AN ECONOMY-WIDE FRAMEWORK FOR MONITORING THE MDGs

François Bourguignon
Senior Vice President and Chief Economist
The World Bank

Presentation to Africa PREM Day, The World Bank

April 29, 2004 [1]

[1] A version of this paper was presented at the International Financing Facility Conference, Paris, April 8, 2004. I am grateful to Maurizio Bussolo, Luiz Pereira da Silva, Jean-Jacques Dethier, Hans Timmer and Dominique van der Mensbrugghe for their help in preparing this paper.

This paper is a contribution to the work examining how to accelerate progress toward the MDGs. It builds on the Baird/Shetty report,[2] on the 2004 World Development Report, [3] on the Global Monitoring Report 2004 [4] and on other major contributions (such as the UN Millennium Development Project).[5] The paper presents an analytical framework to monitor, at the country level, the cost of achieving the MDGs taking into account institutional, technical and financial constraints. It provides numerical examples from a typical, though imaginary, low-income country to illustrate the main points being made. This paper is part of the Bank's broader efforts to develop analytical tools to cost the MDGs and to quantify the time path of reaching the MDGs—i.e., to make gradual improvements in "absorptive capacity." These efforts should feed directly into PRSPs and country work for low income countries.

Section 1. Introduction

Reaching the Millennium Development Goals (MDGs) will depend to a large extent on the ability of developing countries to sustain high rates of growth over long periods. But the process of economic growth will face important constraints. An optimistic view considers that the binding constraint to reaching the MDGs is essentially financial, and that all other possible constraints can be overcome by some modern form of "technical engineering." According to this view, national governments and international agencies working together would have no problem implementing "big push" investment strategies to address major sectoral bottlenecks if only sufficient external financing were available.

---

2 Development Committee (2003). "Supporting Sound Policies with Adequate and Appropriate Financing." Report to the Development Committee prepared by a team led by Mark Baird and Sudhir Shetty, Annual Meetings of the World Bank and the IMF, DC2003-0016, 22 September 2003, Washington D.C.

3 The World Bank (2003). World Development Report 2004: Making Services Work for Poor People. Washington, DC: Oxford University Press.

4 Development Committee (2004), Global Monitoring 2004. Policies and Actions for Achieving the MDGs and related Outcomes, Report to the Development Committee prepared by a team led by M. Zia Qureshi, Spring Meetings of the World Bank and the IMF, April 25, 2004, Washington D.C.

5 See background papers under http://www.unmillenniumproject.org/html/secretariat.shtm See also Jeffrey Sachs (2000, http://www.un.org/millennium/).

This optimistic vision seriously underestimates the institutional and economic issues that are involved when countries attempt to adjust their capacity to meet the challenge of the MDGs. It also downplays the effect that large capital inflows could have on the domestic economy and institutions prices and other lessons on the possible distortions brought by disproportionate aid flows. It postulates that there are positive (or at least constant) returns to aid (financial) flows, and no or little implementation constraints—in particular on the availability of human capital—to deliver improved development outcomes.

The pessimistic view sometimes aired by donors is that "they cannot find projects to finance" in poor countries because these countries "just don't have the capacity to absorb the aid." Either institutions are so weak that additional aid would be immediately translated in an equivalent amount of "leakage," or the delivery of social services is hopelessly inefficient, or human capital to build new water supply and sanitation systems, new schools and health centers, and to staff them is simply not available.

This perspective, in our view, is seriously flawed. True, the evidence on the last decades provide a sobering assessment of the impact of aid flows. But viewing capacity as something that is either present or not is the wrong perspective. Capacity for delivering social services and to reduce poverty, and therefore to absorb external aid is something that is gradually built up. Therefore it is important to focus on the *time path* to develop capacity in the whole economy as well as in critical sectors such as education, health and water supply. High levels of aid has an essential role to play to support this capacity building effort by contributing finance to support skill-building, training, construction of roads, clinics, schools, etc.[6] In terms of messages, our perspective has two important implications: first, that capacity building is a process which is essentially gradual (and possibly exhibits with increasing returns): small beginnings can lead to accelerating improvements, therefore "don't start too big because you will essentially be inefficient"

6 It is possible that high levels of aid could have negative macroeconomic effects (such as a "Dutch-disease" type appreciation of the real exchange rate) but this is something that can be prevented with adequate policies.

and, second, in order to build capacity today and thus achieve the MDG targets in a decade or so, the predictability of aid levels is critical.

The key messages of the paper are as follows:

- In order to properly monitor the impact of policies to achieve the MDGs, quantitative evaluations are important. These evaluations need to be done on a country-by-country basis.

- In order to discuss in a realistic fashion how to achieve the MDGs, it is necessary to adopt a long term perspective. Moving toward these goals implies on the part of developing countries that they have to sustain their effort over long periods and that commitments for long periods are required from donors if aid is to be supportive of that effort.

- Developing an analytical framework such as the one presented in this paper helps to gain an understanding of the intertemporal profile of changes/adjustments in absorptive capacity and of their financing.

- In low-income countries, in general terms, it is likely that an intense focus on capacity building, combined with more direct delivery of human development services and humanitarian assistance will work very well. Of course, solutions have to be tailored to each country's circumstances. In low income LICUS countries, donors should focus on institution building, capacity building, and knowledge transfer to facilitate change. Given the constraints on government capacity, such efforts should concentrate on a limited reform agenda that is both economically sensible (and mindful of sequencing issues) and socio-politically feasible.

Section 2. Definition and Role of Absorptive Capacity

A concern that is often voiced among donors is that many potential aid recipients have insufficient structural and institutional capacity to absorb new aid—that is, their economies might lack "absorptive capacity." The literature on the subject usually considers that a country has reached its absorptive capacity for foreign aid when the marginal rate of return on additional aid falls to a minimum acceptable level (Radelet, 2003, p. 136).[7]

There are several empirical cross-country studies (most notably Collier and Dollar 2002) that show that, when aid reaches a certain level, additional aid has little or no effect on growth. This "saturation point" is a function of the absorptive capacity. Countries with good policies in place (or, in World Bank parlance, with a high CPIA rating) tend to have a higher absorptive capacity to utilize aid productively than countries with poor policies. This essential point—that countries can also absorb larger amounts of aid before the diminishing returns to aid set in, if they have good policies and institutions—is discussed in an extensive literature.[8] In countries with low capacity, the "saturation point" arrives much sooner, so additional aid may not be very productive.

While the literature provides ample evidence that many low-income countries suffer from capacity constraints and that large increases in aid (relative to the size of the economy) do not always achieve their desired objectives, it is not always clear on the causes of this complex phenomenon: is this because the recipient government's administrative capacity is overwhelmed? [9] Or because of governance deficiencies,

---

[7] The literature on aid effectiveness discusses two types of complications that can arise if flows of foreign aid are large: macroeconomic and structural complications. Whereas in the case of macroeconomic problems, it is the quantity of aid and its allocation between the tradable and nontradable sectors that matter, in the case of absorptive capacity, the issue is the quality of spending. See the detailed discussion in World Bank (2002).

