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Implications of Slowing Growth in Emerging Market Economies for Hunger and Poverty in Rural Areas of Developing Countries

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Contents

Tables

Figures

ABSTRACT

Over the past 25 years, economic growth rates in many developing countries have outpaced those in industrialized countries, and per capita incomes of these two groups of countries have started to converge. Growth in developing countries contributed to a dramatic drop—from 37 percent to 13 percent—in the global extreme poverty rate between 1990 and 2012. However, the global economic outlook has deteriorated recently. This paper examines the impact of the actual and projected slowdown in the world economy since 2012 on the poor and on the potential for achievement of the Sustainable Development Goals (SDGs). It builds on the changes between 2012 and late 2015 in the International Monetary Fund's World Economic Outlook projections to provide the basic slowdown scenario. It then uses a global model to assess the impacts of lower rates of productivity growth and consequent lower savings and investment on key price and income variables. The productivity shocks are passed directly to the production activities included in household microsimulation models for almost 300,000 households. These households are also affected by the modeled changes in prices and wages. Simulations allow us to assess the impacts of the slowdown on the real household incomes of the poor, and hence on the poverty rate. The results suggest that the poorest countries will see the greatest slowdown in poverty reduction, with over 5 percent of their population projected to remain below the poverty line, and poverty rates still alarmingly high in a number of countries. Overall 38 million fewer people will leave extreme poverty compared to earlier projections. Farm households are at particular risk in middle-income countries, with over 1.5 percent more of the farming population potentially not escaping extreme poverty in these countries. By 2030, average extreme poverty in rural areas is now projected to be about 7.5 percent, rather than 7.1 percent. While substantial poverty reduction is still expected between now and 2030, a strong focus on policies for poverty reduction will be vital to achieving the first SDG goal of eliminating poverty.

Keywords: economic growth, world economy, Sustainable Development Goals (SDGs), economic slowdown, poverty reduction

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ACRONYMS

BRIC	Brazil, Russia, India, and China
CAB	current account balance
CGE	computable general equilibrium
CIS	Commonwealth of Independent States
EFTA	European Free Trade Association
GDP	gross domestic product
IMF	International Monetary Fund
MENA	Middle East and North Africa
MIRAGE	Modelling International Relations under Applied General Equilibrium
MIRAGRODEP	Modelling International Relationships under Applied General Equilibrium for AGRODEP
OECD	Organisation for Economic Co-operation and Development
OPEC	Organization of the Petroleum Exporting Countries
PPP	purchasing power parity
S0, S1, S2	Scenario 0, 1, 2
SACU	Southern African Customs Union
SDG	Sustainable development goal
TFP	total factor productivity
UN	United Nations
USD	United States dollar
WAEMU	West African Economic and Monetary Union
WEO	World Economic Outlook

1. INTRODUCTION

Since the global financial crisis that began in 2007–2008, the global economy has suffered a sustained slowdown, with growth levels frequently falling below earlier forecasts. For example, the International Monetary Fund (IMF) *World Economic Outlook* (WEO) forecast for global growth in 2015 declined from 4.8 percent in September 2011 to 3.1 percent in October 2015. For most but not all countries, recent forecasts are substantially lower than they were in more optimistic times, such as 2012. Other international organizations, such as the Organisation for Economic Co-operation and Development (OECD 2016a), have also made sizeable downward revisions to their long-run projections, with global growth expected to change quantitatively and qualitatively. This report looks at the implications for poverty of the slowing growth of advanced and emerging market economies, and particularly, how these less optimistic macroeconomic projections may affect achievement of the Sustainable Development Goals (SDGs) by 2030.

The approach taken in this study focuses on several of the key linkages between growth and the real incomes of the poor, and particularly the rural poor. In particular, it considers the impacts of: (1) lower productivity growth on the incomes of the poor, (2) changes in wage rates for unskilled workers on the incomes of the poor, (3) changes in key commodity prices on the incomes of the poor, and (4) changes in the cost of living on the incomes of the poor. By taking into account these key changes, we aim to capture the economic impacts of the decline in global, regional, and national growth rates in a way that complements the analysis in World Bank (2015). We then assess the impacts of changes in growth on the real incomes of individual households, both those arising from changes in the productivity of their own activities and those arising from changes in the prices and wage rates that they face. We then check whether these income changes result in the household rising from below the poverty line to above, or from above the poverty line to below, and use the resulting changes in the poverty headcount as an indicator of their impact on the poor. We could use measures of the poverty gap and the poverty gap squared to provide additional indicators of the impacts on the poor, but we face a plethora of results and have found from experience that these measures usually respond in ways that are similar to the poverty headcount.

In this report, we first consider the conceptual framework, focusing on the links between growth in developing countries and the real incomes of the poor. A good understanding of the ways in which the slowdown might affect people's welfare is crucial to building a cohesive analytical framework. We then describe this analytical framework: a combination of a global computable general equilibrium (CGE) model offering household disaggregation features developed by the team (MIRAGRODEP) with a systematic household modelling approach to properly identify short-term versus long-term consequences on poverty and hunger. Finally, we describe the different growth scenarios analyzed and discuss the results.

2. ECONOMIC GROWTH: TRENDS, DRIVERS, AND PROJECTIONS

Changes in growth rates in developing economies can clearly have large impacts on the welfare of poor people in rural areas. As seen during the past 15 years, during which many developing economies substantially outperformed industrial economies, rural incomes can rise rapidly and millions can move out of poverty. The projected slowdown in economic growth in many developing countries is therefore a potentially serious source of concern. However, to make any assessment of the implications of this change for the poor, we need to think very carefully about the channels through which the slowdown might affect people's welfare in different countries.

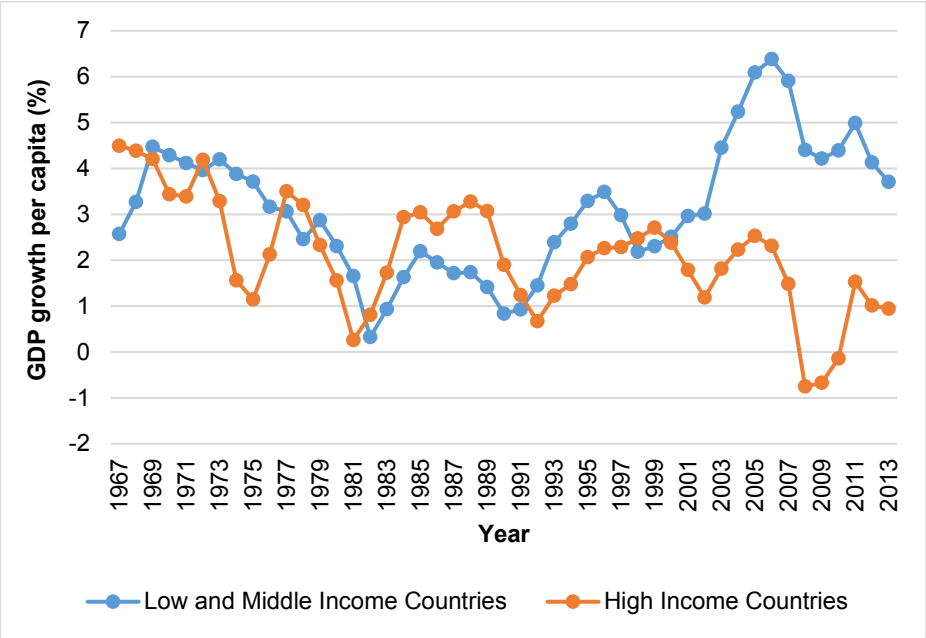
In a first subsection, we examine the recent history of economic growth in developing countries. Then we consider some key channels through which reductions in growth rates in developing countries might be expected to affect the real incomes of the poor and near-poor, and hence poverty rates. Then we review the most recent projections for growth over the next five years. Finally, we consider how we capture the impacts of the growth slowdown on poverty.

Developing Country Growth and Poverty: Recent Trends

There are good reasons to expect that poorer economies should grow faster than higher-income economies. To the extent that the most advanced economies are generally using the best available production techniques, they can only improve economic efficiency and systematically raise their incomes at the rate that the best available technology improves. By contrast, in poorer economies, it is possible to increase efficiency by catching up with the economies at the frontier, as well as by taking advantage of improvements in the best available technology. A number of initially-low-income economies have been able to increase their incomes very rapidly in this way (Lucas 1988). Quah (1995 points to a very wide range of cases in which lower-income countries or regions were able to catch up with their higher-income counterparts at a rate of around 2 percent per year. Barro and Sala-i-Martin (1992) pointed to strong convergence between US states, and Dowrick and Nguyen (1989) within the OECD set of developed economies. Ben-David (1994) pointed to convergence between countries with strong trade links.

Prior to the 1990s, however, most developing countries appeared unable to grow as rapidly as their more developed counterparts, with consequent widening of the distribution of income across countries (Lucas 1988). In the 1990s, perhaps following the extensive policy reforms in many developing countries, a pattern of higher growth in developing rather than in developed countries emerged. As shown in Figure 2.1, with the exception of the Asian crisis period, average growth rates of per capita incomes in developing countries have been substantially higher than in high-income countries—with the gap in the order of 4 percentage points during much of this period. This graph understates the outperformance of developing countries because of a composition effect—some middle-income countries with very high growth rates move into the high-income group while poor performers initially in the high-income group move into the developing country group. The great turnaround in the performance of developing countries has, justifiably, received enormous attention because of its importance in reducing poverty in developing countries, and raising the geo-political importance of the larger developing countries (O'Neill 2001).

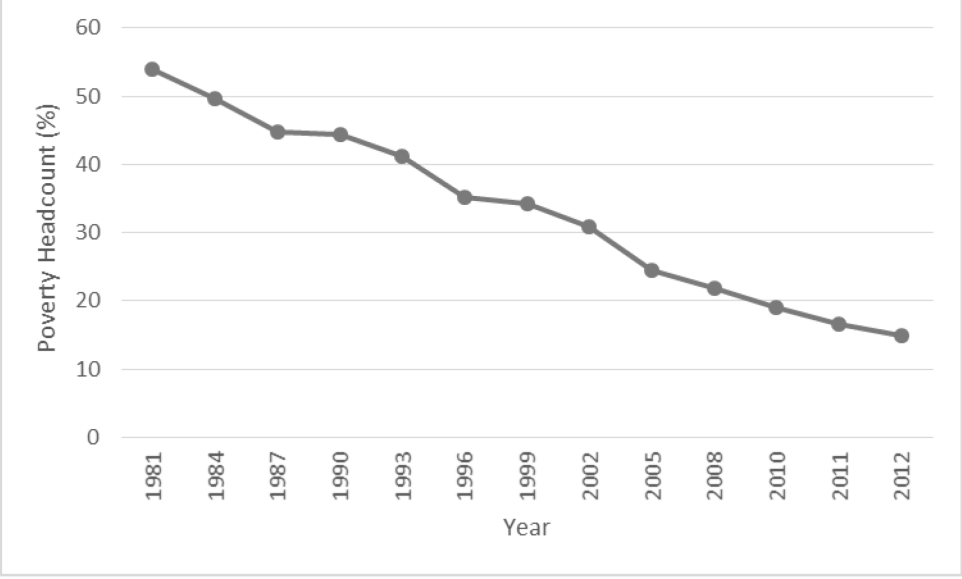
Figure 2.1 Growth rates of GDP per head in developed and developing countries (3-year moving average)



Source: World Development Indicators (World Bank 2015b).
Note: Database version updated September 24, 2015.

This increase in the growth rates of developing countries contributed to a dramatic reduction in the global poverty headcount, from 44 percent of the population of the developing world in 1990 to 15 percent in 2012, the year for which the most recent estimates are available (see Figure 2.2). As a share of the world population, the decline was from 37 percent in 1990 to 13 percent in 2012.

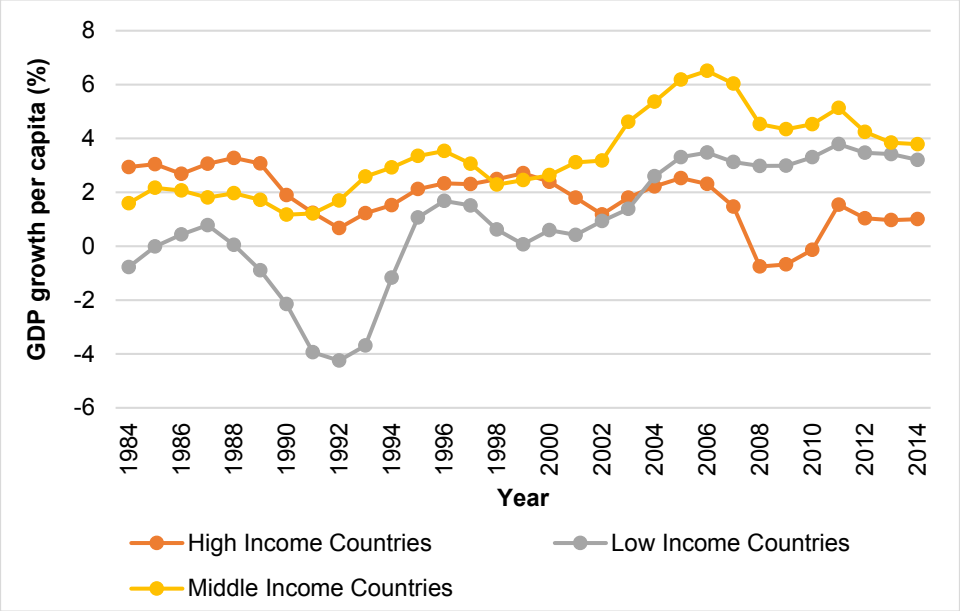
Figure 2.2 Developing countries' poverty head count rate (% population)



Source: World Development Indicators (World Bank 2016).
Note: Extracted March 30, 2016. Poverty headcount ratio at $1.90 a day (2011 purchasing power parity/PPP) (% of developing country population).

However, as Figure 2.3 shows, until the last decade, low-income countries frequently lagged behind the other groups, increasing the development gap between the most vulnerable economies and advanced and emerging economies. In the last 10 years, low-income countries have managed to outperform rich countries despite the composition effect described earlier and, since the last financial crisis, have even surpassed the growth performance of middle-income countries, giving inclusive economic growth for the first time in decades. In this context, it is crucial to understand the extent to which the global slowdown may oppose or confirm this trend, and, if convergence does occur, the extent to which its speed will be impacted. This outperformance is all the more remarkable given the tendency for this measure to understate the growth performance of the low-income country group, as countries with the worst growth performance fall into this group from higher-income groups while countries with the best growth performance rise out of the group.

Figure 2.3 Growth rates of GDP per head (% per year) in low-income, middle-income, and high-income countries (3-year moving average)



Source: World Development Indicators (World Bank 2015b).

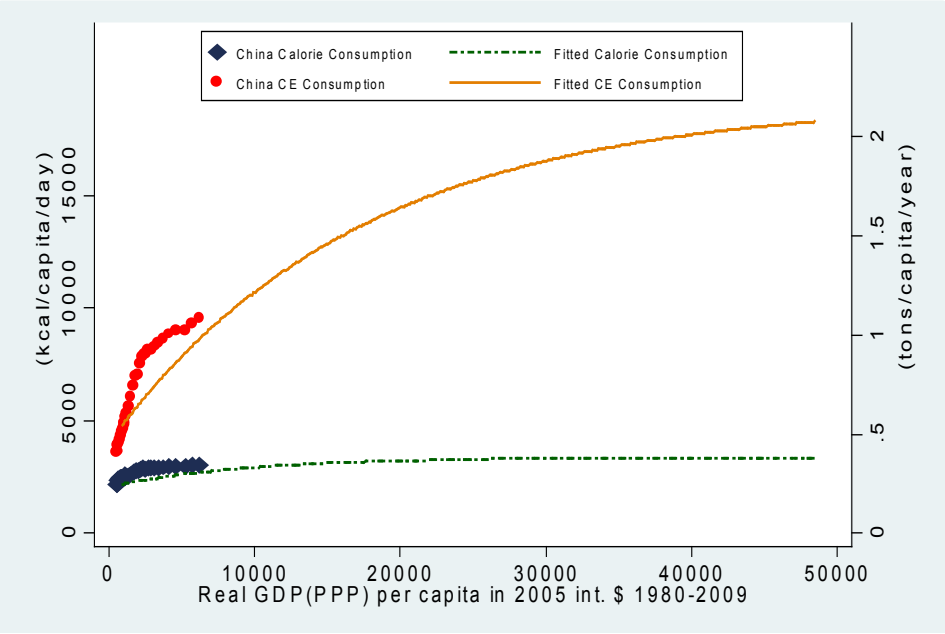
Drivers of Economic Growth and Implications for the Poor

Sustained growth in the measure of gross domestic product (GDP) used in Figure 2.1 can only be achieved through improvements in productivity. The increases in productivity tend to be associated with reforms that allow increased access to imported intermediates (Amiti and Konings 2007) and to other economy-wide policy changes that allow increases in productivity in a wide range of sectors. To the extent that these productivity gains raise the productivity of the business activities of poor households—such as farms or other small businesses—they are likely to be strong contributors to poverty reduction. Productivity gains may also raise the returns to poor households by raising the wage rates earned by their household members.

Other potentially important linkages between growth in developing countries and poverty are likely to operate through changes in relative prices. Food prices are likely to be particularly important because of their importance in both the consumption and the incomes of many poor people (Ivanic and Martin 2014). One linkage with potentially important impacts on poverty works through demand for food products. While demand for calories tends to flatten out at quite low levels of income, the demand for agricultural output continues to grow quite rapidly through the income range of today's middle-income

countries and to level out only at the income level of today's highest-income countries. This growth in demand for agricultural output is not for greater quantities of the same products or for more calories, but through shifts in the consumption of food towards products that require greater productive inputs—and particularly through a shift from plant-based to animal-based products (Fukase and Martin 2016). The relationships between income levels and demand for final calories and for total cereal equivalents are shown in Figure 2.4, with actual figures for China. The cereal equivalent measures in Figure 2.4 take into account the much higher agricultural output requirements for producing products such as meat and dairy products more heavily consumed in richer countries.

Figure 2.4 Calorie consumption versus total cereal equivalent (CE) consumption



Source: Fukase and Martin (2016).

Given the concave relationship between food demand and income, an average rate of global economic growth resulting from economic converge is likely to result in a larger increase in food demand than one resulting from higher growth in the highest-income countries. These linkages are incorporated in multi-sectoral CGE models through higher income elasticities of demand for non-staple foods, and through the intermediate use requirements for production of livestock products.

Another potentially important linkage between economic growth in developing countries and relative prices operates through the demand for investment goods in high-growth economies. If we take Doblin's (1991) estimate of the capital-output ratio of around 2.5 and assume a depreciation rate of 5 percent, then maintaining the capital stock at its initial level will require an investment rate of 12.5 percent of GDP. If, consistent with Kaldor's (1957) stylized facts of economic growth, the capital-output ratio is to stay constant, an economy growing at 5 percent per year needs an investment rate of 25 percent of GDP and one growing at 10 percent per year needs an investment rate of 37.5 percent of GDP. The dramatic increase in average growth rates in developing countries in the past 15 years was associated with sharp increases in the prices of investment and energy products, particularly in the 2008–10 period.

Recent Projections

The outlook for economic growth and poverty reduction in developing countries appears to have deteriorated in recent years. Growth in a number of major developing countries has decelerated sharply and the outlook appears less optimistic. The OECD (2016b) identifies this slowdown with economy-wide reductions in productivity growth. In this section, we review the different inputs based on the IMF WEO 2012 and 2015 and identify key drivers and narratives for our scenarios. The IMF projections are probably the most comprehensive and carefully scrutinized set of economic projections available. They provide estimates of growth in national GDP, savings rates, and changes in current account balances (CABs). The changes in CABs, given developments in savings rates, reflect changes in investment rates of the type considered in the previous section.

