Closing Rural-Urban MDG Gaps in Low-Income Countries

A General Equilibrium Perspective

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Abstract

This paper addresses policies aimed at closing the rural-urban gap for one of the Millennium Development Goals (MDGs), the under-five mortality rate (U5MR). The paper relies on the Maquette for MDG Simulations (MAMS), a computable general equilibrium model, applied to the database of an archetypical low-income country. The scenarios, which focus on the period 2013–2030, include a “business-as-usual” base scenario and policy scenarios that analyze efforts to raise the rural population up to the urban level in terms of health services or the under-five mortality rate. The policy scenarios are implemented with alternative sources of fiscal space. The results indicate that, if current trends continue, considerable progress for MDGs should be expected by 2030. If the government raises rural health services, then the decline in the rural U5MR would

accelerate. If most additional resources come from foreign grants or government efficiency gains, then the repercussions for other development indicators, including poverty reduction, would be positive. However, if most additional resources are from domestic taxes or borrowing, then progress for the rural U5MR would come at the expense of less progress for other indicators. Sensitivity analysis shows that these qualitative findings are robust to different values for two parameters related to initial rural-urban cost and service gaps. However, quantitatively, the results depend on the values of these two parameters, implying that individual country characteristics strongly influence the fiscal-space requirements for and consequences of equalizing rural-urban MDG services and outcomes.

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Closing Rural-Urban MDG Gaps in Low-Income Countries: A General Equilibrium Perspective

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1. INTRODUCTION AND SUMMARY²

One enduring feature of the development process, highlighted by Lipton (1977), is that rural populations are lagging behind their urban compatriots – this observation also applies to Millennium Development Goal (MDG) indicators (Figure 1.1). This paper is focused on policies aimed at closing this gap for one of the MDGs, the under-five mortality rate (U5MR or MDG 4), trying to shed light on what may be required to raise the rural population up to the urban level for this indicator or, more modestly, in terms of the government health services that reach them. The size of the effort that is required to achieve such objectives depends on a number of structural features of the modeled economy, including the rate of urbanization, rural-urban cost differentials for health services, and the magnitudes of initial rural-urban gaps in terms of the indicator itself, the U5MR, and its determinants, including access to health services and other aspects of rural living conditions.

Figure 1.1. Rural and urban MDG data for low-income countries in 2009

Analytically, this paper relies on MAMS (Maquette for MDG Simulations), a computable general equilibrium (CGE) model, applied to the database of an archetypical low-income country (LIC). The rationale for choosing a general equilibrium approach is that, in the presence of large rural-urban gaps and large rural population shares in most LICs, it would be misleading to limit an analysis of policies aimed at achieving such objectives to a partial-equilibrium framework: given macroeconomic and market constraints, required changes in government activities (spending level, spending efficiency, or revenue level, from domestic or foreign sources) would have effects that make themselves felt throughout the economy, often pointing to trade-offs and

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interactions between different objectives and policies. The analysis is based on a fiscal space perspective with its focus on the sources and uses of space for expanded priority spending (Heller 2005; World Bank 2007b), singling out four sources of such space: increases in taxes, grant aid, domestic borrowing, and efficiency in the government health sector. Depending on the source of fiscal space, the broader effects of raising spending and service levels in a priority area may differ sharply.

The simulation scenarios include a base scenario, designed to provide a plausible projection for a typical LIC up to 2030, and two sets of policy scenarios, analyzing the efforts to raise the rural population up to the urban level in terms of health services or the U5MR. Both sets of policy scenarios are analyzed with alternative sources of fiscal space. In addition, the analysis addresses the sensitivity of qualitative and quantitative results to alternative initial values for two parameters related to rural-urban access and cost gaps for government health services. The need for this type of sensitivity analysis stems from the fact that very little information is available on cost and service gaps between rural and urban areas; indeed, also more generally, little information about developing countries is aggregated along the rural-urban dimension.

According to the simulation analysis, assuming that the trends of the first decade of this millennium continue, considerable progress for MDG indicators is projected for the period up to 2030. If the government, by mobilizing required resources and/or raising its own efficiency in the health sector, manages to raise the level of real health services reaching the rural population, then it is possible to add considerably to the decline in the rural U5MR. If the bulk of resources come in the form of foreign grants or cost-reducing efficiency gains, then progress in the form of a lower U5MR can come with positive repercussions for other development indicators, including poverty reduction. However, if most additional resources are mobilized from domestic sources, then this progress for the rural U5MR would threaten to come at the expense of less progress in terms of poverty reduction and other indicators, illustrating the difficult tradeoffs faced by LICs and their governments. The sensitivity analysis shows that these qualitative findings are robust to different values for parameters that define initial rural-urban cost and service gaps. However, the detailed quantitative results differ significantly depending on the values of these two parameters, with the implication that, not surprisingly, individual country characteristics for these (and other) parameters have a strong bearing on the requirements for and consequences of equalizing rural-urban MDG services and outcomes.

We proceed as follows. Section 2 overviews the model structure and the database, and presents the base scenario. Section 3 presents and analyzes the results of the non-base simulations. The main conclusions are summarized in Section 4. Appendices 1-3 provide additional details on the model structure, the database, and the simulation results, respectively.

2. MODEL, DATABASE, AND BASE SCENARIO

This section briefly overviews the model and its database, focusing on adjustments and extensions related to the disaggregation of MDGs into rural and urban. Drawing on this information, we turn to the *base*, presenting its assumptions and analyzing its results.

2.1. Model and Database³

MAMS (Maquette for MDG Simulations) is a CGE model designed for country-level analysis of medium- and long-run development policies, including strategies for improving and targeting MDG outcomes. Technically, it is made up of a set of simultaneous equations. The model is economywide and multi-sectoral, providing a comprehensive and consistent view of the economy, including linkages (via markets and payment flows) between production, the incomes it generates, households, the government (its budget and fiscal policies), and the balance of payments.

The different agents (producers, households, government, and the nation in its dealings with the outside world) are subject to budget, market, and macro constraints. For producers, total sales receipts equal the sum of factor, intermediate input, and tax payments. In the budgets of households, the government, and the rest of the world (the balance of payments), receipts and spending, the latter including savings and net borrowing, are by definition equal. The decision rules of each agent – for producers and households, the objective is to maximize profits and utility, respectively – ensure that these budgetary constraints are respected: for example, households set aside parts of their incomes to direct taxes and savings, allocating what is left to consumption. The government budget is balanced via adjustments in one or more items on the receipt or spending sides with the specifics varied depending on the question that is posed. In the balance of payments, adjustments in the real exchange rate ensure that the nation's external accounts are in balance. In product and factor markets, quantities demanded and supplied are equal; typically, adjustments in domestic commodity prices, labor wages, and capital and land rents ensure this outcome. For exports and imports, the model follows the small-country assumption: export demands and import supplies are infinitely elastic at given world prices. Domestic prices of output that at least in part is exported and/or competes with imports are influenced by international prices since domestic producers and demanders adjust their supplies to and demands from domestic markets in response to changes in the prices they receive or pay if they export or buy a competing import, respectively.

