United States Department of Agriculture

Economic Research Service

Economic Research Report Number 272

January 2020

Factors Contributing to Changes in Agricultural Commodity Prices and Trade for the United States and the World

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United States Department of Agriculture

Economic Research Service
www.ers.usda.gov

Recommended citation format for this publication:

Nigatu, Getachew, Flavius Badau, Ralph Seeley, James Hansen. 2020. *Factors Contributing to Changes in Agricultural Commodity Prices*, ERR-272, U.S. Department of Agriculture, Economic Research Service.

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Abstract

Agricultural commodity prices play an important role in the production decisions of farmers and ranchers, including planted/harvested acreage of crops or inventory of livestock and, thus, the supply of agricultural commodities. This report examines changes in global demand and supply factors that contributed to agricultural commodity price declines during 2014-19 and changes that contributed to the rising trend in prices that peaked in 2007/08 and 2011/12. Additionally, the report projects how global commodity prices and trade could change out to 2021/22 given various assumptions on key factors, such as the growth in Gross Domestic Product (GDP) and agricultural production across countries. Information on these factors and their market impacts can inform and enhance public and private decision making on issues relating to agricultural markets. Model results suggest that if GDP growth slows in developing and emerging economies by 2.3 percentage points annually (the average annual rate of decline experienced in these countries over 2007-09), commodity prices would decrease on average by 4 percent per year over 2018/19 to 2021/22. However, the volume of global commodity trade would remain relatively stable. Second, if crop production by major producing countries (including the United States) were to decline by 3 percentage points, commodity prices are projected to rise by an average of 12 percent per year over 2018/19 to 2021/22. The volume of global commodity trade is projected to fall by an average of 2 percent per year for this scenario. Third, if U.S. crop production increases by an average of 1 percentage point, average commodity prices decline by 2 percent, and the volume of global commodity trade increases by an average of less than 1 percent over 2018/19 to 2021/22.

Keywords: Agricultural commodity prices, USDA Agricultural Projections, trade, agricultural demand responses, agricultural supply responses

Acknowledgments

The authors thank the following peer reviewers: Seth Meyer, former chair, USDA, World Agricultural Outlook Board; David Laborde, International Food Policy Research Institute; Lorrie Mitchell for technical review, USDA, Economic Research Service (ERS); and two anonymous reviewers. Joe Cooper and Erik O'Donoghue, formerly with USDA, ERS offered helpful comments and edits. Thanks to ERS staff members John Weber and Courtney Knauth for editing the report and to Cynthia A. Ray for designing it.

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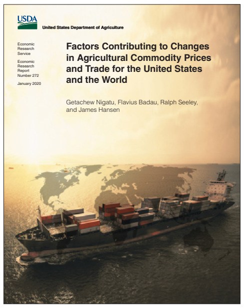

Factors Contributing to Changes in Agricultural Commodity Prices and Trade for the United States and the World

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What Is the Issue?

Expected agricultural commodity prices can influence production decisions of farmers and ranchers on planted/harvested acreage of crops or inventory of livestock and, thus, affect the supply of agricultural commodities. Commodity price changes also affect farms' financial well-being, for example sustained periods of low commodity prices reduce farm revenues and cause farmers to increasingly rely on credit, making them vulnerable to higher interest rates and other changes to economic conditions. Sustained periods of high commodity prices can contribute to increases in farm revenues and farm operator resilience to changes in economic conditions. Changes to commodity prices also have implications for food security: sustained low prices increase consumers' ability to purchase adequate quantities of food, while sustained high prices decrease their food security, particularly in developing countries. This study examines the changes in demand and supply factors that contribute to higher or lower agricultural commodity prices and estimates their effects on commodity markets in terms of trade. A better understanding of these factors and their impacts can inform and enhance public and private decision making on issues relating to agricultural markets.

What Did the Study Find?

Global and U.S. macroeconomic and agricultural conditions contributed to commodity price instability. Key findings from three simulated scenarios based on historical trends follow:

- The first (demand-side) scenario simulates weaker economic growth. It assumes a 2.3-percentage-point slowdown in Gross Domestic Product (GDP) growth per year over 2018-19 to 2021-22 in developing and emerging economies only, based on the average annual rate of GDP slowdown experienced only in these countries during 2008-11. Results suggest that this GDP slowdown would lead to commodity prices falling by an average of 4 percent per year, with the largest decreases for soybeans, beef, and poultry. Despite falling prices, the volume of global trade would remain stable.

