

# Poverty Impact of Food Price Shocks and Policies

*David Laborde*

*Csilla Lakatos*

*Will Martin*



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## Abstract

In the event of large swings in world food prices, countries often intervene to dampen the impact of international food price spikes on domestic prices and to lessen the burden of adjustment on vulnerable population groups. While individual countries can succeed at insulating their domestic markets from short-term fluctuations in global food prices, the collective intervention of many countries may

exacerbate the volatility of world prices. Insulating policies introduced during the 2010–11 food price spike may have accounted for 40 percent of the increase in the world price of wheat and one-quarter of the increase in the world price of maize. Combined with government policy responses, the 2010–11 food price spike tipped 8.3 million people (nearly 1 percent of the world's poor) into poverty.

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# Poverty Impact of Food Price Shocks and Policies

David Laborde, Csilla Lakatos and Will Martin\*

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\*D. Laborde: International Food Policy Research Institute (IFPRI); Email: [d.laborde@cgiar.org](mailto:d.laborde@cgiar.org). C. Lakatos: Prospects Group, World Bank; Email: [clakatos1@worldbank.org](mailto:clakatos1@worldbank.org). W. Martin: IFPRI; Email: [w.martin@cgiar.org](mailto:w.martin@cgiar.org). We thank John Beghin, Andrew Dabalen, Elena Ianchovichina, Ayhan Kose, Shiva Makki, Franziska Ohnsorge and David Rosenblatt for their valuable comments. David Laborde and Will Martin acknowledge the funding support of the CGIAR Research Program on Policies, Institutions, and Markets (PIM) led by IFPRI. The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the views of the International Food Policy Research Institute or of the International Bank for Reconstruction and Development/World Bank and its affiliated organizations, or those of the Executive Directors of the World Bank or the governments they represent.

# 1 Introduction

In August 2011, nominal international food prices hit an all-time high.<sup>1</sup> This followed shortly after the 2007-08 food price spike, which pushed an estimated 105 million people into extreme poverty (Ivanic and Martin 2008). This event also prompted widespread concerns about the food security of the poorest and fears over a potential world food crisis. Although food prices have declined considerably since then, in real terms, they are still significantly above their lows in 2000 (Figure 1).

Food price spikes such as in 2010-11 may materialize again as the growing frequency of extreme weather events increases the risk of disruption to food production, setbacks in food availability and access to food. World hunger and severe food insecurity rose during 2014-17, reversing the decline of the previous decade. In 2017, the number of undernourished people reached 821 million, up by 5 percent since 2014 and a setback in achieving the Sustainable Development Goal of eradicating hunger by 2030 (FAO et al. 2018). G20 policy makers have recently reiterated the urgency of tackling the challenges to achieving food security (G20 2018).

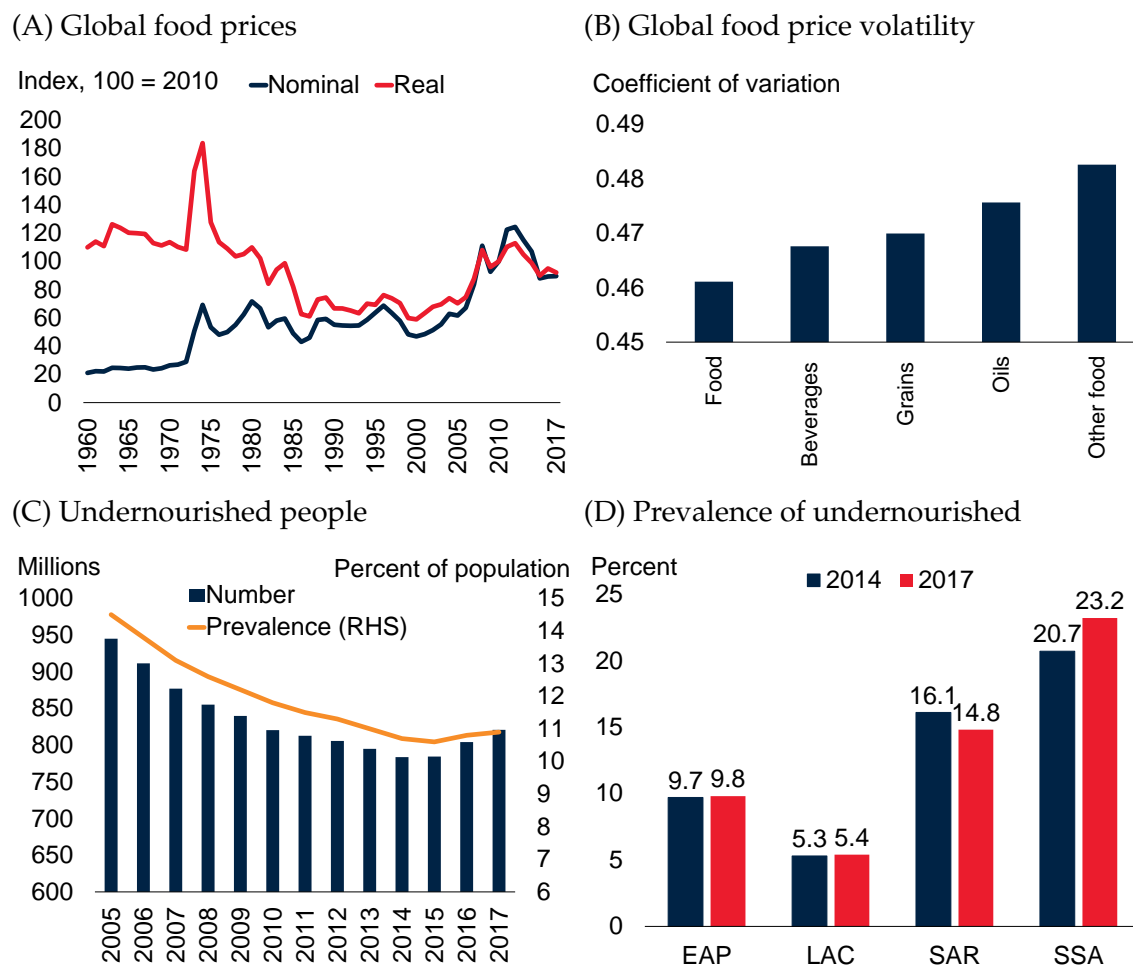
While agricultural and food prices are expected to rise only moderately in 2019, significant upside risks could materialize as a result of higher-than-expected energy prices, El Niño events, or trade tensions. First, higher-than-expected energy prices, a key input in the production of most agricultural commodities, could raise grain and oilseed prices. Energy prices affect agricultural production costs directly (through fuel use) and indirectly (through fertilizer and other chemicals use and an incentive to shift production to biofuels). Second, an El Niño event is expected with an 80 percent probability during December 2018-February 2019. Should this materialize, heavier-than-expected rains could occur in Central Asia, South America, and East Africa, while drier-than-normal conditions could affect Central America, the Caribbean, and Southern Africa, affecting the prices of many agricultural commodities. Finally, although the escalation of existing trade frictions represents a downside risk for the price of agricultural commodities, policy measures introduced by major producers and exporters in response to higher tariffs could also affect prices (World Bank 2018).

Several forces have contributed to the rise in food prices during the 2000s. A dramatic increase in demand for feedstock for biofuel production in the early 2000s put considerable pressure on markets for grain and contributed to a rundown in stocks (Akiyama et

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<sup>1</sup>Unless otherwise stated, the concept of food prices as used in this paper refers to the commodity price of major staple foods such as rice, wheat, and maize.

Figure 1: Global food prices



Source: Food and Agriculture Organization of the United Nations, World Bank.

A. Based on yearly commodity price indexes between 1960-2017.

B. Based on monthly nominal commodity price indexes between January 1960 – November 2017.

C.D. Undernourishment is defined a state, lasting for at least one year, of inability to acquire enough food, defined as a level of food intake insufficient to meet dietary energy requirements.

al. 2001; Wright 2014). Population growth and urbanization, as well as a shift in diets toward animal-based foods, created demand pressures despite an increase in agricultural productivity in emerging market and developing economies (EMDEs; Fukase and Martin 2017). Slowing yield growth and declining availability of agricultural land constrained food production growth. Extreme climate events (e.g., El Niño, droughts, and natural disasters), particularly when agricultural stocks are low, and the financialization of agricultural futures markets have also contributed to food price volatility.

Food price increases have important macro- and microeconomic impacts through several channels. At the macroeconomic level, food price increases result in higher inflation, which can reduce household real incomes. For food-importing countries, high food prices can also result in terms of trade shocks that lower growth and reduce government policy space.

The microeconomic impact of food price increases on poverty and inequality depends on the net food seller/buyer status of the poorest households. For households that are net sellers of food products (such as farmers, agricultural workers, and small land owners), rising food prices increase real incomes. By contrast, they lower the real incomes of households that are net buyers of food. On average, sharp increases in food prices raise poverty, reduce nutrition, and curtail the consumption of essential services such as education and health care (World Bank 2011).<sup>2</sup>

Countries often use policy interventions to dampen the domestic impact of international food price spikes and lessen the burden on vulnerable population groups. For example, during the 2007-08 food price spike, close to three-quarters of EMDEs took policy action to insulate their domestic prices from the sharp increase in international food prices (World Bank 2009). In the event of food price spikes, net food-importing countries usually intervene by lowering trade protection (typically tariffs) on food items, while net food-exporting countries impose export restrictions or bans. These policies are often complemented with social safety net programs such as cash transfers or school feeding programs.