The model includes a human development module that covers MDGs and higher education. It generates a set of MDG indicators, in this application MDGs 1 (poverty), 2 (completion of

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³ Appendix 1 looks at the model during a single year from an aggregate and more intuitive perspective, focusing on the interactions between its main building blocks: production activities, households, the government, the rest of the world, and markets for factors and commodities. Appendix 2 presents the database in more detail. For more materials and applications related to MAMS, visit www.worldbank.org/mams and, for a more exhaustive presentation of the model, see Lofgren *et al.* (2012).

primary education), 4 (under-five mortality rate), 7w (safe water access), and 7s (improved sanitation access). Among these, MDGs 1, 4, 7w and 7s are disaggregated into rural and urban. In the area of education (which is not disaggregated into rural and urban), the primary level is part of a module that also includes secondary and tertiary education with links to the labor market, supplying it with graduates and dropouts who enter the market in the segment that corresponds to their educational attainments.

For MDG 1, it is assumed that, in both rural and urban areas, per-capita (goods and service) consumption follows a lognormal distribution parameterized on the basis of a Gini coefficient and an initial headcount poverty rate.⁴ As summarized in Table 2.1, for MDGs other than MDG 1, the outcome determinants include the real supply of any related government services (measured per capita or per student),⁵ the stock of government infrastructure capital, real household consumption per-capita (an indicator of the ability of households to make purchases in support of stronger MDG and education outcomes), and other MDG indicators (reflecting the fact that progress for one MDG may have a positive impact on other MDGs, in this application, with MDG 7w influencing MDG 4). For MDGs that are split into rural and urban, the determinants are also disaggregated along this dimension.

Table 2.1. Determinants of MDG outcomes

MDG	Service delivery**	Household consumption per capita	Wage incentives	Public infra-structure	Other MDGs
1. Headcount poverty rate*		x*			
2. Primary education	x	x	x	x	
4. Under-five mortality*	x	x*		x	7w*
7w. Access to safe water*		x*		x	
7s. Access to basic sanitation*		x*		x	

Note:

*Indicator or data disaggregated into rural and urban

**Service delivery refers to government services in the relevant area, measured per student for MDG 2 and per capita for MDG 4.

In order to make the disaggregation of MDGs into rural and urban feasible, the aggregate urban population share is endogenous, modeled as a function of the employment share of agriculture, with the rest of the population being rural. This relationship draws on the fact that, globally, there is a strong association between urbanization and a declining share of agriculture in

⁴ It is widely accepted that the lognormal provides a good approximation for within-country income and consumption distributions even though it may fail to account for phenomena such as consumption smoothing (Easterly 2007, pp. 5-6; Lopez and Servén 2006, p. 2).

⁵ The model includes government services related to MDGs 2 (primary education) and 4 (health, split into rural and urban), as well as secondary and tertiary education services. It does not single out government services related to MDG 7 (water and sanitation).

employment (and value added); the treatment of households is explained further down in this section and in Appendix 1.⁶ Given this information and related endogenous data on household incomes and spending, it is possible to compute per-capita household consumption in rural and urban areas, both of which enter some of the MDG functions (cf. Table 2.1).

The above discussion refers to how the model works in any given year. Over time, production growth is determined by growth in factor employment and TFP. Growth in capital and labor stocks is endogenous. For capital stocks, growth depends on new investment and depreciation. Growth in the aggregate labor stock depends on growth in the population in labor force age, the labor force participation rate, and school attendance. At a disaggregated level -- the labor force is disaggregated by educational attainment into segments with less than completed secondary, completed secondary but not completed tertiary, or completed tertiary -- growth depends on the evolution of the educational system. For other factors (in this application agricultural land), stock growth is exogenous. TFP growth is made up of two components, one that is exogenous and one that responds to endogenous developments, in this application, growth in government infrastructure capital stocks, urbanization, and MDG 4 (as a proxy for the health status of the population). The inclusion of a link between urbanization and TFP (with a stronger link for non-agricultural sectors) is based on research indicating urban agglomeration tends to generate more rapid productivity growth.

A typical MAMS application requires an extensive data set for the application base-year -- a social accounting matrix (SAM);⁷ stocks for production factors (including different types of labor and capital), population, labor unemployment (broadly defined to include underemployment) and school enrollment; indicators for MDGs and the educational system -- as well as a set of elasticities (for production, consumption, trade, and MDG, and non-MDG education relationships). The database also includes projections into the future (for growth in GDP at factor cost and the evolution of disaggregated MDG and education indicators and their determinants), to which the MAMS baseline simulation is calibrated.

The database for the current application (including its disaggregation) to a typical LIC was designed in light of data availability and the analytical objective of shedding light on the impact

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⁶ Note that it is not (implausibly) assumed that the population who primarily earns its living from agriculture is rural while those depending on industry or services are urban -- in LICs (and, indeed, in countries at all income levels), in terms of location and residence of workers, to varying degrees agriculture is urban and industry and services rural. For example, in Uganda, the 2005/2006 urban employment shares were 8 percent for agriculture, 44 percent for industry, 45 percent for commerce, and 51 percent for services; i.e., except for agriculture, all other sectors were quite evenly split between rural and urban employees (UBoS 2007).

⁷ A SAM is a square matrix with identical row and column accounts, providing a comprehensive representation of payments flows in the economy of a geographical unit (typically a country) during a period of time (typically one year). Cell entries represent payments from its column account to its row account. In a SAM without errors, row and column totals are equal. SAMs appear with widely varying degrees of disaggregation. The payments flows are expressed in current local currency or some transformation thereof -- in Table A2.2, the value of each cell has been transformed into percent of GDP at market prices in the same year. For more on SAMs, see for example Reinert and Roland-Holst (1997) and Round (2003). The detailed LIC MAMS SAM for this application is available on request.

of closing of rural-urban gaps in health.⁸ In the production sphere, it is disaggregated into 14 activities, including 8 associated with the government. Each activity produces one commodity (good or service); the database also includes one commodity without domestic production (refined petroleum). (Table A2.1 presents the detailed model disaggregation.) The government activities cover human development (health and three levels of education), infrastructure and other areas. The factors of production are split into land (for the agricultural activities) and different types of labor and capital.

The database includes four representative households (RHs), initially rural and urban low- and high-income households, each of which is characterized by specific income and spending patterns; for example, on the income side, rural households (especially the high-income group) depend much more heavily on land rent than their urban compatriots. The population of each RH grows endogenously; in order to match the aggregate urban (and rural) population shares that, as noted above, are driven by changes in the share of agricultural employment, in each year, shares of the initially rural or urban RHs migrate to the aggregate urban or rural population groups, respectively. (See Appendix 1 for details on this.)

The simulations include a *base* and a set of policy scenarios, with the analysis focused on the period 2013-2030. The *base* is designed to generate a plausible projection into the future to which the other scenarios can be compared. The policy scenarios are designed to simulate efforts to improve rural outcomes for the under-five mortality rate without adversely affecting the urban population, relying on alternative sources for needed fiscal space.

2.2. Base Scenario

Our presentation of the *base* starts with an overview of key assumptions, followed by an analysis of the simulation results for the period 2013-2030.

Assumptions

By construction, the *base* depicts a future of “business-as-usual”, designed to represent a plausible projection for a typical LIC economy for the period 2014-2030. Compared to the situation in 2013, gradual progress is realized in terms of key indicators without any major structural change and with roughly unchanged ratios to GDP for domestic and foreign government debts.

For the *base* (but not for the other scenarios), growth in GDP at factor cost is exogenous, set at the average annual trend growth rate for all LICs for the period 2000-2009 (the base year), 5.2 percent (World Bank 2012).⁹ Other key assumptions may be summarized as follows:

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⁸ See Appendix 2 for more detail on the database.