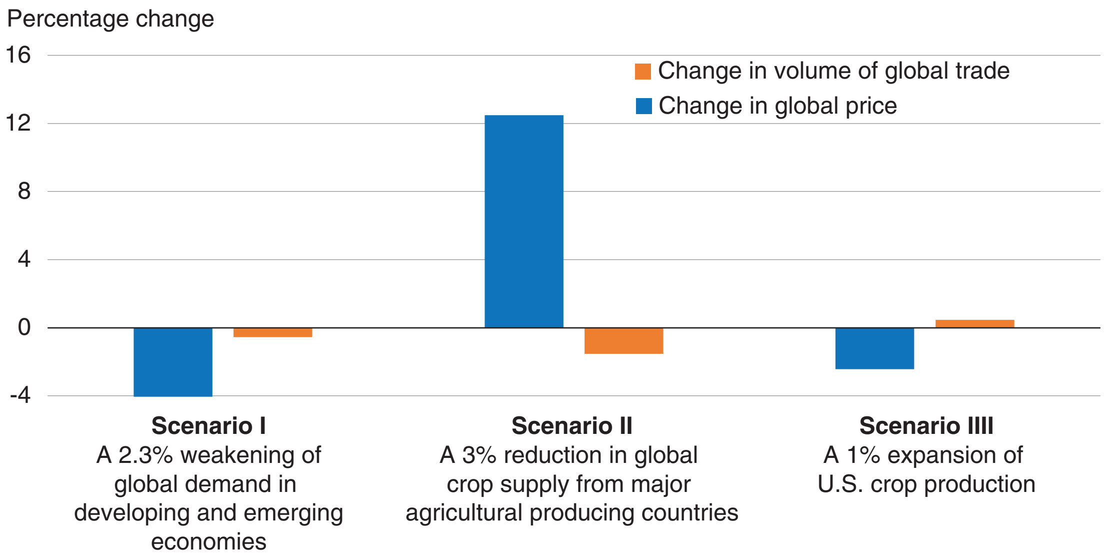
- The second (supply-side) scenario simulates a downturn in supply based on recent historical trends. It assumes a 3-percentage-point annual decline in crop area harvested for major agricultural commodity-producing countries. Results suggest that commodity prices would increase by an average of 12 percent per year from 2018-19 to 2021-22, with the largest increases for corn and wheat. The volume of global trade would decrease by an average of 2 percent per year.

ERS is a primary source of economic research and analysis from the U.S. Department of Agriculture, providing timely information on economic and policy issues related to agriculture, food, the environment, and rural America.

- The third (supply-side) scenario simulates an upturn in supply. It assumes an increase in U.S. crop area harvested by an average of 1 percent per year, based on average production for 2011-16. Results suggest commodity prices decline by an average of 2 percent per year over 2018-19 to 2021-22, with the largest drop for soybeans. Average global trade volume would increase by less than 1 percent per year over the simulation period.

- Prices for many agricultural commodities declined between 2014 and mid-2019. Weak global economic growth and slowing growth in biofuel mandates contributed to declining agricultural commodity demand. Additionally, the continued expansion of cropland and improved yields, coupled with declining energy and oil prices, led to higher global commodity supplies. In sum, contraction in demand-side factors and expansion in supply-side factors resulted in falling global commodity prices. However, some of these demand and supply factors moved in opposite directions during 2000-07 and 2011-12, leading to global agricultural commodity price hikes.

Global prices are more sensitive than global trade volume to changing global macroeconomic and agricultural production



Source: USDA, Economic Research Service simulation using Country-Commodity Linked System.

How Was the Study Conducted?

This study summarizes the factors that contribute to changes in commodity prices. Three scenarios are simulated using ERS's Country-Commodity Linked System of models, which provides estimates of supply, demand, trade, and market-clearing world prices for USDA's annual 10-year agricultural projections. These projections serve as the baseline scenario. Results are presented for commodity prices and global and U.S. commodity trade for the near term (2018-19) and medium terms (2019-20 to 2021-22).

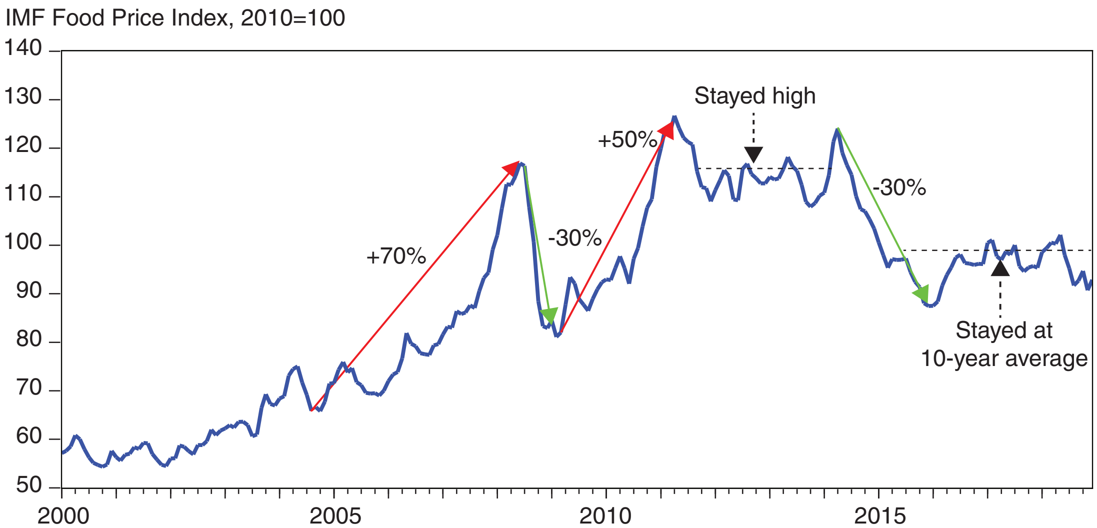
Factors Contributing to Changes in Agricultural Commodity Prices and Trade for the United States and the World

Introduction

Expected agricultural commodity prices play an important role in the production decisions of farmers and ranchers, including planted/harvested acreage of crops or inventory of livestock and, thus, the supply of agricultural commodities. If the financial situations of farmers and ranchers worsen because of downward swings in the prices of agricultural commodities they sell, their management decisions may be affected by their views on whether commodity prices have swayed downward or upward and on the choices they have to address these price swings (Motamed et al., 2018).