To the extent that policy interventions reduce the transmission of international price spikes to domestic markets, they may appear to be successful for individual countries. However, the combined intervention of many countries raises international prices. These insulating policies tend to encourage consumption and reduce production during price spikes. This,

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<sup>2</sup>In the longer term, once producers and consumers have adjusted to the increases and wage rates have responded, sustained increases in food prices may lower poverty by raising incomes of poor food producing households (Ivanic and Martin 2014a; Gillson and Fouad 2014).

in turn, results in higher import demand and reduced export supply that further drive up global prices. During price plunges, government interventions encourage greater exports and greater global supply that further depresses prices. Only countries that insulate themselves to an above-average degree can reduce price volatility in their domestic markets (Anderson, Martin, and Ivanic 2017).

The international community has recognized the importance of ensuring the stability and availability of food supplies as key to addressing several development objectives. The Sustainable Development Goals (SDGs) give food security a high priority: the second SDG sets out explicitly the goal to “end hunger, achieve food security and improved nutrition, and promote sustainable agriculture.” Other SDGs are strongly interconnected: food, agriculture and nutrition play an important role in SDGs on ending poverty, improving health, fostering sustainable consumption and production, and encouraging climate change adaptation and mitigation.

In this context, this paper addresses the following questions:

- How do food price shocks affect EMDEs?
- How do countries intervene to reduce the impact of food price shocks?
- What was the impact of the 2010-11 food price shock on poverty?

The paper presents the following findings:

- At the macroeconomic level, a high share of agriculture and food in total output, consumption, employment, trade, and government revenues heighten countries’ vulnerability to volatility in international food prices. At the microeconomic level, food price spikes are felt most severely by the poorest segments of the population who tend to be net food buyers.
- Governments in EMDEs tend to respond particularly strongly to sharp changes in world prices for staple foods—such as rice, wheat and maize—to smooth volatility. Domestic food prices are considerably less volatile than world food prices in the short run, but over the longer term, there is a tendency for domestic and world prices to return to their original relationship. In the short run, a 1 percent increase in the world price of rice, wheat and maize is associated with an increase in domestic prices by 0.6 percent, 0.7 percent, and 0.8 percent, respectively.

- While individual countries can succeed at insulating their domestic markets from short-term fluctuations in global food prices, their combined interventions make global food prices more volatile. Insulating policies introduced during the 2010-11 food price spike accounted for 40 percent of the increase in the world price of wheat and one-quarter of the increase in the world price of maize. In contrast, a reversal of earlier government interventions in rice markets dampened the degree to which world prices increased by about 50 percent.
- The 2010-11 food price spike, and the wide-spread government intervention that accompanied it, increased the number of poor living on less than \$1.90 per day by almost 1 percent or 8.3 million.

## 2 Food price shocks and their effects

At the macroeconomic level, a high share of agriculture and food in total output, consumption, employment, trade, and government revenues heighten countries' vulnerability to volatility in international food prices. At the microeconomic level, a high share of net food buyers among the poorest segments of society heightens the adverse effects of food price spikes on poverty and income inequality.

### 2.1 Macroeconomic channels

**Reliance on food imports and production.** Agriculture accounts for close to one-third of total value added and two-thirds of total employment in LICs. This is almost three times their shares in the average EMDE (Figure 2; Aksoy and Beghin 2004). For example, in Burkina Faso and Burundi, agriculture accounts for more than four-fifths of total employment. In Chad and Sierra Leone, it accounts for more than half of domestic value added. In addition, more than three-quarters of LICs are net food importers compared to only half of EMDEs.<sup>3</sup> In these net food-importing LICs, net food imports amount to 5.4 percent of private consumption. Benin and Gambia are particularly vulnerable to high food prices, with net food imports adding up to more than 10 percent of private consumption.<sup>4</sup>

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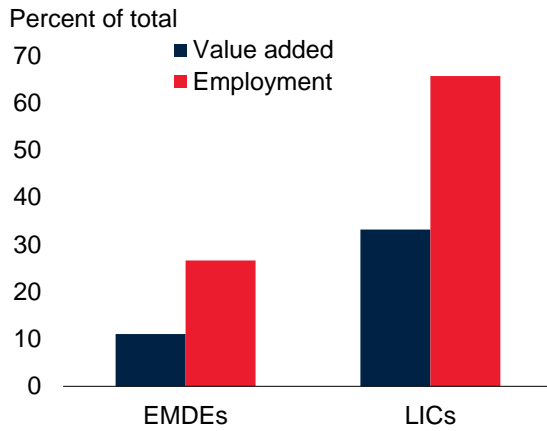
<sup>3</sup>High trade costs, such as tariffs and border delays, can bias downwards estimates of the share of food imports (Tombe 2015).

<sup>4</sup>Conversely, heavy reliance on food exports heightens vulnerability to food price declines. For example, in Malawi, net food exports amount to 12 percent of total private consumption.

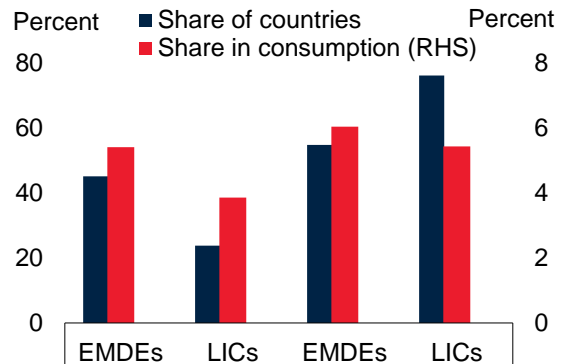


Figure 2: Macroeconomic channels of transmission from global food prices

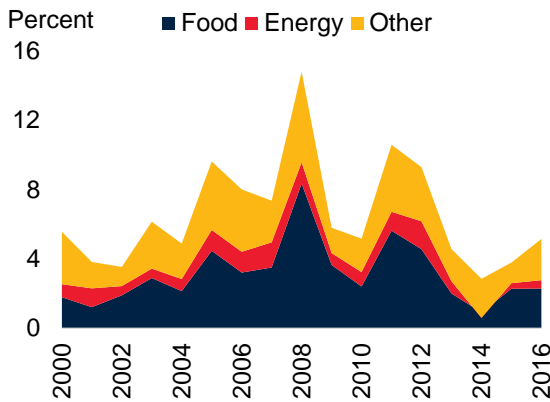
(A) Share of agriculture in economy



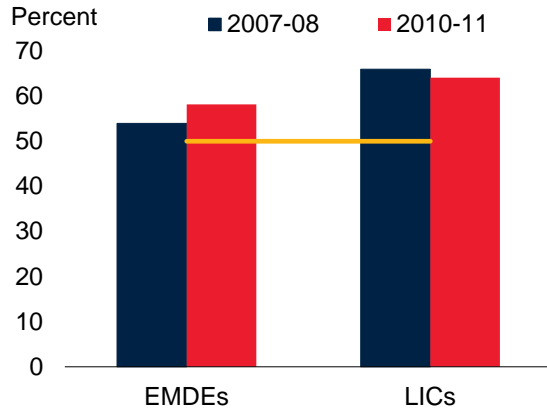
(B) Net food imports and exports



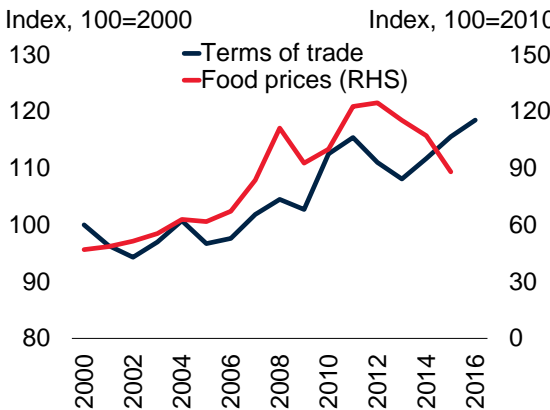
(C) Inflation in LICs



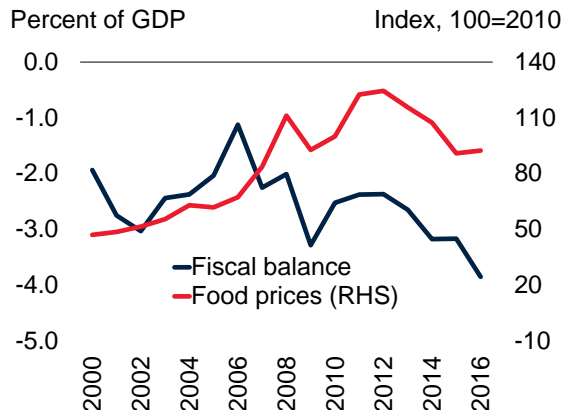
(D) Contribution of food prices to inflation



(E) Terms of trade in LICs



(F) Fiscal balance in LICs



Source: Kose et al. (2017), World Bank.

A. Based on a sample of 93 EMDEs, and 21 LICs. Averages for 2010-2016.

C. Average inflation based on a sample of 12 LICs.

D. Share of inflation accounted for by food price inflation. Yellow line indicates half.

E. Net barter terms of trade index.

F. Median based on a sample of 26 LICs.

**Inflation.** A surge in food prices increases consumer price inflation. For example, the 2007-08 and 2010-11, LIC inflation more than doubled, from 7 to 15 percent during 2007-2008 and from 5 to 11 percent during 2010-2011. The increase in EMDE inflation was less pronounced, from 7 to 11 percent during 2007-2008 and from 5 to 6 percent during 2010-2011. Food prices accounted disproportionately for these increases in inflation—for about two-thirds in LICs and more than half in EMDEs. In vulnerable LICs such as Benin and Niger, where net food imports amount to 15 and 7 percent of household consumption, respectively, inflation surged from 1 percent to 8 percent and 0.2 percent to 11 percent, respectively, during the 2007-08 food price spike.

