades—we introduce a differential delta that would bring down the percentages of educated people in the older cohorts. We then calculate the delta using the data on the two variables that we began with. The delta is calculated and applied to the elder cohorts in the base (first) year part of the model code to obtain the initial age-sex–education distribution.

### 3.3.6 Education Model: Major Algorithms

In the previous sections, we have laid out the foundational blocks of our education model. In this section we shall describe the algorithms inside those blocks.

Some of the algorithms, for example the grade-flow simulation, involve only a particular level of education, like primary, and are replicated as we include the next levels of education—sometimes with slight changes to accommodate the type of data available for any particular level.<sup>38</sup> These level-replicable algorithms are also gender replicated. For example, as income does not influence the demands for schooling equally for the boys and girls in a less developed country, other than the separation of those income-impacts on entrance and persistence, the algorithm for simulating the initial grade-flow remains the same for both the boys and the girls.

Some of the algorithms, for example budget balancing, involve all levels of education and are not disaggregated by gender.

There is yet another kind of algorithm that is unique to the particular level of education for which it is used. Examples of this type of algorithm include the overage-pool algorithm used in primary to model the large differences between age-appropriate and overage students in many of the underefficient elementary education systems.

Another example of this level-unique algorithm is the vocational-enrollment calculation for lower secondary.

#### 3.3.6.1 Grade-Flow Simulation

Grade-flow simulation is the most important and most used of the algorithms in our education model. It does what the name suggests. It simulates the entrance into and progression of students through their school systems, one grade at a time, until they complete the cycle or drop out somewhere along the way. In our model, the algorithm is used independently for each level of education and for each gender.<sup>39</sup> The inputs to the algorithm are the duration of a single level of education in years and the rates of entrance into and persistence in the schools at that level for each gender for each year. The outputs are the rates of enrollment and graduation. The detail of the algorithm is given below.

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<sup>38</sup> An example, would be using graduation rates instead of survival rates at the tertiary level.

<sup>39</sup> In primary, two grade-flows run simultaneously for net and gross enrollment with the consistency maintained by an overage pool algorithm described later in this subsection.

We use the intake rate<sup>40</sup> and survival rate<sup>41</sup> to indicate entrance and persistence in order to construct the grade-by-grade-flow of students demonstrated in the gradewise enrollment rates in Figure 3.8 below. The figure uses UNESCO data for the primary-education flows in Bangladesh in the year 1988<sup>42</sup> to illustrate our simulation of grade-specific enrollment rates. The brown line represents the UNESCO data on gradewise enrollment rates, calculated by using the data on intake rate (i.e., the entrants expressed as a percentage of entrance age children) and on the percentage of entering pupils that persist to each of the grades above the first. The portion of entrants reaching the fifth grade—the final grade of primary education in Bangladesh—is defined as the survival rate, in this case 47 percent. The green line represents the 66.9 percent enrollment rate for the total primary-education sector of Bangladesh in 1988, as reported by UNESCO. The red and yellow lines are the results of our simulation of the total and gradewise enrollment rates, which we shall describe shortly.

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<sup>40</sup> Intake rate is further divided into net and gross (apparent) intake rates to represent the distinction between age-appropriate and overage entrants. We use both of these rates and construct two separate but demographically consistent flows as we shall describe in a later subsection titled “Calculating the Overage Pool.”

<sup>41</sup> Survival rate to the last grade, to be precise. The surviving students include the repeaters.

<sup>42</sup> Data obtained from online UNESCO historical data repository at <http://www.uis.unesco.org/statsen/centre.htm>.



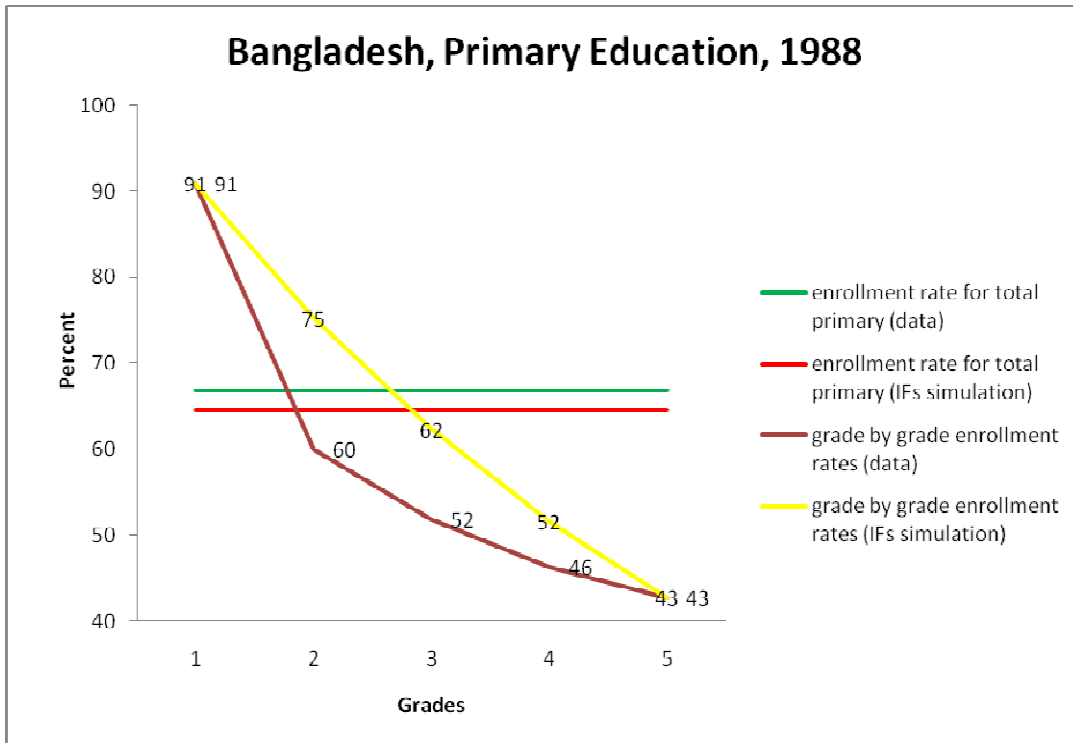


Figure 3.8. Grade-Flow Simulation

Each year, the forecast on the intake rate<sup>43</sup> for a particular level of education serves as the enrollment rate<sup>44</sup> for the beginning grade of that level. As the brown line in Figure 3.8 shows, the survival pattern varies by grade, with most of the dropouts doing so early on, understandably. However, it is complex and confusing to track grade-by-grade survival or dropout rates over a long period of time. Thus, we have developed an algorithm to forecast school enrollment rates using one more variable in addition to the intake rate: survival rate to the final grade, which we simply call *survival rate*. The survival rate is used to calculate an average dropout rate applicable to all the grades of a

<sup>43</sup> For lower and upper secondary, we forecast the rates of transition to those levels from the level below. The transition rate is multiplied with the enrollment rate of the final grade of the level below in the preceding year to get an intake rate for the current year.

<sup>44</sup> It might appear as if we are ignoring the repeaters in the first grade. But as we describe later in this section, the repeater calculation is accounted for by virtue of the use of intake rate and survival rate in our grade-flow simulation.

particular level of education in order to yield gradewise enrollment rates that might differ somewhat from the real grade-by-grade rates, especially in a situation where dropouts are relatively high, but that can still yield a true total enrollment rate for all practical purposes, as we shall elaborate. Our grade-flow structure then works like a conveyor belt, passing the retained students of one grade to the next grade in the following year. The following set of equations summarizes our grade-flow simulation:

$$d^t = (1 - s^t)^{(l-1)} \quad \dots(1)$$

$$g_1^t = i^t \quad \dots(2)$$

$$\forall 1 < n \leq l: g_n^t = g_{n-1}^{t-1} (1 - d) \quad \dots(3)$$

$$e^t = \frac{1}{l} \sum_{n=1}^{n=l} g_n^t \quad \dots(4)$$

Where,

$s$  = survival rate expressed as a decimal

$d$  = average dropout rate expressed as a decimal

$l$  = duration of the level of education<sup>45</sup>

$i$  = intake rate expressed as a percentage

$g$  = grade-specific enrollment rate expressed as a percentage

$e$  = enrollment rate for the level of education expressed as a percentage

$n$  = the subscript used to denote grades from 1 to  $l$

$t$  = the superscript used to denote years, the time interval for the education model

---

<sup>45</sup> The expression  $l-1$  in the first expression is a power, not a superscript.

The yellow line in Figure 3.8 is the grade-by-grade enrollment rate that we have obtained by using the UNESCO data and applying our flow simulation algorithm as described in the above equation set. In this particular case, we not only applied the same dropout rate for all grades as planned but also assumed the same intake rate as the 1988 rate for cohorts entering school earlier than that year, as well as the same survival rate. This does not exactly reflect the reality, but comes very close, as the rates do not change much from year to year. The total enrollment rate (the red line) calculated using our grade-by-grade simulation (the yellow line) is quite close to the data value of the total enrollment rate (the green line), despite the assumptions we made.<sup>46</sup>

In the real world, enrollment in grades above the first one is determined by the number of those who are promoted from the grade below,<sup>47</sup> those who repeat the grade, and those who drop out of the grade, as shown in the equation below:

$$g_n^t = g_{n-1}^{t-1} p_{n-1}^{t-1} + g_n^{t-1} r_n^{t-1} - g_{n-1}^{t-1} d_{n-1}^{t-1} \quad \dots (5)$$

Where,

$p$  is the promotion rate,  $r$  the repetition rate, and the remainder of the symbols carry the same meaning as in the equations (1) through (4).

The above equation will generate the exact enrollment rates for each of the grades at a certain level of education, provided all the relevant data has been gathered and forecast properly. As we have already shown by comparing the brown and yellow lines in

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<sup>46</sup> The figure suggests that our enrollment rate should be more than the data value of the enrollment rate insofar as all points in the yellow line except for the first and the last, are above the brown line. The fact that the brown line, though constructed from data used the same limiting assumption of equal intake (and survival) rates for all the present cohorts in school, explains why the real enrollment rate is actually off of the one averaged from the brown line.

<sup>47</sup> Or those who enter school in the case of the first grade

Figure 3.8, the simulated grade-specific enrollment rates are off in some cases. However, our education model does not produce any final forecast on gradewise enrollment rates. We forecast the total enrollment rate in primary only where we are close<sup>48</sup> and would be even closer if we had all the intake and survival rates in the previous years. Also, as Figure 3.8 shows, the simulated enrollment rates for the first and last grades match with the data for those. That is because both use the same intake and survival rates. The concordance at the tail of the grade flow allows us to express the graduation rate with enough precision using the enrollment rate for the final grade and the dropout rate from our grade-flow simulation.

One of the limitations of our grade-flow simulation is its inability to make a projection of the rate of repeaters. While high rates of both dropouts and repeaters serve as indicators of the inefficiency of a given school system, explicit mention of the repetition rate can be helpful in tracking the waste of resources in the system. Though our forecast for the survival rate captures the dynamics of the internal efficiency of the school system, an explicit forecast of the rate of repetition would make the model more valuable for resource planners.

A more serious question regarding repeaters is whether our model undercounts enrollment by not estimating the repeaters explicitly. We would say we do not, since the survival rate represents all of the students that persist in the system, including the repeaters, according to the practical method of its calculation, the so-called *reconstructed*

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<sup>48</sup> The author has done an analysis to check the validity of this process using the most recent (2004 or 2005) intake, survival, and enrollment rate data from the UIS web database. Despite the limitation of having to use the same point in time rather than following cohorts, among the ninety countries for which we have data, about two-thirds generated simulated enrollments within 8 percent of the data value. Among those that were off by more than 5 percent, there are countries that have an enrollment rate greater than intake

*cohort method* (UIS n.d. b), which starts with grade-specific enrollment and repeater counts for two consecutive years:

“The methodology of the reconstructed cohort flow model is based on the fundamental concept that for pupils enrolled in a given grade at a certain year, there could be only three eventualities: (a) some of them will be promoted to the next higher grade in the next school year; (b) others will drop out of school in the course of the year; (c) the remaining will repeat the same grade the next school year.”

After calculating those three rates, the method—rather than following a true cohort of entrants over time—simulates a cohort of 1,000 entrants, following the assumptions that there is no reentry, that there are homogenous flow rates for first-timers and repeaters, and that there is a limit on the number of times that a student can repeat (Figure 3.9). These assumptions and methods might result in a survival rate that deviates somewhat from the true rate. For a country with no repeater data, UNESCO uses the so-called *apparent cohort method*, resulting in further underestimation of survivors and overestimation of dropouts (UIS n.d. b).

---

rate, inconsistent with our tapering enrollment structure, and those that had a sudden surge in intake, for instance Cambodia.

grades	g1		g2		g3		g4		g5
promotion rate	66.44		83.91		88.94		78.93		
repetition rate	13.58		8.70		4.51		8.14		
dropout rate	19.98		7.39		6.55		12.93		
	LEGEND drop-out repeater promotees g=grade								
	g1		g2		g3		g4		g5
year 1	1000	200							
	136	664							
year 2	136	27	664	49					
	18	90	58	557					
year 3	18	4	148	11	557	37			
	3	12	13	124	25	496			
year 4	3	1	25	2	149	10	496	64	
	0	2	2	21	7	133	40	391	
year 5			4	0	28	2	173	22	391.37
			0	3	1	25	14	137	
year 6					4	0	39	5	
					0	4	3	31	
year 7							7	1	
							1	6	
year 8									
Total Drop-outs by Grade		231		63		49		93	
Total Drop-outs	436								
Total Survival	564								
Survival rate	56.44								

Figure 3.9. Reconstructed Cohort Method

However, as we have shown earlier, we are able to generate an enrollment rate sufficiently close to reality by using the survival rate in our grade-flow algorithm.

Considering these facts, we decided to use our simple grade-flow-simulation, which would allow us to project our variables of interest with enough precision to save us from the difficulties that would arise in the course of forecasting so many flow rates, at least two<sup>49</sup> for each grade. In fact, the sources of the minor discrepancies that we see among the calculated and real-world enrollment rates (total), the static intake, and the survival

<sup>49</sup> The three rates on the right side of equation (5) add to 100.

assumptions, will gradually be corrected as the flow simulation tracks the variations in those variables over time.

The grade-flow simulation is used separately for boys and girls at all levels of education in our education model. In primary, we use separate simulation for gross and net enrollment rates, for reasons we shall now describe.

#### 3.3.6.2 Superimposing Flow Rates on Population Cohorts

Projections of gradewise flow rates can be multiplied with IFs population projections of single-year age-sex cohorts in order to obtain the relevant enrollments. A gendered (gross or net) intake rate applied to the number of entrance-age boys or girls determines the number of students entering the first grade of primary school. The gradewise enrollment rates obtained from the grade-flow simulation described earlier is multiplied by the corresponding population figures, obtained from the IFs demographic module, to calculate gradewise enrollment figures. These enrollment figures are then added to get the total number of students at a certain level of education. The total enrollment number is divided by the school-age population to get the enrollment rate. The process is illustrated in Figure 3.10.

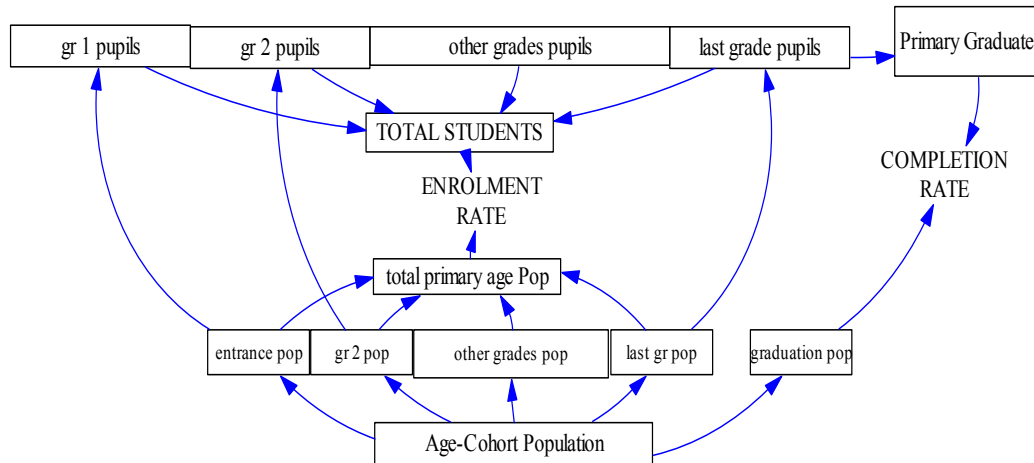


Figure 3.10. Using Gradewise Flow Rates and School-Age Population to Obtain Enrollment

gr = grade, enr = enrollment, pop=population

### 3.3.6.3 Calculation of the Overage Pool

Because of early or late entry and repetition, some students may be younger or older than their classmates. To represent this situation, the educational-flow rates are sometimes expressed as gross and net enrollment ratios, tracking both overage and age-appropriate students. However, gross rates gradually converge toward the net, as access expands, schools become more efficient, and the pool of potential late entrants is exhausted. In the primary-education representation of the IFs education module, we have developed a pool algorithm to represent this.

The difference between gross and net intake is a combination of the late entrants—that is, those who could not enter at the proper age—and the reentrants, or those who dropped out early on in the system but returned. The gross intake rate is calculated by adding a rate for these late and returning entrants to the already calculated net intake rate, using an algorithm that gradually exhausts the pool of potential overage entrants. For the first year of the model run, this pool is initialized using the following



technique. First, we calculate the number of entrance-age children who did not get into school on time by subtracting the net intake rate from 100 percent and then multiplying that with the age-cohort population. Next, we assume that the families of these children will try to put them in school at a later time, provided they have not aged so much as to feel uncomfortable in a classroom with much younger peers. We assume a period of ten years beyond the entrance age<sup>50</sup>. For the initialization of the pool, we assume that within those ten years, one-tenth of the nonentrants will come back for late entry per year. A further addition to the pool of late entrants will be those who dropped out in first grade but return. Again, the dropouts would do so until they are past an age at which they are comfortable doing so. Using these assumptions, we initialize the potential pool of late entrants in the first year. We then calculate the overage entrants for the first year and determine the overage returnees as a percentage of the total pool. For subsequent years, we add the nonentrants (in the appropriate year) and the first-grade dropouts to the pool. We finalize the pool by taking out those who are past the comfortable age for elementary schooling<sup>51</sup> (i.e., entrance age plus ten years). We then apply the proportion of overage pool that returns per year, saved in the first year, to the pool of late entrants. The overage intake is converted to a rate and added to the net intake rate to obtain the gross intake rate.

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<sup>50</sup> The period extends to fifteen years for few countries where there is a large difference between the gross and the net intake rates, possibly because of a systemic disruption in the preceding years.

<sup>51</sup> We can strengthen this by setting the age at fifteen and using EDPRIPER rather than making assumptions about all the overage students coming back for readmission.

#### 3.3.6.4 Budget Balance Algorithm

The budgeting algorithm takes the total educational budget from the broader IFs module and determines the allocation of that budget across various levels of education, using the usual incremental process of government budgeting. Figure 3.11 describes the budgeting process for primary, which is actually an elaboration of Part b of the block diagram of the IFs education module in Figure 3.5. It shows the details of the budgeting process, illustrating the allocations for primary. GDP per capita is used as a principal driver of both education demand and education supply. On the demand side, the percentage of parents sending their children to school rises in conjunction with per capita income. The demand projection of enrollment is multiplied with a projection of unit cost—which also varies positively with per capita income—to obtain the total budget demand. On the supply side, the economic and sociopolitical modules of the IFs system determine overall resource mobilization and spending as well as the total educational budget's share of government consumption (subject to scenario intervention by the model user). Higher public spending is associated with an increase in entrance rates and persistence. In the current version of the model, in order to keep things simple without losing any necessary details, we use a total educational expenditure rather than a disaggregation into recurrent and capital expenditure or other components of recurrent expenditure, such as teacher salary and nonsalary expenditures.

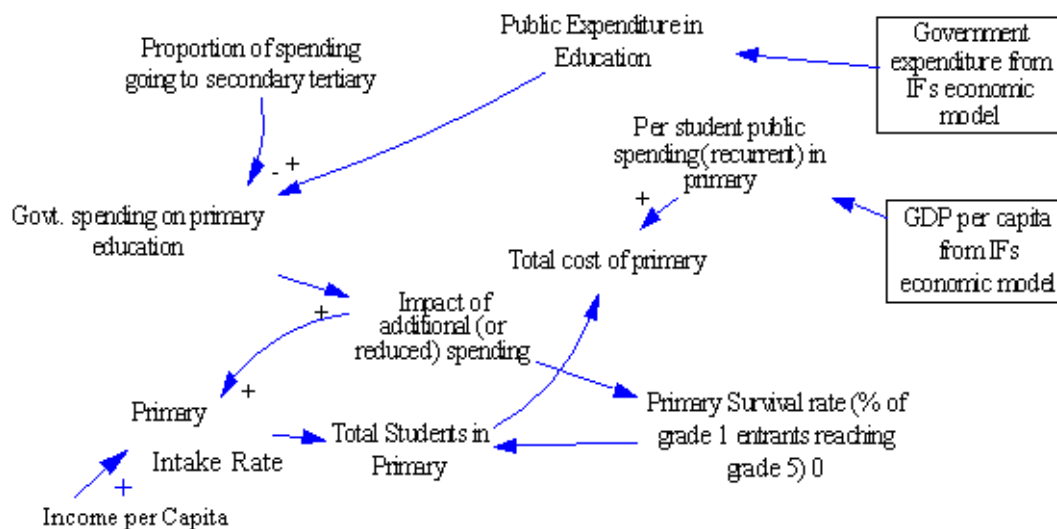


Figure 3.11. Balancing Educational Budget in Primary Education

Countries change their educational allocations over time. There might be changes both in the total educational allocation as well as in allocation across different levels of education.

In IFs, we get the total educational allocation for a given country (in billions of US dollars) from the IFs social and political module. Within the educational module of IFs, we take the total educational allocation and divide it among the various levels of education using an incremental budgeting process, depending on the demand at each level and the total supply. This demand-driven, supply-constrained budgeting process ultimately impacts the income-dependent educational- projection of flows, boosting or reducing them depending on the availability of public resources to sustain demand.

Here are the steps:

1. At the base (starting) year, we calculate the shares of spending at each level of education using the data (or estimations done in pre-processor) on total

educational spending (in billions of dollars), per student public expenditure at each level, and the total number of students at each level

2. For subsequent years, we first make initial income-driven projections for enrollment and for per-student public cost at each level of education. These projections, as well as the total educational allotment in billions of US dollars obtained from the sociopolitical module, are sent to a budget allocation subroutine.
3. In the budget allocation subroutine, we first calculate the initial demand for resources at each level in US dollars, using the initial projections for enrollment and relative per-student expenditures converted to US dollars. All the levels are added to calculate a total initial demand.
4. Next, the total supply of resources (in dollars) is compared with the total demand for resources, and the surplus or deficit is calculated.
5. Next, the initial projection on relative per-student costs at each level is compared with their function-projected value at the current income level of the countries. Those countries that have historically spent less per student might yield lower values than the function-projected values for that particular point in time. Similarly, countries that spend more than other countries with the same average per capita income level might yield a higher value.
6. If there is budget surplus, for all levels of education combined, and if the expenditure per student at any given level is less than the global norm, we attempt to narrow 2 percent of the gap for the per-student cost, using the surplus budget. The percentage of the gap to be closed is determined by a calibration process.

7. If there is a budget deficit, for all levels combined, and if the relative per-student expenditure at any level is above the global average, we attempt to lower that per-student expenditure, narrowing the gap by 2 percent at most.
8. After our attempts to bring the per-student expenditures toward a global norm, we recalculate the demand for resources at each level of education in US dollars. The demands are then attempted to be met using the total supply using a normalization algorithm. Each level gets a share of the supply proportional to demand. These are the budget supplies by level of education.
9. In the next step, we take the budget supply at each level of education and calculate the impact of that budget on the initial projections of student flows. Specifically, there will be a positive impact on the flow rates if there are more funds available than indicated by the initial demand projection.
10. Specifically, we calculate a ratio between budget supply and budget demand at each level. The ratio is then combined with a saturation function to capture the saturation of budget impacts at higher enrollments. The two multipliers (e.g., the budget ratio and the saturating multipliers) are applied to the two entry- and efficiency-related flow rates—that is, intake and survival, which together determine enrollment rate.

#### Demand Supply Ratio Multiplier:

```
calctotpricost = EDEXPERPRI (R%) * GDPPC (R%) *
  convtoexchange (R%) / 100 * (EDPRITOT (R%, 1)
  + EDPRITOT (R%, 2)) * AMAX (0.0000001,
  spendcostRI (R%))
```

```
calctotprispend = GDS (R%, Educ) * GDSED (R%, Primary)
```

```
'budget impact ratio
extrastudentsratio = (calctotprispnd / AMAX(0.0000001,
calctotpricost))
```

Saturation Multiplier:

```
AllowedChangeInNetIntk = AMAX(1, Amin(3, ((101 -
sEdPriIntN(R%, gndr%)) / 101) * 6))
```

11. As a final budget balancing, we calculate the final demand for resources at each level using the final projection on enrollment and the current calculation on per-student expenditure. The demands at all levels are added up and compared with the total educational budget.
12. If there is still some budget surplus or deficit, it is calculated in percentage terms. Per-student expenditures at all levels are then finalized by changing them all according to the residual percentage.

```
BudgetDiff = calctotsupply - calctotdemand
```

```
ChangePcnt = BudgetDiff / calctotdemand
```

```
EDEXPERPRI(R%) = EDEXPERPRI(R%) * (1 + ChangePcnt)
```

### 3.3.6.5 Calculation of Human Capital Stocks

As youth who have completed or partially completed their education age, they join the adult population of their country with a particular level of educational attainment. During the IFs dynamic simulation process, the youngest adult cohorts (ages fifteen through nineteen) are added<sup>52</sup> with the most recent age-appropriate graduates. The cohorts above (twenty-plus in five-year intervals) are also updated by an inward flow from the younger (generally more educated) cohorts and an outward flow to the older (generally less educated) cohorts. The process is illustrated in Figure 3.12 below. Over

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<sup>52</sup> There is a possibility that this would give rise to some numerical-diffusion error, as a portion of fresh graduates pass through the cohorts more quickly than is typical.

time the overall population profile will be altered by changes in the educational attainments of young people and by mortality rates across ages. Following a period of increased educational flows, we see a gradual enrichment of human capital. As we track and forecast human capital, we maintain the detailed age-sex–education distribution of the population, which can be viewed as population-education pyramids. We also calculate aggregated indicators, such as the average number of years of education for adults and the percentages of adults with primary, secondary, or tertiary education.

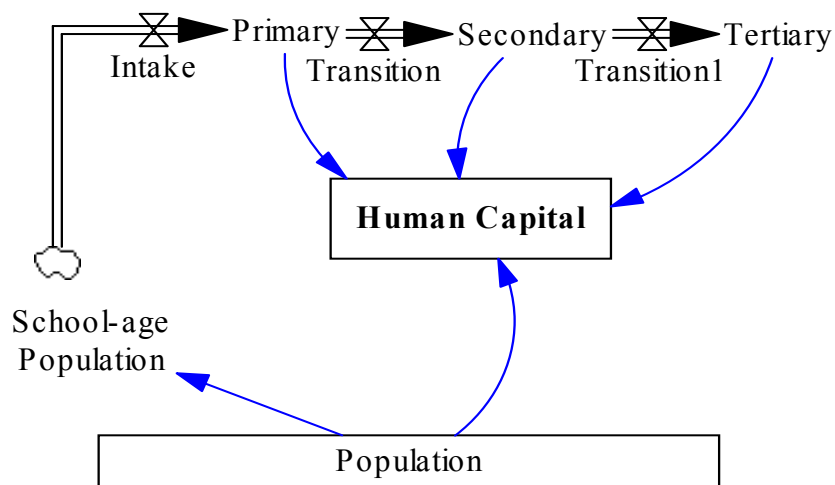


Figure 3.12. Flows from the Education System to Human Capital Stock

### 3.3.7 Model Parameterization

We have already discussed the specifics of our model structure and the benchmarking of the model with base-year data. In this section we shall describe the process of establishing the structural parameters of the model. These parameters measure the responsiveness of educational flow rates to changes in driver variables, but they might not always be elasticity.

As the IFs model runs from one time step (i.e., one year) to another, the endogenous calculation of the driver variables—for example, GDP per capita at PPP dollars—from the previous year is used as exogenous input to the education model. The endogenous calculation of the human capital inside the education model is used as an exogenous input to the other modules of IFs in the same year. The model is thus an annual reiteration, with a new macro equilibrium reached or approximated<sup>53</sup> each year. The usual practice of using estimated parameters to predict future behaviors faces many criticisms, not the least of which is the Robert E. Lucas, Jr.'s 1976 Lucas Critique. To address some of Lucas's points, we can say that we have attempted to uncover the deeper structural parameters as much as possible. For example, instead of relating educational enrollment rates to income and expenditure as many other education models do, we have identified the rates for entrance and progression, which jointly determine enrollment, and have estimated behavioral equations for those rates.

There are some debates in the literature about using cross-sectional data as opposed to time-series or panel data in parameter estimation. We have, however, used the most recent cross-national data from as many countries around the world as have such data. This, we think, represents the structure of the global-educational system more accurately than does a dataset including data from the distant past, when educational systems might have had an entirely different nature. As stated by Walter McMahon (1999, 13–14), we interpret these cross-sectionally estimated parameters as “relating to

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<sup>53</sup> The IFs modeling team prefers the description of *chasing* equilibrium to *reaching* it. It implies a simulation of the movement toward equilibrium in a manner similar to the workings of automatic control devices like auto-pilot or thermostats, the so-called servomechanism (described in Goodwin, 1951, cited in Mitra-Kahn, 2008: 46). While this is different from the optimality approaches toward reaching equilibrium, the mathematics and the data requirements are much simpler and there is a close resemblance to the real-world procedure of adjustment of inventories as a response to demand and supply.



longer-run adjustments between old and new long-run equilibriums after time has been sufficient to react to changes in factors impinging on them and to reach new values.” The assumption here is that the cross-sectional picture portrays the long-run equilibrium reached by the countries. Since all the educational-flow rates—by definition or by virtue of their demographic constraints (in the case of gross rates)—converge to 100 percent at a certain value of the independent variable and since our cross-national estimation process already captures this convergence for all but the tertiary-level flows thanks to the wide variety in the educational situations across the world at present, we can say with some confidence that the parameters will not change much as countries grow.

Of course, our global cross-section contains countries that are relatively new and have not yet reached the equilibrium flow rates. For these countries, our model recognizes the discrepancies and merges them onto the equilibrium path using a converging initial-shift factor. A detail of this residual-shift convergence is described below in the discussion of the individual parameter estimations.

#### 3.3.7.1 Parametrizing Primary Education Model

Primary education corresponds to level one of UNESCO ISCED 97. According to UNESCO statistics, students in different parts of the world enter primary schools (in most cases after spending some time in pre-primary) at ages ranging from four to eight years and stay there for a range from three to seven years. We have a complete set of data for primary entrance age and primary duration for 182<sup>54</sup> countries in our model. Once inside the system, students progress through grades until they complete primary.

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<sup>54</sup> IFs has included one more country in the model and has 183 countries, as of October 2008.

Not all primary pupils, however, fit into the specified age cohorts. In developing countries, there is a greater likelihood of late entrance and grade repetition, resulting in an incidence of pupils who are overaged compared to their classmates. In developed countries, there might be some early entrants. To account for these possibilities, we publish primary-access and participation rates as gross and net rates, including the overage pupils in gross rate calculation. In our primary education model, we have a detailed representation of both gross and net flows. The two flows run simultaneously. With the increases in overage entrance, the algorithm adjusts the pool of age-appropriate nonentrants and first-grade dropouts—who constitute potential late entrants—to yield a gradual convergence of net and gross entry and, consequently, other flows.

Our primary education model (Figure 3.13) is initialized with access (net and gross intake rate), progress (survival or completion), and participation (net and gross enrollment) rates for primary education, as well as its relative per-student costs and budgets in all of the modeled countries using data obtained from UNESCO and estimation techniques to account for missing data. The model forecasts the access (intake) and progression (survival) rates using separate global cross-sectional functions. The functions generated from the most recent data use national income level (per capita at PPP) as the driver. The base-year residuals between data and function are reconciled smoothly with an appropriate time constant. A second driver of the access and progress rates is the systemic shift—that is, the long-term changes in these rates irrespective of income. In addition to these two drivers, access and progress rates are also influenced by budget availability, as will be described in detail. Once the access and progression rates are finalized, an average dropout rate is calculated over the entire period of primary. This

dropout rate is applied to the grade-specific enrollment rates<sup>55</sup> of the previous year to construct current enrollment rates for each of the grades. The grade-flow rates are multiplied with corresponding single-year population cohorts to obtain the number of students in each grade. The students in all grades are added to obtain total students. The total number of students is divided by the number of primary-age children to obtain enrollment rates.

On the finance side, the model forecasts the public expenditure per student at the primary level. The forecast is driven by per capita income. The participation (enrollment) rates that we forecast are multiplied with the IFs demographic forecasts to calculate the number of pupils. The number of pupils is then multiplied with the estimate of per-student costs to calculate total primary spending.

As already described, the flow model is implemented in two stages, with budget balancing among the three levels of education taking place between them.

During the final stage of the flow model, the primary model also calculates the primary completion rate (gross) from the enrollment rate for the final grade of primary in the previous year and the average dropout rate of the current year. The completion rate is applied to the graduation year population to obtain the number of graduates.

In the stock part of the model, the graduates are passed to the adult age cohorts to adjust the stock of population with completed primary education. It is here that we also calculate the average number of years of education by using the figures for both grades completed and grades partially completed (by dropouts) for primary as well as higher levels.

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<sup>55</sup> Data on intake rate and survival rate is used to initialize grade-specific enrollment rates at the first year.