The period from 2007 to 2017 included interludes of relatively high and low agricultural commodity prices. The periods 2007-08 and 2011-12 were notable for agricultural commodity price peaks, with the International Monetary Fund (IMF) monthly global Food Price Index reaching its record high in April 2011 (fig. 1) (see box "Comparison of Food Price Indices" for more information on food price indices). Between 2012 and 2013, the IMF Food Price Index remained unstable but hovered around its peak. The IMF price index subsequently dropped more than 30 percent from April 2014 to January 2016, representing one of the largest sustained drops in recent decades. Even though the index has shown a slight upward trend or at least a flattening out between the beginning of 2016 and the beginning of 2018, the level is still lower than its peak (IMF, 2019).

Figure 1
Food Price Index dropped 30 percent between 2014 and 2016



Note: The International Monetary Fund (IMF) Food Price Index includes cereal, vegetable oils, meat, seafood, sugar, and other food (apples (noncitrus fruit), bananas, chana (legumes), fishmeal, groundnuts, milk (dairy), and tomatoes (veg)) price indices.

Source: USDA, Economic Research Service using data from IMF (2019).

By 2016, prices for most agricultural commodities dropped between 18 and 70 percent from their peaks in 2011 (table 1). Wheat and rice, the two staple food crops, reached their highest prices of $339 and $615 per metric ton, respectively, during the 2011 price hike. By 2016, wheat and rice prices dropped more than 50 and 40 percent, respectively. The 2016 corn and soybean prices were 54 and 36 percent below the 2011 peak prices, respectively. The prices for livestock products experienced much less of a decline, although globally, more people entered the middle class and substituted livestock products for grains (Nigatu and Seeley, 2015). Poultry meat prices declined to $1,587 per metric ton in October 2016, but they reached $4,234 per metric ton in June 2017, an increase of more than 50 percent (World Bank, 2018). Cotton prices dropped more than 70 percent from $5,063 per metric ton in 2011 to $1,443 in 2016. The Food and Agriculture Organization of the United Nations (FAO) and USDA project that in the next few years, inflation-adjusted commodity prices will follow a declining trend unless affected by shocks such as unexpected weather (FAO, 2016b; USDA, 2019b).

Table 1

Agricultural commodity price changes associated with the period from the 2011 peak through the 2016 low (prices in U.S. dollars per metric ton)

Commodity	Price at low in 2008*	Price at peak in 2011	Percent change from low in 2008 to peak in 2011	Price at low in 2016	Percent change from peak in 2011 to low in 2016
Wheat, U.S. soft red winter	179	339	89	158	-53
Rice, Thai 5 percent	376	615	64	365	-41
Corn	158	319	102	148	-54
Soybeans	360	572	59	367	-36
Soybean oil	738	1,374	86	727	-47
Sugar, world	259	653	152	293	-55
Beef	2,477	4,255	72	3,503	-18
Poultry	1,703	1,980	16	1,587	-20
Cotton	1,211	5,063	318	1,443	-71

Note: *Prices in 2008 swung wildly, and low prices were observed mostly in December, except in January for rice and poultry and in November for cotton.

Source: USDA, Economic Research Service using data from World Bank (2018).

Comparison of Food Price Indices

The International Monetary Fund (IMF, 2019), World Bank (World Bank, 2018), the Food and Agriculture Organization of the United Nations (FAO, 2018), the United Nations Conference on Trade and Development (UNCTAD, 2018) and the U.S. Department of Labor, Bureau of Labor Statistics (USDOL/BLS, 2018) publish monthly food and food-related price indices.[1] Each organization's index is based on slightly different basket mixes that consist of food, beverages, or other commodities, the base year pricing point, or area or region coverage. In addition, each organization uses different weights for each individual food or food-related commodity's contribution to the overall index.

While the global food price indices obtained from IMF, World Bank, FAO, and UNCTAD differ from one another, they depict a similar trend over time (box fig. 1). The IMF index reports benchmark prices; the global market commodity weights are derived using the ratio of the export value of the commodity relative to the total value of world export as reported in the UN Comtrade database. The World Bank index's basket is designed to be representative of developing countries. The World Bank includes some food and food-related commodities that are not in the IMF index, such as tobacco, which accounts for about 6 percent of the total weight. In turn, the IMF index includes some commodities not included in the World Bank index, such as sunflower and olive oils, seafood, softwood, wool, and hides. The FAO index consists of the average of five food commodity group price indices (cereal, vegetable oil, dairy, meat, and sugar) weighted by the average export shares of each of the groups (for 2002-04). The weights correspond to the share of the export value of each agricultural commodity in the total export value of the 23 commodities included in the index, averaged over these 3 years. UNCTAD also publishes a free market-food and all-food (including food, tropical beverages, and vegetable, oilseeds, and oils) commodity index that is designed to best represent primary commodities exported by developing economies. Unlike other indices, the UNCTAD food index gives more weight to sugar (23.4 percent), crustaceans (15.5 percent), rice (15.4 percent), and corn (12.8 percent).

The U.S. food price (USDOL/BLS, 2018) index that measures the retail price paid by urban consumers for a representative basket of goods and services, on the other hand, exhibits a strong upward trend over time with little or no fluctuation. For the United States, a simple straight line almost perfectly fits with the observed price indices more than 99 percent of the time, whereas for the global indices, the goodness of fit for a straight line is less than 68 percent of the time (box fig. 1.1).

The broad-based agricultural commodity price decline caused a significant deterioration in the terms of trade[2] for those Latin American and Sub-Saharan African countries that predominately export agricultural commodities (Baffes et al., 2015). Commodity price declines could affect prospects for economic growth in resource-intensive Sub-Saharan African countries, especially those countries that do not have sufficient fiscal buffers like Angola and the Democratic Republic of the Congo (IMF, 2013).