**Terms of trade.** Sharp increases in food prices can constitute significant adverse terms of trade shocks that lower growth, especially in countries that are large net importers of food. More than three-quarters of LICs are net food importers. The median LIC's terms of trade declined by 2 percent and 4 percent during the 2007-08 and 2010-11 food price spikes, respectively. In some, the deterioration was much steeper. For example, the terms of trade of Sierra Leone, a LIC highly reliant on food imports, weakened by 10 percent during each of these food price spike episodes.<sup>5</sup> In heavy food importers, the exchange rate depreciation typically associated with adverse terms of trade shocks can compel central banks to tighten monetary policy and further lower growth. Indeed, during the 2007-08 food price spike, close to half of EMDE central banks responded to rising inflation and depreciation by tightening monetary policy.<sup>6</sup>

**Fiscal policy constraints.** Absent stabilizing fiscal arrangements, heavy reliance on food and agricultural trade can contribute to volatility in public finances and erode fiscal sustainability: rising food prices may increase tax revenues from the agricultural sector and encourage governments to spend. Conversely, when food prices fall, revenue losses in the agricultural sector are exacerbated by political pressures to subsidize food production. During the sharp rise in food prices in 2007-08, LICs' fiscal balances deteriorated, on average, by close to 1 percentage point of GDP, in part due to higher food import bills. Food price spikes may also cause sociopolitical instability, including political unrest and food riots (Barrett 2013).

**Monetary policy constraints.** In countries where inflation expectations are not well-anchored and monetary policy frameworks are weak, the increase in inflation caused by

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<sup>5</sup>Severe terms of trade shocks are considerably more common in LICs than in advanced economies and, of all possible external shocks, tend to have the most severe output cost in LICs (IMF 2011; Becker and Mauro 2006).

<sup>6</sup>Based on a sample of 54 EMDEs.

rising food prices can compel central banks to tighten policy. In heavy food importers, this can be exacerbated by exchange rate depreciation that reflects deteriorating terms of trade. Indeed, during the 2007-08 food price spike, close to half of EMDE central banks responded to rising inflation and depreciation by tightening monetary policy.

## 2.2 Microeconomic channels

Rising food prices impact households through price and income effects. They reduce households' purchasing power but raise income generated from food production. The overall impact on poverty and income inequality depends on the relative magnitude of these effects for households in different segments of the income distribution.

In LICs, households spend on average close to 60 percent of their income on food, more than one-third more than in EMDEs (Figure 3). In countries such as Burundi and Guinea, the share of food expenditures is even higher, accounting for more than 70 percent of total consumption of households. In LICs, more than one-third of households' consumption expenditure on food is spent on staple foods such as cereals and vegetables. These staple foods are considerably more exposed to international price volatility than domestically processed food products (Figure 1).

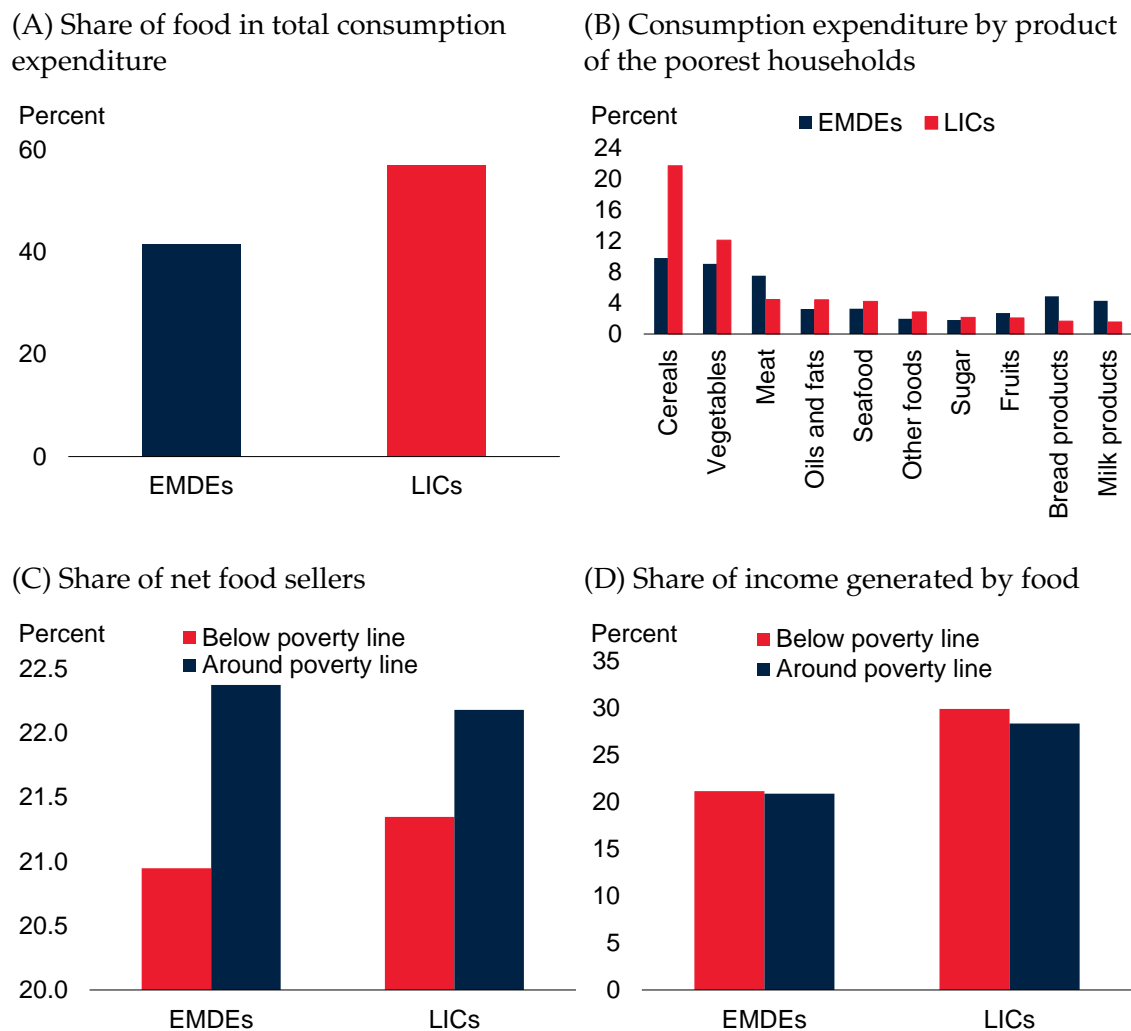
For households that are net sellers of agricultural and food products (e.g., farmers), rising food prices raise incomes. More than one-fifth of households around and below the poverty line of \$1.90 per day are net food sellers in the average EMDE and LIC. Households around and below the poverty line in these countries tend to generate about one-quarter of their incomes from food production. In contrast, poor urban households are typically net buyers of food that spend a large share of their consumption expenditure on food (Aksoy and Hoekman 2010).

On average, many of the poor in EMDEs and LICs are net buyers of food. As a result, food price spikes tend to raise poverty, reduce nutrition and cut consumption of essential services such as education and health care.<sup>7</sup> For example, the 2007-08 rise in food prices is estimated to have raised the number of poor by 105 million (10 percent of the people living on less than a one dollar a day; Ivanic and Martin 2008). In extreme cases, food price spikes can lead to food insecurity and hunger, with severely adverse long-term impacts on human capital.

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<sup>7</sup>Vulnerable groups such as women and children, are more likely to be disproportionately affected.

Figure 3: Microeconomic channels of transmission from global food prices



Source: IFPRI, World Bank.

A. B. Based on data from the Global Consumption Database on the share of products in total household consumption expenditure. Data is available for 63 non-LIC EMDEs and 25 LICs. The base year of the household surveys differs but the data has been converted to a common reference year, 2010. The share of income spent on food is likely to be different.

C.D. Averages weighted by the number of poor for a sample of 22 non-LIC EMDEs and 7 LICs. Poverty line is defined as \$1.90/day.

### 3 Government interventions during food price shocks

In the event of large swings in global food prices, governments are confronted with difficult policy choices. One option is to allow domestic prices to adjust to world food price changes, exposing domestic consumers and producers to changes in their real incomes. Even if a sizable non-tradeable service component in the cost of providing consumers with food such as transportation, storage and retail dampens the pass-through of world food price shocks into domestic markets, allowing domestic food prices to adjust may raise inflation in the short run and, in countries where inflation expectations are poorly anchored, in the medium to long run.<sup>8</sup>

Alternatively, governments can spare consumers or producers from these losses by reducing the transmission of international food price shocks to domestic markets.<sup>9</sup> As measured in this paper, policy intervention is reflected in the ratio of domestic to world prices—the “protection rate.” During a period of rising world prices, the protection rate declines when a country seeks to insulate its domestic markets from the increase in world prices. If the protection rate rises, policymakers are compounding the increase in world prices.

