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

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Abstract

An economy-wide modelling analysis is conducted for four developing countries to quantify social and economic gains of human development investments that have been made to pursue Millennium Development Goals (MDGs). In order for these gains to materialize, it is estimated that public spending would first need to be significantly scaled up to ensure MDG targets are met by 2015. Avoidance of MDG setbacks after 2015 would presumably continue to be highly costly for public finances. The final cost and the effect on economic growth would ultimately depend on macroeconomic hardships that the source of financing of public spending may trigger. At the same time, however, newly-added public spending to meet targets by 2015 is found to boost aggregate demand. The supply-side effect is that more factors are employed and productivity rises as qualified workers are demanded to deliver social services. This would spur economic growth up to 2015. It is further estimated that, as capital accumulates and productivity continues to grow with the employment of better-educated workers, past human development interventions would bring additional GDP growth—between 0.2 to 1.0 percentage points per year—after 2015. Options for countries to magnify long-term social and economic gains are also identified.

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1. Introduction

Member states of the United Nations resolved to pursue 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) and 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 meeting a set of MDG targets by 2015 will imply significantly stepping up public spending and demand more rapid and sustained economic growth. However, achieving economic growth in the midst of a depressed world economy is proving a significant challenge. 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, paradoxically, jeopardize the badly needed economic growth.

In defining what human development interventions they want to pursue, countries should estimate not only short-term public spending requirements and the macroeconomic trade-offs that financing these interventions may trigger, but also the potential long-term rewards. The aforementioned studies provide such estimates for a period up to 2015, the year for which most MDGs are expected to have been achieved. 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 from past human development interventions can effectively materialize, which implies also sustaining human development levels (and spending), economic growth, employment creation and macroeconomic balances.

Understanding the potential long-term payoffs of past human development investments and the policy interventions necessary to ensure them and at what macroeconomic costs may become crucial for countries to define development strategies after 2015. This understanding would come 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: should developing countries realistically expect after 2015 additional social and economic gains associated with investments in human development that have pursued meeting MDGs?; what additional 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. For example, the aforementioned studies for 27 developing countries applied the ***Ma****quette* for **M**DG **S**imulations (MAMS) for assessing feasible MDG-financing strategies. 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, UN System Task Team on the Post-2015 UN Development Agenda, 2012.

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.

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 it for the purposes of 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 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 to determine if gains from past human development investments could be expected after 2015, and conditions that must be met to secure these gains and magnify their impact. The final section concludes and provides policy recommendations.

2. Modelling framework

MAMS is used to simulate various scenarios that are analyzed in the next two sections. 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 would also affect 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 achieving the MDGs, but adjustments in the real exchange rate, real wages and other relative prices may increase the unit costs for meeting the targets 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 from reaching higher human development levels will take some time to materialize and are thus unlikely to trigger its full impact on economic growth in the short term. MAMS is a useful tool to, inter alia, assess short-run macroeconomic trade-offs and see if these would offset potential economic and social gains 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 achievement of universal primary education is the net (on-time) primary completion rate which is a function of student behaviour (enrolment, repetition, graduation). A target is set for completion on time, without repetition, for the relevant age cohort for primary school. 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 listed determinants of MDG achievement follows a non-linear pattern. Logistic functions for the "production" of the different MDG-related services (education, health and water and sanitation) 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 MDG-related 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 investments and expenditures to meet one or more 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 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 representative household follows a log-normal distribution, which 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 are used to estimate the

counterfactual (log-normal) distribution of per capita welfare in all simulated scenarios. Then, poverty and inequality indicators are computed.[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 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.

[2] Studies presented in Sánchez and Vos (2013) and Sánchez and others (2010) have combined MAMS scenario results and a non-parametric microsimulation model that is applied using a household survey in order to calculate poverty and inequality indicators. This approach is a good alternative as it permits full account of the income distribution recorded in a household survey. Assumptions about the income distribution within the model representative household are thus no longer required. However, the simulation period of the said studies extends only up to 2015, such that the assumptions about demographic changes in these studies did not have to be extremely 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, and, as further indicated in the below, this paper's modelling analysis is extended up to 2030. Examples of extreme assumptions one would need to make 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.

[3] Rodríguez and Rodrik (1999) have, however, argued that the vast literature supporting such an 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.