[1]These institutions make their indices publicly available. Some other institutions, namely the Economist Intelligence Unit (EIU) and S&P Goldman Sachs Commodity Index (S&P GSCI), also publish subscription-based privately available commodity indices.

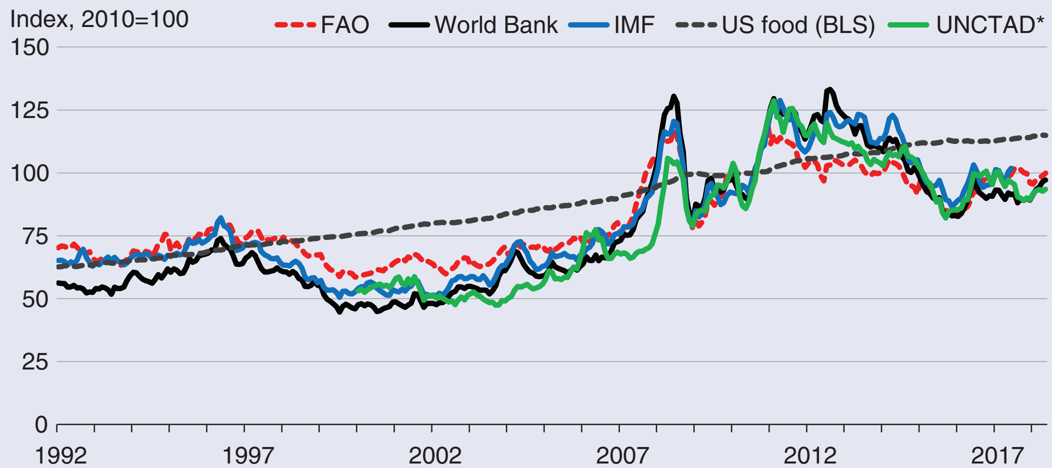
[2]A term of trade is the ratio of export prices to import prices. An increase in a country's term of trade indicates gains from international trade where it can purchase more imported goods per unit of exported good.

Continued—

Comparison of Food Price Indices—continued

Box figure 1.1

Global and U.S. food price indices



Note: International Monetary Fund (IMF), World Bank, Food and Agriculture Organization of the United Nations (FAO), and United Nations Conference on Trade and Development (UNCTAD) represent global food price indices, while U.S. food (Bureau of Labor Statistics (BLS), 2018) represents the U.S. food price index. UNCTAD data start from January 2000. The global indices also depict strong co-movements and experience robust pairwise correlations ranging from 0.93 to 0.99 (box table 1.1). A relatively stable U.S. food price index, however, has experienced minimal co-movement, ranging from 0.79 to 0.84, with the other global price indices.

Source: USDA, Economic Research Service using data from FAO (2018), World Bank (2018), IMF (2019), UNCTAD (2018), and U.S. food (USDOL/BLS, 2018).

Box table 1.1

Pair-wise correlation coefficients and goodness of fit for linear trend

	FAO	World Bank	IMF	UNCTAD	US food (BLS)	Goodness of fit for a straight line
FAO	1					0.57
World Bank	0.97	1.00				0.56
IMF	0.96	0.98	1.00			0.65
UNCTAD	0.93	0.95	0.95	1.00		0.68
U.S. food (BLS)	0.79	0.79	0.84	0.84	1.00	0.99

Note: A straight-line trend is estimated using an equation with a slope and intercept. FAO = Food and Agriculture Organization of the United Nations. IMF = International Monetary Fund (IMF). UNCTAD = United Nations Conference on Trade and Development. BLS = Bureau of Labor Statistics.

Source: USDA, Economic Research Service using data from FAO (2018), World Bank (2018), IMF (2019), United Nations Conference on Trade and Development (2018), and U.S. food (USDOL/BLS, 2018).

For the United States, agricultural export values dropped 8 percent in 2015 from their peak of $152 billion in 2014 and fell an additional 7 percent in 2016, indicating further losses in U.S. export market shares (USDA/ERS, 2019c). For Brazil, falling agricultural (and mineral) commodity prices have dampened export revenues and weighed down the trade balance of the economy (Jain, 2015). Similar situations have occurred in Canada, Argentina, Australia, and South Africa (Monge-Naranjo and Sohail, 2016).

Review of Factors That Affect Agricultural Commodity Prices

Many factors can affect agricultural commodity prices. Some studies have investigated these factors during times of price hikes and price declines. During the price hikes of 2007-08 and 2011-12, several studies hypothesized and empirically investigated the main causes and characteristics of price hikes in agricultural commodities, including two widely cited USDA/ERS reports (see Trostle, 2008; Trostle et al., 2011). Headey and Fan (2008) provided a comprehensive review of the 2007/08 price hikes, Abbott et al. (2011) examined the causes driving the price spikes in 2011, and Baffes and Dennis (2014) assessed the long-term drivers of commodity prices. Among the factors that affect agricultural commodity prices, economic output, or GDP, and inflation could raise agricultural commodity prices (Frankel and Rose, 2010). In addition, unexpected events (sometimes called shocks) affecting interest rates and exchange rates appear to cause fluctuations in agricultural commodity prices (Akram, 2009). Similar support for the impact of monetary exchange rates on commodity prices is found in Nazlioglu and Soytas (2012) and Awokuse (2005). Economic growth (particularly in emerging economies), technological advances, biofuel mandates, and trade policy shifts have long-term effects on commodity markets; more volatile factors, such as exchange rates, interest rates, weather events, and oil prices, influence markets in the short run.