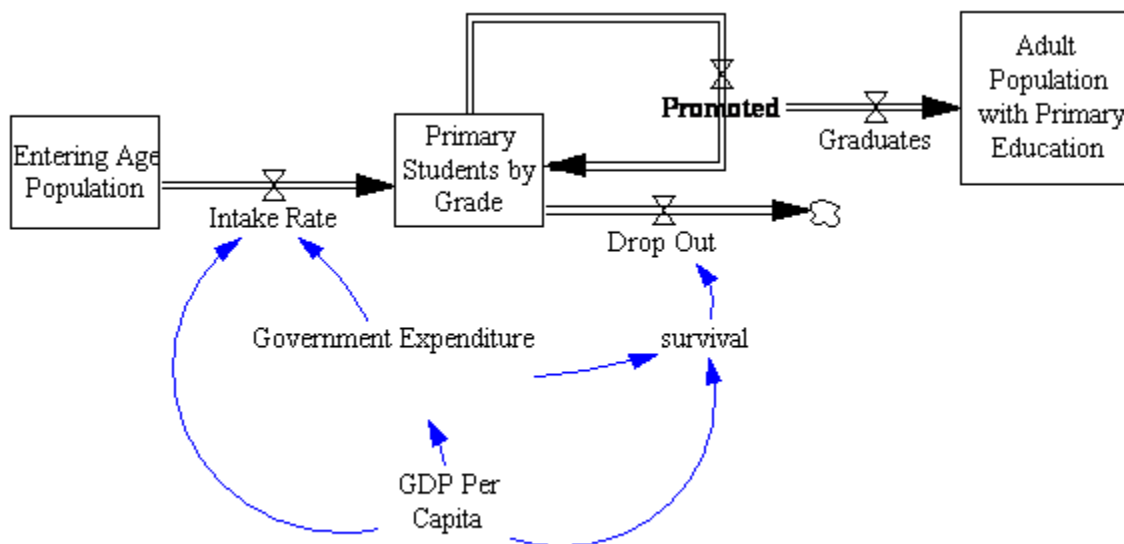


Figure 3.13. Primary Education Model

The variables and their data sources are listed in Table 3.3:

Table 3.4. Primary Education Model Variables

IFs Variable Name	Variable Definition	Dimensions	Data Sources / Availability of recent data (Percent)	Unit
edpristart	Primary start Age	Country	182 (100%)	Years
edprilen	Primary duration	Country	182 (100%)	Years
EDPRIINT	Primary education intake rate, gross	Country; boys, girls, total	UIS	Percent
EDPRIINTN	Primary education intake rate, net <sup>56</sup>	Country; boys, girls, total	UIS	Percent

<sup>56</sup> Adjusted primary net intake rate, to be precise.

EDPRISUR <sup>57</sup>	Primary education survival rate of entering cohort to last grade of primary	Country; boys, girls, total	157 (86%)	percent
EDPRIENRG	Primary gross enrollment rate	Country; boys, girls, total	UIS	Percent
EDPRIENRN	Primary net enrollment rate	Country; boys, girls, total	UIS	Percent
EDPRICR	Primary (gross) completion rate	Country; boys, girls, total	154 (84%)	Percent
EDPRIGRADS	Primary (gross) graduates	Country; boys, girls, total	UIS	Millions
EDPRITOT	Primary (gross) enrollment	Country; boys, girls, total	UIS	Millions
EDEXPERPRI	Expenditure per student in primary as a % of GDP per capita	Country	UIS	Percent

### 3.3.7.1.1 Access to Primary Education

Pupils entering primary could either be of appropriate entrance age or above or below that age. The respective flow rates are gross (apparent) and net intake rate.

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<sup>57</sup>Because of the way it is defined, persistence rate to a certain grade is not reported as net or gross. For countries where net and gross intake and enrollment rates are very different, the survival rate might also be different for the net and gross cohorts. To handle this contingency, we calculate a net survival rate consistent with net intake rate and net enrollment rate for the first year of the model run. In the subsequent years, we advance this net survival rate in such a manner that it converges to 100 percent at the same time as does EDPRISUR.

### 3.3.7.1.2 Net Intake Rate

In the cross-sectional plots of Figures Figure 3.14, Figure 3.15, and Figure 3.16 below, we see that as countries get richer, their primary net intake rates, for both boys and girls, saturate toward 100 percent (at about US\$10,000 PPP dollars per capita) with a nonlinear (logarithmic) pattern. However, there are many developing economies that are able to enroll all boys in primary schools despite relatively low per capita incomes. The cross-sectional graph in the Figure 3.14 contains net intake rates for boys only. A similar function is derived for girls in Figure 3.15. The gender-specific logarithmic functions from these plots are used to fill in missing data for the net intake rate for a particular country and gender for the model base year.

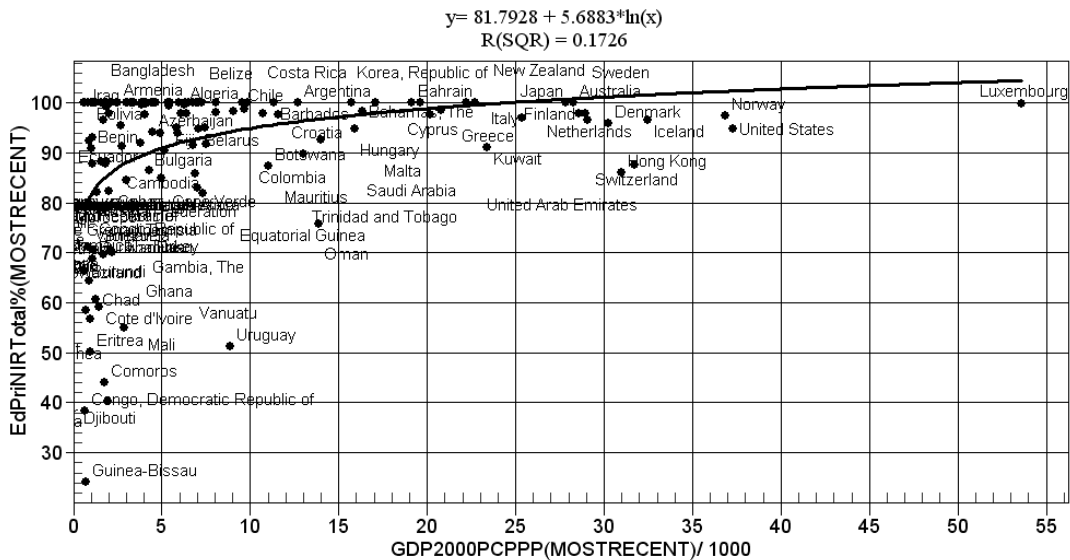


Figure 3.14. Cross-Sectional Function of Primary Net Intake Rate Against GDP Per Capita at PPP

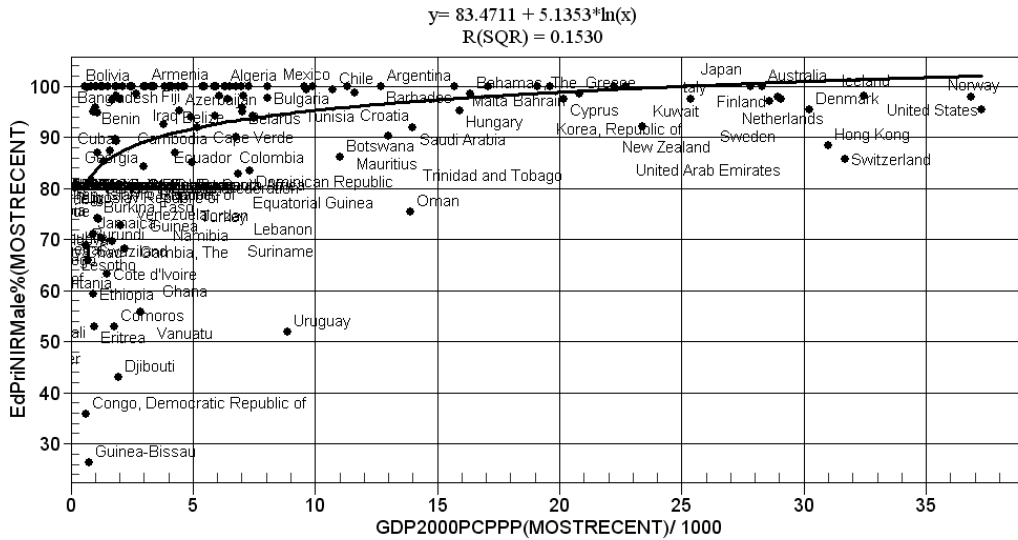


Figure 3.15. Cross-Sectional Function of Primary Net Intake Rate for Boys Against GDP Per Capita at PPP

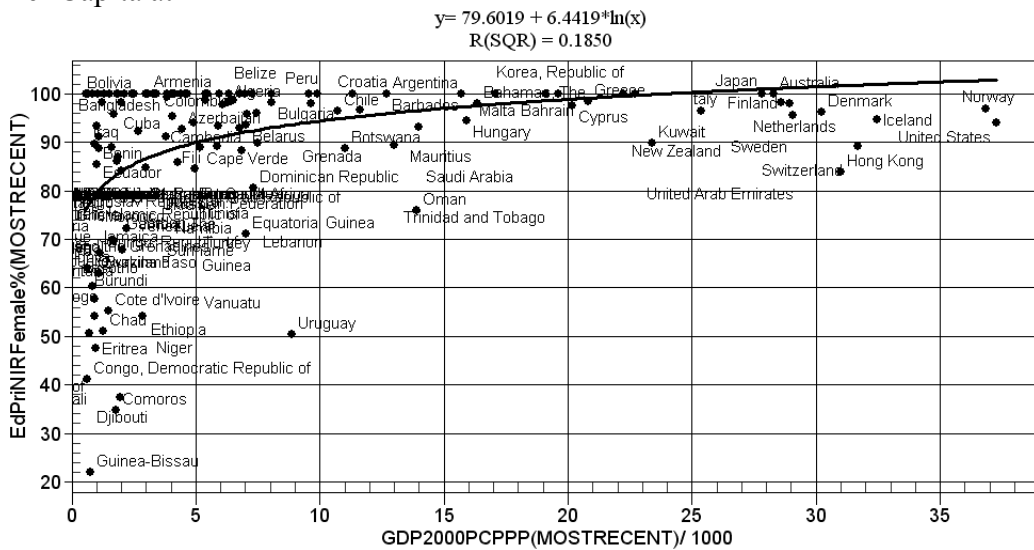


Figure 3.16. Cross-Sectional Function of Primary Net Intake Rate for Girls Against GDP Per Capita at PPP

*Note for Figures Figure 3.14, Figure 3.15, and Figure 3.16: GDP per capita is expressed in thousands of PPP dollars; data from the most recent year for which they are available, mostly 2005.*

The income-driven cross-sectional functions are used as the basis of our forecast for net intake rate. However, as we see from the scatter plots, many countries have surpassed or not yet attained the access rate predicted by the trend graph. These

discrepancies might be due to a number of issues—cultural, historic, political—that influence the acceleration or retardation of educational expansion irrespective of the society in question’s economic plight. In a global model like ours, it would be overly complex and cumbersome to capture those multiple dimensions.<sup>58</sup> However, to match our forecast with the ground realities, we took cognizance of the initial-year residual for each of the countries and added the residuals to our forecast in such a manner that they follow the optimum path toward zero and the forecast converges to trend function. The time constant for the convergence is currently calculated by an examination of the data.<sup>59</sup> As shown in a recent paper by Eric Kemp-Benedict (2008), this method minimizes overall error in the forecast. Since the net educational-flow rates are by definition bound at 100 percent, this type of long-term convergence with a saturating function makes sense in general.

In addition to the income and residual shifts, we found another historical shift to influence the net intake rate. The next diagram (Figure 3.17) plots the net intake rate (for boys) against GDP per capita (at the same PPP dollars) for two points in time, 1992 and 2000. We see some upward shift in the plot within this period of nearly a decade. A country at 5000 PPP dollars of per capita at the year 2000 is likely to have about a 7 to 8 percent higher access rate compared to a country with the same amount of per capita at the year 1992, perhaps because of the global emphasis placed on primary during the 1990s. This finding is also supported by those of Clemens (2004), who has found out that

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<sup>58</sup> We have performed analyses including some control variables in our income-education regressions. In most cases, we did not gain significant changes in statistical power by including those variables.

<sup>59</sup> Eric Kemp-Benedict (2008) has recently suggested a method for calculating the time constant by examining the data.



those countries that have expanded their primary education in the post-Second World War period have done so at an accelerated pace compared to those that expanded mass education in the nineteenth century. Since our forecast spans a substantially long horizon, we felt it necessary to capture these historic shifts in the system. We do so by measuring the gap between the intake rates (bound at 100 percent) as forecast by these two functions for the particular level of income the country averages at a particular point in time, and then adding one-fifteenth<sup>60</sup> of that gap to the income- and residual-driven forecast that we calculated earlier.

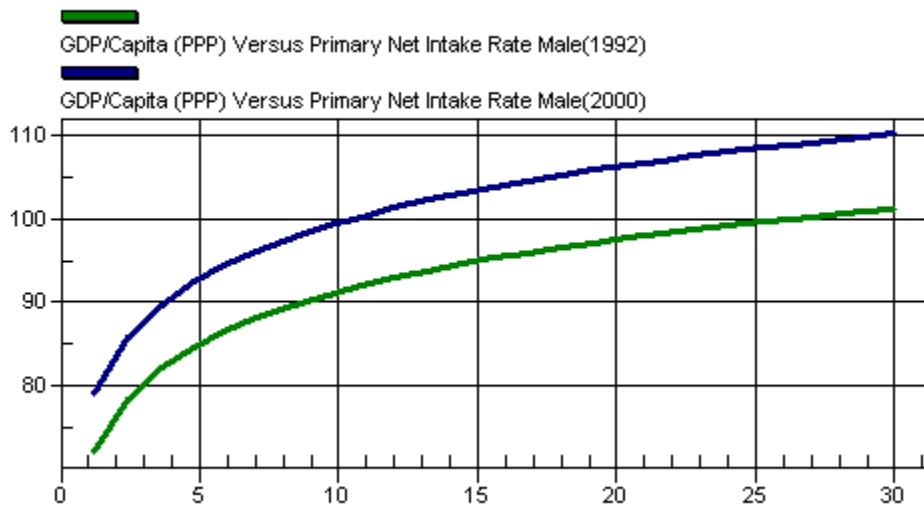


Figure 3.17. Systemic Shifts in the Primary Net Intake Rate for Boys

With the above drivers, a preliminary net intake rate is forecast for each country, each year, and each gender. This initial net intake rate helps determine the gross intake rate using the overage pool algorithm. The forecasts for gross intake rate and survival rate together determine the gross enrollments. The primary gross enrollments along with gross

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<sup>60</sup> We believe that a substantial time gap is required to study and declare any such pattern as a systemic shift. We compared function in eight-year differences since we could not obtain better data for earlier years.

enrollments from the other levels and the per-student cost forecasts at each level are used to balance the total educational budget, which is divided among the levels. Depending on whether the budget allocated is surplus or short, a positive or negative budget-impact parameter drives the net intake rate a little further. The budget impacts are usually gradual and thus the one we have modeled is smaller than the economic and social impacts described earlier. The scale-up of education becomes more difficult as societies try to reach children at the margins. Accordingly, our budget impact also reduces as the countries get closer to intake rates of 100 percent.

#### 3.3.7.1.3 Gross Intake Rate

We have collected the data on apparent (gross) intake rate and net intake rate<sup>61</sup> from UNESCO sources. For developing countries (low-income countries as seen in Figure 3.18),<sup>62</sup> gross intake rates could be either above or well below 100 percent. SSA countries like Democratic Republic of Congo or Mali, with gross intake rates of around 60 percent, indicate an inability to grant access to everybody. Contrastingly, gross intake rates of 150 percent or more in low-income countries like Rwanda and Cambodia show a catch-up from an earlier time when children could not avail primary due to lack of schools, sufferings faced by their families or political conflicts whereby the whole system was shut down. As such countries get richer, those who once could not get access to the

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<sup>61</sup> For net intake rate, the data are available as three series each for each gender and both genders combined. These three are the intake rate for entrance age, a year above the entrance age, and a year below that age. We have added up these three rates to get one net intake rate. Our logic is that those one year older or younger can be considered as the entrants for this year, as they have already or will ultimately enter within a year, keeping the flow rate effectively the same. Of course, we have bound the rate at 100 percent to be consistent with the definition of net rates.

<sup>62</sup> The data used are for the most recent years for which they are available, which for gross intake rate is 2004 for about 75 percent of the countries and 2000 for GDP per capita at PPP for about 85 percent of the countries.

system gradually enter. When the pool of overage entrants is used up, the gross intake rate starts coming down and converges toward the net intake rate, which reaches the maximum of 100 percent gradually.

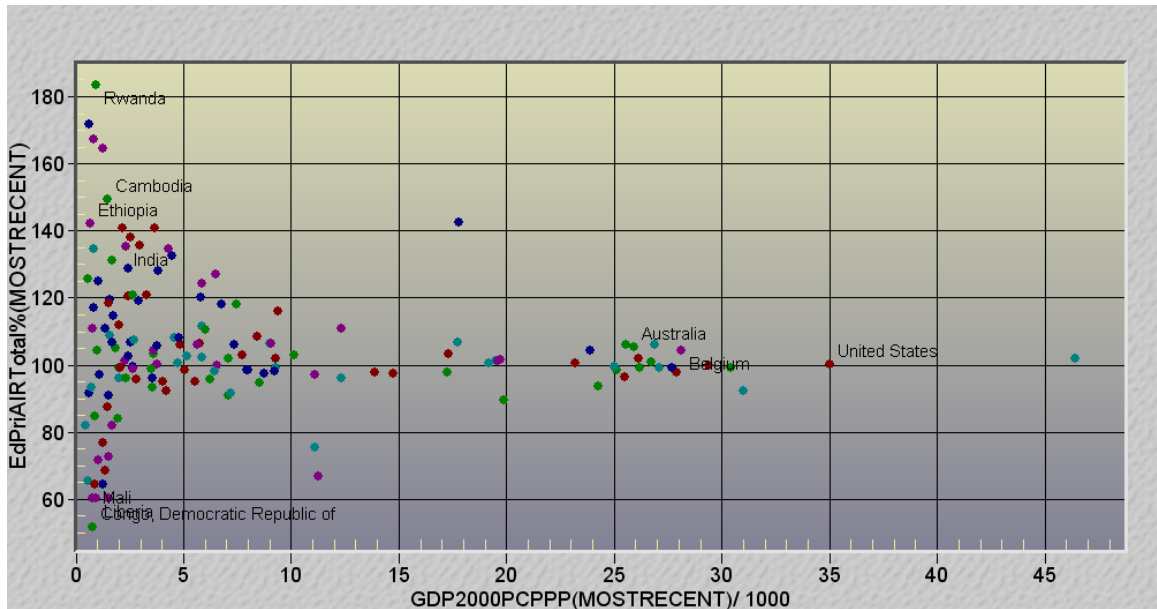


Figure 3.18. Cross-Sectional Function of Primary Apparent (Gross) Intake Rate Against GDP Per Capita at PPP

*Note:* GDP per capita is expressed in thousands of PPP dollars; data from the most recent year for which they're available, mostly 2005.

As evident from Figure 3.18, it is difficult to determine a pattern for the gross intake rate data. Fortunately, we have almost complete sets of data for all but ten countries.<sup>63</sup> For those ten countries, we use the cubic function shown in Figure 3.19, which does a somewhat decent job of capturing the small overshoot and collapse in the low-to-medium income range.<sup>64</sup> And, for about half of these ten countries, we have gross

<sup>63</sup> These are usually small countries (e.g., Micronesia, Bhutan), newly formed countries (e.g., Timor), internationally isolated countries (e.g., North Korea) or countries for which UNESCO would not report data for political reasons (e.g., Taiwan).

<sup>64</sup> The function overshoots with meaningless (in this case) trend above the range of about 20,000 PPP dollars of income per capita.

enrollment data that we use to double-check that the intake estimates conform to participation and progress.

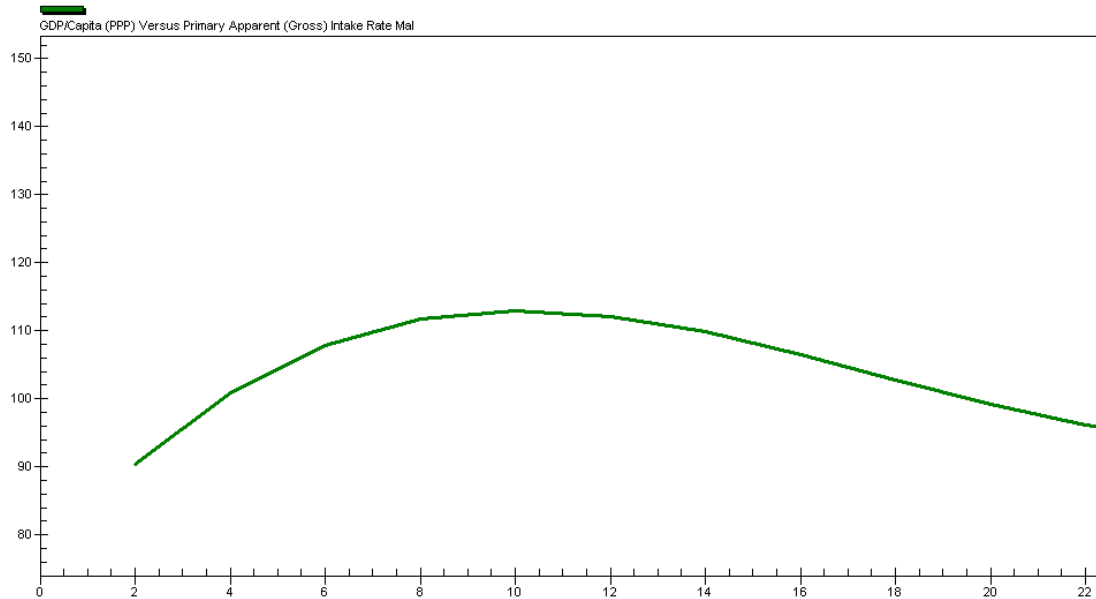


Figure 3.19. Cubic Function Computed for Gross Primary Intake Rate (vertical axis) against GDP Per Capita at thousand PPP dollars  
*Note:* 1990 data used here

During dynamic simulation, the gross intake rate is estimated according to the forecast for the net intake rate and the pool exhaustion algorithm described in the earlier section on major algorithms.

#### 3.3.7.1.4 Primary Survival Rate

We used gender-specific survival rate (EDPRISUR) to the last grade of primary as the measure of persistence in primary education. The UNESCO database has substantial coverage on this indicator (about 86 percent for at least one year between 1991 and 2005). Where we found no data on survival rate for the base or recent years with respect to a given country, we first tried to use the primary completion rate data, if available, making any necessary adjustments. When the completion rate figure was not

available either, we used the cross-sectional functions for boys' and girls' survival rates on GDP per capita at PPP (2000) dollars, as illustrated in Figure 3.20.

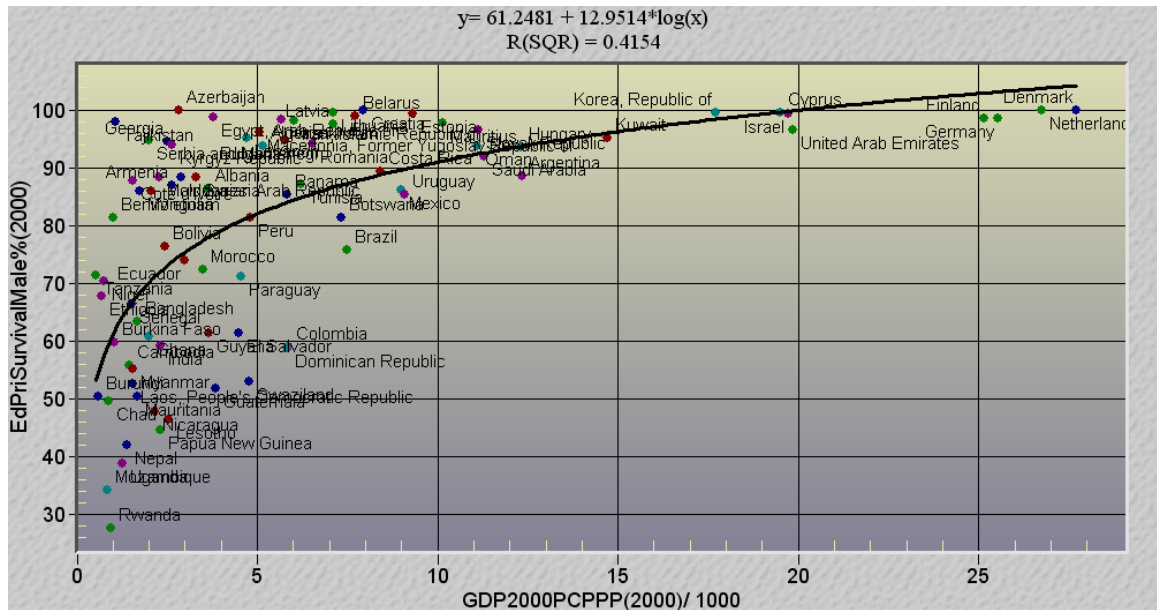


Figure 3.20. Cross-Sectional Function of Survival Rate to the Last Grade of Primary for Boys Against GDP Per Capita at PPP

*Note:* GDP per capita is expressed in thousands of PPP dollars; data from the most recent year for which they're available, mostly 2005.

Primary survival rate is forecast using the same drivers—that is, income, residual, systemic shift, and budget impact, as well as algorithm in the case of primary net intake rate. The systemic shift is much more pronounced in the case of survival rate, as shown in Figure 3.21.

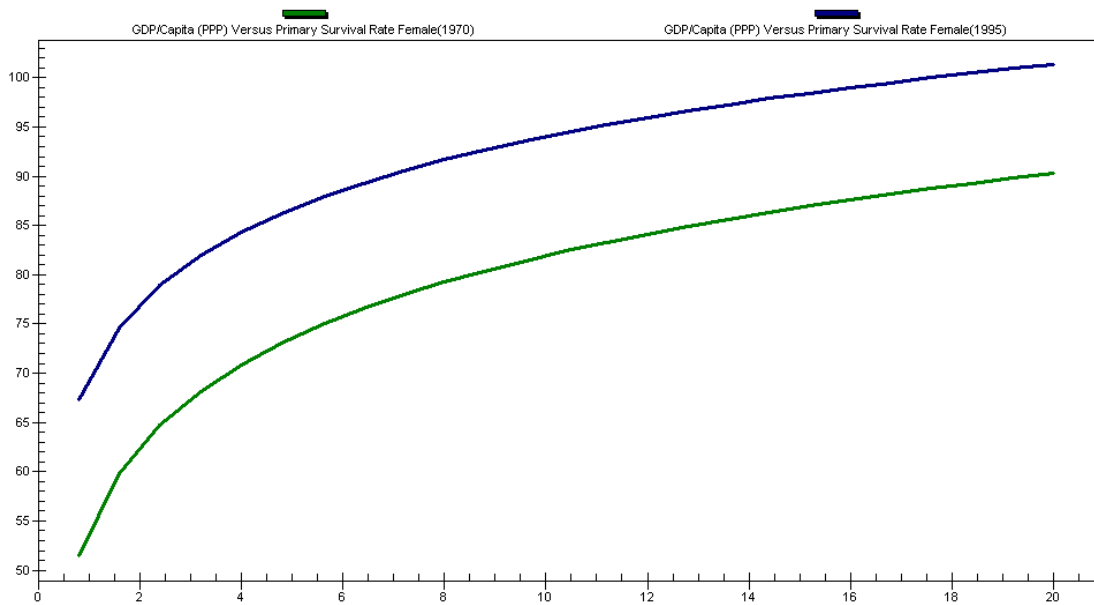


Figure 3.21. Shift in the Survival Rate to the Last Grade of Primary

*Note:* The horizontal axis is GDP per capita at PPP, the vertical axis is the survival rate, the green line represents 1970, and the blue line represents 1995.

Unlike other flow rates, survival rates, calculated on the basis of entrants, do not have a net or gross dimension. However, for the purpose of consistency in the grade-flow simulation resulting in net primary enrollment, we calculate a net survival rate from the net intake rate and net enrollment data at the starting year of the model. Sometimes this net survival rate is different from the survival rate obtained from data. This net survival rate is then forecast with a growth rate such that it converges to 100 percent at the same time as the other survival rate.

#### 3.3.7.1.5 Enrollment Rate

We initialize the model with data for net and gross enrollment rates that offers close to complete coverage. We use cross-sectional functions to account for the few

countries for which we do not have data in the base or near-base years. The function for net primary enrollment rate is shown in Figure 3.22.

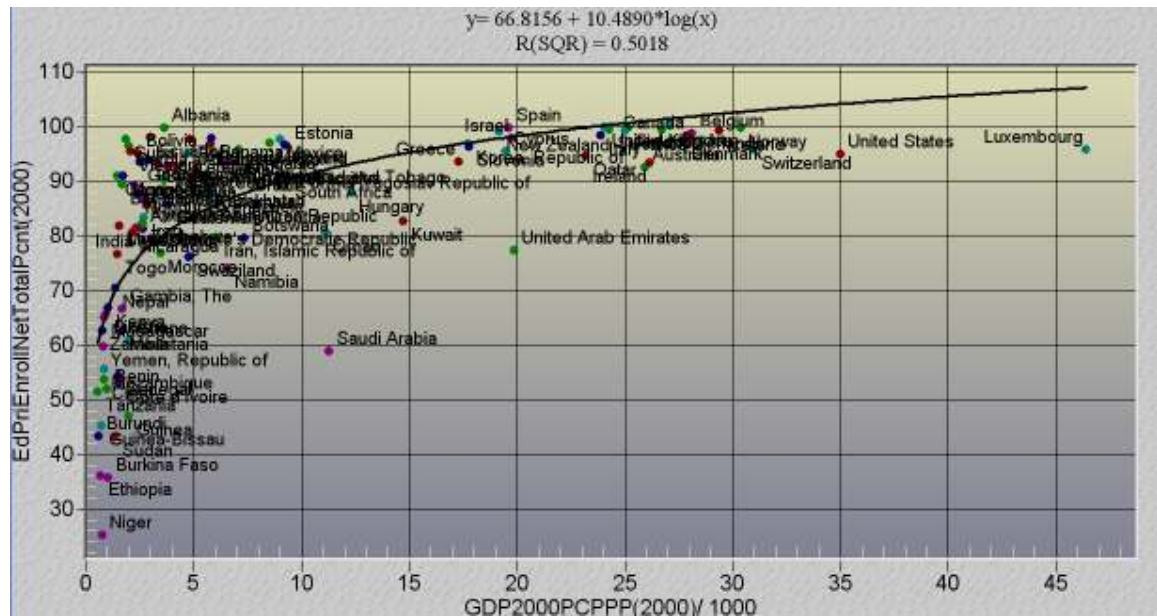


Figure 3.22. Net Enrollment Rate in Primary Plotted Against GDP Per Capita at PPP  
*Note:* GDP per capita is expressed in thousands of PPP (2000) dollars; data from the most recent year for which they're available, mostly 2005.

In our forecast, both the net and the gross enrollment rates are calculated using the grade-flow simulation described in the section on major algorithms.

### 3.3.7.1.6 Primary Completion Rate

Gross primary completion rate is initialized with UNESCO data. For 154 countries we have data for at least one of the most recent years. The cross-sectional function obtained from that data, with per capita income as the independent variable, shows a good logarithmic fit; see Figure 3.23. The countries that lie below the trend path, thus exhibiting low system performance at high income, mostly lie in the Middle Eastern region. The function is used to fill in the data for countries where there are no recent data for at least one gender if not both.

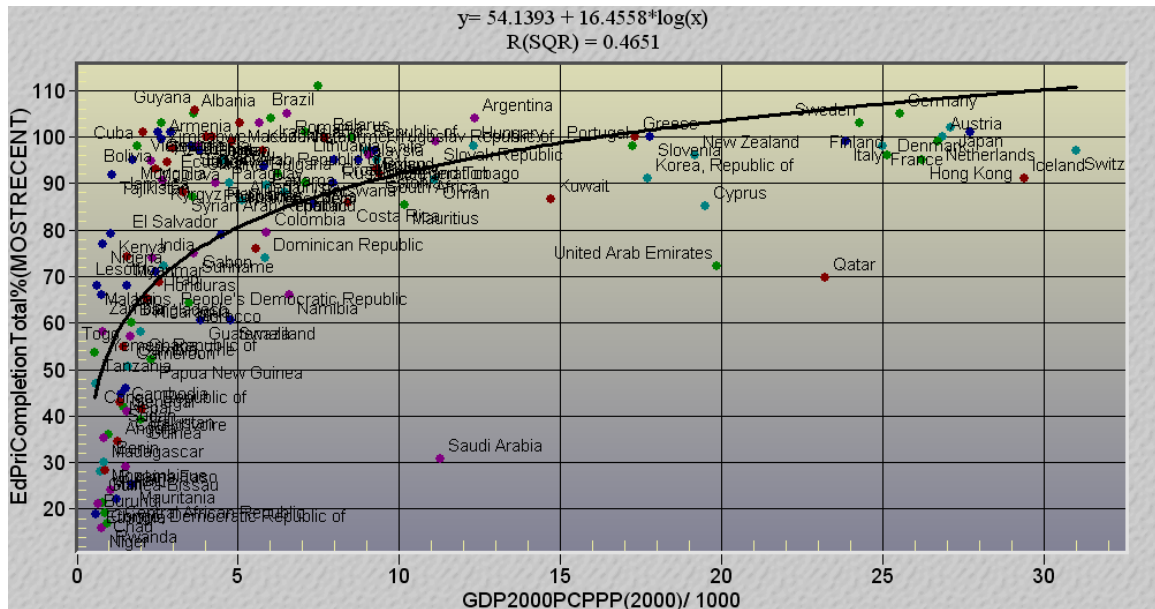


Figure 3.23. Completion Rate in Primary Drawn Against GDP Per Capita at PPP  
*Note:* GDP per capita is expressed in thousands of PPP (2000) dollars; data from the most recent year for which they're available, mostly 2005.

In our forecast, primary graduation rate is calculated by subtracting the dropouts from the final graders of primary. This completion rate, gross by calculation, is multiplied with the population at primary graduation age to obtain the total (gross) number of primary graduates.

### 3.3.7.2 Lower-Secondary Model Parametrization

Both lower- and upper-secondary models are divided into general and vocational education. The number of countries offering vocational education is much lower in lower portion secondary than in upper.

#### 3.3.7.2.1 Vocational Lower Secondary

From UNESCO sources we have collected data on the proportion of lower- and upper-secondary students, respectively, that go to technical and vocational training (TVET) institutes. In the model pre-processor, we have converted those enrollment



proportions to school-age proportions—that is, TVET enrollment rates. As the TVET proportions depend on government-level decisions regarding the implementation of such programs and do not thus follow any particular trend with respect to income or any other variable we can follow over a longer term (as illustrated in Figure 3.24), we have decided to keep the TVET enrollment rate at its initial value—that is, the most recent data value—throughout the model.

