ACHIEVING THE MILLENNIUM DEVELOPMENT GOALS: WHAT'S WRONG WITH EXISTING ANALYTICAL MODELS? [1]

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ABSTRACT

Effective strategic choices for achieving the MDGs must be based on sound assessments of the costs and benefits of alternative policies. However, existing approaches to identifying these costs and benefits are unreliable. In particular, estimates of the costs and benefits of alternative strategies derive from implausible and restrictive assumptions, often depend on poor quality data, and are of limited value in guiding long-term decisions due to substantial uncertainties concerning the future. These weaknesses of existing analytical models can be mitigated but not overcome. An alternative to the technocratic approach to strategic planning is needed, in view of the potential damage from the use of erroneous analytical models.

Keywords: Poverty, Development, Millennium Development Goals.

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1.0 Introduction: Millennium Development Goal Cost Estimates

This study critically evaluates existing analytical models used to estimate the cost of achieving the Millennium Development Goals (MDGs) from a number of sources -including the UN Millennium Project, UN Development Programme, the World Bank and the Zedillo Commission. Effective strategic choice requires the comparison of the costs and benefits of alternative strategies. However, existing approaches to identifying the costs and benefits of alternative strategies for achieving the MDGs are unreliable. A practical alternative to these existing approaches exists. The alternative approach to strategic choice rejects heavy reliance upon "technocratic" models specified *ex ante*, so as to diminish the likelihood of costly errors arising from faulty analytical models.

In this section, we introduce the MDGs, in section two we discuss the importance of cost estimates in the choice of strategies, in section three we discuss the analytical requirements of a cost estimate, in section four we discuss the main methodological problems present in the analytical models surveyed, and in section five we offer a conclusion and alternative.

Introduction to the MDGs:

The Millennium Development Goals (MDGs) are a set of eight specific (in many instances, quantitative) objectives for the betterment of the human condition, including goals of poverty reduction and improvement in education, gender equality, health, and environmental quality[1].

The MDGs replace various previous UN initiatives to provide time-bound and quantitative global goals to guide and influence national and international strategies for development. Since its creation the United Nations system has defined a wide variety of global goals with specific outcome targets, including among others ending colonialism (a focus especially in the period from the 1940s to the 1960s), accelerating economic growth through increased international assistance (a focus during the UN Development Decade in the 1960s and the three subsequent decades) and eradicating smallpox, malaria and other communicable diseases (a focus from the 1950s onward)[2].

In 1995, the OECD Development Assistance Committee (DAC) engaged in a year long process of reviewing past experiences and of planning long-term policies. This initiative resulted in the report *Shaping the 21st Century: The Contribution of Development Co-operation*, published in May 1996, which formulated seven goals extracted from the resolutions of UN conferences and meetings[3]. Subsequent expert meetings led to the definition of quantified International Development Targets (IDTs) (measured by 21 indicators) to be achieved by 2015[4]. The MDGs are a synthesis of the International Development Goals agreed upon at the UN social development conferences and global summit meetings of the 1990s, and the Millennium Declaration adopted by heads of state at the Millennium Summit in New York in September 2000[5]. In 2001, the MDGs were approved by the UN General Assembly as part of the UN Secretary General's report *A Road Map Towards the Implementation of the United Nations Millennium Declaration*[6].

The Millennium Summit integrated most of the IDTs into its Millennium Declaration, while adding new objectives for halving the proportion of people suffering from hunger, reversing the spread of HIV/AIDS, malaria, tuberculosis and other major diseases, halving the proportion of people without sustainable access to safe drinking water, and improving the lives of 100 million of slum dwellers. The addition of an eighth goal (to "Develop a Global Partnership for Development") was meant to complement the seven social and environmental targets and to underline the need for developed countries to bring about policy reforms and provide resources so as to support developing countries' ability to participate effectively in the global economy[7].

The final declaration of the Monterrey Conference on Financing for Development[8] held in 2002 emphasized the dramatic shortfall in the resources required to achieve the internationally agreed development goals, including those contained in the Millennium Declaration.

Global cost estimates[9]:

In the Technical section of the Report of the High Level Panel on Financing for Development (also called the "Zedillo Report", after the former President of Mexico who chaired the Panel), it was suggested that "the cost of achieving the 2015 goals would probably be on the order of an extra $50 billion a year"[10]. The Zedillo Report's estimate of this total derives from adding the costs of achieving individual goals as identified in other sources (typically produced for previous international conferences on sectoral goals) and as produced by its own *ad hoc* calculations. Where cost estimates for specific goals were altogether unavailable or infeasible to produce, the cost of achieving these goals was not included in the analysis. Accordingly, the figures provided in the Zedillo Report are represented as merely indicating "the order of magnitude" of the additional funds required to achieve the Millennium Development Goals.

Subsequently, other actors, including the World Bank and the UNDP have attempted to assess the cost of achieving the MDGs in greater detail.

The World Bank's estimates[11] the cost (to donors) of achieving Goal 1 (the reduction of income poverty and undernutrition) as ranging between US $ 54 billion and $ 62 billion a year. It estimates the cost of achieving the other goals (by adding existing sectoral estimates as did the Zedillo commission) as ranging between US $ 35 and $ 76 billion per year. According to the Bank, which stresses the rather hopeful theory that the attainment of Goal 1 will help to achieve the other goals, these two sets of figures should not be aggregated, in order to avoid 'double-counting'.

A background paper[12] for the UNDP's Human Development Report 2003 (by Pettifor and Greenhill) takes a broadly similar approach to that of the World Bank. It estimates the cost of achieving Goal 1 by attempting (as does the Bank) to identify the investments required to generate poverty-reducing increases in output in developing countries.[13] The total cost estimate is US$ 76 billion, significantly higher than the Zedillo report and in the upper range of the World Bank's estimates. Its sectoral cost estimates derive from previously published sources, as in the case of the Zedillo Commission and the World Bank.

As mentioned, all of these reports draw to a significant extent on existing global cost estimates developed for individual sectors. These sectoral cost estimates are often of poor quality for a variety of reasons (some of which will be mentioned below). Moreover, as the estimates are of different cost concepts, they cannot usually be meaningfully added.

All of the reports recognize (though insufficiently) these inadequacies of global estimates and accordingly call for country-level cost estimates of achieving the MDGs, in the belief that these will be more reliable. Such country-level cost estimation exercises are being undertaken presently by the UNDP, the Millennium Project (described below) and the World Bank.

Country-level cost estimates:

At the national level, UNDP country offices have attempted to estimate the cost of attaining the MDGs in six countries[14]. The reports they have produced focus on six MDG targets, related to income poverty, primary education, child mortality, maternal health, HIV/AIDS and access to water.

The Millennium Project (an advisory body to the UN Secretary-General directed by Professor Jeffrey Sachs), has recently published a major report: "Investing in Development: a practical plan to achieve the Millennium Development Goals"[15] and has prepared a number of country case studies to identify major "interventions" required in its view to achieve the MDGs in the countries concerned. To develop its "MDG needs assessment", the Millennium Project has followed a multi-step approach based on experts' task forces and country institutions' input. The Millennium Project approach develops a list of so-called interventions that can potentially promote the MDGs, and develops investment plans which aim to attain the MDGs through these interventions[16].

The World Bank project focuses on 18 countries[17]. The World Bank approach gives priority to the 'Poverty Reduction Strategy' previously defined by each country, and asks how, given that priority, the MDGs can be best achieved. Since the World Bank gives priority to a goal other than that of achieving the MDGs, it may quite properly be objected that it is not estimating the cost of achieving the MDGs at all. One way to make sense of the Bank's approach is to interpret it as estimating the cost of achieving the MDGs subject to the constraint that a country will adhere to the plans identified in its PRSP. Although this is a coherent exercise, it is certainly not the same as estimating the cost of achieving the MDGs as such, and is therefore of rather limited value. Recent efforts by the World Bank in this area also emphasize the elaboration of a general equilibrium demand-supply framework governing the production of MDGs in each country.[18] Since the data requirement for using a general equilibrium approach of this kind meaningfully to arrive at estimates of the costs of alternative strategies in individual countries are prohibitive, such efforts should be viewed as providing a conceptual framework. Indeed, to the best of our knowledge no detailed cost estimates for individual countries have as yet been produced on this basis, and it will not therefore be considered further here.

Remainder of the paper:

The next section (2.0) of the paper establishes the rationale for estimating the cost of achieving the MDGs – whether taken together or separately, and whether considered globally or in individual countries. The main conceptual and practical requirements of a cost estimate are studied in section 3.0. The primary problems that are present in existing approaches to estimating the cost of achieving the MDGs are presented in section 4.0. In conclusion, we suggest a means of responding to the inadequacies in existing efforts to identify the costs of achieving the MDGs and to use these as a basis for planning and decision-making.

2.0 The importance of cost estimates in the choice of strategies

Typically, there is more than one strategy that can plausibly help to achieve a goal. The comparison of strategies requires attention to relevant information, including the effectiveness with which it is likely to promote the goal, the risks attendant in pursuing the strategy and its costs.

Cost estimates play a role in arriving at an answer to two types of questions. At the risk of some oversimplification, we may view the first question as normative in nature and the second as operational in nature. The central normative question is: should a specific end be pursued at all (given alternative ends)? The primary operational question is: how should a specific end best be pursued (given alternative means to achieve the end)? Cost estimates play an essential role in determining the relative desirability of alternative means of achieving an end. The end that we consider in this paper is the achievement of the MDGs.

2.1 The role of aggregate cost estimates in informing the choice between objectives:

If a decision-maker makes a firm commitment to achieving a particular (feasible) objective, then the total cost of achieving that objective is (by definition of having made a commitment) irrelevant to determining whether or not the objective ought to be pursued. A different situation arises when the commitment to achieving a particular objective is not unconditional (for instance because the decision-maker is prepared to "trade off" distinct objectives against one another). In that case, the cost of achieving a particular objective will be salient to determining whether (or to what extent) the objective should be pursued.

Much of the discussion on MDG cost estimates seems to suppose that a firm commitment to achieving the MDGs does not yet exist. The feasibility of achieving the MDGs, given a sufficient application of resources and adequate policy and institutional reform, is not generally in doubt[19]. However, an implicit rationale for cost estimates is that they are needed to convince developing countries and donors that the MDGs can be achieved without undue sacrifice of other objectives. Thus there has been a desire to argue that the MDGs can be achieved with a 'reasonable' quantity of resources (for instance, for less than the 0.7% of GNP development assistance norm that donors have previously agreed upon). This is the view stressed for example in Millennium Project (2005) and in Sachs (2005).

2.2 The role of aggregate cost estimates in planning to achieve an objective:

Once it has been determined that the MDGs are to be achieved, there remains a question of how best to achieve them. Aggregate cost estimates may be important from the standpoint of budgeting. In particular, it may be necessary to identify *in advance* the resources to be allocated to a specific purpose. If so, it is important to identify realistically the resources that will be required. Failure to do so may lead to the inability to make appropriate expenditures when they are required, with a resulting failure to achieve the objective.

Generally, the optimal level and pattern of current consumption and investment will depend on forecasts of future income and needs. The rationale for current choices regarding the level and pattern of consumption and investment derives from the part they play in an integrated expenditure plan over a relevant budgetary period.

This role of aggregate cost estimates in budgeting to achieve the MDGs may be relevant at both the global and the national level. However, budgeting must be undertaken over a realistic period. The length of the appropriate period over which budgeting should take place will reflect the reliability of forecasts regarding future costs and resource generation opportunities, the likelihood that new information will be revealed at different points in the future, the possibility that over time there will arise changes in priorities, and the costs of undertaking budgeting itself. The appropriate period for budgeting will vary according to context and purpose[5].