⁹ Technically, the level of GDP is fixed, removing one variable from the model for each solution year. At the same time, a variable that introduces a uniform adjustment in TFP in each production activity is flexed, assuring that the exogenous GDP level is reached and that the model continues to have an equal number of equations and variables.

- Government spending. Real government education services grow at rates that are adjusted endogenously to ensure that real services per student grow at around 3.2 percent per year (close to the growth in GDP per capita); drawing on cross-country analysis, these per-student growth rates are slightly higher the lower the educational cycle. For other government functions – health, agricultural services, public infrastructure and the rest of the government – it is assumed that spending is a fixed share of absorption (using the base-year share).¹⁰ Across the board, government investment is set to generate capital stock growth that matches the growth in real government services. Transfers from the government to households are also fixed at the base-year share of absorption.
- Government receipts and government closure. Domestic and foreign government borrowing are defined so that domestic and foreign debt stocks grow at roughly the same rate as GDP, thus maintaining stable ratios between these debt stocks and GDP. Foreign grant aid is fixed at the same share of GDP (4 percent) as in the base year. Among the taxes, import tariffs are kept at base-year rates while the rates for domestic direct and indirect taxes are scaled to clear the government budget.
- With respect to non-government links to the rest of the world, FDI and net receipts of private transfers from abroad (mostly “worker remittances”) are both fixed at the base-year share of absorption. The balance of payments clears via adjustments in the real exchange rate.
- Domestically financed private investment is also fixed at the base-year share of absorption; adjustments in household savings (uniform point changes in the savings rates of all households) ensure that sufficient financing is available.

Results

The results for the *base* are summarized in Figures 2.1-2.4. More detailed results for these and other scenarios are shown in Tables A3.1-A3.6. Starting with macro results for the *base* simulation, the main (but still very moderate) changes in key macro aggregates expressed as GDP shares (Figure 2.1) are a slight switch (totaling around 1 percent of GDP) from private consumption to government consumption and investment. In terms of real growth, the average annual rates are in the range of 5.0-5.6 for the key indicators (Figure 2.2), i.e. as expected also quite even given only small changes in GDP shares. The deviations (which are slight) between the picture in terms of GDP shares and growth are due to the fact that GDP shares are influenced by changes in domestic prices; most noticeably, due to a decline in its relative price, private consumption grows faster than private investment in spite of that its GDP share decreases while the GDP share of private investment is unchanged. In the background, the real

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For non-base scenarios, the GDP level is flexible whereas the productivity adjustment variable is fixed. In per-capita terms, the annual trend growth for 2000-2009 was 3.2 percent.

¹⁰ Although the differences often are small, it is preferable to fix payment flows relative to absorption instead of GDP. Absorption is a better measure than GDP of the capacity of an economy to spend in different areas. The two measures may grow at significantly different rates in the face of changes in net transfers, world prices, or factor incomes from abroad. For example, fixing government consumption as a share of GDP may generate significant unintended changes in the share of government consumption in total domestic final demand.

exchange rate is roughly unchanged, i.e., little change is needed to provide incentives to adjust export and import growth sufficiently to clear the balance of payments. The MDG indicators all improve substantially; while a substantial rural-urban gap remains, in most cases it narrows noticeably (Figures 2.3-2.4).¹¹ For example, using rounded figures, between 2013 and 2030, the rural poverty rate declines from 48 to 18 percent while the urban rate falls from 27 to 9 percent. In general, this reflects that, in a setting with even growth rates in rural and urban areas for the different determinants, the marginal returns are higher in rural areas as they start out at a lower level. With respect to health services per capita, the growth rates in rural and urban areas are identical, at around 3.0 percent per year.

Figure 2.1. Macro indicators in 2013 and 2030 for base scenario (% of GDP)

¹¹ The only exception is sanitation access, for which the rural-urban gap increases. However, also for this indicator, the rural growth rate is higher than the urban rate.

Figure 2.2. Macro indicators: base scenario annual real growth 2014-2030 (%)

Figure 2.3. Poverty and under-five mortality for base simulation

Figure 2.4. Water and sanitation access for base simulation

Among other results, for the *base*, the 5.2 percent GDP growth rate disaggregates into 3.9 percent due to increased factor employment and 1.3 percent due increased TFP. Growth in labor demand is sufficient to significantly reduce the unemployment rate, from 18 to 14 percent. In terms of GDP shares, the changes in the balance of payments are very small; in the government budget, the main change is a tax increase of 1.2 percent of GDP that finances a spending increase of the same magnitude, spread across education, health and other services. Simulated changes in sectoral GDP shares and the degree of urbanization are moderate.

3. RURAL AND URBAN DEVELOPMENT: TRADE-OFFS BETWEEN ALTERNATIVE MDG POLICIES

The policy scenarios, which all are designed to simulate efforts to improve rural outcomes for the U5MR without adversely affecting the urban population, fall into two groups. In the first (Section 3.1), the government gradually raises per capita rural health services to the urban level while maintaining a growth rate for urban services that is sufficient to get the same reduction in the urban U5MR as under the *base*. In the second scenario group (Section 3.2), also simulated with alternative sources of fiscal space, the government more ambitiously gradually raises government health services in rural areas to such an extent that, by 2030, the U5MR of the rural population will have declined to the urban U5MR level in 2030 simulated under the *base*. In addition, under the second group, we explore the impact of relying on increased government efficiency as the source of fiscal space. The final Section 3.3 explores the sensitivity of the findings from the analysis to alternative assumptions regarding initial rural-urban service and cost gaps.

Apart from the changes in government policies and efficiency, which are highlighted below, the assumptions underlying all non-base scenarios are identical, in most instances drawing on the

results from the base scenario. Among other things, it is important to note the following: (a) Outside the health sector, all real government consumption and investment demands are the same as for the base; (b) the values for government foreign borrowing, transfers to households from the outside world (“worker remittances”) and FDI are all fixed in foreign currency at base levels; (c) unless they are flexible as part of the individual scenario (noted below), the values for grant aid to the government and domestic government borrowing transfers to the government are also fixed at base levels, in foreign and domestic currency (in the latter case indexed to the CPI), respectively; and (d) domestic private investment is determined by available financing (private savings net of domestic government borrowing). The main purpose behind these assumptions is to create an even playing field across simulations that permits the conduct of controlled experiments under which unintended changes do not interfere with the policy analysis.¹²

3.1. Equalizing Rural and Urban Health Services Per Capita

The simulation results for the core scenarios are summarized in Figures 3.1-3.4 with more detailed results in Appendix 3 (Tables A3.1-A3.6). In the first simulation (denoted *ser-eq+fg*), rural-urban per-capita service equality is gradually brought about with foreign grants provide the financing needed. More specifically, growth in rural health services is adjusted sufficiently to raise their level per capita to the urban level by 2030 while, at the same time, the *base* outcome for the U5MR is maintained for urban households. As shown in Figures 3.1-3.2, this reduces the 2030 rural U5MR by more than 5 points, closing about 60 percent of the *base* rural-urban gap in 2030 while other MDG indicators (poverty, water access, and sanitation access) register marginal improvements across the board. For MDGs other than the U5MR, these improvements are driven by marginal increases in growth in private consumption. Apart from a noticeable increase in government consumption growth (by 0.6 percentage points; due to increased growth for the health sector), the other macro aggregates do not change by much (Figure 3.3). In the government budget, foreign grants increase gradually to reach an additional 1.4 percent of GDP by 2030 (Figure 3.4), providing the financing that is needed. To provide a different perspective on financing needs, this scenario was also simulated with concessional foreign borrowing covering the gap in the government budget; the results are by definition identical except for the evolution of foreign debt, which by 2030 reaches 42 percent of GDP, compared to 29-30 percent for the *base* and *ser-eq+fg*. In the government budget, health spending in 2030 is at 4.3 percent of GDP compared to 2.8 percent for *base* (Table A3.3).