[8] It is beyond the scope of this paper to survey this literature. For discussions of this perspective on aid effectiveness, see World Bank (1998), Heller and Gupta (2002) and Goldin, Rogers, and Stern (2002). Recent papers that take issue with the result that effectiveness depends on policy and institutional quality include Hansen and Tarp (2001) and Easterly, Levine, and Roodman (2003). The link between country conditions and aid effectiveness is borne out by case studies of individual countries, as well as evidence on project-level returns (see e.g., the studies in Devarajan, Dollar, and Holmgren 2001).

9 This point is emphasized for example in Kanbur, Sandler, and Morrison (1999), Heller and Gupta (2002) and Bulir and Lane (2002). The observed persistent deviation between aid commitments and actual disbursements is at least

including corruption, and weaknesses in public expenditure and financial management weaknesses? Or because of physical infrastructure or human capital bottlenecks?

Ultimately, the concept of absorptive capacity is used in the literature rather vaguely to refer to a variety of initial constraints in a given economy which are very different in nature (and require very different policy solutions), including corruption, lack of accountability of local officials and poor governance, lack of human capital, including (1) skilled teachers, doctors and nurses, (2) skilled administrators in the public sector, (3) skilled contractors, etc (for public works, road construction, etc) and lack of physical capital/infrastructure (lack of road to reach school, lack of potable water, etc).

This paper is a contribution to the literature on aid effectiveness which aims at improving our understanding of what it means to remove the capacity constraint. Aid could be missing its desired objectives for a variety of reasons including

(1) the poor quality of institutions and public service delivery systems, and possible resulting aid "leakage"
(2) the political economic context, and lack of consensus on what to do with aid
(3) the sequencing / timing of investment streams (some "production" processes, in the health sector, for instance, might need complementary factors which are in short supply, operating new schools needs training new teachers, …)
(4) time-lags between decisions taken by agents, possibly with the help of aid, regarding factor accumulation and their effectiveness (e.g., returns on education, etc.);
(5) human capital and training capacity at a point of time are limited
(6) public investment strategies and macro-economic policies may be unbalanced

"Absorptive capacity" is thus a multidimensional concept. Some dimensions have more importance in some countries than in others. Improving the capacity of

---

partly attributable to the administrative and absorptive capacity constraints of recipient countries; see Kanbur, Sandler, and Morrison (1999).

developing countries to absorb more aid and to move toward the MDG targets thus depends on addressing all the dimensions, both the institutional constraints and the economic constraints, including congestion effects that may result from limited supply of some factors in the face of ever increasing demand.[10] Much of the recent literature insists on the institutional constraints, but less so on economic constraints. To discuss concretely the nature of these economic constraints, in the next section, we examine in more details two important education and health-related MDGs and discuss how those various aspects of "capacity" affect the time path of reaching the MDGs.

It is important to understand that absorptive capacity can logically be improved only gradually and that such a gradual improvement depends on a precise sequencing. We can make an analogy with the theory of optimal investment: we cannot go from one level of investment to a higher level in a frictionless manner. We know that, in practice, there will be adjustment costs. The same is true for the adaptation of the economy to a higher level of aid. If we agree that this is the case, then the questions to be asked to achieve the long term MDG goals are:

- What is the time path of adjustments in the policy and public asset accumulation dimensions?
- As a consequence, what should be the aid commitment over the next 10 or 15 years to reach (or to approach) the MDGs?

Answering these questions requires an analytical framework capable of quantifying the time path of reaching the MDGs in terms of financing, other resources and gradual improvements in capacity. This framework is discussed in the next section.

10 This includes lack of donor coordination, and congestion resulting from a limited number of skilled officials having to face donor demands to file reports on the use of aid funds, which prevents them from doing their job in the first place!

Section 3. A Framework for Monitoring the MDGs

In this section, we present a framework to monitor the MDGs at the country-specific level, and measure the cost of achieving them. Our framework takes capacity constraints into account and provides an assessment of the efficiency of the policies being pursued. We consider the five following MDGs building on the recent literature on health and education outcomes: (1) halving poverty and hunger; (2) achieving universal primary education; (3) reducing by two-thirds the under-5 child mortality rate; (4) reducing by three-fourths the maternal mortality rate, and (5) improving access to safe water and basic sanitation, between 1990 and 2015.[11] The socio-economic indicators summarizing the MDGs are considered as outcomes of several inter-related policies.

The kind of exercise carried out here—monitoring policies aimed at attaining a set of target values for the MDGs at the country-based level—is more complex than exercises based on cross-sectional data or on average cost-based approaches because there are (positive or negative) externalities between goals and other variables affecting the outcomes that need to be taken into account. For example, in cross-country regressions, one observes a correlation between higher GDP per capita and higher school enrollment rates and/or literacy rates. But this hides the fact that, at the level of each country, an improvement in social indicators, in effect, represents a gradual increase in the supply side for the "production" of this indicator, to which the demand side responds and also gradually adjusts. Thus is it necessary to have some knowledge about the structure of the economy to model the process of reaching given development outcomes in a country-based framework.

For simplicity's sake, we can view countries as having a fixed—albeit adjustable—capacity to undertake simultaneously several complex policy actions for increasing human and physical capital stocks. Some long run goals might require

[11] The MDGs are: MDG1: Halve, between 1990 and 2015, the proportion of people living in extreme poverty and suffer from hunger; MDG2: Achieve universal primary education (100% completion rate by 2015); MDG3: Promote gender equality and empower women; MDG4: Reduce by 2/3 the under-5 mortality rate, between 1990 and 2015; MDG5: Reduce by 3/4 the maternal mortality rate, between 1990 and 2015; MDG6. Combat HIV/AIDS, malaria, and other diseases; MDG7: Ensure environmental sustainability; MDG8: Develop a global partnership for development.

progressive phasing-in and there could be delays between action and results. Explicitly modeling the relations leading to particular development outcomes allows the assessment of alternative optimization strategies for a given set of objectives.

Increasing "capacity" takes place through asset accumulation. An improvement in the socio-economic indicators associated with the MDGs results from a country-specific process of accumulation of assets (human, physical) and their utilization in combination with intermediate inputs under some binding (macroeconomic and financial) constraints.

But increasing "capacity" through asset accumulation is not sufficient: an institutional environment provides "governance assets" that affect decisively the "efficiency" in the operation of the whole system to produce better socio-economic outcomes. In cross-sectional approaches, these "governance assets" explain a large part of the poor performance of low income countries.

To understand how aid can assist in reaching the MDGs, we have to have a good sense of the dynamics of the process. Public and private agents use instruments that are both of a macroeconomic and sectoral nature (e.g., fiscal expansion, construction of schools and clinics, hiring of teachers and doctors, etc) provided that some required 'balances' are respected at least in an inter-temporal horizon. These balances can be of a shorter-term fiscal-financial nature and also depend on longer-term physical considerations. For example, there are production capacity constraints, trade-offs, irreversibility in production decisions at the country level. Devoting resources to train "doctors" will have—in a general equilibrium sense—effects on how much "teachers" will be trained, given the need to produce "high skill labor" for other sectors of the economy.

