



## Special Feature: Commodity Market Developments and Forecasts, with a Focus on Food Security and Markets in the World Economy

Commodity prices have rebounded since the release of the April 2016 World Economic Outlook (WEO) in spite of rising uncertainty following the Brexit vote—the June 23, 2016, U.K. referendum result in favor of leaving the European Union. Supply outages in various countries have led to tighter oil markets. The announcement of China’s stimulus package increased metal demand prospects and prices. Unfavorable weather conditions have put upward pressure on food prices. This special feature includes an in-depth analysis of food security and markets in the world economy.

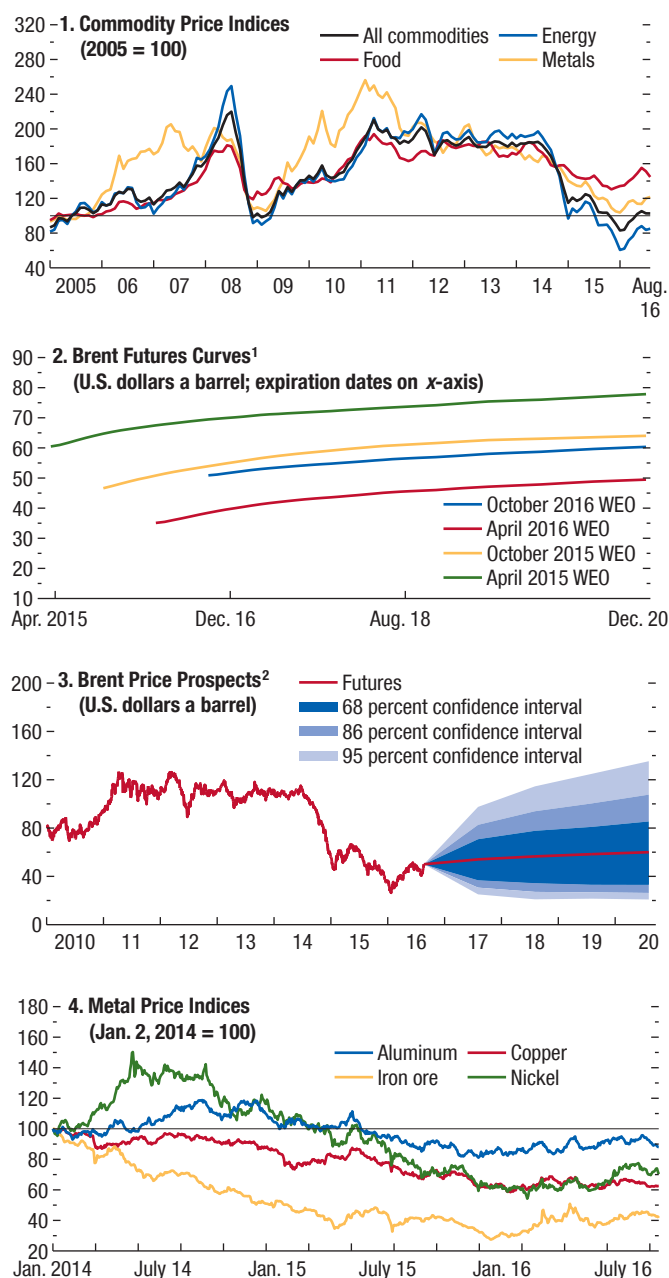
The IMF’s Primary Commodities Price Index has rebounded 22 percent since February 2016, the reference period for the April 2016 WEO (Figure 1.SF.1, panel 1). Oil prices have rallied, by 44 percent, due to involuntary outages. Natural gas prices have declined. With strong supply from Russia, natural gas prices in Europe are at their lowest in 12 years. Asian markets show weaker demand from Japan, which is reactivating its nuclear power plants. Coal prices have rebounded. Nonfuel commodity prices have increased, with metals and agricultural commodities prices increasing by 12 percent and 9 percent, respectively.

Oil markets are in midstream. On the supply side, the market has been hit by a few outages. Some had a short-term impact on production, including the labor dispute in Kuwait and the Fort McMurray wildfires in Canada, but others, such as the geopolitical unrest in Iraq, Libya, Nigeria, and Yemen, could have a long-term impact. These disruptions temporarily brought balance to the oil market. On the policy front, the Organization of the Petroleum Exporting Countries (OPEC) did not reach its production target agreement in June. However, some observers expect OPEC members to set a new target in November once the Islamic Republic of Iran’s production reaches its presanction level.

The recent oil price rebound has helped shale producers, leading to a bottoming of rig count. In addition, drilled-but-uncompleted wells can be completed at current price levels, which will add to U.S. oil

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Figure 1.SF.1. Commodity Market Developments



Sources: Bloomberg, L.P.; IMF, Primary Commodity Price System; Thomson Reuters Datastream; and IMF staff estimates.

Note: WTI = West Texas Intermediate.

<sup>1</sup>World Economic Outlook (WEO) future prices are baseline assumptions for each WEO and derived from future prices. October WEO prices are based on August 18, 2016, closing.

<sup>2</sup>Derived from prices of futures options on August 18, 2016.

production. Tighter credit conditions could, however, limit the recovery in investment. Canada's oil production is strong, but new investment in oil sand fields is limited. In sum, uncertainties over supply stem from the persistence of involuntary outages, OPEC policy, and investment in unconventional oil fields.

After strong global oil demand growth last year—at 1.6 million barrels a day—on account of lower oil prices for the most part, the International Energy Agency expects growth in demand slightly above trend at 1.3 million barrels a day in 2016 and 1.2 million barrels a day in 2017. Given robust oil demand, the continued erosion of high-cost producers, and severe unplanned outages, markets expect the oil market to rebalance during the course of next year.

Natural gas prices are declining—with a key natural gas price index (the price average for Europe, Japan, and the United States) down by 6 percent since February 2016. Falling oil prices, abundant natural gas production from Russia, and weak demand in Asia have contributed to that decline. In the United States, natural gas prices have instead edged higher on account of stronger demand from the power sector, reflecting hotter-than-expected weather. The coal price index of average Australian and South African prices has also increased 32 percent since February 2016 in line with other energy and metal prices.