It appears from the projections that the difficulties of high-income countries in rebounding from the financial crisis and the slowdown of emerging markets, in particular the rebalancing of the Chinese economy, will have important consequences on global growth, commodity prices, and global investment dynamics.

GDP Dynamics

The main measurement of economic growth is the evolution of GDP at constant prices. The current slowdown has led to significant revision of projections for future growth at national and global levels. Since we consider no change in population dynamics, an increase of 1 percentage point in real GDP will imply an identical change in GDP per capita. Two important factors are important to keep in mind, especially when looking forward and considering the 2030 targets (for the SDGs):

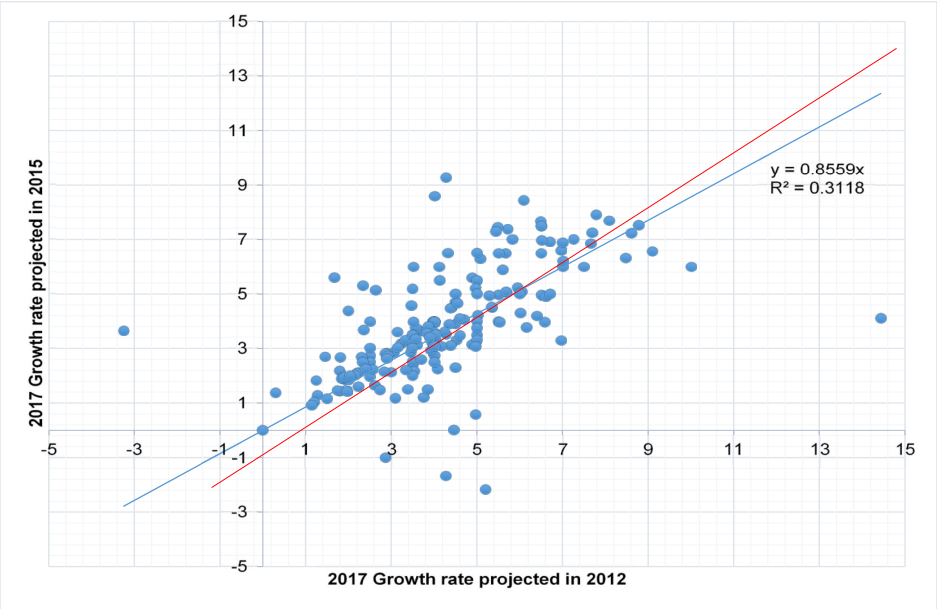
- The current projections involve lower growth rates for the future (for example, 2016–2017 growth rates);
- The actual starting point is lower today (that is, the 2015 GDP level) than expected a few years ago.

Therefore when comparing 2012 projections for the future with 2015 projections, it is critical to see that both the slope and the level of the GDP trajectories have been affected.

For instance, global income growth between 2011 and 2015 was expected to be 17.5 percent in 2012 but turned out to be only 13.9 percent. By 2017, the GDP growth gap reaches 5 percentage points (the 2017 GDP as projected in 2012 is 5 percentage points above the 2015 projection for the same year) and the growth gap (the GDP growth not achieved) reaches 22 percent. A simple extrapolation shows that global GDP in 2030 will be 15 percent lower than initially expected. Our objective is to assess the implications of this substantial decline in anticipated output for achieving the SDGs.

The growth projections have been reduced for 134 countries out of a total of 189, and an overview is displayed in the following figure for the 2017 growth rate. Looking at global GDP, the growth rate was revised from 4.66 percent to 3.80 percent (minus 0.86 points or 19 percent). For the country sample, the median growth rate moved from 4 percent to 3.6 percent (minus 0.4 points or 10 percent). The most recent WEO projections, in April 2016, involve a further decline in growth rates from these levels, but the additional change is fairly small relative to the changes considered—the world average growth rate projected for 2017 declined from 4.7 percent to 3.8 percent in our analysis, while the April 2016 projections involve a further decline of 0.3 percentage points.

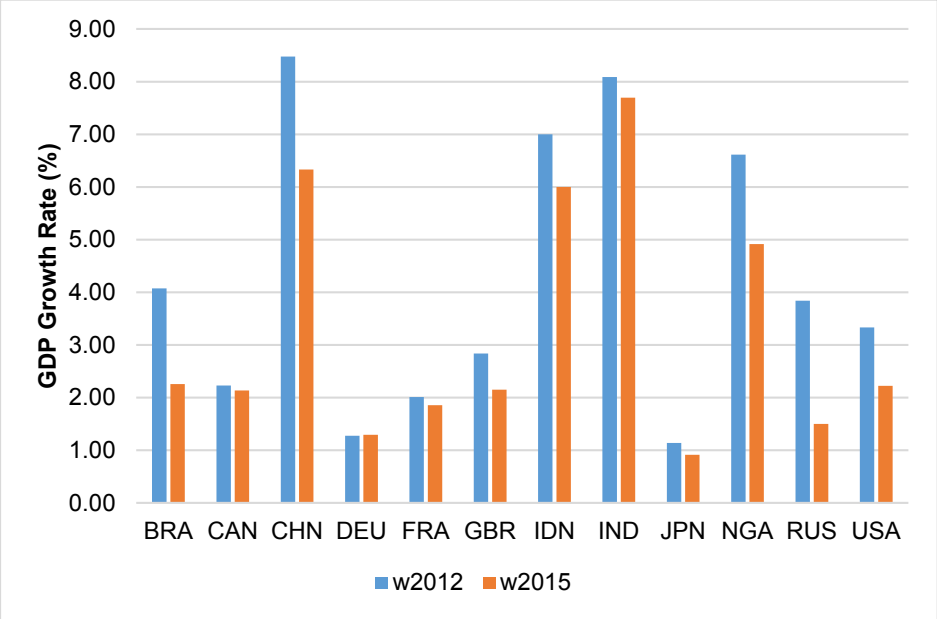
Figure 2.5 Comparison of 2012 and 2015 country GDP growth projections for 2017



Source: World Economic Outlook (IMF 2012; 2015).

In these projections, not all countries are affected in the same way–exporters of raw commodities and crude oil are among the most affected (Persian Gulf countries, but also Angola, Equatorial Guinea, Democratic Republic of Congo) as are some key emerging economies: Brazil and first of all, China, with a decline from 8.5 percent to 6.3 percent. China plays a very critical role due to its size, its growth, and its specific impact on world markets. In advanced economies, recovery is slow but still expected for the most open economies (see Japan). The US case is also very relevant since its growth rate, among the highest among developed economies, is cut by one-third (Figure 2.6).

Figure 2.6 Comparison of 2012 and 2015 GDP growth projections for 2017 (selection of countries)



Source: World Economic Outlook (IMF 2012; 2015).

Savings Rates

Savings rates are another important feature of the projections. Savings rates have an impact on long-term growth by conditioning the feasible level of investment. The latter can be funded domestically or externally with implications for CABs. We discuss the evolution of the current account (and the capacity to provide/require savings to/from the rest of the world) in the next subsection.

Long-run savings rates are also impacted by demographic changes (such as the share of the population in retirement or in their peak earning and saving years), but since demographic patterns are constant across the scenarios, we focus on short- and medium-run variations in the WEO projections. Three main features appear to be:

- An increase in the savings rates of some advanced economies facing significant public and private debt challenges that require macroeconomic adjustment (Ireland, Hungary, and so on).
- An increase or decrease in the savings rates of some oil-exporting countries that face large income shocks and may cut their savings rates to stabilize consumption (most of them), or increase savings rates to support investment (Qatar, Equatorial Guinea).
- The specific case of China, where the savings rate has declined sharply from the 50 percent observed in 2011 and was expected to stay at this level in the WEO 2012 projections, while it has now started to fall and, in the latest projections, reaches 39 percent by 2020.

Current Account Dynamics

An important driver for the world economy is the evolution of current account surplus/deficits which, as noted above, reflect changes in both savings and investment rates. Indeed, they are key drivers of the dynamics of world trade. In our modeling framework, they are exogenous (but not fixed) indicators that allow us to define the evolution of the real exchange rate. Therefore, the current account surplus/deficit may need to be adjusted in the scenarios to be dynamically consistent with our narrative (internal versus external adjustment, real exchange rate appreciation/depreciation). Table 2.1 summarizes the WEO projections (2012 and 2015) for CABs in billion USD for selected economies (those with the largest surplus/deficit in 2012.

A few remarks can be drawn from the following table:

- In both WEO projections, we see significant declines in global imbalances. The overall surplus for the selected "leading" economies declines in both projections. This decline is much larger in the 2015 version-- which includes the global slowdown. In this case, we see that the surplus (that will finance the rest of the world here) disappears by 2017 and a sizeable deficit emerges in 2018.
- Important differences (but not at the aggregate level) exist for the first year, 2013 (see Qatar, Norway, Germany, China, Great Britain, Australia).
- Differences in trends are also noticeable especially in China, Russia, and Brazil.

We consider three main drivers and outcomes when building our scenarios:

- The reduction in oil (and related commodity) prices. It leads to a significant change in the initial (2013) trade balance of oil exporters/importers (very important for Qatar, Saudi Arabia, and countries in a similar situation).
- Shrinking of Chinese external savings (part of the rebalancing dynamics).
- Increase in US requirements for foreign savings.

The combination of these three drivers will lead to a significant reduction in the amount of foreign savings available for middle- and low-income countries, leading to a reduction in their investment and growth.

Table 2.1 Comparison of 2012 and 2015 current account balances projections (selection of countries with larger current account imbalances)

	World Economic Outlook 2012			World Economic Outlook 2015			
Country	**2013**	**2015**	**2017**	**2013**	**2015**	**2017**	**2018**
Australia	-84	-105	-118	-52	-50	-44	-46
Brazil	-80	-97	-112	-91	-73	-67	-70
Switzerland	72	70	65	49	48	52	54
China	229	356	540	348	267	150	95
Germany	175	162	138	286	271	271	270
Great Britain	-30	-12	-17	-136	-114	-83	-86
India	-58	-64	-69	-30	-52	-78	-87
Japan	166	151	129	124	131	132	131
Korea	19	13	12	98	92	91	89
Kuwait	84	73	75	11	13	17	17
Netherlands	64	59	53	72	73	75	78
Norway	70	59	53	28	26	30	28
Qatar	58	36	20	10	-6	1	1
Russia	44	-19	-59	62	75	84	81
Saudi Arabia	152	113	107	-22	-13	4	-2
Singapore	60	61	62	61	55	54	54
Turkey	-72	-79	-100	-33	-39	-49	-50
Taiwan, China	44	53	64	64	63	61	62
United States	-499	-561	-696	-461	-629	-710	-747
South Africa	-24	-27	-33	-14	-15	-16	-16
Total	**390**	**241**	**114**	**376**	**122**	**-24**	**-144**

Source: World Economic Outlook (IMF 2012; 2015).

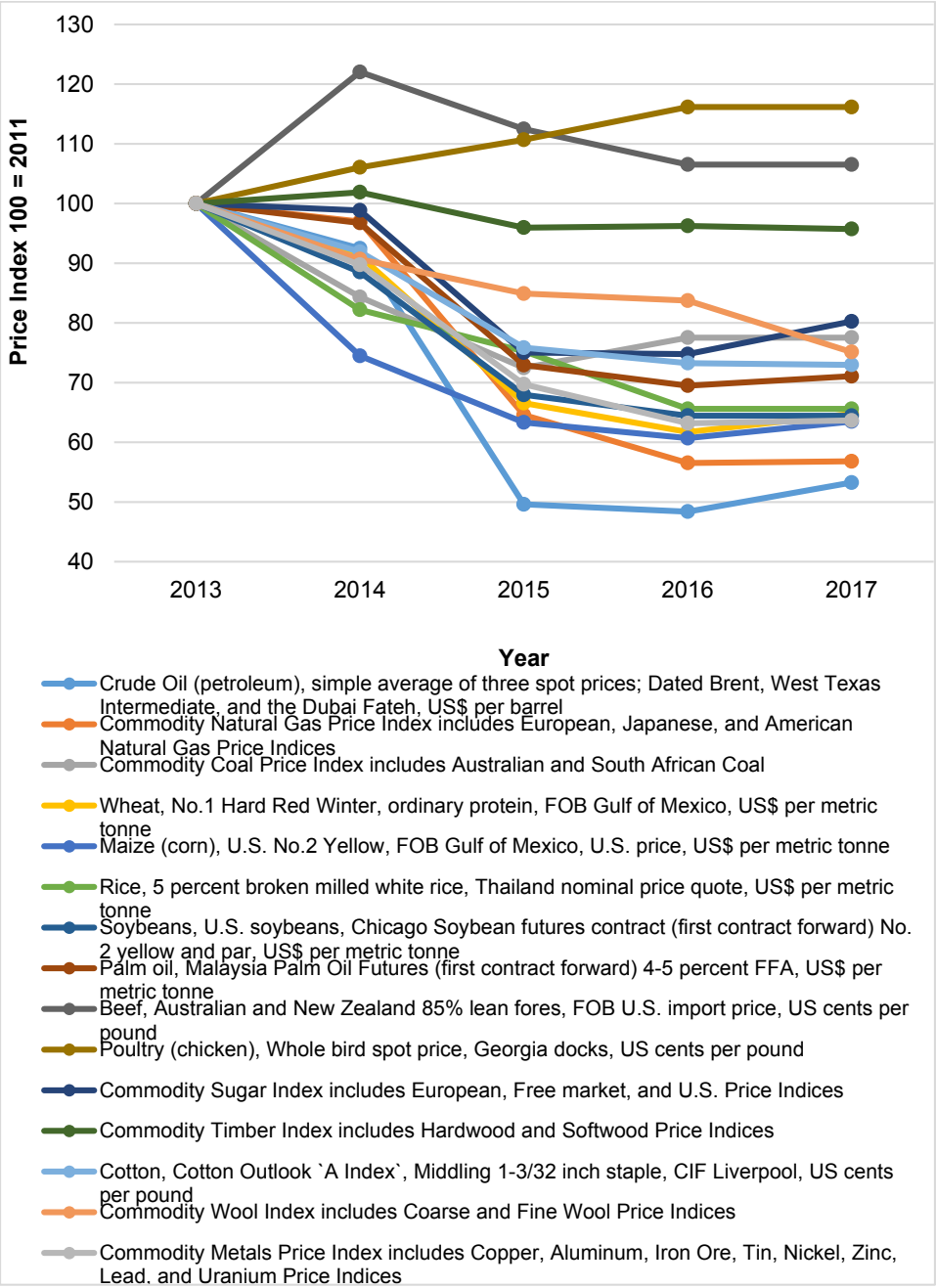
Commodity Prices

Even though commodity prices are endogenous to our model, we are interested to see how some prices evolve in the IMF forecasts for two reasons:

- To see whether the CGE generates a time path consistent with the commodity price forecasts, especially in terms of price dynamics and cross price correlation.
- To assess whether there is a need to add some specific supply shocks, especially on the oil and energy markets, to represent both OPEC (Organization of the Petroleum Exporting Countries) supplies and supplies from nonconventional sources.

There were some major changes between the WEO projections (2015) for world commodity prices and the 2012 forecasts, the most striking being a sharp fall in oil prices, followed by a slow recovery. In Figure 2.7, we see that the 2015 forecasts involve price declines of between 25 percent and 40 percent for most commodities. Cereal prices decline by 36 percent on average and palm oil prices by 45 percent. Agricultural raw materials decline sharply, with cotton and wool prices falling by 45 percent. Finally, meat prices are supported by higher demand.

Figure 2.7 World commodity price projections, 2015



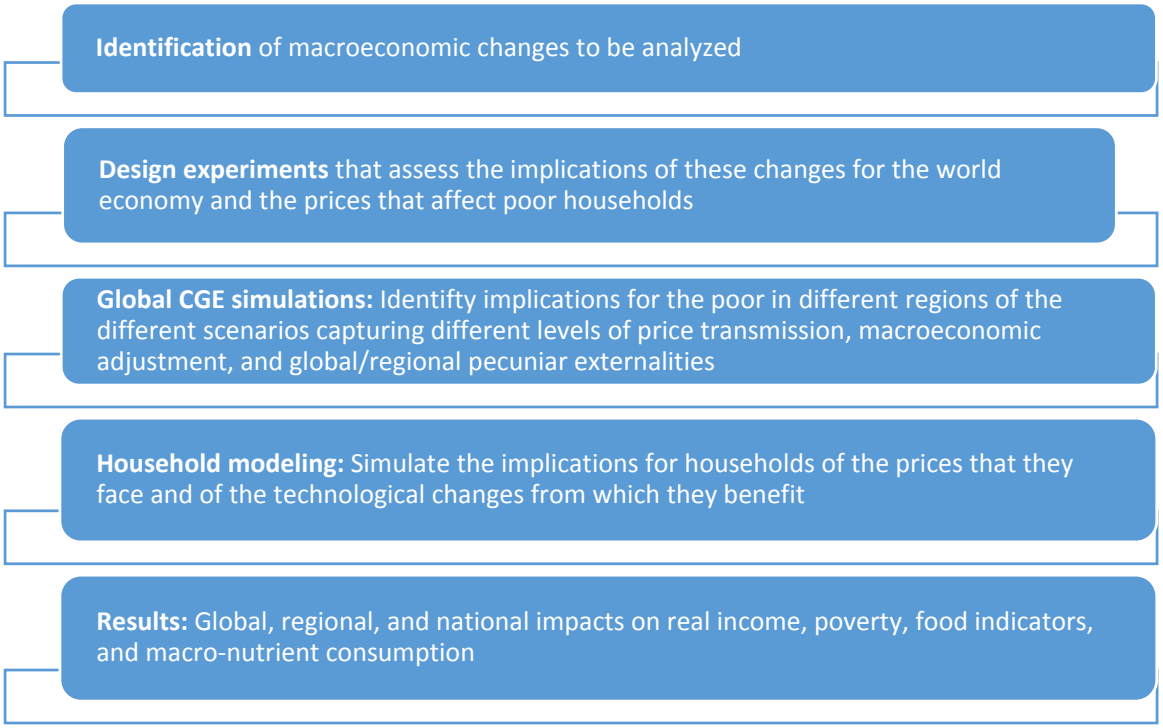
Source: World Economic Outlook (IMF 2015).

These changes in commodity prices are an important reason for us to use a modeling approach in which household characteristics are individually identified. Had we used a simpler modeling approach to model poverty impacts, such as a poverty elasticity (see a number of the studies in Anderson, Cockburn, and Martin 2010) in which a simple relationship between changes in economic growth and in poverty rates is specified for each region, then we would miss the impacts of commodity price changes on poverty. Since these impacts are frequently substantial, and heavily dependent on features such as the net buyer/net seller status of households and countries, they cannot be captured in a poverty elasticity.

3. METHODOLOGY

Regarding poverty outcomes, it is worthwhile to look at both short- and long-run effects. Key impacts will be on commodity prices in the short run (affecting directly both the incomes and the costs of living for households). In the longer run, changes in wage rates for unskilled workers will have major impacts. To disentangle the short- and long-term impacts of these changes, the MIRAGRODEP global economy-wide model (Laborde et al. 2013) is coupled with country-specific household models following Ivanic and Martin (2014). This top-down approach, starting from broad macroeconomic changes and fine-tuning the analysis through the identification of key impacts, is essential to be able to combine the ambition of this project with the very tight constraints on time and resources. Figure 3.1 summarizes our analytical steps, starting from the macroeconomic scenario definitions (based on the IMF outlook), their translation in the structural CGE model, and the poverty and farm analysis.