Agricultural commodity prices in a market economy are a result of the interaction between factors affecting commodity demand and factors that influence farmers' decisions to supply commodities to the market. On the supply side, energy and input markets can also drive changes in agricultural commodity prices as part of the costs of production for farmers. For example, unexpected changes in energy and oil prices could influence commodity price volatility (Wang and McPhail, 2014). Changes in crude oil prices accounted for more than 50 percent of price increases for agricultural commodities (Baffes and Dennis, 2014). Furthermore, U.S. ethanol market expansion was widely mentioned as a contributor to higher commodity prices from 2006 to 2009 (Babcock, 2012). On the demand side, in addition to increases in household income, a number of social and demographic factors can lead to price hikes, including changing consumption habits and diet diversification, an expanding middle class, and increasing urbanization. The economic expansion in many countries produces an upward movement of the urban population into the middle class that can afford to consume high-valued livestock and convenient processed products. Urbanization can also influence the structure of food consumption by altering caloric requirements or preferences, food availability, and food preparation (Hawkes et al., 2017).

Demand-Side Factors That Affect Agricultural Commodity Prices

Economic growth in developing and emerging economies is among the many factors that affect commodity demand. Since mid-2000, increasing use of agricultural commodities for biofuel feedstocks has taken substantial attention in commodity price hikes analysis. These two factors are discussed in this section. Another factor that may affect commodity demand and it price is increasing trading of agricultural commodities in stock markets (see box "Trading of Agricultural Commodities in the Stock Markets").

Trading of Agricultural Commodities in the Stock Markets

Another factor that is frequently mentioned as a driver of changes in agricultural commodity prices is the trading of agricultural commodities in the futures market. Especially during the first decade of the 2000s, hedge funds, index funds, and sovereign wealth funds increased investments in commodity futures markets (Trostle et al., 2011). Agricultural commodity futures contracts have become part of broader commodity index funds in financial markets, at least in part, for a portfolio diversification strategy (Tadesse et al., 2014). Particularly when the expectations for other commodities and financial markets become low (for example, high tech stocks after the dot-com bubble of the late 1990s), futures contracts for agricultural commodities are an attractive proposition (Piesse and Thirtle, 2009). This situation, in turn, increases the demand for agricultural commodities and puts upward pressure on their prices.

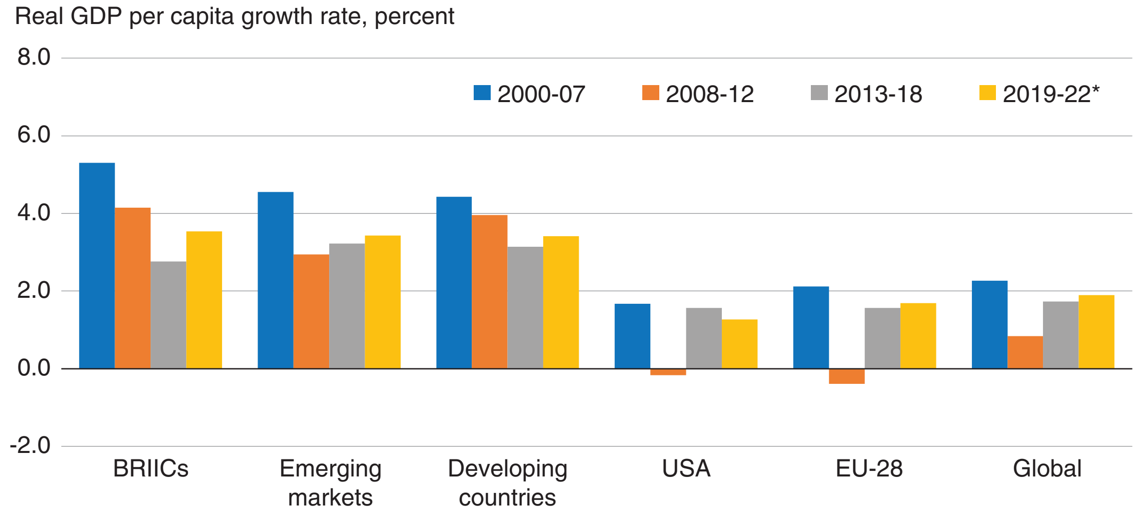
A typical feature of these commodity contracts is that only 2 percent of them end in the delivery of the physical commodity. The Food and Agriculture Organization of the United Nations asserted that excessive speculation amplified soaring agricultural commodity prices in 2007/08, with the claim being that speculation creates excessive demand and disconnects prices from supply-use balance (Abbott et al., 2011; FAO, 2010).

Theoretical and empirical findings connecting futures contracts and prices are weak, although increased financial market activity may coincide with increases in commodity prices (Headey and Fan, 2008). There is little evidence indicating that index funds created a bubble in commodity futures prices (Irwin and Sanders, 2011).