In practice, during the 2007-08 food price spike, close to three-quarters of EMDEs took policy action to insulate their economies from the sharp increase in international food prices (World Bank 2009). The most commonly used interventions were reductions in taxes, including import duties and consumer taxes (Figure 4).<sup>10</sup> Net importers frequently intervened by lowering import tariffs or even by introducing import subsidies, while net exporters imposed export restrictions or bans to dampen the increase in domestic prices.<sup>11</sup>

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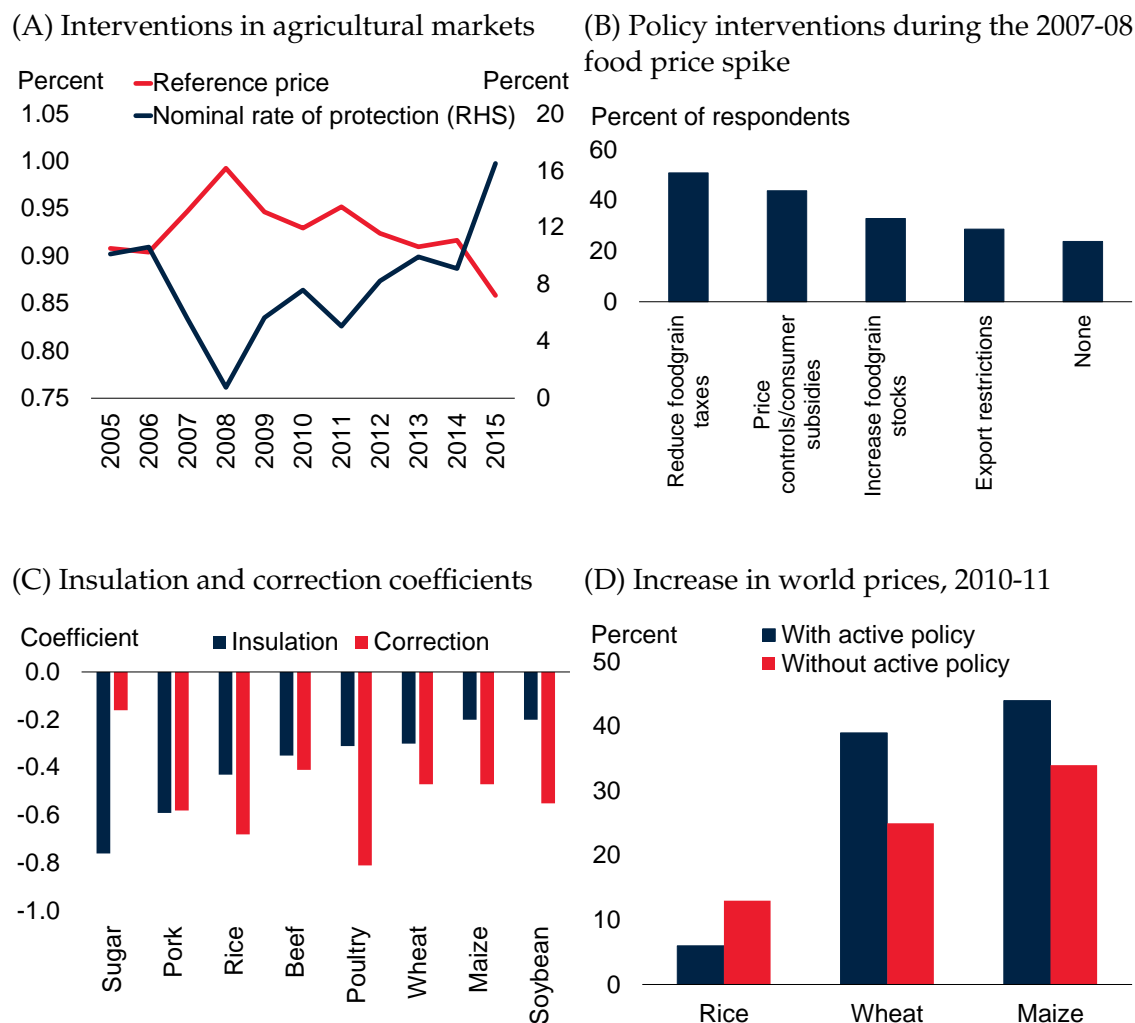
<sup>8</sup>The decline in real incomes associated with higher inflation would entail welfare losses, especially when consumers are loss- and risk-averse (Gouel and Jean 2015; Freund and Ozden 2008; Giordani, Rocha, and Ruta 2016; Easterly and Fischer 2001). In principle, monetary policy tightening can offset inflationary effects from rising global food prices to ensure that rising food prices remain a purely relative price change and do not become entrenched in higher inflation. However, this would come at the cost of reduced economic activity (Lustig 2009).

<sup>9</sup>Policymakers may also have a longer-term goal to protect (or to tax) domestic agents (Grossman and Helpman 1994). In empirical work based on political economy models, protection rates vary to reduce both the costs associated with adjusting prices and the costs of providing a rate of protection that differs from the long-run political equilibrium (Anderson and Nelgen 2011; Ivanic and Martin 2014b).

<sup>10</sup>If countries are insulating primarily through subsidies and are fiscally constrained, their ability to insulate will be limited (Ianchovichina, Leoning, and Wood 2014).

<sup>11</sup>For net importers, untargeted food subsidies have implications for government revenues and fiscal space. If financed by aid, the impact on fiscal space is limited. Alternatively, targeted transfers may be more effective in protecting vulnerable groups with limited macroeconomic repercussions.

Figure 4: Food-related government policies



Sources: Ag-Incentives Database, Ivanic and Martin (2014b), World Bank.

A. Nominal Rate of Protection (NRP) is computed as the price difference between the farm gate price received by producers and an undistorted reference price at the farm gate level. The reference price at the farm gate level is defined as the net price of the product when it leaves the farm, after marketing costs have been subtracted. The undistorted farm gate price is defined as the price prevailing in competitive world markets.

B. Percent of respondents based on a survey of 80 EMDEs.

C. Estimates based on the Error Correction Model described in Annex 6.1. The coefficient of price insulation ranges from 0 for countries that do not insulate against the rise in world prices, to -1 for countries that adopt policies that fully insulate domestic markets. The error correction term represents the cost of being out of equilibrium or the speed with which policies achieve the target level of protection or at which policy makers move back toward this equilibrium after being forced away from it by a shock to world prices. Based on data for 82 countries, of which 26 advanced economies, 44 EMDEs, and 12 LICs for the period 1955-2011.

D. Real terms. Estimates derived based on the methodology described in the Annex.

### 3.1 Domestic and world food price dynamics

Domestic food prices are considerably less volatile than global food prices in the short run, but over the longer term, there is a tendency for domestic prices to return to their original relationship with international prices (Figure 5). This does not necessarily imply that protection rates become zero, but that they return to their pre-spike levels.

Governments in EMDEs tend to respond particularly strongly to sharp changes in the world prices of staple foods—such as rice, wheat and maize—to reduce the volatility of domestic prices. For staple foods, domestic price movements can diverge substantially from international price movements in the short run, but converge in the longer term.

The movements of world and domestic staples food prices during the latest two food price spikes (2007-08 and 2010-11) resembled similar earlier episodes: world prices rose rapidly, while domestic prices rose only gradually. However, the 2010-11 spike was different from previous episodes in several aspects. The 2007-08 increase in food prices came after a long period of stability in food prices. In 2007-08, world prices of all staple foods increased steeply, led by the strong increase in the world price of rice. Most countries reacted strongly by introducing insulating policies. In contrast, the 2010-11 episode occurred when world markets and policies were still normalizing from the 2007-08 episode. Government interventions differed considerably across countries and across commodities. On average, government interventions (or the unwinding of earlier interventions) actually contributed to a decline in the world price of rice.

*Rice.* Rice was the staple food with the largest price increase during the 2007-08 food price spike. Between January 2007 and May 2008, world rice prices almost tripled.<sup>12</sup> This sharp increase reflected export restrictions introduced by major producers (e.g., India and Vietnam) motivated by food security concerns, panic buying by several large importers, a weak dollar, and record high prices of oil, which is a major input into food production (Childs and Kiawu 2009). During this episode, domestic markets were largely insulated from this global rice price spike (Ivanic and Martin 2008). By contrast, during the 2010-11 price spike, rice prices increased much less, by about 30 percent between June 2010 and May 2012. In some countries, adverse supply conditions combined with changes in non-tariff trade policies resulted in domestic rice prices rising above world prices.<sup>13</sup> Instead of

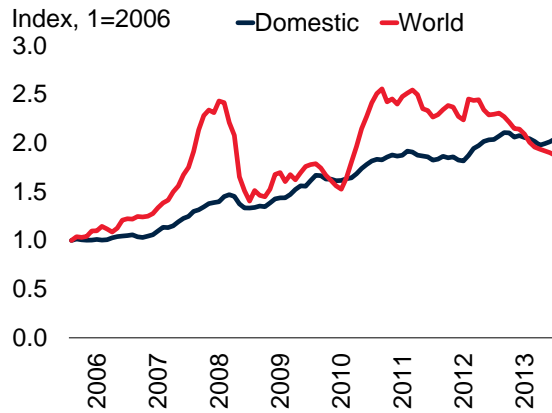
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<sup>12</sup>The world price of 5 percent broken white Thai rice increased from \$313/mt to \$902/mt.

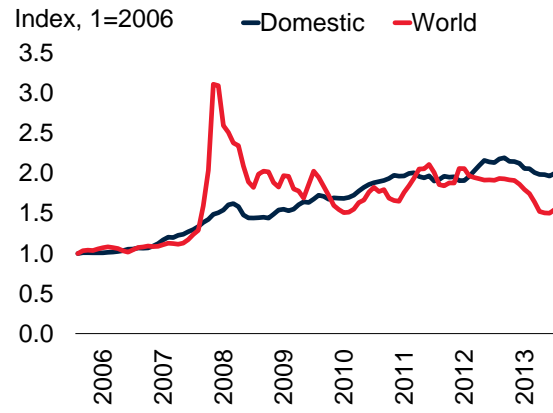
<sup>13</sup>In Vietnam, for instance, domestic rice prices rose by 41 percent between July-October 2010 due to lower-than-expected production, prior commitments on exports, and high inflation from a depreciating currency.