2.3 The role of disaggregated cost estimates in planning to achieve an objective:

It may be desired to achieve the MDGs with the fewest possible resources, so as to leave more resources to achieve other objectives (other than those identified in the MDGs or beyond the thresholds defined in the MDGs), or so as to achieve the MDGs as rapidly as possible. It is necessary to identify the costs of achieving the MDGs through alternate means in order to identify the most efficient approach to achieving the goals. We may consider two distinct types of substitution which can be used to characterize alternative approaches to achieving the MDGs:

Substitution across countries:

A number of the MDGs are phrased as global goals. It is therefore imaginable that they may be best achieved by focusing efforts in a few large countries. If the MDGs are to be pursued on an aggregate global basis, without regard for the fact that individual countries may fall severely behind in their individual attainment of the goals, then the relative cost of achieving the goals in different countries will be of great importance to determining the best strategy to pursue. The interpretation that the MDGs are to be attained globally, and without regard to the extent of their achievement in individual countries, is implicit in certain analyses (such as Bhalla (2002)) and not in others (e.g. the country studies undertaken by international organizations)

[5] It is interesting to note that in the context of national development plans, it has generally been thought unrealistic to produce budgetary plans over periods of greater than five years.

In contrast, the MDGs have been interpreted by others (in particular Devarajan, Miller and Swanson 2002, UNDP and the Millennium Project) as to be achieved on a country-by-country basis. Under this latter interpretation, there is no scope for substitution across countries to achieve the MDGs, and as a result information concerning the relative costs of achieving the MDGs in different countries will be of little relevance.

Substitution across means:

Within any country, the MDGs may be promoted through alternative means. The choice of means may be greatly important to enabling the MDGs to be achieved at all, let alone at the least cost and as rapidly as possible. Therefore, information on the costs of promoting the MDGs through distinct means (e.g. "interventions" and "policies") is indispensable to developing a country-specific plan for achieving the MDGs. For instance, it may be necessary to choose between promoting school enrolment through mid-day meals schemes or through reducing the distance to schools.

3.0 Analytical Requirements of a Cost Estimate

A credible estimate of the cost of achieving the MDGs, within a country or globally, must undertake the following tasks:

Identify the cost concept:

It is necessary to conceptualize costs in some way. For instance, costs to the domestic public sector, costs to the domestic and foreign public sector, aggregate domestic costs (to the domestic private and public sector) and aggregate global costs (to the domestic and foreign private and public sector) are each distinct cost concepts that will give rise to distinct estimates of the costs of achieving a given goal. Moreover, explicit financial costs (at market prices), total resource costs (valued at market prices) and opportunity costs are distinct cost concepts. These distinct cost concepts have often failed to be clearly differentiated in the applied literature on MDGs, although each is appropriate for a different purpose and will give rise to widely divergent estimates of costs.

Accurately identify the baseline scenario:

Estimating the cost of achieving a goal requires an assessment of the starting point in relation to which it is defined. What is the initial level of each indicator (for instance the percentage of persons suffering from hunger, or possessing an income of "less than $1 per day") in relation to which the goals' final targets and ongoing progress ought to be assessed?

Accurately identify the cost function:

An estimate of the cost of achieving a goal requires the identification of the cost function which describes the cost of achieving the goal to a particular extent, given relevant circumstances. Since this cost function is based on a counterfactual that cannot directly be observed, it is necessary to have some other basis for imputing it. Typically, this imputation is disaggregated into the following elements:

Identification of unit costs:

What are the *observed* costs of generating a unit of the desired outcome, either on average or on the margin? Where these costs are not directly observed, they may be inferred based upon experiences elsewhere.

Projection of unit costs over the coverage range:

What are *expected* to be the costs of generating subsequent units of output, until the point that the goal is achieved? Judgments concerning the costs of producing subsequent units of output will generally be influenced by current observations of unit costs and by relevant facts about the world, including the causal process giving rise to a particular outcome. For example, there may be increasing costs of achieving certain outcomes as it becomes necessary to extend services to populations that are geographically or socially difficult to reach. On the other hand, positive 'network externalities' (associated for instance with the spread of information) may reduce the marginal cost of achieving certain goals as they are closer to being attained. Judgments concerning the nature of the cost function will be controversial insofar as the empirical information and causal theories that they depend on are controversial. By definition, unit costs that will hold in the future cannot be observed. They must be estimated based upon present unit costs and (possibly also controversial) assumptions concerning expected technological and institutional changes.

4.0 Main Methodological Problems

Recent estimates of the cost of achieving the MDGs are subject to various criticisms. We examine the most prominent recent estimates, including those from the World Bank and Millennium Project. As we shall see, some recent estimates suffer from more severe problems than do others. *All* existing efforts to identify the cost of achieving the MDGs suffer from problems under *each* of the general headings that we identify below. Of course, different approaches differ in the extent to which they suffer from the *specific* problems that we identify under these headings. In lieu of a goal by goal discussion of the issues, many of which are well known to expert readers, we confine ourselves here to a discussion of issues that are of critical and cross-cutting concern in relation to all MDG cost estimates. We offer examples of difficulties with existing estimates that are merely indicative. Many more can be found through careful scrutiny. Rather than treating each of the estimates individually we group them together in recognition of the common problems from which they suffer.

4.1 Unjustified assumptions:

Existing national and global cost estimates are not robust to the choice of assumptions. A number of simplifying assumptions have been made in each existing study in order to make the analysis tractable. Unfortunately, these assumptions are rarely justified.

Macroeconomic Assumptions:

Studies vary widely in their (invariably ad hoc) assumptions concerning future growth rates of national income, future rates of tax revenue generation, and the levels of public and private financing of expenditure that may reasonably be expected. It might be added that they have often made very optimistic assumptions in this regard as compared with the historical record for the countries concerned. Appendix three shows that the estimates of future national growth that are made by the Millennium Project are highly optimistic as compared with the historical record of many developing countries.

These parameters are of great importance to 'closing a model' and generating a cost estimate, both because estimates of future requirements depend critically on growth assumptions and because it is usually desired to estimate the total costs to the domestic and foreign public sector of achieving the MDGs rather than to estimate the costs to all. There is often no evident basis on which to choose between these qualitatively and quantitatively widely divergent assumptions, and thus the resulting cost estimates lack in credibility.

Devarajan, Miller and Swanson (2002) of the World Bank quite appropriately note that "any attempt to determine the aggregate costs of achieving the development goals is a highly speculative exercise". Indeed, the methodology they themselves employ well illustrates how restrictive assumptions can result in erroneous estimates. The authors' basic method is to "calculate the additional aid required to meet the poverty goal by estimating the additional growth required to raise average incomes by enough to raise the goal, and then estimating the additional aid required to attain that growth". The authors emphasize that their approach is to assume that the MDGs must be met on a country-by-country basis. They state that "Working backward from the existing poverty level and distribution of income, the average rate of growth required to reach the poverty goal in 2015 determines the amount of additional investment needed". The authors have assumed (see Appendix 2 of their paper) that the income distribution will be unchanged (i.e. that growth in incomes will raise all incomes by an equal share). As recent experience in many countries demonstrates, this may be a quite unreasonable assumption (see e.g. Cornia and Kiiski, 2001). The authors estimate the additional resources required to attain the growth target by making alternative assumptions centered on historical experience concerning countries' savings rates and incremental capital output ratios.

The authors also note that there may exist "absorption constraints" that limit countries' capacity to use resources effectively. As a result, beyond a "saturation point", additional resources are assumed to have zero impact. Moreover, this "saturation point" is said to vary with the nature (or "quality") of a country's policies and institutions. The authors report research that finds that "for countries which have policies and institutions that are among the best of [those of] developing countries… the point beyond which the growth impact is zero is reached when aid is around 30 percent of GDP. By contrast, the saturation point for countries with extremely weak (sic) policies and institutions is calculated to be around 6 percent of

GDP". This inference is based on a model that is replete with conceptual problems. The notion of an "absorption constraint" (beyond which the marginal impact of applying additional resources is presumably zero) is ill-conceived. Presumably it is believed that the so-called absorption constraint cannot itself be relieved through the appropriate application of additional resources. It is unclear what would in practice constitute an absorption constraint of this kind. The concept of an "absorption constraint" is however employed extensively in the report of the Development Committee[20] entitled "Supporting Sound Policies with Adequate and Appropriate Financing"[6] which goes even further, and suggests that a rather large share of countries would be altogether unable to achieve the first MDG (and others), irrespective of the degree to which policies are revised and finances augmented![21]

The view that policy revisions (and in particular the abandonment by countries of "bad" policies for "good ones") can by itself lead to the substantial accomplishment of the first MDG appears to be quite popular among some authors (see in particular, Development Committee, 2003 or Collier and Dollar 1999 and 2000). In addition to the admirable terminological clarity which these analysts bring to bear, they should perhaps also be congratulated for the unequivocal character of their analysis. Alas, there is neither universal agreement on how to classify policies as "good" and "bad" nor on the impact that "good" policies have on growth. A country is identified as having "good" policies according to these authors if it receives a high score on the World Bank "Country Policy and Institutional Assessment"[22] (CPIA). This measure relies on the subjective judgments of World Bank "country specialists" and gives importance to criteria such as the presence of a "Competitive Environment for the Private Sector" and "Property Rights and Rule-based Governance"[23]. The CPIA gives equal weights to each indicator, notwithstanding the preponderance of indicators linked to economic policies and outcomes and the relatively few indicators linked to social policies and outcomes. It is unlikely that there would be universal agreement either that such criteria are appropriate to include in a measure of "good policies" (i.e. policies which have the good effects that are presumed to follow in these analyses) or on how to measure them. Importantly, the conclusion that the selected "good policies" have good effects are seriously undermined by omitted variable biases and other econometric failings in the studies that claim to establish their centrality in producing desirable outcomes (in particular economic growth)[24]. It seems imprudent for analysts to base a global cost estimate for achieving the MDGs on such controversial causal theories.

Estimates of the cost of achieving the first MDG are critically dependent on estimates of the so-called poverty reduction elasticity of growth (i.e. the elasticity of the poverty headcount ratio with respect to per capita income). In the case of the World Bank's estimates, this is because the resources necessary to achieve the income growth required to achieve the first MDG depends on the assumed parameters. In the case of the Millennium project's estimates, this is because the resources estimated to be available domestically to achieve the MDGs depend on the assumption that sufficient growth will take place to achieve the first MDG[25]. In fact, estimates of poverty-reduction elasticities of growth vary widely according to the country, sector, and type of income. Recent literature (see for instance Bourguignon (2001), Farr (2001), Heltberg (2002), Kakwani and Pernia (2000), and Ravallion and Datt (1999)) demonstrates that poverty-reduction elasticities widely vary between countries, regions and

[6] Now widely referred to as the "Baird/Shetty report". See e.g. Bourguignon (2004).

persons. Moreover, such elasticities are not inflexible, but are rather greatly influenced by policy variables and by other human development achievements (such as literacy). This is hardly surprising, as it is well-known that individual earnings capacities are deeply dependent on the possession of relevant human capabilities (or as they are more frequently referred to in the literature, 'human capital'). Moreover, unless income distributions and growth dynamics are for a very special kind, it is necessarily true that as poverty reduction takes place, the so-called poverty reduction elasticity of growth will also change. For these reasons, inflexible assumptions (such as the heroic assumption of Collier and Dollar (2000) and Devarajan, Miller and Swanson (2002) that the elasticity of the headcount ratio measure of poverty with respect to growth is everywhere -2 or the equally implausible assumption of the Millennium Project (2004) that this elasticity is everywhere -1.4) are entirely without merit. This assumption plays a critical role in determining the Millennium project's estimates of the aggregate economic growth and public investment that will be required to achieve the MDGs [see appendix three]. The Millennium Project explicitly declines to use country-specific estimates of so-called poverty reduction elasticities of growth because of the large variation between different available estimates[26].

The macroeconomic assumptions underlying each of the major studies of the costs of achieving the MDGs must be seriously questioned.