Economic growth rate expected to remain below the pre-Great Recession period

Global economic growth has not fully recovered since the end of the Great Recession in 2007-08 and is projected to be slower in the coming few years than in the pre-Great Recession period of 2000-07 (fig. 2). On average, the global economy grew at an annual rate of 1.7 percent in 2013-18, which is almost 24 percent lower than the annual rate in the pre-Great Recession years. BRIICS (Brazil, Russia, India, Indonesia, China, and South Africa) and emerging economies were among the main driving factors behind the global commodity price hikes of 2007-08 and again in 2011-12 through the magnitude of these countries' shocks that influenced the performance of the global economy. Annual economic growth rates in these countries slowed nearly 50 percent in 2013-18 compared with 2000-07. For developed economies, such as those of the United States and the European Union (EU), growth rates have not reached levels attained prior to the Great Recession. In particular, the growth rate for the EU-28 country economies was 1.6 percent during 2013-18, more than 25 percent lower than pre-Great Recession era growth. The global economy is expected to grow at an annual average of 1.9 percent from 2019-22, which is 17 percent lower than the 2.3-percent growth in the pre-Great Recession years.

Figure 2
Through 2019-22, annual real GDP per capita growth rate is not expected to recover to its pre-Great Recession (2000-07) rate



Note: GDP = Gross Domestic Product. BRIICS countries include Brazil, Russia, India, Indonesia, China, and South Africa. Based on ERS's Country-Commodity Linked System (CCLS), Emerging Markets include Mexico, Brazil, Chile, Czech Republic, Hungary, Poland, Slovakia, Russia, China, India, Indonesia, Malaysia, Philippines, Thailand, and Vietnam (Hjort et al., 2018). *The 2019-22 data are based on USDA baseline macroeconomic projections (USDA/ERS, 2019b).

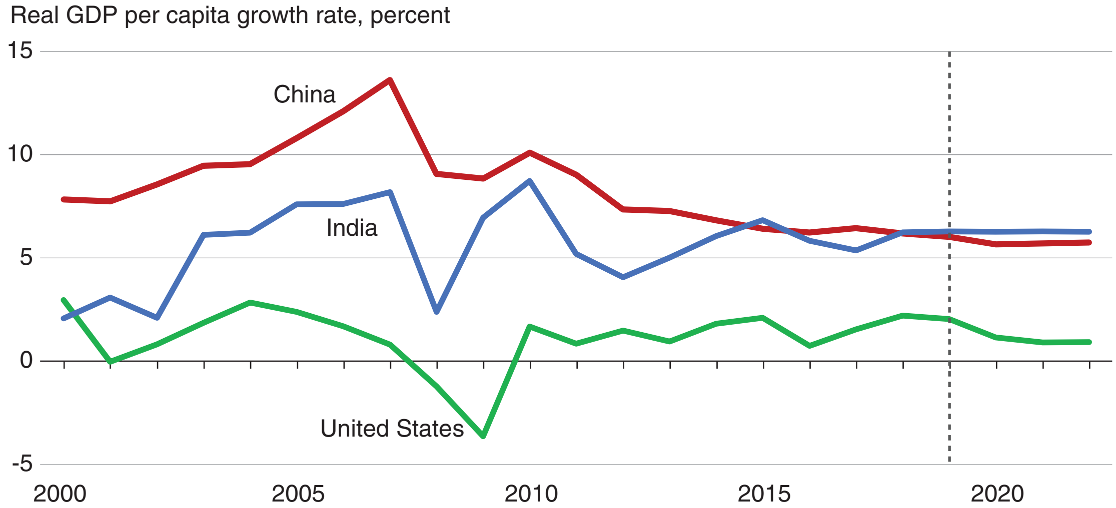
Source: USDA, Economic Research Service, International Macroeconomic Data Set.

A recent economic slowdown in China, largely driven by the country's gradual rebalancing from an export-oriented economy to a domestic-demand economy, has many spillover impacts, including weaker commodity prices (Cashin et al., 2017). China's economy grew 6.6 percent on average in 2013-18, a rate almost 34 percent lower than that in the pre-Great Recession years of 2000-07. China's economy is projected to grow at an average annual rate of 5.8 percent for 2019-22, almost 42 percent lower than in the pre-Great Recession years (fig. 3). On the other hand, India became the world's fastest growing economy in 2019, surpassing China. Nevertheless, India's commodity demand alone has not spurred significant growth in global trade or exerted upward pressure on commodity prices. Instead, India's agricultural exports have climbed to record highs, and India has emerged as a large net exporter of agricultural products, especially rice, beef, and cotton (USDA/FAS, 2014).

Biofuel mandates are not diverting much more feedstock in the 2010s than in the expansion stage in the 2000s

At the time of the commodity price peaks of 2007-08 and 2011-12, biofuel mandates in many countries were frequently mentioned as a contributing factor (see, for example, Babcock, 2012; Wise and Cole, 2015). There is, nevertheless, no established consensus on the overall impact of biofuel policies on commodity prices (Timilsina et al., 2012; Baffes and Dennis, 2014). A review of 121 studies reveals that there is still considerable uncertainty around the connection between biofuel policies and their impact on agricultural commodity prices (Persson, 2015). Nevertheless, at the very beginning of biofuel mandate and expansion, the increased use of food and feed crops to produce biofuels, and the depletion of feedstocks, coincided with the 2007/08 commodity price spike.

Figure 3
India surpassed China in 2019 as the world's fastest growing economy



Note: Growth rates are in annual terms. The 2019-22 data are projections based on USDA macroeconomic assumptions (USDA/ERS, 2019b). GDP=Gross Domestic Product.
Source: USDA, Economic Research Service, International Macroeconomic Data Set.

While biofuel mandates create a demand for feedstocks, ethanol production from grain feedstocks results in a coproduct called dried distillers' grains with solubles (DDGS) that can be used for feed. DDGS partially offset the diverted grains that would otherwise be used for feed or exports. In 2016, U.S. ethanol plants used 132 million metric tons of corn and produced 15.41 billion gallons of ethanol and 36 million metric tons of DDGS (USDA/ERS, 2018b).