Oil futures contracts point to rising prices (Figure 1.SF.1, panel 2). Baseline assumptions for the IMF's average petroleum spot prices, which are based on futures prices, suggest average annual prices of \$43.0 a barrel in 2016—a decline of 15 percent from 2015—and \$50.6 a barrel in 2017 (Figure 1.SF.1, panel 3). The e remains substantial uncertainty around the baseline assumptions for oil prices. Although geopolitical tensions in the Middle East could cause oil market disruptions, high inventory and a rapid response from U.S. shale producers should mitigate a sharp rise in prices in the near future. Oil demand could weaken if the consequences of Brexit for global aggregate demand are more severe than anticipated. In the medium term, the oil market is expected to remain quite tight in light of supply constraints, considering that the decline in oil prices has dramatically reduced investment in extraction, unless shale production can be boosted or global demand falters. In that environment, geopolitical events could trigger oil price hikes.

Metal prices have rebounded 12 percent since February 2016 (Figure 1.SF.1, panel 4). Prices have been gradually declining since 2011 because of a slowdown

and a shift away from commodity-intensive investment in China. However, the recent stimulus program announcement directed toward the construction sector has provided some support to prices. Metal prices are projected to decline by 8 percent in 2016 and to increase by 2 percent in 2017. Futures prices point to continued low prices.

Prices of agricultural commodities have increased by 9 percent overall since February 2016. Food prices rose by 7 percent, with increases in most food items, except a few, such as wheat and corn. International prices have not fully reflected the adverse weather shock until recently, but El Niño and a potential La Niña took a toll on international food markets. In addition, Brazil—a big producer of corn, soybeans, coffee, beef, and other food products—has been suffering a prolonged drought. In the past two years, other regions have made up the difference, but global stocks of corn and soybeans are now expected to decline. Wheat stocks are expected to rise due to favorable production in the United States, the European Union, and Russia, pushing prices down.

Annual food prices are projected to increase next year on account of changing weather conditions. Food prices are projected to increase by 2 percent in 2016 and to remain broadly unchanged in 2017; current price levels are already 3 percent above 2015 levels. Over the next two years, prices for major food products, such as rice, are expected to increase slightly from current levels. Risks to food prices are associated with weather variability, particularly concerns over La Niña, which typically has a stronger negative impact on harvests than does El Niño.

The following section takes a longer view and explores the evolution of food markets over the past decades.

## Food Security and Markets in the World Economy

The debate over the evolution of food supply relative to population growth dates back at least to the influential theory laid out by Malthus (1798). Since then, a large body of literature has explored the interplay between technology, population, and income per capita and how different growth regimes emerge.<sup>1</sup> A central insight is that the modern era has been characterized

<sup>1</sup>See, among others, Galor and Weil 2000; Galor 2005 and 2011; and Gollin, Parente, and Rogerson 2002.

by rapid economic growth and divergence across countries, and that this stands in contrast with most of human history (the so-called Malthusian era), which was characterized by stagnant income per capita.

Today, access to food is mainly seen as an issue facing poor countries. However, developments in food markets are far reaching and indicative of structural developments at the global level.<sup>2</sup> The rapid growth in emerging markets, the demographic transition, and technological developments have and will continue to shape food markets. Furthermore, food markets are segmented and subject to multifaceted distortions to investment and trade. It is thus appropriate to take an in-depth look at the recent and future evolution of food markets and discuss what it means for food security.<sup>3</sup>

This feature answers the following questions related to the evolution of food markets and food security:

- What is special about food markets?
- What are the drivers of food production and consumption?
- How has global food trade evolved?
- What are the risks?

### What Is Special about Food Markets?

Food is an edible or potable substance that helps sustain life. Food crops include cereals (for example, wheat, maize, and rice); fruits and vegetables (for example, oranges, and potatoes); meat and seafood (for example, pork and shrimp); beverages (for example, coffee, tea, and cocoa); oilseeds (for example, soybeans and groundnuts); and sugar.<sup>4</sup> These categories differ in a variety of ways in terms of nutritional value, perishability, and storability. The agricultural sector is a source of livelihood for millions, whether through cash cropping or subsistence farming. Globally, over 750 million individuals work in agriculture—that is, 30 percent of the workforce. In sub-Saharan Africa, 60 percent of the workforce labors in agriculture (see World Bank 2015a). Historically, the process of structural transformation that drove labor from the

<sup>2</sup>See Arezki and others 2016 and references therein for a discussion on food price fluctuations and their consequences.

<sup>3</sup>According to the World Food Summit 1996 declaration, “Food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.”

<sup>4</sup>Some of the aggregate figures presented in this special feature also include nonedible agricultural commodities such as cotton, rubber, wool, and hides.

agricultural (low-productivity) sector to the industrial (high-productivity) sector can explain most of the fast increase in aggregate productivity (see Duarte and Restuccia 2010).

Unsurprisingly, most food production is consumed domestically—about 85 percent of food is produced in the country where it is consumed, according to the World Bank (2015a). There are important differences across types of food depending, among other things, on whether or not they are cash crops. The transmission of international price variations from the border is often limited by taxes, subsidies, price controls, weak market integration, and local distribution costs. In advanced economies, the average long-term pass-through of a 1 percent food price shock to domestic food prices is about 0.10 percent and about 0.15 percent in emerging market economies (see Chapter 3, Box 3.3).<sup>5</sup> For these reasons, and because most food production is consumed domestically, local agricultural and weather conditions are influential, alongside global market developments.<sup>6</sup>

Food has been a long-standing sticking point in trade negotiations, including over tariff and nontariff barriers, even though it is a relatively small portion of global trade—8 percent of merchandise in value terms according to the World Trade Organization (2015). Tariff and nontariff barriers often result from concerns over food sovereignty and the protection of domestic farmers. The Doha Round trade negotiations stalled in July 2008 over disagreements on agriculture. More recently, the special safeguard mechanism proposal to allow temporary tariff hikes when food imports surge was opposed by exporters—in both advanced and developing market economies.

The rationale for a special safeguard has been to counterbalance official agricultural support in exporting countries. Direct agricultural support in countries

<sup>5</sup>See also Furceri and others 2016.