Nature of production:

A subtle but profound obstacle to producing estimates of the cost of achieving individual MDGs is that this concept is not well-defined. The reason is that, as has been widely recognized, the distinct MDGs are likely to be "jointly produced". The interventions that help to promote a given MDG are likely very often also to promote other MDGs. To take just one example, better nutrition may promote both the ability of children to learn and to survive. In such circumstances, it is not feasible unambiguously to identify the cost of achieving the goals associated with education and with good health. The reason is that it is not possible to unambiguously identify the share of the cost of an intervention (serving as a joint input to more than one MDG) that should be attributed to each of the goals. Only the cost of achieving the MDGs jointly can, properly speaking, be identified. The cost of achieving individual MDGs can be specified by arbitrarily attributing the cost (or a share of the cost) of a particular input to a specific MDG. However, under this approach (which, for example, is that taken by the Millennium Project) the presumed cost of achieving the MDGs jointly (i.e. the sum total of the costs attributed to each MDG) will not equal the true cost of achieving the MDGs jointly. All of the existing efforts to estimate the total global cost of achieving the MDGs, which have simply added estimates of the presumed costs of achieving individual MDGs defined as above, are invalid[27]. Efforts to identify the cost of achieving the MDGs jointly require an adequate understanding of the *joint* production function for MDGs. The requirements for understanding the causal pathways by which the MDGs are interrelated are immense and strain the limits of existing knowledge. Problems in the estimation of costs which arise due to the presence of joint production, which are conveniently ignored in many empirical economic analyses, cannot be ignored in the context of the MDGs, in view of the highly interdependent causal processes that are likely to underlie aggregate social and economic achievements in developing countries.

Focal Decision Variables:

The Millennium Project needs assessment establishes a list of interventions required to meet each of the goals[28]. These (possibly overlapping) lists identify appropriate "interventions" ("defined broadly as the provision of goods and services as well as infrastructure") needed to meet each of the goals, and their costs. The Project's methodology distinguishes between "policies" and "institutions" (defined as "means" for delivering specific interventions). Although the Millennium Project recognizes the role of policies, it focuses its analytical work on interventions. However, a list of interventions, as comprehensive as it may be, cannot provide an adequately sound framework for the comparison of alternative strategies to achieve the MDGs (which necessarily consist of both interventions and policies). It is clear that institutions and policies in rich countries such as the regime governing trade and capital flows will have a significant impact on the ability of poor countries to achieve the MDGs, just as will the nature of institutions and policies in poor countries themselves. Moreover, the "interventions" that are most effective may depend on the policies that are in place. Although policy choices are discussed in the Millennium Project's report, this is often done formulaically. Claims concerning the policies and institutions that are most desirable are often asserted without justification. Ultimately, a discussion of strategic choice that declines seriously to discuss the choice among policies is akin to Hamlet without the prince.

Estimates of Unit Costs:

Existing methodologies for estimating the cost of achieving the major MDGs (for instance those related to education and to health) rely on the generalization of unit cost estimates derived from rather limited evidence. A major issue concerns the accuracy of these unit cost estimates. Often, it is not made clear whether they refer to average or marginal costs, and what is their source (e.g. national average data or on a specific local observation that has been generalized). Estimates of marginal costs are based on assumptions regarding counterfactuals (for instance, concerning what factors are fixed and what factors are flexible in the short-run). These can be specified in many different ways. The methodologies used are rarely made clear and may well be mutually incompatible.

Generalization of unit cost estimates across countries is invariably done (for instance, by Kumaranayake, Kurowski and Conteh (2001) in their report for the Commission on Macroeconomics and Health and by recent MDG country studies) by using general purchasing power parity conversion factors, which may be based on poor underlying information in poor countries as mask considerable diversity of relative prices across different types of commodities. The resulting estimates of the cost of expanding MDG achievements could be potentially quite incorrect. To illustrate this point, Appendix four shows that the relative costs of the components of health care (such as drugs or the services of physicians) across countries can be widely divergent from the relative costs of general consumption.

This point is further illustrated by Table 1, which draws on the data in Appendix Four to demonstrate that the relative price structure across different components of health expenditure is widely divergent even among poorer countries. It may easily be checked that these divergences exist even between pairs of countries in the same region. This suggests that the use

of general consumption PPPs (or even existing disaggregated PPPs) to predict overall costs of achieving health improvements in poor countries may lead to non-negligible errors.

Table 1: Correlation between PPP for all consumption and PPP for components of health care (for Poor Countries*)

Drugs	Medical Supplies	Therapeutic Appliances	Hospital Care	Physicians' Services	Dentists' Services	Nurses' Services
0.943861	0.94096333	0.44176484	0.64295312	0.64568034	0.60078694	0.94344501

* All countries for which data is reported in Appendix four.

It has been widely noted that existing PPPs are based on data drawn from price points in major cities (and often from capital cities alone). As a result, they are unlikely accurately to reflect the costs of purchasing goods and services in small towns and in rural areas, in which both the level and the structure of prices are likely to be different, in ways that vary from country to country. This is an additional reason that estimates of unit and total costs based on PPPs are unlikely to be accurate.

Quite apart from the difficulties involved in generalizing cost estimates across countries, recent country studies from different sources have made unit cost estimates for the extension of particular services in the *same* country that vary widely. Table 2, comparing estimates of the cost of achieving universal primary education in Uganda from different sources, is illustrative.

Table 2: Unit costs of Universal Primary Education in Uganda[29]

Study	Estimated annual cost per pupil
UNICEF 2001[30]	$13 (1998 prices)
EPRC 2001[31]	$46 (2001 prices)
World Bank 2003[32]	$27.5 (2000 prices)
Millennium Project 2003[33]	$53 (2000 prices)

Although these cost estimates are phrased in dollars of different years, it is clear that they are widely discrepant (indeed, they vary by a factor of about four). Of course, this variation may in part appropriately reflect differences in the understanding of the goal and in detailed analytical premises. From this standpoint, the existence of discrepancies is not necessarily embarrassing (although, in the absence of adequate explanation, it is still worrying).

Deficiencies in the quality of unit cost estimates can certainly be diminished over time. However, at the present time, these deficiencies are rather severe.

Extrapolation of unit costs:

Should unit costs be taken as likely to remain fixed even as the goal is progressively attained, as is done in all of the recent estimates of the cost of achieving the individual goals? There are

strong *a priori* reasons to think that decreasing or increasing marginal costs (economies and diseconomies of scale) may play an important role in relation to the MDGs. For instance, in poor countries, those who are not already the beneficiaries of relevant services may be those who are most difficult to reach, for geographical or social reasons. The limited supply of skilled personnel and the impact of ODA on the exchange rate may make it increasingly costly to extend services. Contrarily, positive externalities may lower barriers to service provision as more units of a service are provided. Transformations in social norms and transmission of relevant knowledge within social networks are likely to be among the reasons for such phenomena[34]. Although it is difficult to know in advance what the scale of such effects is and what form they take, it seems entirely plausible that they exist. Similarly, there are strong a priori reasons to think that there are significant complementarities between distinct MDGs. For instance, it seems likely that greater access to safe drinking water and literacy will both improve health outcomes. On the other hand, achieving certain goals may increase the cost of achieving others. For instance, reductions in child mortality will increase the school-age population and thereby increase the cost of achieving universal primary education. Similarly, pecuniary externalities associated with the achievement of a given MDG (such as the effects on wages and exchange rates mentioned above) may also raise the cost of achieving other MDGs. It is not difficult to think of these and other connections, or indeed to imagine that the magnitude of their impact may be sizable. Such quantitative work as exists on the complementarities between distinct development achievements suggests that this is indeed the case. We may refer to such complementarities as "economies of scope" (and their opposite as "diseconomies").

How accurate is a cost estimate likely to be if it assumes that unit costs are fixed when (in fact) there exist economies (or diseconomies) of scope or scale? In order to answer this question, we have undertaken a simple numerical exercise (reported in Appendix five), drawing on actual data, from a background paper of the Commission on Macroeconomics and Health, which appears to have played a critical role in the cost estimates of the Commission and to have influenced those of the Millennium Project[35]. For a variety of health interventions, we have inferred the unit costs of coverage extensions (i.e. the costs of expanding the percentage of the population covered by one percentage point) that are implicitly assumed in this background paper, which assumes a linear and separable cost function (i.e. that there are no economies or diseconomies of scale or scope). We have also used the actual baseline coverage levels and the targets (for 2007 and 2015) specified in the paper. Whether the unit cost estimates of the Commission on Macroeconomics and Health are accurate is not in itself of great importance, as the purpose of the exercise is merely to show that the impact of divergence from the assumption that there are no economies of scale or scope can be large over realistic coverage ranges. In particular, the numerical exercise shows that the impact of the presence of (dis)economies of scale or scope by themselves on total cost estimates is significant. Moreover, the impact of the interaction of even moderate levels of (dis)economies of scale and scope is to generate truly massive discrepancies in total cost estimates. As shown in Tables A8 and A9 in the Appendix, the inclusion of reasonable economies of scale and scope can lead to variation in total cost estimates of more than an order of magnitude! The conclusion we would draw is that in the absence of far greater knowledge concerning the causal processes at work, we should be greatly wary of current cost estimates, which almost universally depend upon simple linearity assumptions (which preclude economies and diseconomies of scale) and separability

assumptions (which preclude inter-goal externalities in production-- economies or diseconomies of scope). Indeed, even if the assumptions were to be relaxed, the sensitivity of total cost estimates to the assumptions made should be cause for great concern. Some of the results of these exercises are summarized in Table 3 below.

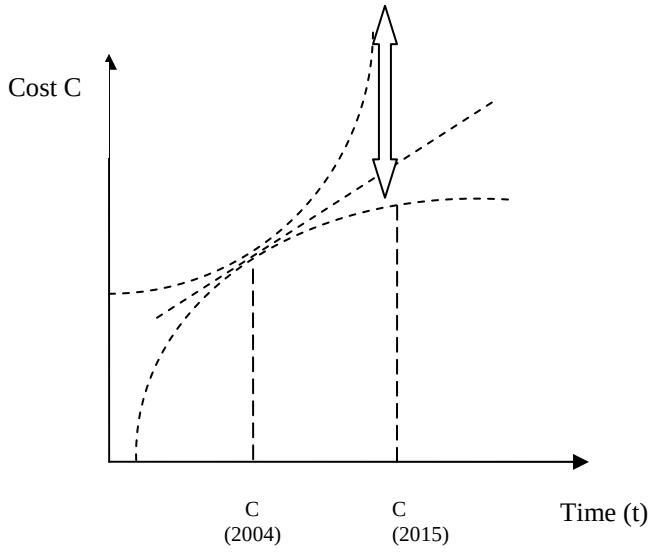
Table 3: Total (tuberculosis treatment and malaria diagnosis) health costs in billions of (2002) dollars per year under different assumptions concerning economies of scale and scope*.

Neither Economies of Scale nor Scope	Economies Of Scale Alone	Diseconomies of Scale Alone	Economies of Scope Alone	Diseconomies of Scope Alone	Economies of Scale and Scope	Diseconomies of Scale and Scope
4.3	1.442	17.215	2.213	6.387	0.737	25.516

*The figures presented in the table are taken from Tables A8 and A9 of Appendix five. The results represent the values obtained for the highest and lowest magnitude of the parameters used in the exercises (i.e. Beta = +/- 0/5 and Delta = +/- 1).

Figure 1 below graphically demonstrates how estimates that fail to take account of economies or diseconomies of scale and scope (represented in the diagram by the straight line extrapolation) can lead to potential errors in the estimation of total costs. *Ex ante*, there is insufficient knowledge with which to conclude that the cost function for achieving the MDGs has a particular form. The resulting uncertainty undermines the credibility of long-range cost estimates.

Figure 1: Potential error from disregarding economies of scale or scope



The existence of potentially large but unknown economies and diseconomies of scale and scope is reason to doubt the credibility and accuracy of current MDG cost estimates. The

World Bank acknowledges the "inter-dependence of MDGs"[36] without assessing – explicitly and transparently - the impact of this interdependence on the cost of achieving the MDGs. The Millennium Project makes a partial and unsatisfactory attempt to estimate complementarities between the different goals. Synergies between and within the MDGs are only assessed in the health sector –where most complementarities are assumed to occur[37], and "estimated" (by what means is unclear) to "have the potential to save 20-35 percent of the total health costs"[38]. Despite these flaws, the Millennium Project forcefully insists that "our treatment of synergies is not comprehensive, but we feel confident that our analysis captures some of the most important savings that can be realized by 2015 through implementing an integrated package of interventions[39]."

