Inter-temporal macroeconomic trade-offs and payoffs of human development strategies:
An economy-wide modelling analysis

Marco V. Sánchez and Martín Cicowiez [+]

Abstract

This paper quantifies potential long-term social and economic gains developing countries can reap from investing in human development. The discussion revolves around public spending and financing strategies in pursuance of the Millennium Development Goals (MDGs) in four countries. Quantifications are based on scenarios that are simulated by applying an economy-wide modelling framework that captures the wide range of effects of bold public interventions throughout the economy. Simulated significant stepping up of public spending to pursue a set of MDG targets by 2015 and maintain sound human development indicators thereafter spurs economic gains in the long run. The macroeconomic implications of using alternative sources of financing for the newly-added spending ultimately define the effect on public finances and economic growth. Simulated public spending unambiguously boosts aggregate demand, though. The supply response is such that product factors accumulate and productivity rises as larger numbers of better-educated workers are effectively employed to deliver social services and in other sectors of the economy. GDP growth gains between 0.2 to 1.0 percentage points per year after 2015 are estimated and options to magnify them are identified.

JEL Classification: C68 (Computable General Equilibrium Models); F35 (Foreign Aid); H2 (Taxation, Subsidies, and Revenue); H5 (National Government Expenditures and Related Policies); I25 (Education and Economic Development); I3 (Welfare and Poverty); J24 (Human Capital; Skills; Occupational Choice; Labour Productivity); O4 (Economic Growth and Aggregate Productivity); O11 (Macroeconomic Analyses of Economic Development).

[+] The two authors are, respectively, Economic Affairs Officer at the Development Policy an Analysis Division of the United Nations Department of Economic and Social Affairs (DPAD/UN-DESA) and Lecturer at *Centro de Estudios Distributivos, Laborales y Sociales* (CEDLAS) of University of La Plata. Comments are welcome and can be addressed by email (sanchez-cantillo@un.org and martin@depeco.econo.unlp.edu.ar). The paper was initially elaborated as an input to the elaboration of the United Nations World Economic and Social Survey (WESS) 2013. It was presented and discussed, on 23 April 2013, as part of the Development Policy Seminar Series hosted by the Development Strategy and Policy Analysis Unit of DPAD/UN-DESA. The paper has been further fine-tuned before presenting it at the International Conference of the Human Development and Capabilities Association (HDCA), to be held in Managua, Nicaragua, on 9-13 September 2013. The authors are grateful to Diyora Kabulova for her support in compiling key literature and Marcelo Lafleur for his valuable comments. Views and opinions expressed are those of the authors and do not necessarily reflect those of the institutions to which they are affiliated.

1. Introduction

Member states of the United Nations resolved to pursue the achievement of the Millennium Development Goals (MDGs) in 2000. They set concrete targets to be met by 2015, aiming at a future of less poverty, hunger and disease, better education, gender equality, greater prospects of survival for children and mothers and a more sustainable environment. Much progress has been made since then, but this has been uneven across and within countries (United Nations, 2012). Some countries have witnessed human development setbacks as a result of the global financial crisis (United Nations, 2011).

Business as usual is not proving enough to achieve the pace of progress necessary to meet international agreed development goals by 2015 in many developing countries. Additional policy interventions will be needed. Studies for 27 developing countries, documented in Sánchez and Vos (2013) and Sánchez and others (2010), estimate that to be put on full track to meet a set of MDG targets by 2015 countries would have needed significant stepping up of public spending and more rapid and sustained economic growth. Achieving economic growth in the midst of a depressed world economy is proving a significant challenge, though. And, as these studies also show, given existing financing constrains, accelerated human development investments up to 2015 would overstretch countries' public finances with potential short-term macroeconomic hardships that might jeopardize the badly needed economic growth.

In defining what human development interventions they want to pursue, countries should estimate not only public spending requirements and the macroeconomic implications of financing these, but also the potential social and economic rewards. The aforementioned studies provide rigorous estimates for simulation periods until 2015, the year for which most MDG targets are expected to have been met. Nonetheless, estimations of how soon long-term rewards of human development interventions can materialize and the degree of their significance are less known. Gains from investing in human development take time to materialize. Capital may be accumulated relatively quickly but it takes time for better education and health outcomes to translate into social outcomes and human capital that produces higher labour productivity (and economic growth), if only because children need to go through one or more educational cycles and improved child and maternal health care today will pay off in terms of healthier students

and workers several years from now. Equally important, countries need to identify the set of policies that can give coherence to the multiple tasks of ensuring that such long-term rewards can effectively materialize, which implies also sustaining sound human development levels (and spending), economic growth, employment creation and macroeconomic balances.

Understanding the potential long-term rewards of human development investments and the policy interventions necessary to ensure they materialize and at what macroeconomic costs is crucial to define national development strategies after 2015. This understanding comes timely to inform the process of defining the post-2015 UN development agenda in the making.[1] In this vein, this paper aims to answer two fundamental questions: what social and economic gains associated with past investments in human development, especially those made in the context of pursuing the MDGs by 2015, can developing countries realistically expect?; what policy interventions would contribute to ensure that such social gains and economic payoffs effectively materialize?

Finding coherent and rigorous answers to these questions requires the use of an economy-wide modelling framework. The aforementioned studies for 27 developing countries applied the ***Ma****quette* for **M**DG **S**imulations (MAMS) in order to assess feasible financing strategies to meet the MDGs. MAMS is a dynamic-recursive, computable general equilibrium (CGE) model (Lofgren and others, 2013). It is innovative in the sense that it comprises a set of basic human development objectives related to poverty reduction, primary education, maternal and child mortality, and access to water and basic sanitation. Policy efforts to meet these objectives, which are not restricted to the social policy arena, involve the entire economy through a number of transmission mechanisms that are captured in MAMS. For example, poverty reduction efforts that run from, say, cash transfers, require financing by the government and are expected to affect household consumption, all of which can trigger additional effects through production, employment, wages and prices. Expansion of social services in education, health and basic sanitation also requires additional spending efforts that may strain public and private budgets. Adjustments in taxes and public and private credit demand to finance those spending

[1] For more details on this process, see, for instance, the report to the Secretary-General of the UN System Task Team on the Post-2015 UN Development Agenda, *Realizing the Future We Want for All*, available at: http://www.un.org/en/development/desa/policy/untaskteam_undf/untt_report.pdf

needs, in turn, will have repercussions throughout the economy. Better education and health outcomes are expected to yield, over time, positive spinoffs on productivity and incomes. This range of transmission mechanisms justifies the use of an economy-wide model such as MAMS to assess the impacts and costing of human development policies.

However, the majority of existing applications of MAMS with country datasets have focused on assessing financing strategies to achieve the MDGs by 2015, without looking beyond that target year. That is to say, these applications have not explicitly determined payoffs and potential macroeconomic costs of policy interventions tilted towards keeping human development goals fully achieved after 2015. This paper addresses such longer-term perspective and, in doing so, it makes some necessary extensions to MAMS and applies it to four developing countries (Bolivia, Costa Rica, Uganda and Yemen).

MAMS and the extensions made to one of its functional specifications for the purposes of elaborating this paper are briefly described in section 2. The subsequent section addresses data and calibration issues that are relevant to explain how the model was applied using datasets for the four selected countries. Also, a baseline scenario that was generated for each of these countries is described. Section 4 focuses on the analysis of policy scenarios that are compared with the baseline scenario to quantify potential gains from past human development investments and identify certain conditions that once met would contribute to secure these gains and magnify their impact over the years. The final section concludes and provides policy recommendations.

2. Modelling framework

MAMS is used to simulate various scenarios. As indicated, the use of a dynamic-recursive CGE model, such as MAMS, is justified because the pursuit of a strategy towards the achievement of the MDGs, or any other human development aspiration in general, will likely have strong effects throughout the economy. Such strategy would affect demand and supply in the different markets (goods and services, factors and foreign exchange), and the related adjustments may imply important trade-offs throughout the period for achieving the development goals and beyond. MAMS, in particular, also takes into consideration the possible synergies between the different goals.

Such synergies may influence the required expansion of services (for example, greater coverage of drinking water supply may reduce the need for health service expansion) or the speed at which the various MDGs are achieved.

The strategy adopted to finance the required public spending also affects the outcomes. For example, foreign financing may induce real exchange rate effects while financing through domestic taxes could reduce private consumption demand, among other things, and domestic borrowing could crowd out credit resources for private investment. No doubt, increased public spending is essential for meeting human development goals, but adjustments in the real exchange rate, real wages and other relative prices may raise the unit costs for meeting these goals along with the costs for other sectors, or discourage exports, thereby widening the external deficit that needs to be financed, and so on. Productivity gains accruing exclusively from reaching higher human development standards will take some time to materialize and are thus unlikely to immediately trigger their full impact on economic growth. MAMS is a useful tool to, inter alia, assess short-run macroeconomic trade-offs and see if these would offset economic and social gains that can potentially be reaped in the longer-run.

MAMS has been built from a fairly standard CGE framework with dynamic-recursive features but it innovatively incorporates a special module which specifies the main determinants of MDG achievement and the direct impact of enhanced public expenditures on MDG-related infrastructure and services—as explained in length in Lofgren and others (2013). It considers specific targets for achieving universal primary education (MDG 2), reducing under-five and maternal mortality (MDGs 4 and 5) and increasing access to safe water and basic sanitation (MDG 7). The indicator used for monitoring MDG 2 is not just enrolment but the net (on-time) primary completion rate which is a function of student behaviour (enrolment, promotion, graduation)—since most developing countries have already achieved decent levels of enrolment in primary education. A target is set for completion on time, without repetition, for the relevant age cohort for primary school—where developing countries lag far behind more. Student behaviour, in turn, depends on the quality of education (service delivery per student), income incentives (the expected wage premium from education), the under-five mortality rate (a proxy for the health status of the student population), household consumption per

capita (as indicator of real living standard) and public infrastructure (such as roads, bridges, electricity networks, and so on, which facilitate access to and functioning of education centres). Under-five and maternal mortality rates are considered to be determined by the availability of public and private health services per capita, household consumption per capita, the level of public infrastructure (such as roads, bridges, electricity networks, and so on, which facilitate access to and functioning of health centres and hospitals), and the coverage of water and sanitation services. Access to water and sanitation, on the other hand, depends on household consumption per capita, the provision of such services by public or private providers and public infrastructure.

