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World Food Prices and Human Development

Policy Simulations for Archetype Low-Income Countries

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Abstract

In recent years, world food prices have increased and fluctuated widely. This paper explores the impact of international food prices and domestic policies on Millennium Development Goal (MDG) and macro indicators for two archetype low-income countries, a net food exporter and a net food importer, using Maquette for MDG Simulations (MAMS), a Computable General Equilibrium model. The simulations, which cover the period 2011–2025, indicate that the size of positive (negative) effects on macro and MDG indicators of a food export (import) price increase depend on the initial gross domestic product share for food exports (imports), leaving countries that are heavily involved in international food trade more exposed to international shocks. Given relatively low elasticity estimates, the impact of changes in food prices on undernourishment are relatively marginal. Flexible responses (in terms of production shares, whether output is exported or sold at home, and whether domestic demanders buy imports or domestic output) enable countries to benefit from or be less hurt by price changes. The case for policy responses to higher import prices is stronger for the net food importer. An untargeted food subsidy, financed by taxes or spending cuts, reduces undernourishment at the cost of a slight deterioration for most other indicators. By contrast, aid-financed food subsidies neutralize the negative impact of higher import prices whereas financing via domestic borrowing is counterproductive, leading to a deterioration across all indicators. If administered at moderate costs, tax-financed targeted transfers more effectively reduce headcount poverty and inequality with macroeconomic repercussions similar to those of tax-financed subsidies.

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World food prices and human development:
Policy simulations for archetype low-income countries

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1. INTRODUCTION AND CONTEXT[1]

In recent years, world food prices have increased and fluctuated widely. This may have serious consequences for the achievement of Millennium Development Goals (MDGs) as food prices are linked to the broader economy through a wide range of channels: nutrition, trade, production, consumption and the government budget. These impacts are likely to vary across countries and household groups, depending on structural features. For a country, they depend in part on whether the country is a net exporter or a net importer of food. For households, the effects depend on the consequences of world food prices changes for incomes and for prices of the full set of goods and services in their consumption baskets, with food items having a particularly strong link to nutrition outcomes.

This paper explores how structural features, domestic policy responses, and foreign aid together condition the impact of world food prices on MDGs and other economic indicators in low-income countries (LICs). In terms of method, we employ MAMS, a CGE model developed at the World Bank for analysis of medium- to long-run country strategies, including strategies aimed at improving MDG outcomes.[2] Given the focus of this analysis, MAMS has here been extended to cover undernourishment. MAMS is applied to an archetype LIC database with two variants that differ in terms of trade structure, a net food exporter and a net food importer. The simulations, which cover the period 2009-2025, address the consequences of changes in world food (processed and unprocessed) price changes for MDGs and other indicators, as well as how domestic policy responses (subsidies and transfer schemes) may mitigate negative repercussions, with additional financing mobilized from alternative sources (domestic taxes, domestic borrowing, and foreign grant aid).

In outline, we proceed as follows. Section 2 describes the model structure and the database, while Section 3 presents the simulations and analyzes their results. The main conclusions are summarized in Section 4. Appendices 1 and 2 provide additional details on the database and the simulation results, respectively.

2. MODEL STRUCTURE AND DATABASE

MAMS is a dynamic Computable General Equilibrium (CGE) model designed for country-level analysis of medium- and long-run development policies, including strategies for reducing

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[2] For more on MAMS, visit www.worldbank.org/mams

poverty and achieving the Millennium Development Goals (MDGs). Compared to other CGE models, MAMS is distinguished by its coverage of human development, including MDGs, education and its link to the labor force and its educational make-up, as well as the interaction of human development with other aspects of economic policy and performance. In MAMS, government spending is disaggregated by function, singling out spending on education (disaggregated by level), health, and infrastructure, and other areas. Government financing is disaggregated into different types of taxes, domestic and foreign borrowing, and foreign grant aid. MAMS generates a wide range of measure of economic performance including the evolution of

- poverty and selected other MDG indicators, in this application also including undernourishment;
- macro indicators: private and government consumption and investment, exports, imports, GDP and absorption; [3] the government budget, the balance of payments; the savings-investment balance; total factor productivity; and domestic and foreign debt stocks;
- the sectoral structure of production, employment, incomes, and trade;
- the labor market: unemployment; and the educational composition of the labor force.

This section provides a non-technical summary of MAMS, split into two modules – core, and MDG and education – and its LIC database, developed for this application.[4]

Core module

Figure 2.1 summarizes the payment flows that are captured by MAMS for the model country, here referred to as the LIC, in any single simulation year. In any application, including the current one, most of the payments flows and boxes shown in Figure 2.1 are further disaggregated; we present the current disaggregation later in this section. Activities produce, selling their output at home or abroad, and use their revenues to cover their costs (of intermediate inputs, factors, and taxes). Their decisions to pursue particular activities and employ factors are driven by profit maximization. The shares exported and sold domestically depend on the relative prices of their outputs in world and domestic markets.

MAMS includes three core institutions: households, government, and the rest of the world. Households 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.[5] 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

[3] Absorption is defined as total domestic final demand, i.e. the sum of household and government consumption and investment. Starting from the 1993 revision of the System of National Accounts (SNA), absorption is referred to as "gross national expenditure" although the latter term does not yet seem to be widely used.
[4] For a detailed presentation of MAMS, see Lofgren et al. (2012).
[5] 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.

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, transfers from abroad, and domestic and foreign borrowing; it uses these for consumption, transfers to households, and investments (providing the capital stocks required for activities producing government services). 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 or more types in order to finance its spending plans.

The rest of the world (which appears in the balance of payments) sends foreign currency to LIC in the form of transfers to 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 of payments is in surplus or deficit.[6]

Private investment financing is provided from domestic private savings (net of lending to the government) and foreign direct investment (FDI). For the domestic component, either private savings must adjust to private investment (which, if so, follows some other rule, for example being fixed as a share of GDP or absorption; a case of investment-driven savings) or vice versa (a case of savings-driven investment).

In domestic commodity markets, flexible prices ensure balance between demands for domestic output from domestic demanders and supplies to the domestic market from domestic producers. Domestic demanders decide on the shares of imports and domestic production in their demands on the basis of the relative prices of commodities from these two sources. Similarly, as already noted, 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.[7] Import demanders and export suppliers face exogenous world prices – the LIC is viewed as a small country in world markets without any impact on the international prices that it faces.

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

[6] 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 response, the exchange rate (expressed in local currency units per unit of foreign currency) would decline, reducing the local-currency price of exports and imports relative to domestic outputs in the same sectors, i.e. an appreciation of the real exchange rate. This relative price change would encourage domestic producers to switch part of their outputs from exports to domestic sales and induce domestic demanders to switch part of their demands from domestic sources to imports. This process would continue until the balance of payments surplus is eliminated. The opposite would happen in the case of a balance of payments deficit.

[7] In this LIC application, refined petroleum product has no domestic production; all of domestic demand is satisfied via imports – the presence of such products reduces economic flexibility.

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 2.2; its wage curve assumes a minimum unemployment rate of 5%). Unemployment is defined more broadly than in official statistics to include un- and under-employment. In the simulations, a broad definition of unemployment increases the scope for the existing labor force to generate a larger (smaller) amount of effective labor if the incentives to work were to improve (deteriorate) without any change in the labor-force participation rate; in most developing country contexts, this seems realistic. For non-labor factors, the supply curves are typically vertical.

The above discussion did not refer to the evolution of the economy over time. In MAMS, the economy grows over time due to accumulation of capital (determined by investment and depreciation), labor (determined by demography and the educational system), and other factors (following exogenous growth trends), as well as because of improvements in total factor productivity (TFP). Apart from an exogenous component, TFP depends on the levels of government capital stocks.[8] In the context of factor markets, these developments lead to rightward shifts in both demand and supply curves.

MDG and education module

MAMS includes a set of HD (MDG and education) indicators. A built-in poverty module computes the three standard Foster-Green-Thorbecke poverty indicators (headcount poverty, poverty gap, and severity of poverty) on the basis of the assumption 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.[9] The prevalence of undernourishment (the share of the population that does not satisfy its dietary energy requirements, i.e. suffer from calorie poverty) is computed on the basis of similar assumptions and data (per-capita calorie consumption, a Gini coefficient for calorie consumption, and an initial rate of undernourishment). However, in the absence of more

[8] In Appendix 1 (on the MAMS database), we discuss our treatment of the links between productivity and government capital stocks.

[9] 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). However, in this application, some of the simulations (especially the targeted transfer schemes) invalidate the assumption of an unchanged distribution. To account for this, the following procedure was applied in the computation of poverty and inequality results: (1) a synthetic distribution was generated on the basis of initial rural and urban Gini coefficients; and (b) for each simulation, household consumption observations were scaled on the basis of the change in household consumption per capita for the model household to which the observation was mapped. Poverty and inequality indicators were computed from the resulting distribution. The mapping between model households and observations was possible given that the model households initially represent the top and bottom halves of the income distribution in rural and urban areas. Except for the targeted transfer simulations, this procedure had little impact on the results; however, for the targeted transfer simulations, it made a significant difference.

disaggregated data, this calorie computation is done at the national level.[10] Per-capita calorie consumption is a constant-elasticity (CE) function of per-capita real food consumption. A CE function is also used to model the link between per-capita calorie consumption and labor productivity; it is assumed that, across all production activities, an increase in average per-capita consumption raises the productivity of the segment of the labor force with less than completed secondary education (the least educated segment) across all production activities. This group of workers was singled out on the assumption that they are more likely to do physical work that is relatively energy-demanding at the same time as they also are more likely to belong to households that are calorie deprived.[11]

A different treatment is used for other MDG and education indicators: MDGs 4 (under-five mortality), 5 (maternal mortality), 7w (improved water access), 7s (improved sanitation access); net intake to first grade of primary, promotion to next grade in each of three education cycles, and continuation into next cycle (for primary and secondary). For these indicators, a two-level formulation is used. At the bottom level, an intermediate variable specific to each indicator is expressed as a CE function of a set of determinants, summarized in Table 2.1. At the top level, each MDG and education indicator is a logistic function of its intermediate variable. The parameters of these two-level functions are calibrated to replicate data on projected progress for the top-level indicators under the *base* scenario, with upper or lower limits imposed on the basis of logic or cross-country experience (e.g. the net intake rate has an upper limit of 100 percent; mortality rates cannot fall below some low positive value). As shown in Table 2.1, the determinants include the supply of government services (measured per student for each cycle of education and per-capita for health), the stock of government infrastructure, 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 (to reflect the fact that progress for one MDG may have a positive impact on other MDGs).[12] In the absence of cross-country data for the provision of water and sanitation services, an alternative variable, absorption per capita (an indicator of overall capacity to support the living standards of the population), is the single determinant for MDGs 7w and 7s.[13] A wage incentive indicator is a determinant specific to education; it is expressed as the ratio between the wages for labor at the next higher and current levels of education for the student in question (an indicator of payoff from continued education). From a broader perspective, the education module tracks base-year stocks of students and new entrants through the different grades of the three cycles (primary, secondary, and tertiary). In each year, students will successfully complete their grade,

[10] Given our focus on food prices, our nutritional analysis is focused on calorie undernourishment – the link between food prices, food consumption and calorie consumption is relatively direct and clear-cut. For other nutrition indicators, like wasting (weight for age) or stunting (height for age), the relationships are more long run while data on the impact of food prices and food consumption on these indicators are lacking.