<sup>6</sup>Changes in transportation technology and costs have shaped the degree of integration of commodity markets, including for food, which initially had very limited geographical reach. These changes occurred in two stages (see Radetzki 2011). The first took place in the latter half of the 19th century and included the introduction of refrigerated ships permitting long-distance shipment of meat and fruit. The second stage began in the 1950s, but came to fruition in the 1970s. This stage involved the introduction of huge specialized bulk carriers, along with their harbor loading and unloading facilities, which allowed economical shipment of low-value products across much greater distances. The result was a further dramatic decline in the cost of shipping—particularly across vast transoceanic shipping routes—which led in turn to convergence of prices across regional markets.

of the Organisation for Economic Co-operation and Development has declined, while emerging markets have ramped up their support (Figure 1.SF.2). Historically, in developed economies, the distortions tended to favor farmers, whereas in developing economies they tended to favor urban consumers at the expense of small farmers (Anderson 2016). Over the past two decades, high-income countries have generally reduced the distortions in their agricultural sectors. Most developing regions, especially in Asia, have switched from taxing their farmers to providing them with support. All countries continue to have a strong antitrade bias in the structure of assistance to their agricultural sector (Anderson 2016).<sup>7</sup> Trade-policy instruments, such as export and import tariffs, subsidies, and quotas, have serious distributional consequences for consumers. Markets that are specially distorted include those for soybeans, sugar, rice, wheat, beef, pork, and poultry (Anderson, Rausser, and Swinnen 2013).<sup>8</sup>

### What Are the Drivers of Food Production and Consumption?

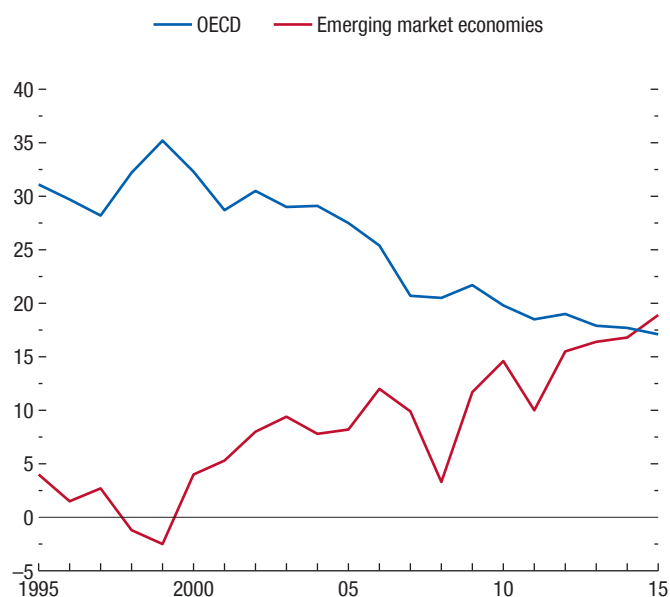
Production and consumption centers for food are concentrated in a few countries, but the location of production centers varies considerably with the type of food under consideration (Figure 1.SF.3). The main production and consumption centers, however, often overlap. For example, China is both a large consumer and producer of rice and pork, as well as a large importer of soybeans—a key animal feed. The United States is a large producer and consumer of both corn and beef, as is the European Union for wheat. Of course, many raw food products are key intermediate inputs to the agricultural industry, which in turn produces and exports processed products.

Population growth is a key factor behind food consumption. Income growth reorients the composition of demand, for instance, toward meat, dairy,

<sup>7</sup>Available data from the World Bank's World Integrated Trade Solution on the evolution of import tariffs on food products indicate that they fell from 22 percent to 11.5 percent between 1991 and 2014. Tariffs did not increase in any region. However, tariffs remained especially high in east Asia at 30 percent. In North America, tariffs were the lowest at about 8–9 percent. These results are based on effectively applied average import tariff data for food products (in percent) calculated by aggregating, over all trading partners, the lowest applicable tariff for each partner.

<sup>8</sup>Cotton markets are also severely distorted.

**Figure 1.SF.2. Producer Support Estimate**  
(Percentage of gross farm receipts)



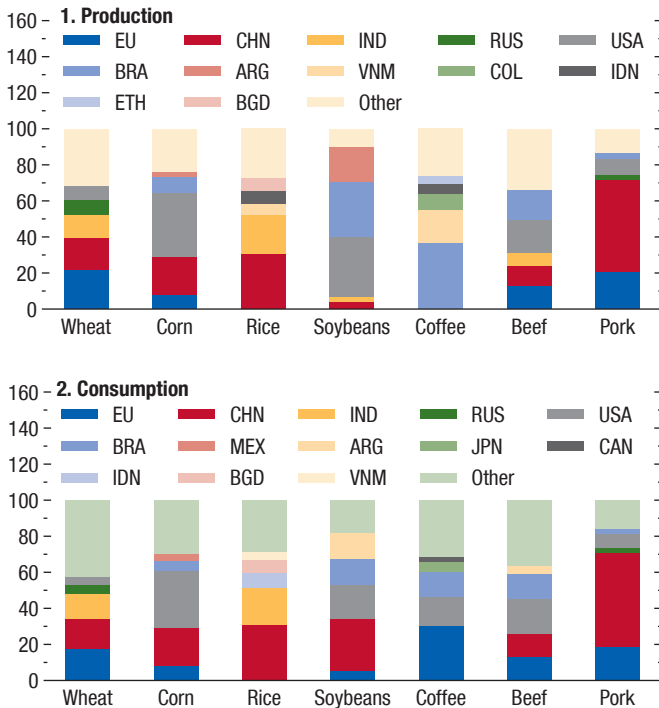
Source: Organisation for Economic Co-operation and Development (OECD), Producer and Consumer Support Estimates, Agriculture Statistics (database). Note: OECD country classification is based on current membership. Emerging market economies comprise Brazil, China, Colombia, Indonesia, Kazakhstan, Russia, South Africa, Ukraine, and Vietnam. Vietnam is included from 2000 onward.

vegetables, and fresh fruits (Figure 1.SF.4).<sup>9</sup> A case in point is China's remarkable economic growth over the past 30 years, which brought sustained increases in consumer income. Chinese consumers have moved away from staples (such as grains and rice) toward a more diversified and higher-quality diet.<sup>10</sup> The effect of course is important differences in preferences across countries that lead to a differentiated effect of income growth on the composition of food demand. India is a major exception to the trend toward higher meat

<sup>9</sup>Tilman and Clark (2014 and 2015) show that there is a strong relationship between income per capita and consumption of (1) meat protein; (2) refined sugars and animal fats, oils, and alcohol; and (3) total calories. Global food demand could double by 2050 compared with 2005, with dietary shifts responsible for about 70 percent and global population growth responsible for the remaining 30 percent (Tilman and Clark 2015).