Figure 5: Domestic and global food prices

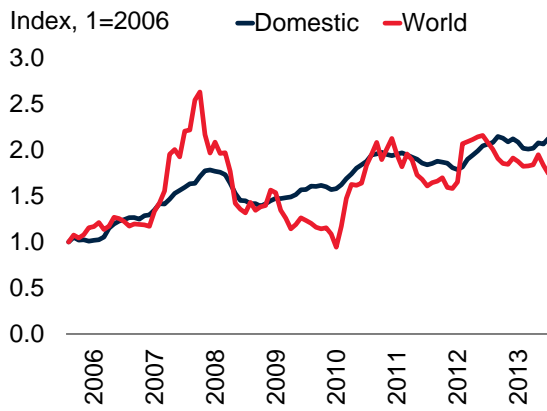
(A) Prices of staple foods



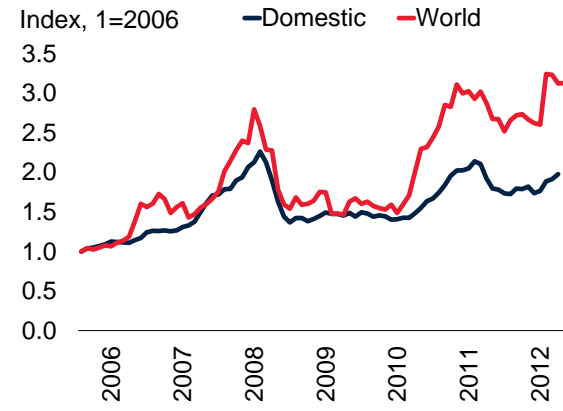
(B) Rice prices



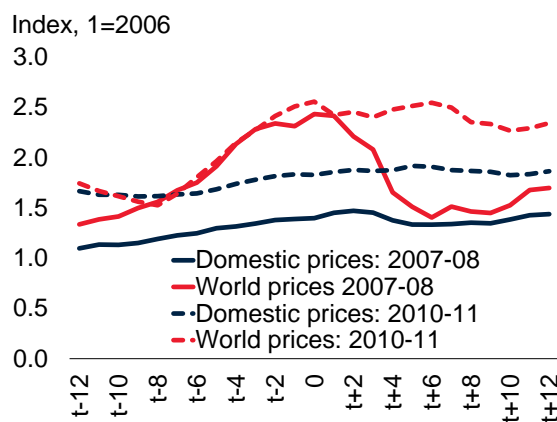
(C) Wheat prices



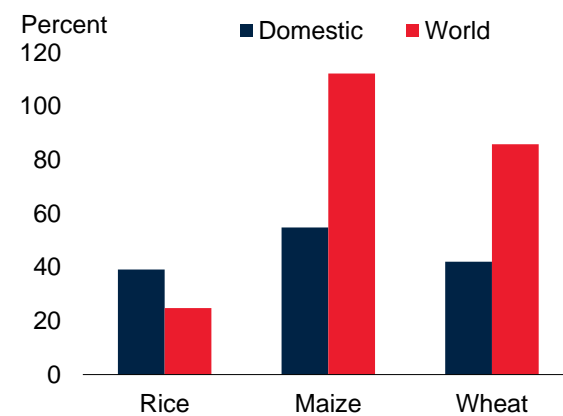
(D) Maize prices



(E) Domestic and global staple food prices during 2007-08 and 2010-11



(F) Average increase in world and domestic price index, 2010-11



Sources: Ivanic and Martin (2014b), World Bank.

A. Rice, wheat, maize, oil and sugar prices.

E. Event study based on monthly cross-country average domestic staples prices (average of wheat, rice and maize prices) and global staples prices (average of wheat, rice and maize) during 2007-08 and 2010-11. Period 0 represents the month of the peak of the world food price spike.

F. Average percent increase in the price index.



insulating policies, on average, EMDEs implemented policies that raised domestic prices relative to world prices (Figure 5).

*Wheat.* Between February 2007 and March 2008, world wheat prices more than doubled, partly in response to lower-than-anticipated wheat production caused by drought in Australia, Ukraine and other major exporters.<sup>14</sup> Strong policy intervention partially insulated domestic markets from the global wheat price spike and their subsequent collapse in the aftermath of the global financial crisis in 2009-10. Similarly, during the 2010-11 event, world wheat prices more than doubled between June 2010 and May 2011.<sup>15</sup> This time, the increase in world prices was partly driven by lower-than-expected production and exports in Kazakhstan, Russia, and Ukraine and excessive rains in Australia that damaged wheat crops (World Bank 2010). Large orders from major wheat importers in the Middle East and North Africa added to price pressures. Since 2011, global and domestic wheat prices have fluctuated, broadly synchronously.

*Maize.* During the 2007-08 food price spike, the world price of maize almost doubled, partly as a result of increasing U.S. demand for maize stimulated by mandatory targets for ethanol production.<sup>16</sup> Similarly, during the 2010-11 episode, the world price of maize increased significantly. As in the case of wheat, adverse weather-related events in major maize exporting countries contributed to the spike in world prices. In contrast, many countries in Sub-Saharan Africa benefited from excellent maize harvests, which in combination with unpredictable trade policies led to sharp falls in domestic prices.

### 3.2 Insulation of domestic food markets

**Measuring the insulation of domestic markets.** The degree of insulation of domestic markets from world food price swings can be quantified using an Error Correction Model (Annex 6.1). The model regresses the log of the protection rate on the log of world prices and the deviation from long-term “equilibrium” food prices. The model estimates the degree of insulation to global price changes in both the short run (specifically, a negative coefficient on short-term changes in global food prices) and long run (specifically, a negative coefficient on the long-term relationship between domestic and global food prices). The sample used here includes annual data for 8 food commodity prices in 82 countries, of which 44 are EMDEs and 12 are LICs, during 1955-2011.

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<sup>14</sup>The world price of U.S. Hard Red Wheat (HRW) increased from \$196/mt to \$440/mt.

<sup>15</sup>The world price of U.S. Hard Red Wheat (HRW) increased from \$158/mt to \$355/mt.

<sup>16</sup>Between January 2007 and June 2008, the world price of maize increased from \$165/mt to \$287/mt.

**Estimates of short-term insulation.** Estimates point to considerable short-term insulation in markets for key staple foods such as rice and wheat (Figure 4). Among these key staples, insulation is the highest for rice. In the short run, a 1 percent increase in global rice, wheat, and maize prices is associated with an increase in domestic prices of 0.6 percent, 0.7 percent, and 0.8 percent, respectively.

**Effectiveness of insulating policy measures.** Certain types of interventions in markets for staple foods have raised volatility in domestic markets. For example, during the 2008-09 food price spike, several African countries intervened using food pricing, marketing, and trade policies to stabilize domestic maize markets. Countries that intervened most intensively experienced the highest domestic price volatility, mostly because of the ad hoc and unpredictable nature of these interventions (Chapoto and Jayne 2009).<sup>17</sup> The use of an export ban during food price spikes, possibly related to a domestic drought, illustrates the trade off between different policy instruments:

- *Ensuring food security.* By restricting the sale of food for exports, an export ban increases domestic supply and dampens domestic food price increases. This can help net-food buyers access food.
- *Alleviating poverty.* Net food-selling farmers are likely to be hardest-hit by a drought. An export ban reduces their ability to mitigate their production losses with higher incomes from higher prices. If these farmers are among the poorer segments of the income distribution, the export ban will likely increase poverty, as it did in Zambia during the 2016-17 El Niño event (Al-Mamun et al. 2017).
- *Volatility.* While export bans may alleviate pressures during a specific situation, they heighten domestic price volatility by preventing domestic shocks from being dissipated through changes in trade. If bans are backed up by stockholding measures such as those used in India, they can be consistent with domestic price stabilization, although the fiscal costs of this policy approach tends to be high relative to that of price insulation (Gouel, Gautam, and Martin 2016).

**Synchronous policy measures.** While individual countries can succeed at insulating their domestic markets from short-term fluctuations in global food prices, their combined policies may make global food prices more volatile. Government interventions tend to increase consumption and reduce production during price spikes and support production

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<sup>17</sup>After abstaining from the use of interventions in staple food markets for several years, policymakers in Eastern and Southern Africa used extensively pricing, marketing, and trade policy tools during the 2015-16 agricultural season to contain the impact of an El Niño-induced decline in output and food security (Al-Mamun et al. 2017; Tschirley and Jayne 2010).

and discourage consumption during price plunges. During price spikes, this results in higher import demand and, hence, higher global demand that further drives up global prices. During price plunges, it encourages greater exports from each country and, hence, greater global supply that further depresses prices. Only countries that insulate themselves to an above-average degree are able to reduce the transmission of international price volatility to their domestic markets (Anderson, Martin and Ivanic 2017; Martin and Anderson 2012; Ivanic and Martin 2014b).<sup>18</sup>

## 4 Poverty impact of the 2010-11 food price shock

The impact of the 2010-11 food price shock on poverty is quantified in two steps. The first step estimates the degree of policy intervention by countries (Anderson, Ivanic, and Martin 2014). In the second step, these estimates are fed into a computable general equilibrium (CGE) model in combination with household models for 285,000 households from 31 countries to determine the impact of policy interventions on poverty (Annex 6.3; Laborde, Robichaud and Tokgoz 2013). Two scenarios are compared. In the first scenario, the impact of countries' own interventions on poverty is considered. In the second scenario, the combined effect of all policy interventions on global food markets and their feedback to domestic poverty is quantified.