[11] Empirically, the impact of changes in per-capita calorie consumption on labor productivity turned out to be negligible in the context of moderate changes in calorie consumption and plausible elasticities of labor productivity with respect to calorie consumption.

[12] Sadoulet and de Janvry (1995, p. 16) observe that absorption is a better measure of the welfare of the population than GDP, which is an indicator of the aggregate level of production.

[13] In cross-country regressions (in log form) of MDGs 7w and 7s on absorption per capita, the coefficients for the absorption variable are highly significant (at the 1 percent level), with an R2 of 0.41 and 0.39, respectively.

repeat it, or drop out of their level. A share of labor-force-age students exiting from the school system enters the labor force in the segment that matches their educational background. Similarly, a share of the non-school population (perhaps drop outs at an earlier age) that each year reaches labor force age enters the labor force, typically in its least educated segment.

Database

A typical MAMS application requires an extensive data set for the application base-year – a social accounting matrix (SAM); stocks for production factors (including different 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), to which the MAMS baseline simulation is calibrated. (See Appendix 1 for more details.)

The database for the current application was designed in light of data availability and the analytical objective of shedding light on the impact of changes in world food prices on MDGs and other major social and economic indicators in LICs. Two database variants were constructed: a LIC net food importer with trade shares that characterize a LIC that is relatively dependent on imports for its food consumption; and a LIC net food exporter that represents a country that has a relatively strong reliance on food exports. In other respects, including initial macro structure and HD, the starting points for the two archetypes are identical, facilitating comparisons between the two.

As shown in Table 2.2, the database is disaggregated into 14 production activities, each of which produces one commodity (good or service), as well as one commodity without domestic production (refined petroleum). Among the sectors, government production is represented by 8 services, covering human development, infrastructure and other areas. The factors of production are split into land (for the agricultural activities) and different types of labor and capital. Tables 2.3-2.5 summarize the macroeconomic and sectoral structure of the archetype LIC net exporter and importer economies in 2009: a macro SAM (common to both archetypes) and tables showing sector structure (in terms of value-added, production, employment, and trade) for each of the two archetypes.[14] In addition, median LIC observations were collected for a set of MAMS-relevant HD indicators.

[14] 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 2.3, 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 SAMs for this application are available on request.

The initial situation for food trade (trade in raw food from agriculture and processed food from industry) is of particular importance for the simulations in this paper. Drawing on data in Tables 2.3-2.5, for the net food exporter, exports, imports, and the trade balance for food (raw agricultural and processed industrial) represent 7.2, 4.4, and 2.8 percent of GDP, respectively; for the food net importer, the same shares are 2.8, 7.7, and -4.9 percent.[15] At a more disaggregated level, exports and imports represent only a few percent of domestic output or domestic demand for food agriculture (unprocessed food) but are more important for processed food for which the correspond shares range between 8 and 27 percent.

3. SIMULATIONS

Initially we analyze the *base* and world price shock simulations for each of the two LIC archetypes, starting with the net exporter. Given that the impact of world price shocks on the net exporter LIC are positive or only mildly negative, not warranting major domestic policy responses, we limit our domestic policy simulations to the net importer archetype, for which we address the impact of domestic subsidy and transfer policies aimed at mitigating negative effects of world price shocks.

BASE AND WORLD PRICE SHOCKS: THE CASE OF THE NET EXPORTER

The *base* scenario is designed to represent a plausible projection for an LIC economy for the period 2009-2025; it also serves as a benchmark for comparisons with alternative simulations.

For the *base* scenario (but not for the other scenarios), growth in GDP at factor cost is exogenous. The growth rate in 2010 is set at 6.3 percent, the observed aggregate rate for all LICs. Starting from 2011, we impose the average annual growth rate for the same group of countries for the period 2000-2010, 5.2 percent.[16] Other key assumptions may be summarized as follows:

- Government spending. Real government education services grow at rates that are adjusted endogenously to ensure that services per student grow at around 2-3 percent per year (close to the growth in GDP per capita). Drawing on cross-country analysis, the growth rate is 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).[17]

[15] To exemplify these calculations, the food export GDP share of 7.2 percent is the product of a total export GDP share of 22.8 percent and a food share of 31.8 in total exports.

[16] Given an annual population growth rate of 2.2 percent the per-capita average annual growth rate for 2000-2010 for the aggregate of all LICs was 3.1 percent (World Bank 2011b).

[17] 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 or factor income from

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 absorption (3.4 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 other (non-government) links to the rest of the world, FDI and net receipts of private transfers from abroad (including "worker remittances") are both fixed at the base-year share of absorption. The balance of payments clears via adjustments in the real exchange rate (as described in above Section 2).
- 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 (cf. description in Section 2).

The results for the *base* and other scenarios for the net exporter are summarized in Tables 3.1-3.3 and Figures 3.1-3.2. (Detailed distributional results are shown Table A.2.1.) Given the forward-looking nature of the analysis, we view 2011 as the starting year even though the scenarios also are simulated for 2009 and 2010; however, across all scenarios, the results are identical for these initial years. The macro results for the *base* simulation are summarized in Table 3.1. Absorption grows at 4.7 percent (2.6 percent per capita), a rate that is slower than the rate of GDP growth, indicating that, as a combined result of terms-of-trade changes and growth in non-trade balance-of-payments items, it is necessary for exports to grow more rapidly than imports, with a depreciation of the real exchange rate (at 0.7 percent per year) providing incentives for domestic demanders and suppliers to generate the required balance between export and import growth. The different parts of absorption grow at rates between 2.6 and 5.5 percent.[18] Growth in total factor productivity (TFP) is respectable, at 1.4 percent per year. Production growth is sufficient to marginally reduce the unemployment rate. Government foreign and domestic debts are roughly unchanged relative to GDP. At a more disaggregated level (see Table 3.2), sectoral growth rates vary between 4.1 and 9.1 percent per year. In terms of ranking, the highest growth rates are for private services, followed by government services (the aggregate of disaggregated services), non-food industry, and food and agriculture. Growth in government service production is relatively low for primary education and relatively high for secondary and tertiary education while other government functions grow at rates slightly above

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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.

[18] The fastest growth rate is for exports, the slowest for government investment. In MAMS, growth in government investment may be quite volatile as it is a function of the need for additional government capital, which in its turn largely depends on current and recent growth in government consumption. A better indicator of government investment for the full simulation period (less dependent on values in the initial and final years) is the growth rate for the government capital stock, which is at 5.5 percent per year.

the aggregate GDP growth rate. Except for the fact that government services are non-traded, the ranking between sectors for export growth is similar to the GDP growth ranking. Import growth is most rapid for petroleum and most slow for agriculture. The HD indicators all improve (Table 3.3), with the most striking improvement for headcount poverty, the rate of which falls from 48 to 32 percent.[19] Calorie intake increases moderately, from 2159 to 2252 calories per capita and day, leading to a decline in the prevalence of undernourishment by 4.5 percentage points.

The other simulations in Table 3.1 explore the impact of a gradual doubling of international prices of agricultural and processed food products, with increases of 26 percent in 2012-2014 for the prices of both exports and imports (*pw+*), only exports (*pwe+*) and only imports (*pwm+*). Starting from 2015, prices remain doubled relative to their 2009 levels. Apart from the shocks and policy changes that are specific to each simulation (discussed below), the assumptions for the non-*base* simulations are, with two exceptions, identical to those of the *base* simulation. The two exceptions are: (1) The savings-investment rule: for all non-*base* scenarios, domestic private investment is determined by available savings (savings-driven investment) instead of being fixed as a share of absorption (the *base* assumption); and (2) Rules for selected non-trade foreign exchange payments -- foreign grant aid, net private transfers from abroad, and foreign direct investment: for all non-*base* scenarios, these are exogenous in foreign currency instead of being fixed shares of absorption (the *base* assumption). Change 1 is introduced to ensure that private investment responds to changes in domestic growth and other conditions that influence the level of private savings. Change 2 is introduced to avoid automatic and typically unrealistic responses in these inflows to changes in domestic economic growth and the foreign exchange rate. The definitions of parameters related to 1 and 2 draw on the results of the *base* simulation so as to ensure that the changes in non-*base* scenarios results are due to the shocks that are introduced, not due to the changes in these rules.

Turning to the results of the non-*base* simulations, increases in both export and import prices (*pw+*) bring about a 0.6 percentage point increase in annual GDP growth. As a consequence of the terms of trade gain, the real exchange rate appreciates while imports expand at a much faster rate than exports, permitting an acceleration in annual absorption growth of 1.1 percentage points. Among the components of absorption, the growth acceleration is weakest for government consumption and government investment since government consumption suffers from a relative price increase due to its large non-tradable component (a consequence of real exchange rate appreciation) and, for government investment, given that it is driven by growth in government consumption and the resulting production of government services. Unemployment declines significantly. The GDP shares for the two debt stocks decline strongly (in spite of unchanged borrowing) thanks to more rapid GDP growth (for both stocks) and appreciation (only for the foreign debt stock). These strong gains are in part brought about by adjustments in production and trade structure in response to these changes in international market conditions. The acceleration in value-added growth is particularly strong for the agricultural and processed food sectors while export growth is biased in favor of and import

[19] The primary gross enrollment rate declines from over enrollment to enrollment slightly below 100 percent.

growth against these sectors (Table 3.2). The different HD indicators register across-the-board improvements, including an additional decline of 6.8 percentage points for headcount poverty and 1.6 percentage points for the prevalence of undernourishment. Calorie consumption per capita is also around 1.6 percent higher in 2025 than for *base*. At a more disaggregated level, per-capita food consumption grows more rapidly than under the *base* for all four household groups.

As expected, the simulated improvements are stronger (albeit moderately so) for the simulation *pwe+* since the international price increases here are limited to the exports of the country. Compared to *pw+*, absorption growth accelerates by 0.3 percentage points per year and growth in GDP at factor cost by 0.1 percentage points. The main change in production and trade structure is more rapid growth for food imports, reflecting the fact that the incentives to avoid food imports are weaker (the latter due to appreciation and lower world prices for imported food). The performance of HD indicators is more positive in general due to slightly stronger growth. For undernourishment, this outcome is reinforced by lower prices for imported food.

On the other hand, if international price increases instead only affect imported food items (*pwm+*), the consequences are negative across the board: slower growth in production, domestic absorption, and weaker improvements for MDGs and education (see Tables 3.1-3.3). However, as a result of the relatively weak reliance on food imports for this archetype, the negative effects are quite minor; for example, while absorption growth accelerates by 1.1 percentage points for *pwe+* the deceleration is a mere 0.3 percentage points for *pwm+*. Similar observations can be made with respect to poverty and other indicators.

Figures 3.1 and 3.2 summarize the changes for the net exporter in terms of macro and human development indicators. Per-capita growth in GDP and absorption of around 3 percent per year for the *base* scenario increase to around 4 percent when the country is exposed to a positive terms-of-trade shock (*pw+* and *pwe+*) but decrease slightly when the shock is negative (*pwm+*). The changes are larger for absorption since terms-of-trade effects augment the changes in GDP growth; for example, ceteris paribus, for any given levels of GDP and exports, higher export prices translate into capacity to increase imports, adding to absorption. The more positive the terms-of-trade shock, the stronger the positive impact on human development. Accordingly, the strongest and weakest performances of MDG indicators are registered for *pwe+* and *pwm+*, respectively.