<sup>10</sup>In China, per capita food consumption of cereals decreased by 7 percent, while consumption of sugar and vegetable oils increased by 14 percent and 16 percent, respectively. Consumption of protein increased as well: meat by 37 percent and seafood by 42 percent. The increases in fruit and milk consumption were especially dramatic, both increasing by 115 percent.

**Figure 1.SF.3. World Food Production and Consumption by Country, 2015**  
(Percent of world production or consumption)

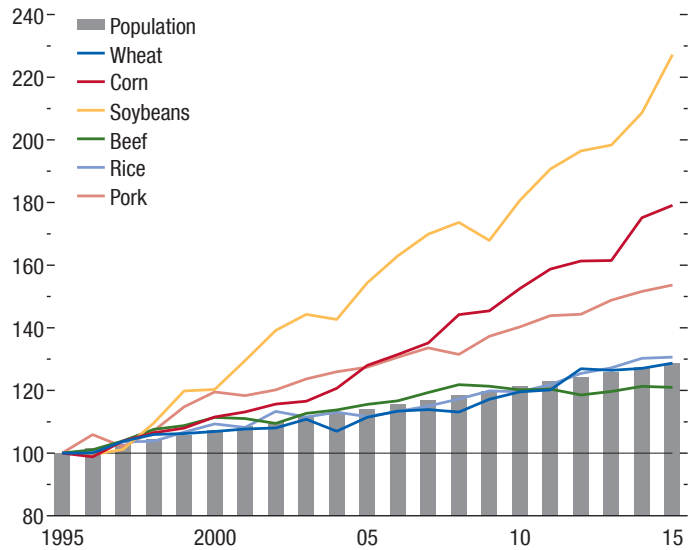


Sources: U.S. Department of Agriculture; and IMF staff calculations.  
Note: Data labels in the figure use International Organization for Standardization (ISO) country codes.

consumption, due to religious traditions.<sup>11</sup> Besides population and income growth, the advent of some types of biofuels—whose share has doubled over the past decade—can put pressure on food markets and

<sup>11</sup>See Anand and Cashin (2016) and Tulin and Anand (2016) for additional details on India's changing food demand.

**Figure 1.SF.4. Population and World Food Consumption**  
(Index 1995 = 100)



Sources: U.S. Department of Agriculture; World Bank, *World Development Indicators*; and IMF staff calculations.

has been blamed for food price increases (Chakravorty, Hubert, and Marchand 2015).

Land and technology availability are key drivers of food production. Most of the available land suitable for agriculture is located in developing regions—mostly sub-Saharan Africa and South America, as shown in Table 1.SF.1. Growing population, especially in Africa and Asia, will require an increase in food calorie production by 70 percent by 2050 (IFPRI 2016).<sup>12</sup> Putting all unused land into service, assuming everything

<sup>12</sup>The global population is forecast to reach 9.7 billion by 2050, up from 7.3 billion as of 2015 (United Nations 2015). More than half of this increase—that is 1.3 billion—is expected to occur in Africa, the fastest growing region, and Asia is estimated to contribute 0.9 billion.

**Table 1.SF.1. Used-to-Available Land Suitable for Agriculture by Region, 2013**  
(Thousand hectares)

	North Africa	Sub-Saharan Africa	South America	North America	Europe	Oceania	Asia	World
Used land (2013)	46,151	221,805	192,393	205,091	292,457	48,912	568,454	1,575,263
Unused suitable land	46,595	162,198	130,946	7,242	27,189	15,628	13,392	403,190
Total available land	92,746	384,003	323,339	212,333	319,646	64,540	581,846	1,978,453
Ratio used/available	0.50	0.58	0.60	0.97	0.91	0.76	0.98	0.80

Sources: Food and Agriculture Organization of the United Nations (FAO), FAOSTAT and Global Agro-Ecological Zones (GAEZ); and IMF staff calculations.  
Note: Used land is the total of arable land and land under permanent crops, from FAOSTAT. Unused suitable land is calculated from GAEZ. Land is considered suitable if the land is ranked by GAEZ as highly or very highly suitable in one crop out of five (maize, soybean, wheat, sugarcane, palm oil). Oceania includes American Samoa, Australia, Cook Islands, Fiji, French Polynesia, Guam, Kiribati, Marshall Islands, Melanesia, Micronesia, Nauru, New Caledonia, New Zealand, Niue, Norfolk Island, Northern Mariana Islands, Pacific Islands Trust Territory, Palau, Papua New Guinea, Pitcairn Islands, Polynesia, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu, and Wallis and Futuna Islands.

**Table 1.SF.2. Food Exports**  
(Share of global exports)

Region	1990	2000	2013
OECD	0.7766	0.7406	0.6240
Non-OECD	0.2234	0.2594	0.3760
Brazil	0.0236	0.0292	0.0661
China	0.0370	0.0411	0.0393
India	0.0051	0.0103	0.0263
Argentina	0.0258	0.0281	0.0262
Indonesia	0.0046	0.0108	0.0224

Source: Food and Agriculture Organization of the United Nations (FAO); and IMF staff calculations.

Note: Food refers to food excluding fish aggregate from FAO. OECD = Organisation for Economic Co-operation and Development. OECD and Non-OECD country classification is based on current membership.

else remains equal, would help feed 9 billion people—less than the 9.7 billion who will need to be fed by midcentury. It is important to note that this back-of-the-envelope calculation leaves aside other factors, such as potential technological innovations, reductions in food waste, and land degradation.

Future food supply increases—necessary to feed the growing global population—ought to come mostly from productivity increases. Expanded use of land for agriculture should be limited to the extent possible in the interest of the environment and social concerns: biodiversity loss, ecosystem degradation, increased carbon emissions, and traditional land-use rights. The challenge therefore, is to find a way to increase the productivity of currently cultivated land and slow the rate of land degradation and deforestation. The potential to increase agricultural productivity is especially high in sub-Saharan Africa, where yields are 50 percent below their potential level (Fischer and Shah 2011).

### How Has Global Food Trade Evolved?

Over the past decades, the global pattern of food demand has shifted relatively more than it has for sup-

ply. Demand has shifted from west to east on account of differences in population growth, as well as changes in income affecting the composition of demand. The supply shift from north to south for food has been more modest than for other commodities, such as minerals and metals. While some emerging markets have increased their shares, the lion's share of global food trade is still sourced from advanced economies (Table 1.SF.2). This is true despite potentially high returns on capital in the agricultural sector in many developing economies, which would justify capital flowing into that sector (for example, see Gollin, Lagakos, and Waugh 2014a and 2014b).