4.2 Weaknesses in Data

The data required to assess the baseline scenario of the MDGs and to monitor their progress over time are at present severely deficient. As a result, it is often not possible meaningfully to judge either the extent of progress required or the costs of achieving progress. A recent study published in *Nature*[40] found that the number of malaria cases worldwide may be close to double that previously estimated by the World Health Organization (WHO). It points out that WHO relies heavily on clinical reports of the disease for its statistics, while many sufferers do not seek treatment. Apparent spatial and temporal variation in data is often not meaningful, as a result of which efforts to identify the sources of this variation and estimate relevant parameters (such as so-called "poverty reduction elasticities of growth"[41]) are also not meaningful. Estimates of unit costs (whether of providing interventions or of achieving outcomes) are rare, and where available are produced using methodologies that are most often both inadequately described and not comparable across countries. There is widespread confusion as to whether the unit costs being used refer to average or marginal costs, and there are rarely careful attempts to distinguish between these.

The estimation of the joint production function for MDGs (i.e. the impact that interventions have on outcomes) amounts to the estimation of an interdependent ('simultaneous equation') system. The number and complexity of the causal inter-linkages that are present between distinct MDGs as well as the uncertainties concerning these relationships and the underlying data make this task of 'identification' a difficult one, to say the least, and subject to uncertainties sufficient to raise serious doubts about the credibility of the exercise.

Weaknesses in the database for defining and monitoring the goals are most evident in regard to the first goal. Although the goal contains two components, in practice there has been a tendency to focus on the first component (halving from 1990 levels the proportion of people whose income is less than one dollar per day). Regrettably, this indicator lacks in credibility. There is no convincing way in which to monitor this indicator either over time and space, because of basic weaknesses in its definition and in its methodology of estimation. Reddy and Pogge (2002) and Pogge and Reddy (2003) have extensively discussed the difficulties involved with the "1 dollar per day" indicator of extreme poverty. There are two distinct issues here. The first is that the indicator is not meaningfully defined. The second is that it is poorly estimated.

The first concern is that the '$1/day' indicator fails meaningfully to capture extreme poverty. In a majority of poor countries, national poverty lines are substantially above the "$1 per day" line. In fact the "$1 per day" line was not designed to reliably capture the cost of achieving any particular set of elementary human requirements. As a result, the assumption that data on '$1/day' poverty captures the reality of extreme poverty is simply false. This is an error to which the Zedillo commission falls prey, when it writes rather casually in its technical appendix that "It seems reasonable to suppose that extreme poverty and hunger go together; halving one would more or less halve the other". In fact, there is no evidence of a relationship between "1 dollar per day poverty" and other measures of human well-being, such as undernutrition (see e.g. Karshenas, 2000), and no reason to expect one.

More fundamentally and damagingly, estimates of $1/day poverty for a specific country and year can fluctuate wildly due to irrelevant factors (in particular, the base year in relation to which the international poverty line is defined), undermining confidence in the meaningfulness of these estimates[42]. Confidence in the estimates is further undermined by the fact that the PPP conversion factors used to translate the international poverty line (of $1/day) into local currency units are both inappropriate (as they capture the price level of general commodities rather than essential commodities) and are often based on an inadequate (or even altogether absent) evidence base. This is true even for large countries such as India and China which contribute a great deal to the global poverty total. Different estimates of PPPs for these countries would lead to radically different estimates of the global poverty headcount and trend. Estimates of "$1 per day" poverty do not provide a basis for meaningful comparisons of absolute poverty across time or space. As a result, the target of "halving the proportion of people whose income is less than one dollar a day" is not well-defined, contrary to appearances. Although this is a criticism of the formulation of the first MDG, it is also a criticism of analyses that purport to identify the cost of achieving it.

The "poverty reduction elasticities of growth" employed by Collier and Dollar (2000), Hanmer and Naschold (1999), and by the Millennium Project (2004)[43] in the production of their cost estimates are based on these figures and therefore lack in credibility. Beyond casual empiricism, there is little basis for conclusions regarding the magnitude or determinants of the elasticities of poverty indicators with respect to income. The absence of reliable and accurate estimates of "poverty reduction elasticities of growth" for individual countries is a reason to adopt a very skeptical view of the resulting global estimates.

The second (undernourishment) target corresponding to the first goal is currently measured by the FAO using a 'food balance approach' that combines information on the net material balances of food available in each country with distributional assumptions concerning nutritional intake. Unfortunately, the FAO has not adopted a clear and uniform standard of undernourishment to be applied in all countries. As well, as pointed out in particular by Svedberg (2001) the FAO's estimates are extremely sensitive to variations in parameter assumptions. Significant strengthening of the evidential basis for judgments concerning undernutrition is necessary. As pointed out, by Reddy and Pogge (2002), however, the strengthening of the database for the measurement of global income poverty and the database for the measurement of undernutrition are likely to be tasks that are closely related in practice.

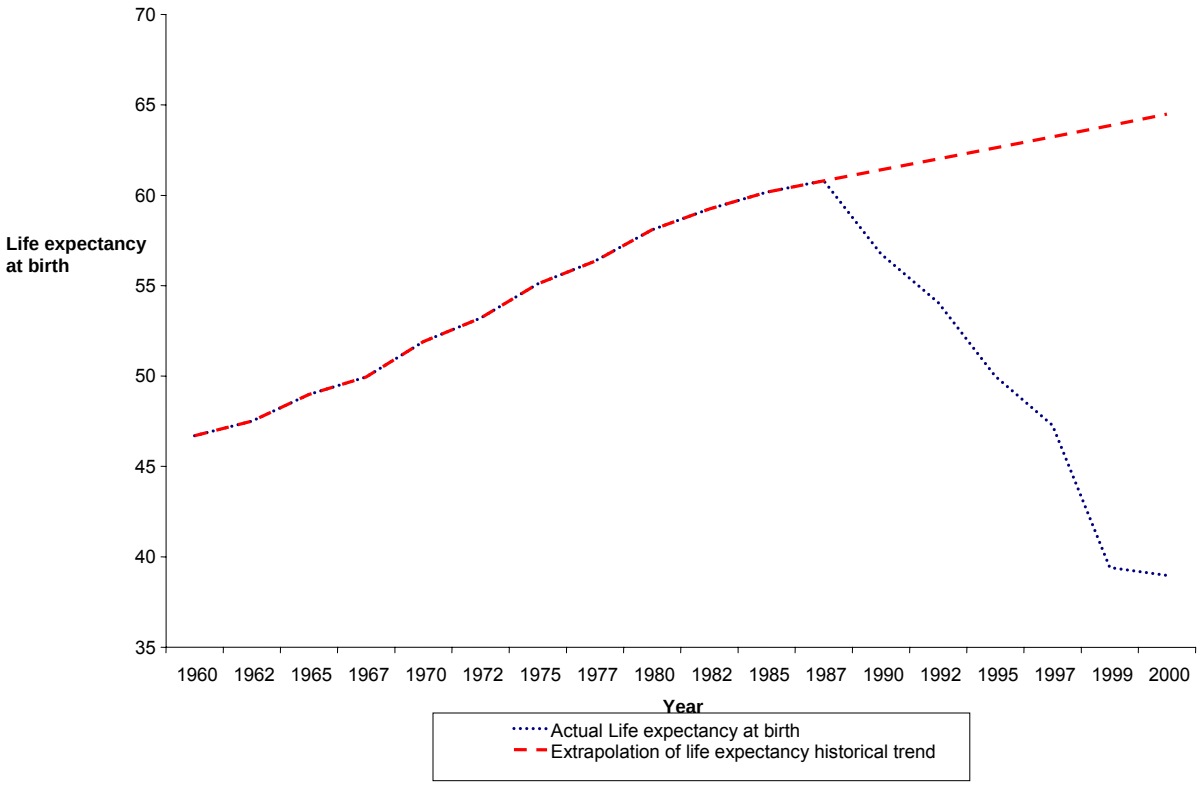
4.3 Unpredictable Future Shocks

Even the most carefully constructed cost estimates are unlikely ultimately to prove accurate, especially over longer time horizons. The reason is that unpredicted future shocks are sure eventually to undermine the accuracy of these estimates. The number and breadth of the assumptions required to generate global cost estimates for the MDGs all but ensures that the resulting cost estimates will eventually be made inaccurate by unpredicted shocks, operating at national or global levels, which are sure to influence both the level of achievement of the goals and the cost of extending them. Examples of significant shocks of this nature that have arisen in the past or may occur in the future include new diseases (such as HIV/AIDS), climatic events (such as the 26th of December 2004 Tsunami, El Niño and global warming), and civil and regional wars. In addition to shocks of this kind that influence the aggregate cost of achieving the MDGs, unpredictable events such as shocks to terms of trade and global demand may in turn influence both the level and distribution of domestic income, and thereby influence both the total resource requirements for achieving the MDGs and the shares of these overall costs that will have to be borne by developed countries if they are to be achieved.

The impact of AIDS in Botswana provides an example of the negative consequences of an unpredicted shock. In Botswana, while life expectancy grew from 47 to 61 between 1960 and 1987, it plummeted to 39 in 2000 as a result of HIV/AIDS. The extrapolation of historical trends of life expectancy before the spread of HIV/AIDS would have led to projections of life expectancy quite at variance with what in fact took place. The effects of HIV/AIDS on other human development indicators have also been significant. Unpredicted extreme events of this kind are likely to continue to arise, and will influence our judgments concerning resource needs and priorities. It is important to recognize that ex ante cost estimates based on simplified analytical models and assumed parameters are likely ultimately to prove wrong.

The solutions that are likely to be most promising are also difficult to predict in advance. It is interesting in this regard to note that many of the interventions identified by the Millennium Project as constituting “quick wins” that ought to be applied widely are precisely ones whose value was widely doubted before it came to be proved through experience. For example, the value of free school meals was widely doubted when they were first introduced on a mass-scaled in India, as there had been a focus on the impact of such programs on nutrition rather than on school enrolment, which proved subsequently to be the area in which they had the greatest impact. Similarly, the importance of eliminating user-fees for basic health services was only learnt through bitter experience, as a result of the failure of World Bank, WHO and Unicef sponsored programmes (e.g. the so-called “Bamako initiative”) to introduce user fees in this area in the 1980s and 1990s.

Figure 2: The Impact of HIV/ AIDS on Life Expectancy in Botswana: Historical Trend and Reality.



Source: World Development Indicators 2003.

5.0 Conclusions

It is not hard to see that damage can arise from the use of unreliable cost estimates in decision-making. Inaccurate cost estimates can cause significant misallocation of resources and errors in policy choice. Such misallocation and error can reduce the effectiveness of resource use, and diminish the pace with which the MDGs are attained, or make it infeasible for them to be attained at all. Unreliable cost estimates can cause estimated resource requirements to be either higher or lower than the actual requirement. If higher, resource requirements may be perceived as prohibitively high, and the effort to raise these resources may not be undertaken, or if the resources are raised this may entail directing some resources away from other potentially valuable development goals. If lower, the MDGs will not be attained. The credibility of the MDG effort will have been undermined and it may become increasingly difficult to mobilize around similar future goals.

Existing approaches to estimating the cost of achieving the MDGs, globally, in specific countries, and through alternative means, are flawed as a result of their reliance on unjustified assumptions and weak data. Moreover, it is probable that they will ultimately be incorrect because unpredicted shocks will arise. Although *any* cost estimates are likely to suffer from such problems, the potential damage from the use of incorrect cost estimates as a guide to

decision-making is likely to be greater in contexts in which they serve as a guide to decision-making over long periods of time. If the cost estimates used in decision-making (and in resource allocation and policy choice) are adjusted periodically, as new information regarding needs, options, and costs becomes available, and if critical decisions are also periodically adjusted on the basis of revised cost estimates, then the damage from the use of incorrect cost estimates can be limited.