With respect to the government, the results that emerge from this aggregate perspective suggest that, unless the increase in world prices is limited to food imports, food price changes do not impose any obvious need for additional government actions in support of the HD of the population, including its nutritional status. Also for the case of increased food import prices, the negative repercussions are very moderate. However, depending on country and local specifics, some household groups may fall between the cracks even when aggregate developments are positive, gaining little from income increases while facing higher food prices. To provide an extreme example, households that rely heavily on migrant remittances would face the same

price increases at the same time as they see their incomes decrease (due to exchange rate appreciation) unless their relatives abroad increase their transfers (in foreign currency) on the basis of the conditions in the LIC. Households relying on transfer payments from the government may be similarly disadvantaged.

BASE AND WORLD PRICE SHOCKS: THE CASE OF THE NET IMPORTER

The results for the *base* and the world price shock scenarios for the net importer archetype are summarized in Tables 3.4-3.6 and Figures 3.3-3.4. (For distributional results, see Table A.2.2.) The assumptions are the same as for the net exporter (including the key assumptions, discussed above). The *base* results are very similar to those of the net exporter. Compared to the *base*, for the scenario with increases both in export and import prices (*pw+*), the net importer archetype suffers minor growth losses in GDP, absorption and disaggregated final domestic final demands as opposed to gains for the net exporter. The magnitude of the negative impact is kept in check by domestic responses in food supply and demand, most importantly reduced growth rates for domestic demand and imports, replaced by food output that is reallocated from exports to the domestic market, accompanied by some efficiency losses since the ability of the economy to bring about a transformation of output between different destinations is imperfect (due to quality differences). By 2014, these changes have together led to a switch to being a net exporter food due to the fact that higher import prices simultaneously encourage food production (both for import substitution and exports, encouraged by exchange rate depreciation) while discouraging food consumption, especially of imports.[20] MDG and education outcomes also register declines compared to the *base* outcome in 2025; for example, the 2025 rates for headcount poverty and undernourishment increase by 0.2 and 0.5 percentage points, respectively.

As expected, the scenario with world food price increases limited to food exports (*pwe+*) brings about gains across all highlighted indicators, including increases in annual growth rates of GDP and domestic final demand items by 0.2-0.6 percentage points compared to the preceding scenario (*pw+*). In the food sector, the major difference is that imports grow more rapidly as they now are available at lower prices.

The scenario with world prices increases limited to imports (*pwm+*) brings about a more significant negative impact on development for the net importer archetype. Relative to the *base*, annual growth in GDP declines by 0.2 percentage points per year, while the growth declines for domestic final demands are stronger with an average of 0.6 percentage points as the economy has to make up for its terms-of-trade loss by reducing the real trade deficit. Other consequences include more unemployment, an increase in headcount poverty of above 4

[20] The changes in sectoral GDP shares in response to this doubling in world food and agriculture prices are not dramatic. Under the *base* scenario, total GDP share for agriculture and food declines from 27 percent in 2011 to 25 percent in 2025; under *pw+*, this decline is reversed as the GDP shares of these sectors instead increase to 29 percent by 2025.

percentage points by 2025, a 1.7 percentage point increase in the prevalence of undernourishment as well as weakened performance for other HD indicators. Per-capita calorie consumption in 2025 is 1.6 percent lower than for the *base*, at 2219 calories, a moderate change.

Figures 3.3 and 3.4 compare the impact of the different world price scenarios on macro aggregates and HD, confirming the above observations and highlighting the fact that, for the scenarios *pwe+* and *pwm+*, the changes are stronger for absorption growth than for GDP growth. The figures also underline the fact that the changes are quite moderate for *pw+* but stronger for *pwe+* and *pwm+*, especially the latter.

Figure 3.5 compares MDG outcomes for the net exporter and the net importer, for each showing the changes in MDG outcomes in 2025 for the scenario with increased import prices (*pwm+*) relative to the *base*; in the graph, the values for MDGs 2, 7w, and 7s refer to relative declines in the rates of primary net completion, water access, and sanitation access, respectively. While all indicators deteriorate due to the import price increase, the percent deterioration in each indicator in 2025 compared to the *base* is invariably more severe for the net importer, suggesting that the urgency of domestic policy responses is stronger for this archetype. Given this, the subsequent simulations, which explore domestic policy responses to increased import prices (as for *pwm+*), are limited to the net importer archetype.

POLICY RESPONSES TO HIGHER FOOD IMPORT PRICES

Table 3.7 defines the simulations that address policy responses to an increase in import prices for the net importer archetype. Two kinds of policy responses are considered:

- An untargeted subsidy on processed food that keeps the year-to-year evolution of prices of processed food for domestic demanders the same as under the *base* scenario. In alternative scenarios, the additional government financing that is needed is generated by increases in domestic direct tax rates (*sub+tax*), foreign grant aid (*sub+aid*), domestic government borrowing (*sub+bor*) or cuts in government spending on services and infrastructure except for investments in agricultural infrastructure (*sub+spnd*); and
- Government transfers targeted to the bottom half of the income distribution in both rural and urban areas, financed by the same tax rate increase as for the above *sub+tax* scenario. It is not unlikely that such a transfer program will give rise to administrative costs. To test the sensitivity of the impact of the transfer program to such costs, we implement the transfer program in two scenarios, first without and after this with an expansion of the government administration (*trn+tax* and *trn+tax2*).

The policy responses are introduced in 2012; i.e., the results for all simulations (*base*, *pwm+* and policy simulations) are the same up to and including 2011. The results for this set of simulations are summarized in Tables 3.8-3.11 and Figures 3.5-3.8. (For distributional results, see Table A.2.2.) For the first scenario, *sub+tax*, the subsidy required to keep processed food

prices at the *base* levels is at 5.3 percent of GDP in 2025 (after peaking in 2014 at 5.7 percent; Table 3.11). Not surprisingly, the direct tax increase needed to cover this additional expense is similar in magnitude, in 2025 representing more than a quadrupling in the GDP share of direct taxes (from 1.5 to 6.5 percent of GDP).[21] Among macro indicators, the repercussions of this policy change include a small decline for absorption growth (of 0.1 percentage points), no decline for private consumption (the latter is encouraged by the food subsidies), slightly larger declines for the other final demands (of 0.3 percentage points; Table 3.8). Among the sectors, output of processed food production increases most strongly, benefitting from a subsidy-driven increase in domestic demand. Agriculture is also boosted marginally while other sectors face slightly lower growth rates. The repercussions are favorable for unemployment, poverty, and undernourishment but marginally unfavorable for other HD indicators. While the subsidy policy manages to bring about a decline in undernourishment, the 2025 undernourishment rate is still 0.9 percentage points higher than for the *base* because of the negative broader repercussions of higher taxes.

In the next simulation (*sub+aid*), these negative repercussions are avoided as the country, instead of taxing its population, manages to mobilize an increase in foreign grant aid to cover additional financing needs. At the macro level, this aid-financed subsidy program eliminates all significant impacts of higher food import prices – the growth rates for GDP, absorption, and disaggregated final demands differ very little from the *base* simulation. The only noteworthy change is an increased real exchange rate appreciation (by around 0.5 percentage points per year, a consequence of the increased inflow of foreign currency), bringing about slower export growth and accelerated non-food imports while food import growth slows down due to the world price increase (as domestic demanders in part shift toward domestic food). As a share of GDP, foreign grant aid is at 9.4 percent in 2025 (as opposed to around 4 percent for the other scenarios), after having peaked at 9.9 percent in 2016. As a result of unchanged processed food prices and little change throughout the economy, HD indicators, including undernourishment, are also all virtually the same as for the *base*.

As an alternative to taxes or grant aid, additional financing for the subsidy program may be furnished by domestic government borrowing (*sub+bor*). Compared to the other domestic alternative – tax financing (*sub+tax*) – the repercussions are much more negative. Increased domestic government borrowing cuts financing of domestic private investment, reducing its annual growth rate from 4.1 to 0.1 percent, with a negative impact on growth in GDP and absorption (both by around 1 percentage point), as well as other domestic final demands. The policy intervention is counterproductive in terms of its nutrition objective since, as a result of the different indirect effects, the prevalence of undernourishment in 2025 ends up being slightly higher than for *pwm+*. At the same time, other HD indicators deteriorate across the board. Moreover, in 2025, the domestic government debt has climbed above 78.5 of GDP as compared to 19-22 percent of GDP for all other scenarios.

[21] An increase in direct taxes may be relatively non-distortionary compared to an increase in indirect tax rates, if the latter involve large differentials between sector rates.

Instead of creating the fiscal space needed for the subsidy by raising its receipts, the government may alternatively reduce spending in other areas. For the scenario *sub+spnd*, the government budget is balanced via scaled-down growth in all areas of government spending except for food subsidies, household transfers and investment in agriculture. Compared to *sub+tax*, the main macro difference is that the *sub+spnd* simulation raises private final demands while government demands decline. The GDP and absorption growth rates are virtually identical for the two simulations. The fact that GDP growth for the two scenarios is almost identical indicates that the gain from more rapid private investment growth and capital accumulation is counterbalanced by productivity losses stemming from less public investment, especially in public infrastructure. In the HD area, the growth acceleration compared to *sub+tax* primarily benefits high-income households (Table A2.2), leaving the headcount poverty rate unchanged but leads to weaker performance for other HD indicators, indicating that higher aggregate private consumption does not make up for slower growth in targeted government services.[22] In the real world, the net difference between these two simulations in terms of impact on non-poverty HD indicators is likely to be context-specific, depending on the details of the changes in both government and private spending.[23]

The second set of simulations considers an alternative policy response: instead of using subsidies to protect households from the negative repercussions of higher food prices, governments may instead design transfer programs targeted at low-income households, perhaps also conditional on other actions such as school attendance or participation in health programs. In the last two simulations (*trn+tax* and *trn+tax2*), the tax rate increases are the same as for the simulation *sub+tax* but, instead of allocating them to an untargeted food subsidy, they are transferred to the bottom half of the income distribution in rural and urban areas. Relative to food subsidies, such a transfer program may be relatively demanding of administrative resources. To explore the potential role of administrative costs the simulation *trn+tax* assumes that the transfer program can be handled by the existing government administration while *trn+tax2* imposes an additional demand for government services that corresponds to 25 percent of the cost of the transfer program during its first three years (2012-2014) after which the cost declines to 20 percent in the fourth year (2015) and is limited to 15 percent starting from 2016.[24]

Using *sub+tax* as the comparator, the growth rates for GDP and absorption for the first transfer simulation (*trn+tax*, without transactions costs) decline very marginally. The two driving forces behind this decline (albeit a moderate one) are (a) a decline in household savings and private investment as the transfer program involves a redistribution of income from (high-income) households with relatively high savings rates to (low-income) households with relatively low

[22] The undernourishment rate, which is computed assuming that the distribution is unchanged, declines slightly for *sub+spnd* compared to *sub+tax*; however, this may be misleading since consumption distribution becomes less equally distributed.

[23] The outcome would be more positive for a scenario in which government spending reductions to a larger extent target relatively unproductive government functions, in the context of MAMS this would translate into spending cuts in areas other than HD and infrastructure.