Figure 3.1 Analytical steps



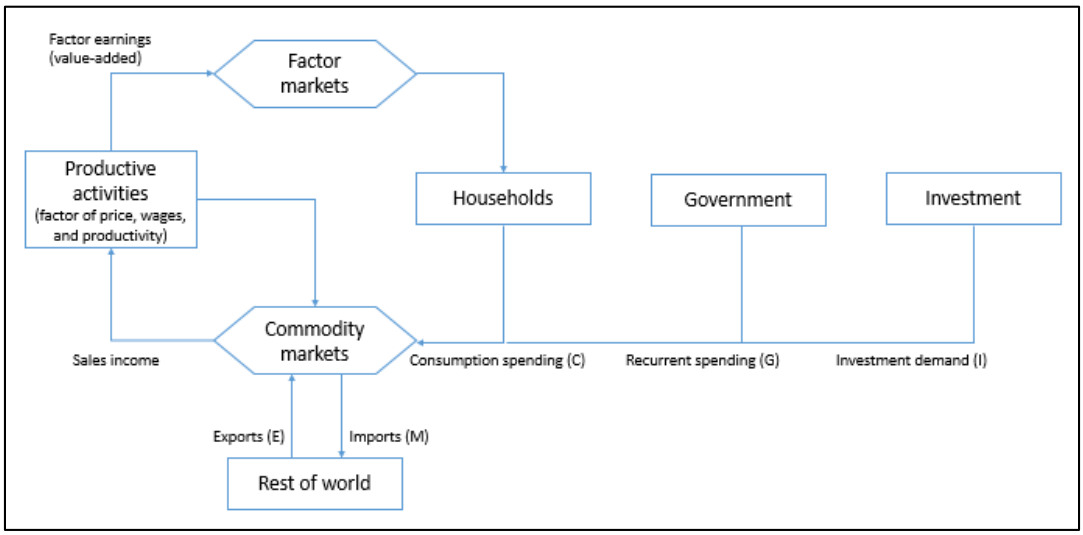
Source: Authors.

Implementing Alternative Macroeconomic Scenarios in the CGE

This assessment utilizes a recursive dynamic multi-region, multi-sector CGE model: the MIRAGRODEP model. MIRAGRODEP (Laborde et al. 2013) is a CGE model based on MIRAGE (Modelling International Relations under Applied General Equilibrium; Decreux and Valin 2007).

The multi-country CGE model that we use allows a detailed and consistent representation of the economic and trade relations between countries (see figure 3.2). International economic linkages are captured through international trade in goods and services, and through capital flows. A dynamic, recursive solution is obtained by solving the model sequentially and moving the equilibrium from one year to another. In our study we assume perfect competition in all sectors, which allows us to have a detailed geographic and sector decomposition.

Figure 3.2 Analytical framework



Source: Authors.

In each country a representative consumer maximizes a CES-LES (Constant Elasticity of Substitution – Linear Expenditure System)[1] utility function under a budget constraint to allocate expenditures across goods. The LES system allows for different income elasticities of demand, with those for food typically lower than those for manufactures and services. Once total consumption of each good has been determined in the top level, the origin of the goods consumed is determined by another CES nested structure following the Armington assumption.

On the production side, value added and intermediate goods are complements under the Leontief hypothesis that intermediate inputs are needed in fixed proportion to output. Total value added is represented as a CES function of unskilled labor and a composite of skilled labor and capital: this allows us to specify a lower degree of substitutability between the last two production factors. In agriculture and mining, production also depends on land and natural resources. New capital is perfectly mobile across sectors while installed capital is immobile. Skilled labor is perfectly mobile across sectors while unskilled labor is imperfectly mobile between the agriculture sector and non-agriculture sectors. Investment is savings-driven and the real exchange rate adjusts endogenously such that the current account is constant in terms of world GDP. In some scenarios, we exogenously decrease (increase) the current account of some countries, and restore global balance by proportional increases (decreases) to the CABs of other countries with initial imbalances. As is common in modeling long-term productivity growth or trade reform, the supply of labor is treated as exogenous. While the supply of labor clearly adjusts to changes in wages in complex ways (Blundell and Macurdy 1998; Keane and Rogerson 2012), any resulting welfare gains are second-order once the transitional dynamics have died down, coming at the cost of reductions in nonmarket activities such as leisure.

By contrast with MIRAGE and most global general equilibrium models, the government is explicitly modelled as distinct from the private agent in MIRAGRODEP. The income of the government consists of taxes collected on production, on factors of production, on exports, on imports, on consumption, and on households' income. The government is assumed to maximize a Cobb-Douglas utility function so that spending on each commodity remains a fixed value share of total public expenditure on goods and services. The model structure ensures that both domestic and external constraints are respected in each country.

[1] The CES-LES is a variant of a CES function where minimal consumptions are introduced. It is equivalent to replacing the Cobb-Douglas structure of the Stone-Geary function (that is, LES) by a CES structure.

As in Lakatos et al. (2015), we begin our global macroeconomic analysis with an assessment of the key macroeconomic adjustments under review. This builds on the analyses of the macroeconomic situation by the IMF, comparing projections made in 2012 with the latest 2015 release. New trends are identified at the global, regional, and national level. A very important task is to identify in these new scenarios the drivers at play in the OECD economies, in the BRICs (Brazil, Russia, India, and China), and in other low- and middle-income countries. The case of China is particularly relevant for poor countries in Africa, Asia, and Latin America and considers the direct impacts of the economic slowdown in China but also the rebalancing of its economy between domestic and foreign demand, final consumers, and investments. An important element of this scenario is changes in the opportunities for other countries to take up production of labor-intensive goods currently produced in China, but expected to migrate to other developing countries. The turning point in 2015 from growth to decline in China's labor force reduces China's overall growth rate, and also reduces China's ability to continue to expand exports of labor-intensive goods. These elements of the projections will affect demand and supply on world markets in heterogeneous ways.

For the purposes of this project, we consider three scenarios between 2011 and 2030:

- Scenario 0 (S0), the baseline, is based on the old, "optimistic" projections. We consider the growth trajectory from the WEO 2012. Starting from our base year (dataset 2011) we implement the growth trajectory from WEO 2012 for 2012 to 2017. Demographic projections are taken from the United Nations (UN) and the change in the economically active population is used to define the growth of the labor force. Total factor productivity (TFP) is computed at the country/regional level to match the GDP trajectories. To build the growth trajectory to 2030, we assume that the average annual TFP growth rate projected for the 2015–2017 period is maintained between 2017 and 2030.
- Scenario 1 (S1) is our "first" change scenario looking at the reduced growth projections. Starting from the base year, we implement the actual growth rate from 2011 to 2014 for all countries, and the WEO 2015 projections from 2014 to 2020 for our group of "leading" economies, defined as high-income countries + Russia + Brazil + China. For the group of leading economies, we assume that the average annual TFP growth rate projected for each of these countries in the 2017–2020 period is maintained between 2020 and 2030. For all other middle- and low-income countries, we maintain the TFP growth rates computed in S0 between 2014 and 2030. In addition, we implement structural reforms in China, leading to a "rebalancing" of its economy through an increase in domestic consumption and a decrease in domestic savings, leading to a reduction in domestic investment but also a reduction in the current account surplus. Other changes from S0 include reductions in energy prices; in savings rates in oil exporting countries, in CABs; and in natural resource endowments for energy products.
- Scenario 2 (S2) includes all elements of S1 but considers additional drivers for the low- and middle-income countries. Particularly, the TFP growth rates between 2014 and 2030 are adjusted to our new scenario for these countries, as well as for the "driver" economies.

These scenarios attempt to capture, in a very simple way, the decline in optimism about the outlook for many countries between 2012 and 2015. Since all of the scenarios are based on projections beyond the sample period of the WEO projections, none of them should be interpreted as a forecast for the period to 2030. However, they do allow us to build on the detailed and carefully scrutinized projections at country level prepared for the WEO, and to perform a sensitivity analysis on the impacts of a decline in growth on achievement of SDG 1, the elimination of global poverty by 2030.

Table 3.1 Scenario summary table

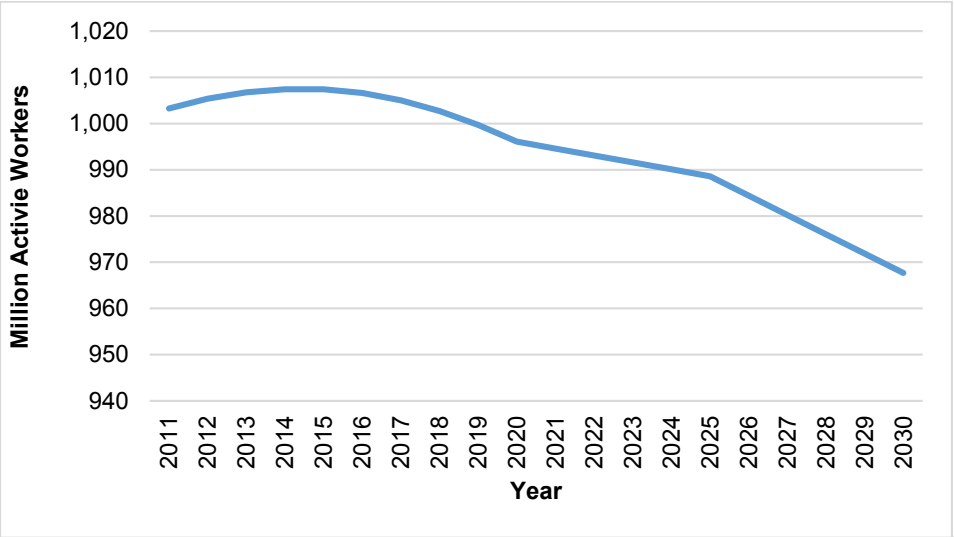
Variable	Scenario 0	Scenario 1	Scenario 2
GDP Trajectory – Leading economies (HIC+Russia+Brazil+China)	Exogenous	Exogenous	Exogenous
GDP Trajectory – MIC + LIC	Exogenous	Endogenous (unconstrained)	Exogenous
TFP – Leading economies	Calibrated (WEO 2012)	Calibrated (WEO 2015)	Calibrated (WEO 2015)
TFP – MIC + LIC	Calibrated (WEO 2012)	Same value as in scenario 0	Calibrated (WEO 2015)
Agricultural TFP	Same dynamics as national TFP	Same dynamics as national TFP	Same dynamics as national TFP
Savings rate	Unchanged	Exogenous change in China 50% to 40% by 2020, 40% to 35% by 2030 Adjusted for oil-producing countries to stabilize consumption	As in scenario 1
Current Account Balance	Unchanged	Surplus reduction in China Strong surplus Reduction in oil-exporting countries Increase deficit in the US	As in scenario 1
Remittances	**Endogenous**, expressed as a percentage of national (source country) unskilled labor payments	**Endogenous**, expressed as a percentage of national (source country) unskilled labor payments	**Endogenous**, expressed as a percentage of national (source country) unskilled labor payments
Natural resource endowments	Unchanged	Calibrated for Gulf countries, US, Russia, Australia, China to target oil, gas and coal prices	As in scenario 1
Labor force	Exogenous, follow medium UN projections for active population	As in scenario 0	As in scenario 0

Source: Authors.
Note: HIC= high-income country; MIC = middle-income country; LIC = low-income country.

Population and active population growth rates follow the UN projections (central scenario). This implies increases and decreases in the labor forces in particular countries. The case of China is particularly interesting, with the workforce declining by 4 percent over the period to 2030 (Figure 3.3). The labor force evolves over time but is constant across scenarios, so differences between scenarios are unaffected by the projections.

Overall, the main exogenous driver of differences between the scenarios is TFP. It captures changes in both per unit productivity at a constant utilization rate and in the utilization rate of productive factors (that is, for the same population, a reduced number of effective working hours or underutilization of the physical capital stock). The latter interpretation is particularly relevant when addressing downturns in a macroeconomic cycle, with both having the same effects on income per capita outcomes when considering homogenous changes in utilization rate across factors and agents.

Figure 3.3 China's labor force, aged 15-64 years, 2011–2030



Source: MIRAGRODEP baseline dataset, based on UN demographic projections.

Analyzing Macroeconomic Changes at the Household Level

The impacts of macroeconomic changes on the incomes of the poor are more complex than is commonly realized. These impacts are perhaps simplest when a decline in productivity lowers the efficiency of production within an unincorporated firm (such as a family farm) owned by a household. Another relatively simple case arises with a shock that results in a sizeable change in a commodity price for which a poor household is a net seller or net buyer. In the short run, the effect of this shock on real income can be identified with knowledge of the net seller or net buyer status of the household (although recent evidence from household surveys suggests that our knowledge of these net trade shares may be less reliable than we formerly thought (Headey and Martin 2016). The longer-term impact takes into account impacts of productivity changes on the real wages obtained by household members from their sales of labor (and other factors) sold outside any family-owned firm. It also needs to take into account the potential for changes in the output and consumption patterns of the household, which may move from being a net seller of a good whose price has fallen to being a net buyer. Major changes in income in different countries may also be expected to result in changes in remittances from family members working abroad. So, macroeconomic shocks can be expected to affect the real income of households through different channels with macro- and microeconomic implications:

1. The direct impacts on the incomes of producers;
2. Through changes in the cost of living, and;
3. Through impacts on factor returns, particularly wage rates for unskilled labor sold outside the household's business activities; and
4. Changes in remittances.

The methodology can be understood using the following approach. The impact of an external shock on the real income of a household can be obtained using a money measure of household welfare W at a given utility level, u, given by:

$$\boldsymbol{W = \pi(p^*, w, \tau) - e(p, w, u),} \quad (1)$$

where $\pi(\boldsymbol{p}^*, \boldsymbol{w}, \tau)$ is a profit function representing the profits generated by any unincorporated household enterprise, such as a farm firm, specified as a function of effective commodity prices ($\boldsymbol{p}^*$), factor prices (w), and technology ($\boldsymbol{\tau}$); $e(\boldsymbol{p}, \boldsymbol{w}, u)$ is a full cost function of the type used by Deaton and Muellbauer

(1981) for a household that consumes goods and supplies factors at a given vector of commodity and factor prices, p, factor prices, w, and utility level, u. The distinction between actual and effective output is discussed in Martin and Alston (1997). From the point of view of the firm, quantity q^* of effective output now translates into a larger quantity, q, of output, where $q = q^*\tau$. The increase in the actual output from any given effective output results in an increase in the effective price of output at any actual price, where the effective price is defined as $p^* = p\tau$.

Note that the prices of goods and factors are frequently endogenous in the macro model but are always exogenous at the household level. Therefore, we need a large-scale CGE, here the MIRAGRODEP model, to be able to provide the right information regarding price changes to the household modeling component. Since a macroeconomic slowdown can include differentiated evolution of technology (productivity) between agriculture, industry, and services, this framework allows us to tackle such heterogeneity at the household level.

The right side of equation (1) may usefully be rewritten as $\boldsymbol{z}(\boldsymbol{p}, \boldsymbol{w}, \boldsymbol{\tau}, u)$. With this simplification, a second-order approximation of the welfare impact of changes in $\boldsymbol{p}$, w, and τ is given by:

$$\boldsymbol{\Delta W} = \begin{bmatrix} \boldsymbol{z_p} & \boldsymbol{z_w} & \boldsymbol{\pi_\tau} \end{bmatrix} \begin{bmatrix} \boldsymbol{\Delta p} \\ \boldsymbol{\Delta w} \\ \boldsymbol{\Delta \tau} \end{bmatrix} + \frac{1}{2} \begin{bmatrix} \boldsymbol{\Delta p} & \boldsymbol{\Delta w} & \Delta\boldsymbol{\tau} \end{bmatrix} \begin{bmatrix} \boldsymbol{z_{pp}} & \boldsymbol{z_{pw}} & \boldsymbol{\pi_{p\tau}} \\ \boldsymbol{z_{wp}} & \boldsymbol{z_{ww}} & \boldsymbol{\pi_{w\tau}} \\ \boldsymbol{\pi_{\tau p}} & \boldsymbol{\pi_{\tau w}} & \boldsymbol{\pi_{\tau\tau}} \end{bmatrix} \begin{bmatrix} \boldsymbol{\Delta p} \\ \boldsymbol{\Delta w} \\ \boldsymbol{\Delta \tau} \end{bmatrix} \quad (2)$$

This quadratic form takes into account both the nonlinear (in this case quadratic) relationships between welfare and prices and technological changes in equation (2). The first term in (2) includes the net sales of the household times the change in the price of the commodity, $z_p\boldsymbol{\Delta p}$, the measure of welfare change emphasized by Deaton (1989) for analysis of commodity price changes. It also takes into account the impact of changes in factor prices, and especially wage rates, times the net sales of the household outside any family-owned firm, $\boldsymbol{z_w \Delta w}$. Finally, it takes into account the direct impact of changes in technology on the profits generated by the family farm given a change in technology, $\boldsymbol{\pi_\tau \Delta \tau}$. As shown in Ivanic and Martin (2016), the second-order terms generalize these familiar first-order impacts, taking into account the changes in the output of farm firms and changes in sales of labor off-farm when changes in prices and productivity are large.

Assessing impacts at the household level for both rural and urban households is much more complicated than assessing aggregate impacts since household impacts depend not only on the characteristics of the household as a producer, but also impacts on the cost of living and on household members' participation in labor markets. Fortunately, a vast amount of work has been done by Ivanic and Martin (2014) to collect data including income from agriculture and expenditures on agricultural products (particularly food), and on household income received from labor markets. We do not form "representative" households using these data, which necessarily aggregates away a great deal of valuable information. Rather, we retain and use directly all of the information available from household surveys on the income sources and expenditure patterns in each of our more than 285,000 sample households.

These two-tiered approaches have already been implemented in both Bouet, Estrades, and Laborde (2011) and Ivanic and Martin (2014). The overall modeling framework was explained in Figure 3.1. While Bouet, Estrades, and Laborde (2011) use the MIRAGE model and Ivanic and Martin (2014) use the GTAP model to determine the price changes that are fed to the household models, the differences between these two models are relatively minor.

The second-order effects identified in equation (2) are likely to be much more important when looking at price changes than when the primary shock is changes in productivity, as in this study. However, even in this situation, Ivanic and Martin (2014) found that second-order impacts were considerably less important than first-order impacts—which include both effects resulting directly from price changes and those resulting from the impacts of price changes on wage rates for unskilled labor. Since the primary impact of a productivity change is through first-order impacts on producers' income and resulting changes in factor prices, we decided not to incorporate second-order impacts resulting from induced price changes in our empirical analysis at this stage.

Compared with a static shock, we also need to capture the poverty evolution in the baseline from 2014 to 2030. The same principles are applied to the dynamic changes as in comparing one scenario with another. Only one additional assumption is introduced in this dynamic framework; as the demographic weight of each household is adjusted to reflect the evolution of the total population, no biases are introduced: within a country, relative weights are maintained but since different countries have different demographic evolution, the dynamics still have an impact in terms of global poverty outcomes. For example, the relatively rapid population growth in relatively low-income Sub-Saharan Africa reduces the rate of reduction in global poverty. Other variables at the household level evolve with their matching concept in the CGE.

- Wages evolve for all households as they evolve in the CGE (including rural versus non-rural wages);
- Non-labor factor endowments (capital, land, natural resources) and prices define a "mix income" category. This source of income for each household evolves as in the CGE, on a per capita basis;
- For goods and services used as inputs in the business activity, the output/input ratio is kept constant (as in the CGE since it relies on a Leontief assumption between value added and inputs);
- The labor productivity for each activity/crop for small business activity is indexed on the average labor productivity of each activity/crop in the CGE;
- All input and output prices in the business activities of the household follow the domestic CGE price trajectory; and
- Prices for goods and services consumed by the household evolve as in the CGE.