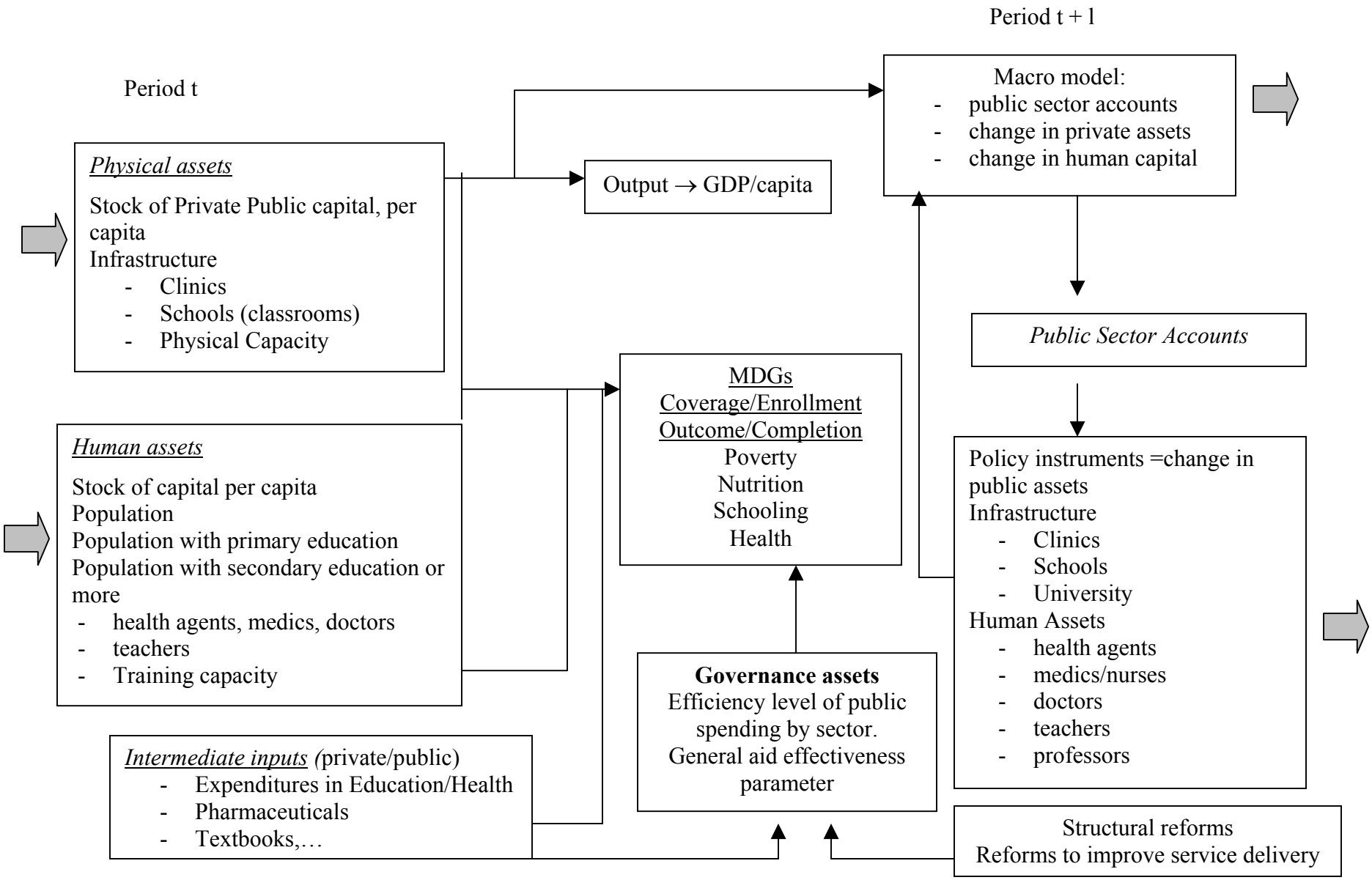
Ideally, one could think of a more complete long run growth model—with fully-specified, inter-temporal and general-equilibrium relations—that would capture the demand and supply sides of health, education and other development outcomes,

permitting us to understand how interventions today can have effects on education attainment and other development goals in the future. In such a complex framework, it could be possible to model the principal-agent relationships that are typical of service delivery on the supply side, and combine it with the forward-looking demand side model. But we are depicting here is a much more modest framework. This framework has the advantage of being simple while making explicit the key relationships. Our framework has the following characteristics:

- an explicit link—subject to binding fiscal and balance-of-payments constraints—is established between a macroeconomic growth and public finance framework and sectoral policies, to assess the budgetary/balance of payments implications of MDG-related (recurrent and investment) public expenditures;
- the "production" of MDG outcomes with physical and human capital inputs is explicitly modeled; and
- the interdependence and complementarity (positive and negative externalities) across policies aimed at reaching several of the MDGs is taken into account. For example, better sanitation affects health of children which, in turn affects demand for schooling.

The framework is depicted in Figure 1.

Figure 1: General architecture of the MDG analytical framework (long run, dynamic, general equilibrium model)



Based on the framework sketched above,[12] we simulate various scenarios tracing the paths of the MDGs through 2015 using a "macro-micro" model. Micro and sector-specific variables and data that are inputs in the "production" of MDGs-related outcomes are embedded in a macroeconomic model to provide aggregate consistency. The country-specific calibration for initial conditions and parameters for the "production" of MDGs has to be done using household surveys and other micro data.

Though it would be desirable to link development outcomes to agents' behavior explaining factor accumulation and productivity, and hence to long run growth determinants, at this stage we limit ourselves to an open-loop model with no feedbacks from MDG attainment to long-term growth. The model has several components:

- A macro model: a standard macro-consistency framework for growth, aid flows (from the balance of payments) and public expenditures (from the budget) provides a baseline scenario for MDGs.

- Sectoral supply-demand models: For each MDG, outcomes are modeled through "production functions". For example, in education, we model how people demand more "enrollment" based on their income level but also on their assessment of the quality of service delivery (e.g., a low "completion" primary school rate, seen as the probability for a child in a cohort to finish primary school, will cause a decline in demand for education); then we model the "quality" of basic services delivery that takes into account specific variables identified by sectoral experts (e.g., how crowded are class rooms, whether teachers show up for work, etc.). In addition, quality can be influenced by externalities (e.g., better child health influences educational achievement).

12 This paper only presents an outline of the model, as this is sufficient to present the points we wish to make. The details can be found in Bourguignon, François, Maurizio Bussolo, Luiz Pereira da Silva, Hans Timmer and Dominique van der Mensbrugghe (2004), "MAMS. Maquette for MDG Simulations," The World Bank, Draft March. Macro-micro linkage models of this kind are discussed in details in Bourguignon, François and Luiz Pereira da Silva, editors. 2003. The Impact of Economic Policies on Poverty and Income Distribution. Washington: The World Bank and Oxford University Press.

- Budgetary and technological constraints explain how the stock (supply) of each 'production' factor can increase and its associated budgetary cost.

- Human capital constraints explain how the model's human capital accumulation is restricted by existing capacity to train/produce more teachers, doctors, medics, etc.