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. For this reason, the impact of pursuing education- and health-related goals on economic growth is expected to be larger than 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

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

education. In this paper it is alternatively proxied by the stock of skilled labour which is defined by the number of workers who have at least completed secondary education and are effectively employed.[5] The applications of MAMS presented here assume no full employment of labour; instead, 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, the 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 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 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

[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. Also, it is being assumed that

[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 with the technical guidance of this paper's authors, as part of capacity development projects coordinated by DPAD/UN-DESA and other partners.

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 in 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 application of MAMS reproduced past MDG progress which was projected into the future under a continuation of past economic trends and public spending policies.[8]

The parameterization of the endogenous drivers of productivity growth is conservative. The following elasticities (and ranges used for all four countries) were used: 0.01 for openness to foreign trade, 0.01-0.05 for the stock of public infrastructure, and 0.25 for employment of skilled labour. The latter elasticity has roughly been placed in the middle of a range of elasticities that has been defined drawing on existing empirical literature.[9]

[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.

[9] The elasticity of productivity growth with respect to different types of R&D stocks and expenditure, for example, have 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, the elasticity has been found to be around 0.09.

A baseline scenario was generated for each country after completing the model calibration, 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 specific to each country application. In order to mimic unchanged expenditure policies of the recent past, government consumption and other components of recurrent spending evolve following a "closure" 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 each country model application's base year to 2015) and post-2015 (2016-2030) periods. Baseline GDP growth resembles observed GDP growth starting from each country model application's base year to 2012. Between 2013 and 2030 GDP grows steadily at the rate observed in 2012. GDP growth decelerates (and even becomes negative in Costa Rica) owing to the global financial crisis in 2008-2009, except in Uganda's baseline as this is generated 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

[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. On the other hand, being an upper-middle income country Costa Rica is less likely to receive foreign grant aid from donors to support its government budget. 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.

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 with 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 past economic conditions and policies, and considering also the complementarities or synergies in achieving the various development goals. As described in the previous section, MAMS considers how much improved health helps 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-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]

[11] Newfound oil resources in Uganda are expected to flow in the near future. As a consequence, the country could be projected to generate new export and tax revenues. Export growth does not account for potential growth of crude oil exports to generate the baseline scenario in the case of this country as there is no empirical ground to generate a plausible trend of expected revenues.

[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.

Under the said baseline assumptions, all four countries would make apparent progress towards meeting, by 2015, those MDG targets being analyzed here (Figure 1). Costa Rica, the country that records the lowest initial MDG gaps, does not meet all targets by 2015 only by small margins; which in the particular case of non-poverty MDG indicators is primarily explained by the fact that government consumption grows more rapidly than GDP (see Table 1).[13] Bolivia meets the water and sanitation targets only whereas Uganda and Yemen meet none of the targets. In sum, continuing at past 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 aspects the modelling analysis cannot fully account for, but they are worth underlying to understand the real challenges that these countries may face to achieve human development goals.

4. Policy scenarios and analysis

Four "MDG-achieving" scenarios (**Sim1**-**Sim4**) are compared with the baseline aiming at, on one hand, quantifying social and economic growth gains that may accrue after 2015

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

owing to past MDG-related investments and, on the other hand, identifying coherent policy interventions that may contribute to ensure that payoffs from past human development investments materialize. These scenarios delineate a path towards fully meeting the non-poverty targets depicted in Figure 1. Public spending interventions, at each country's estimated effectiveness, are scaled up to increase net (on-time) primary school completion rates, 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) are maintained unchanged post 2015 as a way to avoid setbacks in human development, with some exceptions as further explained below. 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 **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] The relevance of running this scenario is that reliance on foreign resources may not be a sustainable option in the long run in view of debt sustainability considerations and less availability of foreign aid. Countries may 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

[14] To achieve this, public spending in primary education, health and water and sanitation is assumed to be endogenous up to 2015 (that is to say, it no longer evolves following a rule as under the baseline scenario). MAMS remains fully determined because non-poverty MDG indicators are assumed to be exogenous at fixed, MDG-achieving values along a logistic function up to 2015.

[15] The budget financing assumptions of the baseline are changed for **Sim2** as any fiscal deficit emerging in 2016-2030 would be financed through direct-tax revenues rather than foreign resources. In all four policy scenarios, private investment becomes "savings-driven" and no longer follows a rule as under the baseline scenario. That is to say, the amount of private investment that can be realized at the end of the day depends on the total availability of savings. 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.