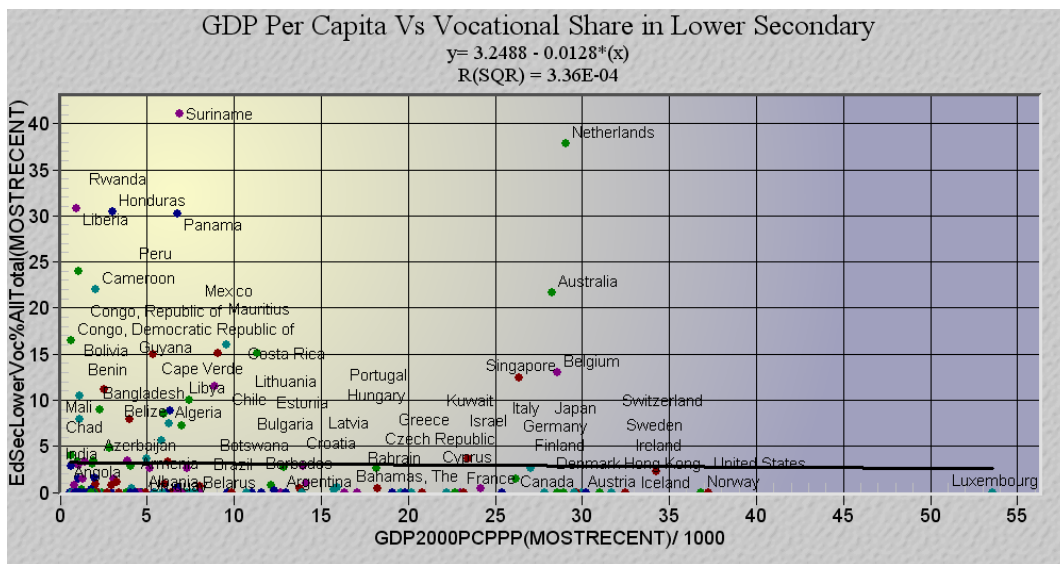


Figure 3.24. Cross-Sectional Function of Vocational Share in Lower Secondary Against GDP Per Capita at PPP

*Note:* GDP per capita is expressed in thousands of PPP (2000) dollars; data from the most recent year for which they're available, mostly 2005.

### 3.3.7.2.2 General Lower Secondary

The general portion of the lower-secondary model follows basically the same algorithm as the primary with few variations. The intake in lower secondary is determined by the transition of primary completers into lower secondary.

### 3.3.7.2.3 Lower-Secondary (General) Transition Rate

The transition rate that UNESCO publishes is defined as the percentage of students in the final grade of primary who get admitted into general lower secondary the following year. By definition, the rate is bound at 100 percent. Figure 3.25 shows the variation in the transition rate across countries with different income levels. The data are from 2005, the most recent year for which they are available. While transition rate in a country reaches 90 percent by 3000 PPP dollars of per capita GDP, it takes quite some effort for the countries to advance that transition rate by another 10 percent.

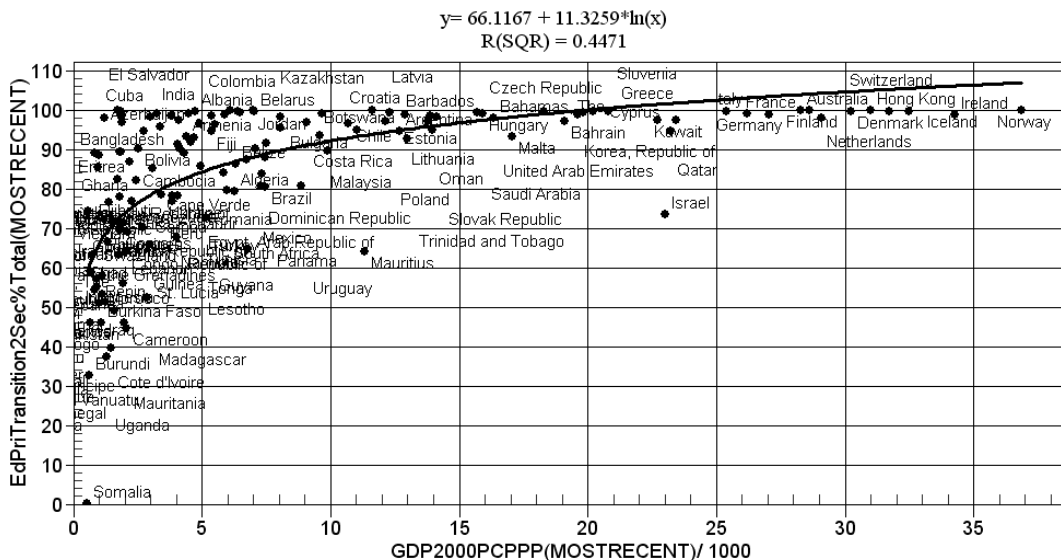


Figure 3.25. Cross-Sectional Plot of Transition Rate from Primary to General Lower Secondary Against GDP Per Capita at PPP

Note: GDP per capita is expressed in thousands of PPP (2000) dollars; data from the most recent year for which they're available, mostly 2005.

Transition rate is forecast using two cross-sectional functions, one for boys and one for girls, similar to the cross-sectional function shown the previous figure.

### 3.3.7.2.4 Lower-Secondary (General) Survival Rate

UNESCO does not publish any survival rates for lower secondary. We have used the reconstructed cohort method to calculate survival rates in general lower secondary using grade enrollment and repetition figures obtained from the UIS website. Figure 3.26 once more shows a positive but saturating relationship between survival rate and income. One thing worth noting in that figure is the position of the Netherlands, a high-income country with an apparently low survival rate. That rate, however, is because of the large vocational share in the Netherlands' lower-secondary system. While most of the primary graduates start lower secondary at the same grade, at some point a large number of them shifts to vocational, giving the impression that survival in general education is very low. In our model, we have developed an algorithm to analyze such system anomalies, and have bound the survival or transition rates in general lower secondary accordingly.

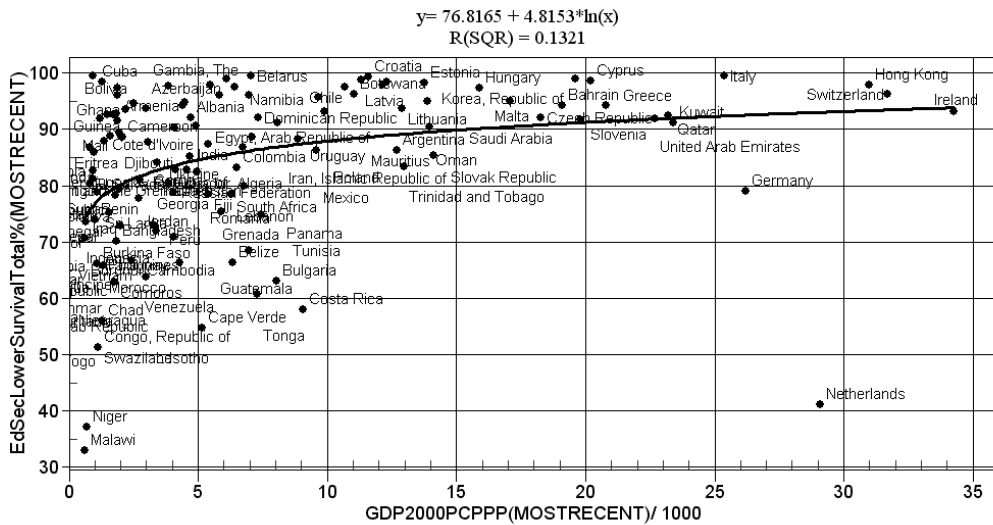


Figure 3.26. Cross-Sectional Plot of Survival Rate to the Last Grade of General Lower Secondary against GDP Per Capita

*Note:* GDP per capita is expressed in thousands of PPP (2000) dollars; data from the most recent year for which they're available, mostly 2005.

#### 3.3.7.2.5 Lower-Secondary Enrollment

The enrollment rate in lower secondary is determined using the grade-flow algorithm in the same way as primary. There are two differences. First, lower-secondary intake (general only) is calculated internally by applying the forecast for the lower-secondary transition rate to the enrollment rate for the final grade of primary, another internal variable,<sup>65</sup> from the previous year. Second, the grade-flow structure is applied only to determine the general portion of the lower-secondary enrollment. To that general education enrollment forecast, we add the constant TVET enrollment rate to calculate a total enrollment rate.

#### 3.3.7.2.6 Lower-Secondary Graduation Rate

Graduation rate in general lower secondary is obtained by subtracting the dropouts from those who survived to the last grade. We use the ratio between the general and TVET enrollment rates to calculate the TVET graduates as a proportion of the general education graduates. The two types of graduates are then added to get the total graduates in lower secondary.

### 3.3.7.3 Education Financing: Model Calibration

#### 3.3.7.3.1 Per-Student Expenditure in Primary

Data on public expenditure per student in primary are obtained from UNESCO. These data are expressed in relative terms, as a percentage of GDP per capita, and thus comparable. The expenditure includes government (central or local) expenditure, both

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<sup>65</sup> Internal variables are those coded in model algorithms but are not saved as a model output variable,

current and capital, on primary-level institutions. Total expenditure is divided by the total enrollment to get the per-student expenditure, which is then expressed as a percentage of GDP per capita. In our model pre-processor, we convert these percentages into exchange-rate dollars using GDP data from the IFs economic module. For about thirty countries with no recent data, we first determine the relative per-student cost from a cross-sectional function (shown in Figure 3.27) and then convert the relative unit cost to absolute.

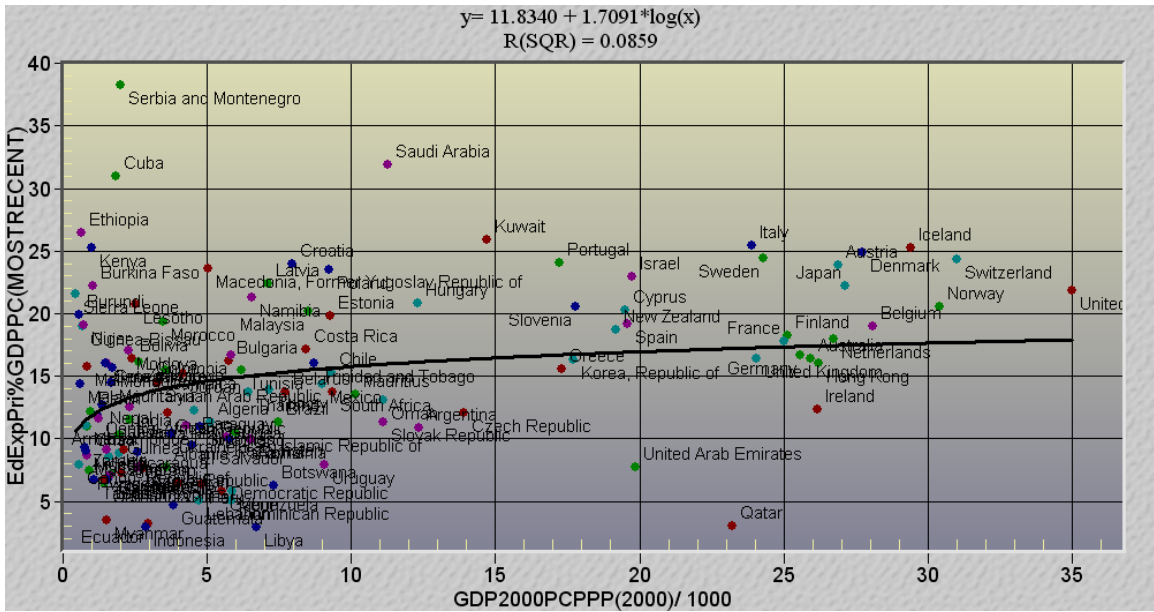


Figure 3.27. Cross-Sectional Plot of Relative Per-Student Expenditure in Primary Education Against GDP Per Capita at PPP  
*Note* GDP per capita is expressed in thousands of PPP (2000) dollars; data from the most recent year for which they're available, mostly 2005.

The per-student cost is forecast in two stages. At the first stage of the flow model, the portion of per capita income spent publicly per primary student is obtained from the cross-sectional function described above.<sup>66</sup> In the final stage of the flow model, after budget balancing per student, expenditure is recalculated using final enrollments and allocation.

<sup>66</sup> With an initial shift (residual), which is multiplicative in this case.

### 3.3.7.3.2 Per-Student Expenditure in Lower Secondary

In contrast to its data on primary education, UNESCO reports lower-secondary expenditure data as a share of total educational expenditure. We have calculated the per-student expenditure in lower secondary as a percentage of GDP per capita using the relevant UNESCO data series. In the following figure, we plot those per-student expenditures against income per capita of the countries for the latest year for which we have data. While there is no mathematically significant correlation among the two variables it is quite evident from the next plot (Figure 3.28) that the percentage of income spent in lower secondary averages around 20 percent across the board.

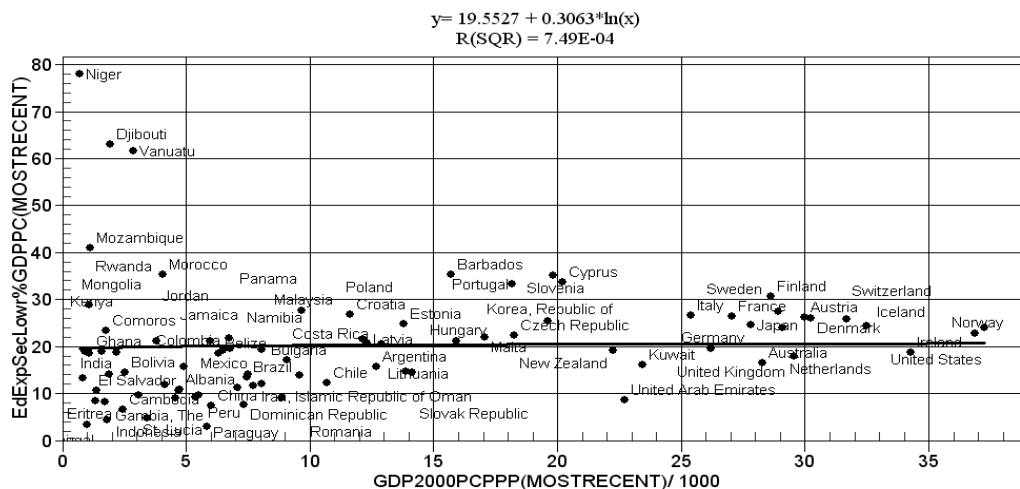


Figure 3.28. Relative Per-Student Expenditure in Lower Secondary Education Against GDP Per Capita at PPP

Note: GDP per capita is expressed in thousands of PPP (2000) dollars; data from the most recent year for which they're available, mostly 2005.

### 3.3.7.3.3 Total Educational Spending (Total Supply)

The IFs economic submodel provides total government spending. The IFs sociopolitical module calculates the fractional share of government expenditures in various sectors, including health care, military, and education, using cross-sectional functions built with initial data for the share of each type of expenditure. Spending in all categories is renormalized to equal total governmental spending.

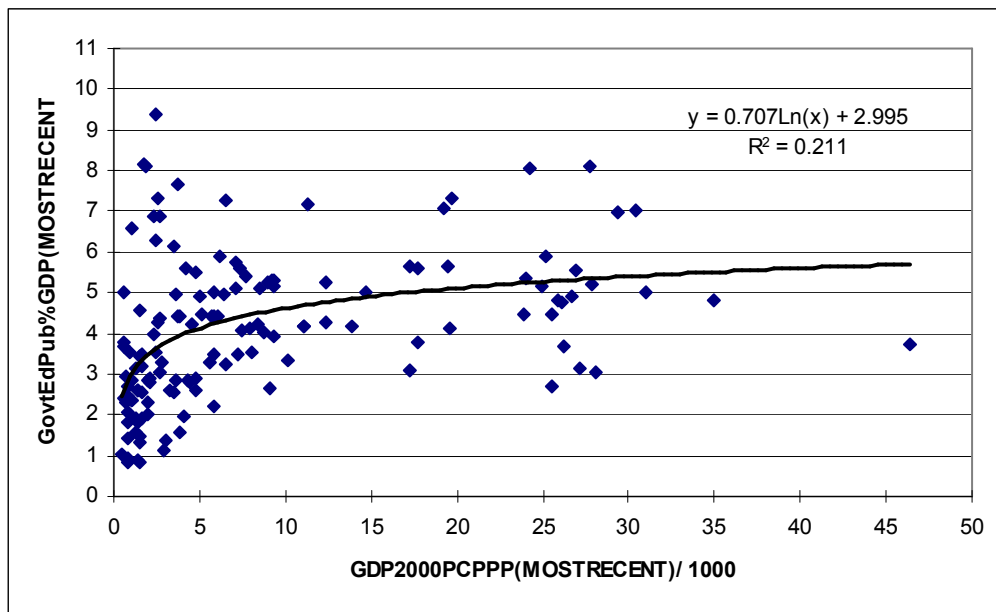


Figure 3.29. Cross-Sectional Function of Government Expenditure on Education as a Percentage of GDP Versus GDP Per Capita at PPP

*Note:* GDP per capita is expressed in thousands of PPP (2000) dollars; data from the most recent year for which they're available, mostly 2005.

From Figure 3.29, we see that low-income countries (below 5000 PPP dollars per capita) spend between 1 and 3 percent of GDP on education. This share gradually increases for higher income countries. The saturation of the relative spending can be represented by a logarithmic function with a fair fit. According to the function, the percentage share of GDP allocated to the education sector stabilizes at slightly below 6

percent for countries with a GDP per capita at PPP of 40,000 or more. There are some exceptions to this picture. Some of the SSA countries spend less than 1 percent of their income on education, while the social welfare countries of Scandinavia and socialist Cuba spend 8 percent or more on education.

The IFs database has data for the percentage of public expenditure in education for 164 of the 182 IFs countries for the base year (i.e., 2000). For the few countries that we do not have data, the cross-sectional function described earlier is used in the IFs pre-processor to fill in the data for the initial year.

During the model simulation, the cross-sectional function represents the major dynamic at work in the total education budget of countries as they get richer.

```
Call XYTABL("GDP/Capita (PPP) Versus Govt Exp Educ as % of
            GDP (2002) - log", Amin(40, GDPPCP(R%)),
            gkcomp(Educ))
```

The percentage of spending is also refined by a multiplicative shift, calculated at the initial year, to correct for any possible deviation of function output from data. The shift has a long-term convergence value of one, such that the percentage of spending gradually merges towards the trend function.

```
gkri(R%, S%) = gk(R%, S%) / AMAX(0.001, gkcomp(S%))
```

```
GKShift = ConvergeOverTime(gkri(R%, S%), 1, 200)
```

```
gk(R%, S%) = gkcomp(S%) * GKShift
            AMAX(0.0000001, spendcostRI(R%))
```



### **3.4 Conclusion**

In this chapter, we have presented a detailed description of the education model that we have developed for the purpose of this dissertation. The model code is written in Microsoft Visual Basic<sup>®</sup> and the background database uses Microsoft Access<sup>®</sup> software. Full model code is available in the help system of the IFs application software.

#### **4 Universal Basic Education: What Path Is the World On?**

Examination of the past helps exploration of the future. The historical educational data that we have gathered and the educational model that we have developed guide us in examining the future. This chapter presents our assessment of the progress the world has recently made and the path it is likely to take in providing basic education to all children. We analyze primary and lower secondary education either separately or under a combined category of basic education as applicable. Our dependent variables are the participation rates and gender parity which we examine at a global, regional, and, when useful, country level. We contrast our findings with those from other comparable studies whenever such studies are available.

Our analyses of historical educational data support the rapid post–World War II educational progress found in the literature. The richer Organization of Economic Co-operation and Development (OECD) countries have already met the quantitative educational targets at the level of basic education and have shifted their focus towards on the quality of education as well as further expansion upward. However, the picture is not equally optimistic throughout the world. While most of the developing countries continued their educational expansion at a speed faster than the now developed countries when they were at a comparable stage, some of the developing regions are still far away from universal participation or gender parity in primary and lower secondary, a major reason of which is the low initial condition in these regions. Forecasts from the base case

of our educational model show the pace of progress will not be sufficient to reach universal primary education in the near future. Two of the world regions, sub-Saharan Africa (SSA) and South and West Asia (SWA), might not be able to enroll all their children in elementary schools by 2015. These two and one other UNESCO region, the Arab States, do not see universal lower secondary education by 2020. Our conclusions are in line with the general concerns about the educational futures of SSA and SWA, though we differ on the pace of progress calculated by extrapolative forecasts.

This chapter is broadly divided into four sections. The first section looks at the historic progress of primary and lower secondary education in the last three and a half decades. The second section explores the unfolding of global basic education up until the mid-twenty first century as demonstrated by the base case forecasts of the International Futures (IFs) education model. The base case, while it is based on recent trends, is not a simple extrapolation. It is rather a dynamic and simultaneous progression of the education sector and the demographic and economic system into which that sector is embedded. It formally represents the dominant interactions between population, pupil, income, and expenditure with the reasonable assumption that the direction and magnitude of these interactions will continue to follow the current pattern. In the following section we shall compare the foresight from our base case with other forecasts on basic education. This validation is an essential step in narrowing the band of uncertainty and increasing the level of confidence in our own forecast, which is no less immune from the usual empirical and analytical limitations of such projects. The final section will explicitly explore some of the key dimensions of uncertainty around educational forecasting in an attempt to frame that uncertainty.

In the analysis of this and the next chapter we shall group data and forecasts for presentation using the eight standard regions of UNESCO: the Arab States, Central and Eastern Europe, Central Asia, East Asia and the Pacific, Latin America and the Caribbean, North America and Western Europe, SWA, and SSA. The typical UNESCO regional groupings differ from those of other international agencies like the United Nations organizations and the World Bank. We use them because UNESCO is the premier international organization in the global educational arena. One clear weakness of the UNESCO regionalization is the aggregation within its East Asia and Pacific grouping of Australia, Japan, the Republic of Korea, New Zealand, Singapore, and Taiwan with many lower-income countries. We shall most often divide that grouping into two sub-groupings: a higher-income or “rich” one and a lower-income or “poor” one<sup>67</sup>.

#### **4.1 Historic Context**

There has been remarkable global progress in basic education in the recent decades. Close to ninety out of each one-hundred primary school-age children in the world go to school today.<sup>68</sup> Pupils enrolled in lower secondary schools across the planet make up a gross-enrollment ratio of little less than 80 percent.<sup>69</sup> The close to 20 percent leap in global net primary enrollment rate, from 72 percent to 88 percent, and a more than doubling of the gross-enrollment rate in lower secondary, from 37 percent to 78 percent,

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<sup>67</sup> Such categorization of East Asia and the Pacific is first used in the draft of the education volume of the Potential Patterns of Human Development series published by the Pardee Center for International Futures. (Dickson, Hughes, Irfan, Forthcoming).

<sup>68</sup> Global net primary enrollment rate in 2005 is 88% according to IFs calculation done with UIS data.

<sup>69</sup> Global gross lower secondary enrollment rate in 2005 is 78% according to IFs calculation done with UIS data.

within the three and a half decades starting in 1970, make us optimistic about the potential achievement of universal basic education in the not so distant future. This ongoing transition from low to high basic education participation can be compared (Dickson, Hughes, and Irfan 2008) to the transition from high to low fertility and mortality, the so-called demographic transition. Both of these transitions are largely complete in more developed countries, thereby mapping a path likely to be followed by less developed ones, possibly more rapidly.

Girls followed boys closely in this educational transition. The Gender Parity Index (GPI) in global net primary enrollment rate rose from a value of little over 0.80 in 1970 to a value of about 0.98, very close to parity, by 2005. In lower secondary, having to base the GPI on gross enrollment rates, makes it less useful for monitoring the historical progress. However, the world lower secondary GPI of 0.96 in 2005 tells us that girls are not much behind boys in this area.

All the regions, especially those with the most room to expand, expanded their basic educational system greatly in this period. In the regions that were below 90 percent net primary enrollment rate in 1970, that rate has gone up by anywhere from 17 (in Latin America and the Caribbean) to 38 percentage points (in Arab States), in the thirty-five year period. With the exception of SSA, the further behind a region was in 1970, the more progress it made in the next thirty-five years. Even in SSA, the pace of progress in a typical country was quite high compared to the speed of a now developed country during the early stages of its educational expansion, especially when we contrast the economic situations in the two cases (Clemens 2004). A similar and even larger leap is observed in

the case of lower secondary. Gross lower secondary enrollment rates increased in all the regions, the range of that increase being from a low 7 percentage points for the richer countries of East Asia and the Pacific to a close to 60 percentage point jump for three of the UNESCO regions-Latin America and the Caribbean, and the two transitional regions of Central Asia and Central and Eastern Europe.<sup>70</sup>

Gender parity improvements are also distributed across the world regions. Girls' progress in the Arab States was much higher than that for boys, taking the net primary enrollment GPI in the region from 0.58 to 0.93. Similar improvements are visible in SWA and there is a somewhat less prominent improvement in East Asia and the Pacific. In SSA between 1995 and 2005, a period showing some regularity in the trend, GPI rose from 0.82 to 0.92. Other regions were either already at or close to parity in the 1970s and 1980s.

The widespread advancement in basic education did not make all world regions reach or even close-in on the much talked about transition to universal primary education by 2015, the second of the eight MDGs. The achievement of 100 percent gross lower secondary enrollment rate, the next step towards universal basic education, is elusive for several regions. While some regions are closing their gender gap fast, a few others have begun to see a reverse gender gap whereby boys are falling behind girls.

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<sup>70</sup> The 1970 group aggregation of Central and Eastern Europe includes three countries only, Turkey, Poland and Hungary.

At least two regions, namely SSA and SWA, are quite far from the transition to universal<sup>71</sup> primary education that the rest of the world has completed or gone a long way into. SSA, the worse of these two, was running 30 percent short of universal primary education in the year 2005. SWA, with a net primary enrollment rate 2 percent below the global average of 88 percent, was not much behind the rest of the world at that time. There are two other regions, the Arab States and Central and Eastern Europe, which will not need any further acceleration but will have to sustain their rate of progress, in the case of the Arab States, or prevent any deterioration, in the case of Central and Eastern Europe, in order to reach the MDG target of universal primary education on time.

Even within the same region, the patterns of educational participation in primary vary from one country to another. In SSA, for example, national net primary enrollment rates span a wide range of values starting at a mere 42 percent for the landlocked West African republic of Niger and going all the way to a very high 96 percent for the small island nation of Sao Tome and Principe. In fact, within each of the developing regions, member countries can be categorized into clearly distinct groups in terms of their position in the path of educational transition. Even in SSA, there are six other countries alongside Sao Tome that had reached an impressive 90 percent net primary enrollment rate by the turn of the century. However, in twenty-one out of forty-three SSA counties, three or more school-age children in every ten remained out of school in the year 2005.

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<sup>71</sup> While the literal meaning of the word universal includes all, in reality, not every single child, of relevant age, may be in school at any time. For practical purposes, we use the word universal to mean 100% or a very close to 100% value of the flow rates.

Low primary education countries are also characterized by asymmetry in the age-education structure. Within the primary level, due chiefly to the late entrants and repeaters, a country can have a gross enrollment rate, the calculation of which includes all students irrespective of age, substantially higher than its net enrollment rate, which considers only the age-appropriate students. The gross-net differential can be a result of catch-up after a period of slippage, for example in Afghanistan or Cambodia, or a sign of an inefficient educational system, as in countries like Gabon.

Low primary enrollment combined with low transition from primary to lower secondary worsen the situation of lower secondary for the two primary problem regions (SSA and SWA), as well as several other developing regions. The gross lower secondary enrollment rate in SSA in the year 2005 was 40 percent, a little more than half the global average of 78 percent, which itself was 22 percent short of universal coverage. SWA, with a 67 percent gross participation in lower secondary, was somewhere in the middle of the global and the SSA average. Two other regions, Central Asia and the East Asia and the Pacific, were at least 10 percentage points or more behind a 100 percent gross enrollment rate, our proxy for universal lower secondary enrollment, in the year 2005.

As alluded to in the previous paragraph, high achievement in primary is not always accompanied by high participation in lower secondary. In the early stages of expansion of lower secondary, all graduates of primary may not be able to get a place at the next level. The resulting gap between primary and secondary participation would become clearer by contrasting the country level data. Most of the developed economies (e.g., Singapore, the United Kingdom) have already achieved high participation rates at



both primary and lower secondary, narrowing the gap between the two rates to almost zero. For some of the middle and lower income countries (e.g., Brazil, Kenya) and the lowest of the high-income countries (e.g., Portugal) the emphasis on primary has been transmitted upward towards their lower secondary and, as such, lower secondary gross enrollment rates, in these countries, are growing as fast as their gross enrollment in primary, though the primary net enrollment rate remains low. For low-income low-net primary participation countries (e.g., Equatorial Guinea, Myanmar, Zambia, Rwanda) the gap from net primary enrollment rate to gross lower secondary enrollment rates can be as high as 40 percent. The gap narrows with the expansion of primary, settling down to a range of about 10 to 20 percent at about 80 percent of net primary enrollment ratio.

During the early stages of the educational expansion boys seem to enjoy more attention than girls. While the transition to universal basic education ensures the ultimate gender parity, girls seem to catch-up with boys, and in some cases reverse the gender parity, as the transition nears. Developed countries, already at universal basic education, have started to demonstrate such reverse gender parity at the higher levels of education. The region of Latin America and the Caribbean is still undergoing this phenomenon at the level of basic education. Even for a low income country like Bangladesh, where the participation in lower secondary is still as low as a gross enrollment rate of a little over 60 percent, girls have passed the boys, taking a lead of more than 5 percentage points. As Wils and Goujon (1998, 367) described, “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.”

In the following sub-sections we present the above general findings of impressive but varied historical progress in basic education in a more detailed fashion, discussing the regional and national situation of universal enrollment in problem countries as we go. Historical educational data are often limited or tap somewhat different dimensions than those of direct interest to us. Problems in data availability and quality increase the further back we look. Under these limitations, we were able to go as far back as 1970 data, making the basic educational transition or some part of it visible in as many of the global regions as possible. If we do not have 1970 data for a particular country, we use the data from the closest available year.

#### 4.1.1 Historical Patterns: Enrollment Rate

Enrollment rate is ultimately the result of entrance and progression through the educational system, the educational flows that are shaped by the supply and demand of education and educational resources in the society. In this section we shall elaborate the historical patterns of progress in enrollment rates and assess the regional and country position in achieving universal enrollment in primary and lower secondary. While the net enrollment rate is the more appropriate indicator of the coverage of primary education among the school-age children of a country, we also discuss gross primary enrollment rates, mostly to shed light on the wastage and inefficiency in the countries furthest from the goal of universal primary. In lower secondary, the gross enrollment rate is the only indicator of participation that we have data on. We use a 100 percent gross enrollment rate as a proxy of universal lower secondary, which is accurate in terms of capacity but not necessarily coverage.

#### 4.1.1.1 Enrollment in Primary

Historical net and gross enrollment rates at primary for the world and world regions (as defined by UNESCO) for the three and a half decade period from 1970-2005 are listed in the next two tables (Table 4.1 and Table 4.2). In all the world regions except those already at a high participation in 1970, both the gross and the net enrollment rates in primary have gone up dramatically within the three and a half decades that we will analyze. For example, for the world as a whole, as well as four of its nine regions, gross primary enrollment rates went up hugely, from 20 to almost 50 percentage points, during that period (Table 4.1). Since gross enrollment rates represent total enrollment irrespective of age, the 2005 value of close to 100 percent or higher gross primary enrollment ratios in all world regions give us the impression that the world is already at capacity for universal primary education assuming that the current personnel and resource share per student is not a hindrance to the goal.

Table 4.1. Historical Gross Primary Enrollment Rates in UNESCO Regions: 1970-2005

UNESCO Regions	Gross Primary Enrollment Rates			
	1970	1980	1990	2005
Arab States	64	84	85	98
Central & Eastern Europe	105	100	100	111
Central Asia	111	92	92	99
East Asia & Pacific (Poor)	90	111	121	110
Latin America & Caribbean	108	105	106	112
South and West Asia	71	77	90	111
Sub-Saharan Africa	48	81	76	97
North America and W. Europe	99	102	103	102
East Asia & Pacific (Rich)	101	103	101	101
World	85	97	103	106

Turning our attention to the net primary enrollment rates (Table 4.2) we can easily single out the two regions at risk-SSA and SWA. SSA, with a net enrollment rate of less than 70 percent in 2005, is seriously short of meeting the Millennium Development Goal of Universal Primary Education by 2015. These two problem regions are behind other developing regions in advancing their primary education.

Table 4.2. Historical Net Primary Enrollment Rates in UNESCO Region: 1970-2005

UNESCO Regions	Net Primary Enrollment Rate			
	1970	1980	1990	2005
Arab States	53	75	77	91
Central & Eastern Europe	95	97	91	91
Central Asia			85**	89
East Asia & Pacific (Poor)	70	91	97	93
Latin America & Caribbean	77	80	89	94
South and West Asia	59	29	64	86
Sub-Saharan Africa	52	51	47	69
North America and W. Europe	95	97	97	95
East Asia & Pacific (Rich)	99	100	100	99
World	72	85	87**	88

\*\* 1991

The next figure (Figure 4.1) compares the longitudinal trends<sup>72</sup> in the two underperforming regions-the SSA and the SWA-and the Arab States, the net enrollment rates in all three of which were in the 50s in 1970. The Arab States made most of their progress in the seventies and eighties, when other regions, because of the oil shock, made slower progress. For SSA, with its first independent country, Ghana, emerging only in 1957, the educational underachievement in the seventies and the eighties might be the

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<sup>72</sup> Estimations used to fill in missing data

result of several causes, such as the domestic political turmoil, the unchecked population growth, resource constraints resulting from global shocks in oil and commodity prices, and the environmental calamities like the drought in the eighties.