[24] These percentages are based on Caldes et al. (2006).

savings rates; and (b) a less labor-intensive demand pattern under the transfer scheme than under food subsidies, leading to downward pressure on unemployment (and lower wage growth). The difference between low- and high-income household savings rates is a stylized fact of development economics that also is reflected in our archetype LIC.[25] It is also plausible that a transfer scheme of this type, which encourages increased production of commodities with relatively high-income elasticities, is less labor-intensive than a scheme that encourages food demand.[26] On the other hand, the transfer program reaches its objective of benefitting low-income households. Compared to *sub+tax*, the growth rates for real per-capita consumption are 1.2-1.4 percentage points higher for rural and urban low-income households and 0.5 percentage points lower for high-income households in both regions, reducing aggregate Gini inequality to 0.34 from around 0.38-0.40 for all non-transfer scenarios. Among the HD indicators, the head count poverty rate in 2025 is 9 percentage points lower than for *sub+tax*, a significant change, while undernourishment increases and other indicators do not change by much.[27]

The final simulation, *trn+tax2*, imposes the tax-financed transfer scheme with the above-mentioned administrative costs, reducing the amount of money that can be transferred. Compared to *trn+tax*, the main difference in the government budget is more government consumption, imposing a reduction in transfers to low-income households that, in 2025 throughout most of the simulation period amounts to around 0.6 percent of GDP. There are virtually no differences in aggregate growth rates except for slightly more rapid consumption growth for the government (to handle program administration) and slightly less rapid growth for low-income households (since the transfers that they receive are lower), leading to a marginally higher Gini coefficient. However, if transactions costs were significantly higher, the distributional consequences of the transfer scheme would also be more significantly weakened. This points to the importance of considering administrative costs and means of keeping them in check when transfer schemes are considered. This observation also applies to untargeted food subsidies since they typically also impose administrative costs.

Figures 3.6-3.8 compare selected MDG outcomes for the policy scenarios to the scenario with the same increase in food import prices but without any policy response (*pwm+*). For MDG 1 (headcount poverty; Figure 3.6), the scenarios with targeted transfers dominate. Among the food subsidy scenarios, financing from grant aid dominates as it does not require either higher

[25] In the net importer archetype database, the base-year savings rates (average and marginal) are considerably lower for rural and urban low-income households (6.6 and 1.8 percent, respectively) than for high-income households (with rates of 12.5 and 16.4 percent for the rural and urban high-income households, respectively).
[26] To verify that the growth difference between the *trn+tax* and *sub+tax* scenarios is driven by these two differences (in savings and labor-intensity, the two scenarios were rerun with alternative assumptions for savings (scaling of household savings rates so that the private investment share in absorption is the same as under the *base* scenario) and a fixed (base-year) unemployment rates for the full simulation period. When these two changes were combined, the growth and absorption outcomes for the two scenarios were practically identical.
[27] However, these results are based on national relationships that do not consider likely positive effects of income redistribution on undernourishment and the other HDs as low-income households with relatively low HD are in a better position to buy goods and services food or other) and make other decisions (like reducing child labor), all of which may have high marginal HD returns.

taxes or spending cuts – the results for this scenario are virtually identical to the *base*. By 2015, borrowing-financed subsidies (*sub+bor*) have brought about a fairly strong reduction in poverty but by 2025, poverty has increased as the negative impact of borrowing on domestic private investment makes itself felt. Financing via spending cuts (*sub+spnd*) or taxes (*sub+tax*) have similar impacts on poverty. The main difference between the two is that *sub+spnd* permits more rapid private investment growth while *sub+tax* permits more rapid growth in growth-promoting government services. The absolute and relative impacts of these two scenarios depend on the details and various trade-offs are at work. For example, spending cuts focused on unproductive spending would lead to less poverty; while higher direct taxes for high-income households do not distort relative prices, they reduce growth via the savings – private-investment channel. For MDG 1u (rate of undernourishment; Figure 3.7), the food subsidy scenario does better than the transfer scenarios; among the food subsidy scenarios, the ranking is similar, including a long-run negative effect also on this MDG if the subsidy is financed via domestic borrowing; the only exception if borrowing-financed subsidies, which are counterproductive, raising undernourishment. MDG 4 (under-five mortality rate; Figure 3.8) increases most strongly if government spending is cut or if subsidies are financed by borrowing; only the aid-financed subsidy scenario reduces the rate significantly.

In sum, these results suggest that governments that prioritize MDG achievements may do best protecting vulnerable households via targeted transfers (as long as this can be done with moderate administrative costs); in order to avoid increased undernourishment, they may also consider targeted food subsidies (as opposed to the untargeted subsidies that are simulated here), perhaps as a complement to transfers, possibly administered in conjunction with a transfer system. If transfers and administrative targeting are not feasible, then untargeted food subsidies can reduce the negative impact of world price shocks on nutrition. The impact on nutrition and the broader economic consequences are more positive it the subsidies can be financed with taxes that protect private investment or vulnerable households and/or with spending cuts that are focused on relatively low-priority areas.

4. MAIN CONCLUSIONS

This paper presents a set of simulations aimed at exploring how structural features, domestic policy responses, and foreign aid together condition the medium- to long-run impact of world food prices on MDGs and other economic indicators in two archetype low-income countries (LICs), a net food exporter and a net food importer.

For the net food exporter, the main findings are that a doubling of world food prices has a positive impact unless the price increases are limited to its food imports. The impacts on the macro level and for MDGs are all positive, including reduced undernourishment. At a more disaggregated level, the different types of factor incomes grow more rapidly and the different household groups (urban and rural, both divided into upper and lower income) are all better off. If the price increases are limited to imports, then the impact is negative but relatively limited, given a small import share for food. Unless the increase in world prices is limited to

food imports, these price shocks do not generate any obvious need for government additional actions in support of the HD of the population, including its nutritional status. However, depending on country-specifics, some groups may fall between the cracks, gaining little from income increases while facing higher food prices, in which case there may be a case for targeted government actions.

For the food net importer, the over-all directions of change in response to the same set of world price changes are the same as for the food net exporter when world price increases are limited to exported or imported food; however, the effects are less positive or more negative. For the scenario with world price increases for both exported and imported food items, the impact is negative, i.e. the direction of change is reversed compared to the net food exporter, even though the effects are still quite moderate as the country adjusts its production and demand structure in response to changed incentives for suppliers and demanders.

Given more negative effects, the case for policy responses in response to higher import prices is stronger for the net food importer. Among such policy responses, an untargeted tax-financed subsidy of processed food achieves its objective of insulating the domestic consumers from international price increases at the cost of a general but slight deterioration in economic performance, as a result leaving the economy slightly worse off than under the scenario with increased import prices, with a slight reduction in undernourishment as the main exception. The macroeconomic repercussions are similar if the food subsidy is financed by broad cuts in government spending but much more positive if they are financed with foreign grant aid: in the latter case, the increase in world food prices is fully neutralized. By contrast, the introduction of a food subsidy program financed by domestic government borrowing is counterproductive, as it by 2025 will lead to less encouraging outcomes across all indicators, including nutrition and a drastic increase in the domestic government debt relative to GDP. Finally, if they are well-targeted and administered at moderate costs, tax-financed transfer programs hold the promise of more effectively reaching social and distributional objectives by significantly reducing headcount poverty and inequality albeit with macroeconomic repercussions that are slightly negative but very close to those of the scenarios with food subsidies financed by domestic tax increases or broad spending cuts.

The fact that, also for the net food importer, the medium- and long-run impacts of higher food prices for imports still are quite moderate reflects the combined impact of moderate international trade shares (limiting the macro impact of world price changes), other changes brought about during a period of economic growth, and structural economic flexibility: in response to changes in economic incentives, significant adjustments occur in growth rates for production (underpinned by factor reallocations), exports, domestic sales, imports and domestic demand. In fact, one implicit lesson of this analysis is that, in the medium- to long run, economic flexibility can play an important role by dampening the impact of initially unfavorable changes in the international arena. Given this, in addition to protecting vulnerable groups from short-term negative effects, it is important for governments to pursue medium- to long-run actions that contribute to the development of institutions, infrastructures, and a labor force

that have the capacity to adjust in response to a changing economic and technological environment.

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APPENDIX 1: BUILDING A MAMS DATABASE

As noted in Section 2, 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 steps followed when building the database for this application and cite some of the data and their sources.[28]

Like other CGE models, MAMS is calibrated so that its base-year solution exactly replicates the base-year SAM. MAMS is typically 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.

The main inputs into the construction of a detailed LIC SAM with the disaggregation shown in Table 3.1 (a square matrix with 59 accounts) were (a) an existing detailed SAM for a low-income country (Uganda); (b) a macro SAM for a median LIC during the period 2005-2009 – see Table 3.2; 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 disaggregated exports and imports, drawing on the United Nations commodity trade (ComTrade) data, the LICs were split into two groups depending on whether they during the period 2005-2009 were net exporters or net importers of food (raw agricultural and processed industrial); medians for disaggregated export and import data were computed for each country group.[29] For the estimation of balanced SAMs for the net exporter and net importer, an entropy program was applied (Robinson et al. 2001). Both of these SAMs draw on the original LIC SAM and replicate the macro SAM and other structural data. The only differences between the net exporter and the net importer stem from the differences in trade shares, which have some effects on the rest of each SAM, most importantly translating into larger domestic food demands for the net importer.

[28] Lofgren (2012) includes more suggestions on data sources and steps that may be followed.

[29] ComTrade data is available for the period 1980-2009 for some 130 countries and 784 products (the SITC Rev. 2 Classification at the 4-digit level).

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). [30] 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). [31]

With regard to undernourishment, the required information – the rate of calorie poverty, and the Gini coefficient of calorie consumption and per-capita calorie consumption, all at the national level – are based on medians for LICs according to recent FAO data (FAO 2010). On the basis of LIC cross-country data from the same source, the elasticity of calorie consumption with respect to real food consumption was estimated at 0.17.

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) 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). 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 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.

[30] 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).

[31] Israel Osorio-Rodarte extracted the rural and urban poverty data from the I2D2 database.

Finally, this MAMS application includes links between growth in total factor productivity 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 2007, p. 65), the productivity parameters were defined to generate internal rates of return of 17-18 percent for government investment in these areas.

Figure 2.1. Summary of MAMS payment flows in a single year.