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 scenario between 2016 and 2030, for the reasons explained below. As a consequence, the assumption that MDG-achieving GDP shares are fixed after 2015 implies there is overachievement of MDG targets post 2015 in the first two scenarios (for illustrative purposes see results for **Sim1** in Figure A1, in the Appendix). In view of these results, the last two scenarios (**Sim3**-**Sim4**) assume that the net (on time) primary completion rate (mdg2) achieved under the first two scenarios in 2015 is left unchanged in 2016-2030. Thus public spending in primary education in the last two scenarios is relatively less than in the first two, both as a share of GDP and in absolute terms. The resulting "public spending savings"—compared with the first two 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 two simulations have been designed with a purpose. More spending in higher levels of education is expected to increase the stock of better-educated workers, a number of who may become employed and thus impact productivity and economic growth. New investments in public infrastructure, in turn, may directly spur productivity and economic growth and indirectly they could also yield additional productivity gains if newly-added GDP growth is skilled-labour intensive.

Decreasing marginal returns to highly costly interventions

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

[17] Tax revenues around 2010 represented only 17.0, 13.5, 12.0 and 7.0 per cent of GDP in, respectively, Bolivia, Costa Rica, Uganda and Yemen.

[18] In the last two scenarios spending in secondary and tertiary education (**Sim3**) and public infrastructure (**Sim4**) becomes endogenous to accommodate the newly generated fiscal space. Foreign resources used to finance the budget are maintained fixed at the absolute levels of the first scenario (**Sim1**)—to maintain the model fully determined. The choice of keeping unchanged the net (on time) primary completion rate after 2015 is arbitrary and fixing any other non-poverty indicator would have also resulted in "public spending savings" that could be used to incur expenditures in other sectors.

the MDG-achieving scenarios from the same type of spending recorded under the baseline scenario. MDG-related spending includes all investment and current expenditures in primary education, health and water and sanitation. 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, especially in Costa Rica where targets fall short of being met by just small margins, the four countries would need to significantly step up 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 the MDG targets by 2015. This finding accords with that of existing country studies presented in Sánchez and Vos (2013) and Sánchez and others (2010) for a larger sample of developing countries. This paper's modelling analysis provides new insights in regards to public spending that may be required to avoid human development setbacks after 2015.

[Figure 2 around here]

In addition to the direct costs of the interventions aiming at meeting the MDG targets by 2015, the 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. As a consequence, additional public spending requirements to meet MDG targets tend to be larger the closer to 2015 which is the target year. And, keeping GDP shares of MDG-related public spending unchanged after 2015, as assumed under the policy scenarios, would turn out to be significantly costly for public

[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.

finances under the assumption that countries continue to achieve decent and sustained rates of GDP growth (see Figure 2).

The cost estimates suggest that aspiring to higher levels of human development may turn out to be excessively costly to achieve after 2015 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, again, 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 are repeating the grade. In this particular case, then, reforms to the teaching, learning and evaluation system may be more cost-effective to increase primary school completion than 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 GDP shares of MDG-related public spending are maintained unchanged after 2015 and GDP grows at decent and stable rates. But, at the same time, such high estimated cost may be also reflecting that some of the internationally agreed goals that have been targeted 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.

Domestic resource mobilization and macroeconomic trade-offs

A comparison between scenarios **Sim1** and **Sim2** is also illustrative that the financing mechanism matters for the estimates of additional MDG-related spending requirements. Financing through higher direct-tax revenues somewhat raises the total costs of pursing human development goals in all cases but one (Uganda), as compared with a scenario where external resources are the financing source (Figure 2). Raising taxes to finance the MDG-related spending affects private consumption (by reducing disposable incomes through taxation) which, as further explained below, hurts output and employment

growth and also affects private provisioning of and demand for social services. The government needs to further step up efforts to keep MDG-related public spending unchanged as a percentage of GDP in order to compensate for the loss of private spending on social services. Such macroeconomic trade-offs would need to be taken into consideration should governments pursue domestic resources mobilization to ensure human development levels show no setbacks after 2015.

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. The high estimates of MDG-related public spending for the post-2015 era would make it very challenging for developing countries to afford further improvements in human development as estimated here, considering that large amounts of foreign or domestic resources would need to be mobilized. The magnitude of these resource requirements would create undesirable macroeconomic hardships and may not be feasible from a political point of view either. 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 levels. 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. Past human development investments can also contrite to this process by spurring additional economic growth in the long run, as the results in Table 3 suggest.