### 4.1 Impact of policy interventions on global and domestic prices

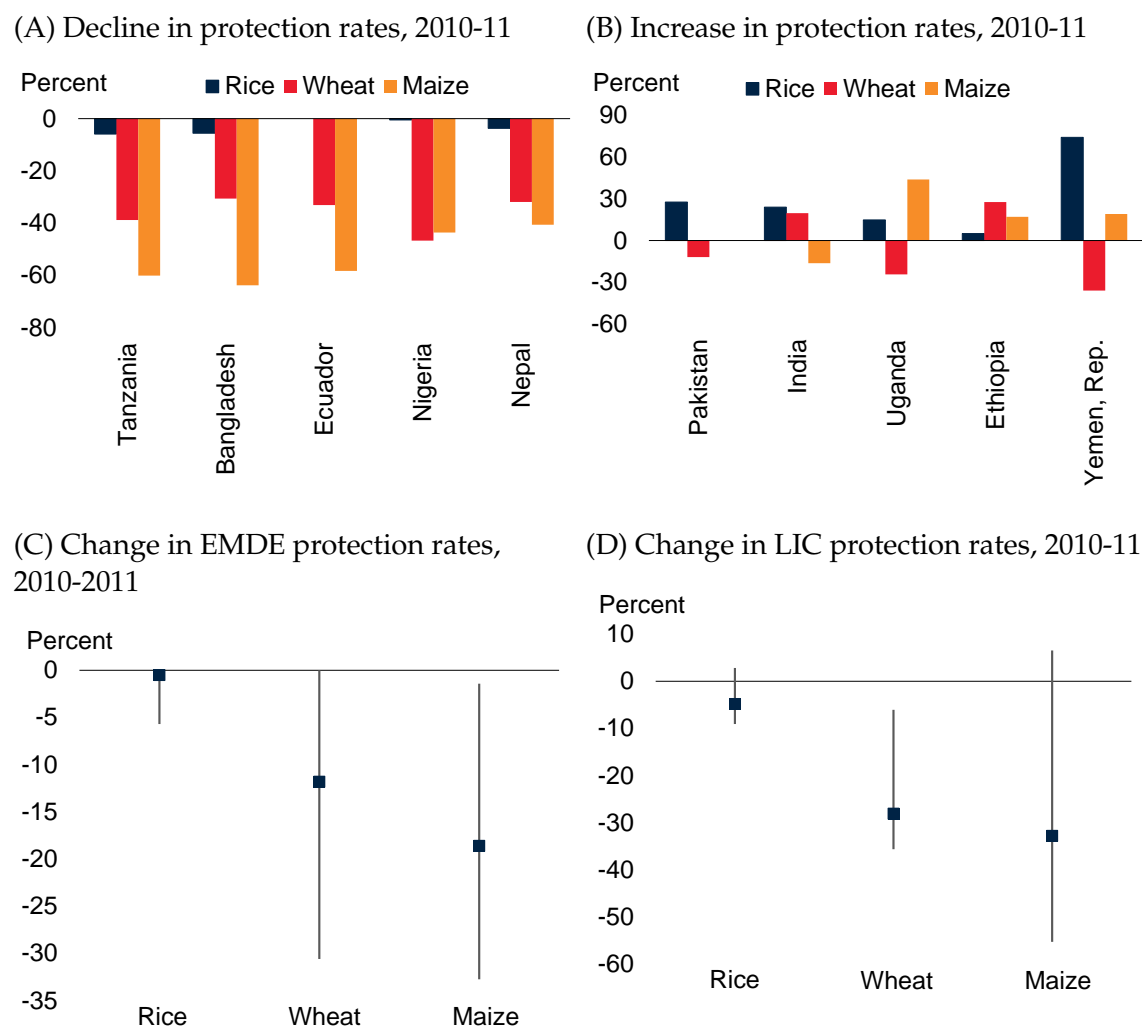
**Quantifying policy interventions.** A primary shock, such as a weather shock, is assumed to generate initial production shortfalls that are calibrated to match the observed changes in protection rates and world prices shown in Figure 6.<sup>19</sup> In attempting to insulate domestic markets from the increase in world prices, governments take offsetting trade measures, such as the introduction of export bans (food exporters) or the reduction of import duties (food importers). These policy responses are calibrated to match the observed protection rates and world price increases in 2010-11. As the model distinguishes between domestic and imported goods, two potential policy instruments are considered—an import duty (or

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<sup>18</sup>Consistent with Martin and Anderson (2012) and Anderson, Ivanic, and Martin (2014).

<sup>19</sup>For example, a negative production shock of 55 percent for rice, 27 percent for wheat, and 35 percent for maize in advanced economies and Russia generates an increase of 10 percent in average world prices for these commodities.

Figure 6: The extent of government interventions during the 2010-11 food price spike



Source: Ag-Incentives Database.

Note: Estimates based on the methodology described in Annex 6.2. Changes in the rates of protection are presented in the form:  $T_i = \Delta t / (1 + t_0)$ , where  $t$  is the initial rate of protection (positive if an import tariff or export subsidy) and  $\Delta t$  is the change in this rate of protection. If the change in the rate of protection is negative during a period of rising world prices, countries are seeking to insulate their markets from the increase in prices. If it is positive, policymakers are compounding the increase in world prices with an increase in protection, which may be due to the correction of past "errors": If domestic prices fall below policymakers' desired long-run level of protection, or if a policy that insulated the domestic market from world markets and a subsequent exogenous shock—such as a harvest shortfall—has caused the domestic price to rise relative to the world price.

C.D. Median and interquartile range in the change for protection rates for rice, wheat, and maize in EMDEs (C) and LICs (D).

subsidy) and an export subsidy (or tax).<sup>20</sup> These measures, in turn, reinforce the original shock to world prices. The data used for quantifying the extent of trade policy interventions are taken primarily from the Ag-Incentives Consortium database reflecting changes in domestic and world prices for 57 countries and 68 agricultural and food commodities during 2005-2015.<sup>21</sup> Where data from the Ag-Incentives database were unavailable, alternative data were used from FAOSTAT, GIEWS and Fewsnnet. Overall, this analysis covers 24 major food producing and consuming countries, using data on household income sources and spending patterns from 2011. Of these, 18 are EMDEs and 6 are LICs.

**Impact of policy interventions on global prices.** During the food price spike of 2010-11, world prices of maize, wheat and rice rose by 44, 39, and 6 percent, respectively, but domestic prices considerably less (Figure 4). Model results suggest that the combined action of government policies amplified global wheat and maize price increases, accounting for about 40 percent of the increase in world price of wheat and one-quarter of the increase in the price of maize. In contrast, combined policy action reduced the rice price surge compared to a non-action scenario.<sup>22</sup>

*Rice.* Some countries (e.g., Bangladesh, Nepal, Panama, Tanzania and Zambia) reduced trade barriers to partially offset the rise in world rice prices. However, important net rice exporters such as India, Pakistan, and Yemen implemented policy interventions that, ultimately, raised domestic rice prices more than the increase in world prices. In India, the world's second-largest rice producer, quantitative restrictions imposed in 2007 initially prevented domestic price increases. However, the subsequent abolition of export quotas in September 2011 resulted in a surge in exports and a rise in domestic prices. In Pakistan, heavy summer flooding that affected one-fifth of the country's land area and inflicted extensive damage to crops raised domestic rice prices relative to the world price over the same period. A large increase in domestic prices relative to external prices occurred in Yemen, amid persistent water shortages and a shift to less water-intensive non-staple

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<sup>20</sup>Many countries typically put in place flanking policies. In 2007-08, for example, Indonesia subsidized imports of wheat and rice, respectively, to hold down domestic consumer prices. To avoid subsidizing exports of the same goods, export restrictions were also introduced. Because rice, wheat, and maize are bulk commodities that are less strongly differentiated than manufactured products, two-way trade in these goods is unusual—except when there are regional differences in varieties (for example, Indian exports of Basmati rice and imports of Jasmine rice). Models of differentiated products are needed to adequately capture actual bilateral trade flows in these commodities (Thursby, Johnson, and Grennes 1986).

<sup>21</sup>The data is available at [www.ag-incentives.org](http://www.ag-incentives.org).

<sup>22</sup>This primarily reflects the elimination of export restrictions in India and the increased import protection in Pakistan, Indonesia, Uganda, and Yemen.

crops and, in Ethiopia and Uganda, amid drought. The combined intervention of all countries dampened the increase in the world price of rice by about 50 percent compared to a scenario without insulation policies.

*Wheat.* Most EMDEs took measures to offset the increase in global wheat prices in 2010-11, broadly similar to those employed during the spike in wheat prices in 2007-08. Policymakers justified efforts to dampen the impact of the global wheat price spike by noting that the world wheat price spike partly reflected a catching up with rising domestic wheat prices.<sup>23</sup> The combined intervention of countries accounted for close to 50 percent of the increase in the world price of wheat.

*Maize.* Although most countries insulated their domestic maize markets against maize price increase during 2010-11, there was considerable heterogeneity in policy responses. In Bangladesh, Ecuador, Malawi, Tanzania, and Zambia, protection rates fell, fully offsetting the rise in global maize prices. Ethiopia, Uganda, and Yemen increased protection rates or used policies that, in combination with domestic output shocks, amplified the increase in domestic prices.

## 4.2 Impact of policy intervention on poverty

**Poverty impact of hypothetical food price spikes without policy intervention.** A hypothetical 10 percent surge in rice, wheat, and maize prices raises the number of extreme poor living on less than \$1.90 per day by 0.22 percent or 2.1 million. Among staple foods, an increase in wheat prices raises the number of poor most (by 0.01 percentage points for a 10 percent wheat price increase). Rice price increases cause particularly large increases in the number of poor in Sub-Saharan Africa (0.13 percentage points). Finally, maize price increases tend to have a lesser impact on the number of poor.