In the remainder of this section, we provide more details on two MDGs: primary school completion rates, and infant/maternal mortality rates.

Education Goal: Primary School Completion Rate

Our first example explains how specific policies can "produce" primary school enrollment and completion rates.[13] The completion rate can be seen as the probability for any child of a given cohort to complete primary school. In order to keep it simple, we disregard the consequences of these policies on the demand for secondary schooling even though it is clear improvements in primary school enrollment and completion rates would have an effect on the demand for secondary education—an effect which policy-makers would be wise to take into account in their supply-side decisions.

On the demand side, at any point in time, the primary school enrollment rate is the number of children of certain age groups (say 6-14) enrolled and attending primary school divided by the population group of the same age group. It is a function of the mean income (per capita output) and of the perceived "quality" of the supply of primary education. Other things being equal, demand will increase with the overall improvement in general economic conditions and with the quality of the primary education system.

On the supply side, "quality" of the supply of primary education is the completion rate for a cohort of primary school children. It is the number of enrolled children that complete primary school every year. This number is a function of three elements: the wage of teachers relative to mean income (which explains inter alia teacher absenteeism);

[13] MDG2 targets universal primary school *completion* and not enrollment. Completion can be also calculated from enrollment by estimating repetition and drop-out rates by age groups.

a variable representing "capacity" in the education sector on a per pupil basis; and policies that are unrelated to primary education (e.g., health policies such as de-worming, improvements in health status, etc.);.

In primary education, "capacity" is a composite stock of three elements: the amount of public non-wage recurrent spending on primary education, the number of classrooms, and the number of primary school teachers. This composite is "scaled" by a parameter which measures the efficiency of the institutional framework.[14] (we follow here Bruns and Mingat 2003). This composite affects the quality of the educational system on a per student basis, depending on how crowded classrooms are, what the teacher/pupil ratio is and how adequate is per capita public non-wage recurrent spending in primary education.

This is shown graphically in Figure 2. The demand for education increases up to the maximum of say 100% of a population age group when quality increases (i.e. completion rates seen as the "probability" for an enrolled child to complete primary school) for a given level of income. For a given level of all other variables, the supply side will generate a declining rate of children completing primary school when enrollment grows since "capacity"—or the educational capital stock—will decline on a per student basis. For a given level of income, "equilibrium" (at$E1^{q,s}$) corresponds to the intersection of the two curves, and can be interpreted as the perceived probability of having a child in a given cohort, given the existing resources of the system, completing primary school.

An increase in per capita income raises the demand for education, produces higher enrollment and shifts the demand curve to the right. When more resources are made available (say, there is an increase—due to policies—in the composite per capita stock of capital in this sector), the supply curve will shift upward producing a higher completion rate for this higher level of demand and reaching a better "equilibrium" ($E2^{q,s}$), i.e. a higher probability of having a child complete primary school.

Conversely, an increase in demand with no supply improvement (e.g., no change in the per capita composite stock, in real wages or other MDGs), could produce a decrease in the completion rate, depending on the point characteristics of the supply curve (this is point $E3^{q,s}$ on the graph).

The important feature in this representation is the inter-play of two variables, per capita income and the quality of primary education, in the demand for primary education. A virtuous circle—of good policies in education pre-empting the increase in demand due to the income effect—drives the system to a new level ($E2^{q,s}$) with higher enrollment and completion. As observed empirically,[15] there could, however, be other possible outcomes with higher enrollment but lower completion (such as $E3^{q,s}$). Empirically, we see that there is a great diversity in enrollment vs. completion rates in low-income countries. There are three distinct groups of countries: (1) countries with a high enrollment and high completion rates; (2) countries with high enrollment and low completion rates; and (3) countries with mediocre enrollment and mediocre completion rates.

Policy Changes under Budgetary and Technological Constraints.

Let us now introduce policy-induced changes. Income per capita, populkation and public expenditure are linked to general macroeconomic conditions given by a macro model (with associated balance-of-payments, and private and public budget constraints). We assume that there is a country-specific and exogenous efficiency factor. Policy changes consist in increasing the number of class rooms and the number of teachers. These changes can be exogenous or endogenous depending on whether we model the supply of new teachers and new classrooms in relation to their relative returns.

Let us chose the exogenous route which leads to a simpler projection rule. The construction of new class rooms[16] depends on productive capacity in the construction

[15] see Bruns, Mingat and Rakotomalala (2003).

[16] We have to take into account an obsolescence factor for classrooms corresponding to destructions of old classrooms and depreciation.

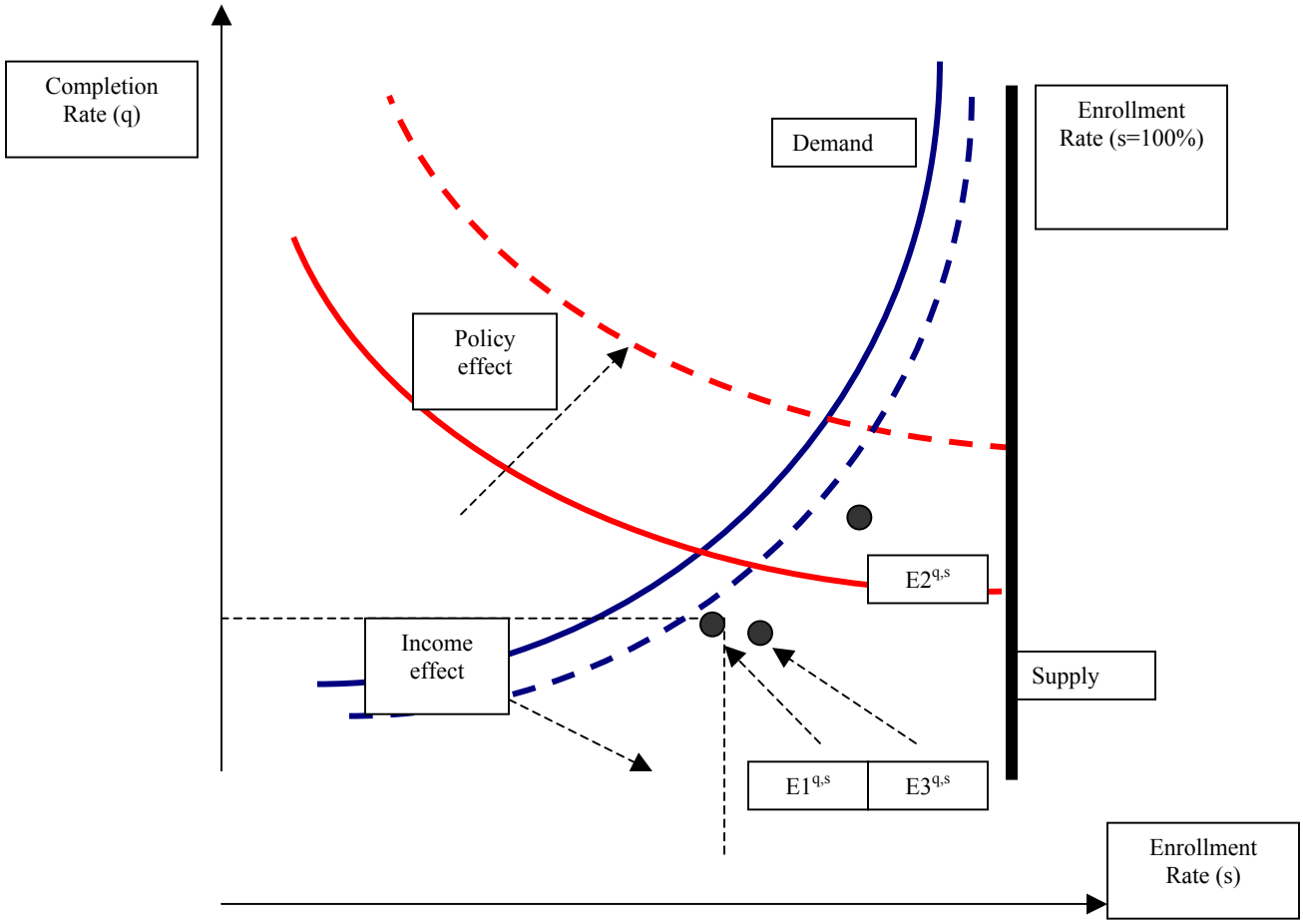
sector and on the budget constraint of the provider (e.g., the public sector) since new class rooms have to built and financed at a given unit cost.