The effectiveness of these determinants of MDG achievement follows a non-linear pattern. Logistic functions for the "production" of the different MDG indicators and student behaviours are generated in such way that each determinant becomes relatively less effective as progress towards a predefined target is made. Social services may be provided publicly or privately; nonetheless, it is only new government investment and current expenditures that will lead to a policy-driven increase in the supply of social services and public infrastructure that ensures meeting one or simultaneous development targets. The government can be assumed to mobilize sufficient domestic or foreign resources to finance new spending requirements to meet these targets.

The goal of reducing extreme poverty (MDG 1) is not targeted in the same way as the other MDGs are targeted given the absence of tools that policymakers realistically could resort to achieve specific poverty outcomes in most real-world, developing-country contexts. CGE models like MAMS also typically fail to specify the income distribution detail that is required to properly estimate poverty at the household level, given the use of "representative households". The approach to compute poverty followed here is simple and has shortcomings in view of the long-term perspective of the modelling analysis. It is assumed that an initial distribution of per-capita welfare (income/consumption) within the model's single representative household follows a log-normal distribution. This approach is widely accepted as a good approximation for within-country income/consumption distributions (Bourguignon, 2003; Easterly, 2009). Changes in welfare per capita of the model representative household with respect to the initial situation due to a simulated policy shock, for example, are used to estimate the counterfactual (log-normal)

distribution of per capita welfare in all simulated scenarios. Poverty and inequality indicators are computed for both the initial and the policy-shock situation and can be compared.[2]

Output growth in MAMS depends on the accumulation of production factors (labour at different educational levels, private capital, and other factors such as land and natural resources) and changes in total factor productivity (TFP). In the original version of MAMS, TFP, in turn, is influenced by the accumulation of government capital stocks and openness to foreign trade. These relationships count on empirical backing. Arslanalp and others (2010), for instance, have estimated the impact of public capital on economic growth for 48 OECD and non-OECD countries during the period from 1960 to 2001. Using the production function approach and its extensions, they find a positive elasticity of output with respect to public capital, which is robust to changes in time intervals and varying depreciation rates. A vast empirical literature also agrees on the positive association between openness and growth, and in some studies such an association is found to be robust to the measure of openness (see, e.g., Greenaway and others, 2001; Edwards, 1988, 1998).[3]

Given the long-term perspective of this paper's modelling analysis, MAMS has been extended to include an additional, key driver of productivity growth. As indicated, it takes time for better education and health outcomes to translate into higher labour productivity if only because children need to go through one or more educational cycles and improved child and maternal health care today will pay off in terms of healthier

[2] Studies presented in Sánchez and Vos (2013) and Sánchez and others (2010) combine MAMS scenario results and a non-parametric microsimulation model that is applied using household survey data in order to calculate poverty and inequality indicators. This approach permits full account of the income distribution recorded in a household survey such that assumptions about the income distribution within the model representative household are no longer required. The simulation period of these studies extends only until 2015, however, such that their assumptions about demographic changes need not be fairly restrictive. Household surveys are not available for many years into the future and using one or a set of existing surveys would require accepting a number of additional assumptions that become very restrictive into the longer run. Examples of these assumptions are that no demographic changes take place during the simulation period or that these changes can be imposed exogenously with limited information about population dynamics. The use of a microsimulation model is avoided in this paper because the modelling analysis is extended up to 2030.

[3] Rodríguez and Rodrik (1999) have, however, argued that the vast literature supporting this association may be affected by methodological problems because the indicators of openness used may be poor measures of trade barriers or may be highly correlated with other sources of bad economic performance.

students and workers several years from now. Spending more to improve education and health outcomes is one of the policies governments undertake to invest in human capital.

Nelson and Phelps (1966) developed the first model of endogenous technological progress to analyse the role of human capital in technological progress. Edwards (1992, 1998) adapted this model to include the role of openness on growth and TFP growth. In these models, TFP growth is positively correlated with the domestic rate of innovation and the speed at which a country closes the 'knowledge gap'. The domestic rate of innovation depends on the level of human capital, in line with a number of models of endogenous economic growth whereby larger stocks of human capital allow countries to catch up with the technological leaders faster (Romer, 1990; Lucas, 1988).[4] A positive and significant impact of human capital on growth and TFP growth has been observed in studies conducted for a large sample of countries (see, e.g., Edwards, 1998; Barro, 1991). The speed at which a country closes the 'knowledge gap' depends on the rate at which the country is able to absorb (or imitate) technological progress originated in the leading nations. Such absorption is positively related to the degree of openness, since this is expected to allow the introduction of new products and methods and provide more contact with the world market, as suggested by some literature (Barro and Sala-i-Martin, 1995; Romer, 1992; Grossman and Helpman, 1991). In consequence, more open economies will lead to a higher steady-state stock of knowledge and, other things remaining the same, higher productivity and output growth.

Investment in schooling (whether this is represented by the number of years of education of the population or spending in education), which, as said, is a policy typically used by governments to build human capital, has also been found to be positively correlated with GDP growth in large samples of countries (see, e.g., Klenow and Rodríguez-Clare, 2005, and evidence and literature referred to in Hughes, 2007).

Against this theoretical and empirical background, MAMS has been extended to incorporate the direct impact of human capital on TFP. In view of this extension to the modelling framework, the impact of pursuing goals for education and health on economic

[4] The endogenous productivity growth literature also emphasizes the role of R&D on innovation as this enables a more effective use of existing resources. There is convincing evidence that R&D is an important determinant of productivity in developed nations (see, e.g., Coe and Helpman, 1995; Coe and Moghadam, 1993; Griliches, 1988).

growth is expected to be larger than it is recorded in existing MAMS applications. The stock of human capital as a determinant of productivity is often proxied by the years of education of the population or spending in education. In this paper it is alternatively proxied by the stock of skilled labour. The latter, in turn, is defined by the number of workers who have at least completed secondary education and are employed.[5] The applications of MAMS presented in this paper assume that there is not full employment of labour. The unemployment rate is endogenous and clears the market for each type of labour.[6] As a consequence, skilled workers, as defined above, would affect productivity only if they are employed. This specification is useful to pin down mismatches between the supply of and demand for skilled labour. Unemployment of skilled labour, for example, may signal investments in human capital do not go hand in hand with economic changes that are necessary to adequately absorb the population of skilled workers.

3. Data, calibration and baseline scenario

The basic accounting structure of MAMS is derived from a Social Accounting Matrix (SAM). For each of the four countries under study, a SAM has been constructed using data from official national accounts (i.e., supply and use tables, institutions' accounts and macro aggregates), fiscal accounts, balance of payments information and a recent household survey.[7] These SAMs share the following characteristics: (a) possess a relatively detailed treatment of public investment and its financing; (b) seven government activities correspondingly provide seven services: three types of education (primary, secondary and tertiary), health, water and sanitation, public infrastructure and other government services; (c) the private service sector is also disaggregated into three education activities and a private health activity, in addition to other private services; (d) the rest of the economic activities are disaggregated into various sectors the number of

[5] The educational attainment of the population at working age (for instance, age 15 and above) is being used rather than the education of the population of age 25 and above which has been a common stock measure of human capital. As explained in Hughes (2007), conceptually, a focus on the education of the population above age 15 might be better, especially for developing countries where most of those above 15 will be in the labor force.

[6] This mechanism would no longer hold if the unemployment rate reaches a predefined minimum; at this point the real wage becomes the clearing variable of the market.

[7] These SAMs have been built by teams of national experts under technical guidance of this paper's authors, as part of capacity development projects coordinated by DPAD/UN-DESA and other institutional partners.

which varies by country; (e) among the factors of production, there are three types of labour that are linked directly to an educational cycle: workers with less than completed secondary education (unskilled), with completed secondary education but not completed tertiary (skilled) and with completed tertiary (highly skilled). The remaining factors of production include public capital stocks by government activity, a private capital stock, and natural resources used in mining and agriculture; and (d) the institutions include the government, a "representative" household (the private domestic institution, which represents both households and domestic enterprises), and the rest of the world.