Aggregate demand is pushed up by increased government spending to meet the MDG targets before 2015 in the policy scenarios. This translates into higher GDP growth in all scenarios compared with the baseline, by an average annual range of 0.6 to 1.8 percentage points, except in Bolivia for the reasons explained below. Increased government spending is reflected in more hiring of teachers, doctors, and so on, and more

demand for capital, such that factor employment explains most GDP growth gains. However, the larger number of skilled workers employed, mostly in MDG-related sectors, also spurs total factor productivity which favourably impacts GDP growth before 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 the scaling up of 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 also lose export competitiveness for the same reason, but the pace at which government spending is stepped up 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 to finance human development.

[Table 3 around here]

Interestingly, according to the results of scenario **Sim1**, GDP growth continues to be higher in than in the baseline scenario after 2015—even in Bolivia—even though the government is no longer assumed to step up interventions to meet human development targets. It 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 3). This happens for two reasons. Firstly, economic dynamism and capital accumulation carry on into the post-2015 period where factor employment continues to be, by and large, the most important supply-side driver of GDP growth. Domestic demand and exports adjust commensurately to match such 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 could afford to grow at such relatively high and stable rates, as assumed under the simulated policy scenarios. As said, persistent 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 grow and poverty reduction gains seen in the first scenario dissipate in the second (**Sim2**) whereby the government is assumed to use taxation to maintain human development levels after 2015 without setbacks (Table 3). Therefore, macroeconomic trade-offs of financing human development can also pose potential challenges after 2015.

Complementary investments

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 scenarios (**Sim3**-**Sim4**) help illustrate that this may be

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

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 improvement). The "public spending savings" that result from no longer overachieving the primary education target are allocated to secondary and tertiary education in scenario **Sim3** or public infrastructure (roads, bridges, and so on) in scenario **Sim4**. As shown in Table 3, there are productivity gains in these last two scenarios that, relative to what is seen in the first two scenarios, contribute to an increase in GDP growth after 2015, which on average ranges between 0.1 and 0.5 percentage points per year. Although modest, such gains may not be negligible for developing countries in desperate search of economic growth.

Economic structure and labour market constraints

Human development investments would not yield further productivity fruit should the economy's structure not adjust commensurately to absorb the increased stock of better-educated 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 MDG-achieving scenarios. Let us use as examples results of scenario **Sim1** for Costa Rica and Yemen, the two countries that, by and large, reap most productivity gains from employing better-educated workers in the MDG-achieving 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 MDG-achieving scenarios, tough, 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 MDG-achieving scenarios compared with the baseline.

[Figure 3 around here]

A labour-market trend like the described above may have important implications for economic growth and development in post-2015 years—or the long run in a broader context. 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.

5. Conclusions and policy implications

Developing countries have made considerable progress towards meeting the MDGs, but the 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 past MDG-related investments have been quantified using an economy-wide modelling scenario analysis applied four developing countries: Bolivia, Costa Rica, Uganda and Yemen. Policy interventions that may contribute to ensure that such payoffs from past 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, the four countries 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 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 taxes, for example, may affect private consumption (by reducing disposable incomes through taxation) thus hurting output and employment growth, as well as private provisioning of and demand for 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 declining trend of foreign aid.

In view of the demanding spending requirements and the said 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, 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.

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 past 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.

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 in this paper.

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 in this paper.

Table 3 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)	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)	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)	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