Global biofuels production grew exponentially from 5.3 billion gallons in 2001 to 22.6 billion gallons in 2008, a 21-percent annual growth rate attributed primarily to ethanol production (table 2). The expansion during this period was due to policies mandating consumption of biofuels and favorable market factors (Beckman and Nigatu, 2017; FAO, 2016a). This period coincided with spikes in agricultural commodity prices. Between 2008 and 2012, biofuels production grew 6 percent per year. Since 2012, however, the growth rate of biofuels production has slowed to 5 percent per year, and, concurrently, global agricultural commodity prices have been on a falling trend. Global biofuels production in 2016 was 34.9 billion gallons, of which 26.6 billion gallons (or 76 percent) is ethanol and the remainder is biodiesel.

Several factors account for the declining growth of biofuels production. In 2016, the United States produced 15.4 billion gallons of fuel ethanol. Current corn-based ethanol uses to meet the "conventional gap" under the new Renewable Fuel Standard (RFS2) of 2007, however, are capped at 15 billion gallons, and domestic consumption has already reached this cap. Any additional production beyond this cap could be used for exports, given favorable conditions on the global market. At present, the incentive to further increase corn-based ethanol production in the United States appears minimal.

Table 2
The growth of global biofuels production has slowed in recent years

Type of biofuels	Country/ region	Production				Average annual growth rates		
		2001	2008	2012	2016	2001-08	2008-12	2012-16
		Billion gallons				*Percent*		
Ethanol								
	US	1.8	9.3	13.2	15.4	24	9	4
	Brazil	3.0	7.1	6.2	7.3	12	-4	4
	EU	0.0	0.7	1.0	1.4	42	10	7
	All other	0.1	1.5	1.9	2.6	35	6	8
	Global	5.0	18.7	22.3	26.6	19	4	4
Biodiesel								
	US	0.01	0.68	0.98	1.57	62	9	12
	Brazil	0.01	0.31	0.72	1.04	49	21	9
	EU	0.29	2.27	2.61	3.35	30	3	6
	All other	0.00	0.76	2.30	3.52	73	28	11
	Global	0.30	4.02	6.61	8.36	37	12	6
Biofuels								
	Global	5	23	29	35	21	6	5

Note: Growth rates are continuously compounded.

Source: USDA, Economic Research Service using data from U.S. Department of Energy, Alternative Fuels Data Center (AFDC, 2018); U.S. Department of Energy, Energy Information Administration (EIA, 2018).

Brazil is the world's second-largest producer of ethanol and accounts for 27 percent of global ethanol output. Brazilian ethanol is sugar-based, thus having little or no effect on global grain markets. Growth in ethanol production in the EU slowed after 2010 because of falling profits (a combination of lower ethanol prices and dependency on imported feedstocks), reduced total fuel consumption, and reduction in mandates. Other countries, including India and China, both of which planned to expand their biofuels production during the mid-2000s, have not achieved their targets and have slowed production. Therefore, it appears that global biofuels production is not creating as much demand for agricultural commodities in the 2010s as was projected during the expansion stage of biofuels production in the 2000s.

Supply-Side Factors That Affect Agricultural Commodity Prices

Costs of production declining since 2016

Economic theory dictates that keeping all demand and other supply factors constant, low costs of production would decrease equilibrium in agricultural commodity prices. Given that fertilizer purchases represent a substantial portion of agricultural operation costs,[3] fertilizer prices are a significant portion of the costs of production. The main components of the fertilizer price index and the energy price index are the price of natural gas and the price of crude oil, respectively. In the United States and many other countries, natural gas is the primary source of hydrogen used to produce ammonia, the base for all nitrogenous fertilizers (Huang, 2007). The production of

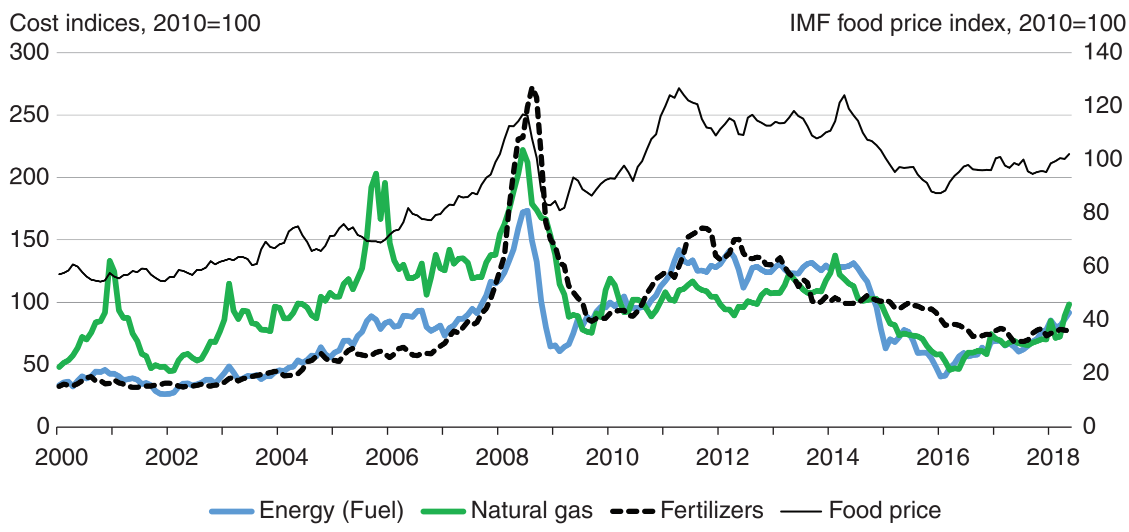
[3]In the United States, fertilizer accounts for 15-35 percent of operating costs for corn, soybeans, wheat, rice, and cotton (USDA/ERS, 2019a).