MAMS' datasets for each of the countries also include data related to the different MDGs, the labour market, and a set of elasticities. Key information to calibrate the model are levels of service delivery that would presumably be required to meet the different MDGs, number of students at different educational cycles, student behavioural patterns in terms of promotion rates and other indicators, and number of workers and initial unemployment rates for the three types of workers. The elasticities define behaviour in production, trade, consumption and MDG functions. As for the later, logistic models have been estimated to identify the influence of both supply and demand factors on outcomes in education, health and coverage of drinking water and sanitation. The findings of these empirical analyses were used to calibrate the MDG module of MAMS for each country application. Calibration was subsequently made to ensure that each country application of MAMS reproduced past MDG progress which was projected into the future under a continuation of economic trends and public spending policies.[8]

The parameterization of the endogenous drivers of productivity growth is conservative and has been defined on the basis of existing empirical evidence. The following elasticities (and ranges used for all four countries) were used: 0.01 for openness to foreign trade, 0.05 for the stock of public infrastructure, and 0.25 for

[8] The calibration took as starting points elasticity values computed in the framework of capacity development projects coordinated by DPAD/UN-DESA. The authors of this paper acted as resource persons and technical advisors to these projects. For details on the initial elasticity values used in the calibration of the MDG module of MAMS, see Ponce (2012) for Bolivia, Pacheco (2012) for Costa Rica, Matovu and others (2011) for Uganda, and Sánchez and Sbrana (2009) and Sbrana (2009) for Yemen.

employment of skilled labour. The latter elasticity is essentially in the middle of a range of elasticity values that have been defined after reviewing empirical literature.[9]

A baseline scenario was generated for each country after completing the model calibration process, in order to formulate a benchmark against which different policy scenarios are compared. Starting from a base year (2004 for Yemen, 2005 for Costa Rica, 2006 for Bolivia and fiscal year 2009/2010 for Uganda), the baseline scenario replicates actual economic performance under policies implemented in recent years (until around 2011/2012) and projects it up to 2030. Economic growth assumptions—including the deceleration in GDP growth caused by the global financial crisis of 2008-2009—are country-specific. In order to mimic unchanged expenditure policies of the recent past, government consumption and other components of recurrent spending evolve following a rule: that is to say, they represent a pre-defined share of GDP. Government investment spending depends on the demand for capital in the public services sector and the latter, in turn, varies as the government consumes to deliver services. Any emerging fiscal deficit (or surplus) is assumed to be financed (adjusted) by transfers from the rest of the world (foreign borrowing for Costa Rica and grant aid for the other three countries).[10] Private investment is assumed to remain fixed as a share of GDP, while savings rates of private agents adjust endogenously to ensure the model consistency requirement that total savings equal total investment is met.

Under these economy-wide assumptions, countries' GDP and their demand-side components evolve as shown in Table 1 for pre-2015 (from base year to 2015) and post-2015 (from 2016 to 2030) periods. Baseline GDP growth resembles observed GDP growth until 2012. Between 2013 and 2030, GDP grows steadily at the rate observed in 2012. GDP growth decelerates owing to the global financial crisis in 2008-2009, except

[9] The elasticity of productivity growth with respect to different types of R&D stocks and expenditure, for example, has been found to be in the range of 0.07-0.56 (Abdih and Joutz, 2005; Furman and Hayes, 2004; Wang and Tsai, 2003; Guellec and van Pottelsberghe de la Potterie, 2001; Cameron, Proudman and Redding, 1999). Or, with respect to the share of GDP spent on secondary and tertiary education, this elasticity has been found to be around 0.09.

[10] Uganda and Yemen are low income countries and Bolivia is a lower-middle income country, according to the World Bank country classification by income. These countries have relied heavily on foreign aid to finance human capital investments. Costa Rica is less likely to receive foreign grant aid from donors to support its government budget being an upper-middle income country. Alternatively, MAMS permits to finance the emerging fiscal deficits in scenarios such as these, through increased taxation or domestic public borrowing, options that are used as part of this paper's policy scenario analysis.

in Uganda's baseline which starts from the fiscal year of 2009/2010. Economic recovery after the global financial crisis is modest in all cases but Uganda's where GDP grows notably more after 2015 owing to a projected increase in aggregate demand. Economic growth is by and large fairly balanced over the years in all four countries, as measured by the GDP share of demand-side components. Aggregate demand continues to rely heavily on private consumption mainly, but also on exports to a lesser extent.[11] Foreign savings increase relative to GDP over the years, which is consistent with the government financing its deficit using foreign sources.

[Table 1 around here]

The baseline scenario also depicts the (endogenous) evolution of MDG indicators under a continuation of economic conditions and policies, and considers the complementarities or synergies in achieving the various development goals. As described in the previous section, MAMS considers how much improved health contributes to accelerate progress towards the education goal and how much increased access to drinking water and basic sanitation contributes to reducing mortality rates. Continued public spending in MDG-related services (primary education, health and water and sanitation) is one of the key drivers of MDG outcomes under the baseline (Table 2). Government service delivery continues to grow after 2015 due to the projected continuation of social spending policies implemented after the global financial crisis and the growth of GDP—of which government consumption of MDG-related services is a fixed share, especially in those countries (Bolivia, Uganda and Yemen) where output is projected to gain steam after 2015. Public investment spending increases to the extent needed for the government to be able to deliver social services (not shown in Table 2). Private consumption of primary education, health, and water and sanitation, total real per-

[11] Newfound oil resources are expected to flow in Uganda in the near future. The potential growth of crude oil exports has not been taking into consideration to generate Uganda's baseline scenario, though, due to lack of empirical ground to generate a plausible trend of these expected revenues.

capita private consumption and the accumulation of public infrastructure capital stock grow at rates that also permit them to trigger a positive impact on the MDG indicators.[12]

[Table 2 around here]

Under the said baseline assumptions, all four countries would make apparent progress towards meeting, by 2015, those MDG targets being analysed (Figure 1). Costa Rica, the country recording the lowest initial MDG gaps, does not meet all targets by 2015 only by very small margins; which in the particular case of non-poverty MDG indicators is primarily explained by government consumption growing more rapidly than GDP (see Table 1).[13] Bolivia only meets the water and sanitation targets whereas Uganda and Yemen meet none. In sum, in spite of projected progress, continued trends of economic growth and social public spending would not be enough to achieve all MDG targets by 2015. Additional policies and higher and more sustained economic growth will be required.

[Figure 1 around here]

The challenges to achieve human development goals by 2015 may be of more significance in the face of volatile economic conditions of which the recent global financial crisis was but one manifestation. Persistent international financial market and commodity price instability have affected the economies of the four countries covered to varying degrees, and differences in policy responsiveness further explain varying impacts on human development. Economic uncertainty has been compounded by political conflict and instability of different nature in countries such as Uganda and Yemen. These are

[12] MDG indicators are also influenced depending on the importance of the GDP shares of each government and private spending item and the country-specific elasticity values by which determinants presented in Table 2 are estimated to affect the indicators. Income incentives (the expected wage premium from education) are not estimated to have any strong influence on student behaviour in primary education.

[13] In spite of the higher human development levels achieved under Costa Rica's baseline scenario, the evolution of the primary completion rate reflects, on one hand, marked inefficiencies of spending that are not assumed to be as strict under the other countries' baseline scenarios and, on the other hand, more aggressive targeting of outcomes in secondary education.

aspects the modelling analysis cannot fully account for but are worth considering to understand these countries' real human development challenges.

4. Policy scenarios and analysis

Four policy scenarios are generated (Sim1-Sim4) which are compared with the baseline scenario to: (i) quantify social and economic growth gains after 2015 owing to past MDG-related investments and (ii) identify policy interventions that may contribute to secure them. These policy scenarios delineate a path towards fully meeting the non-poverty targets depicted in Figure 1. They are hereafter regarded as the "MDG-achieving scenarios". The policy variable is "MDG-related public spending", which includes all investment and current expenditures in primary education, health and water and sanitation. This spending is scaled up, at each country's estimated effectiveness, in order to increase the net (on-time) primary school completion rate, reduce child and maternal mortality rates and improve access to drinking water supply and basic sanitation until targets are met by 2015.[14] GDP shares of public spending in primary education, health and water and sanitation in 2015 (hereafter, "MDG-achieving GDP shares of public spending") are maintained unchanged after 2015 to avoid setbacks in human development in the first two policy scenarios.

Additional public spending requirements to meet non-poverty targets by 2015 and maintain MDG-achieving GDP shares of public spending unchanged afterwards are financed through foreign sources in all scenarios but the second (Sim2). In the latter**,** the government is assumed to have the capacity to mobilize direct-tax revenues, instead of foreign resources, in order to maintain MDG-achieving GDP shares of public spending unchanged after 2015.[15] Running this scenario is relevant because reliance on foreign

[14] To meet the targets, MDG-related spending is assumed to be endogenous through 2015—that is to say, it no longer follows a rule as in the baseline scenario. MAMS remains a fully determined model to generate the policy scenarios because non-poverty MDG indicators become exogenous at fixed, MDG-achieving values along a logistic function through 2015. The caveat is that public spending increases from the base year of each country's application, not from a more recent year. Therefore, the scenarios help to quantify the additional public spending that the four countries should have scaled up by, say, 2012 to have been fully on track to meet their MDG targets by 2015. This comes on top of the additional public spending that these countries would have to incur between 2013 and 2015 to meet the targets.

[15] The budget financing assumptions of the baseline scenario are changed for scenario Sim2 where any fiscal deficit emerging in 2016-2030 is financed through direct-tax revenues rather than foreign resources. Also, in all four policy scenarios, private investment becomes "savings-driven" and no longer follows the

resources may not be a sustainable option in the long run in view of debt sustainability considerations and the apparent declining availability of foreign aid by international donors. Countries will eventually be required to deepen domestic resource mobilization.[16] The four countries under study, in particular, may still have ample scope for reforms aiming at increasing tax revenues; in fact, the tax burden in these countries is relatively low as large parts of their (informal) economy remain untaxed and there is substantial tax evasion and exceptions.[17] In any case, even in most low-income countries social service delivery and poverty reduction programmes are largely financed through domestic resource mobilization.