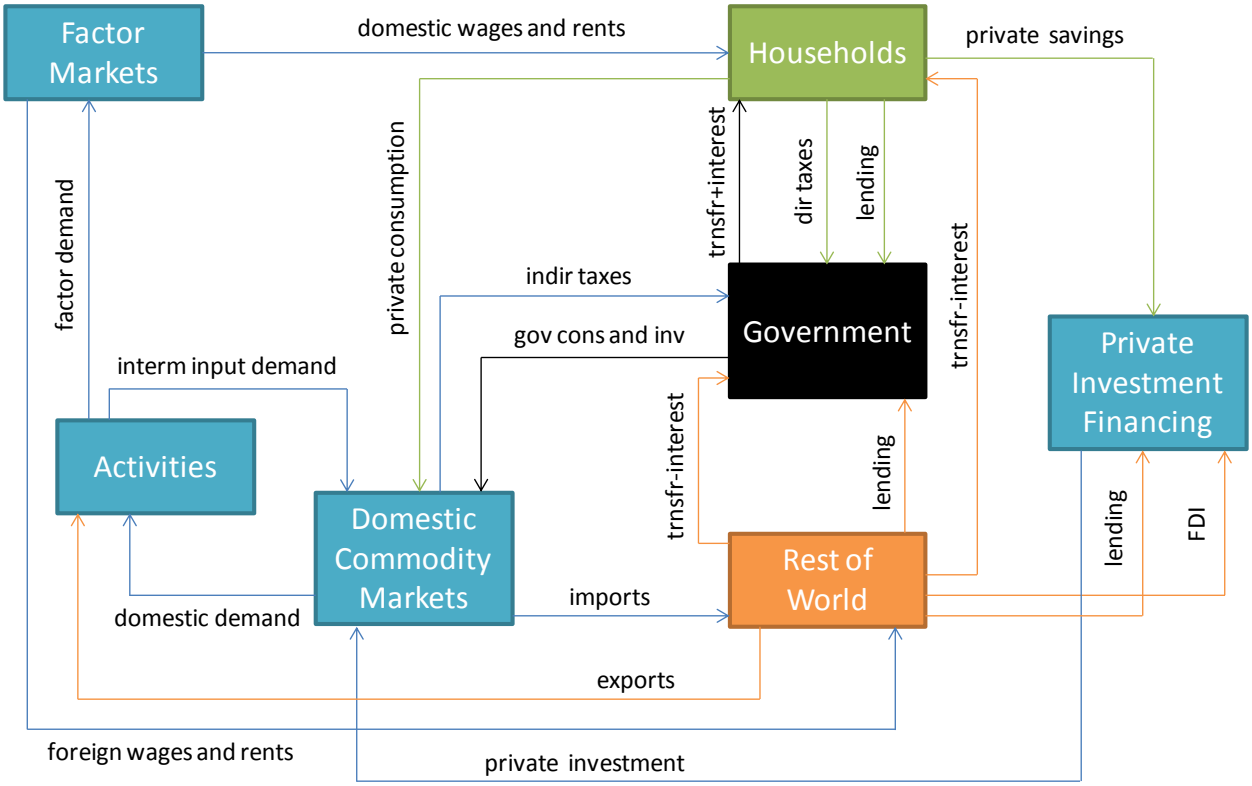
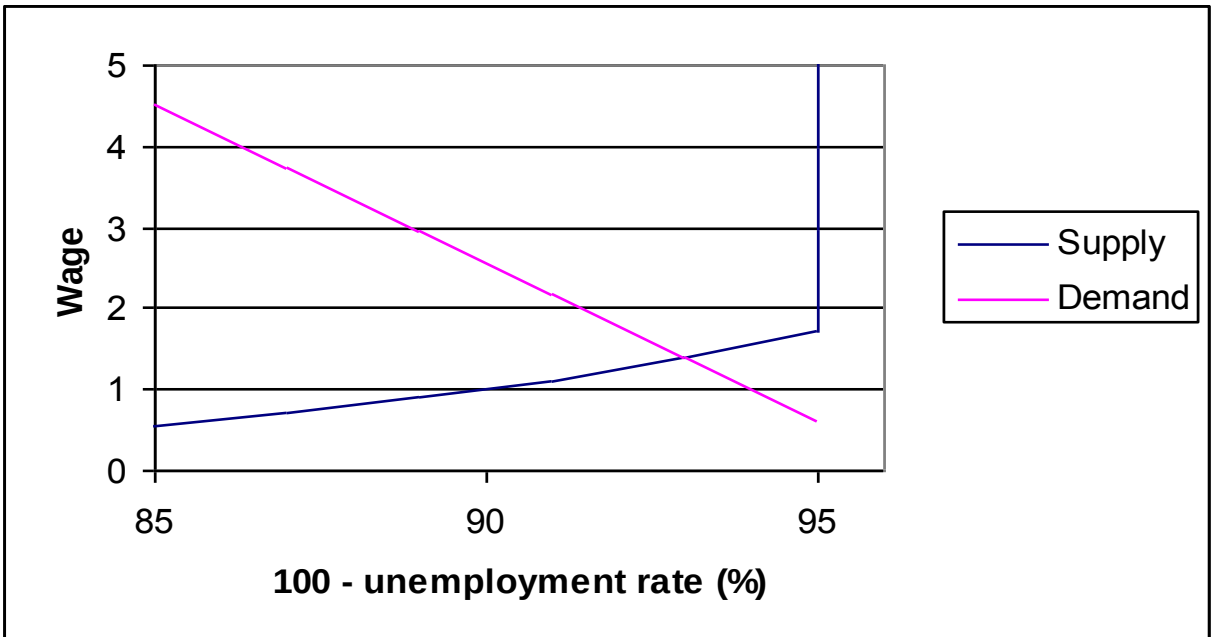


Figure 2.2. Factor market with endogenous unemployment.



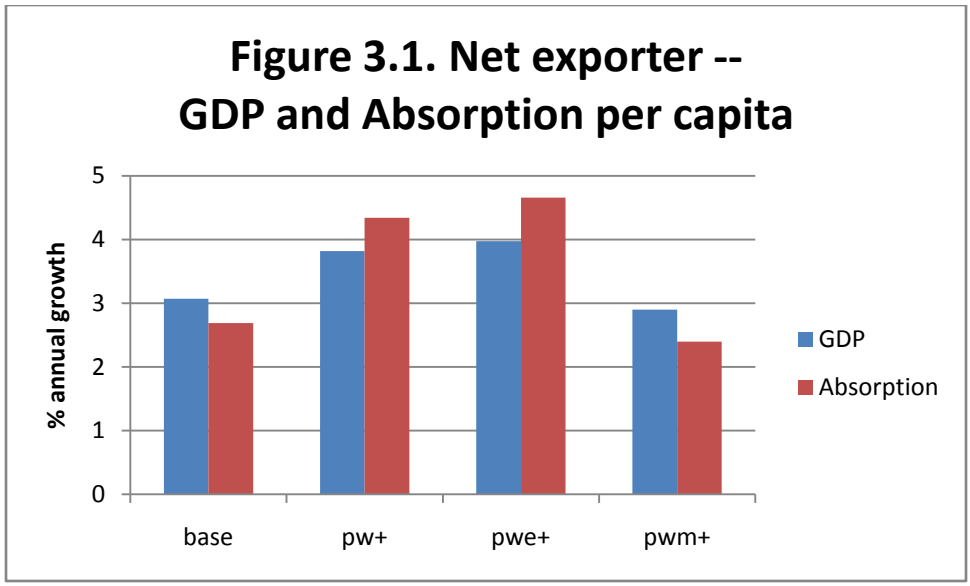


Figure 3.1. Net exporter --
GDP and Absorption per capita
% annual growth
5
4
3
2
1
0
base
pw+
pwe+
pwm+
GDP
Absorption

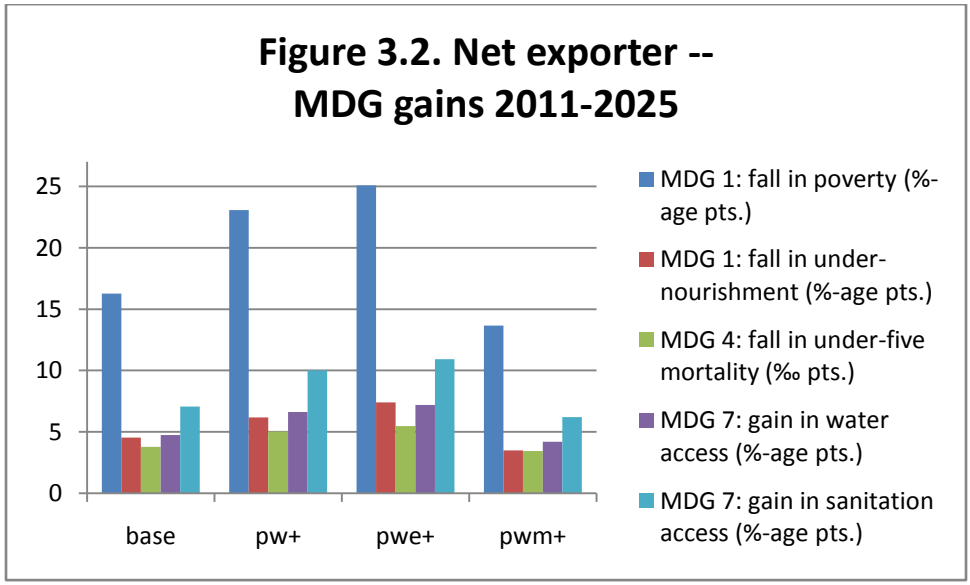


Figure 3.2. Net exporter --
MDG gains 2011-2025
25
20
15
10
5
0
base
pw+
pwe+
pwm+
MDG 1: fall in poverty (%-age pts.)
MDG 1: fall in under-nourishment (%-age pts.)
MDG 4: fall in under-five mortality (‰ pts.)
MDG 7: gain in water access (%-age pts.)
MDG 7: gain in sanitation access (%-age pts.)

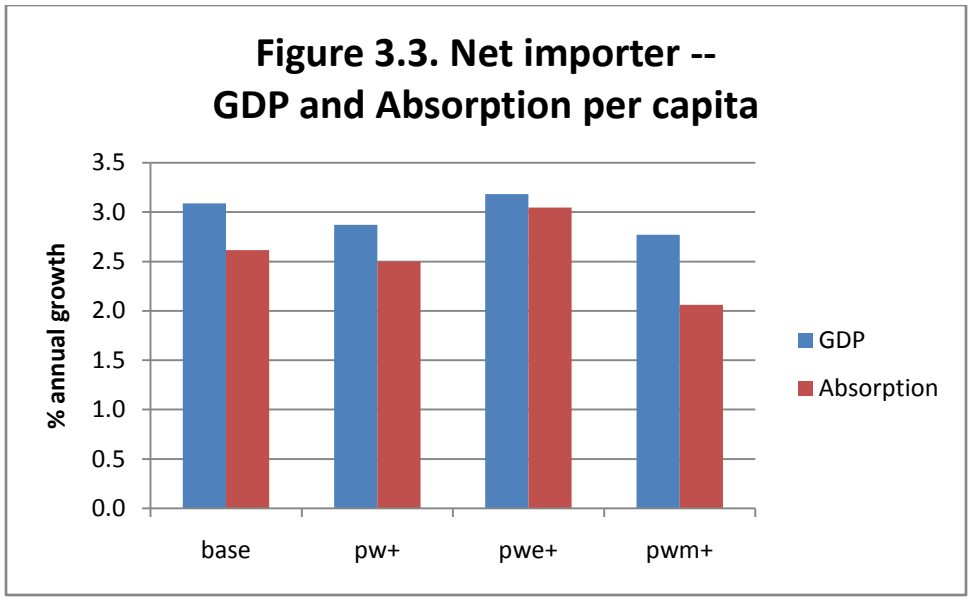


Figure 3.3. Net importer --
GDP and Absorption per capita
% annual growth
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
base
pw+
pwe+
pwm+
GDP
Absorption