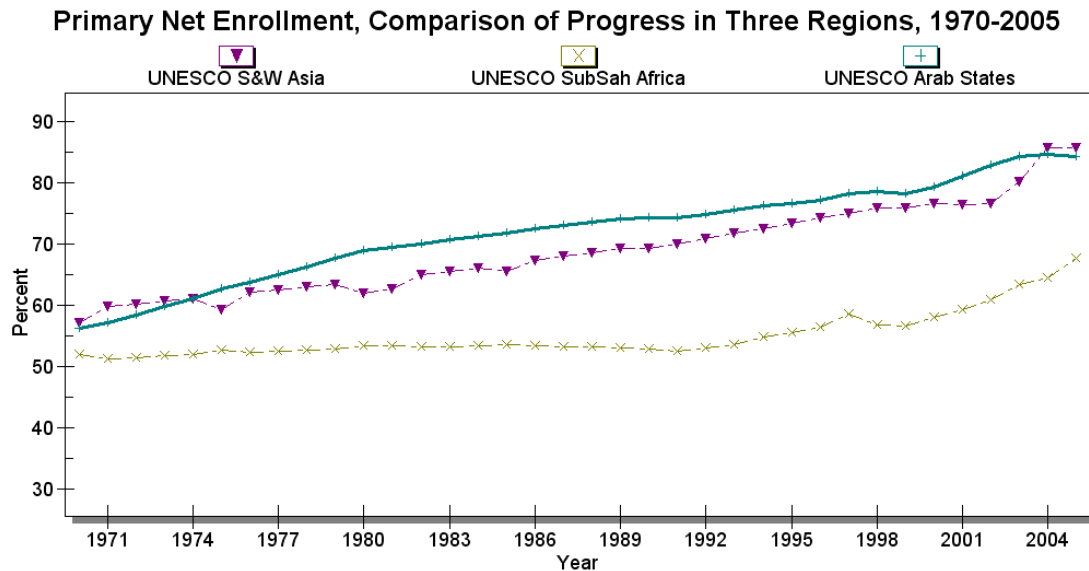


Figure 4.1. Primary Net Enrollment Rate in the SSA, SWA and the Arab States

#### 4.1.1.1.1 Enrollment in Primary: Country Level Patterns

Let us now zoom in to the level of countries. Since a country’s distance from universal primary education appears most clearly in the net primary enrollment ratio, we shall look at that indicator for countries around the world. In four of the nine UNESCO regions-the high-income North America and Western Europe, the relatively rich part of East Asia and the Pacific, the transition region of Central and Eastern Europe, and the mostly middle-income region of Latin America and the Caribbean-the majority of the countries are at or above 90 percent net enrollment rate in primary, an indication that they will not have any problem reaching universal primary if they have not already done so. In another transition region, Central Asia, six out of the ten members-Armenia, Azerbaijan,

Georgia, Kyrgyzstan, Turkmenistan, and Uzbekistan-have net primary enrollment ratios within the healthy band of 80 to 90 percent, while the remaining four, including Turkey, are already at or above 90 percent.

The picture is not so coherent consistent within any of the remaining UNESCO regions. The next table (Table 4.3) divides the member countries of the four UNESCO regions-the Arab States, SSA, SWA, and the poorer part of East Asia and the Pacific-into three groups of low (below 70 percent), middle (70 to90 percent), and high (above 90 percent) net primary enrollment rate, as of 2005.

Table 4.3: Countries in Four UNESCO Regions Divided into Low, Medium and High Net Primary Enrollment Rate Categories

Region	Net Primary Enrollment Rate, 2005		
	Low (below 70%)	Medium (70%-90%)	High (above 90%)
Arab States	Djibouti, Sudan	Iraq, Kuwait, Lebanon, Mauritania, Morocco, Oman, Palestine, Saudi Arabia, UAE, Yemen	Algeria, Bahrain, Egypt, Jordan, Libya, Qatar, Syria, Tunisia
South and West Asia	Afghanistan, Pakistan	Bangladesh, Bhutan, India, Nepal	Iran, Maldives, Sri Lanka
Sub-Saharan Africa	Angola, Burkina Faso, Burundi, Central Africa, Chad, Comoros, Congo Democratic Republic of, Congo Republic of, Côte d'Ivoire, Eritrea, Ethiopia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, Somalia	Benin, Botswana, Cameroon, Equatorial Guinea, Gabon, Gambia, Kenya, Lesotho, Mozambique, Namibia, Rwanda, South Africa, Swaziland, Togo, Uganda, Zimbabwe	Cape Verde, Madagascar, Malawi, Mauritius, Sao Tome and Principe, Tanzania, Zambia
East Asia and Pacific, Less developed*	Solomon Islands, Timor	Laos, Micronesia, Papua New Guinea	Brunei, Cambodia, China, Fiji, Indonesia, Malaysia, Myanmar, Philippines, Samoa, Thailand, Tonga, Vanuatu, Vietnam

\* Uses net primary enrollment rate data for the year 2005. No reliable data or estimate available for North Korea

For the four regions together, countries are almost evenly split among the three categories of performance as evident from the next figure (Figure 4.2). However, in SSA, there is still a huge prevalence of low enrollment countries. The Arab region, on the other hand, has most of its countries in the mid-range.

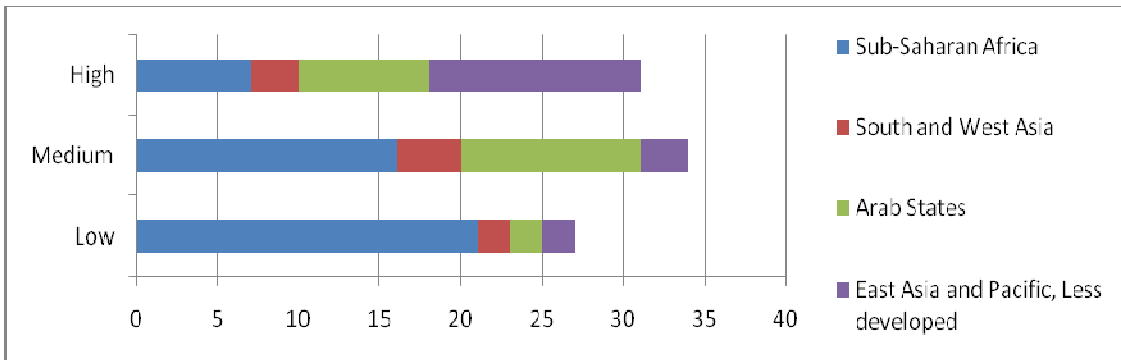


Figure 4.2: Distribution of High, Medium and Low Primary NER Countries in the Four UNESCO Regions

The next figure (Figure 4.3) shows how the net primary enrollment rate evolved in the high, medium, and low NER members of the four UNESCO regions. During the score of years in between 1985 and 2005, the high enrollment group did not make much progress. This demonstrates the difficulty in increasing participation once the countries are near universal participation. The middle enrollment group added approximately 1 percentage point and a third of net enrollment each year and reached near the high enrollment group with an impressive 26 percentage point advancement in twenty years. An equally impressive average progress among the third group (those with NER below 70 percent by 2005) closed their gap with universal primary. This group, however, is still much behind universal primary as they have started with a low value.



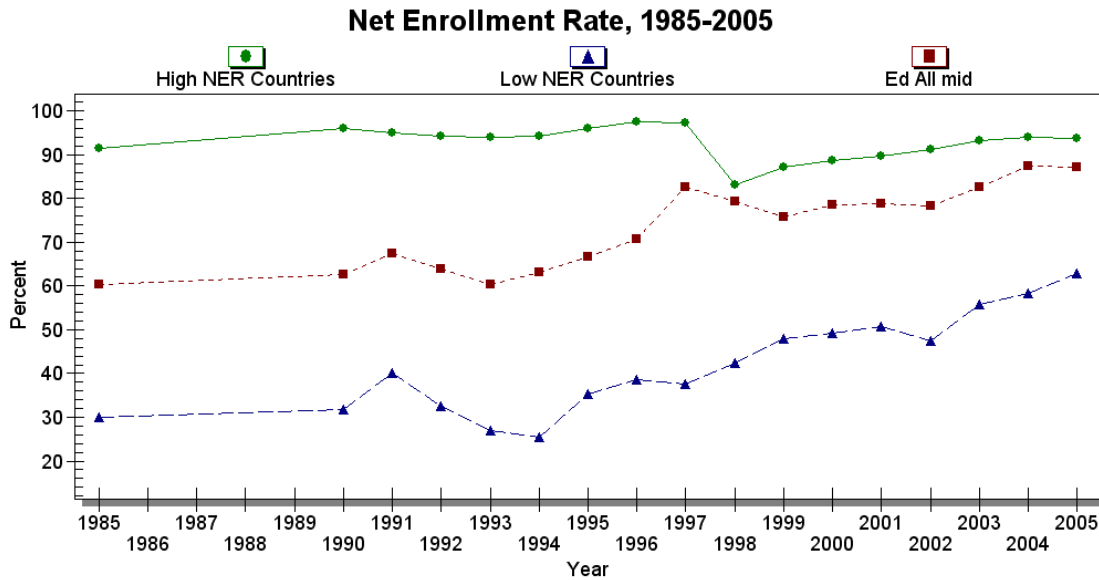


Figure 4.3: Primary NER trends in the High, Medium and Low countries of the Four UNESCO Regions

#### 4.1.1.1.2 Gross-Net Differential in Primary

A national comparison of the net and gross enrollment rates of primary education illustrates a large difference between the rates in various countries, due either to a catch-up after a systemic disruption or a sequential unfolding of educational expansion characterized by some initial wastage.

As of today, about two-thirds of the world's countries, all of which are low-income developing countries, have a large gap between their gross and net primary enrollment rates. These gaps range from 10 to 25 percentage points.<sup>73</sup> Among the countries that have a very high gross net differential, some are in a catch-up mode with over-age children availing school after a period of slippage due to regional conflicts, civil wars, or cultural retardation. Afghanistan's gross enrollment rate of a little over 100

<sup>73</sup> IFs analysis

percent and net enrollment rate of just fewer than 30 percent in the year 2005 is reminiscent of the disruption of their education system under the Taliban and the desire of the families to send their children back to school as soon as everyday life improved. Somalia is another country where a continued civil war for the last two decades, with short interludes of peace, has resulted in an overall low participation with an overwhelming majority of over-age students.

A second group of high gross-net differential countries are those in the early stages of their fast-paced educational transition. During the early stages of educational expansion, due to the emphasis put on education, schools start to receive over-age entrants who have not enrolled before. Moreover, quantitative expansions begin to crowd the schools for some time before the construction of more schools and hiring of more teachers starts to happen. This results in a deterioration of the quality of education in the early expansion period, resulting in an increased number of repeaters and dropouts, some of whom drop back in at an older age. The late entry, repetition, and reentry might combine to produce a large proportion of students who are over the expected age for the school. This manifests in a large difference between gross and net enrollment rate. Gabon, a prosperous West-African country with a stable democracy since the nineties, is an example of this with a gross enrollment rate of about 150 percent but a net enrollment rate under 80 percent.

Over time as the entrance gets regularized and the schooling quality improves, net and gross enrollment will converge towards a value of 100 percent.<sup>74</sup> The developed countries that are at or very close to universal net primary enrollment have already narrowed down their gross-net differential through the attainment of universal access and persistence.

#### 4.1.1.2 Enrollment in Lower Secondary

Participation rates at lower secondary, like primary, have gone up in the last thirty-five years. The next table (Table 4.4) disaggregates the global lower secondary progress into UNESCO regions. The two developed regions spent the last three and a half decades crossing the last 10 percent of a 100 percent lower secondary participation. Two of the developing regions, Central and Eastern Europe and Latin America and the Caribbean, made the most progress in lower secondary in this period, both covering over 60 percentage points and reaching toward the 90s by the end of the period. It can be said that these regions adopted the right policy of expanding lower secondary as their primary participation and completion were peaking. Because of the lack of data, not much can be said about the progress in Central Asia. However, by 2005, the region had reached a safe spot with a lower secondary gross enrollment rate in the mid-90s.

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<sup>74</sup> In some countries, most of them from the developed regions, there is a tendency of children to enter school early. Officially, these underage entrants should be in the gross intake and enrollment rate. However, as we explained above, considering the continuously flowing nature of the intake, we have calculated an adjusted net intake rate that adds up the entrants of one year above or below the entrance age. In terms of enrollment rate, where the denominator contains multiple single-year cohorts, the impacts felt from the entrants one year over or under age would ultimately be compensated across cohorts.

There are at least four regions which are between almost 20 to 60 percentage points short of a 100 percent gross enrollment rate in lower secondary in 2005. In addition to SSA and SWA, two other regions, the Arab States and the developing (poorer) East Asia and the Pacific are at risk of making a smooth and quick transition to universal lower secondary. One important thing to notice about SSA is the region's lack of progress in lower secondary, compared to that in primary, in the 1990s and the first decade of the twenty-first century, the period when primary education goals were being pursued heavily. This indicates that an excessive prioritization of one level of the education sectors might hurt the other levels.

Table 4.4. Historical Lower Secondary Enrollment Rates in the UNESCO Regions

UNESCO Regions	Lower Secondary, Gross Enrollment Rate			
	1970	1980	1990	2005
Arab States	28	52	77	81
Central & Eastern Europe	29	74	64	91
Central Asia				94
East Asia & Pacific (Poor)	22	67	68	79
Latin America & Caribbean	31	61	71	94
South and West Asia	28	41	50	67
Sub-Saharan Africa	8	20	33	40
North America and W. Europe	90	91	98	105
East Asia & Pacific (Rich)	93	100	96	100
World	37	63	70	78

#### 4.1.1.2.1 Lower Secondary Enrollment: Country Patterns

The next figure (Figure 4.4) shows the gross lower secondary enrollment rates for the three groups of high, middle, and lower net primary enrollment rate in 2005 that we

have identified above. The high primary enrollment group was busy expanding their lower secondary throughout this period. In fact, both of the high and middle groups (in primary) made substantial progress in the range of 25 to 30 percentage points in these thirty-five years. The progress of the low enrollment group in primary is less impressive in lower secondary. This group made less than a half of 1 percentage point progress in each year on average. Again, the figures follow the conclusion of the S-shaped pattern of growth with highest growth around the mid-point (the mid-point in the case of gross enrollment in lower secondary would be little above 50 percent).

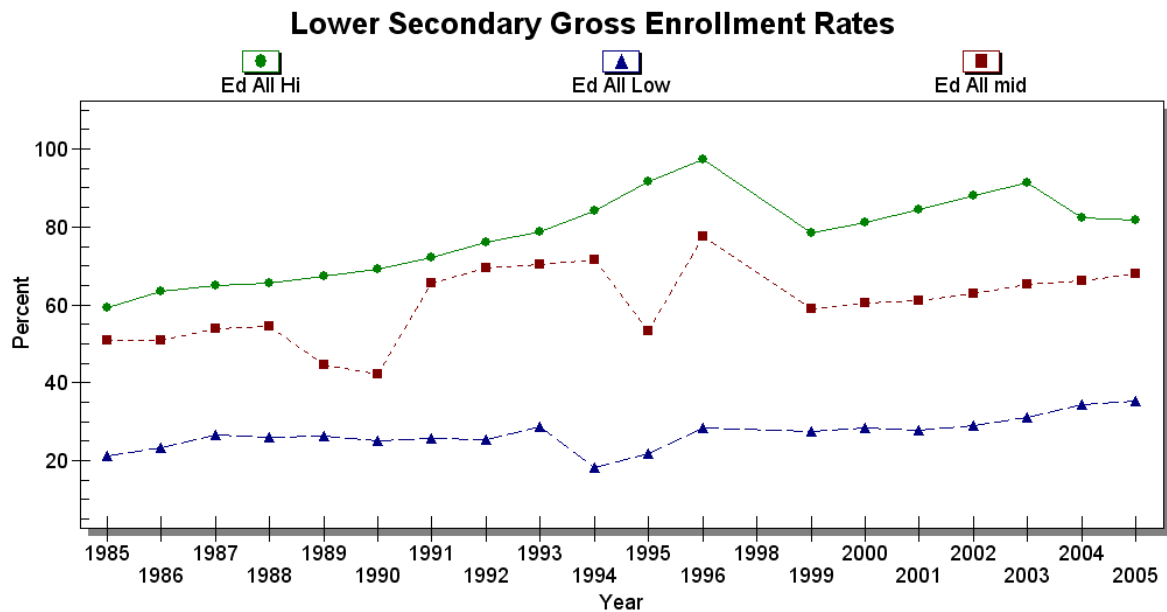


Figure 4.4. Lower Secondary Enrollment Trends in High, Medium and Low Primary NER Members of the Four UNESCO Regions

Some of the developing countries failed to open the doors of lower secondary in time for their primary graduates. However, this difference does not always translate to an under-estimation of the demand of lower secondary. The following table (table 4.4) contrasts primary completion rates against lower secondary enrollment rates for thirteen developing countries, ten from SSA and three from East Asia and the Pacific. For

countries like Benin, Cambodia, and Rwanda the low participation in lower secondary is a result of low completion in primary or inefficiency in primary. For the rest of the countries, there is a huge gap between primary completion rate and lower secondary participation rate expressing either the households' low esteem about the values of lower secondary education or the countries' inability or unwillingness to expand lower secondary side by side with primary.

Table 4.5. Gap between Primary Completion and Lower Secondary Participation

<u>Country</u>	<u>Primary Completion Rate</u>	<u>Lower Sec GER</u>
Benin	40	41
Cambodia	42	48
Cameroon	54	46
Lesotho	65	46
Madagascar	43	28
Malawi	68	39
Mauritania	12	21
Mozambique	30	19
Papua NG	52	31
Rwanda	16	18
Tanzania	56	8
Vanuatu	84	43
Zambia	66	47

*Data for 2005 or the most recent year between 1999 and 2005.*

#### 4.1.1.3 Gender Parity in Basic Education: Historic Progress

Girls' enrollment shares in primary and lower secondary went upward worldwide in the period between 1970 and 2005. In 1970 elementary-age girls worldwide were enrolled at a rate more than 15 percent less than that for the boys of the same age (Table

4.6). By 2005, there was a six-fold narrowing of that gap and the girls, with an 87 percent net primary enrollment rate, are trailing the boys by only 2.5 percentage points.

Table 4.6. Gender Gap in Primary Participation, World, 1970-2005

Global Net Primary Enrollment Rate		
Year	Boys	Girls
1970	79.0	65.0
1980	88.9	83.4
1990	94.6	91.3
2005	89.5	87.0

Historical lower secondary (gross) enrollment rates are calculated by using UIS data on the grade-specific enrollment count in general secondary and by simplified assumptions about historical trends in the vocational share of the enrollment as well as the duration of lower secondary. Because of those simplifications, the gender-wise rates are not as reliable as the total rates. We thus compare the lower secondary enrollment rate for boys and girls for the period between 1999 and 2005, for which UIS reports these rates themselves. As shown in the next figure (Figure 4.5), a narrowing of the global gender gap is happening in lower secondary as well. However, the 5 percentage point gender gap in global lower secondary enrollment, in 2005, is twice as much as the same in primary.

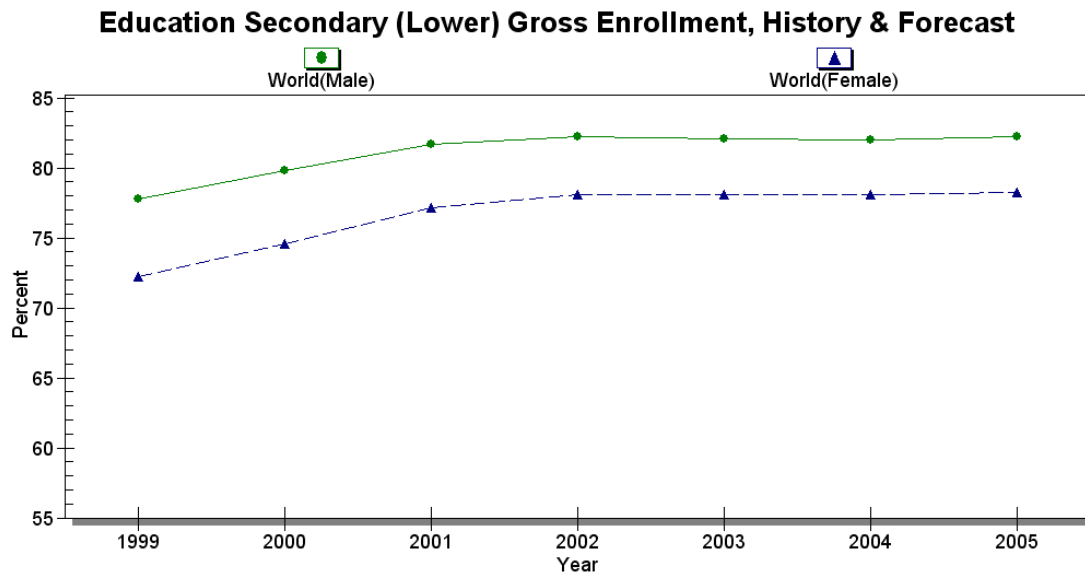


Figure 4.5. Historic Progress in Lower Secondary Enrollment Rates by Gender, World, 1999-2005

#### 4.1.1.3.1 Gender Parity Patterns Affected by Economic Growth

We have shown above that the low-income developing regions are generally behind the high-income developed regions in the educational participation as a whole. However, the girls in the developing regions are further behind than the boys. The following figure (Figure 4.6 ) shows the progress in net primary enrollment rate for girls and boys separately for the period of 1970-2005, for the developed OECD and the generally underdeveloped non-OECD economies. It is clear from this figure that the girls in the richer economies were on par with boys in this region to begin with. The underdeveloped economies, as a result of the emphasis from donors and the domestic governments, started to do better starting early seventies. However boys have benefitted more than girls in the early periods of the expansion. It was not until the mid-eighties that girls started to narrow the gap faster. However, two decades after the narrowing started,



the girls are still behind the boys in the non-OECD region by a 3 to 4 percent gap in primary educational participation.

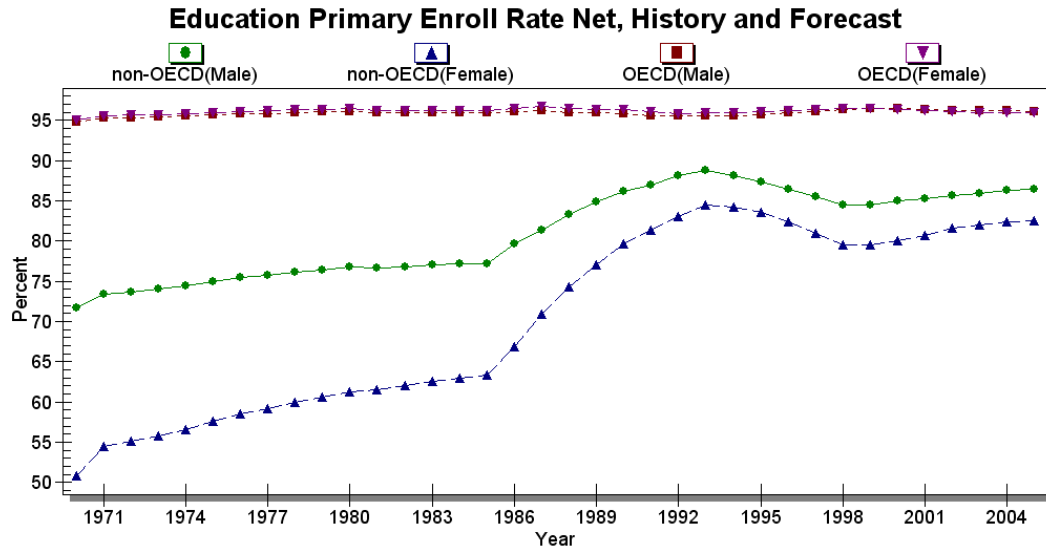


Figure 4.6. Historic Progress of Primary Education by Gender, OECD and Non-OECD Region

In lower secondary (Table 4.7), the high income OECD is, once more, almost at gender parity at present (2005). Girls in the non-OECD countries have narrowed their gap with boys by about 1 percentage point within this six-year period.

Table 4.7. Lower Secondary Enrollment Rate by Gender, OECD and Non-OECD, 1999-2005

Year	Lower Secondary Gross Enrollment Rate			
	non-OECD		OECD	
	Male	Female	Male	Female
1999	72.9	66.0	102.6	102.5
2000	72.1	63.9	102.8	103.0
2001	77.2	71.6	103.6	102.1
2002	78.9	73.9	103.2	101.6
2003	80.4	76.9	104.1	103.4
2004	74.0	69.4	102.5	102.5
2005	72.3	66.2	103.7	102.2

#### 4.1.1.3.2 Gender Parity: Regional Analysis: MDG Missed

We have further explored the issue of gender parity across UNESCO regions belonging to the group of underdeveloped economies. The next figure (Figure 4.7) shows the gender parity indices<sup>75</sup> for net primary enrollment rate in the seven less-developed UNESCO regions for the last decade of our historical analysis period. The three regions that had a gap at the beginning of that period—the Arab States, SSA, and SWA—each narrowed down the gap, with SSA making the biggest progress. Again, despite the progress, SSA is still the only region needing to make a more than 5 percentage point increase to reach gender parity. The Arab States, probably because of social barriers to girls’ schooling, did not move as fast as poorer SSA and SWA in closing their gender gap. It is clear from this analysis that part of the gender parity goal of MDG, namely to attain gender parity at primary and secondary by 2005, is already missed.

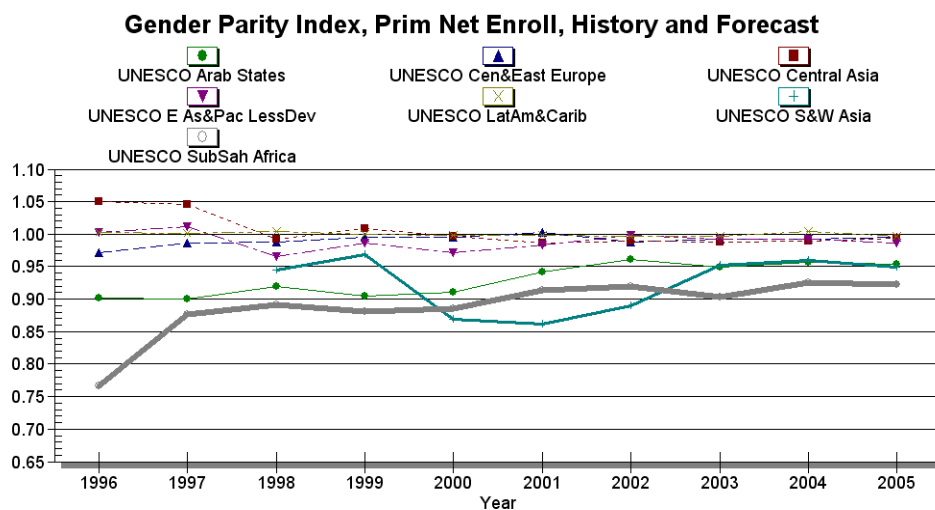


Figure 4.7. Gender Parity Indices in Seven UNESCO Regions: 1996-2005

<sup>75</sup> Define Gender Parity Index here if not defined before

#### 4.1.1.3.3 Gender Parity: Country Patterns

In the following table (Table 4.8), we compare the gender parity in primary and lower secondary participation rates (gross in both cases) for countries in the UNESCO Arab States against their economic situation. For low-income countries like Yemen or Djibouti, we see that the gender parity is worse at both levels, but more so at lower secondary. However, at per capita incomes above four-thousand international (Purchasing Power Parity) dollars, girls start to catch up with boys and at some points even surpass them.

Table 4.8. Gender Parity Index in Primary and Lower Secondary Gross Enrollment against Income Per Capita, Arab Countries, 2005

Country	GDP PC, 2000, Thousand\$	Primary, GPI	Lower Sec., GPI
Yemen	0.82	0.74	0.52
Sudan	1.51	0.87	0.89
Djibouti	1.86	0.82	0.67
Mauritania	1.89	1.06	0.91
Iraq	2.70	0.83	0.64
Syria	3.16	0.95	0.93
Egypt	3.53	0.94	0.92
Morocco	3.58	0.89	0.83
Jordan	4.11	1.00	1.01
Lebanon	4.34	0.97	1.09
Algeria	5.33	0.93	0.95
Tunisia	6.28	0.97	1.00
Libya	6.75	0.98	1.00
Oman	12.60	1.00	0.92
Saudi Arabia	13.15	0.97	0.95
Bahrain	15.54	0.99	1.01
Kuwait	19.60	0.98	0.97
UAE	21.48	0.99	0.98
Qatar	23.20	0.99	0.95
Palestine		0.99	1.04
Total UNESCO Arab States	4.60	0.92	0.91

Turning to the region of SWA, at least one country catches our attention immediately. Bangladesh, a country born with a value of merely 0.5 GPI in primary education in the early 1970s, has reversed the gender parity in both the primary and the lower secondary situation by 2005. This is an impressive achievement for a low-income, high natural calamity country situated in a region where educational performance is generally low. This achievement of Bangladesh can be contrasted against the richer but coreligionist Pakistan, which is the next to worst performer in this region after Afghanistan. While the ban on girls' education during the Taliban is commonly held as the cause of the sudden downturn in the Afghan GPI, Pakistan is a unique case where feudal landlords, a disinterested urban ruling elite, a continuation of authoritarian regimes, and a spontaneous and sometimes state-sponsored growth of religious fundamentalism in the society created an environment completely hostile, or at least indifferent, to girls' education. The pioneer in gender parity, and in educational expansion in general, in this region is the island nation of Sri Lanka, which as early as the eighties had close to parity enrollments in both primary and lower secondary.

In the next figure (Figure 4.8), we compare China and India, the two emerging giants in the global economy, in terms of their lower secondary enrollment rates for boys and girls in the year 2003, the most recent year for which we have data for both countries. As we can see, the authoritarian regime of China has done much better in enrolling the country's children into lower secondary. The democratic India was not only behind; it was also more unequal when expanding its lower secondary education. This data, as it appears, supports once more the stronger connection between education and economy as compared to other related variables.

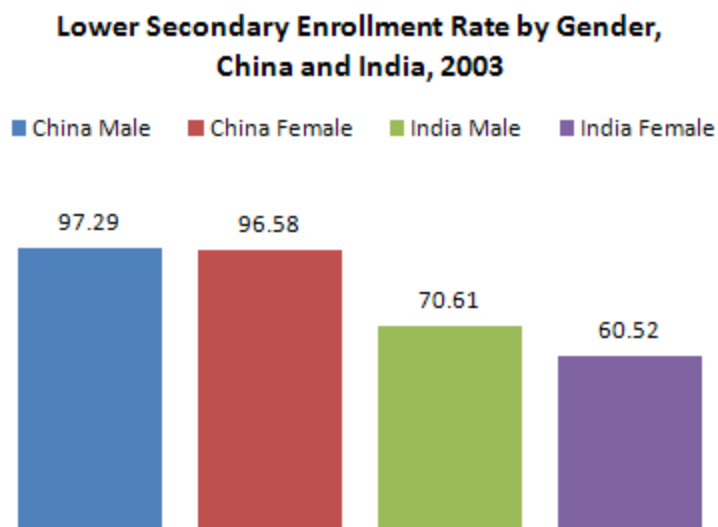


Figure 4.8. Gender Parity in Lower Secondary, China and India, 2003

The next figure (Figure 4.9) plots gender parity indices for basic education,<sup>76</sup> primary and lower secondary combined, for some SSA countries for 2005 or a close-by year with data. Looking at the performances of individual countries in SSA, we again find a strong positive correlation between income and gender parity. Other than income, the high performers are either West African coastal nations (e.g., Ghana, Gabon, or Gambia) or island countries (e.g., Mauritius or Cape Verde) or a landlocked country contiguous to the rich South Africa (e.g., Botswana, Lesotho, or Swaziland). In Lesotho, while girls and boys enroll equally in primary, girls outnumber boys in secondary. Lesotho is a unique African country with a history of higher participation of girls in secondary and higher education, despite its low income. In a 2002 paper Nicola Ansell draws attention to the Lesotho case by citing several authors who have studied this phenomenon. According to her summary (2002: 93), “Several factors account for girls’

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<sup>76</sup> Ratio of gross enrolment rates in basic education, lower secondary and primary combined, for girls and boys

predominance in school [in Lesotho], particularly boys' herding duties and the gendered labor market which facilitates employment of minimally educated men”.

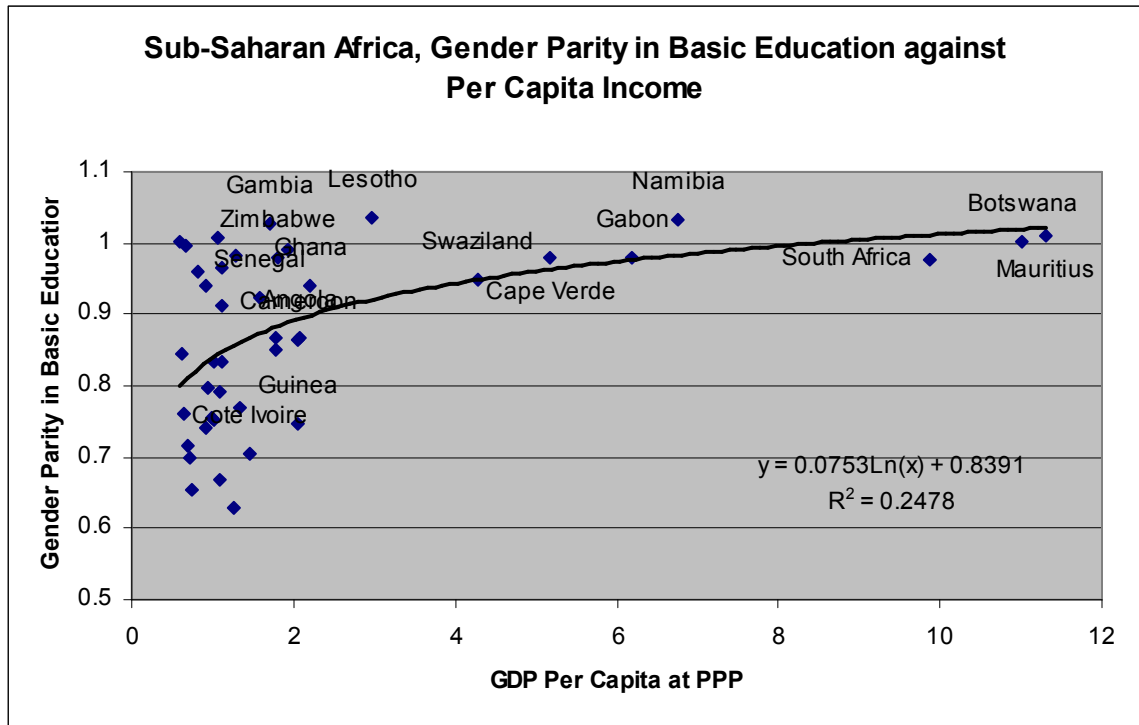


Figure 4.9. Gender Parity Enrollment, Basic Education, SSA Countries, 2005

#### 4.2 IFs Base Case Forecast

This section contains the future potentials in basic education as demonstrated by the base case of the IFs education model. The base case is not a simple extrapolation of the educational flows. It is rather a dynamic and simultaneous progression of educational supply and demand, influenced by and affecting the demographic and economic systems into which this sector is embedded. Here, using the base case forecasts, we shall explore the possibility of achieving the MDGs and the potential and timeline of achieving universal basic education in the years to come.