GDP growth in the MDG-achieving scenarios is found to be higher than under the baseline between 2016 and 2030, as further explained below. As a consequence, the assumption that MDG-achieving GDP shares of public spending are fixed after 2015 implies overachievement of MDG targets post-2015 in the first two scenarios (see results for Sim1 in Figure A1, in the Appendix). In view of this result, the net (on time) primary completion rate (mdg2) achieved in 2015 under the first two scenarios is left unchanged in 2016-2030 in the last two scenarios (Sim3-Sim4). Thus, public spending in primary education in the last two scenarios is lower than in the first two both as a share of GDP and in absolute terms. Resulting "public spending savings"—relative to the first two policy scenarios—are allocated to secondary and tertiary education in the third scenario (Sim3) and public infrastructure (roads, bridges, and so on) in the fourth (Sim4).[18] These

---

rule that it is a fixed share of GDP as in the baseline scenario. The amount of private investment that can be realized at the end of the day depends on the total availability of savings in the policy scenarios. Generally speaking, it can be argued that the four countries under study tend to face overall financing constraints, especially given their generally low initial levels of domestic savings which prompts them to resort to already limited access to international capital markets.

[16] Domestic borrowing is unlikely to quickly become a real financing source for development in the four countries under study where domestic capital markets are shallow and domestic savings are constrained. For this reason, it was not considered as a feasible option to include in the policy scenarios.

[17] According to World Bank data for the most recent year available, tax revenues as a percentage of GDP represented 17.0 in 2007 in Bolivia, 13.5 in 2011 in Costa Rica, 16.1 in 2011 in Uganda and only 7.0 in 2009 in Yemen.

[18] In the last two policy scenarios spending in secondary and tertiary education (Sim3) and public infrastructure (Sim4), respectively, becomes endogenous to accommodate to the newly generated fiscal space from not pursing further improvements in the net (on time) primary completion rate. Foreign resources used to finance the budget are maintained fixed at the absolute levels of the first scenario (Sim1)—and the model remains fully determined. The choice of keeping the net (on time) primary completion rate unchanged after 2015 is arbitrary and fixing any other non-poverty indicator would have also resulted in "public spending savings" that one could use to incur expenditures in other sectors.

two simulations have been designed with a purpose. More spending in higher levels of education increases the stock of better-educated workers, a number of who may become employed, thus spurring productivity and economic growth. On the other hand, new investments in public infrastructure directly drive more productivity and economic growth and indirectly they also yield additional productivity gains if the newly-added GDP growth is skilled-labour intensive. The most salient aspects of each of the four policy scenarios are summarized in the following table.

[Table 3 around here]

Keeping sound human development levels is costly

The comparison of the policy scenarios and the baseline yields interesting results. Additional public spending requirements to meet non-poverty targets by 2015 are estimated from subtracting total spending on MDG-related public spending under each of the MDG-achieving scenarios from the same type of spending recorded under the baseline. In the pre-2015 period, additional public spending requirements represent, on average, around 4.0 per cent of GDP per year in Bolivia (BOL) and Costa Rica (CRI), and 8.5 per cent of GDP per year in Uganda (UGA) and Yemen (YEM) (see Figure 2).[19] Interestingly, in spite of good progress towards the non-poverty targets under the baseline scenario, especially in Costa Rica where targets fall short of being met by very small margins, the four countries need significant stepping up of upfront public spending in order to achieve the non-poverty goals. Uganda and Yemen would have to scale up spending in amounts that would be much larger than what they would have otherwise spent without additional interventions. Some of these countries could unlikely incur such expenditures to meet MDG targets by 2015. This finding accords with that of a number of country studies presented in Sánchez and Vos (2013) and Sánchez and others (2010). This paper's modelling analysis provides new insights in regards to public spending that may be required to avoid human development setbacks after 2015.

[19] Yemen's estimate of additional public spending requirements likely would have turned out to be larger should the effects of recent conflict were fully taken into account.

[Figure 2 around here]

The direct costs of the interventions aiming at meeting the MDG targets by 2015 are high in part because the baseline reproduces actual MDG progress—from the base year to around 2012—and for some of the targets countries have not been fully on track. But the high cost estimates—in terms of additional public spending requirements—are also affected by complementarities or synergies in achieving the various development goals, decreasing marginal returns to additional public spending and the source of financing for the additional public spending. Decreasing marginal returns to additional public spending, in particular, over time increase the marginal costs to achieve each of the development goals, particularly when countries are approaching meeting their targets. MDG-achieving GDP shares of public spending set at the point of highest decreasing marginal returns to additional public spending such that keeping these shares unchanged after 2015 turns out to be most costly for public finances (see Figure 2).

These cost estimates suggest that keeping sound human development levels after 2015 could be excessively costly to achieve because of decreasing marginal returns to public spending interventions. Countries will need to find ways to enhance the efficiency of service delivery in order to contain costs. In the case of Costa Rica, for instance, where public spending in education represents nearly 8 per cent of GDP, the government would already find it quite challenging to further increase primary school completion because nearly 11 per cent of students enrolled in first grade repeated the grade by 2012. In this particular case, then, reforms to the teaching, learning and evaluation system may be more cost-effective to increase primary school completion than merely continuing raising public education expenditures. Examples of similar inefficiencies could be provided for other sectors and countries.

Obviously, the high estimated costs are not solely associated with the lack of effectiveness of spending. They are partly model driven as in the policy scenarios the so-called MDG-achieving GDP shares of public spending are maintained fixed after 2015 and GDP grows at decent and stable rates. Compared with the estimates of the previous studies mentioned above, they are also higher estimates because the effects of the global financial crisis on economic growth and human development setbacks have been more

fully accounted for under the baseline. At the same time, the high estimated costs may be also reflecting that some of the internationally agreed goals that have been targeted in the policy scenarios may be overly ambitious for particular developing countries' contexts. Al-Batuly and others (2013), for example, who also use MAMS to analyze MDG-achieving scenarios up to 2015 for Yemen, concluded that it would be unrealistic to pursue internationally agreed goals in this country given fairly high public spending and financing requirements. In our policy scenarios, in fact, we are by and large treating global goals as national targets. Literature points to the inaccuracy that one may run into when estimating the shortfall between achievement and target in the context of the MDGs (see, e.g., Fukuda-Parr and others, 2013; Easterley, 2009). However, our focus is more on the extent to which financing the additional spending requirements triggers macroeconomic trade-offs that may hamper potential long-term rewards of human development investments, rather than on claiming there is full accuracy in the estimates that we present.

Domestic resource mobilization and macroeconomic trade-offs

A comparison between the first two policy scenarios (Sim1 and Sim2) is also useful to illustrate that the financing mechanism matters for the estimates of additional public spending requirements to pursue human development. Financing these requirements through higher direct-tax revenues after 2015, for example, somewhat raises the total costs for public finances in all cases but one (Uganda), as compared with a scenario where external resources are the financing source (Figure 2). This type of taxation depresses private consumption (by reducing disposable incomes) which hurts output and employment growth and also affects private provisioning of and demand for social services. In our second policy scenario, therefore, the government needs to compensate for the loss of private spending on social services and further steps up efforts to keep MDG-related public spending unchanged as a percentage of GDP after 2015. Such macroeconomic trade-offs would need to be taken into consideration should governments pursue domestic resources mobilization to finance spending needs in pursuance of sound human development levels.

Other aspects, like debt sustainability, support from foreign donors and the real feasibility of raising tax burdens need to be taken into consideration as well. It will be very challenging for developing countries to maintain solid human development indicators considering that large amounts of foreign or domestic resources will need to be mobilized to finance the required public investments. Depending on the magnitude of these resource requirements, there could be undesirable macroeconomic implications and the interventions may confront political resistance. Tax revenues, in particular, can be raised depending on the initial levels of tax burden and, no less importantly, on political economy considerations. However, one should not be overly optimistic in regard to the speed at which developing countries would be able to effectively increase tax collection.

Growth and productivity bonuses

Governments of the four countries studied here will no doubt require stepping up upfront social spending and increasing effectiveness of this spending to aspire to sound human development standards. At the same time, they will need higher and sustained economic growth that creates private demand for education, health, and water and sanitation and allows easing fiscal constraints over time. Human development investments can also contribute to this process by spurring additional economic growth in the long run, which is corroborated by results presented in Table 4.

In the four policy scenarios, aggregate demand is pushed up by increased government spending to meet the MDG targets by 2015. This translates into higher GDP growth in all four scenarios (Sim1-Sim4)—compared with the baseline scenario—by an average annual range of 0.6 to 1.8 percentage points, except in Bolivia. Increased government spending is reflected in more hiring of teachers, doctors, and so on, and more demand for capital, such that factor accumulation explains most GDP growth gains. However, the larger pool of employed skilled workers, mostly in MDG-related sectors, also contribute to an increase in TFP thus spurring GDP growth up to 2015. In the case of Bolivia, however, GDP growth is lower—than under the baseline scenario—because the mobilization of foreign resources mainly, but also new government investments in non-tradable sectors such as education, health, and so on, trigger a real exchange rate appreciation that penalizes exports and incentivises imports to an extent that cannot be

fully offset by the push from government demand. The other three countries lose export competitiveness for the same reason, too, but the pace at which their government steps up interventions in the simulations more than offsets the deterioration of their trade balance. These are other macroeconomic trade-offs that countries may have to confront when using foreign sources for financing human development.