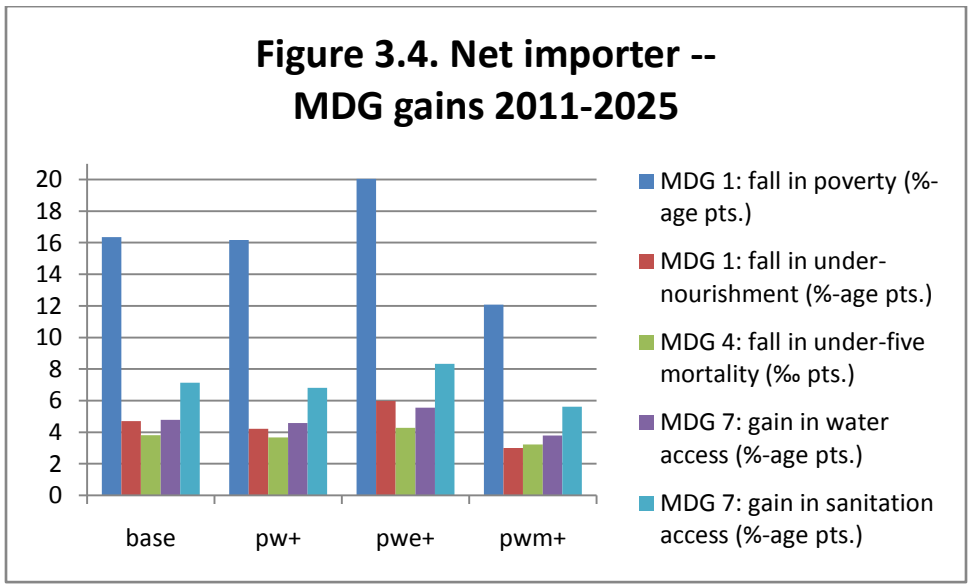
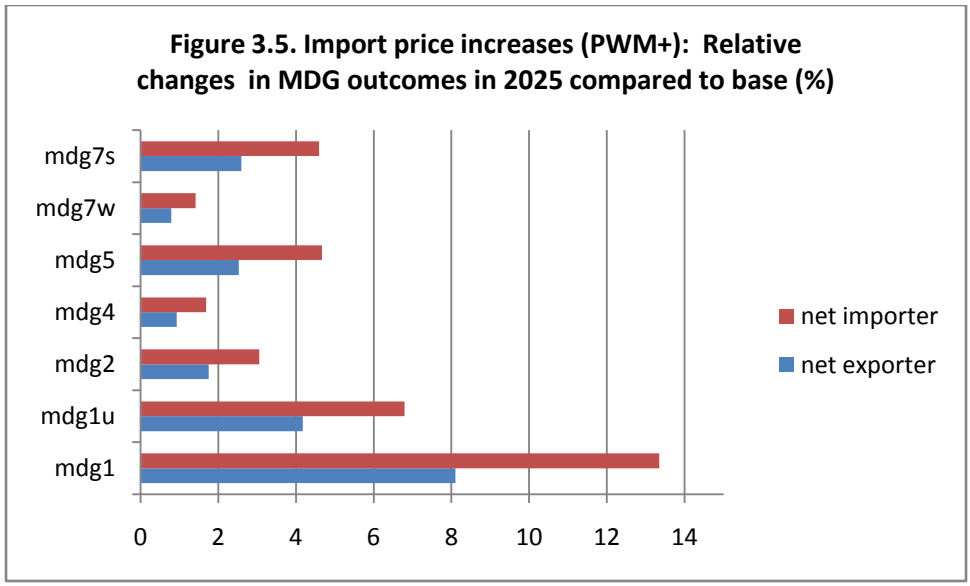


Figure 3.4. Net importer --
MDG gains 2011-2025
20
18
16
14
12
10
8
6
4
2
0
base
pw+
pwe+
pwm+
MDG 1: fall in poverty (%-age pts.)
MDG 1: fall in under-nourishment (%-age pts.)
MDG 4: fall in under-five mortality (‰ pts.)
MDG 7: gain in water access (%-age pts.)
MDG 7: gain in sanitation access (%-age pts.)



Note: The values for MDGs 2, 7w, and 7s refer to relative declines in the rates of primary net completion, water access, and sanitation access, respectively.

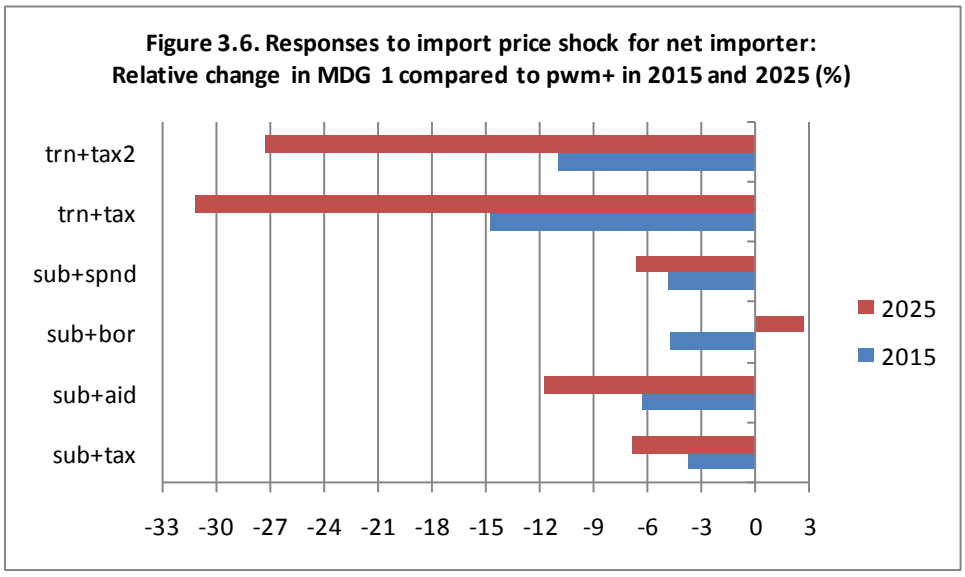


Figure 3.7: Responses to import price shock for net importer: Relative changes in MDG1u compared to pwm+ in 2015 and 2025 (%)

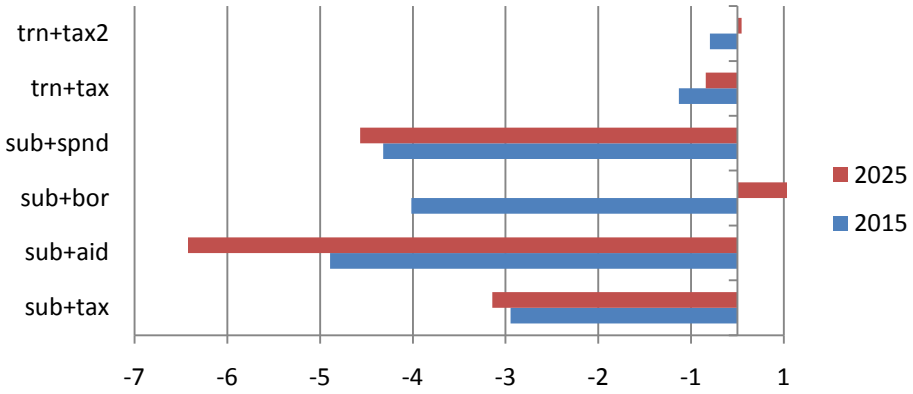


Figure 3.8. Responses import price shock for net importer: Relative changes in MDG 4 compared to pwm+ in 2015 and 2025 (%)

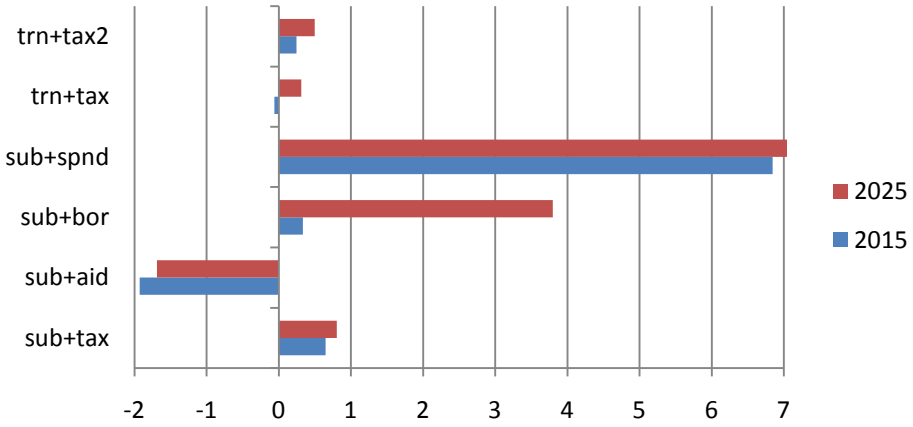


Table 2.1. Determinants of selected MDG outcomes

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

Note: Service delivery refers to services in the relevant area (primary education, health, water, or sanitation).

Table 2.2. Disaggregation of MAMS LIC archetype database

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

Table 2.3. Macro SAM for archetype LIC (% of GDP)

	act	com	fac	hhd	gov	row	tax-dir	tax-imp	tax-act	int-dom	int-row	cap-hhd	cap-gov	cap-row	inv-prv	inv-gov	dstk	total
act		97.4																97.4
com				85.7	8.3	22.8									13.6	6.5	0.5	137.3
fac	91.9																	91.9
hhd			91.9		0.6	7.2				0.4								100.1
gov						3.9	2.1	2.6	5.5									14.1
row		37.3	0.04								0.4							37.8
tax-dir				2.1														2.1
tax-imp		2.6																2.6
tax-act	5.5																	5.5
int-dom					0.4													0.4
int-row					0.4													0.4
cap-hhd				12.3														12.3
cap-gov					4.3							1.1		1.1				6.5
cap-row						3.9												3.9
inv-prv												10.7		2.9				13.6
inv-gov													6.5					6.5
dstk												0.5						0.5
total	97.4	137.3	91.9	100.1	14.1	37.8	2.1	2.6	5.5	0.4	0.4	12.3	6.5	3.9	13.6	6.5	0.5	

Table 2.4. Trade and production structure of net exporter

	Share (%) in national					Export share (%) in domestic sector supply	Import share (%) in domestic sector demand
	Value-added	Gross output	Employ-ment	Exports	Imports		
Food agriculture	22.8	16.3	43.4	1.8	0.9	1.4	1.2
Other agriculture	9.1	5.6	15.9	2.3	0.1	5.2	0.6
Food industry	4.8	14.3	1.7	30.0	10.8	26.6	18.2
Other industry	15.1	21.8	5.9	28.9	55.6	16.8	39.8
Primary education	1.5	0.8	0.9				
Secondary education	0.4	0.2	0.0				
Tertiary education	0.4	0.2	0.0				
Health	1.0	0.6	0.2				
Agricultural infrastructure	0.1	0.0	0.0				
Other public infrastructure	0.3	0.2	0.1				
Transfer administration	0.0	0.0	0.0				
Other government	5.5	4.1	1.4				
Transportation services	15.7	13.3	15.9	14.3	15.8	13.7	22.3
Other private services	23.5	22.6	14.5	22.7	11.0	12.8	10.4
Refined petroleum					5.8		100.0
Total	100.0	100.0	100.0	100.0	100.0		