Principles underlying an alternative approach

The methods of cost estimation surveyed above are based on an unreliable informational base and often rigid and simplistic methods of analysis. They therefore offer a poor basis for decision-making. The rationale of the alternative approach is Bayesian: Its premise is that knowledge of how best to achieve the MDGs is necessarily imperfect, and continually evolving on the basis of experience. It is therefore important to avoid using the imperfect knowledge available at a moment in time as the basis for decision-making over long periods of time. Judgments about how best to achieve the MDGs ought to be frequently updated in light of new information. Strategic choices can be made more effective by seeking out and incorporating relevant information to the maximal extent. This approach incorporates this Bayesian insight in two ways. First, it seeks to avoid ex ante "one size fits all" analyses and periodically to reassess the appropriate choice of strategies in light of new information concerning conditions in each country. In an approach to decision-making of this kind the damage done by inaccurate forecasts of the future can be limited. Second, it seeks to identify appropriate strategies in light of information from other countries. In this way it ensures that the pace of learning concerning the strategies most appropriate to each country is accelerated, thereby diminishing the likelihood of error and increasing the likelihood of success. The role of experts in this approach is to inform decision-makers who are empowered to synthesize available knowledge, to take account of its limitations, and to make and revise decisions. The statistical theory of decision-making suggests that the intelligent synthesis of information from multiple expert who express 'reasonable disagreement' with one another is likely to lead to improved outcomes.[7] The logic and possible design of a possible alternative approach employing these principles is described in an accompanying paper (Reddy and Heuty (2005)).

The supposition that solutions to complex world problems can be known in advance does no service to the cause of identifying relevant and applicable actions and policies. Such solutions can only be identified in the crucible of experience.

[7] See French and Rios Insua (2000), chapter 4.

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APPENDIX 1: THE MILLENNIUM DEVELOPMENT GOALS

GOALS AND TARGETS	INDICATORS
GOAL 1: ERADICATE EXTREME POVERTY AND HUNGER	
Target 1: Halve, between 1990 and 2015, the proportion of people whose income is less than one dollar a day	**1.** Proportion of population below $1 per day **2.** Poverty gap ratio [incidence x depth of poverty] **3.** Share of poorest quintile in national consumption
Target 2: Halve, between 1990 and 2015, the proportion of people who suffer from hunger	**4.** Prevalence of underweight children (under-five years of age) **5.** Proportion of population below minimum level of dietary energy consumption
GOAL 2: ACHIEVE UNIVERSAL PRIMARY EDUCATION	
Target 3: Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling	**6.** Net enrolment ratio in primary education **7.** Proportion of pupils starting grade 1 who reach grade 5 **8.** Literacy rate of 15-24 year olds
GOAL 3: PROMOTE GENDER EQUALITY AND EMPOWER WOMEN	
Target 4: Eliminate gender disparity in primary and secondary education preferably by 2005 and to all levels of education no later than 2015	**9.** Ratio of girls to boys in primary, secondary and tertiary education **10.** Ratio of literate females to males of 15-24 year olds **11.** Share of women in wage employment in the nonagricultural sector **12.** Proportion of seats held by women in national parliament
GOAL 4: REDUCE CHILD MORTALITY	
Target 5: Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate	**13.** Under-five mortality rate **14.** Infant mortality rate **15.** Proportion of 1 year old children immunized against measles
GOAL 5: IMPROVE MATERNAL HEALTH	
Target 6: Reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio	**16.** Maternal mortality ratio **17.** Proportion of births attended by skilled health personnel
GOAL 6: COMBAT HIV/ AIDS, MALARIA AND OTHER DISEASES	
Target 7: Have halted by 2015, and begun to reverse, the spread of HIV/AIDS	**18.** HIV prevalence among 15-24 year old pregnant women **19.** Contraceptive prevalence rate **20.** Number of children orphaned by HIV/AIDS
Target 8: Have halted by 2015, and begun to reverse, the incidence of malaria and other major diseases	**21.** Prevalence and death rates associated with malaria **22.** Proportion of population in malaria risk areas using effective malaria prevention and treatment measures **23.** Prevalence and death rates associated with tuberculosis **24.** Proportion of TB cases detected and cured under DOTS (Directly Observed Treatment Short Course)
GOAL 7: ENSURE ENVIRONMENTAL SUSTAINABILITY*	
Target 9: Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources	**25.** Proportion of land area covered by forest **26.** Land area protected to maintain biological diversity **27.** GDP per unit of energy use (as proxy for energy efficiency) **28.** Carbon dioxide emissions (per capita) [Plus two figures of global atmospheric pollution: ozone depletion and the accumulation of global warming gases]
Target 10: Halve, by 2015, the proportion of people without sustainable access to safe drinking water	**29.** Proportion of population with sustainable access to an improved water source

Target 11: By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers	**30.** Proportion of people with access to improved sanitation **31.** Proportion of people with access to secure tenure [Urban/rural disaggregation of several of the above indicators may be relevant for monitoring improvement in the lives of slum dwellers]
GOAL 8: DEVELOP A GLOBAL PARTNERSHIP FOR DEVELOPMENT*	
Target 12: Develop further an open, rule-based, predictable, non-discriminatory trading and financial system Includes a commitment to good governance, development, and poverty reduction – both nationally and internationally	**Some of the indicators listed below will be monitored separately for the Least Developed Countries (LDCs), Africa, landlocked countries and small island developing states**
Target 13: Address the Special Needs of the Least Developed Countries Includes: tariff and quota free access for LDC exports; enhanced programme of debt relief for HIPC and cancellation of official bilateral debt; and more generous ODA for countries committed to poverty reduction	**Official Development Assistance** **32.** Net ODA as percentage of DAC donors' GNP [targets of 0.7% in total and 0.15% for LDCs] **33.** Proportion of ODA to basic social services (basic education, primary health care, nutrition, safe water and sanitation) **34.** Proportion of ODA that is untied **35.** Proportion of ODA for environment in small island developing states **36.** Proportion of ODA for transport sector in land-locked countries
Target 14: Address the Special Needs of landlocked countries and small island developing states (through Barbados Programme and 22nd General Assembly provisions) **Target 15:** Deal comprehensively with the debt problems of developing countries through national and international measures in order to make debt sustainable in the long term	**Market Access** **37.** Proportion of exports (by value and excluding arms) admitted free of duties and quotas **38.** Average tariffs and quotas on agricultural products and textiles and clothing **39.** Domestic and export agricultural subsidies in OECD countries **40.** Proportion of ODA provided to help build trade capacity **Debt Sustainability** **41.** Proportion of official bilateral HIPC debt cancelled **42.** Debt service as a percentage of exports of goods and services **43.** Proportion of ODA provided as debt relief **44.** Number of countries reaching HIPC decision and completion points
Target 16: In cooperation with developing countries, develop and implement strategies for decent and productive work for youth	**45.** Unemployment rate of 15-24 year olds
Target 17: In cooperation with pharmaceutical companies, provide access to affordable, essential drugs in developing countries	**46.** Proportion of population with access to affordable essential drugs on a sustainable basis
Target 18: In cooperation with the private sector, make available the benefits of new technologies, especially information and communications	**47.** Telephone lines per 1000 people **48.** Personal computers per 1000 people

The selection of indicators for Goals 7 and 8 is subject to further refinement

APPENDIX 2: MILLENNIUM DEVELOPMENT GOALS GLOBAL ESTIMATES

	Zedillo Report		Debt Relief and the Millennium Development Goals, Background Paper for HDR 2003		World Bank	
	Estimate in billion USD	**Source**	**Estimate in billion USD**	**Source**	**Estimate in billion USD**	**Source**
Halving Poverty and hunger	20	UNCTAD & WB	45.7	See Paper by Gottschalk, R (2000) & own calculations	54 to 62	WB model
Halving Population without access to safe drinking water	0	Global Water Partnership	2.4	Vision 21: A Shared Vision for Hygiene, Sanitation and Water Supply	5 to 21	WB model
Achieving UPE	9	UNICEF	9.1	UNICEF (low)	10 to 30	WB model
Achieving gender equality in primary education	3	Own estimates	-	-	-	WB model
Achieving 3/4 decline in maternal mortality	-	-	20.03	Report of the Commission on Macroeconomics and Health, page 4	20 to 25	WB model
Achieving 2/3 decline in U5MR	-	-				
Halting and reversing HIV/AIDS	7 to 10	UN Secretary General				
Providing special assistance to orphans	-	-	-	-	-	-
Improving lives of 100 million slum dwellers	4	WB Cities without slums action plan	1.7	WB Cities without slums action plan	3.5	WB Cities without slums action plan
Total (Goal1)	**20**		**45.7**		**54 to 62**	
Total (Excluding Goal1)	**30**		**30.6**		**35 to 76**	
TOTAL	**50**		**76.3**		**-**	

APPENDIX 3: MILLENNIUM PROJECT GROWTH ASSUMPTIONS

The Millennium Project states that its estimate of "the 2015 level of GDP per capita that is consistent with halving the incidence of extreme poverty in the country [is] based on an average elasticity of poverty reduction to income growth, estimated from existing literature at –1.4.", and that "An elasticity of –1.4 implies that countries would need to grow by an average 2.0 percent per capita between 1990 and 2015 in order to halve income poverty" (Millennium Project 2004, page 124). The difficulties associated with assumptions concerning fixed poverty elasticities have been addressed in the body of the paper and will not be detailed here.

However, given the Millennium Project's assumption concerning the magnitude of the poverty reduction elasticity of growth, it can be verified that per capita growth must as least be 1.95 percent per annum in order for the first MDG to be met. To see this solve,

$$H\,(1-0.014*g)^{n}=H/2$$

Where:

- H represents the poverty headcount as a percentage of the total population
- g is the annual per capita growth (in percent)
- n is the number of years

Since n = 2015-1990 = 25 and since the H drops out, we can solve this equation for g:

$g = (1-(0.5)^{(1/25)})/0.014 = 1.95$ or 1.95%

The growth requirement is independent of the initial headcount. The analysis of population weighed per capita GDP growth in constant 1995 US $ over the 1990-2000 decade both at the country and regional level (presented in the table below) demonstrates that the Millennium Project's hypothesis may be optimistic[8]. Among the countries selected by the Millennium Project for case studies of country strategies to achieve the MDGs, only Bangladesh (3%), Cambodia (2.4%) and Uganda (3.3%) display an average per capita growth rate above 2 percent per year. The Millennium Project emphasizes that the growth rates for Tanzania and Ghana must be accelerated and assumes that these two countries will respectively have an annual per capita growth rate of 3.3 and 2.2 percent. However the way these growth rates will be achieved is not explained or detailed in the Tanzania and Ghana case studies. Although it is suggested that public investment to promote the MDGs and to develop infrastructure will guarantee higher per capita income growth rates, no explicit argument is provided as to why. The impact of MDG and other

[8] We computed population weighed GDP per capita income (defined in terms of constant 1995 US$ and drawn from the World Bank's World Development Indicators 2003) growth rates. Based on population and per capita GDP in 1990 and 2000 for each country, we calculate total GDP for regional aggregates. For individual countries, the growth rate in per capita GDP can be obtained directly. We use the following formula:

Growth rate in per capita GDP = [(GDPTOTAL2000/POPTOTAL2000)/(GDPTOTAL1990/POPTOTAL1990)]^0.1 – 1

The results are presented in Table 2 for individual countries involved in Millennium Project MDG needs assessment and for the East Asia and the Pacific and South Asia regions (with and without India and China). For Latin America and Sub-Saharan Africa, the average has been calculated by taking a decadal geometric average of the annual regional per capita income growth rates from 1990 to 2000 as reported in the World Development Indicators. The results are reported in Table 1.

public investment on per capita growth rates is not at present modeled explicitly. As a result, it is difficult to assess the validity of the growth assumptions that are being made without making historical comparisons.[9].

Although even without China and India, both South Asia (2.27% annual per capita income growth rate over the decade) and East Asia and the Pacific (2.53% annual per capita income growth rate over the decade) are likely to experience sustained growth rates that would be sufficient (given the Millennium Project's elasticity assumptions) to halve income poverty by 2015, the following table demonstrates that for individual countries as well as for entire regions such as sub-Saharan Africa (-0.57% average annual GDP per capita growth in the 1990s), the growth target of 1.95% is likely to be out of reach. The Latin American regional average (1.28% annual GDP per capita growth in the 1990s) suggests that the region has also not had sufficient recent growth to generate confidence in its ability to achieve the required threshold.