#### 4.2.1 Base Case Forecasts: Participation

The next figure (Figure 4.10) shows the IFs base case forecasts on global educational expansion. The base case reveals a cautionary tale on the face for elementary participation. It looks like it would take beyond the middle of the century for the primary education to be truly universalized. However, there are enough reasons to be optimistic about the above 90 percent primary NER that the world would attain by 2015, the MDG timeframe. In fact, by 2030, global primary net enrollment rate will be at 95 percent, the 2005 participation rate in the richest UNESCO region of North America and Western Europe.

At the level of lower secondary,<sup>77</sup> it appears that there is much that needs to be done. It would take three decades of the century to reach a 90 percent gross enrollment rate worldwide if things are allowed to continue in the same way. Even as late as 2050, the global lower secondary participation will be at 95 percent, 5 to 6 percentage points below the slightly over 100 percent enrollment rate at this level in the richest UNESCO region.

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<sup>77</sup> The lower secondary graph represents gross enrollment. The effects of downward convergence of some of the countries from an above 100 percent peak rate might make the global trend difficult to follow at certain points.

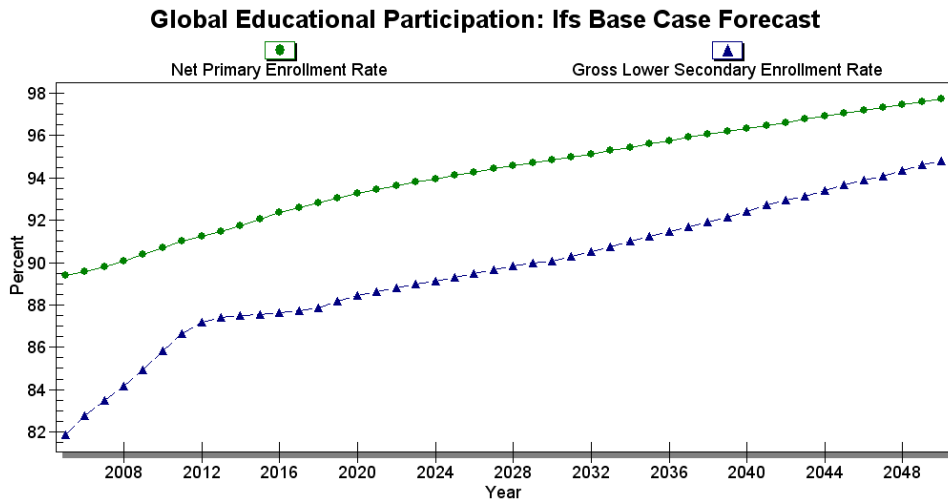


Figure 4.10. Global Primary and Lower Secondary Participation: IFs Base Case Forecast  
 4.2.1.1 Base Case Forecasts: Participation in Primary

In the base case forecasts of our education model, regional expansion of primary education continues, albeit at different speeds, as shown in the next figure (Figure 4.11).

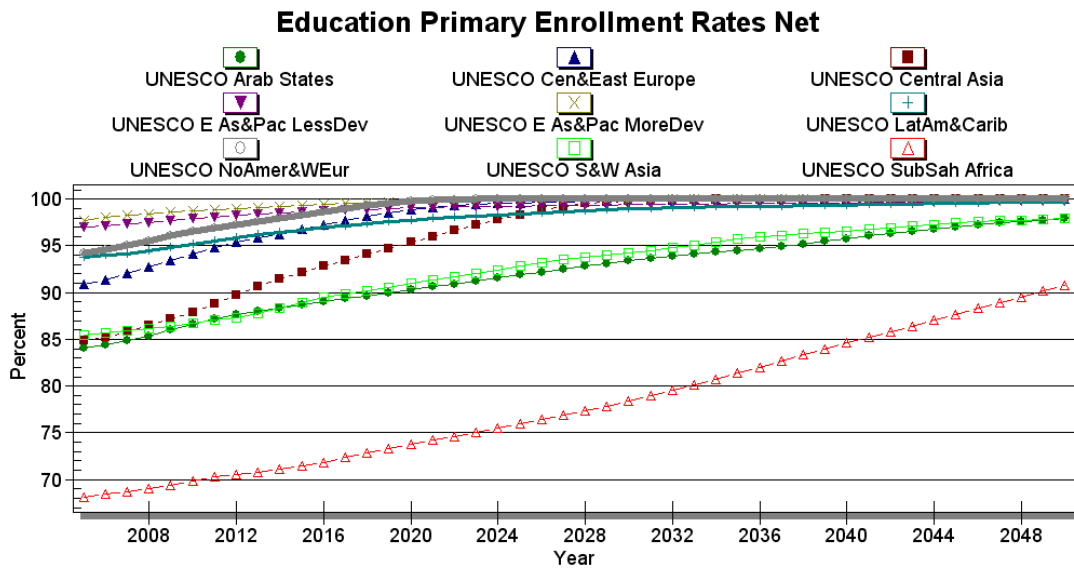


Figure 4.11. Primary Net Enrollment Rate Forecasts: Base Case: UNESCO Regions



At least two UNESCO regions<sup>78</sup>, North America and Western Europe and East Asia and the Pacific, were already within 5 percent of the maximum net enrollment at the dawn of the millennium. Two other regions, Central and Eastern Europe and Latin America and the Caribbean will follow suit by 2015. However, at least four UNESCO regions, the Arab States, Central Asia, SWA, and SSA, will not be anywhere near universal primary enrollment by 2015 according to our base case forecasts listed in the next table (Table 4.9). At 2030, three of these four regions will still be short of 95 percent enrollment. Enrollment rates in SWA and SSA, despite the rapid convergence evident in the slope of the curves (Figure 4.11), fail to catch up with those of the other regions because the initial shortfalls in enrollment rates are so large. The IFs base case suggests that SWA will be, essentially, at universal enrollment by mid-century. SSA will increase its enrollment rate by more than 20 percentage points and will be at little over 90 percent net primary enrollment rate by mid-century as per the base case.

Table 4.9. Primary Net Enrollment Rate Forecasts: Base Case: UNESCO Regions

Primary Net Enrollment Rates, Base Case Forecasts				
UNESCO Regions	2005	2015	2030	2050
Arab States	84	89	93	98
Central and Eastern Europe	91	97	100	100
Central Asia	85	92	100	100
E Asia & Pacific (Poor)	97	99	99	100
Latin America and the Caribbean	94	97	99	100
South and West Asia	85	89	94	98
Sub-Saharan Africa	68	71	78	91
E Asia & Pacific (Rich)	98	99	100	100
North America and Western Europe	94	98	100	100
World	89	92	95	98

<sup>78</sup> Three according to our categorization of dividing East Asia and the Pacific into two regions.

#### 4.2.1.1.1 Country Level: Extension of Historical Patterns

The next figure (Figure 4.12) disaggregates the SSA forecasts at a country level<sup>79</sup> and compares the forecasts with historical progress. Focusing on countries of this region with relatively more extensive historic data, the plot shows net primary enrollment rate and primary completion rate forecasts from the base case of IFs as an extension of history. Two insights are worth mentioning.

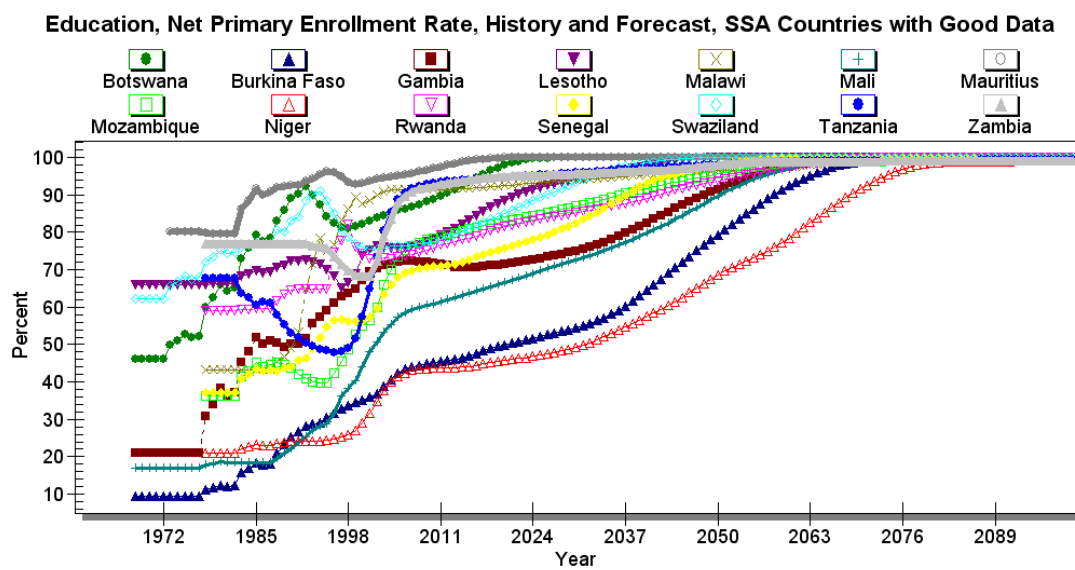


Figure 4.12. Primary Net Enrollment Rate Forecasts: Base Case: SSA Countries with Good Historical Data

First, as a general result, the forecasts of IFs, at least for these countries in SSA, appear somewhat optimistic relative to the historical performance of these countries. Several of these countries, it appears from data, have experienced reversals in elementary enrollment historically, possibly for reasons of civil conflict, economic crises, the ravages

<sup>79</sup> Some of the analysis in this subsection appeared in a paper jointly authored by this author and others for the 2007 Human Development and Capability Association conference in New York (Dickson, Hughes and Irfan, 2007)

of disease, or other reasons.<sup>80</sup> In general, the figure (Figure 4.12) suggests that there was something close to stagnation in enrollment rates across the entire historic period in a handful of countries (see Lesotho, Niger, Mozambique, and Zambia), while others (note Malawi and Gambia) have demonstrated substantial but irregular advance. Only a few (namely Burkina Faso and Mali) have exhibited a pattern of fairly regular, steady growth.

Second, very roughly speaking, a general S-curve characterizes patterns of transitions from low to high enrollments (that is more apparent in the longer-term, so the figure extends the horizon to 2100, the final year of the IFs model). This will be important when we compare the forecasts of IFs with others, because the S-curve can help in the forecasting process itself. However, the sigmoid is evident only over a very long period.

#### 4.2.1.1.2 Millennium Development Goal of Universal Primary

These forecasts (Figure 4.11, Figure 4.12 and Table 4.9) all suggest that the Millennium Development Goal of universal primary education is essentially unattainable, at least for some countries and regions. Again, the IFs forecasts are, if anything, optimistic extensions of history. There are two primary reasons for optimism. One is that the goals themselves have mobilized very great efforts to achieve them, if not by 2015 then in the more mid-term future. Second, there appears to have been, even before the MDGs, an acceleration of enrollment rate increases at all levels of country income. The discussion will return to this.

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<sup>80</sup> It is also important to note, however, that data series historically are not strictly comparable (Clemens, 2004: 64) and that what sometimes appear to be reversals can simply be artifacts of changes in data series.

The next table (Table 4.10), however, shows the base case forecasts on net enrollment that might be expected by 2015 in the first nine alphabetically of the relatively data-rich SSA countries that Figure 4.12 identified. Burkina Faso and Niger may be at or below, respectively, 50 percent net primary enrollment. Only Mauritius, a small island country with a much higher than regional average income, will likely be within the reach of universal primary enrollment by the year 2015. And, as indicated earlier, SWA is also likely to fall short of the goal, although by a much more manageable distance.

Table 4.10: Primary Net Enrollment Rate: Base Case Forecasts: Selected SSA Countries

Primary Net Enrollment Rates, Total, Percent									
Year	Burkina Faso	Gambia	Lesotho	Malawi	Mali	Mauritius	Mozambique	Niger	Senegal
2000	35.77	66.04	81.07	89.15	46.5	92.89	50.05	25.26	54.36
2001	36.22	66.29	81.5	89.28	47.03	94.01	50.81	25.8	54.79
2002	36.87	66.6	81.99	89.26	47.6	95.25	51.74	26.37	55.15
2003	37.67	66.97	82.61	89.28	48.1	96.81	52.75	27.01	55.82
2004	38.58	67.44	83.25	89.37	48.68	98.17	53.88	27.61	56.56
2005	39.56	67.91	83.88	89.57	49.38	99.09	55.11	28.19	57.31
2006	40.64	68.45	84.54	89.8	50.23	99.57	56.25	28.85	58.1
2007	41.59	68.94	85.57	89.99	50.94	99.79	57.33	29.48	58.9
2008	42.49	69.41	86.41	90.29	51.57	99.83	58.56	29.7	59.31
2009	43.5	69.98	87.09	90.62	52.43	99.83	59.92	30.2	59.99
2010	44.54	70.55	87.59	90.96	53.42	99.83	61.38	30.87	60.9
2011	45.63	71.17	87.94	91.29	54.5	99.83	62.93	31.67	61.88
2012	46.75	71.8	88.17	91.59	55.65	99.83	64.26	32.61	62.94
2013	47.9	72.46	88.3	91.84	56.86	99.83	65.58	33.74	64.08
2014	48.96	73.02	88.71	92.05	57.84	99.83	66.91	34.5	64.84
2015	50.02	73.55	89.13	92.23	58.77	99.83	68.25	35.26	65.58

#### 4.2.1.2 Base Case Forecasts: Universal Lower Secondary and Universal Basic Education

Universal enrollment in lower secondary would mean the attainment of universal basic education. As said earlier, in the absence of net rates we have decided to consider the gross enrollment rate as the proxy measure for universal lower secondary. The next table (Table 4.11) shows our base case forecast on the gross lower secondary enrollment rates for the UNESCO regions. According to this forecast, at least one UNESCO region,

SSA, will be below 50 percent enrollment in lower secondary at 2015, while another one, SWA, will be a little below three-quarters universal enrollment at that time. However, by the middle of the century, all but one UNESCO region will be at or above 95 percent gross lower secondary enrollment rate. Had it not been for SSA, it would be possible for the world to attain universal lower secondary by as early as 2030, maybe with a little push.

Setting aside SSA, which we shall discuss later, the most impressive advancements will be in the SWA and the Arab states which will improve their participation by 20 and 30 percentage points respectively by 2050. Two of the regions, Central Asia and Central and Eastern Europe, start with gross enrollment rates of about 10 percent below one-hundred at the beginning of the century, and reach to about 10 percent above one-hundred by the second decade before returning back to the proximity of one-hundred as the entrance gets regularized with respect to age and the dropouts and repetition decrease. The only region that would be well short of one-hundred percent even by mid-century is SSA. This region grows rather slowly (less than a percentage point each year) up until the third decade into the century, at which point it picks up some speed enabling it to narrow the gap with other regions and be very close to 80 percent enrollment by mid-century.

Table 4.11: Lower Secondary Gross Enrollment Rates: Base Case Forecasts: UNESCO Regions

Lower Secondary Gross Enrollment Rate, Base Case Forecast						
UNESCO Regions	<u>2005</u>	<u>2015</u>	<u>2020</u>	<u>2025</u>	<u>2030</u>	<u>2050</u>
UNESCO Arab States	80	89	91	94	97	102
UNESCO Central and Eastern Europe	91	110	112	109	105	100
UNESCO Central Asia	93	105	108	106	103	100
UNESCO E Asia & Pacific (Poor)	92	98	97	96	96	99
UNESCO Latin America and The Caribbean	101	102	100	100	100	101
UNESCO South and West Asia	66	74	79	84	88	95
UNESCO Sub-Saharan Africa	41	49	52	55	57	77
UNESCO E Asia & Pacific (Rich)	101	102	102	102	101	101
UNESCO North America and Western Europe	103	103	104	104	102	101
World	82	88	88	89	90	95

#### 4.2.1.2.1 Lower Secondary Forecasts: Country Patterns

The next graph (Figure 4.13) shows the gross lower secondary enrollment rate forecasts for the three groups of high, middle, and lower net primary enrollment rate countries in 2005 that we have identified in Table 4.3 above. The middle group catches up with the high group by mid-century, both groups reaching at the vicinity of 100 percent by 2050. The low group make a huge move up from about 35 percent in 2005 to 80 percent in 2050, a movement of about 1 percentage point each year. However, without any special efforts made, the world will still be short of universal lower secondary, in the sense that we defined it, by the middle of the current century.

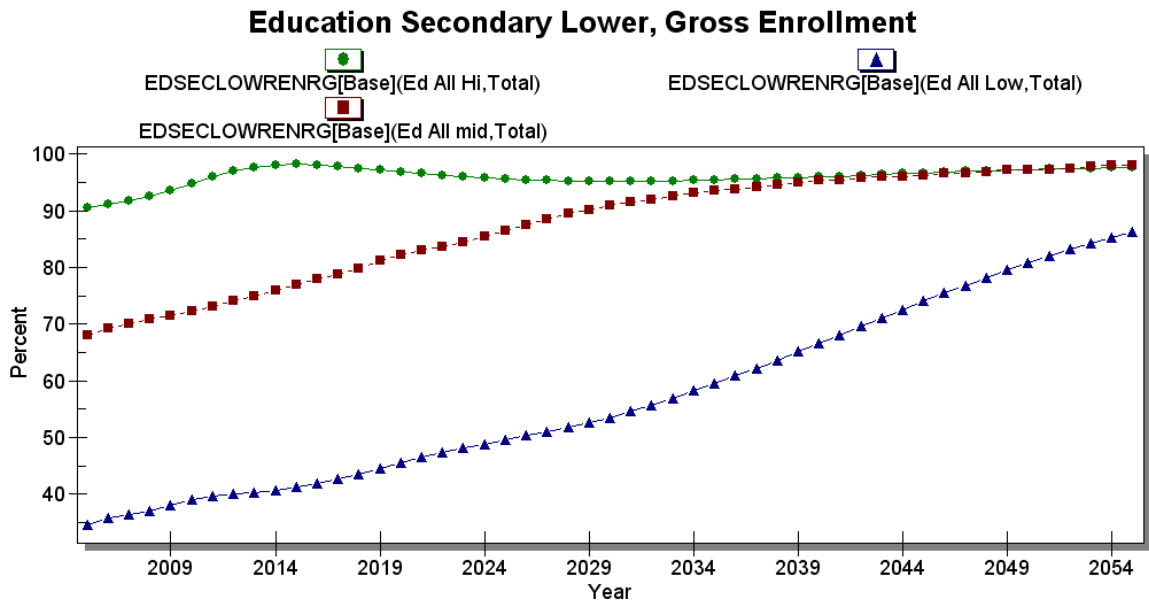


Figure 4.13. Lower Secondary Enrollment Forecast: Base Case: High, Medium and Low Countries

In the following figure (Figure 4.14), we show the lower secondary enrollment forecast for twenty SSA countries, all of which were at or below 40 percent in 2005. Two of these twenty countries, Angola and Djibouti, will have reached or exceeded 100 percent by mid-century while others stay at or below 80 percent at that time. However, a closer examination of those two countries will reveal that their high lower secondary gross enrollment is a result of their over 100 percent gross enrollment in primary, 133 percent for Angola and 125 percent for Djibouti in 2050. In other words, their primary system would still be recovering by the time they erect a dependable lower secondary system. A second thing evident in the figure below is a steeper ascent as the countries reach 50 percent enrollment, hinting a sigmoid pattern of growth.

## Lower Secondary Gross Enrollment Rate, History & Forecast

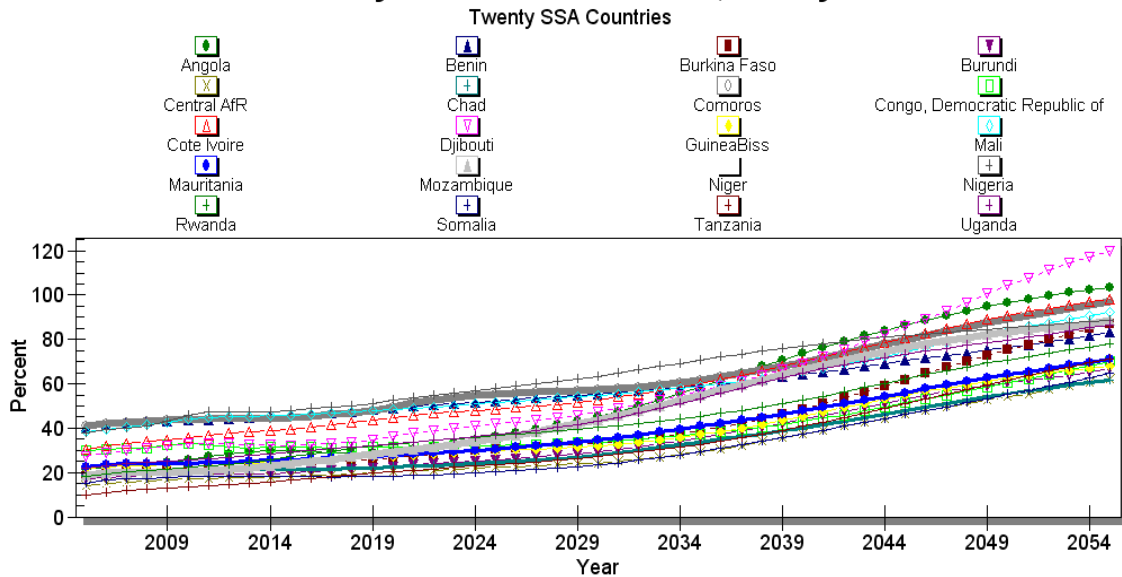


Figure 4.14. Lower Secondary Enrollment Forecast: Base Case: Twenty SSA Countries

### 4.2.1.3 Base Case Forecasts: Gender Parity

In our analysis of the historical progress in gender parity we have found that in rich OECD countries girls and boys, both of whom have reached close to 100 percent enrollment, are going forward at an equal pace. On the other hand, in comparatively poorer non-OECD countries, the girls were 5 percent behind the boys by 2005. The following figure (Figure 4.15) illustrates the net primary enrollment rate forecasts for boys and girls, side by side, for the OECD and the non-OECD group of countries. In the OECD countries, understandably, the already achieved gender parity in primary education is maintained as both the sexes improve their participation equally. Girls in the non-OECD group will gradually reduce the gap between the boys bringing in parity in global primary education by mid-century.



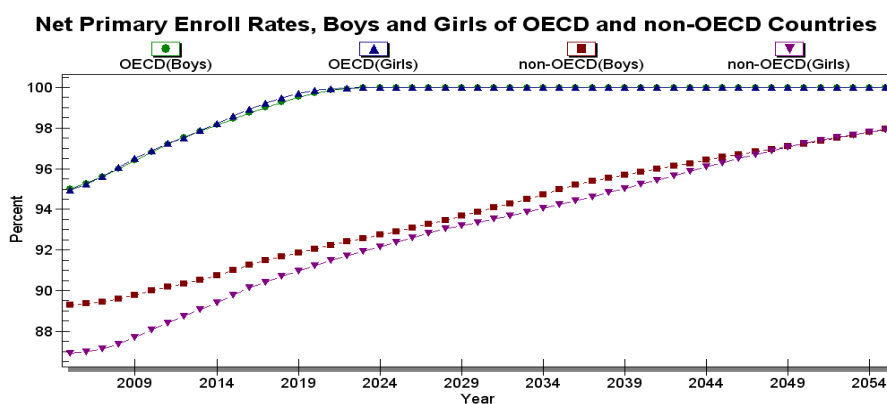


Figure 4.15. Primary Net Enrollment Forecast by Gender: Base Case: OECD and non-OECD

Within the non-OECD group, not all the regions will reach gender parity at the same time. The following table (Table 4.12) lists the base case forecasts for the gender parity indices in primary net enrollment rate for all UNESCO regions. According to the table, all UNESCO regions except SSA and the Arab States will reach gender parity (or a very close value) by 2015. While the Arab States will be close to parity by 2030, the SSA index won't reach parity until the mid-century. Latin America and the Caribbean, on the other hand, might experience a reverse bias by 2015, but will re-approach parity later.

Table 4.12. Gender Parity Index, Primary: Base Case Forecasts: UNESCO Regions

Gender Parity Index in Net Primary Enrollment: Base Case Forecasts				
UNESCO Regions	2005	2015	2030	2050
Arab States	0.93	0.97	0.99	1.00
Central and Eastern Europe	1.00	1.00	1.00	1.00
Central Asia	0.99	1.00	1.00	1.00
E Asia & Pacific (Poor)	1.00	1.00	1.00	1.00
Latin America and The Caribbean	1.00	1.02	1.00	1.00
South and West Asia	0.95	0.99	1.00	1.01
Sub-Saharan Africa	0.92	0.94	0.96	1.00
E Asia & Pacific (Rich)	0.99	1.00	1.00	1.00
North America and Western Europe	1.01	1.01	1.00	1.00
World	0.98	0.99	1.00	1.00

The next figure (Figure 4.16) plots forecasts on gender parity index for net primary enrollment rate for several countries which had low parity to begin with. Two of the African countries portrayed in that figure, Djibouti and Sudan, are put into the group of Arab states by UNESCO. The relatively lower value of gender parity indices in these two countries are the reason why the UNESCO Arab States do not reach parity as late as 2030. Afghanistan starts with a very low GPI of about 0.35 and makes the most impressive progress improving the index more than 2.4 times to a value of about 0.84 by 2050. The reason UNESCO SWA's average is slightly above one despite Afghanistan is that some of the high population countries in the region are a little above one and we did a population weighted average to get the group values. In the UNESCO SSA region, the Central African Republic, Guinea-Bissau, Mali, and Niger will be well below parity, the regional average, even at 2050.

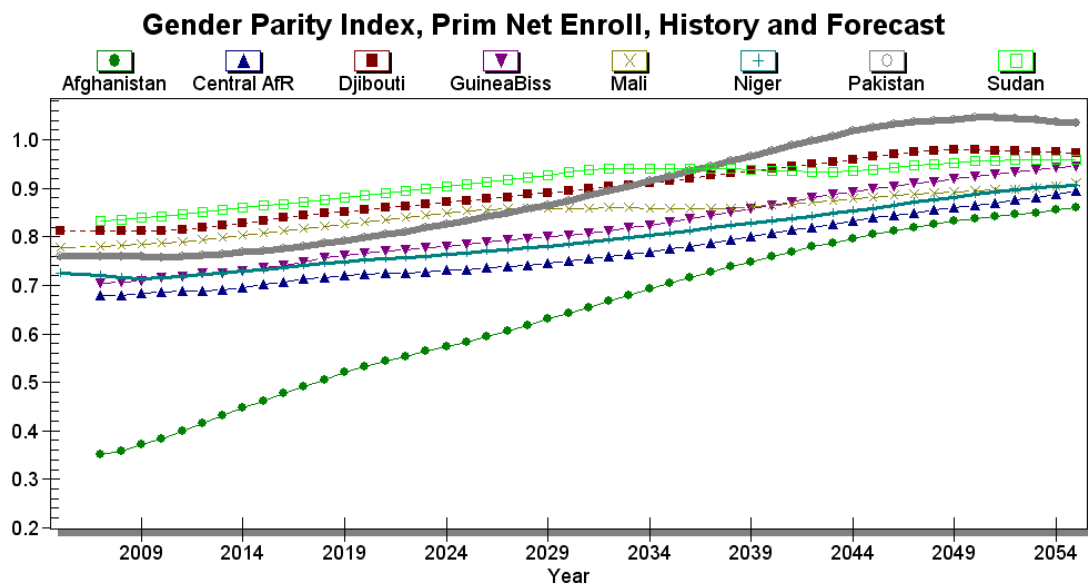


Figure 4.16. Gender Parity Index: Base Case Forecast: Selected Countries

For lower secondary we had no other choice but to use gross enrollment rates for girls and boys to build the gender parity index for participation. As countries are undergoing a transition from low to high enrollment, the use of gross rates might, at times, result in an index not very helpful in understanding the progress in gender parity. For example, the table below (Table 4.13), listing the forecasts on gender parity index for gross enrollment in lower secondary, shows that, by about 2020, more girls will be enrolled than boys in lower secondary even in SSA. However, girls will be in the catch-up mode in SSA in the 2030s and the 2040s, before they start to come back towards parity, as has already occurred in Latin America.

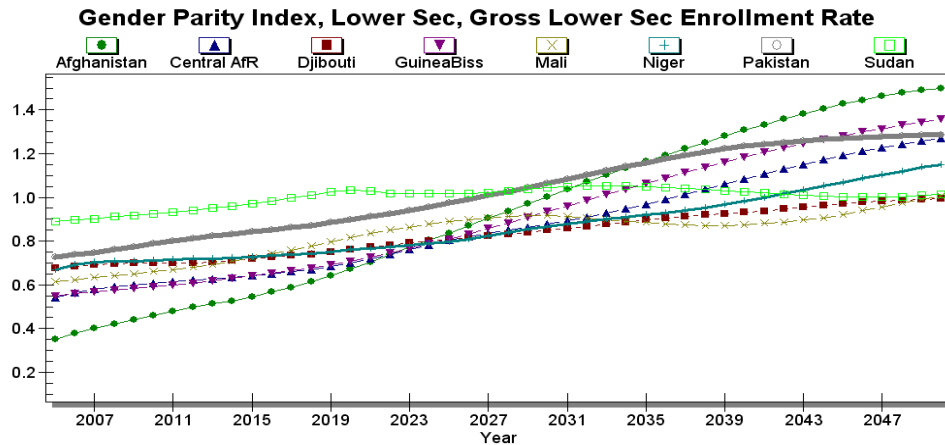
Table 4.13. Gender Parity Index, Lower Secondary: Base Case Forecasts

Gender Parity Index: Lower Secondary Enrollment Rate: Base Case Forecasts						
UNESCO Regions	2005	2015	2020	2025	2030	2050
Arab States	0.89	0.96	0.99	0.99	0.99	1.00
Central and Eastern Europe	0.96	0.99	1.01	1.01	1.01	1.00
Central Asia	0.99	1.01	1.01	1.01	1.00	1.00
E Asia & Pacific (Poor)	1.00	1.02	1.01	1.01	1.02	1.01
Latin America and The Caribbean	1.04	1.04	1.05	1.04	1.02	1.01
South and West Asia	0.89	0.96	0.99	1.00	1.02	1.03
Sub-Saharan Africa	0.83	0.90	0.97	1.01	1.05	1.11
E Asia & Pacific (Rich)	1.00	1.00	1.01	1.00	1.00	1.00
North America and Western Europe	0.99	1.00	1.00	0.99	1.00	1.00
World	0.96	0.99	1.00	1.01	1.02	1.03

The next figure (Figure 4.17) shows the lower secondary gender parity indices of the eight countries that were identified as problem countries in the analysis at the level of primary education. We find the primary level underperformers like Afghanistan, Guinea-Bissau, or Central African Republic have their lower secondary gender parity indices go

above one by mid-century. This as explained above is a result of later catch-up of girls in these countries.

Figure 4.17. Gender Parity Index, Lower Secondary: Base Case Forecast: Selected Countries



### 4.3 Model Validation: Comparison with Other Forecasts

Models in natural sciences are validated by matching the results predicted by the model with those obtained from the laboratory experiments. In social science, especially for long-term forecasting models, it is neither possible nor desirable to perform some numeric validation. Firstly, it is not always possible to perform a controlled experiment incorporating all the aspects of such a model. Secondly, social models are more useful for gaining insights about the future and how things evolve over time, rather than for furnishing precise predictions. After algorithmic and structural verification, such models are validated among other methods by starting the model at an earlier point in time and comparing model results with real data, the so-called historical validation, or by comparing the results with other forecasts. Despite the differences in model assumptions and model structure, the forecasts on the broader system variables over a long period

should be similar and comparable, unless either or both of the models are missing something important.

#### 4.3.1 Comparison of Education Model with Others<sup>81</sup>

Let us now compare the forecasts from the base case of our education with those from other models. Among the education models that we discussed, the ones from Michael Clemens (2004) and from Annababette Wils' team (2005) identify patterns of enrollment growth and use the pace of historic growth as an extrapolative basis for their forecasts. Both projects fit S-shaped logistic growth curves to historic data. John Meyer, with other researchers, has previously (Meyer, Ramirez, Soysal 1992; Meyer et al. 1977) identified such sigmoid patterns of diffusion of mass education throughout the world for the very long period of 1870-1980.

Results from Clemens (2004) and Wils et al. (2005) are not directly comparable, either with each other or with the IFs education model, because of differences in the dependent variable and/or the data series that they use. For example, Clemens (2004) uses administrative data on net enrollment rate obtained from UNESCO for the post-World War II period. IFs does as well, but Clemens' use of the pre-2003 revision data make his results not strictly comparable to those from IFs, which is based on post-2003 revision data.

For approximately the same historic period, Wils et al. (2005) tap DHS and MICS<sup>82</sup> survey data on current educational attainment to reconstruct past educational

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<sup>81</sup> Some of the analysis in this section is based heavily on a paper on this topic that the author wrote with two collaborators (Dickson, Hughes and Irfan, 2007).

flow rates, such as entry or completion. These rates, as defined by Wils et al. (2005), represent the proportion of any single-year age cohort that entered (or completed) primary school, either at an appropriate age or later.<sup>83</sup> While this definition sounds close to the gross enrollment rates defined by UNESCO, these flow rates cannot exceed 100 percent by definition and, thus, are not exactly the gross intake or completion rates. The flow rates used by Wils et al. are thus quite different from the similarly titled rates used and forecast by Clemens and IFs.

These dissimilarities in operationalizing basic educational concepts, however, do not preclude us from comparing the *pace* of growth in the education sector flows forecast across these different models. For instance, Clemens (2004, 15) reports that “...the typical transition occurs at a measured pace. . . in the postwar 20th century the typical country – rich or poor – would have risen [from 50%] to 70% after 22.3 years, 80% after 36.4 years, and 90% after 57.7 years.” He also reported (2004, 16) that “the typical country after 1960 took about 28 years to get from 75% of the worldwide maximum level of that enrollment statistic to 90% of the maximum.”