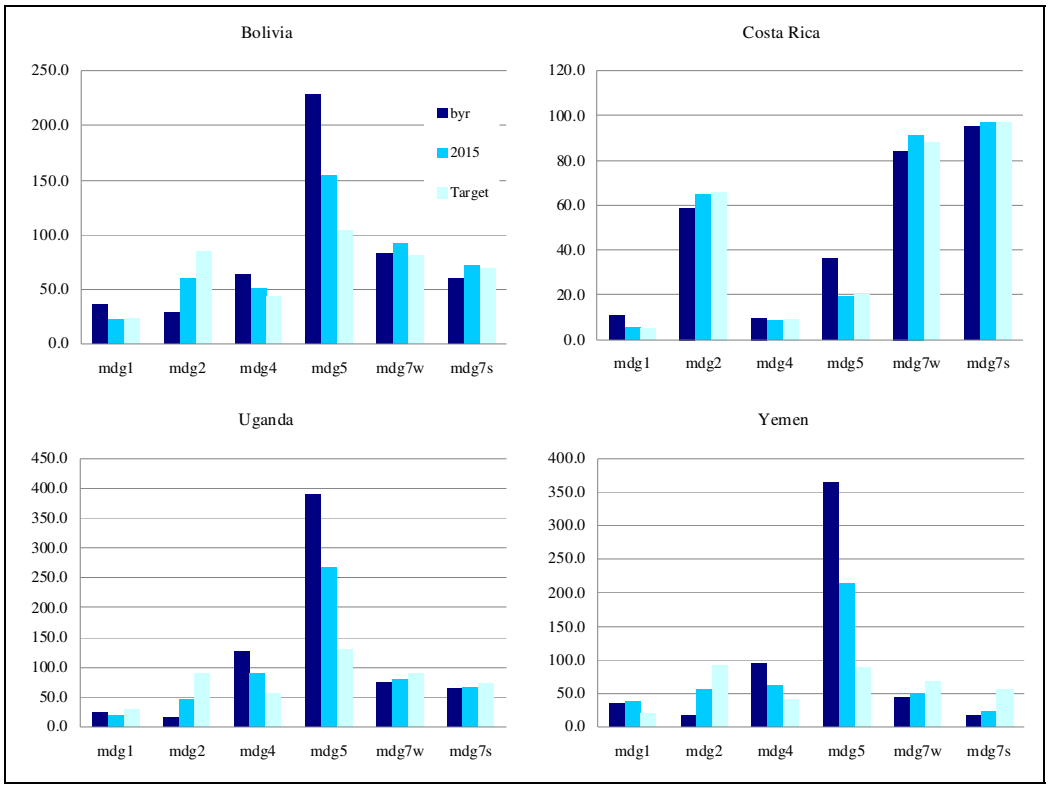
Table 3 continued

		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)	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

Note: 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 in this paper.

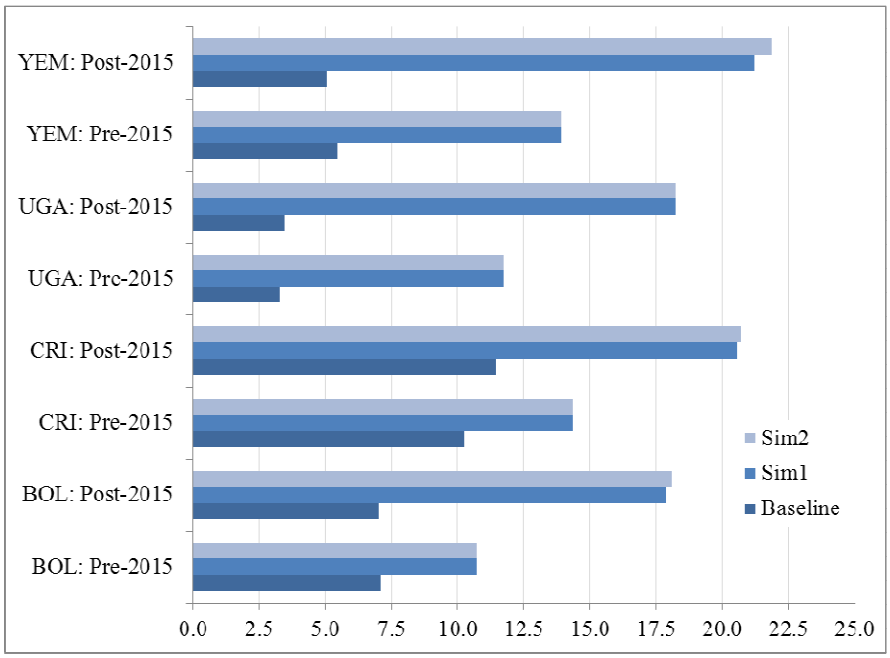
Figure 1 MDG indicators in the baseline scenario and targets



Note: Indicators considered are the following: percentage of the population living on less than an income per capita level below a national poverty line (mdg1), net (on-time) primary school completion rate (mdg2), under-five mortality rate per 1,000 live births (mdg4), maternal mortality ratio per 100,000 live births, and proportion of people with sustainable access to safe drinking water (mdg7w) and basic sanitation (mdg7s). Targets are for 2015 and combine national and internationally-agreed goals depending on the country. 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 in this paper.