There are wide gaps across countries in agricultural yield—defined as crop production per unit of land cultivation, which is a measure of land productivity (Table 1.SF.3). These gaps reflect multifaceted impediments to investment and technology transfers in the agricultural sectors of developing economies. There is limited evidence of catching up in productivity between advanced economies and low-income countries. The example of maize shows a huge divergence in agricultural yields between North America and sub-Saharan Africa (Figure 1.SF.5). While a recent spurt in large-scale cross-border land acquisitions following food price hikes suggests that capital has started to flow from north to south, it has also revealed important fault lines between investors and recipient countries (see Box 1.SF.1).

There are many impediments to investment in the agricultural sector. Scant net capital flows to developing economies, contrary to what neoclassical theory would suggest, are not unique to the agricultural sector (Alfaro, Kalemli-Ozcan, and Volosovych 2008). The many factors that deter investment in agriculture are emblematic of the challenges these countries face in improving their institutions. There is ample evidence of the role of technology adoption (or the lack thereof), and of

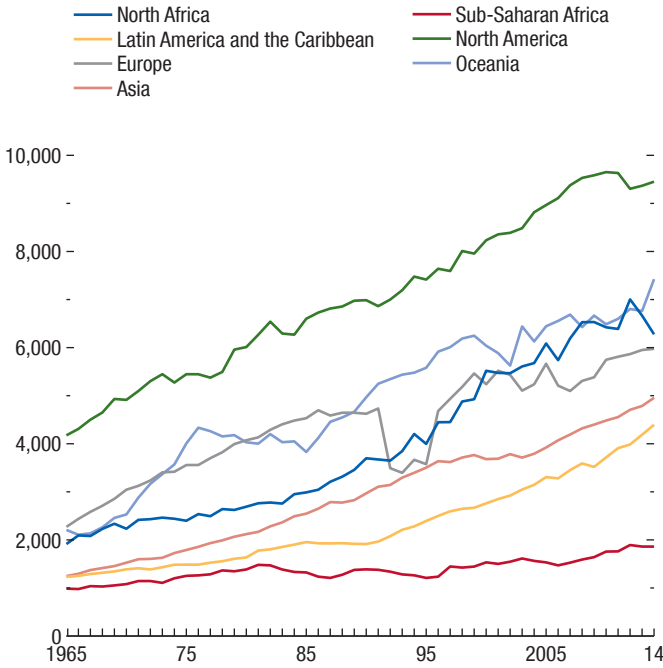
**Table 1.SF.3. Agricultural Yield**  
(Ratio relative to highest producer)

	North Africa	Sub-Saharan Africa	Latin America and the Caribbean	North America	Europe	Oceania	Asia
Maize	0.60	0.19	0.43	1.00	0.56	0.77	0.48
Rice	0.88	0.22	0.48	0.81	0.59	1.00	0.44
Soybeans	0.82	0.40	0.88	1.00	0.63	0.68	0.42
Wheat	0.63	0.60	0.65	0.71	1.00	0.48	0.73

Sources: Food and Agriculture Organization of the United Nations; and IMF staff calculations.

Note: The above table reports the weighted average yield of crops by region, normalized relative to the highest producer. The average yield is weighted by the area of harvested land. Oceania includes Australia, Fiji, Guam, Micronesia, New Caledonia, New Zealand, Pacific Islands Trust Territory, Papua New Guinea, Solomon Islands, and Vanuatu.

**Figure 1.SF.5. Maize Yield**  
(Kilogram per hectare)



Sources: Food and Agriculture Organization of the United Nations; and IMF staff calculations.

Note: Yield refers to a five-year moving average. Oceania includes Australia, Fiji, Guam, Micronesia, New Caledonia, Vanuatu, New Zealand, and Papua New Guinea.

human capital and credit constraints, in agricultural development (see for instance, Besley and Case 1993, Foster and Rosenzweig 1995, and Dercon and Christiaensen 2011). Other factors, such as lack of adequate infrastructure (Donaldson and Hornbeck, forthcoming), expropriation risk (Jacoby, Li, and Rozelle 2002), and questions of land tenure (Besley and Burgess 2000), also limit investment in the sector.

**Table 1.SF.4. Urban Population by Region**  
(Percent of total population)

Region	1990	2014	2050	Change 1990–2014	Change 1990–2050
Africa	31.3	40.0	55.9	8.7	24.7
Asia	32.3	47.5	64.2	15.3	31.9
Europe	70.0	73.4	82.0	3.5	12.0
Latin America and the Caribbean	70.5	79.5	86.2	9.0	15.7
Northern America	75.4	81.5	87.4	6.0	12.0
Oceania	70.7	70.8	73.5	0.1	2.8

Sources: United Nations, World Urbanization Prospects: The 2014 Revision; and IMF staff calculations.

Note: Oceania includes American Samoa, Australia, Cook Islands, Fiji, French Polynesia, Guam, Kiribati, Marshall Islands, Micronesia, Nauru, New Caledonia, New Zealand, Niue, Northern Mariana Islands, Palau, Papua New Guinea, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu, and Wallis and Futuna Islands.

## What Are the Risks?

Amartya Sen (1981) was the first to point out that hunger was not necessarily caused by a lack of food, but by a lack of the capability to buy that food. Food security is a multidimensional concept. The Food and Agriculture Organization of the United Nations (FAO) (2015) identified four pillars for food security:

- *Availability*—The supply side, determined by production, stocks, and trade in food
- *Access*—Economic access (the ability to purchase with disposable income) and physical access (the ability to reach food sources via the transportation infrastructure)
- *Utilization*—Through diet diversity, intrahousehold distribution of food, and food preparation and consumption
- *Stability*—The constancy of the other three dimensions over time

Rapid urbanization and galloping population growth—especially in sub-Saharan Africa and Asia—not matched with increases in domestic food supply, have led to growing dependence on imports (Table 1.SF.4). An overwhelming majority of countries around the world are net importers of food (Table 1.SF.5). Despite the high concentration of countries that have always been food importers, 27 have switched from being net exporters to importers since 1990. These are countries in east Asia, Latin America, and sub-Saharan Africa and include Honduras, the Philippines, Vietnam, and Zimbabwe. These four countries experienced major declines in net food exports of more than 7 percentage points of GDP.