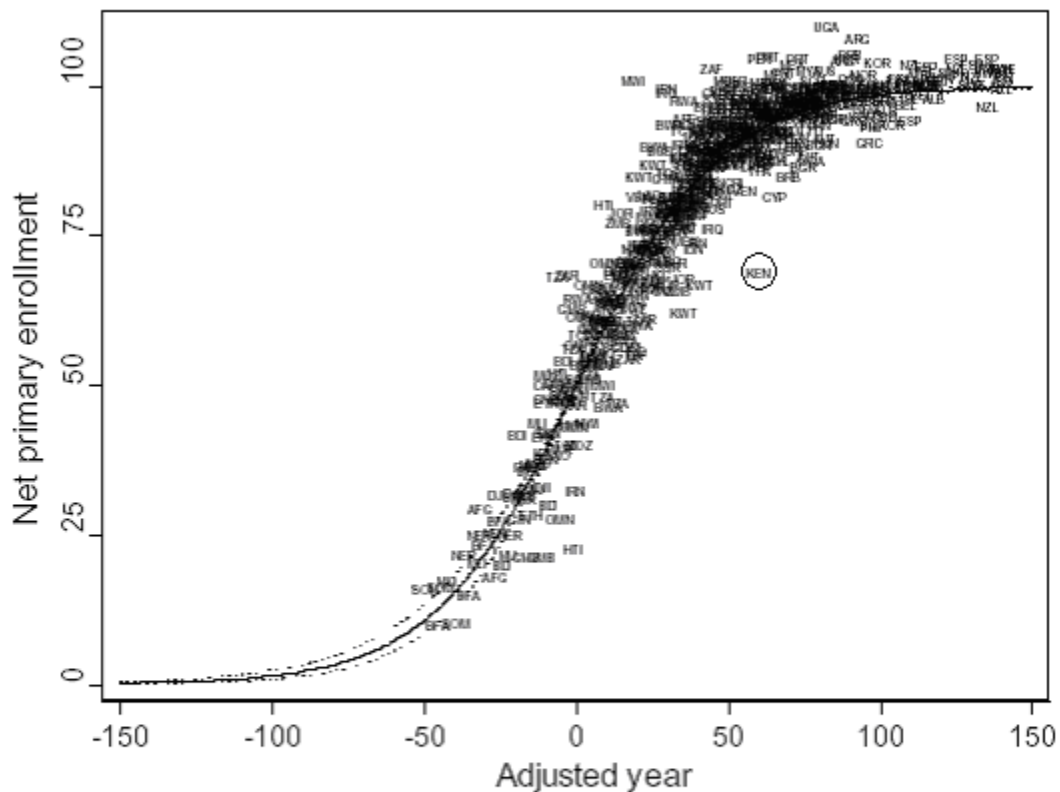
Figure 4.18 shows Clemens’ (2004) historic basis for this analysis. He mapped more than 100 countries at five-year intervals from 1960-2000. Each point represents the net primary enrollment for a country-year related to the number of years it took to move up to or beyond 50 percent enrollment. For instance, the outlier Kenya (Kenya circled for this paper) below and to the right of the curve appears to have taken about sixty years

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<sup>82</sup> USAID-sponsored Demographic and Health Surveys (DHS) and UNICEF-sponsored Multiple Indicators Cluster Surveys (MICS).

<sup>83</sup> Wils et. al. (2005) included entrance up to the age of 14 and completion up to the age of 19 in their entry and completion rate calculations.

(reading from the X-axis) to move from 50 to 70 percent enrollment (reading the 70 percent from the Y-axis), compared to the roughly twenty-two years that the more typical country on the curve would have needed (see that 22 on the X-axis corresponds with 70 on the Y-axis using Clemens' fitted S-curve, and those numbers correspond to what he reported above). Note how steep the ascent of countries is from 50 percent to about 90 percent – it is the last 5 to 10 percent that countries have the most trouble completing.



“Adjusted years” are the elapsed time since 50% enrollment. Datapoints show country-years, spaced quinquennially. Solid line shows fitted line from first column of Table 4, dotted lines show 95% confidence interval on parameter  $\alpha$  from the same table.

Figure 4.18. The Transition in Net Primary Enrollment  
*Source:* Clemens (2004, 42).

How do the transition speeds in the IFs base case forecasts compare with those from the historical analysis of Clemens (2004)? Table 4.14 shows that our model forecasts a faster educational transition than that of Clemens. Specially, at the later stages of the transition, for instance from 50 percent to 80 percent enrollment, Clemens calculates a historically slower pace of transition than those forecast by the IFs model.

Table 4.14. Comparing the Speed of Transition in Primary Net Enrollment

Transition in Net Enrollment Rate	Clemens' transition time	IFs transition time (average from forecasts)
50%-70%	22.3 years	17.6 years
50%-80%	36.4 years	25.9 years
50%-90%	57.7 years	37.3 years
75%-90%	28 years	17.8 years
90%-99%	-	16.1 years

*Source:* Clemens (2004:15-16); IFs with Pardee, Version 6.005

The analysis by Wils and her colleagues (2005) also allows this sort of comparison. That study, however, computed individual transition speeds for seventy low income countries, rather than using the pooled, cross-sectional approach that Clemens (2004) applied to a larger sample of countries, rich and poor. Because of this country-specific analysis, Wils et al. (2005), unlike Clemens (2004), reported a range of transition speeds rather than a typical speed. Wils et al. chose to report the speed for the transition from 10 percent to 90 percent, probably because that is the span of an S-curve where there is most variation. In any case, because they picked different variables for analyses, the range reported in Wils et al.'s 2005 paper is not comparable directly to the speed reported in Clemens (2004). Clemens, however, in a footnote (2004, 15) cautiously compares his 10 percent to 90 percent enrollment transition speed of 115 years with a 35-



80 year range for a 10 percent to 90 percent “hypothetical” enrollment transition reported by Annababette Wils and Raymond O'Connor in a 2003 paper.

For the purpose of comparison with IFs we calculated an average of the transition speeds<sup>84</sup> reported by Wils, Carrol and Barrow (2005) for 80 percent to 90 percent and 90percent to 95 percent transitions in primary completion rates. The figures in Table 4.15 compared Wils’ completion transitions with that for the same set of countries from IFs. Keeping in mind the subtle differences between the ways these two models define the completion rate, the results are comparable.

Table 4.15. Comparing the Speed of Transition in Primary Completion

Transition in Completion Rate	Wils’ transition time	IFs transition time
80%-90%	14.68 years	15.8 years
90%-95%	13.2 years	10.2 years

*Source:* Wils, Carrol and Barrow (2005, 22); IFs with Pardee, Version 6.005; Average of 46 low income countries included in Wils’ analysis

The earlier analysis already suggested a reason why the base case forecasts of IFs are somewhat optimistic relative to historic experience, namely the substantially increased attention now given to increasing educational enrollments around the world. We sometimes refer to this as an example of “systemic shift.” That is, there has been a tendency world-wide for change on many social variables to accelerate independent of income levels (Hughes 2001). It is particularly striking in some instances, such as fertility rates, where cross-sectional functions of fertility related to GDP per capita (at PPP, constant dollars) shifted downward about 1.5 children per woman from 1970 to 2000.

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<sup>84</sup> We estimated the data from the bar graph showing 80%, 90% and 95% completion dates.

The shift has been surprisingly consistent across different levels of GDP per capita. Some of the shift has a material basis, namely improved birth-control technology, but almost certainly some has an ideational basis.

Figure 4.19 shows that the same phenomenon has occurred globally on primary survival rates. Although the shift has been more pronounced for middle-income and to a lesser extent high-income countries, even low-income countries, on average, exhibit an improvement in primary survival rates of about 5 percent from 1970 to 2000 at any given level of per capita income. Interestingly, Clemens (2004) noted exactly this same effect when comparing the experience of the currently developed countries early in the twentieth century with the currently less developed countries in 1960-2000. According to Clemens (2004, 16): “the typical country after 1960 took about 28 years to get from 75% of the worldwide maximum level of that enrollment statistic to 90% of the maximum....before 1914 it took about 41 years to get from 75% of the worldwide maximum value of net primary enrollment to 90% of the maximum.”

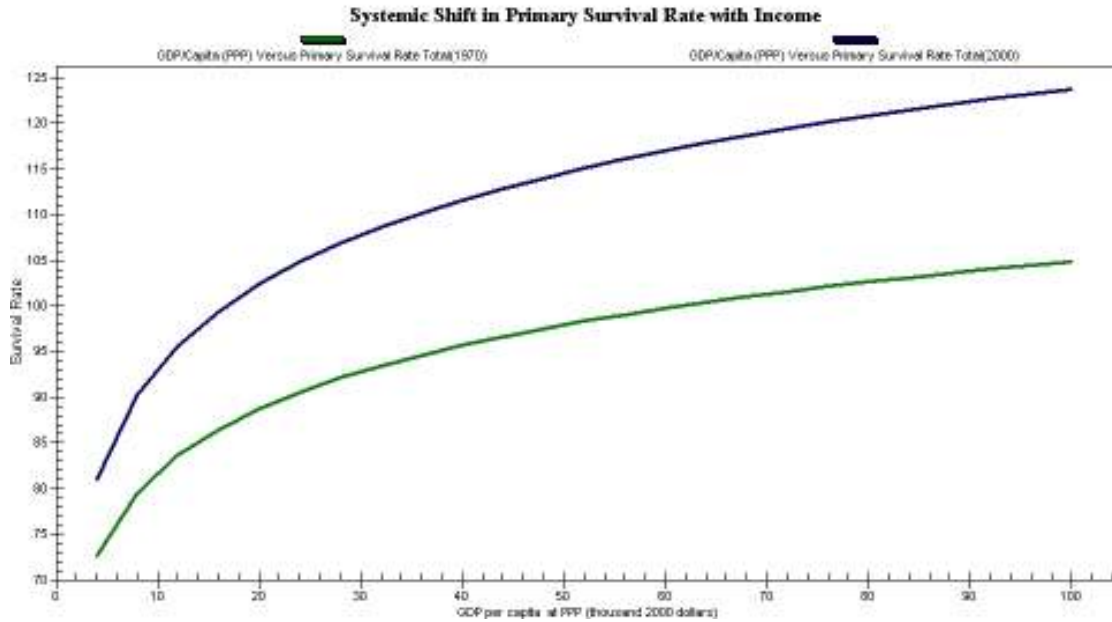


Figure 4.19. Comparative Cross-Sectional Analyses of Primary Survival with GDP per Capita

Source: IFs with Pardee, Version 5.40.

We must be careful not to make too much of Figure 4.19. First, data have not been very good or consistent across this period. Second, there is obviously a ceiling effect with respect to such a shift and it is possible that the world has reached it or will very soon.

Still another reason for the relatively greater optimism of forecasts in IFs, however, is that the S-curve does not completely capture the rapidity of transition up to the last 5 to 10 percent of enrollment. In some ways, the phenomenon is more of a backwards Z-Curve, with rather sharp transitions (see again the points shown by Clemens, 2004 as reproduced in Figure 4.18 above). Our examination, for instance, of historic data for Indonesia, Portugal, and Norway, which have completed the transition to at least 95 percent enrollment, show essentially linear rises to that level rather than slowly decreasing slopes.

## 4.4 Uncertainties in Forecasting

We have contrasted our base case forecasts with historical trends. In the last section we compared IFs base case forecast with other forecasts, mostly using extrapolation as the forecasting method. We have seen how the differences in model formulation might result in differences in forecasts. Even after all these it is not possible to say, for sure, which of the forecasts are more accurate. However, being either near the other forecasts or able to explain why the numbers do not match up increases confidence in model results.

As a last step in model validation, we shall now explore some of the sources of uncertainty in our educational forecasts. These uncertainties are in the areas of school-age population and the income and educational spending as determined by the economy, variables that closely impact educational supply and demand.<sup>85</sup>

### 4.4.1 Demographic Futures

Demographic futures have a direct bearing on educational provision. For example, a gradual decline in fertility over a long period of time would reduce the required number of school-places. On the other hand, a high dependency ratio, the current picture in many developing countries, has put heavy pressure on the educational system. In this section, we shall extend our base case educational forecasts by considering uncertainties along the

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<sup>85</sup> The demographic and economic uncertainty scenarios were developed by Professor Barry B. Hughes for use in the PPHP volumes

demographic futures, as obtained from the IFs demographic forecasts of high and low population growth.

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 (United Nations, n.d.). Because global fertility rates have been dropping steadily for nearly forty years, the constant fertility variant is only a reference point, not a reasonable forecast.

Figure 4.20 shows approximately the same scenarios using the IFs model. The IFs base case is very close to the UN medium variant. Similarly, in the other two cases, IFs largely match the high and low UN variants.

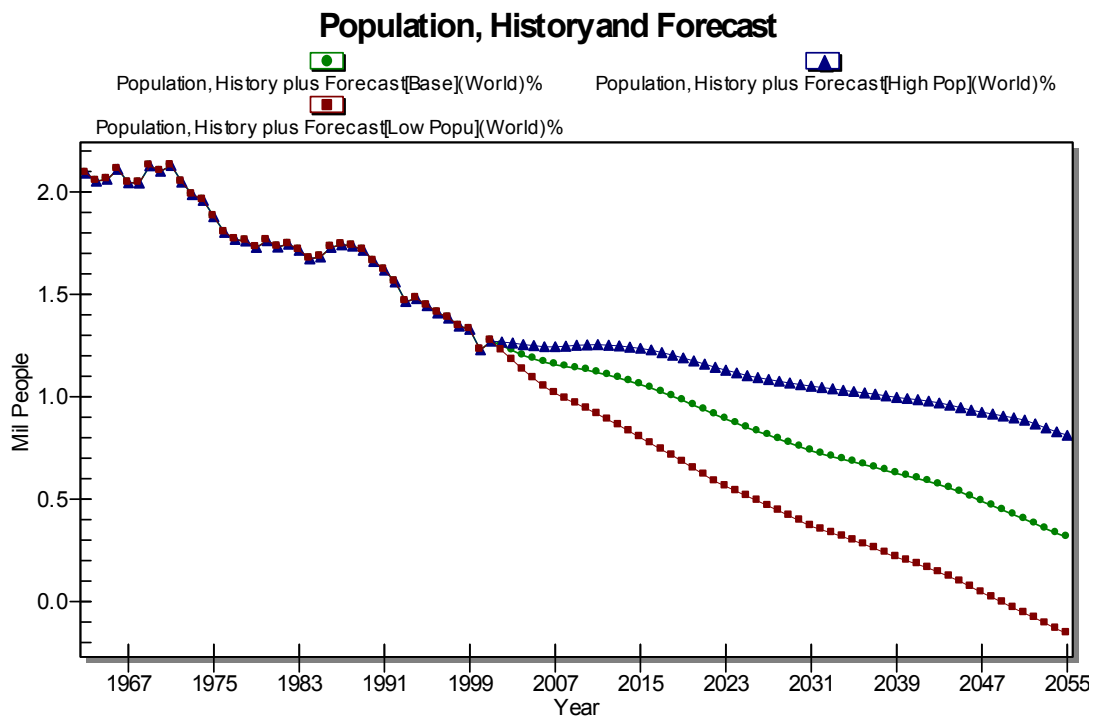


Figure 4.20. Global Population Scenarios  
Source: IFs 5.45

The next table (Table 4.16) shows elementary enrollment effects of the two demographic scenarios and the IFs base case, for the whole world and the two least performing regions. On a global scale, not much difference is visible among the three regions. For SWA, lower population tends to raise enrollment by about 0.5 percent. The most substantial gains would occur in SSA. SSA can raise its enrollment rate by as much as 1.5 percent by 2050, if it can keep its fertility rate low,<sup>86</sup> or it can lose 1 percent enrollment if it fails to bring down fertility.

Table 4.16. Net Primary Enrollment Rate under Demographic Uncertainties

Net Primary Enrollment Rate, Demographic Uncertainties					
Region	Scenario	2005	2015	2030	2050
World	Low Population	89.4	92.7	96.1	99.0
	Base Case	89.4	92.7	95.7	98.5
	High Population	89.4	92.7	95.3	98.0
South and West Asia	Low Population	85.4	89.3	95.8	99.1
	Base Case	85.4	89.4	95.2	98.7
	High Population	85.4	89.5	94.8	98.4
Sub-Saharan Africa	Low Population	68.1	73.1	82.0	94.9
	Base Case	68.1	73.3	81.3	93.3
	High Population	68.1	73.4	80.8	92.3

The next figure (**Figure 4.21**) demonstrates the impacts of demographic uncertainty on global lower secondary enrollment. As seen in that plot, being able to manage fertility rates can make a 3 to 4 percent difference in enrollment at a global scale by 2050.

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<sup>86</sup> In the high population scenario, total fertility rates in SSA 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).

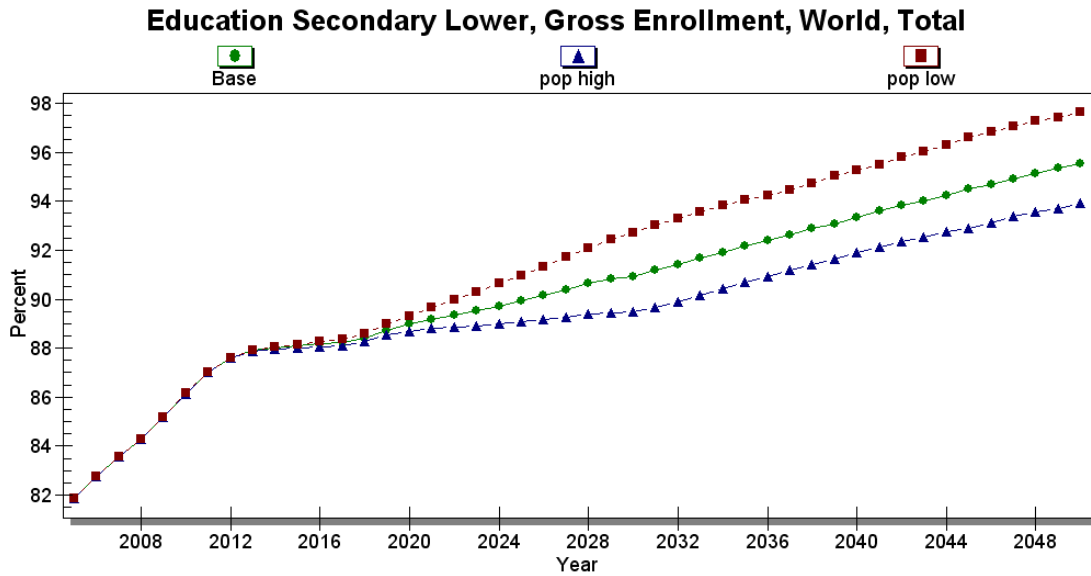


Figure 4.21. Lower Secondary Enrollment (Gross) under Demographic Uncertainties

#### 4.4.2 Economic Futures

Economic situations affect education through more than one channel. A family’s demand for education increases with increased income. On the supply side, governments can allocate more resources to education if they can earn more revenue from a growing economy. In this section, we shall contrast the base case enrollment forecasts with uncertainties around economic growth.

Despite their importance on various issues of public policy, long-term forecasts of economic growth for the world or for multiple countries or global regions are comparatively scarce. 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 2007a: 3; United States Department of Energy 2006: 12; IEA 2007, all cited in Dickson, Hughes, and Irfan, 2008: Chapter 5), as well as placing the scenario in the

context of historic growth. Figure 4.22 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, the rates of growth in SSA, SWA, and Latin America were increased or decreased 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, its high case was increased by only 0.5 percent and low case was decreased by 2.0 percent. Although IFs produces forecasts for GDP at both purchasing power parity (used in most education model calculations) and market prices, Figure 4.22 shows market prices because they are used in most comparative forecasts.

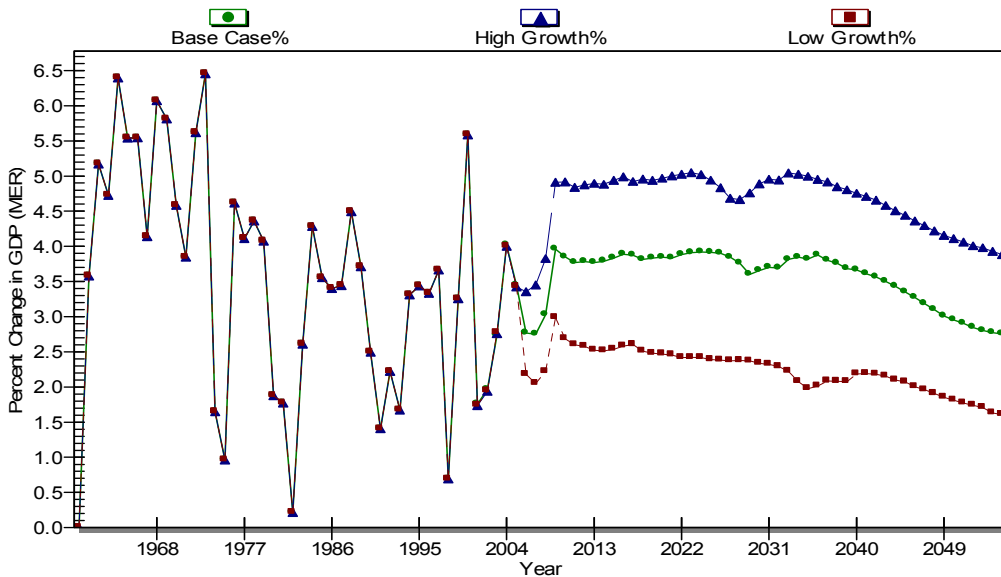


Figure 4.22. Global Economic Growth Rate and Scenarios  
*Source:* IFs 5.45 Base Case.



The next table (Table 4.17) shows enrollment impacts of the economic growth scenarios. Again, the impacts are more pronounced for low growth and low enrollment region of SSA. By 2050, the region might see a 1 percent additional elementary enrollment in a high economic growth situation or a 2 percent loss in the low growth case. This once more signifies the importance of relationship between economy and education.

Table 4.17. Net Primary Enrollment Rate under Economic Uncertainties

Net Primary Enrollment Rate Forecast: Economic Uncertainties					
Region	Scenario	2005	2015	2030	2050
World	Low Growth	89.4	92.7	95.4	98.0
	Base Case	89.4	92.7	95.7	98.5
	High Growth	89.4	92.7	96.0	98.7
South and West Asia	Low Growth	85.4	89.3	94.7	98.3
	Base Case	85.4	89.4	95.2	98.7
	High Growth	85.4	89.5	95.8	99.0
Sub-Saharan Africa	Low Growth	68.1	73.3	80.6	91.1
	Base Case	68.1	73.3	81.3	93.3
	High Growth	68.1	73.3	82.0	94.4

#### 4.5 Conclusion

In the decades after the proclamation of education as a right to everyone through Article 26 of the Universal Declaration of Human Rights, the global community has made rapid progress in expanding education around the world. The advancement is substantial but not sufficient in completing the transition to universal primary education in all the regions of the world by 2015. SSA, where all but a handful of countries suffer from low educational coverage, is the region most challenged in its educational expansion. Among

other regions, SWA, the Arab States, and East Asia and the Pacific, each have few countries taking the risk to reach universal primary in time.

Universal basic education, for the world as a whole, is not attainable even by 2050. SWA will be at 88 percent gross lower secondary by 2030 , but will still be short of 100 percent in 2050.. SSA will have achieved only 77 percent participation rate in lower secondary at mid-twenty first century.

The under achievement in education will be felt more by girls than boys at least up until 2025. By the 2030s and 2040s, girls' enrollment rate seem to exceed that for boys in both the primary and the lower secondary schools even in the developing regions of the world.

The educational expansion of high fertility and low income countries are further affected by the uncertainties around their demographic and economic future. Lowering the fertility can lessen the demand pressure in these countries and thus help them achieve better rates of educational participation. A better economy would allow them to spend more on education and thus improve their results.

## **5 Enhancing Basic Education**

The historical educational trends that we have discussed in the previous chapter show clear signs of progress. As we have shown in the analysis of our base case forecasts, the historic progress, despite its relatively fast pace, is not enough to meet the targets of universal primary, universal lower secondary, and gender equality at these levels of education in the next ten to fifteen years. In this chapter, we would like to explore the possibility of enhancing the educational futures of those countries and regions that are at risk of not making the transition to universal basic education in the near future.

We begin this chapter by drawing attention to the limitations of absolute global educational targets and suggesting relative targeting as a way to take account of the variation among the initial educational profiles of the various countries and regions. Next, we estimate realistic educational progress rates by analyzing the paces and sequences of educational expansion that are taking place around the world. Finally, we develop a normative scenario incorporating the realistic flow targets and efficient financing practices, run that scenario with a desire to advance the global transition to universal basic education well ahead of mid-century, and explore the results.

## **5.1 Relative Targets: Accelerated but Realistic Progress**

International development agencies devise and supervise regional and global educational targets, such as the Karachi plan of 1960, the EFA of 1990, and the MDG of 2000. These goals are helpful in raising awareness and sharing resources in achieving educational objectives. However, the fact that the world failed to meet such goals once in 2000 and will certainly miss once more in 2015 raises some concerns about the benefits of one global goal.

To begin with, time-bound international education targets do not incorporate the initial positions of countries and regions. In a country with very low education, there are many people who need to be educated but the educational infrastructure and the expertise necessary are at an early stage. Thus, the progress in such a country is slower and achieving universal coverage in a short period is quite unlikely to happen. We have discussed the sigmoid shape of educational diffusion that several experts have confirmed (Clemens 2004; Wils 2002; Meyer, Ramirez, and Soysal 1992). Such an S-shaped path exhibits maximum growth towards the center (i.e., around 50 percent in case of an educational flow rate with a ceiling of 100 percent), with lower progress at the lower and upper end due to floor and ceiling effects, respectively (Meyer, Ramirez, and Soysal 1992). In a decadal analysis of enrollment growth for a period in between 1870-1990, John W. Meyer, Francisco O. Ramirez, and Yasemin Nuhoglu Soysal have concluded that the growth in enrollment rate is likely to be related to a country's starting point in a given decade (1992, 141).

The large differences among the countries in their proportions of out-of-school children at the time the goals are set can be taken into account only by relative or differentiated targeting. For example, the global poverty reduction target, the first of the MDGs, pledged to reduce the number of poor people in each country to half of its 1990 value by 2015. Educational targets can be set in a similar fashion, for example, asking each country to double their primary enrollment within a reasonable period. However, a more reasonable approach would be targeting a transition speed practically attainable by a country with its most aggressive efforts.

#### 5.1.1 Primary Education Progress Rate

An analysis of the historical progress made by various countries and regions would help set realistic growth targets. Michael Clemens (2004, 22) has already pointed out the “blistering speed” of the so-called “off track” countries, some of which are advancing their education at twice the speed of a typical rich country in the nineteenth century. The enrollment expansion rates of the fast expanders can work as a guideline for aggressive but realistic targeting. Since educational participation is proximally affected by entry and persistence, we shall explore those flows as well.

##### 5.1.1.1 Growth in Primary Enrollment Rate

Let us start with average historical growth rate in primary enrollment. In an analysis spanning two early postwar decades, Meyer, et al. (1977, 244) showed that the

mean primary gross enrollment rate for the 118 countries<sup>87</sup> of their study went up from 58 percent in 1950 to 83 percent in 1970, gaining 1.25 percent each year. The poorer countries, which started at a lower mean of 37percent, advanced at a rate 0.50 percentage points faster than the study mean.

Progress in net enrollment rate is not as fast as that in the gross rate during the catch-up period. In chapter four, we compared the growth rate from Michael Clemens with those from the IFs base case forecasts. According to that analysis (Clemens 2004, 15-16), in the post-war period countries on average moved from 50 percent net primary enrollment rates to 70 percent in 22.3 years, expanding coverage to primary education by a little over 1 percentage point each year. The pace of progress slows down as coverage expands. According to the same analysis, movement from 75 to 90 percent enrollment rate took twenty-eight years on average, at a rate of approximately 0.5 percent each year. Barry Hughes, in an analysis done for a forthcoming long-term educational futures research volume (Dickson, Hughes, and Irfan 2008, 152), analyzed four fast progress countries in the developing region--Botswana, Bangladesh, Morocco, and Saudi Arabia--and concluded that “increasing enrollment rates by even 1.5 percentage points annually over a prolonged period is very challenging.”

The next table (Table 5.1) summarizes the two decades (1985-2005) of net enrollment growth in the three groups of low, medium, and high enrollment countries that we have identified in the previous chapter (Table 4.3) according to the position of the

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<sup>87</sup> However, thirty-seven of these 118 countries at or above 90% gross primary enrollment rate in 1955 were excluded from the final analysis to avoid ceiling effect (Meyer and Others, 1977:247). That reduces the number of cases to eighty-one.

countries in the year 2005. We find that the group with the lowest mean enrollment exhibits the maximum progress rate.

Table 5.1. Net Enrollment Progress

Primary Net Enrollment Rate			
Group	Low	Medium	High
1985	29.9	60.4	91.4
2005	62.8	87.1	93.7
Total Gain	32.9	26.7	2.3
Annual Gain	1.65	1.33	0.11

*Note: Low (below 70%), medium (70%-90%), high (above 90%) groupings are according to the 2005 NER of developing countries*

Our data analysis and the extant literature suggest that something close to 1.5-2 percentage points gain each year might be at the upper end of realistic sustainable annual increases in enrollment rate. For countries above 70% of enrollment, the rate of progress might be even lower.

#### 5.1.1.2 Primary Intake Rate

Enrollment targets can be reached by improving intake and reducing dropout. UIS data on net primary intake rate goes only as far back as 1999. Gross primary intake rate data, however, is available from a longer period. In the table below (Table 5.2), we show the average progression rates in gross primary intake rate over a period of twenty-five years. As we can see, the countries with low performance rates in 2005 are at that level despite having the greatest increase in intake rates, with an average annual rate of more than 1.5 percent.

Table 5.2. Growth in Primary Intake

Primary Gross Intake Rate			
Group	Low	Medium	High
1980	61.8	97.6	106.6
2005	104.8	125.6	117.2
Total Gain	43.0	28.0	10.6
Annual Gain	1.7	1.1	0.4

*Note: Low (below 70%), medium (70%-90%), high (above 90%) groupings are according to the 2005 Primary NER of developing countries*

Possibly because of the recent emphasis upon education at the global, regional, and local level through global goals like MDG and EFA, there has been some impressive but unusual growth in intake in some SSA countries. The next table (Table 5.3) shows some of these countries with a growth in gross intake rate as high as nearly 75 percent (see Madagascar) within this six-year period.<sup>88</sup> However, as the table below shows, in most cases it is a transient phenomenon occurring over a year or two (see, for example, growth in the intake rate of the Republic of the Congo between 1999 and 2000) rather than a long-term trend.

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<sup>88</sup> This very high growth in gross intake rate is sure to dwindle as the pool of potential overage reentrants and late entrants exhaust. As we shall find out below in our analysis with Ethiopia, the growth in net intake rate is lower than that in gross intake rate.



Table 5.3. Growth in Gross Primary Intake Rate: Countries with High Growth

Gross Primary Intake Rate						
Year	Cameroon	Congo, Republic of	Ethiopia	Madagascar	Mozambique	Zambia
1999	74.3	36.9	77.7	106.6	103.5	83.9
2000	76.7	73.4	78.4	109.6	111.6	89.6
2001	118.0	84.3	80.8	109.5	119.0	88.0
2002	103.1	76.8	78.4	115.6	112.8	88.1
2003	96.5	67.4	78.4	149.3		
2004	100.4	80.3	97.5	167.5	130.7	111.0
2005	104.0	77.8	137.5	181.1	147.8	126.7
Gain (1999-2005)	29.7	41.0	59.8	74.5	44.3	42.8
Annual Gain	4.9	6.8	10.0	12.4	7.4	7.1

We shall now delve into one of the countries from the table above, namely Ethiopia, where there is an average annual growth in intake of about 10 percent. According to a Government of Ethiopia report available in the UNICEF website, with two Education Sector Development Programs, ESDP I and ESDP II, the country has increased its number of primary schools from 10,394 to 16,078, a 54percent increase, between 1996/97 and 2004/05 (Ethiopia, 2007: 44). These new schools, 85 percent of which are in rural areas, covered areas that might not have had any schools in the past, and thus may have attracted over-age children who did not have any chance at formal education in the preceding years. The same report mentions a slower growth in net intake rate, less than 5 percentage point per year, compared to the same in apparent (gross)

intake rate (Ethiopia 2007, 44). In addition, these sudden increases put a lot of pressure on the education system, which reduced the quality of the system. In Ethiopia, despite the construction of new schools, the pupil teacher ratio increased from 42:1 to 60:1 between 1996/97 and 2000/01 (UNESCO-IBE 2006). Reduced system efficiency increases repetition and drop-out, ultimately affecting enrollment. While there is no definitive pattern in the survival rate of Ethiopian elementary pupils in the short period we are discussing, the 2005 survival rate of 68 percent was lower than that in the previous year (73 percent). Worse, the rate reduced further in 2006 to a value (55 percent) below its 1999 level (62 percent).

Net intake rate is the flow variable that we might expect to grow until a convergence with the ceiling rate of 100 percent is achieved. Gross intake rate will differ from the net as long as there is an over-age pool of potential late entrants or re-entrants. The analysis above suggests that, without risking unsustainable pressure on the school system, we can set a normative target of as much as 3 percent net intake rate growth for countries that are about halfway towards universal intake. For countries well above that threshold, a 2 percent intake growth may be more realistic.

#### 5.1.1.3 Primary Survival Rate

Survival rate is the other driver of enrollment. Historical growth patterns in survival are irregular. The following table (Table 5.4) shows stagnation in survival at the upper and lower end of educational enrollment. Only the middle group shows survival growth although at a slow gain of less than 1 percent each year even during the time of fast intake growth. Survival rate is an efficiency indicator that can be improved more than

the historically experienced rates of change. We think that the middle enrollment countries can achieve an annual survival growth rate as high as 1.5 percent. While the low enrollment countries would ultimately reach a similar growth rate, they would take some time in reaching that target. For high enrollment countries, a 1 percent growth in survival looks to be more realistic.

Table 5.4. Growth in Primary Survival Rate

Primary Survival Rate to Last Grade			
Group	Low	Medium	High
1990	69.6	72.0	85.6
2005	68.4	83.6	83.5
Total Gain	-1.2	11.6	-2.1
Annual Gain	-0.1	0.8	-0.1

*Low (below 70%), medium (70%-90%), high (above 90%) groupings are according to the 2005 Primary NER of developing countries*

#### 5.1.1.4 Relationship Between Intake and Survival

We previously discussed the pressure on system efficiency during the initial expansion of access to education. The following figure (Figure 5.1) sheds more light on the sequential relationship between the progresses in access and persistence. In countries with low educational coverage, such as Eritrea, Vanuatu, Mali, or Burkina Faso, located mostly on the left side of the figure, education seems to have become available only to a privileged few who can afford to persist in the system. These countries should be more focused on equity--that is, making education available to everyone--than efficiency—keeping children in school for all available years. In many other countries, for example Mauritania, Madagascar, Uganda, El Salvador, and Guatemala, access expanded rapidly at the cost of efficiency. These countries must improve system quality to reduce the

amount of wastage resulting from dropouts and from repetitions (in most cases high repetitions accompany high dropouts).