Table 2.5. Trade and production structure of net importer

	Share (%) in national					Export share (%) in domestic sector supply	Import share (%) in domestic sector demand
	Value-added	Gross output	Employ-ment	Exports	Imports		
Food agriculture	22.8	16.1	43.4	3.8	1.2	3.0	1.7
Other agriculture	9.1	5.6	16.0	4.5	0.1	10.1	0.7
Food industry	4.8	13.4	1.6	8.7	19.4	8.2	24.9
Other industry	15.1	24.1	6.2	48.6	48.8	25.6	37.4
Primary education	1.5	0.8	0.9				
Secondary education	0.4	0.2	0.0				
Tertiary education	0.4	0.2	0.0				
Health	1.0	0.6	0.2				
Agricultural infrastructure	0.1	0.0	0.0				
Other public infrastructure	0.3	0.2	0.1				
Transfer administration	0.0	0.0	0.0				
Other government	5.5	4.1	1.4				
Transportation services	15.7	13.0	15.8	13.4	15.2	13.0	21.8
Other private services	23.4	21.6	14.3	21.0	10.2	12.4	10.1
Refined petroleum					5.0		100.0
Total	100.0	100.0	100.0	100.0	100.0		

Table 3.1. Net exporter LIC: Macro results for world price simulations

	2011*	base	pw+	pwe+	pwm+
		average annual real growth 2012-2025 (%)			
Absorption per capita (index)		2.6	3.7	4.0	2.3
Absorption	113.8	4.7	5.8	6.2	4.4
Consumption - private	83.2	4.8	6.0	6.3	4.5
Consumption - government	8.2	5.5	6.0	6.1	5.4
Fixed investment - private	13.5	4.8	6.2	6.5	4.5
Fixed investment - government	9.0	2.6	3.8	4.0	2.4
Exports	24.9	6.0	6.5	6.7	5.9
Imports	38.7	4.3	6.8	7.3	3.8
GDP at market prices	100.0	5.2	5.6	5.8	5.0
GDP at factor cost	90.7	5.2	5.9	6.0	5.1
Total factor employment (index)	100.0	3.8	4.2	4.3	3.7
Total factor productivity (index)	100.0	1.4	1.7	1.7	1.4
Real exchange rate (index)	100.0	0.7	-2.3	-2.3	0.7
		value in in 2025			
Unemployment rate (%)	19.8	19.1	15.9	15.2	20.0
Foreign government debt (% of GDP)	31.1	34.3	20.2	19.6	35.1
Domestic government debt (% of GDP)	20.5	20.4	17.3	16.5	21.6

***Unit for 2011 column is % of GDP (unless otherwise noted)**

Table 3.2. Net exporter: Sector results for world price simulations (% annual growth)

	2011*	base	pw+	pwe+	pwm+
Value-added					
Food agriculture	22.2	4.1	5.6	5.7	4.1
Other agriculture	8.9	4.7	5.8	5.9	4.6
Food industry	4.8	4.6	8.3	8.3	4.9
Other industry	15.8	5.6	4.8	5.0	5.3
Primary education	1.4	4.2	4.4	4.5	4.1
Secondary education	0.4	6.6	7.0	7.1	6.6
Tertiary education	0.3	9.1	9.5	9.5	9.0
Health	1.0	5.6	5.8	5.9	5.5
Agricultural infrastructure	0.1	5.5	6.4	6.5	5.4
Other public infrastructure	0.3	5.5	6.4	6.5	5.4
Transfer administration	0.0	0.0	0.0	0.0	0.0
Other government	5.4	5.5	5.9	6.0	5.3
Transportation services	15.9	5.5	5.8	6.0	5.3
Other private services	23.4	6.0	6.1	6.3	5.8
Total	100.0	5.2	5.8	6.0	5.1
Exports					
Food agriculture	1.7	4.1	6.9	6.9	4.1
Other agriculture	2.2	4.7	2.4	2.5	4.7
Food industry	29.6	5.0	10.7	10.8	5.1
Other industry	29.3	6.4	3.0	3.3	6.2
Transportation services	14.2	6.1	4.1	4.3	5.9
Other private services	22.9	6.9	4.4	4.6	6.7
Total	100.0	6.0	6.5	6.6	5.9
Imports					
Food agriculture	0.8	3.7	4.9	7.2	1.5
Other agriculture	0.1	3.6	8.4	8.6	3.5
Food industry	10.2	3.8	2.8	6.8	0.1
Other industry	56.9	4.4	7.0	7.3	4.1
Transportation services	15.4	4.1	7.4	7.6	3.9
Other private services	10.5	4.2	7.6	7.9	3.9
Refined petroleum	6.1	5.3	6.5	6.8	5.0
Total	100.0	4.3	6.8	7.3	3.8

***2011 column shows percent of total in each category (value-added, exports, and imports).**

Table 3.3. Net exporter: Human development results for world price simulations

	2011	base	pw+	pwe+	pwm+
MDG 1 -- headcount poverty (%)	48.4	32.1	25.3	23.3	34.7
MDG 1 -- undernourishment rate (%)	29.5	25.0	23.4	22.2	26.0
MDG 2 -- primary net completion rate (%)	15.3	19.1	20.4	20.8	18.8
MDG 4 -- under-five mortality rate (‰)	106.3	82.9	80.4	79.7	83.6
MDG 5 -- maternal mortality rate (per 100,000)	466.9	345.4	322.8	317.5	354.1
MDG 7 -- improved water access (%)	66.2	70.9	72.8	73.4	70.4
MDG 7 -- improved sanitation access (%)	26.3	33.3	36.3	37.2	32.5
Gross enrollment rate -- primary (%)	104.7	97.8	98.0	98.1	97.8
Gross enrollment rate -- secondary (%)	35.9	46.5	47.7	48.1	46.2
Gross enrollment rate -- tertiary (%)	3.0	5.9	6.2	6.3	5.8
Gross completion rate -- primary (%)	64.2	68.3	69.4	69.8	68.0
Gross completion rate -- secondary (%)	14.3	23.9	24.9	25.3	23.6
Gross completion rate -- tertiary (%)	1.3	2.5	2.7	2.7	2.4
Calories per capita and day ('000)	2.159	2.252	2.288	2.317	2.229

Table 3.4. Net importer: Macro results for world price simulations

	2011*	base	pw+	pwe+	pwm+
		average annual real growth 2012-2025 (%)			
Absorption per capita (index)		2.6	2.5	3.0	2.1
Absorption	113.8	4.7	4.6	5.2	4.2
Consumption - private	83.1	4.8	4.7	5.3	4.2
Consumption - government	8.2	5.5	5.5	5.6	5.3
Fixed investment - private	13.5	4.9	4.7	5.2	4.4
Fixed investment - government	9.0	2.6	2.5	2.9	2.3
Exports	24.7	6.1	5.6	5.8	5.9
Imports	38.5	4.4	4.3	5.2	3.4
GDP at market prices	100.0	5.2	5.0	5.3	4.9
GDP at factor cost	90.6	5.2	5.2	5.4	5.0
Total factor employment (index)	100.0	3.9	3.8	4.0	3.7
Total factor productivity (index)	100.0	1.4	1.4	1.4	1.3
Real exchange rate (index)	100.0	0.5	-0.4	-0.4	0.6
		value in 2025			
Unemployment rate (%)	19.8	19.1	18.8	17.4	20.8
Foreign government debt (% of GDP)	30.9	33.1	29.5	28.0	35.0
Domestic government debt (% of GDP)	20.4	20.4	20.7	18.9	22.6

***Unit for 2011 column is % of GDP (unless otherwise noted)**

Table 3.5. Net importer: Sector results for world price simulations (% annual growth)

	2011*	base	pw+	pwe+	pwm+
Value-added					
Food agriculture	22.1	4.0	4.8	4.9	4.0
Other agriculture	9.0	4.7	4.8	4.9	4.5
Food industry	4.7	4.4	6.4	6.1	4.9
Other industry	16.0	5.7	4.6	5.0	5.4
Primary education	1.4	4.2	4.1	4.3	4.0
Secondary education	0.4	6.7	6.6	6.8	6.5
Tertiary education	0.3	9.1	9.1	9.2	9.0
Health	1.0	5.5	5.5	5.6	5.4
Agricultural infrastructure	0.1	5.6	5.6	5.8	5.5
Other public infrastructure	0.3	5.6	5.6	5.8	5.5
Transfer administration	0.0	0.0	0.0	0.0	0.0
Other government	5.4	5.5	5.3	5.5	5.2
Transportation services	15.9	5.5	5.3	5.6	5.2
Other private services	23.4	6.0	5.6	6.0	5.6
Total	100.0	5.2	5.2	5.4	5.0
Exports					
Food agriculture	3.6	3.8	8.3	8.3	3.9
Other agriculture	4.3	4.5	3.6	3.6	4.5
Food industry	8.4	4.6	10.5	10.4	4.8
Other industry	49.4	6.4	4.5	4.8	6.2
Transportation services	13.2	5.9	5.0	5.3	5.7
Other private services	21.1	6.7	5.6	5.9	6.4
Total	100.0	6.1	5.6	5.8	5.9
Imports					
Food agriculture	1.2	3.7	2.6	4.9	1.5
Other agriculture	0.1	3.9	5.2	5.5	3.5
Food industry	18.4	4.1	1.1	4.9	0.4
Other industry	50.3	4.4	4.8	5.3	4.0
Transportation services	14.8	4.3	4.9	5.3	3.9
Other private services	9.8	4.4	5.0	5.5	3.8
Refined petroleum	5.3	5.3	5.3	5.7	4.9
Total	100.0	4.4	4.3	5.2	3.4

***2011 column shows percent of total in each category (value-added, exports, and imports).**

Table 3.6. Net importer: Human development results for world price simulations

	2011	base	pw+	pwe+	pwm+
MDG 1 -- headcount poverty (%)	48.4	32.0	32.2	28.3	36.3
MDG 1 -- undernourishment rate (%)	29.5	24.9	25.3	23.6	26.5
MDG 2 -- primary net completion rate (%)	15.3	19.2	19.0	19.6	18.6
MDG 4 -- under-five mortality rate (‰)	106.3	82.8	83.1	81.8	84.2
MDG 5 -- maternal mortality rate (per 100,000)	465.9	344.4	347.6	334.3	360.5
MDG 7 -- improved water access (%)	66.2	71.0	70.8	71.8	70.0
MDG 7 -- improved sanitation access (%)	26.3	33.4	33.1	34.6	31.9
Gross enrollment rate -- primary (%)	104.7	97.8	97.8	97.9	97.7
Gross enrollment rate -- secondary (%)	35.9	46.5	46.4	47.0	45.9
Gross enrollment rate -- tertiary (%)	3.0	5.9	5.9	6.1	5.8
Gross completion rate -- primary (%)	64.2	68.3	68.2	68.7	67.7
Gross completion rate -- secondary (%)	14.3	23.9	23.8	24.4	23.4
Gross completion rate -- tertiary (%)	1.3	2.5	2.5	2.6	2.4
Calories per capita and day ('000)	2.159	2.255	2.244	2.284	2.219

Table 3.7. Definitions of policy simulations for net importer archetype.