Table 1: 1990-2000 Average per Capita GDP Growth: Latin America & Caribbean and Sub-Saharan Africa

	Latin America & Caribbean	Sub-Saharan Africa
1990	-2.44	-2.13
1991	2.35	-2.40
1992	1.69	-3.97
1993	2.47	-1.40
1994	3.45	-0.29
1995	-0.15	0.99
1996	1.94	2.11
1997	3.54	0.64
1998	0.59	-0.28
1999	-1.30	0.03
2000	2.12	0.58
Average GDP per capita growth rate 1990-2000	1.28%	-0.57%

Source: World Development Indicators 2003

[9] Interestingly, while the Millennium Project sector costing seems to implicitly assume that the attainment of goal 1 does not contribute the achievement of the other goals in a significant way (which leads the Millennium Project to calculate the total cost of meeting the MDGs at the country level by adding various sectoral estimates); Devarajan, Miller and Swanson make the opposite assumption in "Goals for Development: History, Prospects and Costs", World Bank Policy Research Working Paper 2819. Indeed they develop two independent set of estimates. First Devarajan, Miller and Swanson calculate the cost of raising growth rates to reduce poverty by half and argue that meeting goal 1 would automatically lead to the achievement of the other goals. The second methodology relies on the addition of sectoral estimates for each goal. The stark contrast between the World Bank and the Millennium Project assumptions in this connection brings to the surface the limited understanding that exists at present of the complex causal pathways connecting the MDGs.

Table 2: 1990-2000 Population Weighed Average Per Capita GDP Growth

	POPULATION		GDP PER CAPITA (Constant US$ 1995)		GDP TOTAL		Weighed per capita GDP growth rate 1990-2000
Country Name	**1990**	**2000**	**1990**	**2000**	**1990**	**2000**	
East Asia*	1,517,287,840	1,711,391,130	510	946	738,009,131,322	1,554,601,567,893	6.45%
E.A without China	382,102,840	448,931,130	-	-	340,373,709,731	513,383,356,657	2.53%
South Asia**	1,102,524,170	1,327,368,000	333	457	367,847,016,690	610,049,802,755	3.25%
S.A.without India	253,009,170	311,445,000	-	-	92,659,729,407	142,784,839,902	2.27%
Sub-Saharan Africa	508,621,400	659,010,030	587	563	298,373,575,911	370,956,660,884	-0.41%
Latin America & Caribbean	438,408,340	515,786,800	3,275	3,862	1,435,980,713,751	1,991,884,262,594	1.66%
Bangladesh	110,025,000	131,050,000	278	373	30,604,566,880	48,906,099,670	2.98%
Cambodia	9,145,000	12,021,230	240	304	2,190,776,554	3,656,275,739	2.42%
Ethiopia	51,180,000	64,298,000	100	115	5,134,462,732	7,364,328,804	1.33%
Ghana	15,138,000	19,306,000	346	413	5,236,080,070	7,978,279,246	1.80%
Kenya	23,354,000	30,092,000	358	328	8,360,454,982	9,884,284,651	-0.86%
Senegal	7,327,000	9,530,000	566	609	4,150,162,684	5,806,050,468	0.73%
Tanzania	25,470,000	33,696,000	189	190	4,807,938,209	6,418,594,662	0.09%
Uganda	16,330,000	22,210,000	251	348	4,101,957,646	7,728,045,148	3.31%
Yemen, Rep.	11,876,000	17,507,160	272	316	3,231,057,211	5,539,356,628	1.52%

Source: World Development Indicators 2003

* East Asia: Cambodia, Indonesia, Lao PDR, Mongolia, Papua New Guinea, Solomon Islands, Vietnam, China, Fiji, Kiribati, Marshall Islands, Micronesia Fed. Sts., Philippines, Samoa, Thailand and Vanuatu. Data is missing for Korean Dem. Rep., Myanmar and Timor-Leste.

** South Asia: Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka. Data is missing for Afghanistan and the Maldives

APPENDIX 4: 1985 PPPs OF DISAGGREGATED COMPONENTS OF HEALTH CARE RELATIVE TO PPPS FOR GENERAL CONSUMPTION

Country*	PPP for All Consumption	PPP for Drugs (PPPD)	PPP for Medical Supplies (PPPMS)	PPP for Therapeutic Appliances (PPPTA)	PPP for Hospital Care (PPPHC)	PPP for Physicians' Services (PPPPS)	PPP for Dentists' Services (PPPDS)	PPP for Nurses' Services (PPPNS)	Ratio PPPD / PPP All Consumption	Ratio PPPMS / PPP All Consumption	Ratio PPPTA / PPP All Consumption	Ratio PPPHC / PPP All Consumption	Ratio PPPPS / PPP All Consumption	Ratio PPPDS / PPP All Consumption	Ratio PPPNS / PPP All Consumption
Bangladesh	8.67	5.17	.	9.29	.	1.92	2.50	5.00	0.60	.	1.07	.	0.22	0.29	0.58
Benin	150.87	404.51	257.21	52.69	43.16	27.20	28.97	88.24	2.68	1.70	0.35	0.29	0.18	0.19	0.58
Botswana	0.77	2.04	1.60	0.43	0.29	0.17	0.18	0.50	2.65	2.08	0.56	0.38	0.22	0.23	0.65
Cameroon	207.23	474.23	332.30	138.48	66.28	35.14	37.43	156.89	2.29	1.60	0.67	0.32	0.17	0.18	0.76
Congo	272.25	610.02	558.45	.	57.39	59.06	62.90	247.52	2.24	2.05	.	0.21	0.22	0.23	0.91
Egypt	0.37	0.65	0.72	0.13	0.09	0.08	0.08	0.08	1.78	1.96	0.37	0.25	0.21	0.22	0.21
Ethiopia	1.16	4.66	2.03	0.47	0.28	0.22	0.23	0.96	4.02	1.75	0.41	0.25	0.19	0.20	0.83
Grenada	2.22	3.67	2.05	2.00	2.88	3.78	2.74	2.76	1.65	0.93	0.90	1.30	1.70	1.23	1.24
India	6.28	4.13	6.11	.	6.70	2.45	.	4.28	0.66	0.97	.	1.07	0.39	.	0.68
Ivory Coast	236.11	622.30	524.62	29.11	79.73	55.48	59.09	247.69	2.64	2.22	0.12	0.34	0.23	0.25	1.05
Jamaica	3.07	7.15	4.00	3.90	4.70	7.37	5.34	5.63	2.33	1.30	1.27	1.53	2.40	1.74	1.83
Kenya	7.22	18.09	13.16	.	2.01	1.39	.	11.77	2.51	1.82	.	0.28	0.19	.	1.63
Madagascar	341.42	1036.42	461.49	111.21	72.11	48.80	51.98	217.88	3.04	1.35	0.33	0.21	0.14	0.15	0.64
Malawi	0.63	1.64	0.99	0.08	0.22	0.11	0.11	0.47	2.63	1.59	0.13	0.34	0.17	0.18	0.75
Mali	207.54	430.07	215.28	88.13	47.02	22.77	24.25	101.64	2.07	1.04	0.42	0.23	0.11	0.12	0.49
Mauritius	4.56	12.90	9.29	3.99	1.74	0.98	1.05	8.31	2.83	2.04	0.87	0.38	0.22	0.23	1.82
Morocco	3.25	8.83	.	0.73	1.07	0.74	0.79	3.30	2.72	.	0.22	0.33	0.23	0.24	1.02
Nepal	6.88	4.03	13.51	.	.	1.49	.	1.54	0.59	1.97	.	.	0.22	.	0.22
Nigeria	1.16	3.01	2.11	0.65	0.27	0.22	0.24	0.99	2.59	1.81	0.56	0.23	0.19	0.20	0.86
Pakistan	5.57	4.56	3.06	.	.	0.63	0.57	2.14	0.82	0.55	.	.	0.11	0.10	0.38
Philippines	8.39	12.35	3.70	.	1.34	6.33	.	5.23	1.47	0.44	.	0.16	0.75	.	0.62
Poland	88.16	78.38	29.51	577.19	57.27	77.53	.	.	0.89	0.33	6.55	0.65	0.88	.	.
Rwanda	55.97	146.59	41.69	23.54	13.86	4.41	.	14.30	2.62	0.74	0.42	0.25	0.08	.	0.26
Senegal	197.43	463.98	.	.	68.35	44.44	47.33	198.41	2.35	.	.	0.35	0.23	0.24	1.00
Sierra Leone	3.29	10.67	5.92	6.52	0.49	0.63	0.67	2.79	3.24	1.80	1.98	0.15	0.19	0.20	0.85
Sri Lanka	8.81	6.11	7.77	17.49	0.61	3.47	2.55	3.81	0.69	0.88	1.99	0.07	0.39	0.29	0.43
St. Lucia	1.90	3.09	1.74	1.69	2.37	3.19	2.31	2.33	1.62	0.91	0.89	1.24	1.67	1.21	1.22
Swaziland	0.90	2.83	1.66	0.26	0.33	0.18	0.19	0.78	3.15	1.85	0.29	0.37	0.20	0.21	0.87
Tanzania	18.83	27.71	.	6.61	2.80	1.48	1.57	6.59	1.47	.	0.35	0.15	0.08	0.08	0.35
Thailand	10.15	7.32	.	.	2.52	5.94	6.82	7.23	0.72	.	.	0.25	0.59	0.67	0.71
Tunisia	0.37	0.56	0.62	0.08	0.15	0.07	0.07	0.30	1.52	1.68	0.23	0.39	0.18	0.19	0.80
Turkey	241.16	187.42	229.16	289.96	363.55	243.27	309.74	314.52	0.78	0.95	1.20	1.51	1.01	1.28	1.30
Zambia	1.46	3.27	1.69	0.23	0.39	0.18	0.19	0.80	2.23	1.16	0.16	0.26	0.12	0.13	0.55
Zimbabwe	0.81	2.51	1.72	0.57	0.36	0.18	0.19	0.81	3.11	2.13	0.71	0.45	0.22	0.24	1.00

SUMMARY STATISTICS	**Low and Lower Middle Income Countries**	**Low Income Countries**
Geometric Mean Ratio of PPP for Drugs to PPP for All Consumption	**1.78**	**1.68**
Geometric Mean Ratio of PPP for Medical Supplies to PPP for All Consumption	**1.30**	**1.28**
Geometric Mean Ratio of PPP for Therapeutic Appliances to PPP for All Consumption	**0.55**	**0.48**
Geometric Mean Ratio of PPP for Hospital Care to PPP for All Consumption	**0.34**	**0.24**
Geometric Mean Ratio of PPP for Services of Physicians to PPP for All Consumption	**0.27**	**0.17**
Geometric Mean Ratio of PPP for Services of Dentists to PPP for All Consumption	**0.26**	**0.17**
Geometric Mean Ratio of PPP for Services of Nurses to PPP for All Consumption	**0.72**	**0.56**

* Note: A country's name appears in boldface if it was denoted as "low income" according to the 1990 WDR. Otherwise, it is classified as "lower-middle income" by the same sources.

Source: International Comparison Programme.

APPENDIX 5: ERRONEOUS ESTIMATES OF THE COST OF ACHIEVINGTHE MDGs: AN EXAMPLE

We explore in this appendix the sensitivity of cost estimates to the assumptions of joint production and nonlinearity of the cost function.

We take unit cost and PIN ('Population in Need') data from: Kumaranayake, L., Kurowski, C., and Conteh, L., 2001 "Cost of scaling up priority health interventions in low-income and selected middle-income countries: methodology and estimates", (Commission on Macroeconomics and Health Working Paper WG5 # 18).