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¹² To exemplify, it would be inappropriate to conduct policy experiments with foreign grants defined as a share of GDP since this would lead to that grants are automatically adjusted in response to changes in GDP growth and the exchange rate.

Figure 3.1. Poverty and under-five mortality -- deviation in 2030 from base

Figure 3.2. Water and sanitation access -- deviation in 2030 from base

Figure 3.3. Macro indicators -- deviation from base annual growth

Figure 3.4. Additional foreign grants to finance health spending

Instead of relying on foreign resources to equalize health services, the government may create the fiscal space needed for this increase in health spending by turning to domestic borrowing or higher taxes. For the case of domestic borrowing (*ser-eq+db*), other MDG indicators deteriorate noticeably (Figures 3.1-3.2), driven by declines in absorption and private consumption growth; due to slow private consumption growth, more rapid growth in government consumption (its demand for health services) is needed to achieve the U5MR objective (Figure 3.3). In the government budget, the 2030 borrowing increase reaches 3.0 percent of GDP (Table A3.3). Compared to the scenario *ser-eq+fg*, for which the 2030 financing need was 1.4 percent of GDP, this figure is larger due to several factors: the need to make up for slower private consumption growth via increased growth in health services; slower GDP growth; and the need to cover an

increase in interest payments. If taxes instead provide needed financing (*ser-eq+tx*), the changes are in the same direction as for *ser-eq+db* but more moderate (Figures 3.1-3.3). For both scenarios (*ser-eq+db* and *ser-eq+tx*), the macro slowdown reflects the opportunity costs of reallocating resources to government health spending: less funding for domestic private investment and capital stock growth (*ser-eq+db*), or reduced real disposable income for households, leading to losses spread over private consumption, investment, and capital stock growth (*ser-eq+tx*). The effects are more severe for *ser-eq+db* due to the stronger impact of investment and capital stock growth on GDP growth.

3.2. Closing the Gap between Rural and Urban Under-Five Mortality Rates

Under the preceding scenarios, the rural U5MR remains above the urban level, pointing to the fact that lacking government health services is only one of the factors behind the gaps between rural and urban health outcomes. However, more ambitiously, the government may decide to gradually raise government health services in rural areas to such an extent that, by 2030, the U5MR of the rural population will have declined to the urban U5MR level in 2030 simulated under the *base*; i.e., the government would try to make up for the other gaps suffered by the rural population by providing them with additional targeted health services while, at the same time, maintaining the same per capita real health spending for the urban population as under the *base*.

The results indicate that, on the margin, the increase in real services per capita (or per avoided death) is higher under this scenario, reflecting the need to reach more disadvantaged population groups and to turn to more costly interventions, in effect reversing the initial discrimination against the rural population in health service provision. If rural-urban equality is achieved for the U5MR with foreign grants providing the marginal financing (*mdg-eq+fg*), then these grants would have to reach 8.5 percent of GDP by 2030, compared to 4 percent for the *base* and 5.4 percent for *ser-eq+fg*. Compared to the *base* outcome in 2030, the intended reduction in the rural U5MR is realized, together with small reductions in the urban U5MR and poverty in both rural and urban areas, as well as improved access to water and sanitation (Figures 3.1-3.2). A strong growth increase is recorded for government consumption, along with more modest increases for GDP, private consumption, and absorption, the latter enlarged by the increase in grant aid (Figure 3.3). At a more disaggregated budget level, health spending jumps to 7.7 percent of GDP (Table A3.3). Even though the expansion is gradual, it may nevertheless put considerable stress on government capacity.

In order to assess the feasibility of relying on domestic resources, the same scenario was implemented with taxes covering additional financing needs (*mdg-eq+tx*): the resulting tax share in 2030 reaches 16.9 percent, compared to 10.8 percent for the *base*. The repercussions of such a tax increase are felt in the form of a decline in private consumption growth of 0.4 percentage points, a slightly higher urban U5MR, significant increases in both rural and urban poverty rates (by 1.5-2.0 percentage points), as well as significant declines in water and sanitation access in both rural and urban areas (Figures 3.1-3.2). Growth in government consumption increases by close to 2.0 percentage points, as health spending reaches close to 9

percent of GDP in 2030 (Table A3.3); the need for government services is higher as they have to make up for the loss in private consumption, which also influences the U5MR. A comparison between urban and rural poverty changes across simulations indicates that rural poverty responds more strongly to changes in GDP growth; this is related to the fact that its labor force is more heavily represented in non-government sectors, for which growth rates of which are positively correlated to GDP growth; in these simulations, government growth rates are either fixed or, given the use of government health services as the policy tool for MDG targeting, inversely related to GDP growth since more health service growth is needed to make up for less growth in GDP and private incomes and consumption.¹³

From a different angle, given inefficiencies in the government health sector in many LICs it may be feasible to reduce the need for extra financing by raising government efficiency. A set of scenarios were constructed to learn about what difference this may make: in these, the rural U5MR is gradually raised to reach the urban level by 2030 (as in the preceding scenarios) with different rates of additional health sector efficiency growth combined with marginal financing from foreign grants. The rates of efficiency growth were raised up to the point where there was no need for foreign grants above the level included under the base. (Total foreign grants are here simply defined as the sum of grants in 2014-2030.)

Drawing on the results for these simulations, Figure 3.5 maps out combinations of (a) average per capita foreign grant increases (in 2009 US\$) 2014-2030; and (b) additional annual growth in government health service efficiency, with efficiency defined to cover investment efficiency (measured by the quantities of goods and services needed per unit of new capital), as well as efficiency of labor and capital use but without assuming efficiency gains in intermediate inputs (such as medicines). In the absence of a gain in efficiency, the grant increase in an average year is around US\$22 per capita (at 2009 prices; from the scenario *mdg-eq+fg*). The need for additional grant aid would be eliminated if efficiency in the health sector reached close to 5 percent per year. While such rapid gains may be infeasible, additional growth of at least 1-2 percent per year may be within the realm of the possible.¹⁴

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¹³ An additional simulation showed that the domestic resources that could be mobilized via increased domestic government borrowing were insufficient to finance the health policy of the last two scenarios (*mdg-eq+fg* and *mdg-eq+tx*).

¹⁴ For example, on the basis of surveys in 6 low- and middle-income countries, Chaudhury *et al.* (2006) find that, on average, primary health workers were absent 35 percent of the time. Other things being equal, a gradual reduction in their absenteeism to 17.5 percent of their time by 2030 would correspond to an annual increase in their productivity by around 1.5 percent per year. In the simulations, similar improvements are assumed for capital use and investments.

Figure 3.5. Trade-offs between grant aid and domestic efficiency gains

Interestingly, the shape of the curve in Figure 3.5 indicates that aid is relatively efficient when it is at low levels but less efficient at high levels: when it is at a low level (a low point on the curve), a marginal aid increase reduces the required rate of efficiency growth relatively strongly whereas, when it is at a high level, a marginal increase in aid reduces the required efficiency growth by a relatively small amount. The two reasons for this are (a) exchange rate appreciation -- the domestic purchasing power per unit of aid diminishes as aid increases; and (b) the cost-based price of health services -- as efficiency growth in the health sector declines, the price of health services increases, further reducing the amount of services that one dollar of aid can purchase.