Name	Description
	Higher prices of imported food (raw and processed) combined with …
sub+tax	untargeted processed food price subsidy; financing from taxes
sub+aid	untargeted processed food price subsidy; financing from foreign grant aid
sub+bor	untargeted processed food price subsidy; financing from domestic borrowing
sub+spnd	untargeted processed food price subsidy; financing from spending cuts
trn+tax	transfers to low-income households without administrative cost; financing from taxes
trn+tax2	transfers to low-income households with administrative cost; financing from taxes

Table 3.8. Net importer: Macro results for policy simulations

	2011*	pwm+	sub+tax	sub+aid	sub+bor	sub+spnd	trn+tax	trn+tax2
		average annual real growth 2012-2025 (%)						
Absorption per capita (index)		2.1	2.0	2.6	1.0	1.9	1.9	1.9
Absorption	113.8	4.2	4.1	4.7	3.1	4.0	4.1	4.1
Consumption - private	83.1	4.2	4.2	4.8	3.6	4.5	4.1	4.1
Consumption - government	8.2	5.3	5.0	5.5	4.3	1.9	5.2	5.8
Fixed investment - private	13.5	4.4	4.1	4.9	0.1	4.6	3.9	3.9
Fixed investment - government	9.0	2.3	2.0	2.6	0.4	-1.1	2.1	2.1
Exports	24.7	5.9	5.9	5.5	4.4	5.9	5.7	5.6
Imports	38.5	3.4	3.3	4.2	2.0	3.3	3.2	3.2
GDP at market prices	100.0	4.9	4.8	5.1	3.8	4.8	4.8	4.8
GDP at factor cost	90.6	5.0	5.0	5.2	4.0	4.9	4.9	4.9
Total factor employment (index)	100.0	3.7	3.7	3.9	3.0	3.4	3.6	3.6
Total factor productivity (index)	100.0	1.3	1.3	1.4	1.0	1.5	1.3	1.3
Real exchange rate (index)	100.0	0.6	0.7	0.0	0.8	0.6	0.6	0.6
		value in 2025						
Unemployment rate (%)	19.8	20.8	19.6	18.9	22.1	19.6	20.8	20.9
Foreign government debt (% of GDP)	30.9	35.0	37.0	32.8	43.4	37.1	35.7	35.8
Domestic government debt (% of GDP)	20.4	22.6	22.3	21.6	78.5	22.7	22.5	22.6

***Unit for 2011 column is % of GDP (unless otherwise noted)**

Table 3.9. Net importer: Sector results for policy simulations (% annual growth)

	2011*	pwm+	sub+tax	sub+aid	sub+bor	sub+spnd	trn+tax	trn+tax2
Value-added								
Food agriculture	22.1	4.0	4.1	4.3	3.7	4.2	4.0	4.0
Other agriculture	9.0	4.5	4.6	4.8	4.0	4.7	4.6	4.6
Food industry	4.7	4.9	5.5	5.6	4.8	5.5	4.8	4.8
Other industry	16.0	5.4	5.2	5.2	3.3	5.1	5.1	5.1
Primary education	1.4	4.0	3.7	4.2	3.1	0.6	4.0	4.0
Secondary education	0.4	6.5	6.2	6.7	5.6	3.1	6.4	6.4
Tertiary education	0.3	9.0	8.6	9.1	8.0	5.5	8.9	8.9
Health	1.0	5.4	5.1	5.5	4.6	1.9	5.4	5.3
Agricultural infrastructure	0.1	5.5	5.3	5.7	5.0	5.6	5.4	5.4
Other public infrastructure	0.3	5.5	5.3	5.7	5.0	2.5	5.4	5.4
Transfer administration	0.0	0.0	0.0	0.0	0.0	0.0	0.0	69.8
Other government	5.4	5.2	5.0	5.4	4.0	3.2	5.1	5.1
Transportation services	15.9	5.2	5.1	5.4	3.9	5.3	5.1	5.0
Other private services	23.4	5.6	5.4	5.8	4.5	5.7	5.3	5.3
Total	100.0	5.0	5.0	5.2	4.0	4.9	4.9	4.9
Exports								
Food agriculture	3.6	3.9	4.1	3.6	4.3	4.0	4.0	4.0
Other agriculture	4.3	4.5	4.6	4.1	4.7	4.6	4.7	4.6
Food industry	8.4	4.8	5.8	5.3	5.3	5.7	4.9	4.8
Other industry	49.4	6.2	6.0	5.5	3.9	5.8	5.9	5.8
Transportation services	13.2	5.7	5.6	5.5	4.0	5.7	5.6	5.5
Other private services	21.1	6.4	6.3	6.2	5.3	6.5	6.2	6.1
Total	100.0	5.9	5.9	5.5	4.4	5.9	5.7	5.6
Imports								
Food agriculture	1.2	1.5	1.6	2.2	0.8	1.8	1.5	1.4
Other agriculture	0.1	3.5	3.6	4.6	2.2	3.8	3.6	3.5
Food industry	18.4	0.4	0.5	1.4	-0.2	0.7	0.2	0.2
Other industry	50.3	4.0	3.8	4.7	2.0	3.7	3.8	3.7
Transportation services	14.8	3.9	3.8	4.7	3.0	4.0	3.8	3.8
Other private services	9.8	3.8	3.7	4.8	2.7	3.9	3.6	3.5
Refined petroleum	5.3	4.9	4.8	5.3	3.8	4.9	4.8	4.8
Total	100.0	3.4	3.3	4.2	2.0	3.3	3.2	3.2

***2011 column shows percent of total in each category (value-added, exports, and imports).**

Table 3.10. Net importer: Human development results for policy simulations

	2011	pwm+	sub+tax	sub+aid	sub+bor	sub+spnd	trn+tax	trn+tax2
MDG 1 -- headcount poverty (%)	48.4	36.3	33.8	32.0	37.3	33.9	25.0	26.4
MDG 1 -- undernourishment rate (%)	29.5	26.5	25.8	25.0	26.7	25.5	26.4	26.6
MDG 2 -- primary net completion rate (%)	15.3	18.6	18.3	19.1	17.5	16.4	18.5	18.4
MDG 4 -- under-five mortality rate (‰)	106.3	84.2	84.9	82.8	87.4	94.0	84.5	84.6
MDG 5 -- maternal mortality rate (per 100,000)	465.9	360.5	362.7	344.6	402.9	365.5	364.3	364.5
MDG 7 -- improved water access (%)	66.2	70.0	69.9	71.0	68.1	69.7	69.8	69.8
MDG 7 -- improved sanitation access (%)	26.3	31.9	31.7	33.4	29.0	31.5	31.6	31.6
Gross enrollment rate -- primary (%)	104.7	97.7	97.7	97.8	97.6	97.4	97.7	97.7
Gross enrollment rate -- secondary (%)	35.9	45.9	45.6	46.5	45.0	43.5	45.8	45.8
Gross enrollment rate -- tertiary (%)	3.0	5.8	5.7	5.9	5.6	5.2	5.8	5.7
Gross completion rate -- primary (%)	64.2	67.7	67.5	68.3	66.8	65.5	67.6	67.6
Gross completion rate -- secondary (%)	14.3	23.4	23.1	23.9	22.6	21.3	23.3	23.2
Gross completion rate -- tertiary (%)	1.3	2.4	2.4	2.5	2.3	2.1	2.4	2.4
Calories per capita and day ('000)	2.159	2.219	2.234	2.252	2.215	2.242	2.221	2.219

Table 3.11. Net importer: Fiscal results for policy simulations (% of GDP)

	2011	pwm+	sub+tax	sub+aid	sub+bor	sub+spnd	trn+tax	trn+tax2
Receipts								
Direct taxes	2.4	1.4	6.5	1.6	1.6	1.6	6.2	6.2
Import tariffs	2.8	2.9	3.0	2.9	3.0	3.1	2.9	2.9
Other indirect taxes	6.6	4.2	4.0	4.4	4.3	4.6	3.9	3.8
Foreign transfers	3.9	3.9	4.1	9.4	4.8	4.1	4.0	4.0
Domestic borrowing	1.4	1.6	1.6	1.6	6.8	1.6	1.6	1.6
Foreign borrowing	1.5	1.7	1.8	1.6	2.2	1.9	1.8	1.8
Total	18.6	15.8	21.1	21.5	22.7	16.8	20.3	20.3
Spending								
Primary education - current	1.4	1.0	1.0	1.1	1.0	0.7	1.0	1.0
Secondary education - current	0.4	0.5	0.5	0.5	0.5	0.3	0.5	0.5
Tertiary education - current	0.3	0.5	0.5	0.6	0.6	0.4	0.5	0.5
Health - current	1.0	1.0	1.0	1.0	1.0	0.7	1.0	1.0
Agriculture - current	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Other infrastructure - current	0.3	0.3	0.3	0.3	0.3	0.2	0.3	0.3
Transfer administration - current	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
Other government - current	4.6	4.4	4.4	4.6	4.5	2.9	4.4	4.4
Food subsidies	0.0	0.0	5.3	5.3	5.8	5.8	0.0	0.0
Domestic transfers	0.6	0.6	0.6	0.6	0.7	0.7	5.2	4.6
Domestic interest	0.4	0.5	0.4	0.4	1.6	0.5	0.5	0.5
Foreign interest	0.4	0.5	0.5	0.4	0.6	0.5	0.5	0.5
Primary education - capital	1.4	0.7	0.7	0.7	0.7	0.4	0.7	0.7
Secondary education - capital	1.1	0.5	0.5	0.6	0.5	0.3	0.6	0.6
Tertiary education - capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Health - capital	0.7	0.5	0.5	0.5	0.5	0.2	0.5	0.5
Agriculture - capital	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Other infrastructure - capital	2.1	2.0	2.0	2.1	2.0	1.1	2.0	2.0
Other government - capital	3.4	2.3	2.3	2.4	2.0	1.7	2.3	2.3
Total	18.6	15.8	21.1	21.5	22.7	16.8	20.3	20.3

Table A2.1. Net exporter: Inequality and disaggregated household consumption per capita

	2011	base	pw+	pwe+	pwm+
Gini	0.388	0.397	0.391	0.391	0.396
Households					
Rural low-income	47.9	2.3	3.5	3.8	2.0
Rural high-income	141.9	2.9	4.1	4.4	2.6
Urban low-income	47.7	1.0	2.2	2.5	0.7
Urban high-income	174.1	2.0	3.0	3.3	1.7
National average	100.0	2.7	3.8	4.2	2.4

Note: For households (a) the 2011 shows per capita consumption indexed to 100 for the national average; (b) the other columns show average annual growth in real consumption per capita 2012-2025.

Table A2.2. Net importer: Inequality and disaggregated household consumption per capita

	2011	base	pw+	pwe+	pwm+	sub+tax	sub+aid	sub+bor	sub+spnd	trn+tax	trn+tax2
Gini	0.388	0.396	0.392	0.393	0.396	0.382	0.395	0.384	0.393	0.337	0.343
Households											
Rural low-income	47.8	2.4	2.3	2.9	1.8	2.1	2.4	1.7	2.1	3.5	3.3
Rural high-income	142.2	2.9	2.8	3.5	2.3	2.4	2.9	1.6	2.6	1.9	1.9
Urban low-income	47.6	1.1	1.1	1.6	0.6	0.9	1.1	0.2	0.9	2.2	1.9
Urban high-income	173.6	2.0	1.8	2.4	1.4	1.0	2.0	0.7	1.7	0.4	0.4
National average	100.0	2.7	2.6	3.2	2.1	2.1	2.7	1.5	2.4	2.0	2.0

Note: For households (a) the 2011 shows per capita consumption indexed to 100 for the national average; (b) the other columns show average annual growth in real consumption per capita 2012-2025