Primary Education, Intake Versus Survival, 2004

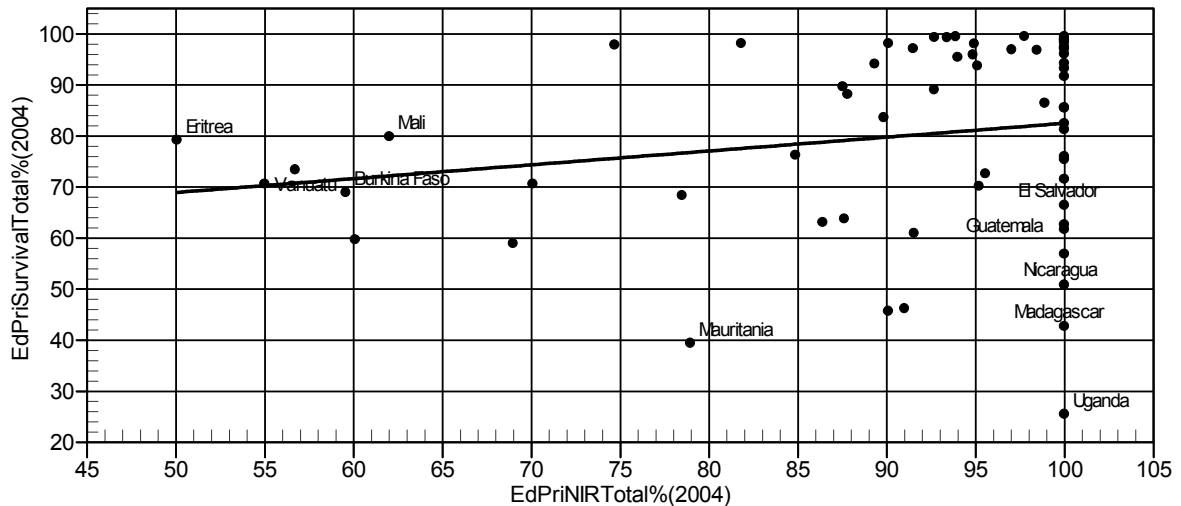


Figure 5.1. Primary Intake versus Survival, 2004

### 5.1.2 Lower-Secondary Progress Rate

Universal basic education can be met by following universal elementary with universal enrollment in lower secondary. As a World Bank study (Cuadra and Moreno, 2005: xvi) puts it, “As more countries achieve universal primary schooling, demand for education is moving to higher levels of the education system, and the world is witnessing an explosion of individual and family aspirations for secondary education.”

However, not all who complete primary education proceed to lower secondary. Especially in the developing countries, substantial portions of primary graduates fail to make the transition to lower secondary. Once pupils are at lower secondary, persistence at that level becomes another important determinant of total enrollment.

### 5.1.2.1 Growth in Lower-Secondary Enrollment

The next table (Table 5.5) illustrates the growth in lower-secondary participation for developing UNESCO regions<sup>89</sup> for a two-decade period from 1985 to 2005. For the region with maximum growth in lower-secondary participation during this period, Latin America and the Caribbean, the annual rate of growth was a little over 2 percentage points. For all other regions, the annual gain was limited to 1.5 percentage points with the least of the growth occurring in SSA and SWA, the two regions that are still struggling with their primary education sector.

Table 5.5. Growth in Gross Lower-Secondary Enrollment Rate, 1970-2005, UNESCO Regions

	Lower-Secondary Enrollment Growth, 1985-2005, UNESCO Regions					
	Arab States	Central and Eastern Europe	E Asia and Pacific Less Developed	Latin America and the Caribbean	South and West Asia	Sub-Saharan Africa
1985	51.31	65.57	60.21	51.18	49.8	23.05
2005	80.8	90.6	78.5	94.4	66.5	39.7
Total Gain	29.5	25.1	18.3	43.2	16.7	16.7
Annual Gain	1.5	1.3	0.9	2.2	0.8	0.8

The over 2 percentage point growth in gross lower-secondary enrollment in Latin America and the Caribbean, listed in the table above (Table 5.5), is higher than the primary net enrollment growth rates that we have listed before (Table 5.1). Interestingly, this region was at 85 percent net primary enrollment rate in 1985. There are two points to note from this analysis. First, lower-secondary enrollment does not start to grow much

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<sup>89</sup> 1970 data for the UNESCO region of Central Asia not available

until countries succeed in increasing primary to a threshold level. Once that threshold level is reached, lower secondary starts to grow as fast as, or even faster in the case of Latin America and the Caribbean, primary. A country should accordingly be prepared for such a period of combined growth in basic education.

#### 5.1.2.2 Growth in Lower-Secondary Transition Rate

The data for transition rate from primary to lower secondary are available only for a short period. The next table (Table 5.6) lists that data for developing regions of UNESCO. We do not see any consistent pattern of growth, some of which might be because of the low data coverage for the countries belonging to the group. The two regions that show consistent patterns of growth are the Arab States and Latin America and the Caribbean. These regions gained about 1 percent or a little less in transition rate per year in the five years between 1999 and 2004. One percent growth in the transition rate seems to be a realistic normative target in this case.

Table 5.6. Growth in Transition Rate from Primary to Lower Secondary

	Transition Rate from Primary to Lower Secondary, UNESCO Regions						
	Arab States	Central and Eastern Europe	Central Asia	E Asia and Pacific Less Developed	Latin America and the Caribbean	South and West Asia	Sub-Saharan Africa
1999	78.8	99.3	97.5	84.5	91.0	87.6	56.7
2000	82.1	98.5	98.2	81.6	88.2	86.2	52.0
2001	82.9	98.8	98.4	83.7	92.7	88.9	59.6
2002	85.8	98.8	99.0	83.4	89.9	87.9	59.1
2003	86.5	96.5	99.1	84.9	89.1	84.8	59.0
2004	84.0	96.1	98.6	80.7	94.3	83.7	56.5
Total Gain	5.2	-3.2	1.1	-3.8	3.3	-4.0	-0.1
Annual Gain	1.0	-0.6	0.2	-0.8	0.7	-0.8	0.0

### 5.1.2.3 Growth in Lower-Secondary Survival Rate

Growth in survival rates in lower secondary is also irregular and somewhat slow, as we have seen in primary. The following table (Table 5.7) lists the data for growth rates in the first five years of the seven-year period for which we have data. In addition, we find that the regions with higher transition rates (as shown in Table 5.6) are showing more progress in survival, whereas those with lower transition rates show almost zero or negative growth. Apparently, like primary, there is a sequencing of the progress in lower secondary going from transition to survival.

Table 5.7. Growth in Lower-Secondary Survival Rate

	Transition Rate from Primary to Lower Secondary, UNESCO Regions						
	Arab States	Central and Eastern Europe	Central Asia	E Asia and Pacific Less Developed	Latin America and the Caribbean	South and West Asia	Sub-Saharan Africa
1999	72.1	96.9	91.4	81.7	78.8	82.6	80.5
2004	87.6	95.1	93.6	81.8	84.2	88.6	76.0
Total Gain	15.4	-1.8	2.2	0.2	5.5	6.1	-4.6
Annual Gain	3.1	-0.4	0.4	0.0	1.1	1.2	-0.9

To find out a normative growth for survival rate amidst the irregular growth rate across developing regions as shown in the previous table, we have aggregated all the developing economies in a single group and found out that the average annual gain in lower-secondary survival rate for the group, for the period of 1999-2004, is 0.8 percent.

### 5.1.3 Gender Parity

In developing countries, girls are generally behind boys in terms of educational participation. Moreover, educational expansion initiatives might benefit boys more than girls unless the governments are careful about gender sensitizing their educational expansion policy.<sup>90</sup> However, as countries get richer, girls not only catch up with boys, but in many cases, they actually pass boys. The reverse gender parity, a consequence of girls passing boys, is a temporary phenomenon in most cases. However, in some developing regions (e.g., Latin America) and countries (e.g., Bangladesh) where the reverse parity is a result of affirmative action that did not accompany improvements in economy and other sectors, it might take a while to return to parity.

The next table (Table 5.8) shows the progress in reaching gender parity in primary for some of the developing UNESCO regions. As the table shows, a region can close the gender gap by as much as 1 percent of the gap (or .012 gain in GPI) each year.

Table 5.8. Progress in Gender Parity in Net Primary Enrollment

	GPI in Primary Net Enrollment			
	Arab States	E Asia and Pacific Less Developed	South and West Asia	Sub-Saharan Africa
1985	0.818	0.955	0.711	0.817
2005	0.954	0.986	0.95	0.923
Total Change	0.136	0.031	0.239	0.106
Annual Change	0.007	0.002	0.012	0.005

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<sup>90</sup> In the Ethiopian expansion that we described above, girls actually made more average annual progress than boys (Ethiopia, 2007: 42)



#### 5.1.4 Targeting Education Finance

Any expansion of basic education needs to be funded with an adequate flow of resources. Numerous issues affect the measurement of educational measures. Some of these measurement problems, as reported by a U.S. Department of Education study, include the identification of educational level boundaries, omission of some sources of funding, and inconsistency and incompleteness in the statistical coverage (USDOE, NCES 1997). Despite these problems, educational expenses can be compared across countries by expressing educational expenses with a relative term. For example, total expenditures in educational can be compared if those are expressed as a proportion of total national product and per-student spending can be compared when they are denoted as a percentage of per capita income. Accordingly, UIS publishes global data on educational expenditure as a per-student cost. To set up a normative target on education financing, policymakers need to know how much a country spends per student at a certain level of education and whether educational participation can be improved by raising or lowering that level to the standard norm.

Alain Mingat and Jee-Peng Tan (1988: 33) proposed the following formula for calculating the educational expenditure at a certain level of education:

$$E = TS + NTS + PM + SS \dots(1)$$

Where E is the total expenditure, TS is teachers' salaries, NTS is non-teachers' salaries, PM is spending on pedagogical materials (others call it learning or teaching materials), and SS is the spending on student support and welfare. While all of these cost components go up as a country increases wealth, the salary components presumably have

the best correlation with income. Therefore, as countries increase wealth, the salaries will go up in all sectors; if teacher salaries do not also go up, countries will fail to attract well-qualified teachers who are able to maintain the efficiency of the school system.

Dividing the left side of the above equation (E) with the total enrollment would give the expenditure per student. What we obtain is a unit cost, which is the average cost of educating each child, but not necessarily the marginal cost, or the cost of adding one more student to the system. At the margin, costs might be higher or lower. For example, costs for setting up a new school at a remote location would be higher than the unit cost, whereas the cost for adding more children to an existing, underutilized facility without hiring additional teachers (or hiring fresh teachers at low cost) would be lower than the unit cost. The existence of both the economies and diseconomies of scale in education is explained in detail by Mingat and Tan (1988: 46-52).

A sophisticated estimation of the marginal cost would be ideal in estimating the precise cost of educational expansion for a client like the Ministry of Education of a country seeking such expansion. However, for reasons we have stated above, an average unit cost might give us a useful foresight about the order of magnitude of the costs that the global community must bear to achieve targets such as universal primary and lower-secondary education.

#### 5.1.4.1 Primary Expenditure Per Student

The next table (Table 5.9) shows public sector expenditure per student in primary education as a percentage of per capita income for countries of the world grouped by

income categories used by the World Bank. There are several important observations. First, the wealthier regions spend more, even in relative terms. Second, expenditure increases over time as countries increase wealth. Third, the low-income economies today allocate about the same amount of what the high-income economies spent in the seventies.

Table 5.9. Expenditure per Student in Primary by Income Regions

	Expenditure Per Primary Student as a Percentage of GDP Per Capita			
	Low-Income	Lower Middle Income	Upper Middle Income	High-Income
1970	5.8	5.0	11.8	10.6
2005	9.8	12.1	14.1	20.7

The converging behavior in per-student expenditure is clear in the next figure (Figure 5.2). The figure plots the historic trends in the relative per-student primary expenditure in the rich countries for the period of 1970 to 2005. Per primary pupil expenditure in these countries clearly converge toward a band of 15 to 25 percent of income per capita. In fact, most of the countries converge at the 20 percent line. The social welfare economies in the Scandinavian regions start high but soon gravitate downward towards the high-income mean.

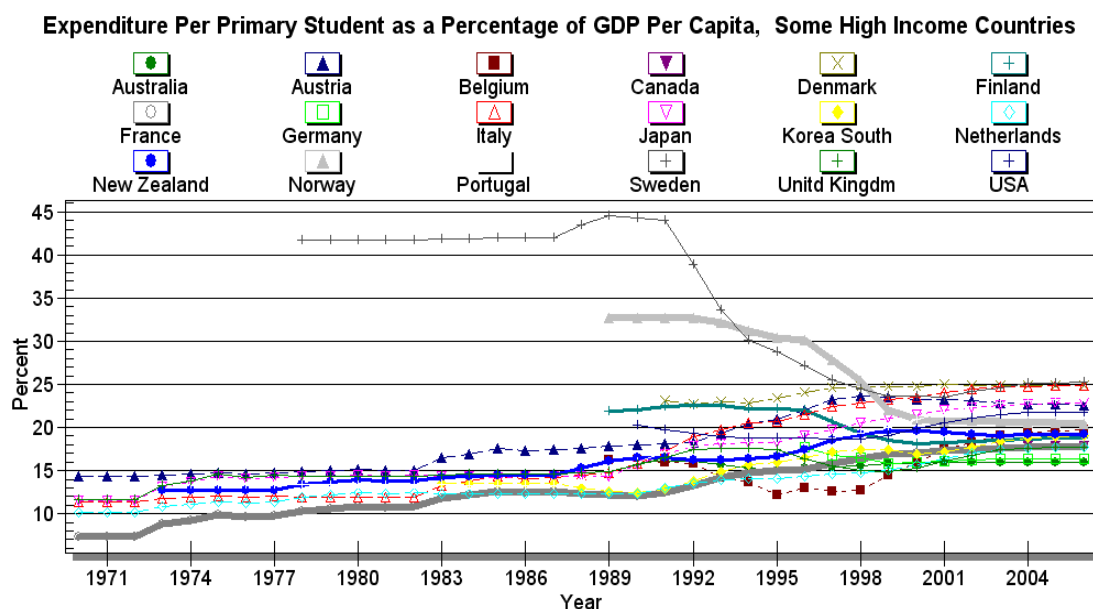


Figure 5.2. Expenditure per Primary Student as a Percentage of GDP Per Capita, Some High Income Countries

Among the lower- and middle-income countries, there is a wide variation in the expenditure per student. Most of the low education countries, especially those in SSA and SWA, invest far less than required per student. Lowest among these is Equatorial Guinea, which spent less than 1 percent of per capita income for each primary student in 2001. Among other low spenders in these regions are the Republic of the Congo, Cameroon, Chad, Gabon, Zambia, and Bangladesh, all of which spend less than 8 percent. Oil-rich Middle Eastern countries like the United Arab Emirates or Kuwait spend about half of what wealthy economies in the West typically spend. The fact that these countries are still about 15 percent short of universal primary is an indicator that even relatively wealthy countries have to work hard to reach the 20 percent target. However, some East and Central Asian, as well as Latin American, countries have performed quite well, at least in terms of quantitative outcomes in primary education at a very low per-student

cost. Countries like China or Indonesia may have benefitted from economies of scale, albeit at the cost of low quality; however, it is not clear why these regions in general exhibit a very low per-student spending.

On the upper end of the lower- and middle-income countries, there are African countries like Djibouti (55 percent) and Burkina Faso (31 percent) that seem to be wasteful, as their results do not match their resource usage. Cuba, spending more than 37 percent of per capita income for each elementary student, is an example of a different kind of over-spending. In Cuba, extra resources brought good outcomes both in quantity and quality, although at a higher relative cost than in an open economy of similar income and educational performance such as Tunisia, which spends a little over 20 percent of GDP per capita per student.

#### 5.1.4.2 Lower-Secondary Expenditure Per Student

UIS does not publish country data on per-student expenditure in lower-secondary education. It does, however, express expenditure in lower secondary as a percentage of total educational expenditure, country by country. Using that and the enrollment data, we have calculated a per-student expenditure in lower secondary and expressed it in relative terms--that is, as a percentage of per capita income. We could come up only with a very short but recent time series, however. The next table (Table 5.10) shows relative per-student costs in lower secondary for the four years after the turn of the millennium for the four World Bank income regions that we used before. Like primary, we see the educational investment to be positively correlated with income. However, unless

countries are able to raise their income quite substantially they have to stay at lower costs.

Table 5.10. Expenditure per Lower-Secondary Student by WB Income Groups

	Expenditure Per Lower-Secondary Student as a Percentage of GDP Per Capita			
	Low-Income	Lower Middle Income	Upper Middle Income	High-Income
2001	9.9	12.0	13.6	23.0
2002	11.2	11.3	13.2	23.8
2003	10.6	11.1	15.1	24.0
2004	10.1	14.0	14.7	24.0

The next figure (Figure 5.3) plots a country's lower-secondary participation rate with its relative expenditure at this level. The plot includes high lower-secondary (above 80 percent gross enrollment) countries that have data only for the most recent year. We see that countries were able to reach high lower secondary with a wide range of expenditure patterns. There are several countries--for example, China, Peru, and Uruguay--that have surpassed 90 percent enrollment with less than one tenth of their per capita income allocated to each of the lower-secondary pupils. However, we see a general upward trend in lower-secondary participation as the relative spending rises above 10 percent.<sup>91</sup>

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<sup>91</sup> Normally, we would have put enrollment on the y-axis to analyze it as a dependent variable. However, for the sake of comparison with the next figure, we have put expenditure on the y-axis and enrollment on the x-axis.

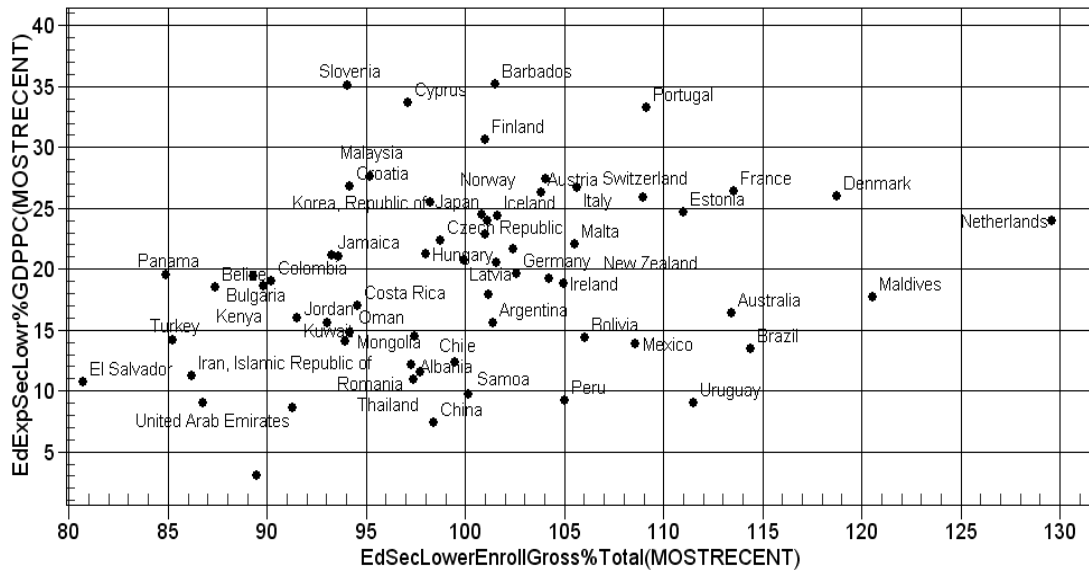


Figure 5.3. Lower Secondary: Expenditure versus Enrollment

The variability in the above plot is a result of the fact that the costs of education are more dependent on income than anything else. The following figure (Figure 5.4) plots per-student expenditure in lower-secondary education against GDP per capita at PPP for the year 2005 or a proximate year. We see clearly that the high-income economies, invariably, have to provide a little less or a little over one-fifth of their per capita income for each lower-secondary student.

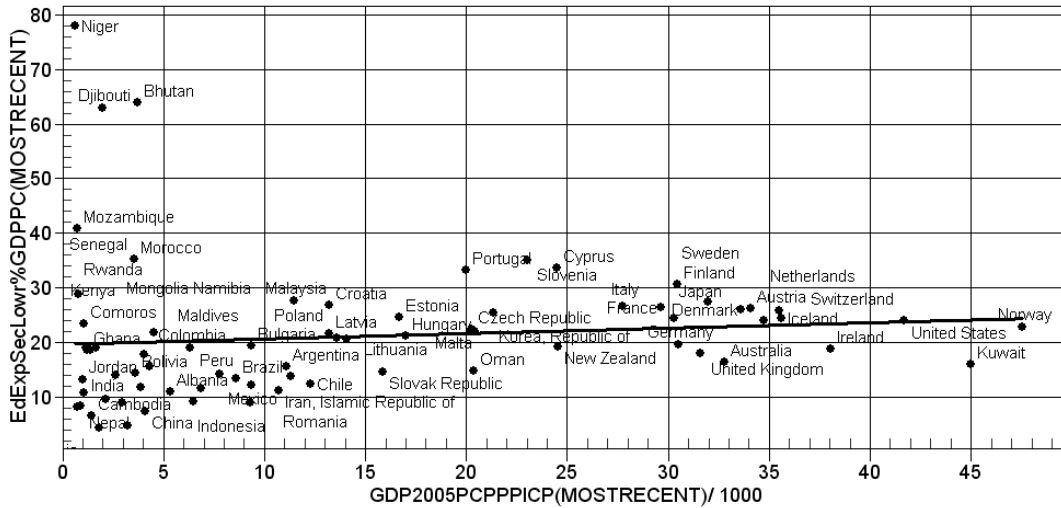


Figure 5.4. Expenditure versus Income

## 5.2 Development of the Normative Scenario

Before going into the detail of our normative scenario, let us present a brief discussion on the Scenario Analysis interface of International Futures application software. IFs has a very flexible Scenario Analysis interface that allows users to run the model under alternative assumptions. To be able to develop a scenario along the lines of our preceding analysis, we have included scenario handles in the IFs scenario database. These handles became part of a tree structure (the so called Scenario Tree of IFs, Figure 5.5) and enable model users to change the student flow growth rates and to adjust the time taken by the relative per-student costs to converge to a benchmark value. Model users are able to change the scenario handles for one or more countries and to group boys and girls separately or together. Any number of scenario handles can be combined. Once the model is run with a newly developed scenario, the results can be compared among other such scenarios and the base or the reference case of the model.



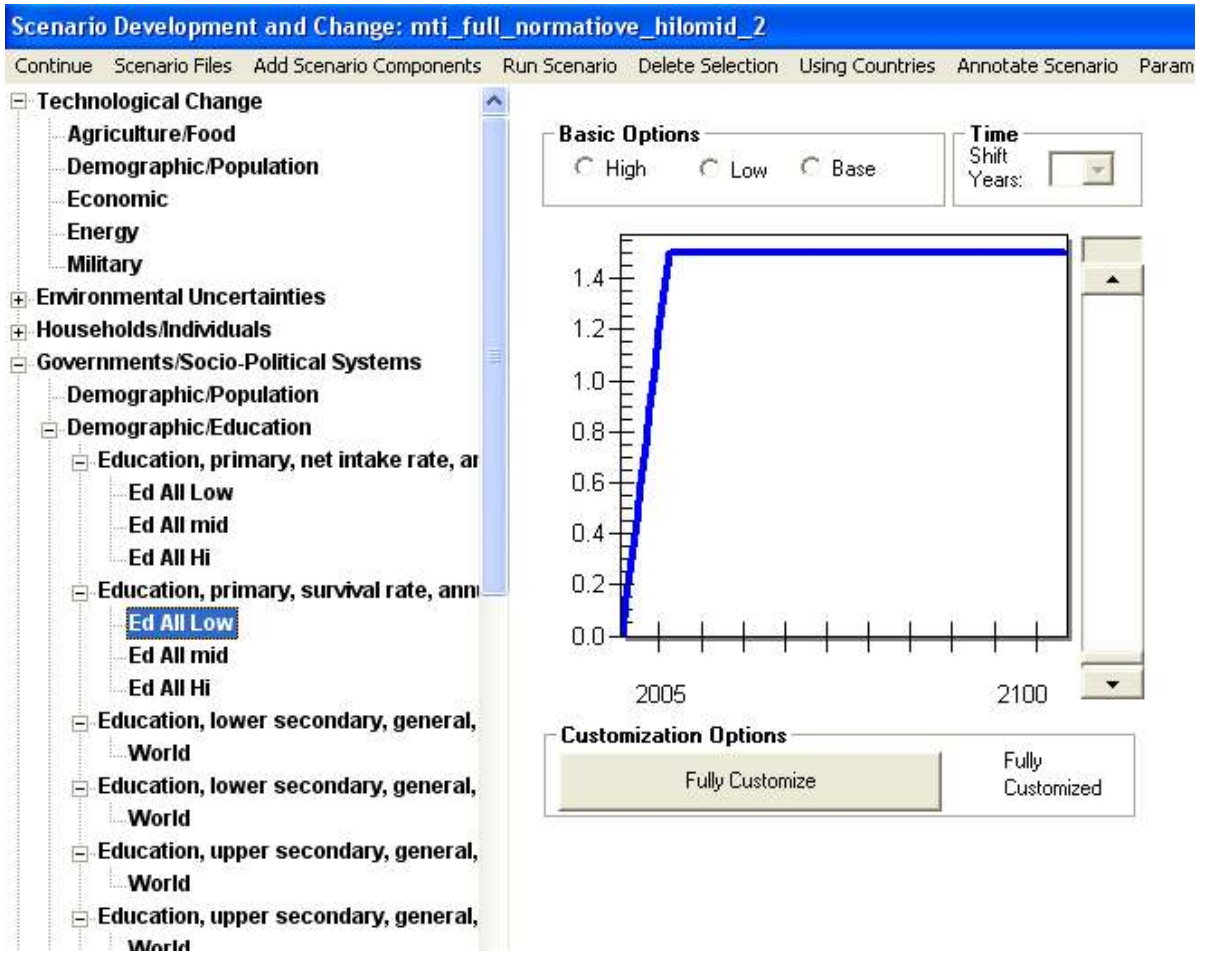


Figure 5.5: IFs Scenario Tree

### 5.2.1 Summary of the Aggressive but Realistic Growth Rates

Before we outline our normative scenario, we would like to summarize our findings on the aggressive but realistic growth rates that we have identified in the preceding analysis (Table 5.11).

Table 5.11. Summarizing Normative Growth Targets

Summarizing Aggressive but Realistic Growth	
Primary Intake Rate	3% net intake rate growth for countries that are at low net primary enrollment <sup>92</sup> (below 70%). For countries with more educational coverage, two percent intake growth may be more realistic.
Primary Survival Rate	Countries midway in their educational expansion (70%-90% net primary enrollment) can achieve an annual survival growth close to 1.5%. Low enrollment countries (less than 70% net primary enrollment) reach that growth rate at a slower pace. For high enrollment countries (those above 90% net enrollment), 1% growth in survival rate each year would be aggressive.
Transition Rate from Primary to Lower Secondary	1% growth in the transition rate seems to be a realistic normative target.
Survival Rate in Lower Secondary	Average annual gain of 0.8% is an aggressive but realistic normative target

### 5.2.2 Specification of the Normative Scenario

Using the analysis above, we have developed<sup>93</sup> a normative scenario with the aggressive but attainable growth rates in the educational flows and the most likely path in educational expenditure. In developing the scenario, changes in parameters are very often ramped up, using linear extrapolation from a base value to a target value, over a period of ten to fifteen years, rather than made in sudden jumps. This gradual change represents the

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<sup>92</sup> The three low, medium and high education groups of developing countries are identified in the analysis of historical educational expansion in chapter four. Table 4.3 lists the countries.

<sup>93</sup> The scenario is developed initially for the Education volume of the PPHP (Dickson, Hughes, and Irfan, Forthcoming). Thus, it includes upper secondary and tertiary targets not discussed in this paper.

incremental nature of political and social change in a more realistic fashion. In some cases, growth rate specification occurred across an entire forecasting range.

#### 5.2.2.1 Student Flows Intervention

Our normative scenario assumes faster growth in the intake (or transition in the case of lower secondary) and survival in primary and lower secondary for all countries. We have assumed a relatively fast, aggressive growth in primary intake for countries that have the lowest coverage at the elementary level (less than 70percent net enrollment rate) at this point. In addition, for this and the middle enrollment (70 percent to 90 percent net enrollment) groups, we have a faster-increasing survival rate. However, for the low enrollment group<sup>94</sup> progress in survival is lagged somewhat from the progress in intake. For all the other countries, same growth rates are used and listed below:

- Primary Education
  - For low enrollment group
    - Three percentage point annual growth in net primary intake rate from 2008
    - Ramp up primary survival rate growth to 1.5 percent per year by 2015
  - For medium enrollment group
    - Two percentage point annual growth in net primary intake rate from 2008 onward
    - One and a half percentage point annual growth in primary survival rate from 2008
  - For all other countries

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<sup>94</sup> Please see Table 5.11 and Table 4.2 for a description of these groups

- Two percentage point annual growth in net primary intake rate from 2008
  - One percentage point annual growth in primary survival rate from 2008
- Lower Secondary
  - For all countries
    - One percentage point annual growth in the transition rate from primary to lower secondary from 2008
    - One percentage point annual growth in lower secondary survival rate from 2008
- Upper Secondary
  - For all countries
    - One percentage point annual growth in the transition rate from lower to upper secondary from 2008
    - One percentage point annual growth in upper-secondary survival rate from 2008

Upper-secondary targets are found by the historical analysis performed for the second volume of the PPHP series on educational Futures (Dickson, Hughes, and Irfan 2008). They are included here to maintain the balance of flows between lower and upper secondary. There is no tertiary target built into the scenario.

The growth rates that we use in our scenario are actually annual percentage point gains and additive in nature. Therefore, each year we add these growth rates to the value of the flow variable (for example, net intake rate or survival rate) from the previous year. Since, both net intake rate and survival rate (to the last grade) are bound to 100 percent by definition, these rates stop growing as soon as they reach that ceiling.

There is a caveat in the way we modeled the more aggressive intake growth for the low enrollment group. These countries keep on growing at a faster rate even after they have reached relatively high enrollment. This results in a faster improvement in the countries belonging to his group compared to those in middle enrollment, as we shall see in the results section that follow. We have plans to update our model formulation to adjust the scenario specified growth rates as countries approach higher participation rates.

#### 5.2.2.2 Financial Intervention<sup>95</sup>

In the base case of our education model, supply and demand forces shape educational expansion. Budget constraints prevent low-income economies from expanding education at a demanded rate in some countries. In the normative scenario, we have let countries expand education at an aggressive but attainable growth rate irrespective of budget constraints. We have however, calculated the costs of pursuing such growth.

One of the components in cost calculation is per-student cost. As we have seen in our analysis above, countries are below and, in some cases, above the global standard in per-student costs. In our scenario, we have assumed the relative per-student costs at the levels of primary, lower and upper secondary to converge with the global best practice within a period of twenty years.

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<sup>95</sup> The specifications of increased spending are rough approximations of the spending needed to achieve the enrollment patterns that the intake/transition rates, the survival rates, and 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.

### **5.3 Results from Normative Intervention**

We shall now explore the educational progress brought upon by the normative scenario. We shall first look at the added possibility of meeting the Millennium goals under the normative scenario. As we have outlined above, cost is not an obstacle in our normative scenario. In reality, cost will be a big issue in meeting those targets. As our scenario is based on realistic targets obtained by historical analysis, we can assume that if the budget can be procured these targets can be fulfilled. We shall thus estimate such a budget.

#### **5.3.1 Primary Enrollment**

The next table (Table 5.12) compares the net primary enrollment forecasts for UNESCO regions for the base case and our normative scenario. Under the normative scenario, SSA could reach 90 percent net enrollment rate as early as 2020. By that time, the Arab States could raise their net primary enrollment rate to a value close to 97 percent, as opposed to the value of around 92 percent in the base case. Over 97 percent of South Asian elementary-age children would be in school by 2020 if the normative flow targets could be implemented. All other regions would be at or above 99 percent net primary enrollment under the normative scenario (some of these would have achieved so even in the base case). Thus, 2020 looks like a possible timeframe for the Millennium Development Goal of universal elementary if the world can start pursuing the normative scenario starting now. Under the normative scenario, 2030 can definitely be considered the year of universal enrollment as all but SSA will be above 99 percent net enrollment rate in that year. Even SSA will be close to 97 percent net enrollment in 2030.

Table 5.12. Primary Net Enrollment Rate Forecast for UNESCO Regions: Base Case versus Normative Scenario

Region	Year	2005	2015	2020	2030	2040	2050
Arab States	Base	84.1	89.6	91.8	95.6	98.0	99.6
Arab States	Normative	84.1	93.0	96.9	99.8	99.9	99.9
Central and Eastern Europe	Base	90.9	97.0	98.9	100.0	100.0	100.0
Central and Eastern Europe	Normative	90.9	98.3	99.0	99.9	100.0	100.0
Central Asia	Base	84.8	92.4	95.7	99.8	100.0	100.0
Central Asia	Normative	84.8	97.6	99.9	100.0	100.0	100.0
E Asia and Pacific Less Dev	Base	97.1	98.6	99.1	99.5	99.7	99.8
E Asia and Pacific Less Dev	Normative	97.1	99.3	99.7	99.9	100.0	100.0
Latin America and the Caribbean	Base	93.8	97.0	98.1	99.2	99.5	99.7
Latin America and the Caribbean	Normative	93.8	98.2	99.3	99.8	99.9	100.0
South and West Asia	Base	85.4	89.2	91.5	95.2	97.7	98.7
South and West Asia	Normative	85.4	93.0	97.3	99.3	99.9	99.9
Sub-Saharan Africa	Base	68.1	72.3	75.2	80.7	87.4	93.2
Sub-Saharan Africa	Normative	68.1	83.7	91.5	96.9	99.2	99.6
North America and W Europe	Base	94.3	99.3	100.0	100.0	100.0	100.0
North America and W Europe	Normative	94.3	100.0	100.0	100.0	100.0	100.0
E Asia and Pacific More Dev	Base	97.8	99.5	99.8	100.0	100.0	100.0
E Asia and Pacific More Dev	Normative	97.8	99.8	100.0	100.0	100.0	100.0

Let us now look at the impact of the normative scenario at the country level. The next figure (Figure 5.6) compares the base case and the normative scenario for the countries from non-SSA UNESCO groupings that would fail to reach 90 percent net

enrollment in primary education by 2015 under the base case.<sup>96</sup> The twenty countries in the plot are distributed among various UNESCO developing regions such as the Arab States, Latin America and the Caribbean, East Asia and the Pacific, and Central Asia. Only one country, the ethnic-conflict ridden Muslim nation of Bosnia comes from the Central and Eastern Europe region. In our normative scenario, all of these countries would be able to reach near universal (90 percent) net primary enrollment by 2025. Nine of the countries, almost half the group, would be able to do so by 2015.