In sum, these results suggest that raising the rural population to the urban U5MR would require a substantial increase in the real health services that the government provides. Such an increase in health services would require additional financing and/or improved efficiency in the health sector. Trade-offs between different targets (for example poverty reduction vs. reduction of the U5MR) appear if financing largely comes from domestic sources; if financing mainly comes from grant aid, then such trade-offs can be avoided.

3.3. Sensitivity Analysis

As noted in the beginning of this paper, information is missing for two parameters that are important for this analysis: the initial ratio between government urban and rural health services per-capita and the ratio between rural and urban unit costs for health services. In order to test the robustness of the above findings, six simulations – the *base* and the five core none-base simulations (covered in Figures 3.1-3.4) – were implemented for four variants, defined by alternative set of values for these two parameters:

- Central: Same as in the preceding simulations, i.e. an initial urban-rural per-capita health service gap of 1.77 and an initial rural-urban cost ratio of 1.14;
- Large urban-rural service gap: 25 percent increase in the initial urban-rural per-capita health service gap (from 1.77 to 2.22)
- Small urban-rural service gap: 25 percent decrease in the initial urban-rural per-capita health service gap (from 1.77 to 1.33)
- Large rural-urban cost gap: 50 percent increase in the initial rural-urban unit cost ratio (from 1.14 to 1.71).¹⁵

For each variant of the six simulations, each of the 22 indicators covered in Tables A3.1 (macro growth rates) and A3.5 (MDG values in 2030) was ranked across the 6 simulations. After this, the resulting rankings for the four variants were compared. It turned out that, out of 132 (22 times 6) rankings, 126 were identical across the 4 variants; the ranking deviations for the remaining 6 rankings were all by one point (where simulations were ranked from 1 to 6) and for deviations in outcomes that were so small that they would be considered identical in a discussion of results.¹⁶ Thus, the qualitative findings, based on comparisons across simulations, are extremely insensitive even to fairly large changes in assumptions with regard to initial cost and service gaps.

However, the magnitudes of initial service and cost gaps obviously have a strong bearing on the requirements for and repercussions of realizing rural-urban equality in terms of health services or the U5MR. In order to gauge the quantitative implications of alternative assumptions, the simulations underlying Figure 3.5 were implemented for each of the above four variants. The results are summarized in Figure 3.6. For the central variant, reported above, an average aid level of close to US\$22 per capita or close to 5 percent of health service efficiency growth is required to bring about rural-urban U5MR equality. For the variants with a large or small urban-rural service gap, the requirements are roughly US\$27 or US\$15 per capita in aid or efficiency growth rates of 6 or 4 percent, respectively. The figures for the variant with a large rural-urban cost gap are similar to those of a large urban-rural service gap. The important implication of these is that requirements in individual country settings would vary quite widely depending on their initial conditions. Initial country data for the rural and urban U5MR and the degree of equalizing that is targeted would also influence the magnitude of the policy and financing challenge. Better data on household use of health services and the health sector (including its cost structure) would be needed to generate reliable assessments in a country setting.

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¹⁵ The rural-urban cost ratio was not varied downwards since it did not seem likely that it would be less than unity (as this would indicate that it is cheaper to provide health services in rural than in urban areas).

¹⁶ The ranking gaps were due to outcome result differences smaller than 0.1 (using the same units as in Tables A3.1 and A3.5). For the largest deviation, the gap between rankings was due to that, for the central case, the 2030 unemployment rate was 0.03 percent higher for *mdg-eq+tx* than for *ser-eq+db* whereas, for the case with a large urban-rural service gap, this unemployment rate was 0.1 percent higher for *ser-eq+db* than for *mdg-eq+tx*.

Figure 3.6. Sensitivity analysis: Initial rural-urban service and cost gaps.

4. CONCLUDING OBSERVATIONS

This paper projects the evolution of an archetypical LIC up to 2030, covering not only standard economic indicators but also human development indicators, including a set of MDGs with a rural-urban disaggregation. The results indicate that, for the “business-as-usual” *base* scenario, considerable progress is realized, including a substantial narrowing of rural-urban MDG gaps.

The policy simulations explore the consequences of increased provision of government health services to the rural population with the aim of closing gaps in terms of per-capita services or the U5MR. The results indicate that, if the government, by mobilizing required resources and/or by raising its own efficiency in the health sector, manages to raise the level of real health services reaching the rural population, then it is possible to considerably reduce the rural U5MR. If the bulk of resources come in the form of foreign grants or cost-reducing efficiency gains, then progress in the form of a lower U5MR can come with positive repercussions for other key development indicators, including poverty reduction. However, if most additional resources are mobilized from domestic sources, then this progress would threaten to come at the expense of less progress in terms of other indicators, illustrating the difficult tradeoffs faced by LICs and their governments.

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http://wits.worldbank.org](http://www-int.imf.org/depts/tgs/bts/bts-ie/cats/appcomtrade.asp?Active=0102;http://wits.worldbank.org)).

APPENDIX 1: STRUCTURE OF MAMS

This appendix is divided into two sections. The first, “A Birds-Eye Perspective on MAMS” offers an aggregate and more intuitive look at how the model works, focusing on the interactions during a single year between the main building blocks of the model: production activities, households, the government, the rest of the world, and markets for factors and commodities. The second provides additional detail on changes related to the extension of the model to rural-urban issues.

A1.1. A Bird’s Eye Perspective on MAMS

Figure A1.1 summarizes the payment flows that are captured by MAMS in any year. In any application, including the current one, most building blocks except the government and the rest of the world are disaggregated, i.e. the model and its database include multiple activities, commodities, factors, and households.

Figure A1.1. Aggregate payment flows in MAMS

Starting on the left, activities produce, selling their output at home or abroad, and using their revenues to cover their costs (of intermediate inputs, factor hiring and taxes). Their decisions to

pursue particular activities with certain levels of factor use are driven by profit maximization. The shares exported and sold domestically depend on the relative prices of their output in world and domestic markets.

MAMS includes three core institutions: households, government, and the rest of the world.

- Households (domestic private or non-government institutions) earn incomes from factors, transfers and interest from the government (with the interest due to loans from the households to the government), and transfers from the rest of the world, net of interest on household foreign debt.¹⁷ These are used for direct taxes, savings, and consumption. The savings share depends on per-capita incomes. Their consumption decisions change in response to income and price changes. By construction (and as required by the household budget constraints), the consumption value of the households equals their income net of direct taxes and savings.
- The government gets its receipts from taxes and transfers from abroad; it uses these for consumption, transfers to households, and investments (providing the capital stocks required for producers of government services), drawing on domestic and foreign borrowing for supplementary investment funding. To remain within its budget constraint, it either adjusts some part(s) of its spending on the basis of available receipts or mobilizes additional receipts of one type or more in order to finance its spending.
- The rest of the world (with the balance of payments as its budget) sends foreign currency to the modeled country in the form of transfers to its government and households (net of interest payments on their foreign debts), FDI, loans, and export payments. The LIC uses these inflows to finance its imports. The balance of payments clears (inflows and outflows are equalized) via adjustments in the real exchange rate (the ratio between the international and domestic price levels), which take place when the balance is in surplus or deficit.¹⁸

Private investment financing is provided from domestic private savings (net of lending to the government) and foreign direct investment (FDI). FDI is determined by earmarked financing from abroad, which may be fixed in foreign currency or as a share of GDP or absorption. On the domestic side, it is either assumed that private investment is adjusted in response to changes in available financing or that private savings is adjusted to finance a level of private investment that is a fixed share of GDP or absorption.