These switches have led to further concerns over food security. Countries can achieve food security through imports, provided that they are able to finance the imports. Economically prosperous countries are



**Table 1.SF.5. Net Food Exporters and Importers**  
(1990 versus 2013, number of countries)

Region	Always Exporter	Always Importer	Exporter --> Importer	Importer --> Exporter	Total
East Asia and Pacific	6	17	7	2	32
Europe and Central Asia	9	13	1	1	24
Latin America and Caribbean	12	14	8	0	34
Middle East and North Africa	0	17	2	0	19
North America	2	1	0	0	3
South Asia	1	6	0	1	8
Sub-Saharan Africa	4	29	9	3	45
Total	34	97	27	7	165

Sources: Food and Agriculture Organization of the United Nations; World Bank: World Development Indicators; and IMF staff calculations.

able to finance their food imports, while impoverished countries struggle to do so.<sup>13</sup> Over the past few years, the commodity price bust (except food) has exposed developing economies to food price shocks by reducing export receipts and fiscal space.<sup>14</sup>

Climate change affects agriculture—through large economic losses such as reduced crop yields and livestock productivity—through changes in average temperatures and patterns of precipitation and extreme weather events such as heat waves.<sup>15</sup> There are a host of other effects too, including changes in pests, diseases, and atmospheric concentrations of carbon dioxide (Porter and others 2014). Generally, research has stressed unequal exposure across countries, with countries closer to the equator being more vulnerable to climate change than countries at higher latitudes (Rosenzweig and others 2014).<sup>16</sup> For example, Ethiopia recently experienced one of the worst droughts in decades. Strikingly, the country's two main rainy seasons supply over 80 percent of its agricultural yield. The agricultural sector employs 85 percent of the population. The lack of rainfall and subsequent drought associated with the El Niño weather phenomenon, therefore, caused a massive spike in humanitarian needs, which are expected to continue through much of 2016 (see Government of Ethiopia 2015).<sup>17</sup>

<sup>13</sup>The poorest segments of the population in some rich countries may, however, be subject to food insecurity.

<sup>14</sup>In principle, food terms-of-trade shocks can also drive a country to go from food exporter to importer. In practice, fast population growth and urbanization, stagnating productivity, and poor infrastructure are key elements explaining many developing economies' dependence on food imports (Rakotoarisoa, Iafate, and Paschali 2011).

<sup>15</sup>See IMF (2016) for a discussion of the effect of natural disasters and climate change on sub-Saharan African countries.

<sup>16</sup>There is evidence to suggest that climate change affects different crops differently.

<sup>17</sup>Beyond Africa, the impact of the 2015–16 El Niño could be even more severe in Asia in locations such as the uplands of Cam-

Such extreme weather events and their threats to food security are expected to continue to worsen and increase in frequency (IFPRI 2016; UNEP 2016; World Bank 2015a).<sup>18</sup> So-called climate-smart agriculture can help mitigate the effects of climate change on agriculture by offering opportunities for smallholder farmers to produce more nutritious crops, sustainably and efficiently (IFPRI 2016).<sup>19</sup> In addition, the FAO and the United States Agency for International Development have established early warning systems to anticipate and prevent famines. The FAO hosts the Global Information and Early Warning System, which monitors the world food situation in 190 FAO member countries and warns of impending crises within countries (Groskopf 2016). The Famine Early Warning Systems Network (FEWS NET, www.fews.net), set up by the United States Agency for International Development, helps anticipate and plan for humanitarian crises in 29 countries.

Volatility in food prices and outright food shortages have a crucial impact on the most basic aspect of welfare in poor countries—namely, survival. As shown in Table 1.SF.6, the share of food consumption in the overall consumption basket is dramatically high for many low-income countries. It is even higher for fragile states such as Guinea and Burundi. For middle-income countries, the share is somewhat lower but still significant—eaching up to about 50 percent

in India, central and southern India, eastern Indonesia, the central and southern Philippines, central and northeast Thailand, Papua New Guinea, and other Pacific island countries. In India, severe floods were reported in several parts of Tamil Nadu during November and December 2015, inundating most areas of Chennai (United Nations 2015).

<sup>18</sup>In Latin America and southeast Asia, floods and droughts during recent El Niño/La Niña episodes, which have already caused heavy losses in agriculture, are likely to double in frequency (World Bank 2015b).

<sup>19</sup>For example, C4 rice has been found to increase yields by 50 percent as a result of doubling water use efficiency and increasing nitrogen use efficiency by 30 percent (IFPRI 2016).

**Table 1.SF.6. Share of Food and Beverages in Total Consumption, 2010**

Area	Share
High-income countries	21.0
Middle-income countries	43.7
Low-income countries	56.6
Burundi	71.0
Democratic Republic of the Congo	69.5
Guinea	71.1

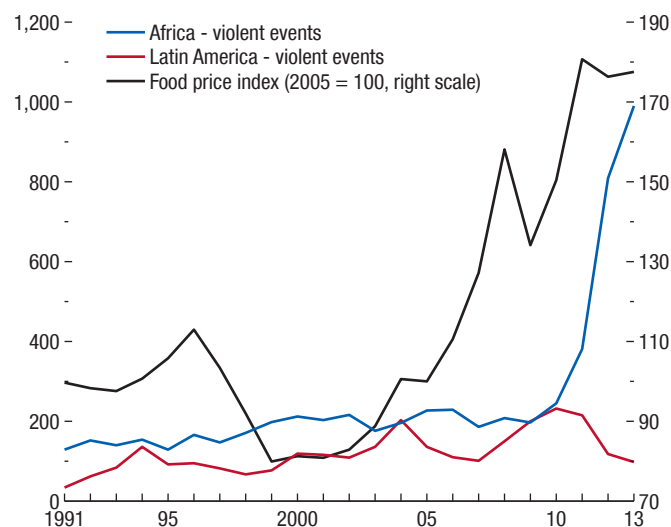
Sources: World Bank, Global Consumption Database; Organisation for Economic Co-operation and Development, National Accounts database; and IMF staff calculations.

Note: Includes processed food such as alcoholic beverages and catering services.

of total consumption. Existing econometric evidence (see Arezki and Brueckner 2014; and Bellemare 2015) suggests that food price volatility can cause enormous distributional challenges within and between countries and lead to conflicts (Figure 1.SF.6).<sup>20</sup> Existing indices of food insecurity (Figure 1.SF.7) show that as a region, Africa is the most prone to such food insecurity, but that pockets of vulnerability also exist in Asia, Central America, and South America.