Let ***c*** = $ 'unit cost' for increasing coverage of a health treatment by 1%
x = increase in prevalence of the treatment in % (i.e. if it is desired to increase coverage from 10% to 80%, then n = 70)

We compare the following two cost functions:

$$\text{Linear cost: } = cx$$

$$\text{Nonlinear cost : } = \frac{cx^{\beta+1}}{\beta+1}; \beta \in R, \beta \neq -1$$

List of interventions:

- ☐ Tuberculosis treatment
- ☐ Malaria prevention + treatment
- ☐ HIV/AIDS care + treatment (HAART)

Countries:

- ☐ poor countries (GPD/capita < 1200 USD in 1999 USD), including ALL sub-Saharan Africa
- ☐ excluding countries with less than 150 000 population
- ☐ sample of 83 countries

Assumptions made by CME background paper:

- ☐ incidence/prevalence of diseases/risks are constant over the time period through 2015, and so are unit costs of providing the health interventions defined

Table A1. Current coverage rates and future targets

Disease	Year	2002 baseline	2007A min target	2007B min target	2015 min target
Tuberculosis	Treatment	44%	50%	60%	70%
Malaria	Diagnosis	31%	50%	60%	70%
	Prevention	2%	30%	50%	70%
HIV/AIDS	Care of OI	10%	25%	40%	70%
	Treatment (HAART)	1%	10%	45%	65%
NOTE: these figures are averages of coverage across relevant countries					

Implied annual unit costs: (total costs/coverage increase to be achieved) from Kumaranayake, Kurowski and Conteh (2001), expressed in $2002 USD:

Disease	Year	2007A	2007B	2015
Tuberculosis	Treatment	$ 66,666,667	$ 31,250,000	$ 34,615,385
Malaria	Diagnosis	$ 63,157,895	$ 68,965,517	$ 87,179,487
	Prevention	$ 10,714,286	$ 10,416,667	$ 14,705,882
HIV/AIDS	Care of OI	$ 106,666,667	$ 93,333,333	$ 106,666,667
	HAART	$ 111,111,111	$ 113,636,364	$ 125,000,000

First exercise ((dis)economies of scale):

Nonlinear cost $= \frac{cx^{\beta+1}}{\beta+1}; \beta \in R,\ \beta \neq 1$ where x is the increase in coverage of the intervention, c is the initial unit cost, and β is a parameter. For β=0, the cost function becomes linear: $= cx$ and there are no economies of scale.

It is assumed that the unit cost, *c*, identified by the CME background paper is correct for the last (observed) unit (1%) of the coverage. For the next unit (1%) of coverage produced, we have:

$MC = \frac{c}{\beta+1}(\beta+1)x^{\beta} = cx^{\beta}$. At the first additional unit produced, $x = 1$, (1% additional coverage of the intervention), the MC is exactly c (the unit cost).

A positive value of β implies rising marginal costs, and a negative value of β implies falling marginal costs. A value of zero implies constant marginal costs, in line with the linearity assumption of the background paper.
A value of 0.5 (the maximum value considered here) implies that the one-hundredth unit costs 10 times as much to produce as does the first. A value of -0.5 (the minimum value considered in the estimates) implies that the one-hundredth unit costs one-tenth as much

to produce as does the first. A value of 0.2 implies that the one-hundredth unit costs 2.5 times as much to produce as does the first. A value of -0.2 implies that the one-hundredth unit costs less to produce than does the first unit by a factor of 2.5. A value of 0.1 implies that the one-hundredth unit costs 1.6 times as much to produce as does the first. A value of -0.1 implies that the one-hundredth unit costs less to produce than does the first unit by a factor of 1.6.

Economies of scale in service delivery may exist due to phenomena such as, for instance, informational externalities and fixed costs of health infrastructure development. Diseconomies of scale in service delivery may exist due to, for instance, increasing difficulty in reaching underserved (e.g. geographically and socially marginalized) populations.

Second exercise ((dis)economies of scope):

What is the cost of achieving the MDGs concomitantly? Are there spillovers between interventions? Are there economies or diseconomies of scope?

An example involving two goals: take tuberculosis treatment and malaria diagnosis, and denote the interventions by *x* and *y*.

In general, let the total cost function identifying the minimum cost of providing a given level of outputs (jointly) be represented by $TC(x, y)$, where x and y denote the improvements in intervention coverage to be attained (by 2007 or 2015).

$$TC(x,y) = \frac{c_1 x^{\beta_1+1}}{\beta_1+1}(1-\delta_1\frac{y}{y_{\max}}) + \frac{c_2 y^{\beta_2+1}}{\beta_2+1}(1-\delta_2\frac{x}{x_{\max}}), \text{ where } \beta \in R,\ \beta \neq -1,\ \delta \in [-1,1].$$

The δ parameters will generate economies/diseconomies of scope. $Y_{\max}$ and $X_{\max}$ are defined as follows: $y_{\max} = 100 - y_{baseline}$, and similary $x_{\max} = 100 - x_{baseline}$ (the coverage extensions which are required to attain complete coverage, beginning at the empirical baseline).

In what follows, assume that $\delta_1 = \delta_2 = \delta$ and $\beta_1 = \beta_2 = \beta$ for simplicity

$\delta = 0$ means that there are no economies of scope.

Note that δ>0 yields economies of scope.

δ<0 yields diseconomies of scope.

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An interpretation of delta is that it corresponds to the percentage decrease (or increase, depending on the sign of delta) in the total cost of producing both outputs to the

maximum extent feasible (i.e. covering the population entirely with both interventions) that arises as a result of the existence of economies (diseconomies) of scope[10].

For example, a value for delta of 0.5 implies that the total cost of covering the entire population is fifty percent lower (due to the presence of economies of scope, or complementarities) than it would have been if there had not been any complementarities.

Economies of scope may exist in the health sector due to the presence, for instance, of positive spillovers in diagnosis. Diseconomies of scope may exist due to the presence, for instance, of 'congestion effects' or crowding out in the utilization of health service infrastructure.

In the exercises below, we have tried to use what we believe to be plausible values of both beta and delta.. In particular, we consider maximum values of β = 0.5, and δ = 1 and minimum values of β = -0.5, and δ = -1. The assumption that δ = -1, which suggests that the total cost of achieving both goals completely is zero, is not as implausible *ex ante* as it may first appear. One reason it is not implausible is that the cost concept employed by Kumaranayake, Kurowski and Conteh (2001) is that of "incremental expensiture" above and beyond existing health expenditures. A second reason is that complete coverage of the population by the diagnostic, preventative and treatment interventions considered entails substantial decreased disease prevalence (indeed possibly to zero). Such substantial decreases in disease prevalence will entail substantial reductions in costs actually incurred.

[10] It may be checked that the marginal cost of producing a single output (say *x*), holding the other output constant, is influenced by the level of the other output (say *y*) in two ways. First, the level of *y* decreases (or increases, depending on the sign of delta) the marginal cost of producing *x* by a multiplicative proportion, given by the magnitude of delta. Second, the level of *y* decreases (or increases, depending on the sign of delta) the marginal cost of producing *x* by an additive constant, also given by the magnitude of delta.

TABLE A2: Comparison between LINEAR AND NONLINEAR costs: DIS/ECONOMIES OF SCALE (DELTA = 0, BETA VARIES)

Figures are in '000 000 000 USD

Scenario 2007A		LINEAR	NONLINEAR					
		Beta →	0.000	0.001	0.005	0.01	0.05	0.1
Tuberculosis	Treatment	0.40	0.400	0.400	0.402	0.403	0.417	0.435
Malaria	Diagnosis	1.20	1.200	1.202	1.212	1.224	1.324	1.464
	Prevention	0.30	0.300	0.301	0.304	0.307	0.338	0.381
HIV/AIDS	Care of OI	1.60	1.600	1.603	1.614	1.628	1.745	1.907
	HAART	1.00	1.000	1.001	1.006	1.012	1.063	1.132

Scenario 2007B		LINEAR	NONLINEAR					
		Beta →	0.000	0.001	0.005	0.01	0.05	0.1
Tuberculosis	Treatment	0.50	0.500	0.501	0.504	0.509	0.547	0.600
Malaria	Diagnosis	2.00	2.000	2.005	2.024	2.048	2.254	2.546
	Prevention	0.50	0.500	0.501	0.507	0.515	0.578	0.669
HIV/AIDS	Care of OI	2.80	2.800	2.807	2.834	2.868	3.161	3.577
	HAART	5.00	5.000	5.014	5.070	5.141	5.754	6.636

Scenario 2015		LINEAR	NONLINEAR					
		Beta →	0.000	0.001	0.005	0.01	0.05	0.1
Tuberculosis	Treatment	0.90	0.900	0.902	0.910	0.921	1.009	1.133
Malaria	Diagnosis	3.40	3.400	3.409	3.446	3.492	3.889	4.459
	Prevention	1.00	1.000	1.003	1.016	1.033	1.176	1.386
HIV/AIDS	Care of OI	6.40	6.400	6.420	6.500	6.601	7.480	8.762
	HAART	8.00	8.000	8.025	8.127	8.257	9.380	11.023

TABLE A3: Comparison between LINEAR AND NONLINEAR costs: DIS/ECONOMIES OF SCALE (DELTA = 0, BETA VARIES)

Figures are in '000 000 000 USD

Scenario 2007A		LINEAR	NONLINEAR					
		Beta →	0.000	- 0.001	- 0.005	- 0.01	- 0.05	- 0.1
Tuberculosis	Treatment	0.40	0.400	0.400	0.398	0.397	0.385	0.372
Malaria	Diagnosis	1.20	1.200	1.198	1.188	1.177	1.090	0.993
	Prevention	0.30	0.300	0.299	0.297	0.293	0.267	0.239
HIV/AIDS	Care of OI	1.60	1.600	1.597	1.586	1.573	1.471	1.356
	HAART	1.00	1.000	0.999	0.994	0.988	0.943	0.892

Scenario 2007B		LINEAR	NONLINEAR					
		Beta →	0.000	- 0.001	- 0.005	- 0.01	- 0.05	- 0.1
Tuberculosis	Treatment	0.50	0.500	0.499	0.496	0.491	0.458	0.421
Malaria	Diagnosis	2.00	2.000	1.995	1.976	1.953	1.779	1.587
	Prevention	0.50	0.500	0.499	0.493	0.486	0.434	0.377
HIV/AIDS	Care of OI	2.80	2.800	2.793	2.767	2.734	2.486	2.214
	HAART	5.00	5.000	4.986	4.931	4.863	4.356	3.805

Scenario 2015		LINEAR	NONLINEAR					
		Beta →	0.000	- 0.001	- 0.005	- 0.01	- 0.05	- 0.1
Tuberculosis	Treatment	0.90	0.900	0.898	0.890	0.880	0.805	0.722
Malaria	Diagnosis	3.40	3.400	3.391	3.355	3.311	2.980	2.619
	Prevention	1.00	1.000	0.997	0.984	0.968	0.852	0.729
HIV/AIDS	Care of OI	6.40	6.400	6.380	6.302	6.205	5.490	4.722
	HAART	8.00	8.000	7.975	7.875	7.752	6.840	5.864

TABLE A4: Comparison between LINEAR AND NONLINEAR costs: DIS/ECONOMIES OF SCALE (DELTA = 0, BETA VARIES)

Figures are in '000 000 000 USD

Scenario 2007A		**LINEAR**	**NONLINEAR**				
		Beta →	**0.15**	**0.20**	**0.30**	**0.40**	**0.50**
Tuberculosis	Treatment	0.40	0.455	0.477	0.527	0.585	0.653
Malaria	Diagnosis	1.20	1.623	1.802	2.233	2.783	3.487
	Prevention	0.30	0.430	0.487	0.627	0.813	1.058
HIV/AIDS	Care of OI	1.60	2.089	2.292	2.773	3.376	4.131
	HAART	1.00	1.209	1.293	1.487	1.720	2.000

Scenario 2007B		**LINEAR**	**NONLINEAR**				
		Beta →	**0.15**	**0.20**	**0.30**	**0.40**	**0.50**
Tuberculosis	Treatment	0.50	0.659	0.725	0.884	1.083	1.333
Malaria	Diagnosis	2.00	2.882	3.268	4.225	5.494	7.180
	Prevention	0.50	0.777	0.904	1.229	1.680	2.309
HIV/AIDS	Care of OI	2.80	4.055	4.607	5.975	7.796	10.224
	HAART	5.00	7.670	8.881	11.969	16.226	22.111