A similar rule applies to teachers. We have to take into account attrition through retirement or disease-related or HIV/AIDS-related death. New teachers have to be trained and their wages have to be paid. We can assume a fixed unit cost for their training (but, in future versions, to determine optimal policies, all these unit costs and prices could be set to capture general equilibrium and crowding-out effects on the rest of the economy).

We have to take into account the sector budget constraint including investment, training, wage and non-wage recurrent expenditures that have to be within a given overall spending envelope in the primary education budget. In addition to this budget constraint, the training of new teachers require a "training capacity", i.e. high level professors required to "produce" new primary school teachers and other skilled workers for the rest of the economy.

Last but not least, there are human capital constraints—these are discussed below for all sectors.

Figure 2: Demand and Supply system for MDG2 (primary education completion rate)



Health Goals: Infant Mortality and Maternal Mortality

For the health MDGs, child mortality (measured by the number of deaths of children under-5 occurring per thousand births) and maternal mortality (measured by the number of deaths of mothers occurring per hundred thousand births), we need to adopt a slightly different reasoning. Health sector outcomes are driven by the supply of specific "treatment" —contrary to the education sector where excess demand or congestion effects negatively impact the outcome or completion rate of the system.[17] To provide an

17 There is a robust epidemiology literature supporting this assertion. See for example, Knippenberg, Soucat and Vanlerberghe (2003)

example, given our knowledge about the main specific causes of under-5 mortality (i.e. 20% due to malaria, 15% to diarrhea and 25% to pneumonia) what is critical for the "production" of fewer deaths is to design coverage packages that are targeted to address the weakest links—or remove bottlenecks—in the process of bringing adequate medical care and/or drugs to individuals and households.[18] Finally, contrary to education where enrollment of additional children can proceed to the detriment of quality (completion), in the health sector, the availability / access to treatment is binding on the outcome, i.e. rationing prevails.[19]

There are three types of coverage rates in the provision of health care, namely family & community interventions; outreach interventions; and clinical/hospital interventions. Family and community interventions are done by health agents—not necessarily with a medical degree—and consist in providing knowledge and information to families and individuals about basic general health precautions. These agents need resources to do their jobs (e.g. transportation, cars, gas, etc). Outreach interventions are done by medics—with a basic medical degree—and consist in providing specific packages of treatment to families, for example, re-hydration, anti-malaria drugs, vaccinations etc. Clinical/hospital interventions are done by doctors in "classic" hospitals or clinics[20] and consist in providing life-saving complex treatments to ailing individuals. These different types of coverage are produced with complementary factors. Together they represent components of the health system's "capacity".

The health sector's overall "preventive and curative capacity" can be represented either as a capital stock—to make a parallel with education—or as an overall coverage rate. The aggregate coverage rate is "produced" by—i.e, is the result of—these three

---

[18] The sectoral literature has pointed to the need to include "specific interventions" i.e. marginal budgeting bottleneck interventions (MBBs) that increase significantly the efficiency of the health system

19 Note that if one could test the skills of children completing primary education with adequate standard measurements (e.g. reading, math, etc.), modeling the MDG2 could possibly go beyond a completion rate and become closer to health in terms of analytical framework.

20 A specific measure of bed-equivalents between clinics and hospitals is needed.

types of coverage. For each health MDG, we assume that the three types of interventions are substitutes to some degree. These outcomes are "scaled" by a factor which accounts for the efficiency of the institutional framework in the health system. This sector-specific efficiency factor could account for the dispersion of health facilities and other inputs across the country, and for other "technical" conditions including corruption and absenteeism in the health sector. The epidemiological literature[21] suggests that the health-sector MDGs (child and maternal mortality rates) are a function of these "capacity" stocks.