Policy interventions can at times magnify food price spikes. The price volatility of weather-dependent commodities, such as food, is exacerbated by the tendency for both developed and developing economies to alter their trade and domestic policies from year to year in an effort to stabilize prices and quantities in domestic food markets (Anderson 2016; FAO 2015). During periods of elevated food prices, as in 2008, net food exporting countries frequently implemented export restrictions, and net food importers lowered import barriers. Both measures were aimed at increasing domestic food supplies. Taken together, these two policy responses exacerbated the food price spike (Anderson, Rausser, and Swinnen 2013; Anderson 2016). To avoid such outcomes, ensuring higher agricultural sector productivity and improved supply chains, as well as regional coordination—including through maintaining and managing

<sup>20</sup>Food production is endogenous to civil conflict; country examples indicate that the presence of civil war may be associated with an increase of domestic food prices. For example, in Darfur, prices of the main food staples increased rapidly after widespread violence started in late 2003 and early 2004 (see, for example, Brinkman and Hendrix 2010).

**Figure 1.SF.6. Food Prices and Violent Events**  
*(Number of events, unless noted otherwise)*


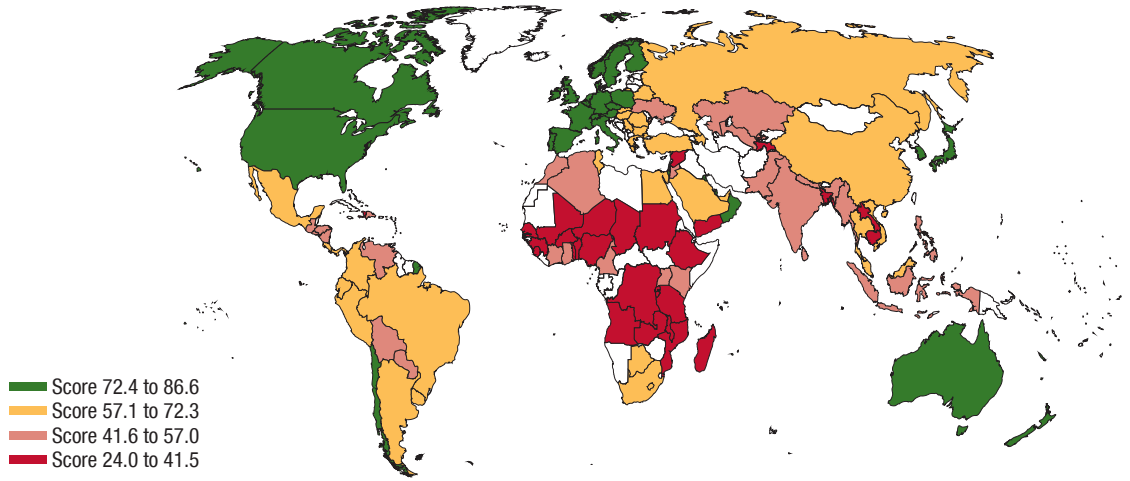
Sources: IMF, Primary Commodity Price System; Social Conflict Analysis Database (SCAD) 3.1; and IMF staff calculations.

regional grain reserves—have proved effective in hedging against the consequences of food price volatility in developing Asia (Jha and Rhee 2012).<sup>21</sup>

Overall, food markets are segmented, owing to distortions in trade and domestic impediments to investment in the sector. Demand for food has and will continue to grow at a fast pace on account of population growth. Income growth also affects the composition of food demand. Fast urbanization trends in Africa and Asia will make even more countries dependent on trade. To meet these challenges and reduce food insecurity, all countries alike must continue to dismantle barriers to trade. Low-income countries should also raise productivity in the agricultural sector by attracting capital flows, but for that to occur, multifaceted institutional improvements are needed.

<sup>21</sup>Other avenues to alleviate food shortages in the long term include: (1) reducing excessive food consumption, which leads to obesity and associated negative health outcomes, and (2) reducing food waste. The FAO estimates that one-third of food produced for human consumption is lost or wasted globally, which amounts to about 1.3 billion tons a year.

**Figure 1.SF.7. Global Food Security Index, 2016**  
(Overall score 0–100, 100 = best environment)



Source: Economist Intelligence Unit, *Global Food Security Index 2016*.

### Box 1.SF.1. A Global Rush for Land

Against the backdrop of increasing demand for food, there has been a growing interest by governments, agribusinesses, and investment funds in acquiring long-term property rights or leases over large areas of farmland, mostly in developing economies (Arezki, Deininger, and Selod 2015). Most of the land acquisitions have been in food-insecure countries that are in dire need of investment in the agricultural sector. These deals could lead to positive or negative outcomes. This box presents evidence related to these transnational land acquisitions and discusses policy implications.

#### What Is Driving Large-Scale Land Deals?

In this box, the term “land deal” refers to a large-scale cross-border acquisition of land, typically at the expense of smallholder production or greenspace.<sup>1</sup> The food crisis of 2007–08 led to a massive increase in food prices, thereby raising farmland value and the option value of securing land for food production to insure against the next food crisis. While the benefits of cultivating vacant land today remain small, increased uncertainty in the wake of the crisis may have increased the future profitability for private investors (Collier and Venables 2012).

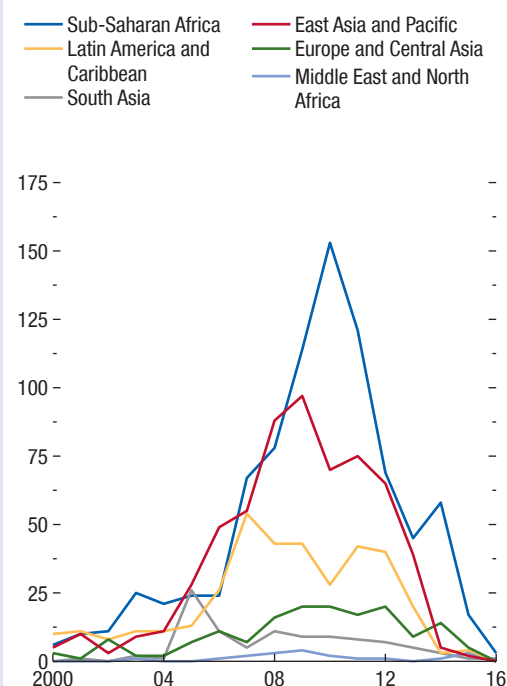
Figure 1.SF.1.1 shows a sharp increase in the annual number of land deals in the years leading up to the 2007–08 financial crisis and peaking shortly thereafter. In 2009, at the height of the rush for land, an average size of 223 square miles a deal was negotiated almost every day, an area more than five times the size of Paris, France. In the years that follow, investors’ and governments’ appetite for farmland has receded.