[Table 4 around here]

Interestingly, according to the results of the first policy scenario (Sim1), GDP continues to grow more than in the baseline after 2015, now even in Bolivia, even though the government no longer deliberately steps up additional interventions to meet human development targets. GDP growth is about 1 percentage point or more higher than under the baseline in Costa Rica, Uganda and Yemen, and 0.2 percentage point above the baseline growth rate in Bolivia (Table 4). This happens for two reasons. Firstly, factor accumulation carries on into post 2015, thus continuing to be, by and large, the most important supply-side driver of GDP growth. Domestic demand and exports adjust commensurately to match the supply-driven GDP growth. Exports, in particular, receive a strong push from real exchange rate depreciation as the need for foreign resources to finance MDG-spending is no longer as pressing as before 2015. Secondly, GDP growth also increases as a result of productivity gains. Enough time has elapsed in the post-2015 period for children to go through one or more educational cycles and child and maternal health care to improve. The resulting increased stock of healthier and better-educated workers translates into more human capital, the employment of which produces higher labour productivity and economic growth. Over the long run, such productivity gains and economic growth would permit to reduce income poverty substantially and meet poverty reduction targets (MDG 1), provided the effect on per capita income is not offset by more income inequality—the analysis of which is beyond the scope of this paper.[20] The question is whether developing countries' economies can grow at such relatively high and stable rates, as assumed under the four simulated policy scenarios. As said, persistent

[20] The effects on poverty, compared with what is seen under the baseline scenario, depend primarily on the final impact of both MDG spending and increased access to foreign resources or increased taxation on per capita income.

international financial market and commodity price instability tend to affect these countries to varying degrees, and, in some cases, this economic uncertainty may be compounded by political conflict and instability.

The financing needed to keep human development standards from deteriorating after 2015 would also continue to be enormous and at the cost of potential macroeconomic trade-offs that may offset part of the economic growth gains. This would be particularly the case should countries need to mobilize domestic resources as this financing option may affect private demand and, as a consequence, producers respond by demanding less factors of production. In fact, GDP growth and poverty reduction gains seen in the first scenario (Sim1) dissipate in the second (Sim2) whereby the government is assumed to use taxation to maintain human development levels without setbacks after 2015 (Table 4). Therefore, the financing source of human development continues to pose macroeconomic challenges after 2015.

Complementary investments to magnify economic gains

In view of fiscal constraints as well as human development gaps in other areas, governments may need to identify spending requirements that allow them to achieve, not necessarily over-achieve, development goals over a period of time. In this way, governments may be able to redeploy some resources and spend them in other key social or economic sectors. Not only could these complementary interventions allow countries to expand the scope of human development but they can also allow for additional productivity gains. The last two policy scenarios help illustrate that this may be the case. As indicated, in these scenarios the net (on time) primary completion rate is maintained just on target after 2015 (that is to say, without further improvements) and the resulting "public spending savings"—relative to the first two policy scenarios (Sim1-Sim2), where the net (on time) primary completion rate improves after 2015—are allocated to secondary and tertiary education (Sim3) or public infrastructure such as roads, bridges, and so on (Sim4). As shown in Table 4, additional productivity gains are seen in these last two policy scenarios. Compared with the first two policy scenarios, the alternative investments that are simulated in the last two scenarios contribute additional GDP growth

between 0.1 and 0.5 percentage points per year after 2015. Such gains may not be negligible for countries in desperate search of economic growth.

Economic structure and labour market constraints

Human development investments would not bear further productivity fruit should the economy's structure not adjust commensurately to absorb the increased stock of better-educated (and likely healthier) workers that forms as education targets are met and more students are likely to complete higher levels of education. This can be illustrated by tracing the unemployment rate of the most skilful workers in any of the four policy scenarios. Let us use as an example the first policy scenario (Sim1) and the simulation results for Costa Rica and Yemen, the two countries that, by and large, reap most productivity gains from employing better-educated workers in all policy scenarios. The level of unemployment of these workers is much lower than that of other workers and declines substantially over the entire simulation period. It declines more rapidly as 2015 approaches in the policy scenarios, though, as more doctors, teachers, and other highly qualified workers are demanded by the public sector (Figure 3). The educational composition of the labour force shifts in favour of the better-educated workers. Interestingly, though, the supply of the most highly skilful workers increases to a point where the economy is no longer capable to absorb it to any further extent. By 2030, unemployment of these highly qualified workers is higher in the policy scenarios compared with the baseline.

[Figure 3 around here]

A labour-market trend like this may have important implications for economic growth and development. If the economy's structure does not adjust commensurately to absorb the increased supply of better-educated workers, the skill premium will likely fall, which may likely provide a disincentive to invest in education. Empirical studies of the determinants of access to education indicate that expected private returns to education are not the sole determinant by far, but an important one nonetheless (see, e.g., Glewwe, 2002). Hence, insufficient creation of skilled jobs in the economy could jeopardize the

achievement of education goals in the post-2015 era. It could also further result in high rates of (youth) unemployment and skill mismatches in the labour market that can be catalysts of underemployment, resulting in negative repercussions in terms of rising inequality of income and opportunities, more poverty (and lower achievement of MDG 1) and even conflict as it has been the case of some Arab countries. While these changes could be counteracted by additional government interventions to stimulate school attendance and temporarily relieve the unemployed, the real problem would be how to improve the environment for stimulating a structural change in the economy towards technologies and activities that can absorb larger amounts of skilled labour. Part of the challenge for governments to address this potential mismatch between education and the labour market will be to make sure that the content of education and the skills that the education system creates are those that are on high demand by production sectors.

5. Conclusions and policy implications

Developing countries have witnessed considerable strides towards meeting the MDGs, but important rewards associated with past human investments may still be to come. Investments in education and health improve social outcomes and human capital, enhancing labour productivity and economic growth. This process takes time, however, as children need to go through one or more educational cycles and improved child and maternal health care today will bring about rewards in terms of healthier students and workers several years from now.

Social and economic gains after 2015 owing to previous human development investments have been quantified in the context of the MDGs using an economy-wide modelling scenario analysis applied to four countries: Bolivia, Costa Rica, Uganda and Yemen. Policy interventions that may contribute to ensure that such payoffs from human development investments materialize have also been recommended. The findings may become relevant at a time when the United Nations system is working ideas to define a broader post-2015 development agenda.

Under a baseline scenario that delineates a continuation of currently expected economic growth and current public spending interventions up to 2030, this paper shows that the four countries under study would make progress but eventually fail to meet, by

2015, MDG targets for primary school completion, child and maternal mortality rates, and access to drinking water and basic sanitation. Under policy scenarios whereby public spending interventions are scaled up by enough to define a path towards fully meeting the targets by 2015, and GDP shares of MDG-related public spending remain unchanged in 2016-2030, estimated fiscal costs are found to be considerable. Gains in economic growth owing to the additional MDG investments would, nonetheless, be expected to materialize owing to capital accumulation and higher labour productivity. Simulation results that most stand out are summarized as follows.

Additional public spending requirements to meet MDG targets would represent at least 4.0 to 8.5 per cent of GDP per year up to 2015 and would continue to be as costly (or even more so) after 2015 owing partly to decreasing marginal returns to additional public interventions. As a consequence, not only will countries confront the challenge of achieving human development goals by 2015 but also the other challenge of keeping them from deteriorating after 2015. Costs for public finances have been estimated to be slightly more if domestic resources rather than foreign sources are used to finance the required social expenditures.

The large amounts of domestic or foreign resources that will be needed could trigger undesirable macroeconomic trade-offs even after 2015, such as crowding out of private spending, loss of export competitiveness owing to appreciation of the real exchange rate, unsustainable debt levels, and others, depending on the financing source. The financing strategy will also matter to define additional spending requirements. Increasing direct-tax revenues, for example, may depress private consumption (by reducing disposable incomes) thus hurting output and employment growth, as well as private demand for and provisioning of social services. Under this scenario, a government would need to further step up efforts to avoid future setbacks in human development. This is a trade-off countries may necessarily need to endure considering that reliance on foreign resources may not be sustainable in the long run due to debt sustainability considerations and the recent declining trend of foreign aid.

In view of the demanding spending requirements and the macro-economic trade-offs, developing countries such as those studied here will have to consider a mixed financing strategy for their development goals. In most cases, the balance in this mix

should be tilted towards broadening the tax base, in particular given already high public debt burdens and the recent declining trend shown by foreign aid. For a number of countries (with less income), however, financing will unavoidably be needed because they have no scope for further raising tax revenues. As a consequence, adequate international financing will be required for these countries and, more importantly perhaps, the recent declining trend in foreign aid will have to be reversed.

Although the financing will be challenging, stepping up upfront public spending to meet MDG targets in the period to 2015 would boost aggregate demand and spur productivity growth as more teachers, doctors and other qualified workers are employed in MDG sectors. Through the scenario analysis it has been estimated that GDP growth would increase by 0.6 to 1.8 percentage points per year if the four countries' governments pursue meeting the targets, provided the demand-driven push is not offset by sluggish export growth owing to real exchange rate appreciation. It has also been estimated that capital accumulation and productivity growth would carry on beyond 2015, generating additional GDP growth gains in a range of 0.2 to 1.0 percentage points per year. This is because enough time has elapsed for children to go through one or more educational cycles and child and maternal health care to have improved. The newly-added stock of better qualified workers is mirrored by more employment of these workers which, in turn, spurs labour productivity growth. Nonetheless, the scenario analysis further suggests that without complementary policy interventions that facilitate structural change there could be a point where the economy is no longer capable of absorbing newly-active skilful workers to a further extent. The effect on unemployment may have undesirable consequences in the path towards development goals. Allowing this to occur would no doubt present a lost opportunity for countries.

Additional policy implications on the basis of the scenario analysis are threefold. Firstly, developing countries may need to enhance the efficiency of service delivery significantly in order to contain costs of maintaining human development goals after 2015. But high estimated costs are also associated with the fact that some of the MDG targets may be overly ambitious in the context of some developing countries when they are applied literally as defined internationally. Countries may need to reconsider redesigning the setting of their human development targets in terms of magnitude and the

timing at which they can be realistically met by and after 2015. Secondly, countries should pursue additional policy interventions to spur stronger long-term economic gains from human development interventions. For example, based on the scenario analysis, more allocation of public spending to secondary and tertiary education or public infrastructure (roads, bridges, and so on) underpins stronger economic growth and expands the scope of human development. Thirdly, insufficient creation of skilled jobs could result in high rates of (youth) unemployment and skill mismatches in the labour market that can be catalysts of underemployment, resulting in negative repercussions in terms of rising inequality of income and opportunities, and more poverty. To avoid such undesirable trade-offs and underpin long-term productivity and economic growth gains, policy interventions will be required to improve the environment for stimulating a structural change in the economy towards technologies and activities that can absorb larger amounts of skilled labour, improve the content of education, and ensure that the skills that the education system creates are those that are in high demand by the productive sector.