Moving to Broader Country Groupings

Our sample of countries is geographically widespread and includes 76 percent of the world's poor people (Ivanic and Martin 2014) so it seems reasonable to assume that it can generate realistic estimates of the global poverty impacts of changes such as the macroeconomic shocks under consideration.

To obtain estimates of poverty changes at the global level, and for meaningful groupings of countries, we clustered countries based on four variables: the poverty headcount rate at $1.90 a day; the rural population share; adjusted net national income per capita (constant 2005 USD), and cereal yields (kg per hectare). If the poverty headcount at $1.90 per day was not available, we used the previous $1.25 at 2005 PPP per day measure and, if this was not available, the poverty rate of 2–3 countries with a similar level of GDP per capita. The needed measures were obtained from the World Bank's PovcalNet database and *World Development Indicators*. With these measures, we used a partitioning method, assigning each country to the group with the nearest mean values while maximizing differences between the country clusters.[2]

Using this method, five country clusters were created, making sure that each group contained at least one of the countries in the Ivanic and Martin (2014) household dataset. We then used the change in the poverty rate for the 31 countries, and applied it to the remaining countries in their respective groups, allowing us to generate estimates of changes in worldwide poverty rates.

Datasets

The main source of data for the economy-wide projections is the GTAP 9 database. For the household simulations we rely on the dataset developed by Martin and Ivanic (2014) that includes 31 countries, representing about 80 percent of the world's poor. This dataset covers large emerging economies, including exporters and importers of food products (for example, Brazil, China, India, Indonesia, Nigeria,

[2] Specifically, we used the kmeans option in STATA.

Pakistan, and Cote d'Ivoire), and smaller or more vulnerable economies (for example, Tanzania, Uganda, Rwanda, Zambia, Malawi, Niger, Yemen, Albania, Moldova, Georgia, Bangladesh, Nepal, Mongolia, Vietnam, Cambodia, Peru, Ecuador, Guatemala, Belize, Nicaragua, and Costa Rica). The consolidated dataset includes more than 285,000 representative households and provides a basis for assessing the global impacts of price and productivity changes on poverty. The individual countries for which household survey data are available and used are also identified in Table A.2.

Regional and Sectoral Disaggregation

Table 3.2 and Table 3.3 summarize the regional and sectoral aggregations used in our analysis. For the country aggregation, we proceed in two steps to address properly some numerical constraints. First, we operate with the 22 key regions and countries, as listed below, to calibrate global and leading economies' trajectories as well as global commodity prices. Then we run specific simulations where we single out key middle- and low-income countries needed for the poverty analysis.

Table 2.2 Country nomenclature

Region Code	Region Label	GTAP Regions
Oceania	Oceania	AUS, NZL, XOC,
CHN	China	CHN, HKG,
HICAsia	High-income Asia	JPN, KOR, TWN, XEA,
Easia	East Asia	KHM, IDN, LAO, MYS, PHL, SGP, THA, VNM, XSE,
Sasia	South Asia	BGD, PAK, LKA, NPL, XSA,
India	India	IND,
NAFTA	United States and Canada	CAN, USA, XNA,
MEXICO	Mexico	MEX,
LAC	Latin America w/o Brazil and Mexico	ARG, BOL, CHL, COL, ECU, PRY, PER, URY, VEN,XSM,
BRA	Brazil	BRA,
CAM	Central America	CRI, GTM, NIC, PAN, SLV, HND, XCA, DOM, JAM, PRI, TTO, XCB,
EFTA	European Free Trade Association	AUT, BEL, CYP, CZE, DNK, EST, FIN, FRA, DEU, GRC, HUN, IRL, ITA, LVA, LTU, LUX, MLT, NLD, POL, PRT, SVK, SVN, ESP, SWE, GBR, CHE, NOR, XEF, BGR, HRV, ROU, XTW,
CIS	Commonwealth of Independent States countries w/o Russia	ALB, BLR, UKR, XEE, XER, KAZ, KGZ, MNG, XSU, ARM, AZE, GEO,
Russia	Russia	RUS,
Gulf	Gulf countries	IRN, ARE, BHR, KWT, OMN, QAT, SAU, XNF,
MENA	Middle East and North Africa countries	TUR, ISR, JOR, XWS, EGY, TUN,
MAR	Morocco	MAR,
NGA	Nigeria	NGA,
WAF	West Africa	SEN, BEN, BFA, CIV, GHA, GIN, TGO, XWF,
CAF	Central Africa	CMR, XCF, XAC,
EAC	East Africa	ETH, KEN, MDG, MWI, MUS, MOZ, RWA, TZA, UGA, ZMB, ZWE, XEC,
SACU	Southern African Customs Union	BWA, NAM, XSC,
ZAF	South Africa	ZAF

Source: Authors.

Table 3.3 Sectoral nomenclature

Sector Code	Sector Label	GTAP Sectors
rice	Rice	PDR, PCR,
wheat	Wheat	WHT,
ocereals	Other Cereals	GRO,
v_f	Vegetable and Fruits	V_F,
osd	Oilseeds	OSD,
sug	Sugar	C_B, SGR,
pfb	Plant Fibers	PFB,
ocr	Other Crops	OCR,
cattle	Cattle	CTL, RMK,
otherAni	Other Animal	OAP,
wol	Wool	WOL,
forest	Forestry	FRS,
fish	Fisheries	FSH,
enepr	Extraction - Energy	COA, OIL, GAS,
miner	Minerals	OMN, NMM,
meatc	Red Meat	CMT,
meato	White Meat	OMT,
vol	Vegetable Oil	VOL,
dairy	Dairy products	MIL,
ofd	Other Food	OFD,
bevtob	Beverage and Tobacco	B_T,
tex	Textile	TEX
wap	Wearing Apparel and Leather products	WAP, LEA
paper	Paper Products	PPP, LUM
ffl	Fossil Fuels	P_C,
crp	Chemicals	CRP,
metal	Other Mineral	I_S, NFM, FMP,
TransEq	Transport Equip.	MVH, OTN,
electronics	Electronics	ELE,
capgoods	Capital Goods	OME,
omanuf	Other Industries	OMF,
utilities	Utilities	ELY, GDT, WTR,
construction	Construction	CNS,
trade	Trade	TRD,
trans	Transportation	OTP, WTP, ATP,
services	Services	CMN, OFI, ISR, OBS, ROS, OSG, DWE,

Source: Authors.

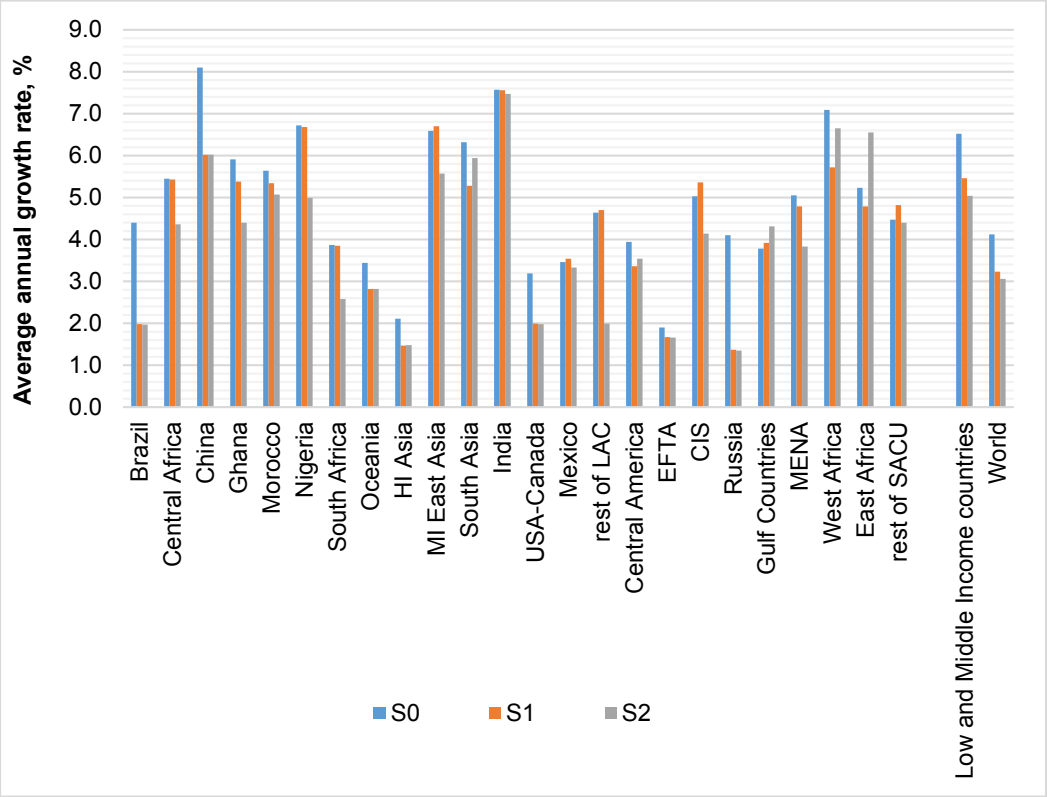
4. MACROECONOMIC PROJECTIONS TO 2030

This section presents findings for our three scenarios.

GDP Projections

The simplest indicator of our different growth trajectories is the real GDP growth rate between 2011 and 2030. Figure 4.1 shows the annual averages over the period and illustrates the very substantial slowdown faced by emerging economies: from 6.5 percent to 5.0 percent for developing countries as a whole; from 8.1 percent to 6 percent in China; from 4.4 percent to 2 percent in Brazil; and from 4.1 percent to 1.4 percent in Russia. Growth remains slow in many advanced economies (EFTA is about 1.7 percent) and is reduced by around one-third in some of the more dynamic OECD economies (for example, the United States, Canada, Japan, and Korea). Middle-income countries are less impacted (for example, a reduction by one-tenth in the growth rate for Morocco). For some West and East African countries, the more recent projections are more optimistic than those of three years ago and more than compensate (S2) for the global slowdown (S1). When we consider the implications of the slowdown in the leading economies (comparing S1 to S0), we find that the negative impacts are more pronounced in West Africa (the annual growth rate declines from 7.1 percent to 5.7 percent) and South Asia than in East Africa and India, showing clearly different trade and investment linkages and regional dynamics.

Figure 4.1 Average annual growth rates for real GDP, 2011–2030



Source: MIRAGRODEP model projections.

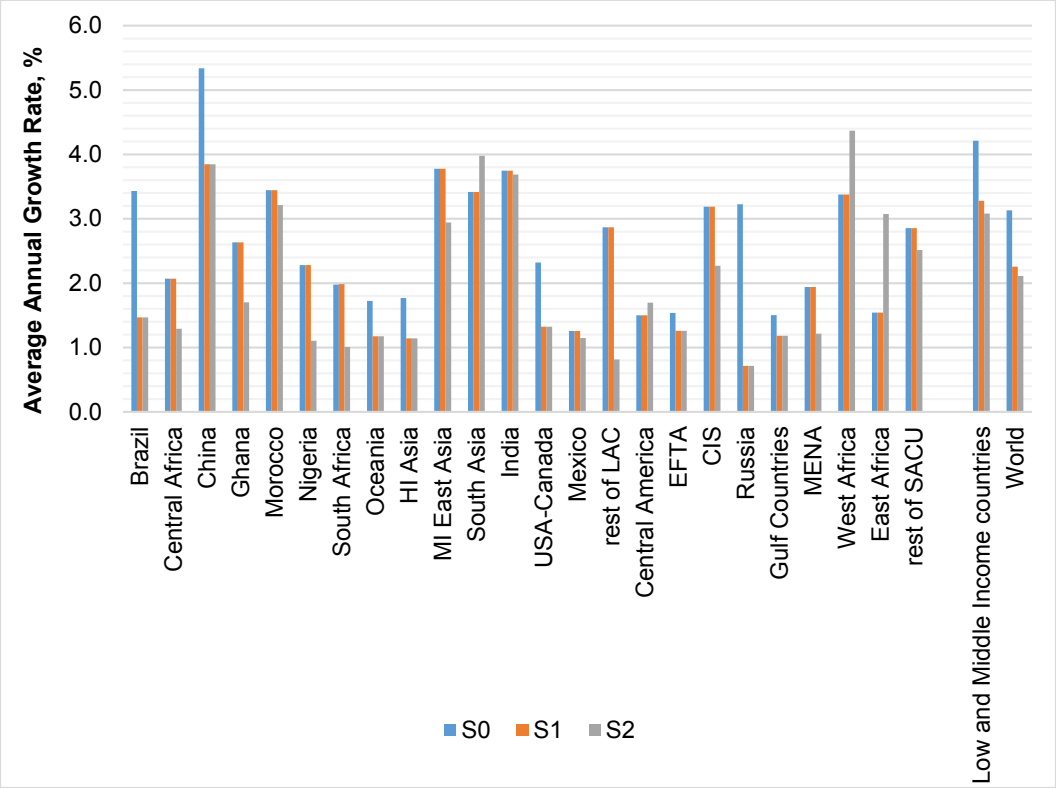
Total Factor Productivity Projections

TFP is a key element in our analytical framework. Indeed, it is the main driver of the calibration exercise to reproduce the GDP trajectories in the WEO scenarios since the growth rates of factor endowments are defined either exogenously (labor) or endogenously (capital) in response to income growth. At the same time, TFP is an essential driver in the evolution of productivity for poor workers and opportunities to achieve real income increases. Given the Solow-type framework that we use, changes in TFP are the primary exogenous source of long-term growth in any country. Other, relatively minor, changes in endowments include declines in land and natural resource endowments per person.

Figure 4.2 displays the annual average growth rate of TFP for the different regions under our different scenarios. They are lower than the GDP growth discussed in the previous section since labor and capital accumulation also contribute to increases in the GDP growth rate. The gap between TFP and the GDP growth rate is particularly large for economies with rapidly increasing workforces (demographics) and investment (for example, Nigeria) and of more limited importance when looking at mature economies where intensive growth (productivity) is the main driver (for example, EFTA).

By construction, TFP is identical between S1 and S2 for the leading economies, and between S0 and S1 for the others. Low-income countries as a group achieve significant productivity gains in all scenarios, especially in S2, with an average annual increase of 3 percent or more. Middle-income economies as a group are the most impacted by the reduction in average productivity gains.

Figure 4.2 Average annual growth rate for TFP between 2011 and 2030



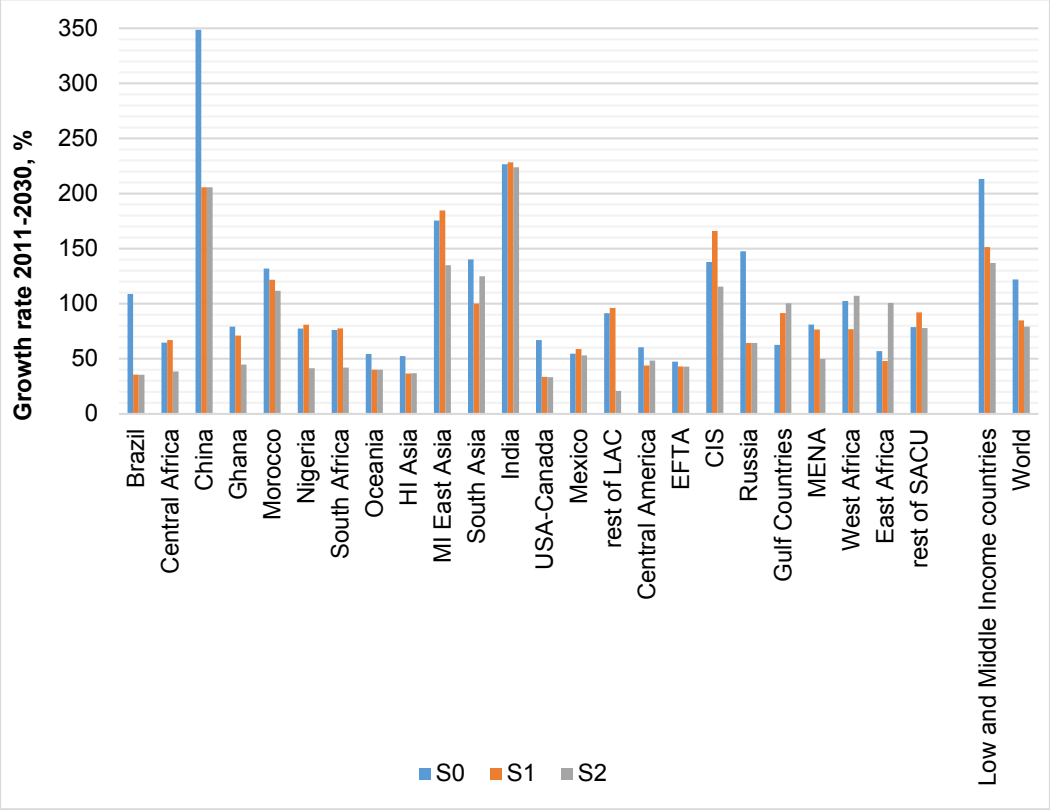
Source: MIRAGRODEP model projections.

Real Unskilled Wages

A first proxy for the impact of these alternative growth paths on the poor is the evolution of the real wage for unskilled labor, a major source of income for poor households. Results displayed in Figure 4.3 show the increase between 2011 and 2030. In our initial scenario (S0), the projections were quite optimistic,

ranging from +57 percent in East Africa to +349 percent in China. The most rapid growth was expected to take place in Asia (South and East), Brazil, and West Africa, with a doubling or more in the real incomes of unskilled workers. Less optimistic scenarios display highly heterogeneous outcomes with countries strongly impacted but still having impressive performance (for example, China); weakly affected but still seeing improvements in the situation of the poor (for example, India); and negatively impacted by the global slowdown (S1) but benefiting from positive domestic dynamics (for example, S2 is better than S1 for South Asia and West Africa as a bloc). For individual and still poor countries such as Ghana, the improvement in unskilled wages is very significantly impacted: +45 percent in S2 versus + 79 percent in S0.

Figure 8 Real unskilled wage rates from 2011 to 2030



Source: MIRAGRODEP model projections.

5. RESULTS

The first step in our analysis is to use the global model to estimate the implications of the growth slowdown for key prices; for aggregate income, and for key outcomes such as agricultural incomes and unskilled wages. We first consider the impacts on world prices, and then turn to the other variables.

Evolution of World Prices

Key results for price changes relative to the US consumer price index (CPI) are shown in Table 5.1.

Table 3.1 World prices: Changes in 2030 compared to the baseline

	S1	S2
Agricultural World Prices		
Vegetable and Fruits	2.22	3.53
Oilseeds	4.81	6.32
Plant Fibers	2.18	1.72
Other Crops	2.88	2.88
Wool	0.17	1.14
Vegetable Oils	1.57	4.05
Processed Food	1.97	2.67
Rice	1.88	2.96
Wheat	3.75	4.00
Other Cereals	2.52	3.90
Sugar	5.36	5.89
Cattle	2.77	2.71
Other Animal Products	3.01	3.36
Fisheries	1.48	2.30
Red Meat	2.59	3.16
White Meat	3.16	3.45
Dairy	1.51	1.79
Non-agricultural World Prices (Selected)		
Energy Commodities	-26.96	-24.36
Mineral Products	-9.30	-8.20
Metal Products	-0.52	0.24
Capital Goods	1.65	1.79
Aggregate World Prices		
Agriculture	2.39	3.19
Manufacturing goods	0.77	1.16
Services	0.82	1.00
Extraction	-22.34	-20.04

Source: MIRAGRODEP model projections.