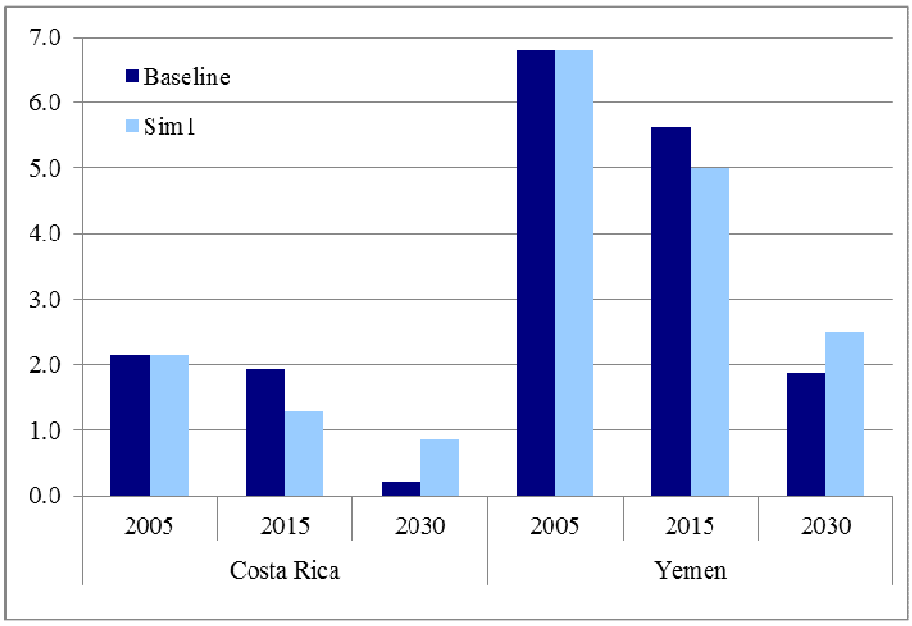
Figure 2 MDG-related public spending in the baseline and MDG-achieving scenarios before and after 2015[a] (per cent of GDP, period annual averages)



[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 in this paper.

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)

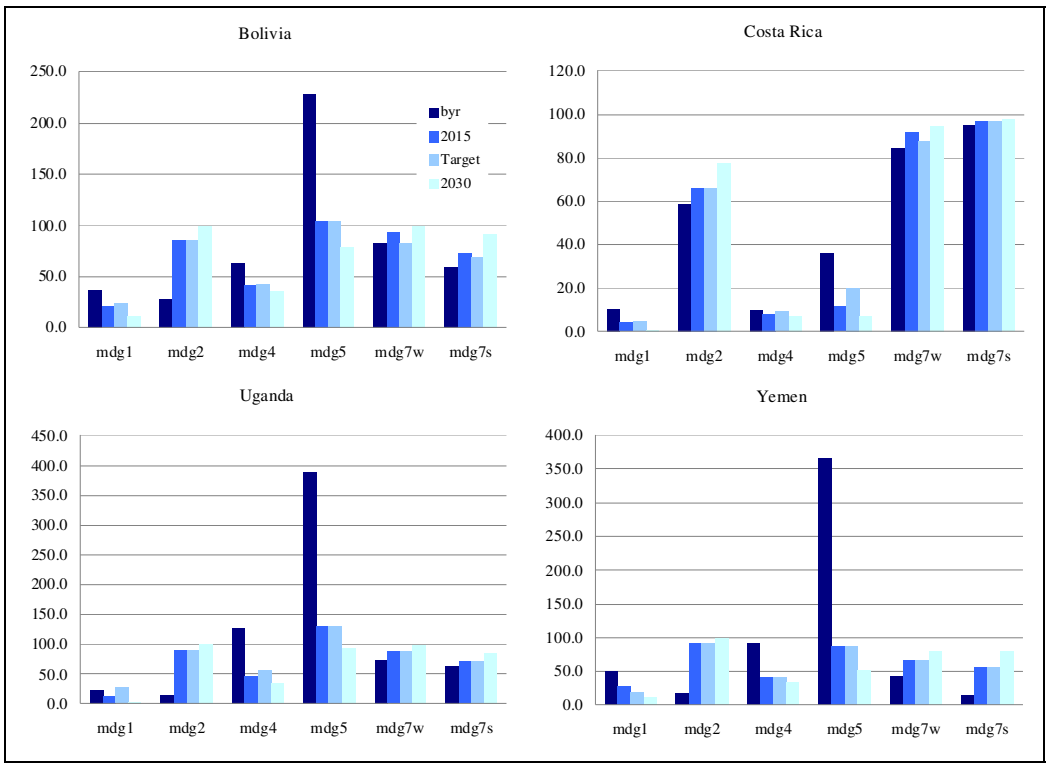


Note: Most highly skilful workers are those who possess a diploma or degree in tertiary education. The MDG-achieving scenario corresponds to **Sim1** as defined in the text.

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

Appendix of tables and figures

Figure A1 MDG indicators in first MDG-achieving scenario, **Sim1**, 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 in this paper.

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