Tables and figures to be inserted in text

Table 1 Macroeconomic indicators in the baseline scenario (period annual averages, per cent)

	Bolivia		Costa Rica		Uganda		Yemen	
	Pre-2015[a]	Post-2015[a]	Pre-2015[a]	Post-2015[a]	Pre-2015[a]	Post-2015[a]	Pre-2015[a]	Post-2015[a]
Real growth rate								
Consumption - private	7.2	4.8	5.2	4.2	6.1	7.5	5.4	4.8
Consumption - government	4.8	4.8	7.2	5.0	7.2	8.3	5.8	5.2
Fixed investment - private	7.1	5.2	5.1	3.7	6.5	8.2	5.3	4.9
Fixed investment - government	4.8	5.1	13.6	3.8	8.7	8.4	5.6	5.1
Exports	2.9	5.8	3.2	3.8	7.1	4.4	2.3	4.3
Imports	7.2	5.2	4.4	4.0	6.3	8.1	4.3	4.6
GDP	4.7	5.0	4.5	4.2	6.5	7.0	5.1	5.2
Share of nominal GDP								
Consumption - private	75.6	73.4	72.3	70.7	78.9	81.6	68.9	73.4
Consumption - government	14.4	14.5	16.6	17.9	9.7	9.7	12.7	12.4
Investment - private	8.6	8.5	16.4	16.3	17.8	17.8	11.1	11.6
Investment - government	6.3	6.0	4.6	5.1	5.8	6.4	10.5	11.0
Exports	28.4	29.7	41.9	41.4	21.4	17.9	35.8	36.1
Imports	-33.2	-32.2	-52.4	-51.4	-33.6	-33.4	-39.0	-44.6
Foreign savings	3.2	5.7	9.7	10.7	9.0	9.6	1.0	5.1

[a] Pre-2015 and post-2015 periods used in this and subsequent tables and figures are defined in the text.

Source: Authors, based on application of MAMS with data for the countries under study.

Table 2 Key determinants of MDG indicators in the baseline scenario (period annual average growth, per cent)

	Bolivia		Costa Rica		Uganda		Yemen	
	Pre-2015	Post-2015	Pre-2015	Post-2015	Pre-2015	Post-2015	Pre-2015	Post-2015
Real per-capita government consumption by MDG-related service								
Primary education	2.7	3.4	6.1	4.4	4.2	4.5	2.9	1.5
Health	2.9	3.5	6.0	3.8	3.9	4.3	2.2	2.5
Water and sanitation	3.0	3.6	4.7	2.7	4.4	4.8	2.0	2.5
Real per-capita private consumption by MDG-related service and total								
Primary education	6.2	4.2	2.4	2.8	2.3	5.1	2.9	2.6
Health	5.0	3.8	2.4	2.7	4.3	4.3	4.3	4.0
Water and sanitation [a]	--	--	2.3	2.0	2.7	4.8	2.2	2.1
Total real per-capita private consumption of the economy	5.2	3.3	3.8	3.2	2.7	4.5	2.3	2.1
Public infrastructure capital stock	5.3	5.3	13.0	6.0	5.6	6.8	5.2	5.2

[a] National accounts used to construct Bolivia's SAM—with which MAMS is calibrated—do not report private spending in water and sanitation separately.

Source: Authors, based on application of MAMS with data for the countries under study.

Table 3 Main characteristics of MDG-achieving scenarios

	Sim1	Sim2	Sim3	Sim4
MDG-related public spending [a]	Increases until targets are met in 2015 GDP share of 2015 fixed in 2016-30	Increases until targets are met in 2015 GDP share of 2015 fixed in 2016-30	Increases until targets are met in 2015 GDP share of 2015 fixed in 2016-30, except for primary education	Increases until targets are met in 2015 GDP share of 2015 fixed in 2016-30, except for primary education
Financing of MDG-related public spending	Foreign financing through 2030	Foreign financing through 2015 Direct-tax financing during 2016-30	Foreign financing through 2030	Foreign financing through 2030
MDG indicators	Improve through 2030	Improve through 2030	Improve through 2030, primary completion rate of 2015 fixed in 2016-30	Improve through 2030, primary completion rate of 2015 fixed in 2016-30
Complementary public investments			Secondary and tertiary education	Public infrastructure

[a] Includes all investment and current expenditures in primary education, health and water and sanitation.

Source: Authors, based on application of MAMS with data for the countries under study.

Table 4 Real macroeconomic indicators and headcount poverty rate in the MDG-achieving scenarios (period annual averages, deviation from the baseline)

		Bolivia		Costa Rica		Uganda		Yemen	
		Pre-2015	Post-2015	Pre-2015	Post-2015	Pre-2015	Post-2015	Pre-2015	Post-2015
Sim1	GDP growth (per cent)	-0.6	0.2	0.9	0.9	1.8	0.7	0.6	1.6
	Total factor employment (index)	-0.6	0.2	0.8	0.4	1.1	0.5	0.4	1.2
	Total factor productivity (index) [a]	0.0	0.1	0.1	0.5	0.6	0.2	0.1	0.5
	- most skilful labour employment	*-0.0502*	*0.0516*	*0.1486*	*0.4432*	*0.6279*	*0.2396*	*0.1466*	*0.4432*
	- public infrastructure	*0.0000*	*-0.0014*	*0.0000*	*0.0118*	*0.0000*	*0.0056*	*0.0000*	*0.0118*
	- trade openness	*0.0017*	*0.0029*	*0.0000*	*0.0000*	*-0.0047*	*0.0004*	*0.0000*	*0.0000*
	Real exchange rate (index)	-4.9	0.2	-3.6	0.1	-6.2	1.0	-4.4	1.3
	Headcount poverty rate (per cent)	-1.4	-1.7	-1.0	-0.9	-4.8	-1.7	-6.0	-12.1
Sim2	GDP growth (per cent)	-0.6	0.0	0.9	0.0	1.8	-0.4	0.6	0.0
	Total factor employment (index)	-0.6	0.0	0.8	-0.3	1.1	-0.3	0.4	-0.3
	Total factor productivity (index) [a]	0.0	0.0	0.1	0.3	0.6	0.0	0.1	0.3
	- most skilful labour employment	*-0.0502*	*0.0285*	*0.1486*	*0.3637*	*0.6279*	*-0.0142*	*0.1466*	*0.3637*
	- public infrastructure	*0.0000*	*-0.0197*	*0.0000*	*-0.0441*	*0.0000*	*-0.0333*	*0.0000*	*-0.0441*
	- trade openness	*0.0017*	*-0.0035*	*0.0000*	*0.0000*	*-0.0047*	*-0.0004*	*0.0000*	*0.0000*
	Real exchange rate (index)	-4.9	3.1	-3.6	2.2	-6.2	3.5	-4.4	4.0
	Headcount poverty rate (per cent)	-1.4	4.2	-1.0	0.4	-4.8	0.9	-6.0	8.1
Sim3	GDP growth (per cent)	-0.6	0.5	0.9	1.0	1.8	0.9	0.6	1.9
	Total factor employment (index)	-0.6	0.4	0.8	0.3	1.1	0.5	0.4	1.3
	Total factor productivity (index) [a]	0.0	0.0	0.1	0.6	0.6	0.4	0.1	0.6
	- most skilful labour employment	*-0.0502*	*0.0222*	*0.1486*	*0.6067*	*0.6279*	*0.3586*	*0.1466*	*0.6067*
	- public infrastructure	*0.0000*	*-0.0002*	*0.0000*	*0.0125*	*0.0000*	*0.0061*	*0.0000*	*0.0125*
	- trade openness	*0.0017*	*0.0027*	*0.0000*	*0.0000*	*-0.0047*	*0.0004*	*0.0000*	*0.0000*
	Real exchange rate (index)	-4.9	0.3	-3.6	0.0	-6.2	1.2	-4.4	1.4
	Headcount poverty rate (per cent)	-1.4	-1.9	-1.0	-0.9	-4.8	-1.8	-6.0	-12.3