The most striking change in Table 5.1 is the sharp fall in the prices of mineral products. This reflects the constraints on the adjustment of output for these products created by mineral and oil resource endowments, and their consequent price volatility in response to substantial changes in demand. The situation for agricultural products is quite different. In this case, the impact of lower productivity is to increase prices. The reason for this seemingly paradoxical result is that we are assuming a homogenous reduction in productivity across all sectors as a key driver of growth changes. When agricultural productivity rises in line with productivity in other sectors, the increase in national income results in a smaller-than-proportional increase in demand for agricultural products simply because of Engel's Law. With equal productivity growth across sectors, higher income results in a decline in the relative price of agricultural products. Thus, a slowdown in the rate of growth results in a modest increase in agricultural prices relative to the S0 baseline, the effects being stronger for staple foods (which have low income elasticities relative to those of high-value products such as meat and dairy products). Based on the results

of Ivanic and Martin (2014) and Jacoby (2016), the increase in agricultural prices is likely to have a long-run positive impact on real wages and a favorable effect on poverty reduction.

The prices of manufactures rise slightly relative to the numeraire. The slowdown in growth reduces the demand for these goods more than for agricultural products, tending to push their prices up more than for agricultural products, but the decline in the prices of minerals and fuels helps to hold them down. The average price of services rises under the lower productivity scenario for a similar reason.

Therefore, we see that the global commodity price effects of the economic slowdown captured in S1 and S2 have contrasting outcomes for the poor. Agricultural prices are more resilient to the crisis and will generate higher incomes for farmers, but they also mean higher costs for food consumers. However, as we will see, these price effects can be dominated by the consequences of declines in productivity on the incomes of the poor.

Impacts on Income

The key variables presented in Table 5.2 show a wide range of responses to the slowdown. Real incomes decline considerably, relative to the more optimistic, earlier scenario in S0, in the countries most seriously affected by the slowdown. Thus, under S1, output declines sharply in leading economies such as Brazil, China, Russia, the United States, and Canada. The impacts of this scenario on other economies tend to be small, and to depend upon whether they are suppliers of minerals or agriculture: suppliers of minerals, such as Morocco, tend to lose while suppliers of agricultural products tend to gain.

Regions depending on global demand and still oriented to OECD markets are particularly negatively affected by these pecuniary externalities. These include: West Africa WAEMU (West African Economic and Monetary Union) countries (-18 percent of real income compared to the baseline in 2030), Ghana (-8 percent), South Asia (-18 percent except India, which is very resilient to the external shock), and Central America (-9 percent). It is important to underline that these countries are also affected by a reduction in availability of global savings to fund their growth. Under S2, real incomes fall relative to the baseline scenario in a wider range of countries where growth prospects have been marked down, such as Ghana (-23 percent), Nigeria (-26 percent), South Africa (-21 percent), and South America. Economies such as those in East Africa, where prospects have been upgraded, experience an increase in real income, while India sees essentially no change in income growth rates. For most of the regions already negatively affected the outcome is worse (except for West Africa, which benefits from updated productivity gains), especially for South American countries (up to -38 percent of projected real income), and the MENA (Middle East and North Africa) region (-18.5 percent).

Table 5.2 Key macroeconomic results, % change from baseline

Country/Region	Real income		Agriculture VA		Unskilled wages		Unskilled wages - rural		Real government income		Real inbound remittances	
	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
Brazil	-35	-35.1	-27.3	-27	-34.4	-34.7	-28.8	-28.7	-35.9	-36.2	-12.1	-17.8
China	-30.5	-30.7	-18.4	-18.5	-31.1	-31.3	-24.8	-24.9	-27.5	-27.7	-21.2	-24
Russia	-38.2	-37.8	-32.1	-32	-32.5	-32.6	-33.1	-33.1	-42.1	-41.1	-2.2	-17.5
Oceania	-10.4	-10.5	-1.2	-2.3	-8.9	-9.2	-3.8	-4.7	-10.4	-10.5	-9.1	-10.5
High-income Asia	-10.4	-10.7	-4.9	-5.1	-10.2	-10.5	-5.8	-6.1	-11.5	-11.9	-16.6	-17.7
United States and Canada	-19.4	-19.6	-6.8	-7	-19.9	-20.2	-10.9	-11.2	-20.2	-20.5	-5.3	-9
EFTA (including EU28)	-3.2	-3.7	1.3	1.1	-2.9	-3.4	0.6	0.5	-4.3	-4.8	-6.6	-9.6
Ghana	-8	-23.1	4.4	-11	-3.6	-18.4	2.5	-12.6	-11	-25.9	-3.2	-9
Morocco	-3.2	-8.4	1.9	-2.7	-3.4	-8.3	0.4	-4.1	-5.8	-10.9	-1.5	-4.5
Nigeria	-1.5	-26.3	3	-17.7	2.7	-20	2.8	-18.2	0.3	-24.7	-9.8	-8.6
South Africa	1.1	-21.8	6.8	-11.5	1.4	-21	7.1	-12.1	-0.2	-22.4	-5.5	-2.1
Central Africa	-1	-17.8	19	0.4	1.5	-15.2	10.4	-6.7	2.7	-14.5	-5.4	-15.1
East Asia (excluding leaders)	3.9	-15.5	4.8	-11.3	5.1	-14.1	4.8	-12.4	2.9	-16.1	-4.7	-11.2
Rest of South Asia	-18.8	2.1	-9.2	8.8	-16.5	4.1	-12.8	6.2	-23.1	-4.3	5.4	8.3
India	2.1	0	2.9	1.1	2.2	0	2.7	0.9	-2.1	-4.2	4.4	7.2
Mexico	3.1	-1	4.8	1.9	3.8	-0.2	5.9	2.8	0.2	-2.5	-17.7	-18.6
South America (excluding Brazil)	2.3	-38	5.6	-27.3	3.7	-36.4	5.4	-29.5	1.8	-38.3	-6.9	-22.6
Central America (excluding Mexico)	-8.9	-8.8	-0.2	-2.8	-9.6	-9.7	-3.2	-3.3	-11.8	-11.8	-16.2	-16.4
CIS	8.5	-12.9	11.2	-7.6	13.2	-8.8	11.5	-8.1	8	-14.1	-11.8	-17.8
MENA	-2.9	-18.5	3.3	-10.2	-1.2	-16.7	2.4	-11.8	-4.8	-20	8.3	4
West Africa	-18.8	-3.6	-7.8	7.3	-11.6	3.3	-7.4	7.4	-27.5	-15.2	-7.1	-1.7
East Africa	-6.6	28.6	-1.5	30.1	-4.7	29.2	-2.2	28.5	-8.8	24.9	-2.4	11.3
Rest of SACU	8.4	0.1	7.9	0.7	8.9	0.6	7.9	0.5	7.6	-0.2	-1.7	-18.1

Source: MIRAGRODEP model projections.

Note: CIS = Commonwealth of Independent States; EFTA = European Free Trade Association; MENA = Middle East and North Africa; SACU = Southern African Customs Union.

Under S1, real agricultural value added falls relative to the baseline in countries directly affected by the shock (leading economies), even despite the rise in real agricultural prices. In countries not directly affected by the productivity shock, however, agricultural prices and incomes rise modestly. For these economies, the situation depends on their exact specialization. If they mainly sell products to advanced economies and are not in competition with the products originating in these countries (for example, cocoa), they are net losers, with shrinking markets and stable or declining prices. On the other side, if they produce similar products to the rich countries, they benefit from the deceleration of productivity in developed economies that pushes up the prices of their exports. Gains in agricultural value added relative to the baseline are substantial in middle-income countries such as Ghana (+4.4 percent), South Africa (+6.8 percent), and Mexico (+4.8 percent), and Southeast Asian (+4.8 percent) and South American (+5.6 percent) countries. A few countries, such as those in West Africa and South Asia (except India), have net losses in real agricultural value added, but these results are mainly driven by the overall macroeconomic slowdown. In all cases, agriculture remains more resilient to the crisis, and its value added much less affected than national income. For instance in Central America, real value added in agriculture remains stable (-0.2 percent) while national income falls by 8.9 percent.

Once the (generally) adverse shocks are extended to a broader set of countries in S2, real agricultural value added also falls in many of these countries. The productivity effects dominate and the gains are reduced or losses increased (for example, from +5.6 to -27 percent between S1 and S2 for South America excluding Brazil). Only in regions with upgraded real income growth projections are farmers better off relative to the baseline (for example, West and East Africa). In almost all cases, agriculture appears to be more resilient to the slowdown, with much lower losses than the economy as a whole.

The third variable presented in Table 6 is the average unskilled wage rate relative to the baseline, which is a weighted average of the rural and urban wage rates distinguished in the model. Average real wages follow a similar pattern to real incomes, declining sharply when productivity falls. In S1, the average unskilled wage rage is strongly negatively impacted in West Africa (-11.6 percent on average for WAEMU countries, -3.6 percent in Ghana), in South Asia (except India, -16.5 percent), and in Central America (-9.6 percent), limiting the opportunity for poverty reduction. Other poor countries are not as strongly impacted and some even experience higher real wages (for example, Southeast Asia and the Southern African Customs Union/SACU countries).

In rural areas, the same pattern appears but with generally better outcomes: losses relative to the baseline are smaller (-7.4 percent in West Africa, -13 percent in South Asia other than India, -3.2 percent in Central America) or substantive gains emerge (+7 percent in SACU, +2.5 percent in Ghana, + 5.4 percent in South America, +2.4 percent in MENA, +10 percent in Central Africa). When the updated productivity projections are applied to all countries, these positive effects tend to vanish (except in WAEMU countries, South Asia, and East Africa, where productivity is updated upward). Real rural unskilled wages are cut by more than 10 percent – and up to 30 percent in South America—in many middle-income economies/regions such as Ghana, Nigeria, South Africa, and MENA.

An important source of income for many poor households in developing countries is remittances from people working in other countries. These tend to respond heavily to changes in wage income in the originating countries. As a consequence, inbound remittances to Mexico decline relative to the baseline projection by almost 18 percent under S1, even though real domestic income rises by 3.1 percent under this scenario. For smaller economies more dependent on this resource in Central America, real inbound remittances fall by 16 percent in S1, affecting several families depending on them, and contribute to the average fall in income nationwide (-8.8 percent).

For other regions, the fall of remittances becomes very significant (between 10 and 20 percent) when the productivity reduction affects developing countries too (S2). The crisis in South Africa, Nigeria, and Brazil leads to reduction of 18 percent in this source of income for other SACU countries, 15 percent in Central Africa, and 23 percent for the rest of South America.

Fiscal Space for Developing Countries

Many potential responses to economic downturns require government spending so it is important to examine the changes in government revenues, for which results are given in the fifth column of Table 6. In most cases, the decline in real income is strongly linked with the decline in the real value of GDP. However, in some cases, the decline in government revenues is greater than the decline in real income, as in Russia because of the strong dependence of Russian real income on revenues from energy.

Governments in small, lower-income countries in Central America will face some of the sharpest declines relative to the baseline in their ability to fund investment and social policies requiring government spending, with government revenues 12 percent lower than initially expected in all scenarios. For other poor countries, the situation is challenging—see, for example, West Africa in S1 (-27.5 percent). However, for most low-income countries the main challenges appear in S2, when declines in productivity growth rates occur in these countries. Except in East Africa, African countries will face declines in public resources relative to the baseline (-26 percent in Ghana, -25 percent in Nigeria, -22 percent in South Africa), leading to difficult tradeoffs in a situation where needs will be increasing (see previous section). This illustrates the key role of maintaining long-term reform and structural investment policies to maintain productivity improvements in these countries.

In this context, it important to discuss the fiscal situation in leading economies where fiscal resources will also be scarcer and foreign aid might decline relative to the 2012 income projections. While European fiscal revenues are relatively resilient relative to the baseline (-4.5 percent on average), North America is more impacted (-20 percent) and newer players such as China (-27 percent) may become less likely than in the baseline to emerge as key donors.

Impacts at the Household Level

Figure 5.1 shows the estimated global poverty rate in 2030 under each of our three scenarios. In each case, the real income of each household changes over time in response to: changes in business incomes (driven by productivity growth); changes in wage rates for households selling labor; and changes in the cost of living and the evolution of income from household business activities. Because our long-run scenarios include substantial economic growth over the period to 2030, the poverty rates under all of these scenarios are substantially below current levels.[3] The first bar in each set of three shows the poverty rate, defined as the share of the population below $1.90 a day, using the 2011 PPP definition, under the baseline assumptions. As expected the poverty rate among farmers is higher than the rate among the population at large. Interestingly, however, the poverty rate is higher for the rural population more broadly than among farmers—with higher poverty rates amongst groups such as the landless poor outweighing lower poverty rates among higher-income groups like teachers living in rural areas.

Net Global Poverty Impacts

The decline in poverty under the baseline scenario (S0) is very similar to the decline in the World Bank (2015) report on the prospects for achieving the goal of reducing global poverty to 3 percent. Our projection based on the 2012 outlook put poverty in 2030 at 4.79 percent, where the World Bank study (page 17) put its median value based on past growth experience at 5.1 percent. Examination of our individual-country results in Table A.2 and the World Bank regional results (page 42) indicate that poverty rates are projected to be very low in all regions except Africa south of the Sahara and South Asia, and only substantial (above 5 percent) in Africa south of the Sahara. On one level, this scenario is enormously encouraging, implying a reduction of two-thirds in the poverty rate from its level in 2011

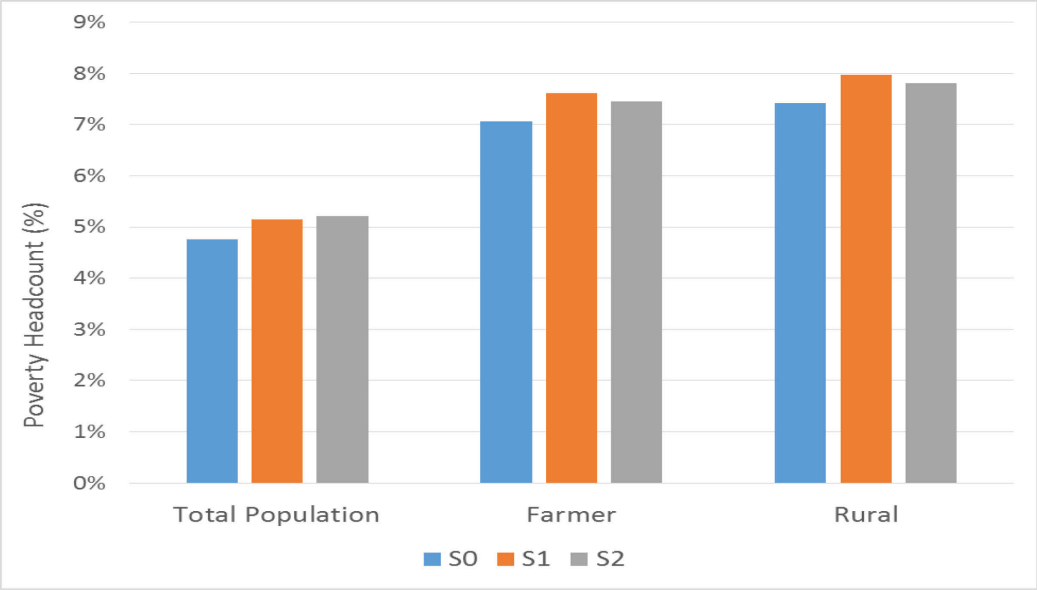
[3] If we keep constant the poverty rate for each country, but factor in the heterogeneous demographic growth pattern, the global average poverty headcount in 2030, without considering economic growth, would reach 20 percent, compared to the 2012 level of 13 percent. This illustrates the importance of rapid population growth in the poorest areas of the planet. However, economic growth reduces this global rate to 4.79 percent with no update in the poverty line definition.

(World Bank 2015a, 41). On another level, this poverty rate is substantially above the 3 percent level that the Bank study uses as a possible criterion for success in achieving SDG 1.

Comparing our scenarios, we see that S1 involves a slowdown in the decline in global poverty relative to the sharp decline under the baseline scenario—with the poverty headcount falling only to 5.21 percent, rather than to the originally projected 4.79 percent. This is an increase of 8 percent from the initial projection, representing 34 million people not lifted out of extreme poverty. For farmers, the increase is larger in absolute terms, but slightly smaller as a share of the initial poverty projection. For the rural group, dominated by farmers, the increase is from 7.15 percent under the baseline to 7.74 percent. When we turn to S2, the overall poverty rate goes up slightly at the whole-country level (38 million fewer people are lifted out of extreme poverty compared to the baseline), but declines slightly for the farmer-headed and rural groups. This decline reflects improvements in the growth outlook in a number of African and South Asian countries noted in Figure 4.2, which contribute to stronger employment growth and poverty reduction in these countries, together with the modest increases in agricultural prices presented in Table 5.1. It also reflects the near elimination of poverty in many countries with substantial numbers of poor people today—with poverty rates below 4 percent in India and as low as 1 percent in Bangladesh under the baseline scenario.

This generally optimistic global view should not, however, lead to complacency. Examination of the country-level results in Table A.2 shows how far the projected outcome would be from the SDG goal of complete elimination of poverty. The four countries with the highest projected poverty rates in our sample—Tanzania with 47 percent, Nigeria with 41 percent, Zambia with 40 percent, and Malawi with 31 percent—would be far from the goal of eliminating poverty. The average poverty rate projected for these four countries is, unfortunately, less than 30 percent of the way from today's level to the goal of poverty elimination.

Figure 5.1 Global poverty headcount under alternative scenarios by 2030 (%)



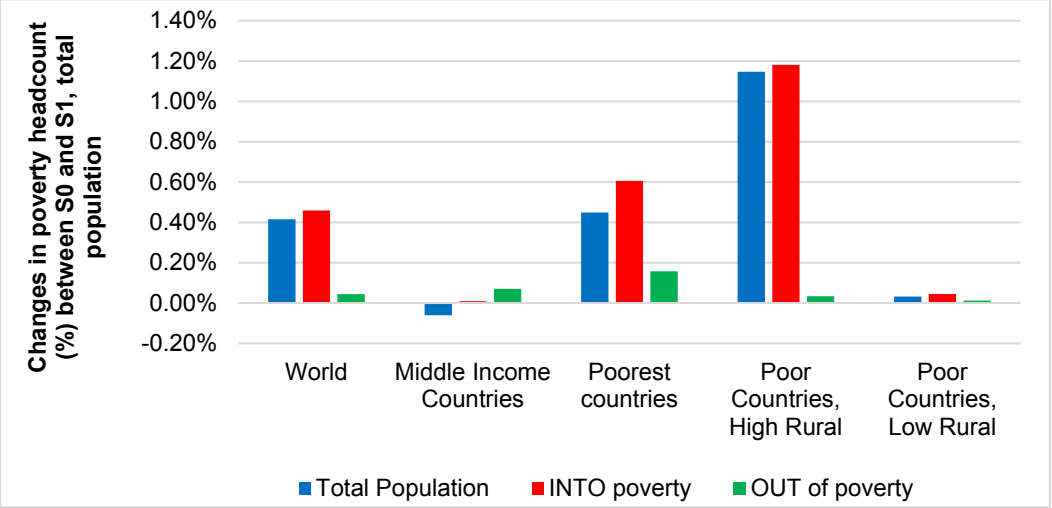
Source: Authors' calculations.
Note: Poverty is defined by the $1.90 PPP 2011 threshold. The 2014 global poverty level is equal to 13 percent.

Gross Global Poverty Impacts

Figure 5.2 presents the net changes in overall poverty between the original forecast values and S1, both at the global level and for four regions that were found useful in organizing the data. It contrasts these net

changes with the gross movements into and out of poverty for the same regional groups. While economists tend to focus on the net movement of people into or out of poverty, policy makers may—given the well-known tendency for people (and voters) to focus more on losses than on gains—be more concerned with the gross movement of people into poverty than with the net changes. A key finding is that for the world and for three of the four groups, the net change in poverty is very similar to the gross flow, with few people rising out of poverty. However, for the poorest country group, important offsetting changes occur, with 0.61 percent of the population falling into poverty and 0.16 percent rising above the poverty line, for a net increase of 0.45 percentage points.