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¹⁷ The household may lend to the government and borrow from the rest of the world; given this, it may receive interest payments from the government and make interest payments to the rest of the world.

¹⁸ For example, starting from a balanced situation, a balance of payments surplus could arise from increases in foreign exchange receipts (perhaps due to an increase in foreign aid or the world price of an export). In this situation, an appreciation of the real exchange rate of appropriate magnitude would eliminate this surplus by reducing the price of tradables relative to non-tradables, encouraging domestic demanders to direct a larger share of their spending to imports and domestic producers to direct less of their output to exports. In this application, adjustments in the nominal exchange rate would bring about the appreciation of the real exchange rate.

In domestic commodity markets, flexible prices ensure balance between demands for domestic output from domestic demanders and supplies to the domestic market from domestic suppliers. The part of domestic demands that is for imports faces exogenous world prices – the LIC is viewed as a small country in world markets without any impact on the import and export prices that it faces. Domestic demanders decide on import and domestic shares in their demands on the basis of the relative prices of commodities from these two sources. Similarly, domestic suppliers (the activities) decide on the shares for exports and domestic supplies on the basis of the relative prices received in these two markets.¹⁹

Factor markets reach balance between demands and supplies via wage (or rent) adjustments. Across all factors, the factor demand curves are downward-sloping reflecting the responses of production activities to changes in factor wages. On the supply side of the labor market, unemployment is endogenous – the model includes a wage curve (a supply curve) that is upward-sloping until full employment is reached, at which point it becomes vertical (see Figure A1.2; its supply curve assumes a minimum unemployment rate of 5%). Unemployment may be defined more broadly than in official statistics to include both un- and under-employment. In the simulations, a broad definition of unemployment increases the scope for the existing labor force to generate a larger amount of effective labor, contributing to a higher output level, if the real wages increase. For non-labor factors, the supply curves are vertical in any single year (the supply is fixed).

Figure A1.2. The labor market in MAMS.

¹⁹ To the extent that the output of individual production activities only has one destination, either exported in full or sold domestically in full, the economywide responses to adjustments in the real exchange rate are weaker, thus requiring a larger real exchange rate adjustment to eliminate any given imbalance in the balance of payments. Responses to changes in the real exchange rate are similarly weakened to the extent that domestic demanders use products the supplies of which only come from one source, domestic output or imports, rather than being provided from both sources.

A1.2. Model Extensions to Address Rural-Urban MDG Issues

As noted in Section 3, some model extensions were needed in order to disaggregate MDGs along the rural-urban dimension; we will here explain these in more detail. The disaggregation of the population into urban and rural is based on an aggregation urban population function in which the urban population is defined as a constant-elasticity function of the employment share of agriculture. It was necessary to reconcile this population split with the disaggregated RHs of the underlying database. As part of this reconciliation, in the base year, the population of each RH is allocated to urban (and, implicitly rural) areas on the basis of exogenous data.²⁰ Over time, the population of each RH is growing endogenously as a function of the educational composition of its labor force – household types with a large share of its labor in fast-growing more educated segments, grow more rapidly (and vice versa). Using the initial rural-urban population shares for each RH, this information makes it possible to generate raw figures for the urban population share in each year. Inevitably, these shares deviate from the share generated by the aggregate urban population function. (In practice, it turned out the deviations were quite small.) In order to reconcile the RH-based urban share with the aggregate urban share, the share of each RH allocated to urban areas is adjusted endogenously, upward for predominantly rural households (if the raw urban share is too small, generating a positive rural-to-urban “migration adjustment”) or downward for predominantly urban households (if the raw urban share is too large, generating a positive urban-to-rural migration adjustment). It is assumed that the households that are reallocated are at the average level of the population of their RH group in terms of incomes and other characteristics. On the basis of this information, it is possible to compute per-capita household consumption in urban and rural areas, variables that appear as determinants in the MDG functions that are disaggregated along urban-rural lines. Other things being equal, (a) positive rural-to-urban adjustment migration leaves the RH-based rural per-capita income unchanged but reduces the RH-based urban per-capita income; and (b) positive urban-to-rural adjustment migration leaves RH-based urban per-capita income unchanged but raises RH-based rural per-capita income. These adjustments do not change nationwide household per-capita income since they also involve changes in RH-based rural and urban population shares.

In addition, the determinants of the rural and urban MDG 4 indicators include the levels of real effective per-capita health services reaching rural and urban populations. In the computation of these levels, government real health services are split into rural and urban (with the shares treated as a policy tool), adjusted for relative cost differences (normalized to one for urban areas), and divided by the relevant population figures. This means that, other things being equal, the effective real per-capita services in rural areas would increase (a) if the government allocated a larger share of its spending to rural areas; (b) if the relative cost of providing an effective service unit in rural areas declines; and/or (c) if the rural population is smaller.

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²⁰ This split is very straightforward given that, in the base-year database, the RHs are low-income rural, high-income rural, low-income urban, and high-income urban; naturally, the initial urban shares are 1 for the two urban households and 0 for the two rural households.

With regard to MDG 1 (poverty), the model generates aggregate urban and rural poverty rates. As a first step, in the poverty module, Foster-Green-Thorbecke (FGT) poverty indicators are computed for the RHs (for each individually or for aggregations of RHs) on the basis of their per-capita consumption, an initial poverty rate, and an initial Gini coefficient.²¹ Drawing on these poverty indicators and the migration of parts of the population of some or all of the RHs that is imposed to generate urban and rural population shares that match the aggregate urbanization function (as discussed above), the final poverty indicators are computed for urban and rural population aggregates.²²

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²¹ In this application, for the purpose of poverty calculations, the rural low- and high-income RHs are aggregated into a raw rural household while, similarly, the urban low- and high-income RHs are aggregated into a raw urban household. Raw rural and urban poverty rates are computed on the basis of the simulated per-capita consumption for each aggregated group, its base-year poverty rate, and its Gini coefficient.

²² In order to verify that the computational procedure is without error, post-calculation checks verify that the poverty rate in each year is the same for national aggregations of the raw and final disaggregated poverty rates.

APPENDIX 2: THE MAMS DATABASE

As noted in Section 3, the database for a typical MAMS application includes a wide range of data for its base-year – a social accounting matrix (SAM); stocks for production factors (including one or more types of labor and capital), population, and school enrollment; indicators for selected MDGs and the educational system – as well as a set of elasticities (for production, consumption, trade, and human development relationships), and projections into the future (for growth in GDP at factor cost and the evolution of disaggregated MDG and education indicators and determinants). We will here outline the contents of the current database and how it was used, emphasizing parameters related to the rural-urban disaggregation and the MDGs.

Like other CGE models, MAMS is calibrated so that its base-year solution exactly replicates the base-year SAM. MAMS is also calibrated dynamically to replicate projected GDP growth and, in this application, projections for a set of HD outcomes, conditional on the simulated evolution of variables influencing these outcomes. Much of the inputs required to construct such a database are available from national and international databases, which in recent years have become richer and more easily accessed in electronic form. However, in some areas, data and knowledge are incomplete or unsettled, requiring the analyst to apply judgment and consult with country and subject specialists. In this context, calibration to base-year and projected data (especially for HD outcomes) provides an important means of eliminating many sources of errors in data and model structure as well as of ensuring that simulation results are consistent with available evidence.