Scenario 2015		**LINEAR**	**NONLINEAR**				
		Beta →	**0.15**	**0.20**	**0.30**	**0.40**	**0.50**
Tuberculosis	Treatment	0.90	1.276	1.439	1.840	2.366	3.059
Malaria	Diagnosis	3.40	5.122	5.895	7.850	10.514	14.155
	Prevention	1.00	1.637	1.938	2.728	3.863	5.497
HIV/AIDS	Care of OI	6.40	10.285	12.096	16.814	23.513	33.049
	HAART	8.00	12.981	15.316	21.429	30.160	42.667

TABLE A5: Comparison between LINEAR AND NONLINEAR costs, DIS/ECONOMIES OF SCOPE (BETA = 0, DELTA VARIES)
Two interventions: tuberculosis treatment and malaria diagnosis

Figures are in '000 000 000 USD

Scenario 2007A		NONLINEAR				
	Delta →	**-0.1**	**-0.05**	**-0.01**	**-0.005**	**-0.001**
		1.624	1.612	1.602	1.601	1.600
Total linear costs: $ 1.6 B	Delta →	**0.001**	**0.005**	**0.01**	**0.05**	**0.1**
		1.600	1.599	1.598	1.588	1.576

Scenario 2007B		NONLINEAR				
	Delta →	**-0.1**	**-0.05**	**-0.01**	**-0.005**	**-0.001**
		2.578	2.539	2.508	2.504	2.501
Total linear costs: $ 2.5 B	Delta →	**0.001**	**0.005**	**0.01**	**0.05**	**0.1**
		2.499	2.496	2.492	2.461	2.422

Scenario 2015		NONLINEAR				
	Delta →	**-0.1**	**-0.05**	**-0.01**	**-0.005**	**-0.001**
		4.509	4.404	4.321	4.310	4.302
Total linear costs: $ 4.3 B	Delta →	**0.001**	**0.005**	**0.01**	**0.05**	**0.1**
		4.298	4.290	4.279	4.196	4.091

TABLE A6: Comparison between LINEAR AND NONLINEAR costs, DIS/ECONOMIES OF SCOPE (BETA = 0, DELTA VARIES)
Two interventions: tuberculosis treatment and malaria diagnosis

Figures are in '000 000 000 USD

Scenario 2007A		NONLINEAR				
	Delta →	**0.15**	**0.25**	**0.35**	**0.40**	**0.45**
		1.564	1.540	1.516	1.505	1.493
Total linear costs: $ 1.6 B	Delta →	**0.50**	**0.55**	**0.60**	**0.65**	**0.70**
		1.481	1.469	1.457	1.445	1.433

Scenario 2007B		NONLINEAR				
	Delta →	**0.15**	**0.25**	**0.35**	**0.40**	**0.45**
		2.383	2.305	2.226	2.187	2.148
Total linear costs: $ 2.5 B	Delta →	**0.50**	**0.55**	**0.60**	**0.65**	**0.70**
		2.109	2.070	2.031	1.992	1.953

Scenario 2015		NONLINEAR				
	Delta →	**0.15**	**0.25**	**0.35**	**0.40**	**0.45**
		3.987	3.778	3.569	3.465	3.361
Total linear costs: $ 4.3 B	Delta →	**0.50**	**0.55**	**0.60**	**0.65**	**0.70**
		3.256	3.152	3.048	2.943	2.839

Table A7: Comparison between LINEAR AND NONLINEAR costs, DIS/ECONOMIES OF SCOPE (BETA = 0, DELTA VARIES)

Two interventions: tuberculosis treatment and malaria diagnosis

Figures are in ‘000 000 000 USD

Scenario 2007A		**NONLINEAR**				
	Delta →	**-0.15**	**-0.25**	**-0.35**	**-0.4**	**-0.45**
		1.636	1.660	1.684	1.695	1.707
Total linear costs: $ 1.6 B	Delta →	**-0.5**	**-0.55**	**-0.6**	**-0.65**	**-0.7**
		1.719	1.731	1.743	1.755	1.767

Scenario 2007B		**NONLINEAR**				
	Delta →	**-0.15**	**-0.25**	**-0.35**	**-0.4**	**-0.45**
		2.617	2.695	2.774	2.813	2.852
Total linear costs: $ 2.5 B	Delta →	**-0.5**	**-0.55**	**-0.6**	**-0.65**	**-0.7**
		2.891	2.930	2.969	3.008	3.047

Scenario 2015		**NONLINEAR**				
	Delta →	**-0.15**	**-0.25**	**-0.35**	**-0.4**	**-0.45**
		4.613	4.822	5.031	5.135	5.239
Total linear costs: $ 4.3 B	Delta →	**-0.5**	**-0.55**	**-0.6**	**-0.65**	**-0.7**
		5.344	5.448	5.552	5.657	5.761

Table A8: Comparison between LINEAR AND NONLINEAR costs, DIS/ECONOMIES OF SCALE AND OF SCOPE (BETA, DELTA VARY)

Two interventions: tuberculosis treatment and malaria diagnosis

SCENARIO 2015

Delta positive (Economies of scope)

Figures are in '000 000 000 USD

Scenario 2015		**NONLINEAR**				
	Delta →	**0.00**	**0.15**	**0.40**	**0.70**	**1.00**
	Beta ↓					
Total linear costs:	**0.000**	4.300	3.987	3.465	2.839	2.213
$4.3B	**0.001**	4.311	3.997	3.474	2.846	2.218
	0.005	4.356	4.039	3.510	2.876	2.242
Disecon. of scale	**0.01**	4.413	4.091	3.556	2.913	2.271
	0.05	4.898	4.541	3.948	3.235	2.522
	0.1	5.592	5.185	4.508	3.694	2.881
	0.2	7.334	6.802	5.914	4.849	3.784
	0.5	17.215	15.970	13.894	11.404	8.913

Scenario 2015		**NONLINEAR**				
	Delta →	**0.00**	**0.15**	**0.40**	**0.70**	**1.00**
	Beta ↓					
Total linear costs:	**0.000**	4.300	3.987	3.465	2.839	2.213
$4.3B	**- 0.001**	4.245	3.977	3.456	2.832	2.207
	- 0.005	4.245	3.936	3.421	2.802	2.184
Economies of scale	**- 0.01**	4.191	3.886	3.377	2.767	2.156
	- 0.05	3.785	3.509	3.049	2.498	1.946
	- 0.1	3.341	3.097	2.691	2.204	1.717
	-0.2	2.629	2.437	2.117	1.733	1.349
	-0.5	1.442	1.336	1.160	0.948	0.737

Table A9: Comparison between LINEAR AND NONLINEAR costs, DIS/ECONOMIES OF SCALE AND OF SCOPE (BETA, DELTA VARY)

Two interventions: tuberculosis treatment and malaria diagnosis

SCENARIO 2015

Delta negative (Diseconomies of scope)

Figures are in '000 000 000 USD

Scenario 2015				**NONLINEAR**		
	Delta →	**0.00**	**- 0.15**	**- 0.40**	**- 0.70**	**- 1.00**
	Beta ↓					
Total linear costs:	**0.000**	4.300	4.613	5.135	5.761	6.387
$4.3B	**0.001**	4.311	4.625	5.148	5.776	6.404
	0.005	4.356	4.673	5.202	5.836	6.470
Disecon. of scale	**0.01**	4.413	4.734	5.269	5.912	6.554
	0.05	4.898	5.254	5.848	6.561	7.274
	0.1	5.592	5.998	6.676	7.489	8.302
	0.2	7.334	7.867	8.755	9.820	10.885
	0.5	17.215	18.460	20.535	23.026	25.516

Scenario 2015				**NONLINEAR**		
	Delta →	**0.00**	**- 0.15**	**- 0.40**	**- 0.70**	**- 1.00**
	Beta ↓					
Total linear costs:	**0.000**	4.300	4.613	5.135	5.761	6.387
$4.3B	**- 0.001**	4.245	4.601	5.122	5.746	6.371
	- 0.005	4.245	4.554	5.069	5.687	6.306
Economies of scale	**- 0.01**	4.191	4.496	5.005	5.615	6.225
	- 0.05	3.785	4.061	4.520	5.072	5.623
	- 0.1	3.341	3.585	3.991	4.478	4.965
	-0.2	2.629	2.821	3.141	3.525	3.909
	-0.5	1.442	1.548	1.724	1.935	2.147

NOTES

[1] Each goal is associated with specific targets, eighteen in total; and each target is related to quantifiable indicators, forty-eight in total. The different goals, targets and indicators are presented in Appendix 1.
[2] For more detailed information on the history of UN global goals, see Jolly, R., 2003.
[3] Five global conferences offered inspiration for the formulation of the seven international development targets: the World Summit for Social Development, Copenhagen; World Conference on Education for All, Jomtien; World Conference on women, Beijing; International Conference on Population and Development, Cairo; UN Conference on Environment, Rio de Janeiro.
[4] The paper "The Millennium Development Goals and the IDC: driving and framing the Committee's work" (2003) developed by the Overseas Development Institute (ODI) provides a full description of the IDTs (in its appendix) and provides a comprehensive genealogy of the MDGs.
[5] United Nations, 2000.
[6] United Nations, 2001a
[7] United Nations, 2001a.
[8] United Nations, 2002b.
[9] Appendix 2 presents a summary of the diverse existing global cost estimates.
[10] United Nations, 2001b. Technical Report, p.16.
[11] Devarajan S., Miller M.J. and Swanson, E.V., 2002
[12] Pettifor A. and Greenhill R., 2003.
[13] Regrettably, the assumptions made by the report regarding growth requirements for poverty-reduction and capital-output ratios are not made at all clear.
[14] UNDP, 2002a.
[15] Millennium Project, 2005
[16] Millennium Project, 2005, page 242-243
[17] The countries studied are Tanzania, Uganda, Ethiopia, Mozambique, Benin, Burkina Faso, Madagascar, Mali, Mauritania; Indonesia, Vietnam; Bangladesh, Pakistan, India; Bolivia, Honduras; Albania and Kyrgyz Republic. See World Bank , 2003.
[18] See Bourguignon, 2004..
[19] There are certain exceptions. See e.g. Devarajan, Miller and Swanson, 2002.
[20] A Joint Ministerial Committee of the Boards of Governors of the World Bank and the IMF
[21] Development Committee, 2003. See page 10, e.g. health in Albania and Mauritania.
[22] See e.g. Dollar and Burnside (1999). The CPIA assigns a value between 1 and 6 to capture perceived performance in twenty different respects, ranging from macro-economic management and factor market policies to policies for social inclusion and public sector management.
[23] Vandemoortele (2003) stresses the subjectivity of evaluations concerning, for instance, whether a country has a distortionary minimum wage, excessive labor market regulations or too many public sector workers (page 14).
[24] For instance, Reddy and Minoiu (unpublished) point out the omission of explanatory variables related to human "capital" (such as life expectancy and school enrolment) and the structure of economies (such as dependence on primary commodity exports) in these analyses. The consequence is to attribute to "good policies" a much larger effect than they may in fact have. See also Dayton-Johnson and Hoddinott (2003).
[25] It is not especially evident why it should be assumed that countries will actually attain this rate of growth. Indeed, the assumed per capita income growth rates (for example, 3.3 percent per annum for Tanzania) are extremely optimistic in relation to historical levels in many countries. A more detailed discussion of that issue is presented in Appendix 3.
[26] Millennium Project, 2004. Page 19
[27] We are very grateful to Sudhir Anand for bringing our attention to this point.
[28] A detailed list of these interventions is available in Millennium Project, 2004, page 200-213.
[29] We would like to thank Lynn McDonald of Unicef for this comparison.
[30] Delamonica E., Mehrotra S. and Vandemoortele J., 2001
[31] Economic Policy Research Centre, 2002
[32] Bruns B., Mingat A. and Rakotomalala R., 2003
[33] Millennium Project, 2004
[34] See e.g. Rosenzweig and Foster, 2003.

[35] In this connection see also Sachs (2005).
[36] World Bank, 2003. Box 1, Page 3.
[37] Millennium Project, 2004, Page 24
[38] Ibid, page 105
[39] Ibid, page 24-25
[40] Snow, 2005.
[41] i.e. elasticities of the poverty headcount ratio with respect to per capita income.
[42] See Reddy and Pogge (2002) and Pogge and Reddy (2003)
[43] See Appendix three