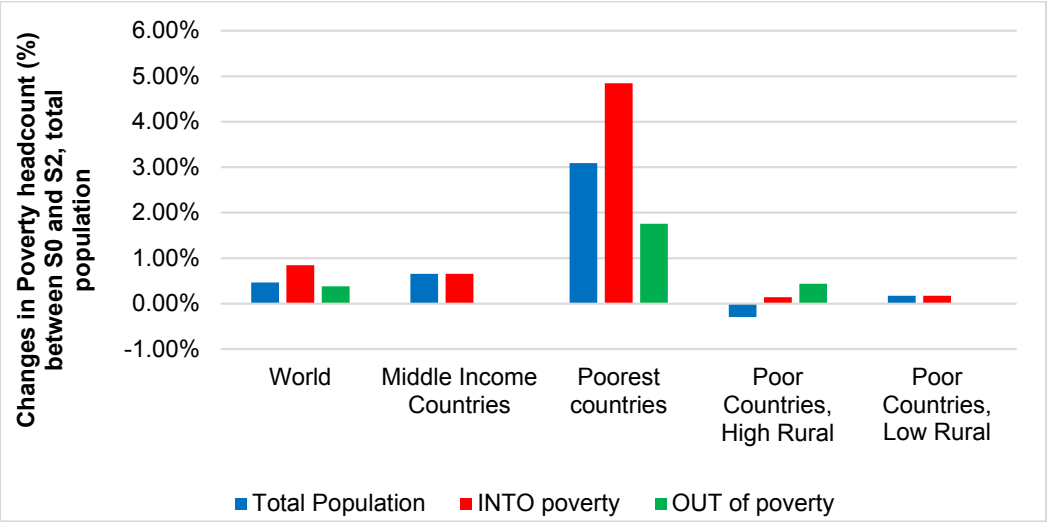
Figure 9 Net and gross movements into and out of poverty relative to baseline, scenario 1, percentage points, total population



Source: Authors' calculations.
Note: Poverty is defined by the $1.90 PPP 2011 threshold. Country grouping refers to our cluster analysis (see Appendix for details).

When we consider changes in the broader set of countries covered by S2, Figure 5.3 shows a strikingly different picture. While the change in the overall poverty rate relative to the baseline is in the same order of magnitude for the population as a whole (0.47 versus 0.42 percent), some of the gross flows into poverty are substantially larger. In particular, the movement into poverty relative to the baseline in the poorest countries is, at 4.85 percentage points, much larger than anything seen in previous analyses. This is offset by a 1.76 percentage point gross movement out of poverty, but the result is still a net increase in poverty in this country group of over 3 percentage points.

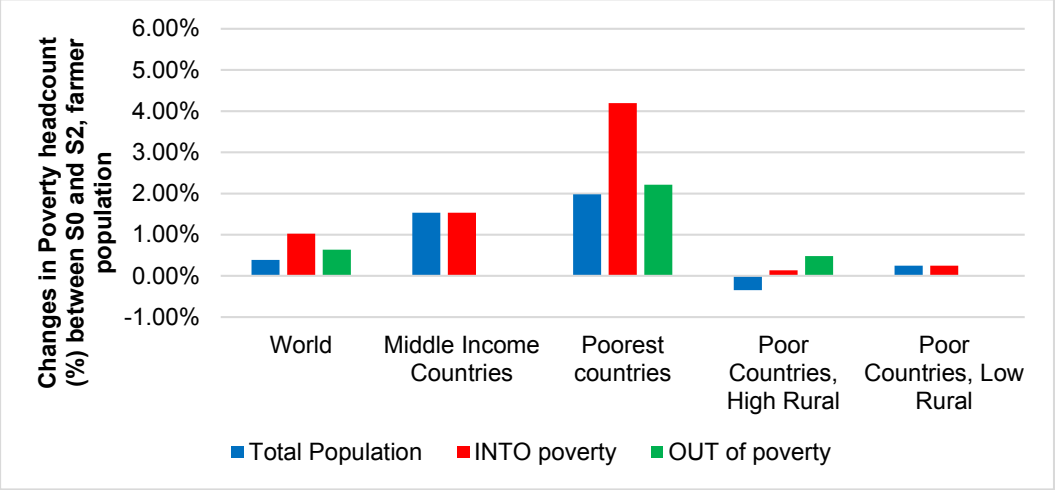
Figure 5.3 Net and gross movements into and out of poverty, scenario 2, percentage points, total population



Source: Authors' calculations.
Note: Poverty is defined by the $1.90 PPP 2011 threshold. Country grouping refers to our cluster analysis (see Appendix for details).

When we focus on households headed by farmers, Figure 5.4 reveals a broadly similar picture, with the biggest impacts on poverty relative to the baseline in the poorest countries, and the (substantial) net increase in poverty being a consequence of a large gross movement into poverty (over 4 percentage points) and a substantial group (over 2 percentage points) moving out of poverty. In middle-income countries, the net poverty rate increases substantially (1.5 percentage points), with almost no farm families moving out of poverty.

Figure 5.4 Net and gross movements into and out of poverty, scenario 2, percentage points, farmer population

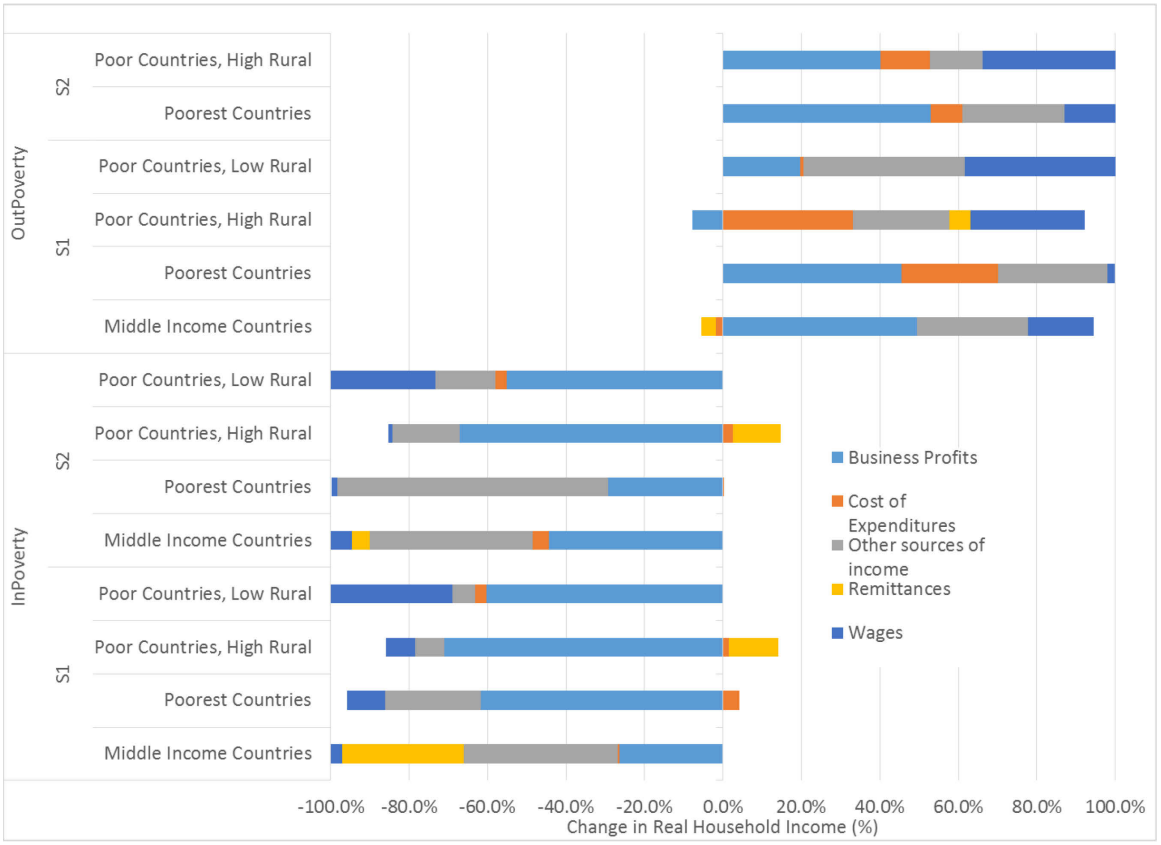


Source: Authors' calculations.
Note: Poverty is defined by the $1.90 PPP 2011 threshold. Country grouping refers to our cluster analysis (see Appendix for details).

Heterogeneous Drivers

To help understand the causes of the large movements into and out of poverty relative to the baseline, it is useful to look at the sources of the changes in income that resulted in households moving the way that they did. In Figure 5.5 , we first examine the changes in income that helped households move out of poverty, and then turn to the changes in income that resulted in households initially above the poverty line falling into poverty. For the sizeable group rising out of poverty in the poorest countries, the most important change was an increase in the business profits of smallholders. In some cases, this resulted from households increasing their sales on the market. However, another element of this rise in income involves households increasing their farm output and reducing their net purchases from the market. In the other group of countries in which lifting households out of poverty made an important contribution to the global poverty outcome—the low-income countries—both increases in farm incomes and in wages for labor sold outside the farm firm were important. When we turn to the households falling into poverty, the largest change is in the poorest countries, and the largest identifiable contribution to this decline is a reduction in sales by smallholders.

Figure 5.5 Relative contributions of different drivers in the change of household real income, breakdown by poverty movement, scenarios 1 and 2 relative to scenario 0



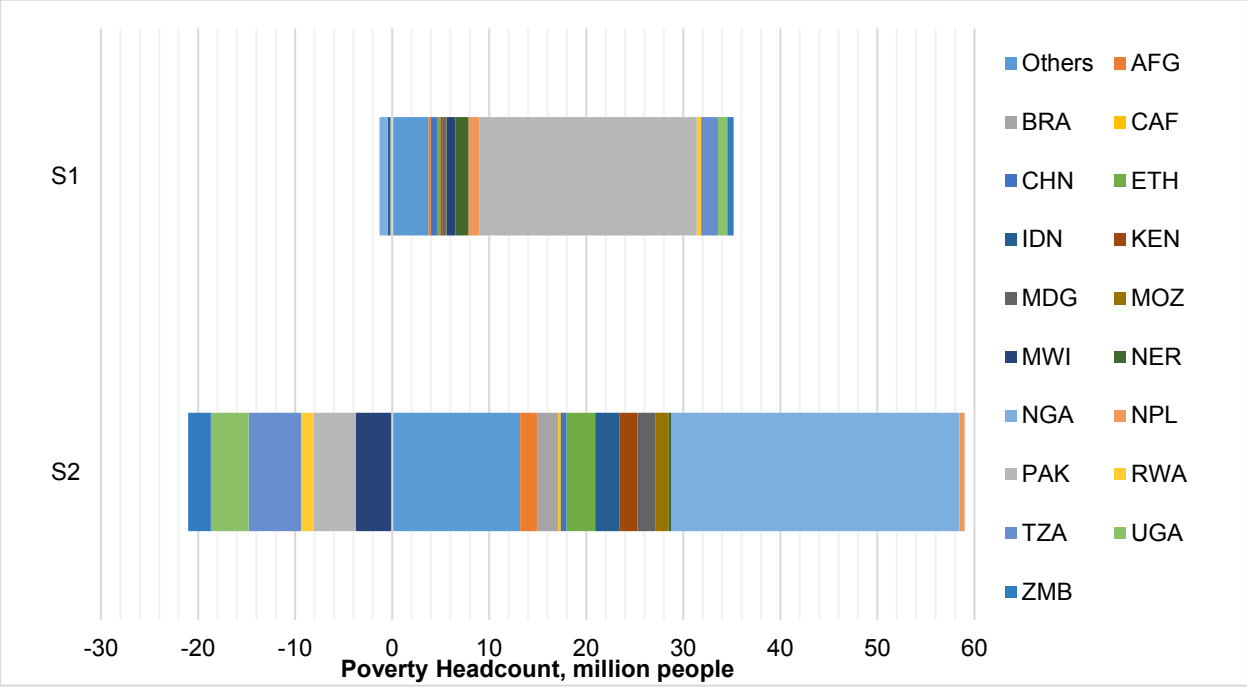
Source: Authors' calculations.

Main Countries Contributing to Global Poverty Changes

Figure 5.6 shows that Pakistan has the largest number of people who would have escaped from poverty under the baseline, but no longer do so under S1, with over 22 million people. Due to its population size, the size of the shock, and the vulnerability of many Nigerians to poverty (see Table 5.2), Nigeria has the most people no longer escaping poverty under S2, with 29 million people who would have risen from

poverty under S0 now remaining mired in poverty. Ethiopia, Indonesia, and Kenya are also hit hard under this scenario. By contrast, poverty falls substantially in Pakistan, Tanzania, Uganda, and Zambia. Detailed country level results are available in the Appendix.

Figure 5.6 Changes in the number of poor people by country ('000s) compared to the 2030 baseline (S0)



Source: Authors' calculations.
Note: 3-letter International Organization for Standardization (ISO) codes are used to identify key countries.

Sensitivity to Sectoral TFP Growth Rates

Thus far in the analysis we have considered the implications of productivity growth rate changes that are uniform across sectors. This assumes that the causes of the slowdown (or, in some cases, improvements in productivity growth) operate in the same way across sectors perhaps because some of the fundamental shocks to growth, such as constraints on access to finance, are likely to affect output levels in all sectors. This assumption is given empirical support by a recent OECD study (2016a, 10) that finds the declines in productivity to have been broadly spread across sectors, with perhaps somewhat larger declines in some financial and professional sectors that are unlikely to be major sources of income for the poor.

As a guide to the robustness of our analysis to the assumption of uniform productivity growth across sectors, in this section, we allow for the possibility that poverty impacts may differ depending upon whether the productivity changes are biased towards agriculture or non-agriculture. We do this because of the considerable evidence pointing to higher sensitivity of poverty outcomes to growth in agriculture than in non-agriculture (for example, Ravallion and Datt 1996; Loayza and Raddatz 2010). To see this in simple, stark terms, we focus on cases where productivity changes by the same amounts as in S1 and S2, but only in one sector of the economy at a time, and then together.

As we move along the diagonal in Table 5.3, we see a pattern consistent with Figure 5.1, with poverty rising by around 0.4 percentage points as we move from S0 to S1, and rising by a smaller amount as we move to S2. For agriculture, we see a sizeable increase in poverty as we move from S0 to S1, with lower agricultural productivity in large, leading economies, and China in particular. In this case, the incomes of large groups of farmers in China are adversely affected by the productivity slowdown. In

addition, declining agricultural productivity raises food prices and hence raises the cost of living for many poor households worldwide, especially in West Africa. As we move to S2, however, global poverty declines slightly. This result reflects the fact that a number of lower-income countries in regions such as East Africa have higher agricultural productivity growth than under S1. This raises agricultural incomes without sharply depressing world prices for agricultural products so that most of the poverty reduction comes about through higher farm incomes.

The fact that our estimated impacts on poverty are higher for the same decline in productivity when the adverse productivity shock occurs in non-agriculture—see particularly the move from S0 to S1—was somewhat of a surprise to us. It reflects the much larger size of the non-agriculture sector relative to the agriculture sector in most economies. It also reflects the fact that our results take into account the growth impacts of the change, with lower growth resulting in additional downward pressure on wages because of the reduction in the capital stock per worker at the end of the period under study. Indeed, overall growth is more affected by the non-agricultural GDP slowdown, and by the consequent declines in investment, both public and private, in this case.

Table 5.3 Global poverty headcount under alternative scenarios by 2030, percentage, total population

		Agriculture sector TFP		
		S0	**S1**	**S2**
Non-agricultural sector TFP	**S0**	4.79	4.92	4.77
	S1	5.28	5.20	
	S2	5.31		5.26

Source: Authors' calculations.
Note: Poverty is defined by the $1.90 PPP 2011 threshold. The 2014 global poverty level is equal to 13 percent.

The results in Table 5.3 are somewhat surprising given the strong evidence from past research that increases in agricultural productivity generate greater benefits in terms of poverty reduction than do equivalent reductions in non-agricultural productivity (see, for example, Ravallion and Datt 1996; Loayaza and Raddatz 2010; Ivanic and Martin 2016). The difference in results may reflect a number of factors, including the fact that productivity increases in some countries under S2, and that the experiment focuses on productivity growth rates by sector, rather than—as in the earlier studies—on the productivity growth in different sectors that yields the same increase in national GDP. To examine the underlying forces for poverty reduction in a way more comparable with earlier studies, we examined the impact of a 1 percent change in GDP emanating from agriculture and from growth outside agriculture. The results presented in Table 5.4 confirm the results from earlier studies: more rapid growth focused in agriculture has a bigger impact on poverty reduction than growth outside agriculture. As might be expected, this result is particularly strong for farmer-headed households. Given the small—and declining—share of agriculture in the world economy, however, a 1 percent increase in GDP now requires a larger increase in agricultural TFP than in non-agricultural TFP. In 2012, the required change in agricultural GDP for a 1 percent change in low- and middle-income economies is 8.4 percent. By contrast the required change in the much larger non-agriculture sector would be 1.2 percent.

Table 5.4 Percentage point reduction in global poverty in 2012 with a 1% increase in GDP in low- and middle-income economies, %

	Overall	**Agriculture**	**Non-Agriculture**
All households	-0.26	-0.37	-0.23
Farmer-headed	-0.44	-0.59	-0.38

Source: Authors' calculations.
Note: Poverty is defined by the $1.90 PPP 2011 threshold. The 2014 global poverty level is equal to 13 percent.

Changes in the Poverty Line

All of the results presented to this point have retained the internationally standard benchmark of $1.90 per person per day at 2011 prices currently used by the World Bank. This means that poverty rates fall to very low levels in many countries by the end of the simulation period. Since this poverty rate is based on the poverty rates chosen by 15 poor countries (Ferreira, Jolliffe, and Prydz 2015), it seems likely that this internationally accepted poverty rate will change as the incomes of the poorest countries rise from today's levels. To assess whether our results are sensitive to the choice of poverty line, we considered a poverty line double the current international standard. The resulting poverty lines and poverty rates are presented in Table 5.5.

These results show that the poverty rate in 2030 is strongly affected by the poverty line. If the poverty line is doubled from $1.90 to $3.80, the 2030 levels of poverty are roughly double those at the current poverty line. The effects of the productivity growth slowdown (in percentage point terms) also roughly double when we move to the higher poverty line. However, there are no changes in the qualitative nature of the impacts.