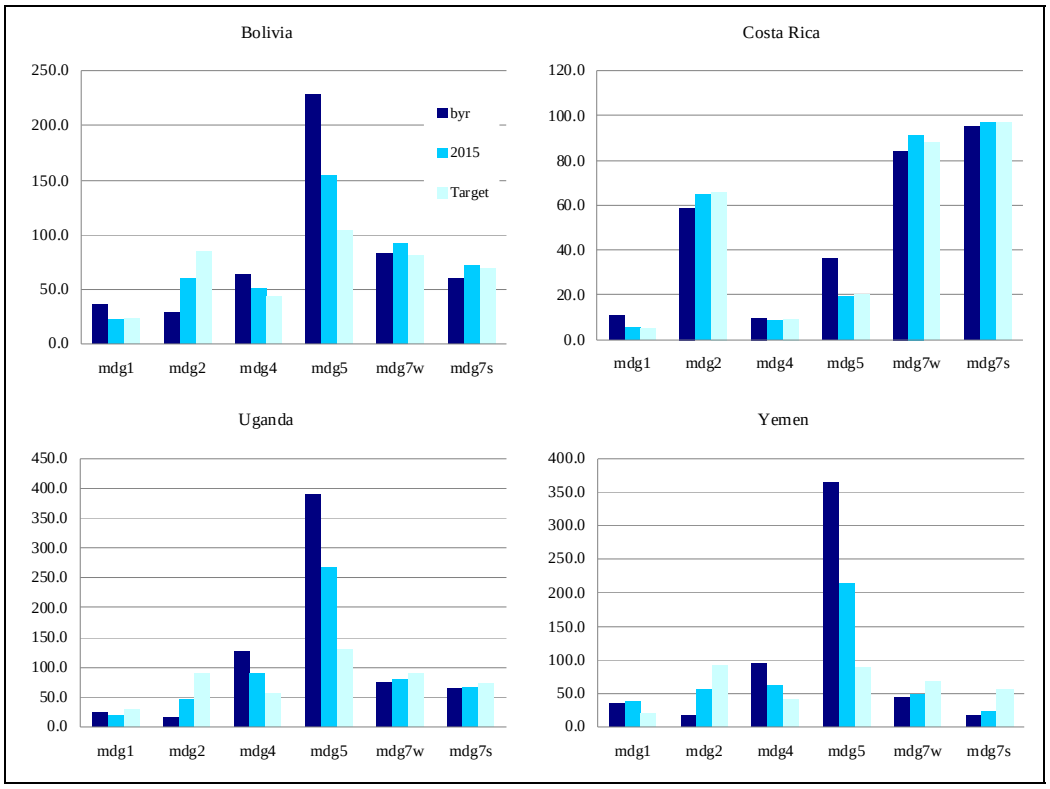
Table 4 continued

		Bolivia		Costa Rica		Uganda		Yemen	
		Pre-2015	Post-2015	Pre-2015	Post-2015	Pre-2015	Post-2015	Pre-2015	Post-2015
Sim4	GDP growth (per cent)	-0.6	0.7	0.9	0.9	1.8	0.7	0.6	2.0
	Total factor employment (index)	-0.6	0.3	0.8	0.2	1.1	0.3	0.4	1.2
	Total factor productivity (index) [a]	0.0	0.3	0.1	0.8	0.6	0.4	0.1	0.8
	- most skilful labour employment	*-0.0502*	*0.0578*	*0.1486*	*0.4677*	*0.6279*	*0.2096*	*0.1466*	*0.4677*
	- public infrastructure	*0.0000*	*0.2739*	*0.0000*	*0.3006*	*0.0000*	*0.1781*	*0.0000*	*0.3006*
	- trade openness	*0.0017*	*0.0023*	*0.0000*	*0.0000*	*-0.0047*	*0.0008*	*0.0000*	*0.0000*
	Real exchange rate (index)	-4.9	0.5	-3.6	0.2	-6.2	1.3	-4.4	1.7
	Headcount poverty rate (per cent)	-1.4	-2.3	-1.0	-0.9	-4.8	-1.8	-6.0	-11.4

[a] Changes in the total factor productivity index are decomposed into three effects. Most skilful labour refers to workers who have completed at least secondary education. In the case of Costa Rica, most skilful labour only refers to workers who have obtained a diploma or degree in tertiary education, an alternative definition that allows us to better adapt the modelling analysis to the country's context.

Source: Authors, based on application of MAMS with data for the countries under study.

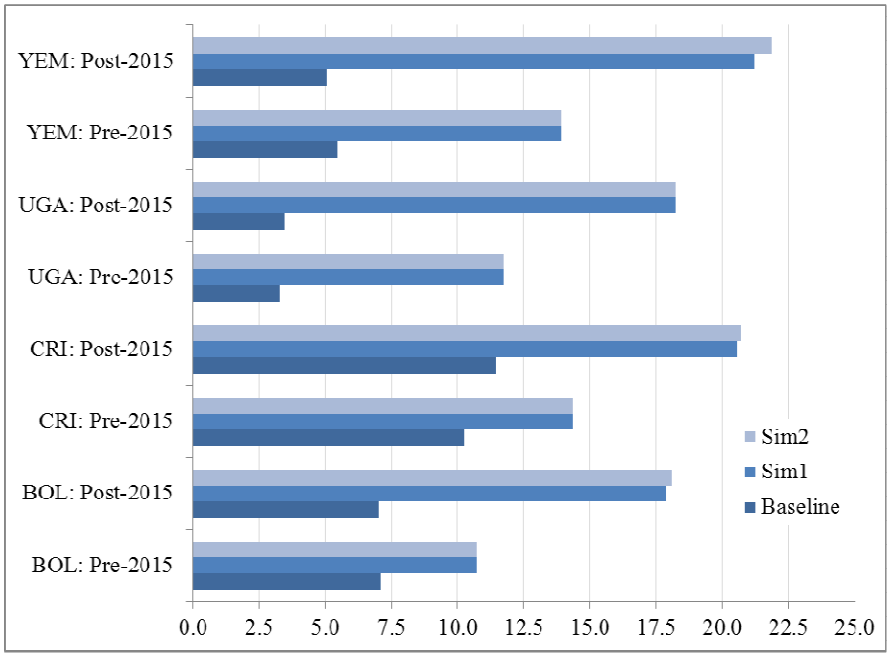
Figure 1 MDG indicators in the baseline scenario and targets [a]



[a] Indicators presented are the following: mdg1, percentage of the population living on less than an income per capita level below a national poverty line: mdg2, net (on-time) primary school completion rate: mdg4, under-five mortality rate per 1,000 live births; mdg5, maternal mortality ratio per 100,000 live births; and mdg7w and mdg7s, proportion of people with sustainable access to, respectively, safe drinking water and basic sanitation. Targets are for 2015 and in most cases refer to internationally-agreed goals. The target for mdg2 relates to completion for the first four grades of primary education in Yemen and for the full primary cycle in the other countries. Base year (byr) is: 2006 for Bolivia, 2005 for Costa Rica, 2009/2010 for Uganda and 2004 for Yemen.

Source: Authors, based on application of MAMS with data for the countries under study.

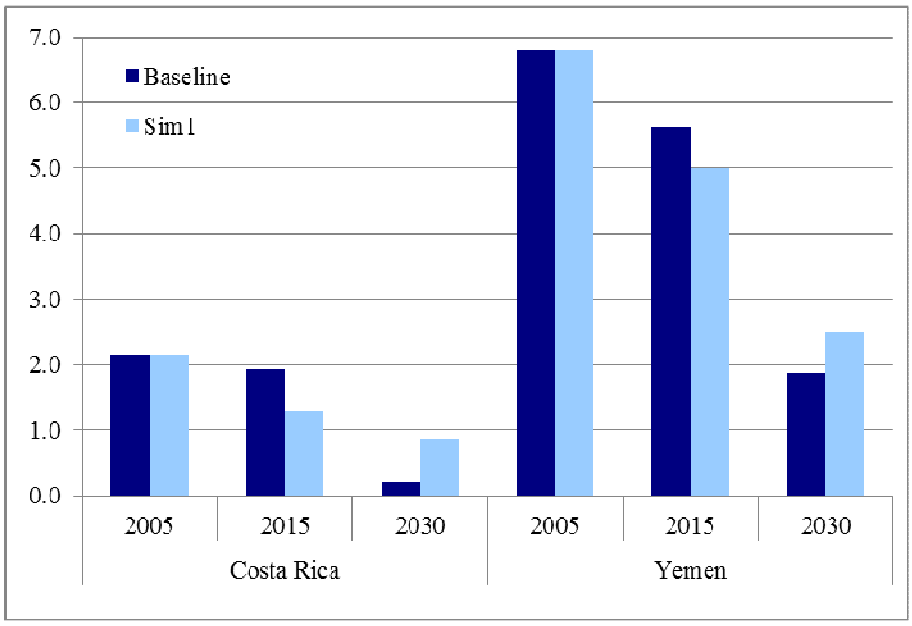
Figure 2 MDG-related public spending in the baseline and the first two MDG-achieving scenarios before and after 2015[a] (per cent of GDP, period annual averages)



[a] MDG-related public spending and MDG-achieving scenarios are defined in the text.

Source: Authors, based on application of MAMS with data for the countries under study.

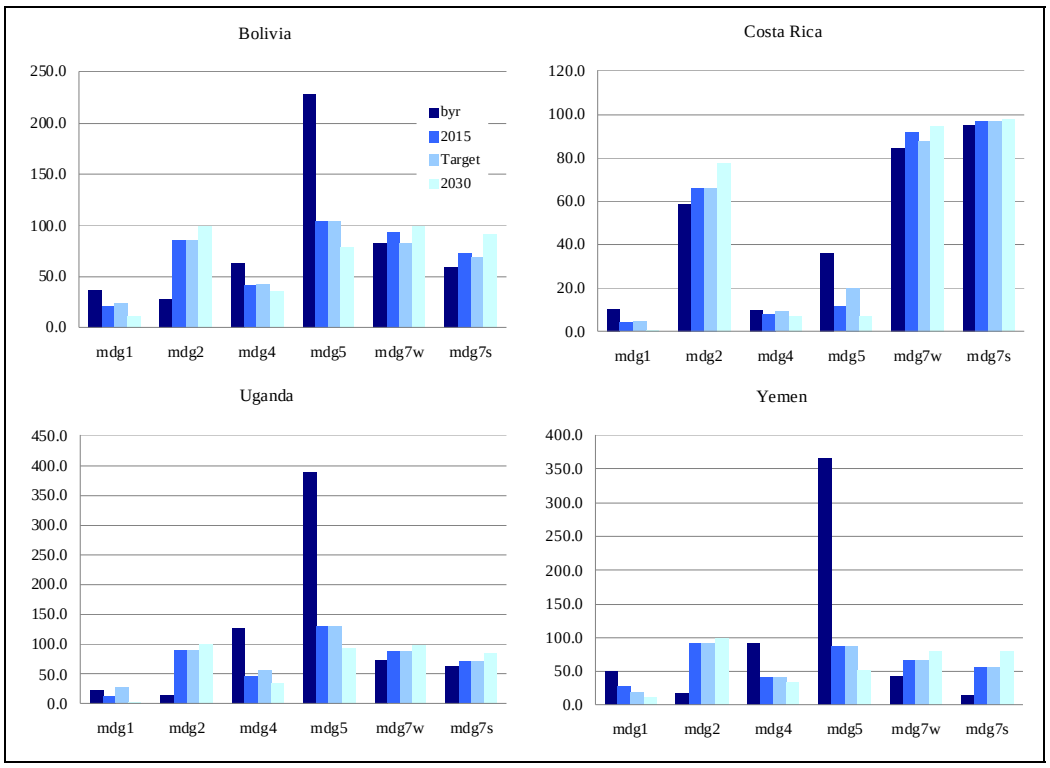
Figure 3 Unemployment rate of the most highly skilful workers under the baseline and the first MDG-achieving scenario, 2005, 2015 and 2030 (per cent)



Note: Most highly skilful workers are those who possess a diploma or degree in tertiary education.
Source: Authors, based on application of MAMS with data for the countries under study.