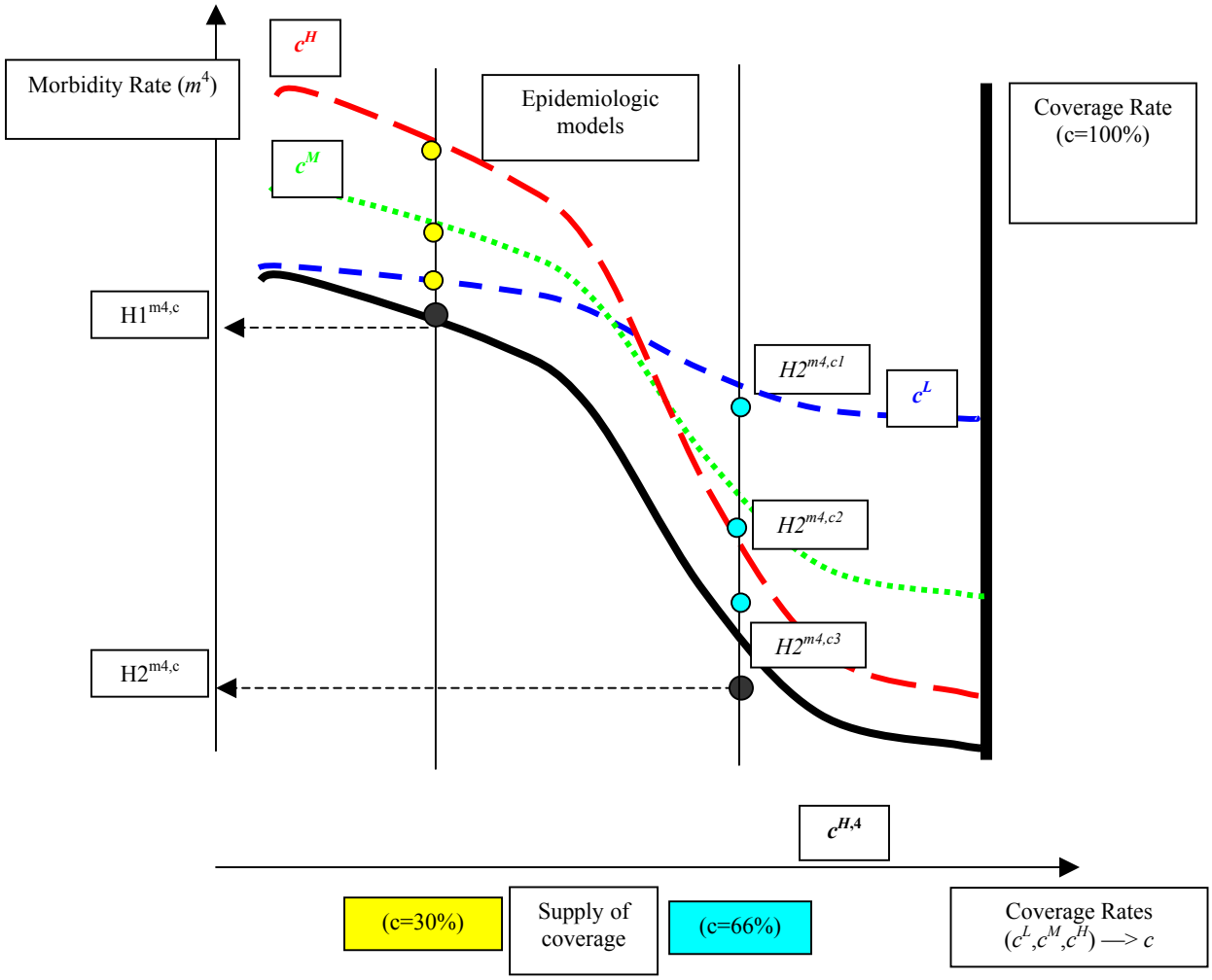
We represent the "production" of health outcomes through a logistic function, an income effect and externalities coming from the health MDGs. The logistic function is depicted in Figure 3. For each MDG (under-5 mortality and maternal mortality), capacity is a coverage (resulting from the aggregation of the three types of coverage). The coverage rate is a "technical" relationship telling us the mortality rate that can be achieved in a given country for combinations of the three coverages.

Since we assume that there is rationing in the health system, the supply of coverage will drive outcomes. At any given level of supply, say at 66% of coverage for the three types of coverage, the shares of each types of intervention in the aggregate depend on country-specific policies and characteristics (e.g., density of population) so as to calibrate properly the epidemiological aspects of the model.

In figure 3, for any level of supply, these shares make the mortality rate vary between the intersection of the supply level with the c^L curve (for example at $m^4=H2^{m4,c1}$) or with the c^M curve at $m^4=H2^{m4,c2}$, or with the c^H curve at $m^4=H2^{m4,c3}$. To take an example, for given country-specific estimated shares, for a supply level of 66%, the under-5 child mortality rate will be given by the combination of c^L, c^M and c^H in the $c^{H,4}$ curve and will yield $m^4=H2^{m4,c}$.

[21] See for example *The Lancet* (2003).

Figure 3: Supply system for MDG4 (under-5 mortality rate)



Budgetary and Technological Constraints.

The main "inputs" for the health MDGs—clinics, health agents, medics and doctors—are subject to a build up (accumulation) process. The overall budget constraint for the health sector is that the sum of investment in health production factors and recurrent expenditure should equals total expenditure on health.

Human Capital Constraint

For both education and health, the training of new teachers, health agents, doctors and new medics is constrained by the existing training capacity. We model this capacity as a function of the stock of professors in higher education. The existing stock of professors has to produce both new educators and health personnel but also the other skilled workers for the rest of the economy and renew its own capacity. Demand and supply considerations also apply to the production of these other skilled workers itself—for example its dependence on the level of per capita income.

Thus, when policy-makers want to improve the quality of the educational and health systems, there are two binding constraints: the demand for *other* skilled labor in the economy and the need to continue replenishing the country's training capacity. Although imports of training capacity, net of human capital flight ("brain drain") can relax the human capital constraint, this obviously cannot a long-term sustainable solution for development. Finally, let us mention that, in order to make our representation more realistic, we could explicitly model relative wages in the human capital constraint.

Water and Sanitation Goal (Population with access to clean water and sanitation)

The reasoning for the modeling of MDG7 (access to clean water and sanitation) is straightforward, and can be done through a reduced form. Both are a function of income per capita and of an output function that relies on recurrent cost and installed capacity. Operational and capital expenditures have to abide by the overall budget constraint of the government. Thus, the MDG outcomes are a function of the 'output' or 'capacity' of water and sanitation services, which itself is an outcome of the combination of recurrent expenditures and installed water and sanitation infrastructure. (We are assuming away use of labor in the production function). We also need a standard accumulation function, where infrastructure in any given period is a function of existing infrastructure, less depreciation, plus investment in new infrastructure. Finally, the budget constraint for water and sanitation expenditures is divided into investment and operational expenses.

Section 4. MDG Scenario Analysis: An Illustration

To illustrate some of the complex issues related to achieving the Millennium Development Goals (MDGs), we design simple scenarios around achieving the goal of 100 percent completion rate for primary education.

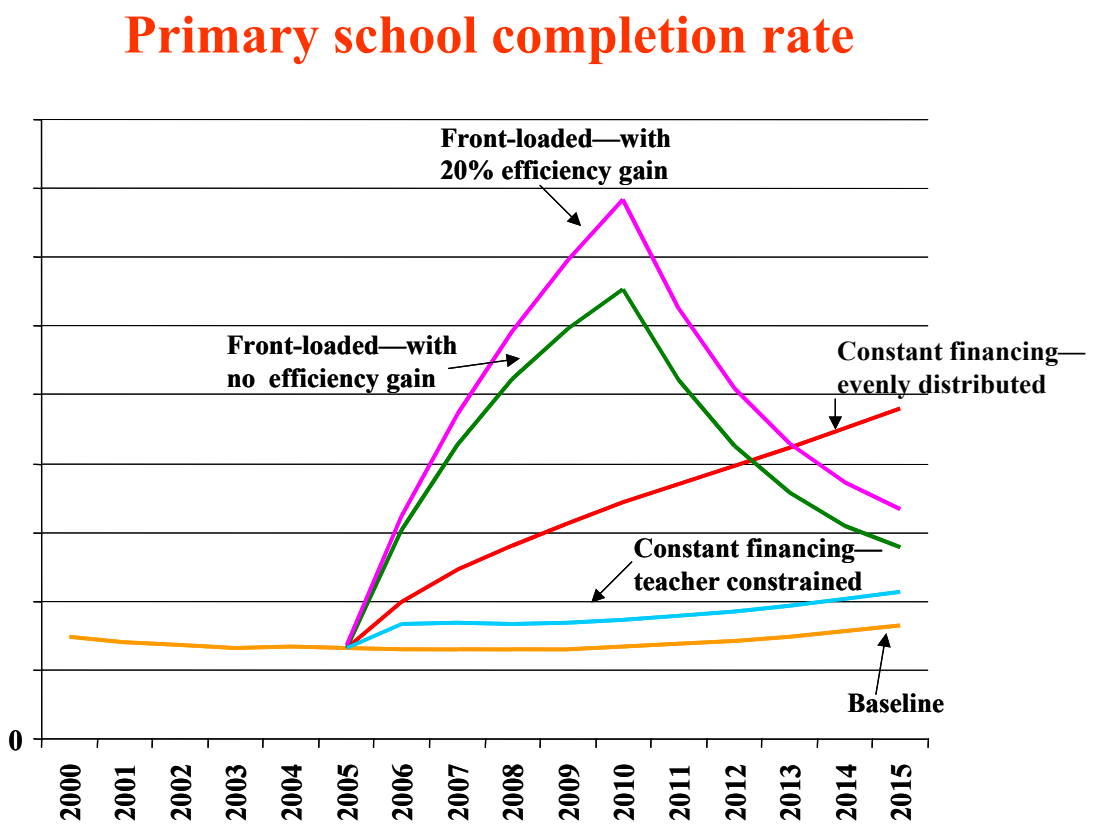
The scenarios are based on a low-income country with a low initial completion rate of around 30 percent. The scenarios assume rapid GDP growth of around 5 percent per annum. But due to high population growth, per capita income rises on average by only around 2.3 percent per annum (between 2005 and 2015). Resources dedicated to primary education—under a baseline scenario—increase by an average of 3.5 percent per annum, somewhat higher than the growth of the student-age population. Under this baseline, the completion rate would see a gradual, but modest, rise and remain around 30 percent, i.e., well below the 100 percent-completion rate target (figure 4).