Table 5.5 Effects of different poverty lines in S0, S1, and S2 on global poverty rate in 2030, %

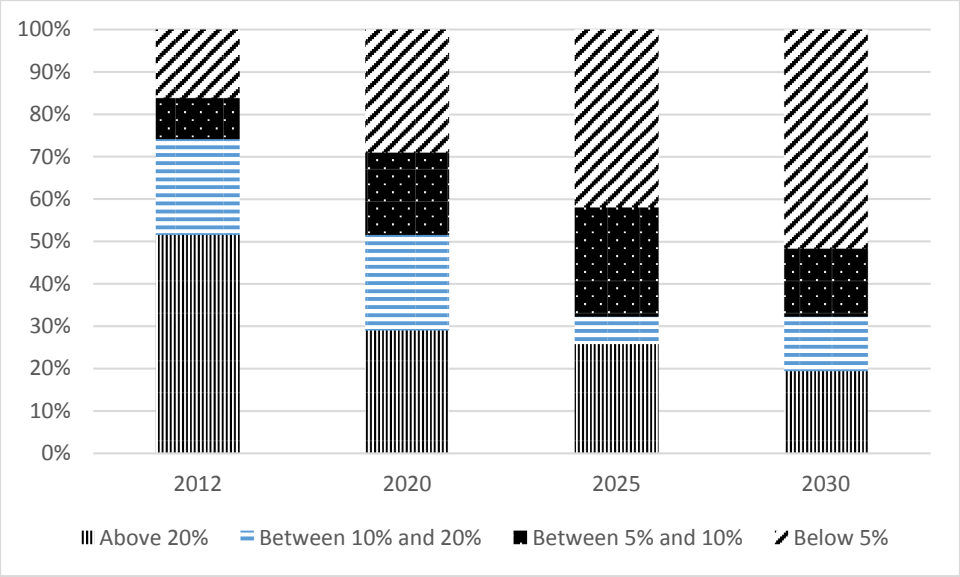
Scenarios	$1.90 poverty line	2030 poverty line defined at $3.80
Total population		
S0	4.79	10.19
S1	5.21	11.02
S2	5.26	11.29
Farmer population		
S0	6.79	13.63
S1	7.38	14.82
S2	7.18	14.76
Rural population		
S0	7.15	14.72
S1	7.74	15.85
S2	7.52	15.77

Source: Authors' calculations.

The Remaining Challenges

The small changes in global poverty rates between S0, S1 and S2 reported in Figure 5.1 are important findings of the study, and worthy of more detailed analysis. One might have expected such a sharp deterioration in the outlook to result in a much sharper increase in poverty in 2030. A key reason for the limited response to the change is that, by 2030 under the baseline scenario, many fewer countries will have high poverty headcounts, and many fewer people in these countries will be near the poverty line and hence vulnerable to falling into poverty following a deterioration in growth. If we focus on the 29 countries for which we used actual data to estimate the poverty impacts, we see in Figure 5.7 that just over half had poverty rates above 20 percent in 2012, while only 16 percent had poverty rates below 5 percent. Under the baseline scenario, however, the share of countries with poverty rates above 20 percent falls to just under 20 percent, while the share with poverty rates below 5 percent rises to 52 percent.

Figure 5.7. The distribution of poverty rates across sample countries, S0



Source: Based on the 29 sample countries with full household data.

This generally optimistic global view should not, however, lead to complacency. Examination of the country-level results shows how far the projected outcome under S2 would be from the SDG goal of complete elimination of poverty. The 10 countries with the highest projected poverty rates under S2 have an average poverty headcount of 24.2 percent in 2030 (Table 5.6). Even in these countries, considerable progress will have been made toward the goal of poverty elimination, with the simple average poverty rate falling by 49 percent between today's levels and 2030. However, this means that under this business-as-usual scenario, these countries would be less than halfway toward achieving the goal of eliminating poverty. Of note is the fact that 9 of these 10 countries are in Africa, where demographic pressures are placing downward pressures on farm size and growth prospects are not projected to be rapid enough to bring about the complete elimination of poverty. Some of these countries, such as Zambia and Sierra Leone are hit quite hard by the downturn in the leading economies under S1, whereas for others, such as Nigeria, it is the slowdown in their own economies under S2 that has the bigger impact. Clearly, this analysis points to a serious, but relatively geographically focused, challenge to the SDG goal of eliminating extreme poverty and hunger.

These results suggest strongly that business as usual will not be enough to achieve the SDG goals of eliminating extreme poverty and hunger. Targeted policies for poverty reduction seem likely to be needed in the countries where growth alone is unlikely to achieve this goal. Such policies are likely to include investments designed to raise the incomes of people vulnerable to poverty and measures—such as social safety nets—designed to reduce their vulnerability to shocks.

Table 5.6. Poverty rates currently and in 2030 for the 10 sample countries with the highest poverty rates under S2 (%)

Country	Current	S0	S1	S2
Tanzania	46.6	53.7	55.8	47.1
Zambia	64.4	51.5	54.1	42.0
Nigeria	53.5	29.1	28.8	40.6
Malawi	70.9	44.6	47.8	31.3
Rwanda	60.3	38.1	40.7	30.5
Sierra Leone	52.3	12.8	20.6	13.7
Uganda	33.2	18.3	19.9	11.8
Niger	50.3	9.4	13.8	10.4
Côte d'Ivoire	29.0	7.7	10.1	8.0
Belize	13.9	6.5	7.0	6.7
Average	47.4	27.2	29.9	24.2

Source: Authors' estimates; current estimates are the latest available from the World Bank's Povcalnet website, accessed August 17, 2016.

6. CONCLUSIONS

The recent sharp downward revisions in the prospects for global economic growth, and for growth in many developing countries, add up to a substantial long-term deterioration of the outlook for many developing countries. Even countries that are not directly affected by productivity changes are likely to be affected by the changes in commodity prices and in CABs associated with this productivity slowdown.

To assess the likely consequences of this growth slowdown for the achievement of SDG 1 by 2030, we compare the most recent IMF forecasts for economic growth to 2017 with those from an earlier and more benign environment—in 2012—and assume that the changes in projected growth rates from the latter part of each of the five-year projection periods are continued to 2030. The resulting changes in the level of GDP are very substantial. They point to sharply reduced growth prospects for many developing countries, particularly relative to the period of more rapid economic growth in developing countries and of income convergence between poor and rich countries experienced since the 1990s.

In this paper, we assess the implications of these changes for the poor—and particularly the rural poor, who tend to be the poorest of the poor—of such a sharp deterioration in the economic outlook. We do this by first projecting the implications of the global growth slowdown at a national level—including reductions in productivity growth rates and the consequential shifts in economic balances and changes in relative prices. Then, we use household models for over 285,000 households to assess the implications of these changes for the poor. These models let us assess the impacts of productivity changes within households' farm firms, and the real income changes associated with changes in real wage rates for labor sold by households and changes in the prices received and paid for food.

We find that the changes in poverty rates associated with this growth slowdown are serious, but perhaps not as serious as might have been expected given the size of the productivity slowdown. Our projection for the global poverty headcount in 2030 is 4.8 percent under the original, optimistic scenario and rises to 5.2 percent under our projection based on more recent forecasts. The relatively small change in the overall poverty headcount reflects the fact that poverty rates in most countries with large numbers of poor people today are projected—under the baseline—to move very close to zero by 2030, leaving relatively few people vulnerable to poverty even under a sizeable deterioration of the macroeconomic outlook such as that considered in this paper. It also reflects the modest improvement in the outlook for a number of countries—especially in parts of Africa south of the Sahara and South Asia—where substantial numbers of vulnerable people are projected to remain under the baseline. While the apparent robustness of the global poverty outcome to the deterioration in the growth outlook is encouraging, poverty rates remain very high even in 2030 in a number of countries. The fact that the poverty rate would move even further away from the SDG goal of eliminating poverty is a serious concern and highlights the need for a strong focus on poverty reduction if this critically important goal is to be achieved.

The effects of the growth slowdown are particularly sharp in the poorest countries. In these countries, there are also very substantial gross changes in poverty, with over 5 percent of the population falling into poverty relative to the baseline, while another 3 percent are able to rise out of poverty, for a net increase in poverty of 2 percent from the original forecast. When we focus on households headed by farmers, the most striking change is a substantial increase in poverty in the poorest countries, with over 4 percent of the farm population no longer lifted out of absolute poverty as a consequence of this growth slowdown. Examination of the detailed results in the Appendix suggest that most of the countries with large numbers of vulnerable people remaining in 2030 are in Sub-Saharan Africa or South Asia.

This analysis highlights the potential power of the framework utilized for this analysis to capture the implications for the poor of a wide range of shocks, such as changes in economic growth, changes in weather and climatic conditions, changes in food prices, and changes in technology. By using economy-wide models to capture the implications of the original shocks for key variables affecting households—such as changes in productivity, changes in commodity prices, and changes in factor prices—and then passing these changes to household simulation models, this modeling approach allows us to capture the

impacts on poor people at national and global scales, rather than to focus only on national aggregates that are likely to be of little interest to policy makers.

Given the overwhelmingly rural and agricultural nature of poverty in the developing world, attention has frequently focused on research designed to raise agricultural productivity, which past research has suggested is disproportionately effective in reducing poverty (Ravallion and Datt 1996; Loayza and Raddatz 2010; Ivanic and Martin 2016). Our analysis finds this still to be the case over the period to 2030 in relative terms, with a 1 percent increase in GDP resulting from productivity growth in agriculture having a substantially greater poverty-reduction impact than 1 percent growth achieved elsewhere. However, over this long haul, the decreasing size of the agriculture sector results in a 1 percent increase in agricultural GDP having a smaller poverty-reduction impact than a 1 percent increase in non-agricultural GDP. The combination of the very high intensity of poverty reduction from agricultural productivity growth and the high estimated rates of return on investments in agricultural research and development (Alston et al. 2000) make it likely that these investments will remain very cost-effective in poverty reduction.

The results of this analysis reinforce the message of the World Bank (2015) report on the achievability of the goal of eliminating poverty by 2030. It will be a challenging goal, for which business-as-usual will not be enough. Identifying the right policies and investments to achieve this goal—especially in sub-Saharan Africa and South Asia—will remain vitally important. These policies are likely to include investments designed to raise the incomes of rural people vulnerable to poverty and measures—such as social safety nets—designed to reduce vulnerability to shocks.

APPENDIX: SUPPLEMENTARY TABLES

Table A.1 Cluster composition (ISO 3 country code): Country groupings

Cluster 1: Middle-income countries	ABW, ARG, ATG, BRA, BRB, BRN, COL, CRI, CUB, DJI, DMA, DOM, DZA, **ECU**, GRD, GUY, IRN, IRQ, JOR, KNA, LBY, MAR, MEX, MHL, **MNG**, MYS, OMN, **PAN**, **PER**, SLV, SYR, TTO, TUN, VEN, WBG
Cluster 2: Poorest countries	AFG, BDI, BEN, BFA, **BGD**, CAF, COM, ERI, ETH, GIN, GNB, HTI, KEN, LAO, LBR, LSO, MDG, MDV, MLI, MOZ, **NGA**, PNG, SEN, **SLE**, SWZ, TCD, TGO, **TLS**, **TZA**, **UGA**, ZAR, **ZMB**, ZWE
Cluster 3: Countries with no significant poverty level	ADO, ARE, AUS, AUT, BEL, BHR, BHS, BMU, CAN, CHE, CHL, CYP, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, GRL, HKG, HRV, HUN, IMY, IRL, ISL, ISR, ITA, JPN, KOR, KSV, KWT, LBN, LTU, LUX, LVA, MAC, MCO, MLT, NLD, NOR, NZL, PLW, POL, PRI, PRT, QAT, SAU, SGP, SMR, SWE, TUR, URY, USA
Cluster 4: Poor countries, high rural	AGO, BIH, BTN, BWA, CHI, **CIV**, CMR, COG, CPV, EGY, FSM, GAB, GHA, GMB, GNQ, **IND**, KGZ, **KHM**, LIE, **LKA**, MRT, MUS, **MWI**, NAM, **NER**, **NPL**, **PAK**, **RWA**, SDN, STP, SYC, **TJK**, TON, UZB, **VNM**, VUT, WSM, **YEM**, ZAF
Cluster 5: Poor countries, low rural	**ALB**, **ARM**, AZE, BGR, BLR, **BLZ**, BOL, **CHN**, FJI, GEO, **GTM**, HND, **IDN**, JAM, KAZ, KIR, **MDA**, MKD, MNE, **NIC**, PHL, PRY, ROM, RUS, SRB, SUR, SVK, SVN, THA, TKM, TUV, UKR

Source: Authors' calculations.

Note. These clusters were created with STATA's kmeans command. The countries with household survey data are shown in bold.

Table A.2 Total, farmer, and rural poverty rates predicted under S0, S1, and S3: Country-level results

		Poverty rate, total population			Poverty rate, farmer population			Poverty rate, rural population			Changes in number of poor people (1000)	
ISO	*Country*	*S0*	*S1*	*S2*	*S0*	*S1*	*S2*	*S0*	*S1*	*S2*	*S1*	*S2*
ABW	Aruba	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.1%	0.1%	0.2%	**-0.01**	**0.06**
AFG	Afghanistan	23.7%	24.1%	27.1%	22.7%	23.2%	24.6%	23.6%	24.1%	25.5%	**226.46**	**1,810.94**
AGO	Angola	9.8%	11.5%	8.9%	8.6%	10.6%	8.0%	9.3%	11.4%	8.7%	**524.43**	**-292.80**
ALB	Albania	0.3%	0.3%	0.4%	0.4%	0.4%	0.5%	0.3%	0.3%	0.3%	**0.00**	**3.20**
ARG	Argentina	0.2%	0.2%	0.3%	0.3%	0.3%	0.7%	0.3%	0.3%	0.6%	**-6.84**	**67.34**
ARM	Armenia	0.3%	0.3%	0.4%	0.4%	0.3%	0.4%	0.3%	0.3%	0.4%	**-1.16**	**2.76**
ATG	Antigua and Barbuda	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.1%	0.1%	0.2%	**0.00**	**0.04**
AZE	Azerbaijan	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	**0.10**	**0.78**
BDI	Burundi	36.2%	36.8%	41.4%	34.6%	35.4%	37.6%	36.0%	36.7%	38.9%	**74.28**	**593.96**
BEN	Benin	21.1%	21.4%	24.1%	20.2%	20.6%	21.9%	21.0%	21.4%	22.7%	**55.28**	**442.05**
BFA	Burkina Faso	19.8%	20.2%	22.7%	19.0%	19.4%	20.6%	19.7%	20.1%	21.4%	**103.65**	**828.90**
BGD	Bangladesh	1.0%	0.9%	1.2%	0.3%	0.3%	0.5%	1.1%	1.1%	1.4%	**-80.91**	**424.81**
BIH	Bosnia and Herzeg.	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	**0.04**	**-0.02**
BLR	Belarus	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	**0.02**	**0.15**
BLZ	Belize	6.5%	7.0%	6.7%	8.7%	9.3%	8.7%	7.1%	7.6%	7.1%	**2.02**	**0.57**
BOL	Bolivia	0.6%	0.6%	0.8%	0.6%	0.6%	0.9%	0.6%	0.6%	0.8%	**4.49**	**34.92**
BRA	Brazil	1.3%	1.2%	2.2%	2.0%	1.9%	4.4%	1.8%	1.7%	3.9%	**-215.1**	**2,119.05**
BRB	Barbados	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.1%	0.1%	0.2%	**-0.02**	**0.15**
BRN	Brunei Darussalam	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.1%	0.1%	0.2%	**-0.03**	**0.28**
BTN	Bhutan	1.8%	2.2%	1.7%	1.6%	2.0%	1.5%	1.8%	2.1%	1.6%	**2.88**	**-1.61**
BWA	Botswana	5.6%	6.6%	5.1%	4.9%	6.1%	4.6%	5.4%	6.6%	5.0%	**22.95**	**-12.82**
CAF	Central African Rep.	28.0%	28.5%	32.0%	26.8%	27.4%	29.0%	27.8%	28.4%	30.1%	**31.93**	**255.30**
CHN	China	0.0%	0.1%	0.1%	0.0%	0.1%	0.1%	0.0%	0.1%	0.1%	**601.56**	**601.56**
CIV	Cote d'Ivoire	7.7%	10.1%	8.0%	11.2%	14.0%	11.1%	10.2%	12.6%	10.2%	**710.61**	**78.40**
CMR	Cameroon	1.7%	2.0%	1.6%	1.5%	1.9%	1.4%	1.6%	2.0%	1.5%	**86.35**	**-48.21**
COG	Congo, Rep.	9.8%	11.5%	8.8%	8.5%	10.5%	7.9%	9.3%	11.4%	8.7%	**104.63**	**-58.42**
COL	Colombia	1.7%	1.5%	3.0%	2.7%	2.6%	5.8%	2.4%	2.3%	5.2%	**-73.73**	**726.18**

Table A.2 Continued

		Poverty rate, total population			Poverty rate, farmer population			Poverty rate, rural population			Changes in number of poor people (1000)	
ISO	***Country***	***S0***	***S1***	***S2***	***S0***	***S1***	***S2***	***S0***	***S1***	***S2***	***S1***	***S2***
COM	Comoros	20.5%	20.9%	23.5%	19.6%	20.1%	21.3%	20.4%	20.8%	22.1%	**4.27**	**34.15**
CPV	Cabo Verde	3.8%	4.5%	3.4%	3.3%	4.1%	3.1%	3.6%	4.4%	3.4%	**3.88**	**-2.16**
CRI	Costa Rica	0.6%	0.6%	1.1%	1.0%	1.0%	2.2%	0.9%	0.9%	2.0%	**-2.82**	**27.80**
CUB	Cuba	0.4%	0.4%	0.8%	0.7%	0.7%	1.5%	0.6%	0.6%	1.4%	**-3.72**	**36.62**
DJI	Djibouti	3.9%	3.6%	6.8%	6.2%	6.0%	13.4%	5.5%	5.3%	12.0%	**-3.78**	**37.24**
DMA	Dominica	0.3%	0.3%	0.5%	0.5%	0.5%	1.0%	0.4%	0.4%	0.9%	**-0.02**	**0.15**
DOM	Dominican Republic	0.5%	0.4%	0.8%	0.7%	0.7%	1.6%	0.7%	0.6%	1.4%	**-4.29**	**42.28**
DZA	Algeria	1.4%	1.3%	2.5%	2.2%	2.2%	4.8%	2.0%	1.9%	4.3%	**-46.91**	**462.05**
ECU	Ecuador	0.8%	0.8%	2.3%	2.9%	2.8%	7.5%	2.0%	1.9%	5.3%	**-7.53**	**275.40**
EGY	Egypt, Arab Rep.	0.3%	0.4%	0.3%	0.3%	0.3%	0.2%	0.3%	0.4%	0.3%	**56.43**	**-31.50**
ERI	Eritrea	18.9%	19.3%	21.6%	18.1%	18.5%	19.7%	18.8%	19.2%	20.4%	**28.51**	**228.00**
ETH	Ethiopia	17.3%	17.6%	19.8%	16.6%	17.0%	18.0%	17.2%	17.6%	18.7%	**368.61**	**2,947.73**
FJI	Fiji	0.2%	0.2%	0.3%	0.2%	0.2%	0.3%	0.2%	0.2%	0.3%	**0.12**	**0.94**
FSM	Micronesia, Fed. Sts.	5.6%	6.6%	5.1%	4.9%	6.1%	4.6%	5.4%	6.5%	5.0%	**1.26**	**-0.70**
GAB	Gabon	0.9%	1.0%	0.8%	0.8%	0.9%	0.7%	0.8%	1.0%	0.8%	**3.26**	**-1.82**
GEO	Georgia	0.6%	0.6%	0.8%	0.6%	0.6%	0.8%	0.5%	0.6%	0.8%	**1.23**	**9.59**
GHA	Ghana	5.2%	6.1%	4.7%	4.5%	5.6%	4.2%	4.9%	6.0%	4.6%	**327.49**	**-182.85**
GIN	Guinea	19.3%	19.6%	22.1%	18.5%	18.9%	20.0%	19.2%	19.6%	20.8%	**55.17**	**441.19**
GMB	Gambia, The	6.1%	7.1%	5.5%	5.3%	6.5%	4.9%	5.8%	7.1%	5.4%	**29.71**	**-16.59**
GNB	Guinea-Bissau	21.8%	22.1%	24.9%	20.8%	21.3%	22.6%	21.6%	22.1%	23.4%	**8.83**	**70.63**
GNQ	Equatorial Guinea	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	**0.09**	**-0.05**
GRD	Grenada	0.3%	0.3%	0.6%	0.5%	0.5%	1.1%	0.5%	0.4%	1.0%	**-0.03**	**0.26**
GTM	Guatemala	2.8%	3.7%	3.3%	2.8%	3.7%	3.3%	5.0%	6.3%	5.8%	**195.32**	**119.09**
GUY	Guyana	1.8%	1.6%	3.1%	2.8%	2.8%	6.2%	2.6%	2.5%	5.5%	**-1.10**	**10.82**
HND	Honduras	0.7%	0.7%	1.0%	0.6%	0.7%	1.0%	0.6%	0.7%	0.9%	**4.10**	**31.91**
HTI	Haiti	27.5%	28.0%	31.4%	26.3%	26.9%	28.5%	27.3%	27.9%	29.6%	**61.72**	**493.56**