The boom-bust pattern in Figure 1.SF.1.1 is consistent with the idea of rapidly changing farmland (option) value fueled by substantial shifts in food prices and uncertainty. Evidence suggests that much of the acquired land has been left idle, raising concern about the motive behind these large-scale land invest-

The authors of this box are Christian Bogmans and Vanessa Diaz Montelongo.

<sup>1</sup>A deal is defined as an intended, concluded, or failed attempt to acquire land through purchase, lease, or concession that meets the following criteria: It (1) entails a transfer of rights to use, control, or ownership of land through sale, lease, or concession; (2) occurred after the year 2000; (3) covers an area of 200 hectares or more; and (4) implies the potential conversion of land from smallholder production, local community use, or important ecosystem service provision to commercial use. The analysis presented in this box focuses on cross-border deals only.

**Figure 1.SF.1.1. Evolution of Deals over Time by Target Region**  
(Number of deals)



Sources: Land Matrix; and IMF staff calculations.

ments and hinting at potential obstacles to bringing their agricultural projects to fruition. According to the Land Matrix database, to date only 49 percent of the acquired land has been cultivated to some extent, and this fraction is significantly smaller in sub-Saharan Africa (37 percent).<sup>2</sup>

#### What Do the Data Tell Us about Land Investments?

As of May 2016, the Land Matrix database has information on 2,152 transnational deals. Slightly more than two thirds are linked to agricultural projects, with a cumulative size of almost 59 million hectares in 88 countries worldwide. This expanse roughly corresponds to an area the size of France or Ukraine. While the amount of land that changed hands is substantial, it is still fairly modest compared with the total stock of uncultivated and (nonforest) suitable land, which amounts to roughly 400 million hect-

<sup>2</sup>The Land Matrix Global Observatory. Accessed May 7, 2016. <http://landmatrix.org/en/get-the-detail/>.

**Box 1.SF.1 (continued)**

ares—one billion hectares when including forestland. Sub-Saharan Africa (884 deals) and east Asia (611 deals) have been the most important target regions for investment, followed by Latin America (368 deals).

To explore the determinants of interest in transnational farmland deals, we use a bilateral Poisson regression to model the occurrence and count of projects in origin-destination pairs. Let  $N_{ij}$  be the expected number of projects undertaken in host country  $j$  by investors from country  $i$ . The regression pools all land deals between 2000 and 2016.

Following the standard gravity model from the trade literature, land investment is attributed to origin and destination country characteristics,  $VarOrig_i$  and  $VarDest_j$ , respectively, and bilateral variables,  $VarBilat_{ij}$ . The baseline specification is:

$$N_{ij} = c + \alpha_i \cdot VarOrig_i + \beta_j \cdot VarDest_j + \gamma_{ij} \cdot VarBilat_{ij} + \varepsilon_{ij} \quad (1.SF.1.1)$$

in which  $\alpha_i$ ,  $\beta_j$  and  $\gamma_{ij}$  are the parameters of interest, and  $\varepsilon_i$  is an error term. With a large number of zeros in the data, the ordinary least squares estimator may be biased and inconsistent. To overcome this issue, a Poisson pseudo-maximum-likelihood estimator is used (Silva and Tenreyro 2006).

The analysis uses a novel measure of uncultivated nonforest land that takes into account proximity to market. Data are obtained from the FAO's *Global Agro-Ecological Zones* (FAO 2016). To analyze the relationship between this type of foreign direct investment and governance, data on law and order from the *International Country Risk Guide* (ICRG 2009), a measure of investor protection from the World Bank's Doing Business dataset, and an index of tenure security (de Crombrughe and others 2009) are included. Physical distance and a dummy variable for former colonial ties are included as proxies for trade costs. Finally, an index of food security from the Economist Intelligence Unit is included.

The results of the regressions based on equation (1.SF.1.1) are presented in Table 1.SF.1.1. They confirm the importance of trade costs and an abundant supply of uncultivated arable land. Interestingly, and in contrast with the existing literature on capital flows, we find that poor land governance is associated with more land deals (see Table 1.SF.1.1, column 1). As weak land governance and food insecurity are highly correlated (with a correlation coefficient of  $\rho = 0.77$ ), this finding suggests that food-insecure regions are associated with more land investment. Governments of

**Table 1.SF.1.1. Impact of Land Governance and Food Security on Land Deals**

	(1)	(2)
<b>Bilateral Variables</b>		
Distance (log)	-0.838*** (0.0669)	-1.061*** (0.0793)
Former Colonial Relationship	1.529*** (0.269)	0.874*** (0.253)
<b>Origin Country Variables</b>		
Net Food Exports (over GDP)	8.199*** (1.180)	
Food Security Index		0.0403*** (0.00447)
<b>Destination Country Variables</b>		
Landlocked	0.234 (0.220)	0.0575 (0.192)
Suitable Nonforest Land	0.525*** (0.0748)	0.810*** (0.0936)
Land Governance	-0.572*** (0.0957)	-0.165 (0.108)
Law and Order	-0.265*** (0.0827)	-0.152 (0.0958)
Weak Investor Protection	-0.00606** (0.00243)	-0.00913*** (0.00256)
Net Food Exports (over GDP)	5.757*** (1.384)	
Food Security Index		-0.0539*** (0.00639)
Number of Observations	19,186	10,044
Pseudo $R^2$	0.217	0.283

Note: Robust standard errors in parentheses.

\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

food-insecure countries, while eager to host large-scale land investments, often face the challenge of ensuring that such outside investments actually help alleviate domestic hunger. This is especially difficult in light of weak land governance.

**What Are the Implications for Food Security?**

Land deals may have either positive or negative effects. On the one hand, these deals signal that capital in the agricultural sector is flowing from rich to poor countries' investors and hence help transfer new technology and agronomic knowledge to local farmers. On the other hand, the clustering of these deals in food insecure countries can potentially amplify the detrimental effects of a future food crisis. Host-country governments can remedy these risks by investing in monitoring capacity to ensure that land is leased to investors who (1) promote integration of local producers into value chains, (2) coinvest in local public goods, and (3) compensate displaced land users.

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