One of the patterns that we see in this (Figure 5.6) and the next (Figure 5.7) figure are the faster progress in the normative scenario for countries that appears to take most time in achieving universal primary enrollment under the base case. This is because of a shortcoming in the model formulation in slowing down the progress once the countries reach higher participation rates, as we have explained in our normative scenario development section of this chapter.

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<sup>96</sup> Nicaragua omitted, as the normative scenario did not improve the situation for that country.



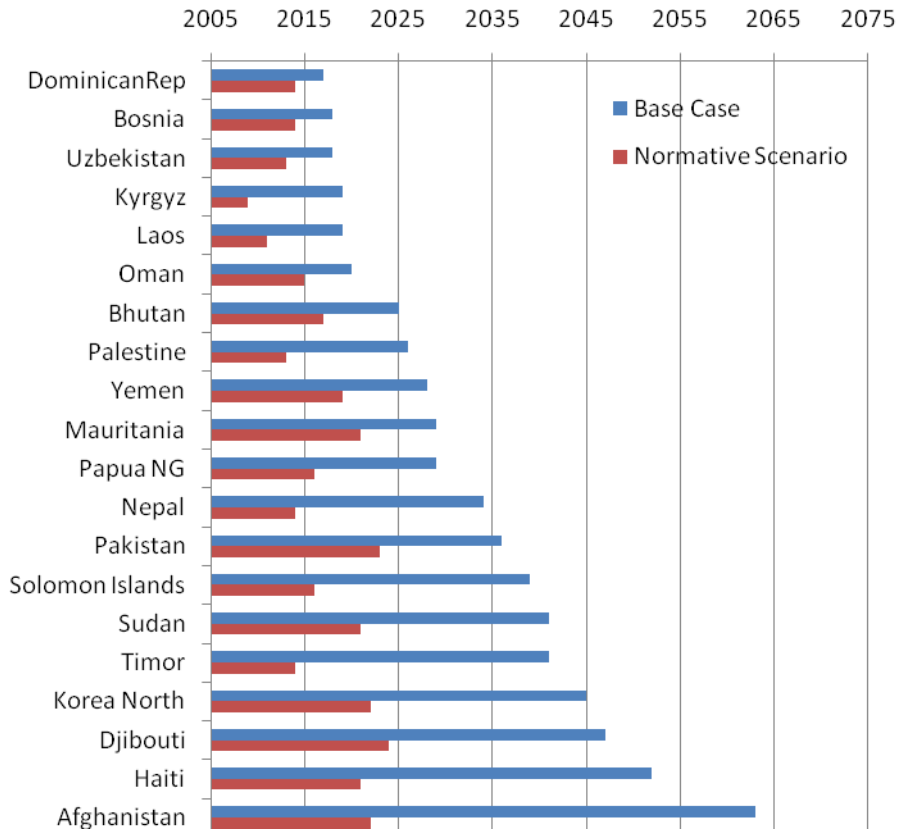


Figure 5.6. UNESCO (non-SSA) Countries Reaching 90% Primary NER: Base Case versus Normative Scenario

The next figure (Figure 5.7) presents the same comparison for the 33 UNESCO SSA countries. In this case, however, the latest a country takes to reach the 90 percent net enrollment rate under normative scenario is 2035. The normative scenario shows only six of the countries, less than a fifth, reaching 90 percent net enrollment rate by the MDG goalpost of 2015.

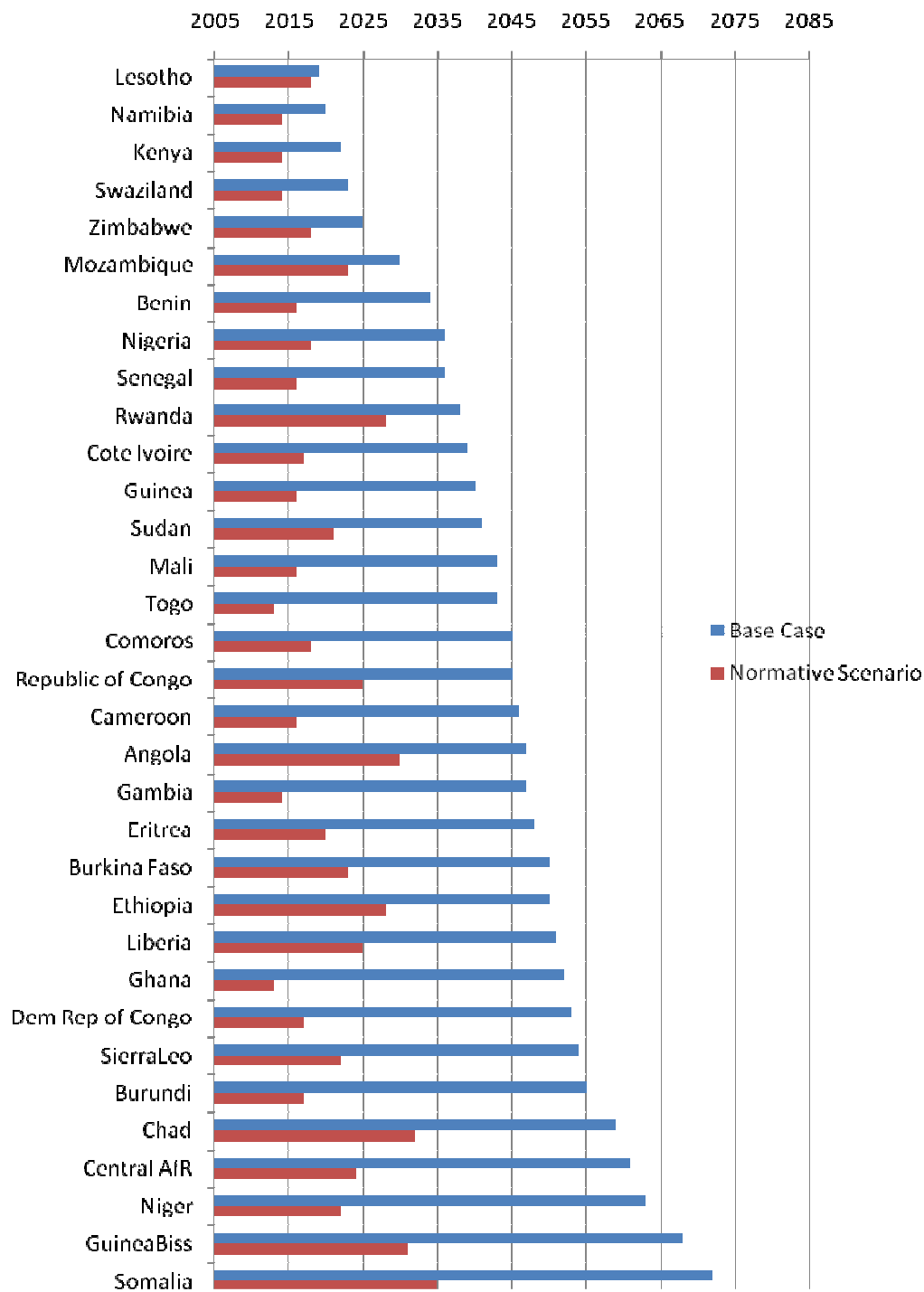


Figure 5.7. UNESCO SSA Countries Reaching 90% Primary NER: Base Case versus Normative Scenario

Despite the aggressive growth suggested by our normative scenario, at least, twenty-one countries would not reach 90 percent net primary enrollment by 2020. Of these twenty-one, all but three (Pakistan, North Korea,<sup>97</sup> and Haiti) are from SSA. By 2030, only four countries will be short of 90 percent enrollment. Of these four, three (Angola, Guinea Bissau, and Chad) would be very close to 90 percent, while Somalia, with a 73 percent enrollment rate, will still be quite far from universal enrollment. The figure below (Figure 5.8) compares the net primary enrollment forecast for Somalia for the base case and the normative scenario. The country's achievement of universal primary, even though as late as around 2040 under the normative scenario, is drastic improvement over the base case.

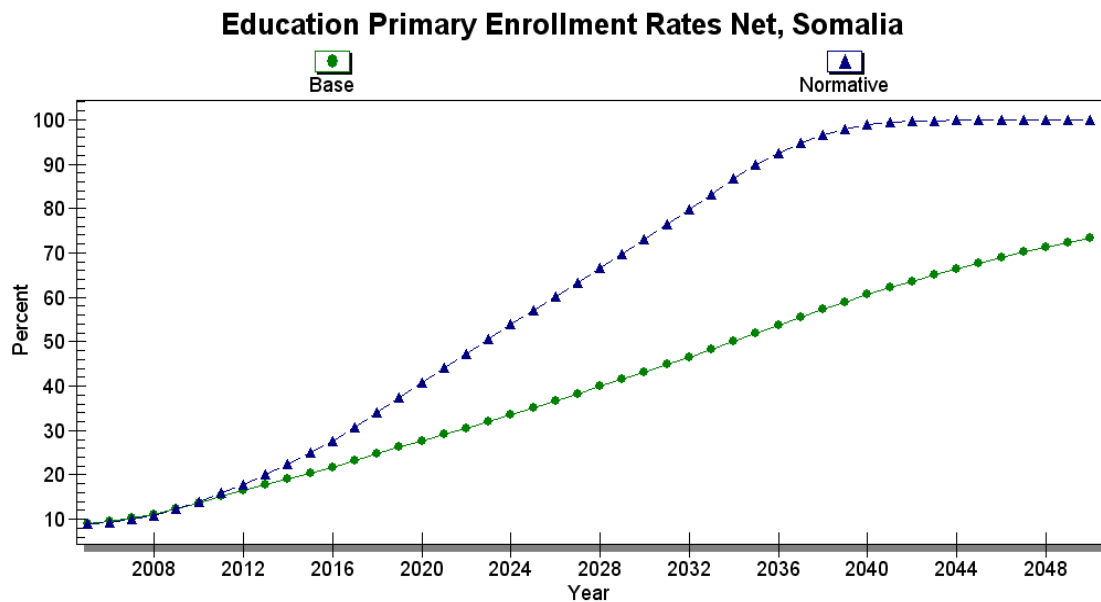


Figure 5.8. Primary Net Enrollment Forecast for Somalia, Base Case versus Normative Scenario

<sup>97</sup> North Korea had almost no data, so it could not be properly initialized.

### 5.3.2 Lower Secondary

Next, we will explore the impacts of the normative scenario on lower secondary. As we see in the next table (Table 5.13), lower-secondary gross enrollments rates exceed 100 percent and peak at a value of about 110 percent to 115 percent before dropping back to 100. Most of these peaks are in 2020, indicating the pressure on lower secondary once the transition to universal primary is mostly completed. While all but one UNESCO region will reach 95 percent gross enrollment in lower secondary by 2020, the remaining region, SSA will not be at 90 percent lower-secondary participation until the late 2040s. Thus, in regions other than SSA, the transition to universal basic education will not be much further than that to universal elementary if the normative scenario can be followed. We should keep in mind that there is a time lag between 100 percent gross and 100 percent net, as is clearly visible in primary. However, as primary is regularized, lower-secondary participation, the sole source of which is primary graduates, should not take long to adjust.

Table 5.13. Lower-Secondary Gross Enrollment Rate Forecast for UNESCO Regions: Base Case versus Normative Scenario

Region	Year	2005	2015	2020	2030	2040	2050
Arab States	Base	80.2	89.6	92.4	96.5	101.0	101.2
Arab States	Normative	80.2	94.8	100.1	102.5	100.7	100.5
Central and Eastern Europe	Base	91.2	108.9	109.9	105.3	101.6	100.4
Central and Eastern Europe	Normative	91.2	112.0	113.7	108.8	103.9	100.6
Central Asia	Base	92.9	104.8	108.5	102.6	100.0	100.1
Central Asia	Normative	92.9	111.3	115.6	102.3	100.3	100.1
E Asia and Pacific Less Dev	Base	91.9	98.4	97.2	96.9	98.0	99.1
E Asia and Pacific Less Dev	Normative	91.9	102.1	100.4	99.9	100.4	100.3
Latin America and the Caribbean	Base	101.1	103.0	100.6	100.7	101.0	101.4
Latin America and the Caribbean	Normative	101.1	109.3	106.6	103.2	102.2	102.1
South and West Asia	Base	65.9	74.8	79.8	88.8	93.2	95.6
South and West Asia	Normative	65.9	85.5	95.1	98.2	99.1	99.9
Sub-Saharan Africa	Base	40.9	50.0	53.2	59.9	69.7	79.8
Sub-Saharan Africa	Normative	40.9	57.6	68.8	79.0	87.5	93.6

### 5.3.3 Gender Parity Index

Our normative scenario does not contain any explicit gender specific intervention. However, the continued aggressive growth rates of the scenario improve the gender parity to some extent.

The next table (Table 5.14) shows the impact of the normative scenario on the gender parity index in primary education. Though we did not incorporate any explicit gender sensitive intervention in our normative scenario, it looks like girls will catch-up to boys in all regions, and exceed them in some, by 2020.

Table 5.14. GPI in Net Primary Enrollment, UNESCO Regions, Base Case and the Normative Scenario

Region	Year	2005	2015	2020	2030	2040	2050
Arab States	Base	0.934	0.969	0.981	0.992	0.998	0.998
Arab States	Normative	0.934	0.975	0.994	1.000	1.000	1.000
Central and Eastern Europe	Base	0.995	0.996	1.000	1.000	1.000	1.000
Central and Eastern Europe	Normative	0.995	1.001	1.002	1.000	1.000	1.000
Central Asia	Base	0.993	1.000	1.003	1.001	1.000	1.000
Central Asia	Normative	0.993	1.000	1.000	1.000	1.000	1.000
E Asia and Pacific Less Dev	Base	0.997	0.996	0.999	1.000	1.000	1.000
E Asia and Pacific Less Dev	Normative	0.997	0.997	1.000	1.000	1.000	1.000
Latin America and the Caribbean	Base	1.002	1.014	1.013	1.002	1.001	1.000
Latin America and the Caribbean	Normative	1.002	1.006	1.001	1.000	1.000	1.000
South and West Asia	Base	0.951	0.988	0.996	1.009	1.009	1.012
South and West Asia	Normative	0.951	0.979	0.995	1.000	1.000	1.000
Sub-Saharan Africa	Base	0.921	0.938	0.949	0.962	0.979	1.000
Sub-Saharan Africa	Normative	0.921	0.961	0.991	1.000	1.000	1.000

There are, however, several countries that would be below 0.97 GPI in primary by 2020, even under the normative scenario. These countries are Afghanistan, Somalia, Uganda, Central Africa, Yemen, and Equatorial Guinea. At least one of these countries, Uganda, will take as late as 2035 to reach the threshold of gender parity.

In lower secondary, there are at least nine countries in which girls' enrollment rates will be less than 95 percent of the rate for boys, even by the mid-century. These countries are Afghanistan, Guinea, Côte d'Ivoire, Chad, Mali, Burundi, Equatorial Guinea, and Central African Republic. All but one of these countries is located in SSA.

#### 5.3.4 Cost for the Normative Scenario

As we have discussed in chapter three, the balancing between the demands for educational funds and the supply of those funds ultimately influences the educational expansion. The aggressive but realistic enrollment growth that we have simulated can be practically planned only when the national authorities have enough resources to pursue those plans.<sup>98</sup> Failing to mobilize requisite funds will surely bog down such growth. However, as we have previously noted, for purposes of keeping the analysis simple we have turned off the budget constraint while running our normative scenario. This simplistic model is not exhaustive in forecasting the financial feasibility of our aggressive normative scenario. However, we can still estimate the magnitude of resources necessary to pursue our normative goal using the enrollment forecasts under that scenario and the forecasts on the unit costs at each level of education, which are affected by income even though the budgeting is off. The figure below (Figure 5.9) shows such a comparison between the total educational cost, across all levels of education, as a percentage of GDP, for the SSA region in the base case and under the normative scenario. The plot makes the need for additional financing very clear. Interestingly though, the relative costs start to come down towards the middle of the century, even though the population of the region, according to IFs demographic forecasts, would still be increasing at that point. This is because primary education will be more efficient by that time and wastage will be reduced. The peak difference between the base case and the normative scenario occurs in

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<sup>98</sup> The scenario can be affected from the demand side as well. Without the improvement of other aspects of economy and society to boost the demand for education, it would be difficult to sustain the growth rates over long periods.

the 2020s, with about a 1.3 percent GDP difference between the base case and the normative scenario around that time.

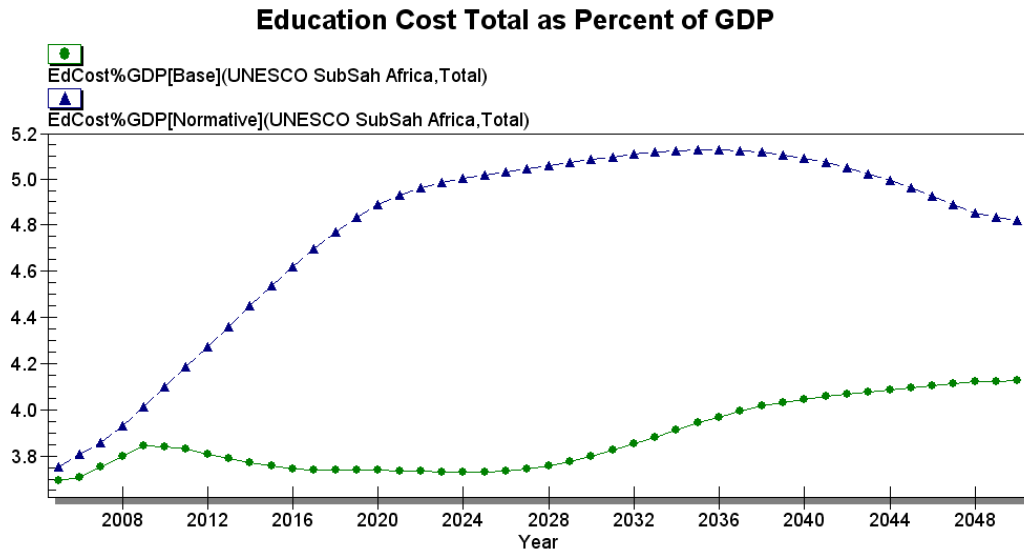


Figure 5.9. Costs under Base Case and Normative Scenario: UNESCO SSA

#### 5.4 Conclusion

In this chapter, we have explored a normative scenario with a view to enhance the educational future portrayed by the reference run of the education model that we have presented in detail in the previous chapter. The drivers for the normative scenario are based on an analysis of the historical growth patterns in student and financial flows. Our scenario analysis then attempted to figure out the possible timeframe by which at-risk countries can reach universal primary education and then proceed toward the transition to universal basic education, assuming they make progress at the possible paces the analysis has found. Our analysis is different from other such normative analyses (e.g., Delamonica, Mehrotra, and Vandemoortele 2001; Bruns, Mingat, and Rakotomalala



2003) because the countries being analyzed are assumed to meet targets like universal primary education whatever the cost may be.

We found that, despite the improvements under the normative scenario, not all countries would be able to reach universal primary enrollment by 2015. Universal basic education in SSA will not be seen until the 2040s.

In most cases, the societies that face challenges in extending elementary and lower-secondary education to all their children are also troubled economically. Feasible acceleration in the growth of educational access and progress in these societies would help them make the educational transition sooner, though not all at the same time. There will of course be some cost involved in expediting the transition.

## 6 Conclusion

This research is a wide and long-term view of education on a global scale in an integrated framework under alternative assumptions. The simulation model developed for the study, which captures not only the educational flows but also the interaction among those flows and their non-education drivers like economy and demography, is one of the largest in terms of its substantial and spatial coverage. The flexibility of the model interface allowed us to combine the countries of the world across various dimensions, for example geography, culture, and economy, in studying the progress and exploring the potential of the global transition to universal basic education.

Our study confirmed the rapid educational expansion across the globe throughout the last half of the twentieth century. That expansion, even if it continues at a similar pace, will not bring every child throughout the world into elementary school in the immediate future, according to our analysis. Some acceleration in the global educational transition is possible, at an added cost.

Our study goes beyond elementary education and beyond 2015. While most of the educational models include only primary education or secondary only in one or two cases, we have modelled the formal education systems of nearly every country for all levels of education, primary to tertiary. Moreover, we have unbundled secondary education into lower and upper secondary, an unpacking necessary to accommodate the different natures of lower secondary and upper secondary.

Like other such tools, ours has its limitations. Despite our efforts in including the key relationships and feedback among education, economy, and society, we cannot claim that we have exhausted all such interactions. The model parameters are only as good as the data and assumptions used to estimate them. The problems with the quality and availability of data may have added to our errors and omissions.

The forecasts that the study makes are more to provide guidelines for action rather than to furnish precise predictions. We have attempted to identify the focal points for global educational intervention and to estimate the order of magnitude of time and effort required to move that foci ahead at a realistic but aggressive pace. We put forward the case for universal basic education as we near the transition to universal primary coverage. The case could be made better by measuring the benefits of such a transition, the costs the acceleration of that transition might pose to other social priorities, and the synergies between those costs and benefits, something that we hope to pursue in the future by using our integrated model.

## **6.1 Accomplishments**

We have reviewed other education models and forecasting efforts of wide and long coverage in our research. Those modeling exercises have captured many, but not all, important aspects of educational expansion. In this section, we shall discuss what we have attempted to add to that body of work.

The growing similarity in the organization of educational systems around the world and the continuous efforts by international organizations like UNESCO to standardize and measure the education related indicators made it easier to compare education systems across the world. The comparison of the historical educational

achievements across time and societies is the natural first step in planning and monitoring the future expansion of education.

Existing global-education models focus on the educational flows, forecasting them mostly through sophisticated extrapolation of their historical path. However, educational outcomes are the results of the supply and demand forces within the broader society and economy. Many believe that the socio-economic changes themselves are more affected by education than the other way around. Either way, there is not much doubt about the interconnectedness of the two. An educational forecasting model needs to consider these interactions as well.

One of the most important topics in the recent education forecasts is the attainability of the second MDG of enrolling all children in primary education by 2015. Acknowledging the critical role of education in realizing other development targets, the MDGs have included education in a framework of development targets. Accordingly, experts developed global educational models to study the likelihood of meeting the MDG targets on education and the associated costs.

Attaining universal primary is only the beginning of a long journey that takes societies through the expansion of the next levels of education, one after another, harvesting benefits like reduced total fertility rate, improved health, and added income along the way. Unlike the demographic transitions that we have likened it with, educational transition is actually a sequence of transitions, the first one being universal primary. The next transition is universal lower secondary. And so on. A long-term outlook on education needs to include all these different levels of education that are

related not only through the progression of students from one level to another but also through the education-society linkages where demands for and outcomes from one level of education influence the supply and demand at other levels.

In this research, we studied the possibilities and potentials for a global transition towards universal primary and universal lower secondary, the two levels increasingly being identified as the basic level of education necessary to bring about a fundamental level of development among individuals and across societies. We needed to develop a long-term educational forecasting model that represents as much of the formal educational system as necessary to understand each of its components and capture the interaction between education and the broader society.

Thanks to more and better data from UNESCO in recent years and a well-developed, comprehensive global modelling platform into which we could embed our model, we came up with an education model where pupils enter the system at elementary school and progress from one level to another all the way up to tertiary education. The participation rate dynamic, in our model, is controlled by the rates of entry into (i.e., intake) and persistence in (i.e., survival) the school system. This formulation helped in developing a formal representation of the over-age entrants and students, a characteristic shown by countries as they go from low to high education. The intake and persistence of students are governed by the supply and demand of school openings and funds that are affected by demographic and economic changes.

In our model, the total number of school-age children in the population, as well as the ability of their parents to send them to school, determines the demand for education. Our model uses a public investment in education that is driven by economic growth,

government revenues, and expenditure. These variables are determined by the broader International Futures model, into which our model is embedded. Our education model allocates the total educational resources among different levels of education according to the funds demanded by each of those levels. We have incorporated the incremental procedure of government budgeting in that allocation mechanism.

One of the novelties of our model is that it represents all levels of education from primary to tertiary. Moreover, we have disaggregated secondary education into two levels, lower secondary and upper secondary, despite the difficulty in gathering data necessary for such a division. There are growing concerns among researchers about studying all of secondary together, rather than as two separate levels--the first level being closer in contents and objectives to elementary, and the second level serving more as a prerequisite for higher education. Our model has disaggregated education into lower and upper secondary enabling us to study universal basic (primary and lower secondary) education. We have also divided secondary education by curriculum into general and vocational education, though that separation is more visible in upper secondary than lower secondary.

The results that we presented in the previous two chapters involve only the levels of primary and lower secondary because those are the areas where the research questions lie. Those results, however, are influenced by outcomes from other levels of education. In general, educational outcomes, from our model, feed back into the broader IFs model and influences socio-economic variables, like fertility and productivity, which drive the educational supply and demand in the subsequent years.

Our model application makes it possible to explore and analyze the historical educational progress by level of education, by gender, by countries, and by a flexible combination of those dimensions. It forecasts educational flows and stocks, students and resources, quantity and quality, over a long period of time, across a wide range of countries and flexible country groupings, and affecting a wide range of other variables that might drive or be driven by educational activities.

Our education model, like other models of IFs, has the capability of developing scenarios under alternative assumptions. Using the scenario development interface of IFs, we were able to study the variations in educational forecasts under framing uncertainties like high or low fertility and rapid or slow economic growth. We have also estimated realistic growth rates in educational flow rates by analyzing historical patterns of change in student and resource flows. We have made flexible growth rate assumptions permanent features of IFs' scenario database. These scenario handles made it possible for us to explore variations in educational transition under a growth rate that is faster than our reference case but still realistic.

Overall, we have developed a comprehensive model with many features and wide coverage. Resolution of our model--into countries, educational levels, and gender of pupils--facilitates a complex analysis of the MDG goals of primary education for various countries, groups, and regions under various scenarios. We believe ours is the first extensive study on universal basic education comparing the transition for various groups and countries under a base case as well as a more aggressive normative growth scenario.

## 6.2 Results

In the post-war period, education, especially elementary education, topped the development agenda locally, regionally, and globally. Consequently, there was an impressive growth in the expansion of mass education during the last several decades. The global community committed itself, more than once, to take education to all the children of the world. The latest of these pledges, the September 2000 Millennium Development Goals, promised elementary education to every children by 2015. The MDGs also pledged to bring parity between schooling for girls and boys, in primary and secondary education by 2005, and at all levels of education by 2015.

There is a consensus among the experts that the education related MDGs will not be met. In fact, the first gender parity goal, achieving gender parity in primary and secondary by 2005, has already been missed. Our analysis shows that the setting of a common goal of universal primary education for all countries by 2015 was not realistically based to begin with.

Mostly because many countries started with a low value, the base case continuation of the rapid historical expansion does not prove to be enough to meet the second MDG of universal primary education by 2015. Under the base case, in SSA, the most troubled of the regions, at least a dozen countries (Burkina Faso, Ethiopia, Liberia, Ghana, the Democratic Republic of Congo, Sierra Leon, Burundi, Chad, the Central African Republic, Niger, Guinea Bissau, and Somalia) would not be able to achieve universal primary even by mid-century. The gender gap in SSA will not be evened out even in primary by 2015. The goal might be elusive to the region up until the end of the third decade of the century, as per our base case.



The historical and projected progress in expanding primary education necessitates planning about the next level of education, lower secondary. By achieving universal lower secondary, the world community can fulfil its commitment to providing a basic level of education to all children.

More of the global regions (the Arab States, SSA, and East Asia and the Pacific) are behind universal participation in lower secondary. And those behind in primary (SSA and SWA) are further off, naturally, in lower secondary. We agree, however, with the notion that lower secondary is closer in content and nature to primary, and upper secondary serves as a gateway to the higher levels of education. Following the terminology used in the Dakar EFA goals and projects like the UBASE project of American Academy of Arts and Sciences, we have explored the potentials of a global transition to universal basic education, a combination of universal elementary and universal lower secondary. As per the base case forecasts from our education model, SSA will not be close to universal lower secondary (more than 90 percent gross enrollment in lower secondary) before the mid-2060s. SWA will reach a similar level of achievement by 2035 and the Arab States by 2020. It is apparent that a single global goal does not make sense for lower secondary education.

Post-Second World War progress in lower secondary was comparable to and followed that of elementary. Exploration of the recent growth patterns in access to and progress in education convinced us that there was room for some acceleration of the progress in these areas. We have combined those findings to develop an aggressive but

realistic normative scenario where growth targets in educational flow rates, rather than an absolute coverage, are pursued.

Even with the improved results from the normative scenario, 2015 MDG targets appear unlikely to be met. The conflict ridden coastal East African country of Somalia would be the latest to achieve 90 percent net primary enrollment rate under the base scenario. Under the normative scenario, that country will achieve that target in primary and a little less (85 percent gross) participation rate in lower secondary by 2035, assuming that the country, by then, would be able to spend more than three times the percentage of their annual income that they are projected to spend in the base scenario. Three other SSA countries (Chad, Guinea Bissau, and Angola) would reach close to universal primary in or before 2030 under the normative scenario. The region, as a whole, would reach the target as early as 2020. Other regions meet the MDG of universal primary under the normative scenario, with SWA barely making it with a 89.2 percent net enrollment in 2015.

Under the normative scenario, which assumes realistic growth rate in lower-secondary flow drivers as well, regions make faster progress in lower secondary. All but one region, SSA, reaches 95 percent or higher gross participation rate in lower secondary by 2020. Even under the normative scenario, it is almost mid-century by the time SSA reaches close to universal lower secondary.

Progress in terms of gender parity is much better under the normative scenario. All regions reach effective gender parity (GPI of .97) in primary education around 2015. By 2020, complete parity (GPI above .99) is visible in all regions. However, a reverse

gender parity that has started to build up in regions like Latin America and the Caribbean does not start to taper off until the 2020s.

### **6.3 Limitations**

Like all models we have our failings, simplifications, and omissions. Some of the limitations of our model were deliberate, some were due to lack of data and other practical considerations, and some were more due to the debates and uncertainties existing in the theory.

One of the levels of education that we did not include in our model is pre-primary education. The exclusion of ISCED level 0 is the result of a conscious decision. Only wealthy countries and a few developing countries have pre-primary education. Even in countries where there is substantial pre-primary education, not all parents send their toddlers there. Thus, we decided that we would not lose much by omitting pre-primary education. However, there are at least two areas where pre-primary might have a significant impact. The first one is a growing literature about the positive connection between the performance of primary pupils and their having some pre-primary education. This will be more important when we more completely integrate quality of education inside our model, something that we shall discuss below. Another concern about the omission of pre-primary is the expenditure at this level, which is as high as 15 to 20 percent for several transition economies, including the Russian Federation. While we have made adjustments for this omission using the data for the base year of our model, over a long period the adjustment may not work properly.

The model we developed focuses more on the quantitative targets in education than the improvements in quality. We include some efficiency aspects of the education system by forecasting persistence of pupils in the system. We have not, however, considered repetition rate, a major indicator of system efficiency and a more effective measure of wastage in the system, for reasons we have described in our methodology section. We have included nothing on the quality of the learning in the current version of our model. The International Futures database, however, now contains a large amount of data related to the quality of education across countries as determined by internationally comparable learning assessments. The forthcoming educational forecasting volume of the Pardee Center for International Futures (Dickson, Hughes, and Irfan 2008, Chapter 6) contains a rich analysis of these quality indicators.

In our estimation of the costs of expansion of education, we have used an average unit cost as a measure of the resources required for each additional school-opening. However, during the early stages of educational expansion there might be economies of scale, for example through higher enrollment in densely populated areas without requiring a proportionate increase in the number of classrooms and teachers. On the other hand, over a longer period, as the countries can afford to turn their attention from quantity to quality, the need to maintain efficient ratios between the pupils and classrooms and teachers will bring the marginal cost closer to the average cost. As countries pursue universal coverage, taking education to the last children and the remotest locations, they might start to experience diseconomies. In higher levels of education, where teachers and other inputs are more costly, economies of scale are felt the most. The higher levels of education play a cost-reducing role, nonetheless, because a

part of their output is used in the education production process at the same and lower levels.

The rather simplistic educational cost function of our model takes into account only the current public cost of education. We also excluded the sources of educational finances from our modelling purview. In developed countries, a major portion of tertiary education is financed through private financing. In several developing and middle-income countries, individual households are still paying for significant portions of education below the tertiary level.

One of the reasons we could not present a richer representation of educational cost is the lack of data in this area. The availability of international education data affected our education model heavily. When we started this modelling, the coverage of data was very low. Over the last few years, the UNESCO Institute for Statistics has improved its data dissemination. However, there are still some data series (for example, survival rate) that have sparse coverage or need to be calculated using assumptions about how the published data are related (e.g., lower-secondary per-student costs). There are also some inconsistencies among the various student flow rates for some countries. The algorithm that we have used to estimate the missing data and to reconcile the flow inconsistencies might not always have captured the reality in each country.

While some of these limitations would be compensated by regional or global aggregation, some of them might actually be magnified. Moreover, for a country-level forecast, the limitations might affect the results more seriously when results are taken as definitive, rather than indicative, and policymakers might be misled.

## 6.4 Future Directions

Like other researchers in the field, we have repeatedly emphasized the bi-directional relationship between education and broader society. There is a broad consensus about how educational activities are influenced by other societal outcomes. However, there is much to resolve in the conclusions about the links that go in the other direction. Without those links clarified, it is difficult to convince the governments of low education countries to make the needed investment in education, potentially at the cost of other social expenditure.

While it is quite intuitive that education will add to people's productivity, health, and income, the experts are divided about the complementarities, the threshold, and the magnitude of such impacts. There are deficiencies and disputes in the empirical support (Pritchett 2001) in establishing those connections. Some researchers (Hanushek and Wößmann 2007) have attributed this shortcoming to the omission of educational quality from the regression estimation of educational returns. Some others (e.g., McMahon 1999), have pointed to the complication in calculating the non-market benefits of education.

More research is needed to establish a concrete basis for the links between education and other areas of development. Without such work, it would be difficult to build a strong model of the benefits of education. The weakness in this area, in turn, will affect the robustness of a feedback model of education, economy, and society. Absent such robustness, it will be difficult to rationalize educational investment through a rigorous cost-benefit analysis.

Educational investments will shift from increasing quantity to enhancing quality as countries achieve better coverage. The growing coverage of international learning ability tests and the availability of those test scores as comparative time series are enabling more rigorous analysis of the quality of education at the levels up to secondary. At the tertiary, in addition to forecasting the enrollment and graduates as a whole, it is important to study the graduates by their fields of expertise and their abilities and contributions in creating new enterprises and new knowledge. With the abundance of data and a clearer understanding about the relationship among education, the broader knowledge infrastructure, the economy, and the society as a whole, it would be possible to expand a formal education model to a comprehensive and integrated national innovation system.

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