We next undertake four alternative scenarios with additional financing for the primary education sector.[22] All three scenarios use the same cumulated amount of financing over a 10-year horizon spanning 2005-2015.

Scenario 1: Constant Financing, Evenly Distributed. The primary education budget is increased by a fixed proportion in each year and the financing is spread over recurrent costs and investment expenditures such that recurrent spending and the *stock* of classrooms and teachers grow at the same rate. The basic idea here is that there is an ideal combination of teachers, classrooms and recurrent expenditures (textbooks, energy, supplies, etc.) and that the three together should grow at similar rates.[23] Under this alternative, the completion rate gradually rises to nearly 100 percent.[24]

---

[22] We ignore the source of the financing and its potential macroeconomic effects.
[23] This is not necessarily an 'optimal' scenario. In other words, there might be alternative combinations of expenditures—both across time and across expenditure shares—which could lead to the same result at a lower cost.
[24] An unresolved issue under these scenarios is what happens beyond the 2015 time horizon.



Scenario 2: Front-Loaded Financing. A second scenario involves the same total expenditure, however, it is front-loaded in the first five years, with expenditure reverting back to its baseline level in 2010 and beyond. As seen in figure 4, this leads to an impressive rise in the completion rate, but then followed by a rapid fall as resources are inadequate to maintain a high quality level in schools. There is a permanent increase in the completion rate compared with the baseline—because the additional classrooms and teachers obtained during the initial years remain in place after 2010, but the lack of additional investments and resources to pay for the recurrent expenditures leads to a decline in the quality of education and a rapidly deteriorating completion rate. This scenario shows the importance of the sequencing of additional financing and its continuity.

Scenario 3. Front-Loaded Financing but with Efficiency Improvements. Same as scenario 2, i.e., same total expenditure but front-loaded in the first five years. However, we also assume that institutions improve leading to an efficiency of 20 percent in the use

of resources (i.e., the same number of teachers and classrooms can "produce" more). This leads to a similar profile over time of the completion rate, with a rapidly deteriorating completion rate after 2010, though it reaches the level of 70 percent (instead of 55 percent in scenario 2) in 2015.

Scenario 4: Constant Financing, Teacher Constrained. The final scenario also uses the same overall additional budget, but only allocated to the financing of classrooms and recurrent expenditures.[25] This leads to an improvement in the completion rate—to somewhat above 40 percent—but well below what could be achieved by a more judicious allocation of resources. This scenario clearly indicates another complexity in the funding of the MDGs, i.e. constraints on the domestic absorptive capacity.

What lessons do we draw from these scenarios?

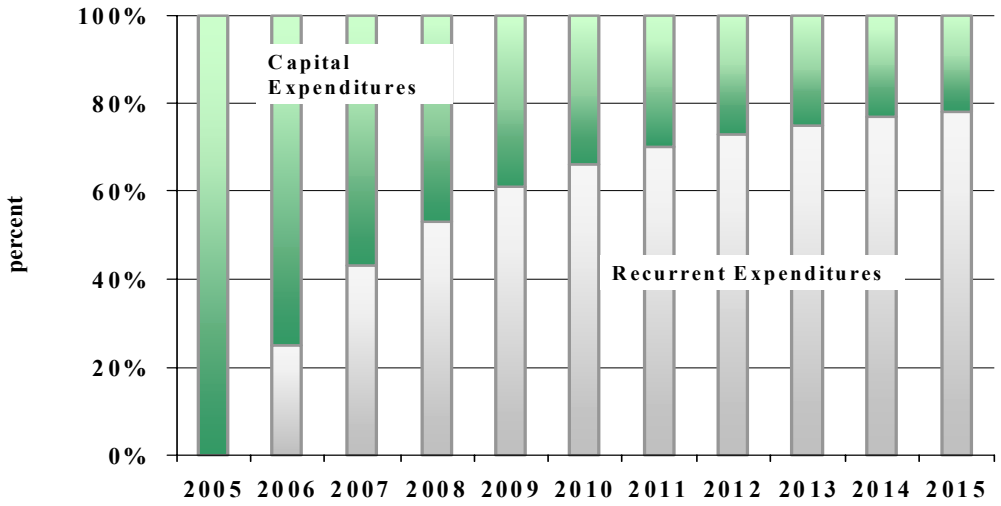
- Scenario 1, with the allocation of additional funding across capital and recurrent expenditures, gives us an opportunity to discuss another interesting feature of the path towards MDGs' attainment. To increase capacity, the initial funding effort is mainly devoted to investments. As seen in figure 5 below, in the very first years, almost 100% of additional money is spent on building new schools and train new teachers, and recurrent expenditures absorb a minor share of the new funds.[26] As time passes, the human and physical capital constraints ease and educational capacity reaches a level sufficient to achieve the MDG by the year 2015. However additional funding is needed to maintain the newly installed capital, to pay teachers and to fund non-wage recurrent expenditures. As shown in the graph, these latter categories increase their importance as shares of the additional budget fairly soon: in the 4th year for non-wage recurrent expenditure and in the 6th year for the wage expenditures.

[25] This is a plausible scenario in a situation where the tertiary education sector is constrained and is unable to train enough teachers—at least in the time framework under consideration.

[26] Complex sequencing and lag issues, such as the multi-year time span necessary to build schools or complete training of new teachers, are for the moment not included, and we assume that additional investments are up and running in the following year.

Figure 5: Shares of Additional Spending per Budget Item

Constant financing evenly distributed



- What if the additional financing of recurrent costs in later years is not guaranteed and all additional expenditure is front-loaded into the first years? This case is analyzed in scenario 2 which shows the importance of the sequencing of additional financing and its continuity.