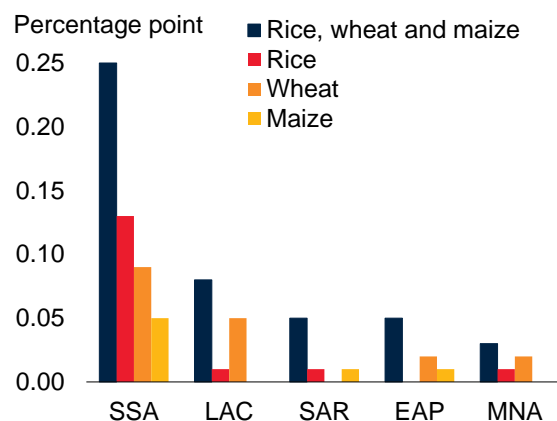
**Poverty impact of 2010-11 food price spike with policy intervention.** When incorporating the effects of government intervention to reduce the pass-through of rising global to domestic prices, model results suggest that the food price spikes of 2010-11 still raised poverty in most countries (Figure 7). On average, the share of extreme poor living on less

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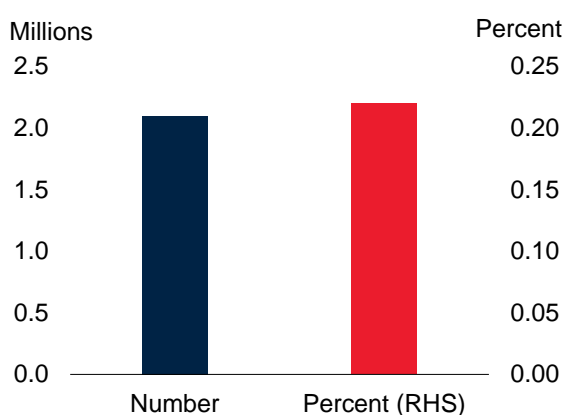
<sup>23</sup>Ethiopia is an exception, where domestic wheat prices rose 28 percentage points more than world prices during 2010-11. This reflected domestic supply shocks, combined with limited access to global wheat markets to alleviate shortages. In particular, wheat output fell by 10 percent in 2010-11 as a result of a fungus that destroyed the wheat harvest and lowered stocks in 2011. Wheat imports rose but were constrained by tight foreign exchange controls, effectively stopping private sector imports and ensuing that all grain imports are channeled through the state-owned Ethiopian Grain Trade Enterprise (Wakeyo and Lanos 2014; Negassa and Jayne 1997).

Figure 7: Poverty impact of policies implemented during 2010-11 food price spike

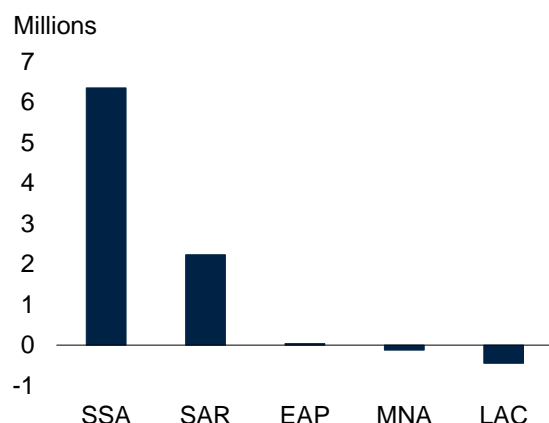
(A) Global poverty impact of a 10 percent rice, wheat, and maize price increase



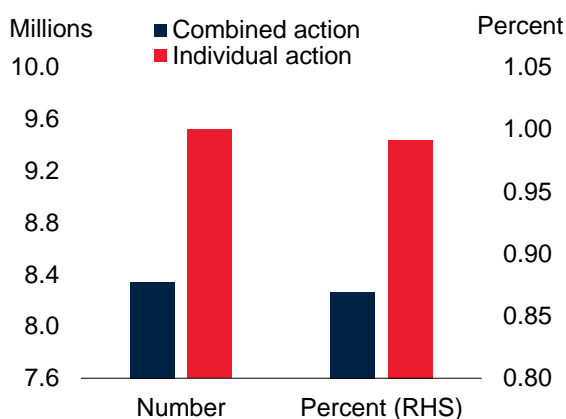
(B) Global poverty impact of 10 percent rice, wheat, and maize price increase



(C) Regional poverty impact of the 2010-11 food price shock



(D) Global poverty impact of policy responses to the 2010-11 food price shock



Source: Authors' estimates.

Note: Based on estimates using the MIRAGRODEP computable general equilibrium model described in Annex 6.3.

A. Change in the poverty headcount measured at \$1.90 per day.

A.C. EAP = East Asia and Pacific; LAC = Latin America and the Caribbean; MNA = Middle East and North Africa; SAR = South Asia; SSA = Sub-Saharan Africa.

C.D. Assuming increases in the price of maize, rice and wheat as represented in Figure 4.D and based on a poverty line of \$1.90 per day.

than \$1.90 per day increased by 0.12 percentage point from 13.7 percent. This is equivalent to an additional 8.3 million, or a 1 percent increase in the number of extreme poor.

**Heterogeneity in poverty impact.** The increase in world food prices, combined with government intervention, was most strongly felt in countries such as India and Uganda, where the extreme poor tend to be net food-buyers whose real incomes declined.<sup>24</sup> The poverty impact of the 2010-11 food price spike on some regions such as East Asia and the Pacific (EAP), and Latin America and the Caribbean (LAC) is estimated to have been limited: low rates of poverty combined with the benefits of the price increase for countries that are heavy exporters of rice (EAP) or maize (LAC) offset some of the losses incurred due to the increase in prices. Even in Sub-Saharan Africa—the region that accounts for two-thirds of the global increase in poverty—countries like Ethiopia and Nigeria implemented insulation policies that reduced poverty.

**Comparison with 2007-08 food price shock.** These poverty impacts are less pronounced than those induced by the 2007-08 food price shock. The 2007-08 food price shocks may have increased extreme poverty by 105 million (Ivanic and Martin 2008). Government policies reduced poverty impacts and their combined effect was close to zero (Anderson, Ivanic, and Martin 2014). The difference in poverty impacts reflects the greater severity of the 2007-08 price shocks, the stronger transmission of price changes from world to domestic markets and higher initial poverty rates (the poverty headcount in India, for instance, fell from 31 percent in 2009 to 21 percent in 2011).<sup>25</sup> While the 2007-08 event was led by rice prices, exacerbated by export restrictions imposed by major rice producers, the 2010-11 food price surge was led by maize and wheat prices, triggered by adverse weather events in major wheat and maize producers in Australia and the Black Sea Basin. During 2007-08, large rice consumers, such as India, imposed export restrictions to contain domestic rice price increases. These were gradually unwound over the following years. In 2010-11, some large wheat and maize producers, such as Russia and Ukraine, introduced export restrictions and import bans to contain domestic price pressures.

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<sup>24</sup>Results reported here do not take into account the impact of safety-net programs such as India's Public Distribution System, which distributes food to poor households at fixed prices.

<sup>25</sup>World Bank (2012) estimate that the 2010-11 food price spike increased the number of poor by 50 million in the short run, and by 34 million in the long run. These higher estimates do not explicitly account for insulation policies and consider price increases of a wider range of food commodities (also beef, chicken, dairy, vegetable oils and soybean prices). In addition, there is uncertainty around poverty estimates due to systematic measurement errors in household surveys that may bias the poor's dependence on food purchases (Headey and Martin 2016). Finally, Jacoby (2016) and Jacoby and Dasgupta (2018) highlight the importance of accounting for the endogenous agricultural wage response and spillover effects to non-agricultural wages (also accounted for in this paper).



## 5 Conclusions

During the 2010-11 food price shock, coming in short succession after the 2007-08 surge in food prices, many countries used trade policies to insulate domestic markets from the increase in world prices. While each country's policies can dampen domestic price movements, the combined use of policies by many countries increases global food price volatility. For example, widespread insulation policies accounted for 40 percent of the increase in world wheat prices and one-quarter for world maize prices. The increase in food prices combined with government policy responses in 2010-11 raised global poverty by almost 1 percent (8.3 million).

These findings highlight that the use of trade policy interventions to insulate domestic markets from food price shocks compounds the volatility of international prices and may not be effective in protecting the most vulnerable populations groups. Instead, targeted safety net interventions such as cash transfers, food and in-kind transfers, school feeding and public works programs can mitigate the negative impact of food price shocks on poor households. Measures such as crop and weather insurance, warehouse receipt systems, commodity exchanges and futures markets could also be used as risk management instruments. Additional policy interventions such as targeted nutrition and health programs can contribute to improving health outcomes in the medium term, while regulatory interventions (taxing unhealthy food) can improve health outcomes in the longer term.

More generally, in addition to targeted interventions it is important to ensure that countries have detailed strategic framework for food crisis response in place and that these programs are sufficiently resourced with administrative budgets. International financial institutions (IFIs) can assist countries to better target the people most vulnerable to a food price crisis. IFIs can also help countries identify practical mechanisms (including indicators) for monitoring nutritional and welfare outcomes, in measuring the impacts of food crises and mitigation programs, and work with them to implement those mechanisms. The private sector can play a crucial role in enhancing investments in food supply in the short and medium term (World Bank 2013), while better collaboration among public and private stakeholders can improve risk management and provide effective responses to reduce the impacts of extreme weather on agriculture (G20 2018).