Table A.2 Continued

ISO	Country	Poverty rate, total population			Poverty rate, farmer population			Poverty rate, rural population			Changes in number of poor people (1000)	
		S0	*S1*	*S2*	*S0*	*S1*	*S2*	*S0*	*S1*	*S2*	*S1*	*S2*
IDN	Indonesia	2.0%	1.9%	2.9%	2.5%	2.4%	3.8%	2.3%	2.1%	3.3%	**-236.4**	**2,530.64**
IND	India	3.9%	3.9%	4.0%	4.2%	4.2%	4.2%	4.7%	4.7%	4.8%	**-350.7**	**1,034.82**
IRN	Iran, Islamic Rep.	0.3%	0.3%	0.5%	0.5%	0.5%	1.0%	0.4%	0.4%	0.9%	**-19.46**	**191.64**
IRQ	Iraq	0.6%	0.5%	1.0%	0.9%	0.9%	2.0%	0.8%	0.8%	1.8%	**-24.76**	**243.90**
JAM	Jamaica	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	**0.01**	**0.10**
JOR	Jordan	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	**-0.16**	**1.58**
KAZ	Kazakhstan	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	**0.04**	**0.35**
KEN	Kenya	19.3%	19.6%	22.1%	18.5%	18.9%	20.0%	19.2%	19.6%	20.8%	**228.27**	**1,825.39**
KGZ	Kyrgyz Republic	1.1%	1.3%	1.0%	1.0%	1.2%	0.9%	1.1%	1.3%	1.0%	**13.02**	**-7.27**
KHM	Cambodia	0.2%	0.2%	0.4%	0.1%	0.1%	0.3%	0.2%	0.2%	0.5%	**-1.78**	**46.02**
KIR	Kiribati	0.5%	0.5%	0.8%	0.5%	0.6%	0.8%	0.5%	0.5%	0.7%	**0.04**	**0.31**
KNA	St. Kitts and Nevis	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.1%	0.1%	0.2%	**0.00**	**0.03**
LAO	Lao PDR	15.1%	15.3%	17.2%	14.4%	14.8%	15.6%	15.0%	15.3%	16.2%	**20.97**	**167.70**
LBR	Liberia	37.3%	37.9%	42.6%	35.7%	36.5%	38.7%	37.1%	37.8%	40.1%	**43.68**	**349.33**
LBY	Libya	3.9%	3.6%	6.9%	6.2%	6.1%	13.5%	5.6%	5.4%	12.2%	**-23.59**	**232.31**
LKA	Sri Lanka	0.3%	0.6%	0.4%	0.5%	0.8%	0.6%	0.4%	0.7%	0.4%	**63.91**	**13.22**
LSO	Lesotho	19.3%	19.7%	22.1%	18.5%	18.9%	20.1%	19.2%	19.6%	20.8%	**8.89**	**71.11**
MAR	Morocco	0.5%	0.5%	0.9%	0.8%	0.8%	1.8%	0.7%	0.7%	1.6%	**-15.02**	**147.92**
MDA	Moldova	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	**0.00**	**0.15**
MDG	Madagascar	36.2%	36.8%	41.4%	34.6%	35.4%	37.5%	36.0%	36.7%	38.9%	**229.30**	**1,833.64**
MDV	Maldives	2.5%	2.5%	2.8%	2.4%	2.4%	2.6%	2.5%	2.5%	2.7%	**0.17**	**1.37**
MEX	Mexico	0.2%	0.2%	0.4%	0.4%	0.4%	0.8%	0.3%	0.3%	0.7%	**-24.75**	**243.72**
MHL	Marshall Islands	0.2%	0.1%	0.3%	0.3%	0.2%	0.5%	0.2%	0.2%	0.5%	**-0.01**	**0.08**
MLI	Mali	22.4%	22.8%	25.7%	21.5%	22.0%	23.3%	22.3%	22.8%	24.2%	**107.83**	**862.31**
MNE	Montenegro	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	**0.00**	**0.01**
MNG	Mongolia	4.5%	3.9%	6.3%	4.2%	3.1%	6.3%	5.6%	4.6%	7.9%	**-21.22**	**61.84**

Table A.2 Continued

ISO	Country	Poverty rate, total population			Poverty rate, farmer population			Poverty rate, rural population			Changes in number of poor people (1000)	
		S0	*S1*	*S2*	*S0*	*S1*	*S2*	*S0*	*S1*	*S2*	*S1*	*S2*
MOZ	Mozambique	26.5%	27.0%	30.3%	25.4%	25.9%	27.5%	26.4%	26.9%	28.5%	**170.79**	**1,365.75**
MRT	Mauritania	4.2%	5.0%	3.8%	3.7%	4.6%	3.4%	4.0%	4.9%	3.8%	**38.19**	**-21.32**
MUS	Mauritius	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	**0.23**	**-0.13**
MWI	Malawi	44.6%	47.8%	31.3%	50.1%	53.3%	35.3%	48.1%	51.3%	33.9%	**899.22**	**-3,734.74**
NAM	Namibia	5.8%	6.8%	5.2%	5.0%	6.2%	4.7%	5.5%	6.7%	5.1%	**30.44**	**-16.99**
NER	Niger	9.4%	13.8%	10.4%	9.0%	13.1%	9.7%	10.9%	16.0%	12.0%	**1,370.40**	**305.66**
NGA	Nigeria	29.1%	28.8%	40.6%	31.4%	31.1%	44.2%	33.8%	33.4%	46.5%	**-861.66**	**29,679.82**
NIC	Nicaragua	3.7%	4.8%	4.4%	6.9%	8.9%	8.0%	7.6%	9.6%	8.9%	**77.61**	**50.42**
NPL	Nepal	3.8%	6.7%	5.2%	3.7%	6.6%	5.0%	2.9%	5.8%	4.2%	**1,141.53**	**535.01**
OMN	Oman	0.2%	0.2%	0.4%	0.4%	0.4%	0.8%	0.3%	0.3%	0.7%	**-0.66**	**6.48**
PAK	Pakistan	5.1%	14.6%	3.2%	5.1%	14.6%	3.2%	5.7%	15.5%	3.4%	**22,359.31**	**-4,331.48**
PAN	Panama	2.7%	2.9%	2.9%	8.2%	8.9%	8.6%	5.3%	5.8%	5.6%	**11.24**	**7.59**
PER	Peru	0.9%	0.8%	2.2%	1.6%	1.5%	4.6%	2.1%	2.0%	5.5%	**-14.43**	**465.71**
PHL	Philippines	0.7%	0.7%	1.0%	0.7%	0.7%	1.0%	0.6%	0.7%	0.9%	**50.01**	**388.75**
PNG	Papua New Guinea	15.9%	16.2%	18.2%	15.2%	15.6%	16.5%	15.8%	16.2%	17.1%	**29.10**	**232.71**
PRY	Paraguay	0.3%	0.3%	0.4%	0.3%	0.3%	0.4%	0.3%	0.3%	0.4%	**1.33**	**10.37**
RWA	Rwanda	38.1%	40.7%	30.5%	41.0%	43.8%	32.7%	42.8%	45.6%	34.4%	**456.40**	**-1,338.99**
SDN	Sudan	3.6%	4.2%	3.2%	3.1%	3.9%	2.9%	3.4%	4.2%	3.2%	**415.00**	**-231.71**
SEN	Senegal	14.9%	15.2%	17.0%	14.3%	14.6%	15.5%	14.8%	15.1%	16.0%	**53.39**	**426.94**
SLE	Sierra Leone	12.8%	20.6%	13.7%	14.4%	21.6%	15.1%	14.7%	22.2%	15.3%	**663.28**	**82.07**
SLV	El Salvador	1.8%	1.7%	3.2%	2.9%	2.8%	6.4%	2.6%	2.5%	5.7%	**-10.11**	**99.58**
SRB	Serbia	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	**0.05**	**0.41**
STP	Sao Tome and Principe	5.1%	6.0%	4.6%	4.4%	5.5%	4.1%	4.8%	5.9%	4.5%	**2.07**	**-1.16**
SUR	Suriname	0.6%	0.6%	0.8%	0.6%	0.6%	0.9%	0.5%	0.6%	0.8%	**0.20**	**1.56**
SVN	Slovenia	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	**0.00**	**0.02**
SWZ	Swaziland	18.1%	18.4%	20.7%	17.3%	17.7%	18.8%	18.0%	18.4%	19.5%	**4.74**	**37.92**

Table A.2 Continued

ISO	Country	Poverty rate, total population			Poverty rate, farmer population			Poverty rate, rural population			Changes in number of poor people (1000)	
		S0	*S1*	*S2*	*S0*	*S1*	*S2*	*S0*	*S1*	*S2*	*S1*	*S2*
SYC	Seychelles	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	**0.01**	**0.00**
SYR	Syrian Arab Republic	0.4%	0.3%	0.6%	0.6%	0.5%	1.2%	0.5%	0.5%	1.1%	**-7.57**	**74.57**
TCD	Chad	27.6%	28.1%	31.5%	26.4%	27.0%	28.6%	27.4%	28.0%	29.7%	**91.17**	**729.06**
TGO	Togo	17.2%	17.5%	19.7%	16.5%	16.8%	17.9%	17.1%	17.5%	18.5%	**26.82**	**214.45**
THA	Thailand	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	**0.58**	**4.53**
TJK	Tajikistan	0.9%	0.8%	1.2%	1.0%	0.8%	1.6%	1.1%	0.9%	1.4%	**-10.60**	**28.30**
TKM	Turkmenistan	0.9%	1.0%	1.3%	0.9%	1.0%	1.4%	0.9%	0.9%	1.3%	**3.29**	**25.56**
TLS	Timor-Leste	9.2%	7.1%	5.9%	10.7%	8.2%	7.0%	11.6%	9.1%	7.7%	**-40.64**	**-64.51**
TON	Tonga	0.3%	0.4%	0.3%	0.3%	0.4%	0.3%	0.3%	0.4%	0.3%	**0.07**	**-0.04**
TTO	Trinidad and Tobago	0.9%	0.8%	1.5%	1.4%	1.3%	2.9%	1.2%	1.2%	2.7%	**-0.90**	**8.82**
TUN	Tunisia	0.3%	0.3%	0.5%	0.4%	0.4%	1.0%	0.4%	0.4%	0.9%	**-2.62**	**25.81**
TUV	Tuvalu	0.2%	0.2%	0.3%	0.2%	0.2%	0.3%	0.2%	0.2%	0.3%	**0.00**	**0.01**
TZA	Tanzania	53.7%	55.8%	47.1%	60.6%	62.5%	53.4%	60.5%	62.4%	53.5%	**1,741.17**	**-5,395**
UGA	Uganda	18.3%	19.9%	11.8%	20.5%	22.3%	13.4%	20.6%	22.5%	13.3%	**965.96**	**-3,880**
UKR	Ukraine	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	**0.05**	**0.41**
UZB	Uzbekistan	0.1%	0.2%	0.1%	0.1%	0.2%	0.1%	0.1%	0.2%	0.1%	**8.37**	**-4.67**
VEN	Venezuela, RB	1.4%	1.3%	2.4%	2.2%	2.1%	4.7%	1.9%	1.9%	4.2%	**-39.03**	**384.39**
VNM	Vietnam	0.6%	0.5%	1.0%	0.7%	0.6%	1.2%	0.8%	0.7%	1.4%	**-70.80**	**423.86**
VUT	Vanuatu	2.8%	3.3%	2.5%	2.4%	3.0%	2.3%	2.6%	3.2%	2.5%	**1.79**	**-1.00**
WSM	Samoa	0.1%	0.2%	0.1%	0.1%	0.2%	0.1%	0.1%	0.2%	0.1%	**0.05**	**-0.03**
YEM	Yemen, Rep.	2.2%	2.4%	3.8%	2.0%	2.3%	3.9%	2.6%	2.9%	4.6%	**100.35**	**699.00**
ZAF	South Africa	2.5%	2.9%	2.2%	2.2%	2.7%	2.0%	2.4%	2.9%	2.2%	**236.19**	**-131.8**
ZMB	Zambia	51.5%	54.1%	42.0%	70.4%	72.9%	59.4%	67.3%	69.7%	56.6%	**640.75**	**-2,337**
ZWE	Zimbabwe	27.1%	27.6%	31.0%	25.9%	26.5%	28.1%	26.9%	27.5%	29.1%	**85.64**	**684.81**

Source: Authors' calculations.
Note: Poverty is defined by the $1.90 PPP 2011 threshold. Countries for which detailed household survey information is available. These countries are used as representative for their respective clusters.

REFERENCES

Alston, J., M. Marra, P. Pardey, and T. Wyatt 2000. "Research Returns Redux: A Meta-Analysis of the Returns to Agricultural R&D." *Australian Journal of Agricultural and Resource Economics* 44 (2): 185–215.

Amiti, M., and J. Konings. 2007. "Trade Liberalization, Intermediate Inputs, and Productivity: Evidence from Indonesia." *American Economic Review* 97 (5): 1611–1634.

Anderson, K., J. Cockburn, and W. Martin. 2010. *Agricultural Price Distortions, Inequality and Poverty*. Washington, DC: World Bank.

Barro, R., and X. Sala-i-Martin. 1992. "Convergence." *Journal of Political Economy* 100 (2): 223–251.

Ben-David, D. 1994. "Income Disparity among Countries and the Effects of Freer Trade." In *Economic Growth and the Structure of Long Run Development* edited by L. Pasinetti and R. Solow, 45–64. London: Macmillan.

Blundell, R. and T. Macurdy. 1998. "Labor Supply: a review of alternative approaches." In *Handbook of Labor Economics. Vol. 3,* edited by O. Ashenfelter and D. Card, 1560–1689. Amsterdam: Elsevier Science.

Bouet, A., C. Estrades, and D. Laborde. 2011. *Household Heterogeneity in a Global CGE Model: An Illustration with the MIRAGE Poverty Module.* Washington, DC: International Food Policy Research Institute.

Deaton, A. 1989. "Rice Prices and Income Distribution in Thailand: A Non-parametric Analysis*." The Economic Journal* 99 (395): 1–37.

Deaton, A., and J. Muellbauer. 1981. "Functional Forms for Labor Supply and Commodity Demands with and without Quantity Restrictions." *Econometrica* 49 (6): 1521–1532.

Decreux, Y., and H. Valin. 2007. *MIRAGE, Updated Version of the Model for. Trade Policy Analysis. Focus on Agriculture and Dynamics.* Centre d'Etudes Prospectives et d'Informations Internationales Working Paper 2007, October 15. Paris.

Doblin, C. 1991. *Capital Stock and Capital Output Ratios: A Comparison between the United States, United Kingdom and the Federal Republic of Germany.* IIASA Working Paper 91–129. Laxenburg, Austria: International Institute for Applied System Analysis.

Dowrick, S., and D.T Nguyen. 1989. "OECD Comparative Economic Growth 1950–1985: Catch-up and Convergence." *American Economic Review* 79 (5): 1010–1030.

Ferreira, F., D. Jolliffe, and E. Prydz. 2015. "The International Poverty Line Has Just Been Raised to $1.90 a Day, but Global Poverty Is Basically Unchanged. How Is That Even Possible?" *Let's Talk Development* Blog. World Bank. Accessed January 12, 2016. http://blogs.worldbank.org/developmenttalk/international-poverty-line-has-just-been-raised-190-day-global-poverty-basically-unchanged-how-even.

Fukase, E., and W. Martin. 2016. "Who Will Feed China in the 21st Century? Income Growth and Food Demand and Supply in China." *Journal of Agricultural Economics* 67 (1): 3-23 doi: 10.1111/1477-9552.12117.

Headey, D., and W. Martin. 2016. "Food Prices, Poverty and Food Security." *Annual Review of Resource Economics*, forthcoming.

IMF (International Monetary Fund) 2012. *World Economic Outlook: Growth Resuming, Dangers Remain.* April. Washington, DC.

———. 2015. *World Economic Outlook: Adjusting to Lower Commodity Prices. October.* Washington, DC.

Ivanic, M., and W. Martin. 2014. *Short- and Long-Run Impacts of Food Price Changes on Poverty.* Policy Research Working Paper 7011, Washington, DC: World Bank.

Ivanic, M., and W. Martin. 2016. *Sectoral Productivity Growth and Poverty Reduction: National and Global Impacts.* Unpublished, International Food Policy Research Institute, Washington, DC.

Jacoby, H. 2016. "Food Prices, Wages and Welfare in Rural India." *Economic Inquiry* 54 (1): 159–176.

Kaldor, N .1957. "A Model of Economic Growth." *The Economic Journal* 67 (268): 591–624.

Keane, M., and R. Rogerson. 2012. “Micro and Macro Labor Supply Elasticities: A Reassessment of Conventional Wisdom.” *Journal of Economic Literature* 50 (2): 464–476.

Laborde, D., V. Robichaud and S. Tokgoz, 2013, “MIRAGRODEP 1.0: Documentation”, AGRODEP Technical Note. December 2013. International Food Policy Research Institute, Washington, DC.

Lakatos, C., M. Maliszewska, M. Osorio-Rodarte, and D. Go. 2015. *China’s Slowdown and Rebalancing: Potential Growth and Poverty Impacts on Sub-Saharan Africa.* Unpublished, World Bank, Washington, DC.

Loayza, N., and C. Raddatz. 2010. “The Composition of Growth Matters for Poverty Alleviation.” *Journal of Development Economics* 93: 137–151.

Lucas, R. E. 1988. “On the Mechanics of Economic Growth.” *Journal of Monetary Economics* 22: 3–42.

Martin, W., and J. M. Alston. 1997. “Producer Surplus Without Apology? Evaluating Investments in R&D.” *Economic Record* 73 (221): 146–158.

OECD (Organization for Economic Cooperation and Development). 2016a. *GDP Long Term Forecast*. Accessed April 17, 2016 https://data.oecd.org/gdp/gdp-long-term-forecast.htm.

———. 2016b. *Compendium of Productivity Indicators.* Accessed May 5, 2016. http://www.oecd.org/std/productivity-stats/oecd-compendium-of-productivity-indicators-22252126.htm.

O’Neill, J. 2001. “Building Better Global Economic BRICs*.” Goldman Sachs Global Economic Paper* 66. London: Goldman Sachs.

Quah, D. 1995. *Empirics for Economic Growth and Convergence.* CEPR Discussion Paper 253, July, London: Centre for Economic Policy Research.

Ravallion, M., and G. Datt. 1996. “How Important to India’s Poor Is the Sectoral Composition of Output?” *World Bank Economic Review* 10 (1): 1–25.

World Bank. 2015a. *A Measured Approach to Ending Poverty and Boosting Shared Prosperity: Concepts, Data and the Twin Goals.* Policy Research Report. Washington, DC: World Bank.

———. 2015b. World Development Indicators database. Accessed September 24, 2015. http://archive.data.worldbank.org/data-catalog/world-development-indicators/wdi-2015.

———. 2016. World Development Indicators database. Accessed March 30, 2016. http://data.worldbank.org/products/wdi.

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