- Scenario 4 clearly illustrates another complexity in the funding of the MDGs, i.e. constraints on the domestic absorptive capacity.

To conclude, these scenarios illustrate two key points:

- The allocation of financing across expenditure categories and across time needs to be taken into consideration
- Domestic absorptive capacity needs to be taken into account and bottlenecks need to be identified.

The scenarios just described are illustrative. They only focus on the impacts of policy changes in a single sector—primary education. The framework presented in this paper can take into account the cross-sectoral complementarities, for example how

improvements in water and sanitation directly impact health outcomes. It can also take into account macroeconomic feedbacks—for example labor market constraints and potential exchange rate impacts of higher external resources.

References

Azam, Jean-Paul, Shantayanan Devarajan and Stephen A. O'Connell (1999), "*Aid Dependence Reconsidered*," Centre for the Study of African Economies Working Paper, WPS/99/05, March.

Barro, Robert J. (1999), "*Human Capital and Growth in Cross-Country Regressions*," Swedish Economic Policy Review, 6(2), Autumn: 237-87.

Bourguignon, François, Maurizio Bussolo, Luiz Pereira da Silva, Hans Timmer and Dominique van der Mensbrugghe (2004), "*MAMS. Maquette for MDG Simulations*," The World Bank, mimeographed, March.

Bourguignon, François and Luiz Pereira da Silva, editors, (2003), *The Impact of Economic Policies on Poverty and Income Distribution: Evaluation Techniques and Tools*, Oxford University Press and The World Bank.

Bruns, Barbara, Alain Mingat and Ramahatra Rakotomalala (2003), *Achieving Universal Primary Education by 2015: A Chance for Every Child*, The World Bank.

Bulir, Ales and Timothy Lane (2002), *Aid and Fiscal Management*, International Monetary Fund, Policy Development and Review Department Working Paper No. 02/112.

Collier, Paul and David Dollar (2002), "*Aid Allocation and Poverty Reduction*," European Economic Review, vol. 46, No.8

Cordella, Tito and Giovanni Dell'Ariccia (2003), *Budget Support versus Project Aid*, International Monetary Fund, Research Department Working Paper No. 03/88.

Devarajan, Shantayanan, David R. Dollar and Torgny Holmgren, editors, (2001), *Aid and Reform in Africa: Lessons from Ten Case Studies*, The World Bank.

Development Committee (2004), *Global Monitoring 2004. Policies and Actions for Achieving the MDGs and Related Outcomes*, Report to the Development Committee prepared by a team led by M. Zia Qureshi, Spring Meetings of the World Bank and the IMF, April 25, 2004, Washington D.C.

Development Committee (2003). *Supporting Sound Policies with Adequate and Appropriate Financing.* Report to the Development Committee prepared by a team led by Mark Baird and Sudhir Shetty, Annual Meetings of the World Bank and the IMF, DC2003-0016, 22 September 2003, Washington D.C.

Easterly, William, Ross Levine, and David Roodman. 2003. "*New Data, New Doubts: A Comment on Burnside and Dollar's 'Aid, Policies, and Growth' (2000)."* New York University: New York, mimeographed.

Goldin, Ian, Halsey Rogers, and Nicholas Stern. 2002. "The Role and Effectiveness of Development Assistance: Lessons from World Bank Experience." in: *The Case for Aid*. Washington, D.C.: World Bank, 25-186.

Gupta, Sanjeev ; Clements, Benedict J. ; Pivovarsky, Alexander ; Tiongson, Erwin R (2003) *Foreign Aid and Revenue Response: Does the Composition of Aid Matter?,* International Monetary Fund, Fiscal Affairs Department Working Paper No. 03/176

Haddad, Lawrence, Harold Alderman, Simon Appleton, Lina Song and Yisehac Yohannes (2003), "*Reducing Child Malnutrition: How Far Does Income Growth Take Us?"* World Bank Economic Review, 17(1): 107-*31.*

Hansen, Henrik and Finn Tarp. 2001. "Aid and Growth Regressions," Journal of Development Economics, 64(2): 547-70.

Heller, Peter and Sanjeev Gupta (20xx), "*More Aid: Making it Work for the Poor*," World Economics, vol. 3, No.4, pp. 131-146.

Heller, Peter and Sanjeev Gupta (2002), "*Challenges in Expanding Development Assistance,*" IMF Discussion Paper PDP/02/5, March.

Hitiris, Theo and John Posnett (1992), "The Determinants and Effects of Health Expenditure in Developed Countries," *Journal of Health Economics*, 11(2), August: 173-81.

Kanbur, Ravi, Todd Sandler and Kevin Morrisson (1999), *The Future of Development Assistance: Common Pools and International Public Goods*, Washington, DC: Overseas Development Council.

Knippenberg Rudolph, Agnes Soucat and Wim Vanlerberghe (2003), "*Marginal Budgeting for Bottlenecks: A Tool for Performance Based Planning of Health and Nutrition Services for Achiveing Millennium Development Goals,*" mimeographed, UNICEF and The World Bank.

The Lancet (2003), *Child Survival*, special issue, Volume 361, Number 9376, June.

Lee, Jong-Wha and Robert J. Barro (2001), "Schooling Quality in a Cross-Section of Countries," *Economica*, 68(272), November: 465-88.

Miguel, Edward and Michael Kremer (2001), "Worms: Education and Health Externalities in Kenya," *The Center for Labor Economics Working Paper*, No. 40, University of California, Berkeley, July.

Obersteiner, Michael and Szymon Wilk (1999), "Determinants of Long-Term Economic Development: An Empirical Cross-Country Study Involving Rough Sets Theory and Rule Induction," *Transition Economics Series Working Paper*, No. 11, Institute for Advanced Studies (IHS).

Powell, Robert K. (2003) *Debt Relief, Additionality, and Aid Allocation in Low Income Countries*, International Monetary Fund, African Department, Working Paper No. 03/175.

Rao, D. N. and R. L. Bhat (1991), "Estimation of a Community Health Status Index on the Basis of a MIMIC Model," *Indian Economic Review*, 26(1), January-June: 51-63.

Radelet, Steven (2003). *Challenging Foreign Aid. A Policymaker's Guide to the Millennium Challenge Account*. Washington, DC: Center for Global Development.

Sachs, Jeffrey D. (2002), "Resolving the Debt Crisis of Low-Income Countries," *Brookings Papers on Economic Activity*, Issue 1: 257-86

United Nations Development Programme (2003), *Human Development Report 2003: Millennium Development Goals: A Compact among Nations to End Human Poverty*, Oxford University Press.

Wagstaff, Adam et al. (1999), "Equity in the Finance of Health Care: Some Further International Comparisons," *Journal of Health Economics*, 18(3), June: 263-90.

The World Bank (2002). *Macroeconomic and Structural Policy Implications of Increased Aid. A Guidance Note for Bank Staff.* Washington, DC, October.

The World Bank (2003). *World Development Report 2004: Making Services Work for Poor People.* Washington, DC: Oxford University Press.