## 6 Annex

### 6.1 Error Correction Model

The analytical framework used to represent the imperfect transmission of changes in international prices into domestic markets relies on an Error Correction Model (ECM) as described in Ivanic and Martin (2014). As noted by Nickell (1985), this model represents a situation in which policy makers seek to reduce both the costs of change, and the costs of being out of equilibrium. A simplified version model used by Ivanic and Martin (2014), expressed in logs, is:

$$\Delta\tau = \alpha(p^w - p_{t-1}^w) + \beta[p_{t-1} - \gamma p_{t-1}^w],$$

where  $p$  represents domestic prices;  $p^w$  world prices;  $\tau$  the rate of protection, approximated by  $(p-p^w)$ ;  $\alpha$ ,  $\alpha < 0$ , the coefficient of price insulation ranging from 0 for countries that do not insulate against the rise in world prices, to -1 for countries that adopt policies that fully insulate domestic markets;  $\beta$ ,  $\beta < 0$ , the cost of being out of equilibrium or the speed with which policies achieve the target level of protection or at which policy makers move back toward this equilibrium after being forced away from it by a shock to world prices;  $\gamma$  determines the long run relationship between a country's protection and the global level of agricultural protection; and  $[p_{t-1} - \gamma \times p_{t-1}^w]$  is the deviation from the political-economy equilibrium. It depends on factors like income levels, exportable/importable status, the elasticity of import demand, and the share of real incomes gains from higher protection that will accrue to politically-organized producers (Anderson 1995; Grossman and Helpman 1994).

The database on Distortions to Agricultural Incentives (Anderson and Valenzuela 2008; Anderson and Nelgen 2013) is the main data source for estimating the ECM model. It includes estimates of domestic and world price levels which also determine the level of protection. The price data used in the model capture both natural shocks (oil prices, weather events) as well as the impact of trade policy interventions the separate impact of which is not possible to disentangle. The model is estimated for eight food commodities with data for 82 countries, of which 26 are advanced economies, 44 EMDEs, and 12 LICs.

### 6.2 Measuring the extent of trade policy interventions

The approach to quantify the extent of trade policy interventions builds on that used in Anderson, Ivanic, and Martin (2014). It is assumed that a primary shock, such as weather shock, generates an initial change in domestic and world prices. In attempting to insulate

consumers and producers from price increases, governments make offsetting changes in protection measures, such as the introduction of export bans or reduction in import duties. These measures, in turn, reinforce the original shock to world prices. When a country imposes an export restriction, the availability of food to the rest of the world is reduced, and this tends to push up world price. Similarly, when an importing country reduces its import tariffs, it increases the demand for imports and hence puts upward pressure on the world price.

The impact of the changes in trade policies can be distinguished from those of the primary shocks by in the following equation:

$$\sum_i S_i(p_i) + v_i = \sum_i D_i(p_i)$$

where  $S_i$  is supply in region  $i$ ;  $D_i$  is demand in region  $i$ ;  $p_i = p^*(1 + t_i)$  is the domestic price;  $p^*$  is the world price;  $t_i$  is a country-specific trade barrier such as a proportional tariff; and  $v_i$  is a random production shift variable for region  $i$ . Totally differentiating the equation above, rearranging, and expressing the results in percentage changes yields an expression of the impact of a set of changes in trade distortions on the world price:

$$p^* = \frac{\sum_i H_i v_i + \sum_i (H_i \gamma_i - G_i \mu_i) T_i}{\sum_i (G_i \mu_i - H_i \gamma_i)}$$

where  $p^*$  is the proportional change in the international price;  $v_i$  is an exogenous output shock such as might result from good or bad seasonal conditions;  $\mu_i$  is the elasticity of demand in market  $i$ ;  $\gamma_i$  is the elasticity of supply in market  $i$ ;  $G_i$  is the share at world prices of country  $i$  in global demand;  $H_i$  is the share of country  $i$  in global production, and  $T_i = (1 + t_i)$ .

In other words, the impact on the world price of a change in trade policies in country  $i$  is given as a weighted average of the changes in trade distortions in different markets, with the weight on region  $i$  depending on the importance of that country in global supply and demand, as well as the responsiveness of its production and consumption to price changes in the country, as represented by  $\gamma_i$  and  $\mu_i$ .

It is thus assumed that elasticities of demand are equal between countries, i.e., that imported and domestic goods are perfect substitutes, and that there are no supply responses. Alternatively, one could allow for differentiation between imported and domestic products, as well as a limited supply response (Jensen and Anderson 2017). The result would

be an expression with weights that depend on, for instance, the shares of imports in consumption in each market. However, the overall result is similar in expressing the change in world prices as a weighted sum of changes in trade distortions.

Assuming away difficult-to-interpret interaction terms, all proportional changes are converted into log changes in  $T_i$ ,  $p_i$  and  $p$  as:

$$p_i = p + T_i$$

Changes in relative prices are measured as in the Agricultural Incentives database and capture a wide range of policy measures used to assess agricultural trade distortions - including tariffs, export subsidies, export taxes, export bans and import subsidies.

Estimates of change in the rate of protection are presented in the form:

$$T_i = \frac{\Delta t}{1+t_0}$$

where  $t$  is the initial rate of protection (positive if an import tariff or export subsidy), and  $\Delta t$  is the change in this rate of protection.

If products are homogeneous, and a country is small, the change in  $\Delta t$  represents the change in the domestic price of the good. Additionally, if  $T_i$  is negative in a period of rising world prices, countries are seeking to insulate their markets from the increase in prices. If it is positive, policy makers are compounding the increase in world prices with an increase in protection. This may be due to the correction of past “errors”. This might occur if domestic prices fall below policy makers’ desired long-run level, or if policy insulated the domestic market from world markets and an exogenous shock—such a harvest shortfall—has caused the domestic price to rise relative to the world price. Such insulation patterns have been observed in the maize markets in many African countries (Chapoto and Jayne 2009).

### 6.3 The MIRAGRODEP model

The analytical framework to measure the poverty implications of the 2010-11 food price spike relies on the MIRAGRODEP model (Laborde, Robichaud, and Tokgoz 2013). MIRAGRODEP is a dynamic, multi-country, and multi-sector computable general equilibrium (CGE) model that extends the standard CGE modelling framework with household surveys for more than 31 countries and 285,000 representative households to capture the poverty impact of different policy shocks. The model relies on GTAP 9, a global database for 2011. The GTAP database includes input-output tables linked by bilateral trade flows

for 140 regions (countries or country aggregates) and 57 sectors. For the purposes of the simulations these countries and sectors were aggregated into 31 countries/regions and [10] sectors among which rice, wheat, and maize are represented separately.

On the supply side, the production function is a Leontief function of value-added and intermediate inputs. The intermediate inputs are represented by a nested, two-level constant elasticity of substitution (CES) function of all goods. Based on this, substitutability exists between intermediate goods, but these are more substitutable when they are in a same category (such as agricultural inputs or service inputs). Value-added is also represented by a nested structure of CES functions of unskilled labor, land, natural resources, skilled labor, and capital. This nesting allows the modeler to incorporate some intermediate goods that are substitutes of factors, such as energy or fertilizers.

On the demand side, a representative consumer is assumed to have a constant propensity to save. The remaining national income is used for the purchase of final consumption goods. Consumers' preferences are represented by a linear expenditure system–constant elasticity of substitution (LES–CES) function, calibrated based on the U.S. Department of Agriculture Economic Research Service (ERS/USDA) income and price elasticities to best reflect non-homothetic demand patterns with changes in revenue. Given an increase in the price staple foods such as rice, wheat or maize, consumers substitute away to consume other food products. Armington elasticities, which measure the elasticity of substitution between products of different countries, are drawn from the GTAP database and are assumed to be the same across regions.

Factor endowments are assumed to be fully employed. The supply of capital goods is modified each year because of depreciation and investment. New capital is allocated among sectors according to an investment function. Growth rates of labor supply are fixed exogenously. Land supply is endogenous and depends on the real remuneration of land. Skilled labor is the only factor that is perfectly mobile; unskilled labor is imperfectly mobile between agricultural and nonagricultural sectors according to a constant elasticity of transformation (CET) function. Unskilled labor's remuneration in agricultural activities is different from that of nonagricultural activities. The only factor whose supply is constant is the natural resources factor. It is, however, possible to endogenously change the factor endowment in the baseline in order to reflect long-term depletion of resources with respect to a price trajectory.

The poverty impact is captured through a top-down approach using a dataset of household surveys for more than 31 countries and 285,000 representative households. The impact of a policy shock on poverty depends on price changes, the relative reliance of

households on the consumption of individual staple foods and the net food buying status of households in different segments of the distribution (Deaton 1989).

Beyond the standard features of a global dynamic CGE model, the MIRAGRODEP model includes several improvements: sub-national land markets (agro-ecological zones or administrative districts) and endogenous land supply; poverty analysis through either a top-down approach for global coverage or a bottom-up approach (for a subset of countries); dual-dual approach for formal/informal and rural/urban labor markets (Stifel and Thorbecke 2003); a consistent aggregator for trade policies (Laborde, Martin, and van der Mensbrugghe 2017); differentiated datasets on actual trade and farm policies and existing policy space for scenario design and endogenous policy responses; macro nutrient (calories, fats, proteins) accounting system based on FAOSTAT food balance sheets and a global Input-Output matrix; and sensitivity analysis framework based on Monte-Carlo simulations.

While the elasticities of substitution for rice, wheat, and maize used in this model, are higher than for manufactured goods, they are not infinite as assumed using the perfect substitutes model (Thursby, Johnson, and Grennes 1986). This specification has important implications for both the economy-wide analysis and at the household level. Given these assumptions, an increase in the price of an imported good has a muted impact on the domestic consumer price of that good. Since, with the Armington assumption—imported goods differentiated based on their country of origin—the composite price of the consumer good is weighted by the shares of domestic and imported goods, the impact of a unit change in the world price, or in trade policy, is given by the share of imports in total consumption. Because the share of imports in total consumption of staple foods is typically small, the impact of trade policy on consumer prices is much more muted than under the assumption of perfect substitution used in Anderson, Ivanic, and Martin (2014). On the production side, the assumption that each country's export product is the same as the products sold domestically means that changes in export trade policies will have a more direct impact on producer prices if the country is an exporter and not too large in the markets it supplies.

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