Table A2.1 shows the basic disaggregation of the current database. The main inputs into the construction of a LIC SAM with a matching disaggregation were (a) an existing detailed SAM for a LIC (Uganda); (b) a macro SAM for a median LIC during the period 2005-2009 – Table A2.2 shows the corresponding macro SAM for 2013; and (c) median data for LICs on sector shares in value added. The median macro SAM is for the most part based on medians of the averages of GDP shares for individual LICs during the period 2005-2009, for some cells complemented by data in the original Uganda data set. For the estimation of a balanced SAM that draws on the original LIC SAM and replicates the macro SAM and other structural data, an entropy program was applied (Robinson *et al.* 2001).

Table A2.1. Disaggregation of MAMS LIC archetype database

<i>Private sectors</i>	Agriculture: food, other Industry: food, refined petroleum (only imports), other Services: transportation, other
<i>Government services</i>	education (divided into primary, secondary, and tertiary) health agricultural infrastructure other infrastructure other government
<i>Factors</i>	labor - unskilled (< completed secondary) labor - skilled (completed secondary) labor - high-skilled (completed tertiary) agricultural land private capital government capital stocks (one per government sector)
<i>Institutions -- current accounts</i>	households: rural and urban, both split into top and bottom half government rest of world
<i>Auxiliary institutional accounts</i>	taxes: direct, import, other indirect domestic interest -- on domestic government debt foreign interest -- on foreign government debt
<i>Institutions -- capital accounts</i>	One account for every institution with a current account
<i>Investment</i>	private capital one investment account for each government service/capital stock stock change

Table A2.2. Macro SAM for archetype LIC in 2013 (% of GDP)

	fac	act	com	hhd	gov	row	tax-dir	tax-imp	tax-com	int-dom	int-row	cap-hhd	cap-gov	cap-row	inv-prv	inv-gov	total
fac	92.6																92.6
act		179.1															179.1
com		86.5		87.1	8.4	23.2									13.6	5.9	224.7
hhd	87.9			5.9	1.6	13.0				0.4							108.8
gov					4.0		2.2	2.8	4.6								13.7
row	4.6		38.2								0.4						43.2
tax-dir				2.2													2.2
tax-imp			2.8														2.8
tax-com			4.6														4.6
int-dom					0.4												0.4
int-row					0.4												0.4
cap-hhd				13.6													13.6
cap-gov					2.9							1.4		1.5			5.9
cap-row						3.0											3.0
inv-prv												12.1		1.5			13.6
inv-gov													5.9				5.9
total	92.6	179.1	224.7	108.8	13.7	43.2	2.2	2.8	4.6	0.4	0.4	13.6	5.9	3.0	13.6	5.9	

Notation:

fac factors
 act production activities
 com commodities (goods and services)
 hhd household (domestic non-government) current account
 gov government current account
 row rest of world current account
 tax-dir direct taxes
 tax-imp import tariffs
 tax-com commodity taxes
 int-dom domestic interest
 int-row foreign interest
 cap-hhd household capital account
 cap-gov government capital account
 cap-row rest of world capital account
 inv-prv private investment (domestic- and foreign-financed)
 inv-gov government investment

Among the non-SAM data, labor, population and school enrollment stocks were readily available (World Bank 2011a; World Bank 2011b). Private capital stocks were estimated on the basis of capital value-added in the SAM, a net profit rate of 16 percent (Nehru and Dhareshwar 1993, p. 53), and a depreciation rate of 4.5 percent based on a review of the literature (Goldman-Sachs 2006, p. 5; Nehru and Dhareshwar 1993, p. 46). Government capital stocks were estimated on the basis of the assumption that base-year investment levels (in the SAM) matched what was required to ensure that these capital stocks grow at the same rate as GDP, after adjustment for depreciation, compared to cross-country data to verify aggregate plausibility (Arslanalp *et al.* 2010).²³ Drawing on surveys of econometric evidence, standard values for developing countries were used for elasticities in trade and production (Annabi *et al.* 2006). Income elasticities for household consumption (entering a linear expenditure system) are from the database of the ENVISAGE model; for details see van der Mensbrugghe (2010). For the poverty module, initial rural and urban consumption poverty rates and Gini coefficients are medians for LICs from the World Bank (2011b) and World Bank (2012).²⁴

MAMS was parameterized to replicate *base-run* projections for MDGs 4, 5, 7s, and 7w (under-five mortality, maternal mortality, water access, and sanitation access, each of which was disaggregated into rural and urban) as well as a wide range of education indicators (with data available for a wider range of indicators the lower the level of education), generated on the basis of constant-elasticity regressions of these indicators on gross national expenditure (or absorption) per capita and the simulated evolution of GNE per capita under the *base run* (Quijada 2012). The definitions of individual elasticities, which drive the relative importance of the different determinants in Table 2.1 (indicated by decompositions) was informed by a survey of cross-country studies, complemented by judgment calls (Lofgren 2010); in this application, roughly 30-40 percent of the changes in MDG and education indicators is attributed to changes in services and private per-capita consumption with the remainder due to the other determinants (cf. Table 2.1). Econometric estimation of the details of these relationships remains very challenging for a number of reasons: causality may go in both directions (higher incomes improve health and better health improves incomes) and include complex time lags; many of the variables (determinants and outcomes) are highly correlated; relationships may vary over time and space; and data is imperfect. To provide an example with regard to the latter point: it is near impossible to determine the levels of real supplies of government education or health services in the absence of relevant price indices and a separation of spending data into current and capital.

This MAMS application includes links between growth in TFP and growth in government capital stocks in agriculture and public infrastructure; drawing on available evidence (see for example Foster and Briceño-Garmendia, 2010, p. 71; IMF 2008, p. 20; and World Bank 2007a, p. 65), the

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²³ Cross-country data on total private and government capital stocks (with values expressed as shares of GDP) constitute a source of checks on initial estimates. As an additional check on initial capital stocks and depreciation rates, dynamically one would expect a growing developing economy with investment rates that match historical data to see its private capital stocks grow faster than its labor force, i.e. to experience a process of capital deepening in its private sector (as well as in the economy in general).

²⁴ Israel Osorio-Rodarte extracted the rural and urban poverty data from the I2D2 database.

productivity parameters were defined to generate internal rates of return of 17-18 percent for government investment in these areas.

Finally, in order to capture the determination and impact of urbanization, elasticities were needed for: (a) the urban population share with respect to the agricultural employment share; (b) the agricultural VA share with respect to GDP per capita; and (c) TFP in individual sectors with respect to the urban population share. On the basis of cross-country regressions covering low- and middle-income countries, (a) and (b) were set at -0.35 and -0.20, respectively. Due to a lack of easily accessible data, (c) was not estimated. On a priori grounds, it is also questionable whether urbanization per se leads to higher productivity; urban concentration may be more relevant and it may depend on the context in which urbanization takes place (for example, the impact may be absent if natural resource rents are driving the process but present if it is driven by expansion of industry and services (Henderson 2003, pp. 49-50; and Jedwab 2013, p. 4). In the MAMS database, the TFP elasticities used for agriculture and non-agricultural sectors were 0.1 and 0.2, respectively. Given limited urbanization, this mattered very little to the findings.