Appendix of tables and figures

Figure A1 MDG indicators in first MDG-achieving scenario and targets [a]



[a] Indicators, targets and base year (byr) are defined in the note to Figure 1.

Source: Authors, based on application of MAMS with data for the countries under study.

References

Abdih, Y. and F. Joutz (2005). Relating the Knowledge Production Function to Total Factor Productivity: An Endogenous Growth Puzzle, *IMF Working Paper No. WP/05/74*, Washington, D.C.: International Monetary Fund.

Al-Batuly, Abdulmajeed and Mohamed Al-Hawri, Martin Cicowiez, Hans Lofgren and Mohammad Pournik (2013). Yemen. In: Marco V Sánchez and Rob Vos (eds), *Financing Human Development in Africa, Asia and the Middle East*, Bloomsbury for the United Nations (forthcoming in August).

Arslanalp, Serkan, Fabian Bornhorst, Sanjeev Gupta, and Elsa Sze (2010). Public Capital and Growth", IMF Working Paper WP/10/175.

Barro, R.J. (1991). Economic Growth in a Cross-section of Countries, *Quarterly Journal of Economics* 106(2): 407-43.

Barro, R.J. and X. Sala-i-Martin (1995). *Economic Growth*, New York: McGraw-Hill.

Bourguignon, François (2003). The growth elasticity of poverty reduction; explaining heterogeneity across countries and time periods. In: Theo S. Eicher and Stephen J. Turnovsky (eds.), *Inequality and Growth: Theory and Policy Implications. Cambridge*: The MIT Press.

Cameron, G., J. Proudman and S. Redding (1999). Technology Transfer, R&D, Trade and Productivity Growth, Working paper, London: London School of Economics.

Coe, D.T. and E. Helpman (1995). International R&D Spillovers, *European Economic Review* 39(5): 859-87.

Coe, D.T. and R. Moghadam (1993). Capital and Trade as Engines of Growth in France: An Application of Johansen's Cointegration Methodology, *IMF Staff Papers* 40(3): 542-66.

Easterly, William (2009). How the Millennium Development Goals are unfair to Africa, *World Development*, Vol. 37, No. 1, pp. 26-35.

Edwards, S. (1988). Terms of Trade, Tariffs, and Labor Market Adjustment in Developing Countries, *World Bank Economic Review* 2(2): 165-85.

Edwards, S. (1992). Trade Orientation, Distortions, and Growth in Developing Countries, *Journal of Development Economics* 39(1): 31-57.

Edwards, S. (1998). Openness, Productivity and Growth: What Do We Really Know?, *The Economic Journal* 108(447): 383-98.

Fukuda-Parr, Sakiko, Joshua Greenstein and David Stewart (2013) How Should MDG Success and Failure be Judged: Faster Progress or Achieving the Targets?, *World Development*, Vol. 41, pp. 19-30.

Furman, J.L. and R. Hayes (2004). Catching Up or Standing Still? National Innovative Productivity Among "Follower" Countries, 1978-1999, *Research Policy*, Vol. 33, pp. 1329-54.

Glewwe, Paul (2002). Schools and skills in developing countries: education policies and socioeconomic outcomes. *Journal of Economic Literature*, Vol. XL (June), pp. 436-482.

Greenaway, D., W. Morgan and P. Wright (2001). Trade Liberalisation and Growth in Developing Countries, *Journal of Development Economics* 67(2002): 229-44.

Griliches, Z. (1988). Productivity Puzzles and R&D: Another Nonexplanation, *Journal of Economic Perspectives* 2(4): 9-21.

Grossman, G. and E. Helpman (1991). *Innovation and Growth in the Global Economy*. Cambridge. Massachusetts: The MIT Press.

Guellec, D. and B. van Pottelsberghe de la Potterie (2001). "R&D and Productivity Growth: Panel Data Analysis of 16 OECD Countries", *OECD Economic Studies*, No. 33, pp. 103-26.

Hughes, Barry B. (2007). Forecasting Global Economic Growth with Endogenous Multifactor Productivity: The International Futures (IFs) Approach, Graduate School of International Studies, University of Denver, Frederick S. Pardee Center for International Futures (December).

Klenow, Peter J. and Andrés Rodríguez-Clare (2005). Externalities and Growth, *Handbook of Economic Growth*, Volume 1A. Edited by Philippe Aghion and Steven N. Durlauf, Elsevier B.V.

Lofgren, Hans, Martin Cicowiez and Carolina Díaz-Bonilla (2013). MAMS – A Computable General Equilibrium Model for Developing Country Strategy Analysis. In: Peter B. Dixon and Dale W. Jorgenson (eds), Handbook of Computable General Equilibrium Modeling, Amsterdam, North-Holland.

Lucas, R.E. (1988). On the Mechanism of Development Planning, *Journal of Monetary Economics* XXII: 3-42.

Matovu, John Mary, and Evarist Twimukye, Albert Musisi and Sebastian Levine (2011). Assessing Development Strategies to achieve the Millennium Development Goals in Uganda. Project Final Report, UNDP-RBA,UN Department of Economic and Social Affairs (UN-DESA) and World Bank, March. Available from http://www.un.org/en/development/desa/policy/capacity/output_studies.shtml.

Nelson, R.R. and E.S. Phelps (1966). Investment in Humans, Technological Diffusion and Economic Growth, *American Economic Review, Papers and Proceedings* 56: 69-75.

Pacheco, José (2012). Determinantes socioeconómicos de la educación, la mortalidad y el acceso al agua potable y el saneamiento: un análisis econométr, Project Final Report, UN Department of Economic and Social Affairs (UN-DESA), November. Available from http://www.un.org/en/development/desa/policy/capacity/country_documents/costarica_report.pdf.

Ponce, Juan (2012). Determinantes del acceso y la permanencia en la educación, la mortalidad de la niñez y materna, y el acceso a servicios básicos de agua y saneamiento: Evidencia empírica para el Estado Plurinacional de Bolivia, Project Final Report, UN Department of Economic and Social Affairs (UN-DESA), July. Available from http://www.un.org/en/development/desa/policy/capacity/country_documents/bolivia_determinantes.pdf.

Rodríguez, F. and D. Rodrik (1999). Trade Policy and Economic Growth: A Skeptic's Guide to the Cross-National Evidence, NBER Working Paper no. 7081. Cambridge, Massachusetts: National Bureau of Economic Research.

Romer, P.M. (1990). Endogenous Technological Change, *Journal of Political Economy* 98(5): S71-102.

Romer, P.M. (1992). Two Strategies for Economic Development: Using Ideas and Producing Ideas, paper presented at the World Bank Annual Conference on Development Economics, supplement to *World Bank Economic Review*, pp. 63-92.

Sánchez, Marco V, and Rob Vos (eds) (2013). *Financing Human Development in Africa, Asia and the Middle East*, Bloomsbury for the United Nations (forthcoming in August).

Sánchez, Marco V, Rob Vos, Enrique Ganuza, Hans Lofgren, and Carolina Díaz-Bonilla (eds) (2010). *Public Policies for Human Development. Feasible Financing Strategies for Achieving MDGs in Latin America and the Caribbean*, London: Palgrave/Macmillan.

Sánchez, Marco V. and Giacomo Sbrana (2009). Determinants of Education Attainment and Development Goals in Yemen. Prepared for the Project Assessing Development Strategies to achieve the Millennium Development Goals in the Arab Region, UNDP-RBAS, UN-DESA and World Bank. Available from: http://www.un.org/en/development/desa/policy/capacity/country_documents/yemen_educ_output_jan2010.pdf.

Sbrana, Giacomo (2009). Technical Note on the Determinants of Water and Sanitation in Yemen. Prepared for the Project Assessing Development Strategies to achieve the Millennium Development Goals in the Arab Region, UNDP-RBAS, UN-DESA and World Bank. Available from http://www.un.org/en/development/desa/policy/capacity/country_documents/yemen_technote_water_jun2009.pdf.

UN System Task Team on the Post-2015 UN Development Agenda (2012). Realizing the Future We Want for All, Report to the Secretary General, New York (June).

United Nations (2012). *The Millennium Development Goals Report 2012*, United Nations, New York.

United Nations (2011). *World Economic Situation and Prospects 2011*, Box 1.3, New York.

Wang, J-C. and K-H. Tsai (2003). Productivity Growth and R&D Expenditure in Taiwan's Manufacturing Firms, NBER Working Paper 9724, Cambridge, MA: NBER.