APPENDIX 3: SUPPLEMENTARY TABLES

Table A3.1. Macro indicators: annual real growth 2014-2030 by simulation (% per year)

	2013	base	ser-eq+fg	ser-eq+db	ser-eq+tx	mdg-eq+fg	mdg-eq+tx
Absorption	115.0	5.2	5.4	4.9	5.2	5.6	5.2
Consumption - private	87.1	5.2	5.3	5.0	5.1	5.4	4.8
Consumption - government	8.4	5.5	6.1	6.2	6.2	7.2	7.4
Investment - private	13.6	5.0	5.1	3.2	4.8	5.3	4.3
Investment - government	5.9	5.6	6.1	6.2	6.2	7.5	7.8
Exports	23.2	5.4	5.2	4.8	5.3	4.7	5.1
Imports	-38.2	5.3	5.5	5.0	5.3	5.7	5.2
GDP at factor cost	92.6	5.2	5.3	5.0	5.2	5.4	5.2
Total factor employment (index)		3.9	4.0	3.8	3.9	4.1	4.0
Total factor productivity (index)		1.3	1.3	1.2	1.3	1.3	1.2
GNI	95.0	5.2	5.3	4.9	5.2	5.4	5.2
GNDI	112.0	5.2	5.4	5.0	5.2	5.7	5.2
Real exchange rate (index)		0.0	-0.1	-0.1	0.0	-0.3	0.0
Unemployment rate (%)	18.4	14.1	14.0	14.9	14.3	13.8	14.9

Note: The column 2013 shows GDP shares (%) whereas the the other columns show annual real growth 2014-2030 (%). The only exception is unemployment; in all columns its unit is the level in percent. An increase (decrease) in the real exchange rate signals depreciation (appreciation). The average annual rate of population growth is 2.0%.

Table A3.2. Macro indicators in 2013 and by simulation in 2030 (% of GDP)

	2013	base	ser-eq+fg	ser-eq+db	ser-eq+tx	mdg-eq+fg	mdg-eq+tx
Absorption	115.0	115.0	116.1	115.2	114.9	118.7	114.8
Consumption - private	87.1	86.0	85.7	86.6	84.5	85.2	80.8
Consumption - government	8.4	9.0	9.8	10.4	9.9	11.5	11.9
Investment - private	13.6	13.6	13.6	10.7	13.3	13.6	12.6
Investment - government	5.9	6.4	6.9	7.5	7.1	8.3	9.5
Exports	23.2	23.5	22.3	22.4	23.1	19.5	22.1
Imports	-38.2	-38.5	-38.4	-37.5	-38.0	-38.1	-36.8
Net indirect taxes	7.4	8.2	8.1	8.0	9.3	8.1	12.4
GDP at factor cost	92.6	91.8	91.9	92.0	90.7	91.9	87.6
GNI	95.0	95.0	95.0	94.4	95.0	95.2	95.2
GNDI	112.0	112.0	113.2	112.1	111.9	115.9	111.8
Foreign savings	3.0	3.0	2.9	3.1	2.9	2.8	2.9
Gross national savings	16.5	17.0	17.6	15.1	17.5	19.1	19.2

Table A3.3. Government budget and debt in 2013 and by simulation in 2030 (% of GDP)

		2013	base	ser-eq+fg	ser-eq+db	ser-eq+tx	mdg-eq+fg	mdg-eq+tx
Receipts	Taxes	9.7	10.8	10.7	10.6	12.5	10.7	16.9
	Foreign transfers	4.0	4.0	5.4	4.2	4.0	8.6	4.0
	Domestic borrowing	1.4	1.4	1.4	4.4	1.4	1.4	1.4
	Foreign borrowing	1.5	1.5	1.5	1.5	1.5	1.4	1.5
	Total	16.6	17.7	19.0	20.8	19.4	22.1	23.7
Spending	Education	4.0	4.5	4.4	4.7	4.5	4.4	4.5
	Health	2.5	2.8	4.3	5.0	4.5	7.7	8.9
	Infrastructure	2.9	2.9	2.9	3.0	2.9	2.8	3.0
	Other services	4.8	5.2	5.1	5.2	5.1	5.0	5.0
	Domestic transfers	1.6	1.6	1.6	1.7	1.6	1.5	1.6
	Interest	0.8	0.8	0.8	1.2	0.8	0.7	0.8
	Total	16.6	17.7	19.0	20.8	19.4	22.1	23.7
Debt	Domestic	20.2	19.2	19.0	39.7	19.2	18.5	19.2
	Foreign	30.1	29.9	29.2	31.1	29.7	27.8	29.3

Table A3.4. Balance of payments in 2013 and by simulation in 2030 (% of GDP)

		2013	base	ser-eq+fg	ser-eq+db	ser-eq+tx	mdg-eq+fg	mdg-eq+tx
Outflows	Imports	38.2	38.5	38.4	37.5	38.0	38.1	36.8
	Factor income to RoW	4.6	4.6	4.6	5.2	4.6	4.4	4.4
	Net interest income to RoW	0.4	0.4	0.4	0.4	0.4	0.4	0.4
	Total	43.2	43.5	43.3	43.1	42.9	42.9	41.7
Inflows	Exports	23.2	23.5	22.3	22.4	23.1	19.5	22.1
	Private transfers from RoW	13.0	13.0	12.7	13.5	12.9	12.1	12.7
	Official transfers from RoW	4.0	4.0	5.4	4.2	4.0	8.6	4.0
	Government borrowing	1.5	1.5	1.5	1.5	1.5	1.4	1.5
	FDI	1.5	1.5	1.4	1.5	1.5	1.4	1.5
	Total	43.2	43.5	43.3	43.1	42.9	42.9	41.7

Table A3.5. MDG indicators in 2013 and by simulation in 2030

	2013	base	ser-eq+fg	ser-eq+db	ser-eq+tx	mdg-eq+fg	mdg-eq+tx
MDG 1: rural poverty rate (%)	47.9	17.8	17.3	19.2	18.3	16.8	20.0
MDG 1: urban poverty rate (%)	27.0	8.7	8.5	9.6	9.1	8.1	10.1
MDG 4: rural U5MR (‰)	93.3	61.4	56.1	56.1	56.1	52.4	52.4
MDG 4: urban U5MR (‰)	71.9	52.4	52.4	52.4	52.4	52.1	53.1
MDG 7: rural water access (%)	61.5	82.5	82.9	81.0	82.0	83.4	80.4
MDG 7: urban water access (%)	88.4	96.6	96.8	96.1	96.5	97.0	95.9
MDG 7: rural sanitation access (%)	34.4	49.2	49.5	47.9	48.7	50.0	47.4
MDG 7: urban sanitation access (%)	50.7	69.3	69.9	67.6	68.7	70.8	66.8

Note: Columns other than 2013 show simulated values in 2030.

Table A3.6. Sectoral GDP shares and urban population share in 2013 and by simulation in 2030 (%)

	2013	base	ser-eq+fg	ser-eq+db	ser-eq+tx	mdg-eq+fg	mdg-eq+tx
Agriculture	23.5	18.8	18.5	18.3	18.5	17.7	18.0
Industry	25.5	26.8	26.6	26.0	26.5	26.2	26.1
Services - private	42.1	44.9	44.6	45.1	44.4	44.1	43.3
Services - government	9.0	9.6	10.4	10.7	10.5	12.0	12.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Urban population share	27.8	29.1	29.2	29.3	29.2	29.5	29.3