ammonia is energy intensive, accounting for 90 percent of the total energy used to produce, procure, and apply nitrogen to fields (Gellings and Parmenter, 2004). When costs for electricity, fuel, and other petroleum-based products used in crop production are added to fertilizer costs, energy-related inputs could account for a significant portion of annual operating costs. These forces push agricultural commodity prices in the direction of crude oil prices. According to one estimate, crude oil prices accounted for at least 50 percent of commodity price changes from 1997-2004 to 2005-12 (Baffes and Dennis, 2014).

Similar to commodity prices, fertilizer prices showed upward trends from 2001 to 2008 and then relatively high volatility until 2011. From 2012 to 2016, the fertilizer price index exhibited a falling trend, declining more than 55 percent from the high index of 159.5 in 2011 (fig. 4). In the same period, commodity prices fell 24 percent.[4] Falling energy and input prices reduced U.S. farm-sector production expenses by $5 billion annually for 2015 and 2016 (Marshall et al., 2015).

As with the commodity price index, natural gas prices and crude oil prices exhibited upward trends during 2000-08.[5] U.S. natural gas prices jumped 200 percent during the period and reached a record high of $12.7 per million British Thermal Units (MMBtu) in June 2008. The crude oil price increased by 370 percent and reached its record high of $133 per barrel in July 2008. After reaching their peak levels, natural gas prices dropped 80 percent over the next 15 months, and crude oil prices dropped 70 percent in only 5 months. The crude oil price immediately started recovering and regaining its value, but natural gas prices swung between $2 and $6 per MMBtu until 2014. Between 2014 and 2016, however, both prices exhibited a declining trend stemming from a number of factors, namely increasing U.S. crude oil production due to fracking, rising global oil reserves, and slower demand from emerging economies (Wiggins and Etienne, 2017).

Figure 4
Broader measures of the cost of production have dropped more than food prices in recent years



Source: USDA, Economic Research Service using food price data from International Monetary Fund (IMF, 2019) and energy, natural gas, and fertilizer price data from World Bank (2018).

[4]Simple linear correlations between fertilizer and natural gas price indices with the food price index from April 2011 to June 2017 are 0.71 and 0.86, respectively. The correlation between fertilized and natural gas price indices is at 0.66.

[5]For the sake of clarity, as the crude oil price is highly correlated with the energy price index, we exclude the former from figure 4.

Increased agricultural commodity supply resulting from area-harvested expansion and improved yield growth

One of the main causes for declining agricultural commodity prices is increased supply—resulting from a combined effect of area-harvested expansion and yield growth—exceeding the increases in agricultural commodity demand. Producers may increase planted acreage in anticipation of greater crop returns. Over the long term, yield growth is due to technical and farm practice changes. Of course, in any given period, good growing conditions leading to yields and harvested acres as a percentage of planted acres above projections can lead to lower prices in the near term.[6] While livestock and dairy production tends to be less sensitive to weather than crops, similar principles apply that can lower their prices. In addition, livestock and dairy prices are linked to feed-crop prices, given that feed is an input to these sectors.

The four major crops (corn, soybeans, wheat, and rice) experienced area-harvested expansion in recent years. Area harvested for these crops reached 700 million hectares (accounting for 70 percent of area harvested out of grains, oilseeds, and cotton) in 2016, up from 625 million hectors in 2007.[7] (One hectare equals 2.47 acres.) Compared with the 0.9-percent average annual area-harvested growth rate in 2000-07, these four crops experienced a 1.3-percent growth rate between 2008 and 2016, mainly from outside the United States, in corn, rice, and wheat area-harvested expansion (fig. 5). Area harvested expanded more rapidly in countries with a reserve of available land and with policies that allowed farmers to respond to prices. South America, Sub-Saharan Africa, the former Soviet Union, and Southeast Asia had the largest increases in harvested area over 2008-16. Area-harvested expansion in Brazil and Argentina was largely due to uncultivated land brought into soybean production in response to increased world demand for protein meals. In the United States, soybeans also accounted for a large share of the area harvested increase from 26 million hectares in 2007 to 33 million hectares in 2016.[8]

In addition to growth in area harvested, the average annual global yield per hectare for the four major crops grew from 1.0 to 1.8 percent between 2000-07 and 2008-16 (USDA/FAS, 2018a). Except for weather-related decreases in rice yields in the United States, crop yields in the rest of the world in 2008-16 improved substantially, with average annual growth rates ranging from 0.8 percent for rice to 2.4 percent for corn (see fig. 5). Yield growth during the period is attributed to low investment costs, technological enhancements, and increasing economies of scale in many countries. In addition, producers increased their intensity of input use, which further improved yields.

The overall impact of area-harvested expansion and improved yields is higher global production and commodity supplies. For the four major crops, global production increased at an average annual growth rate of 3.1 percent during 2008-16, with the largest increase of 5.2 percent for soybeans, compared with 2 percent growth during 2000-07 (see fig. 5). Generally, the declining trend in commodity prices in recent years stems partly from increased commodity supplies, resulting from the combined effect of area harvested expansion and yield growth exceeding increases in demand.

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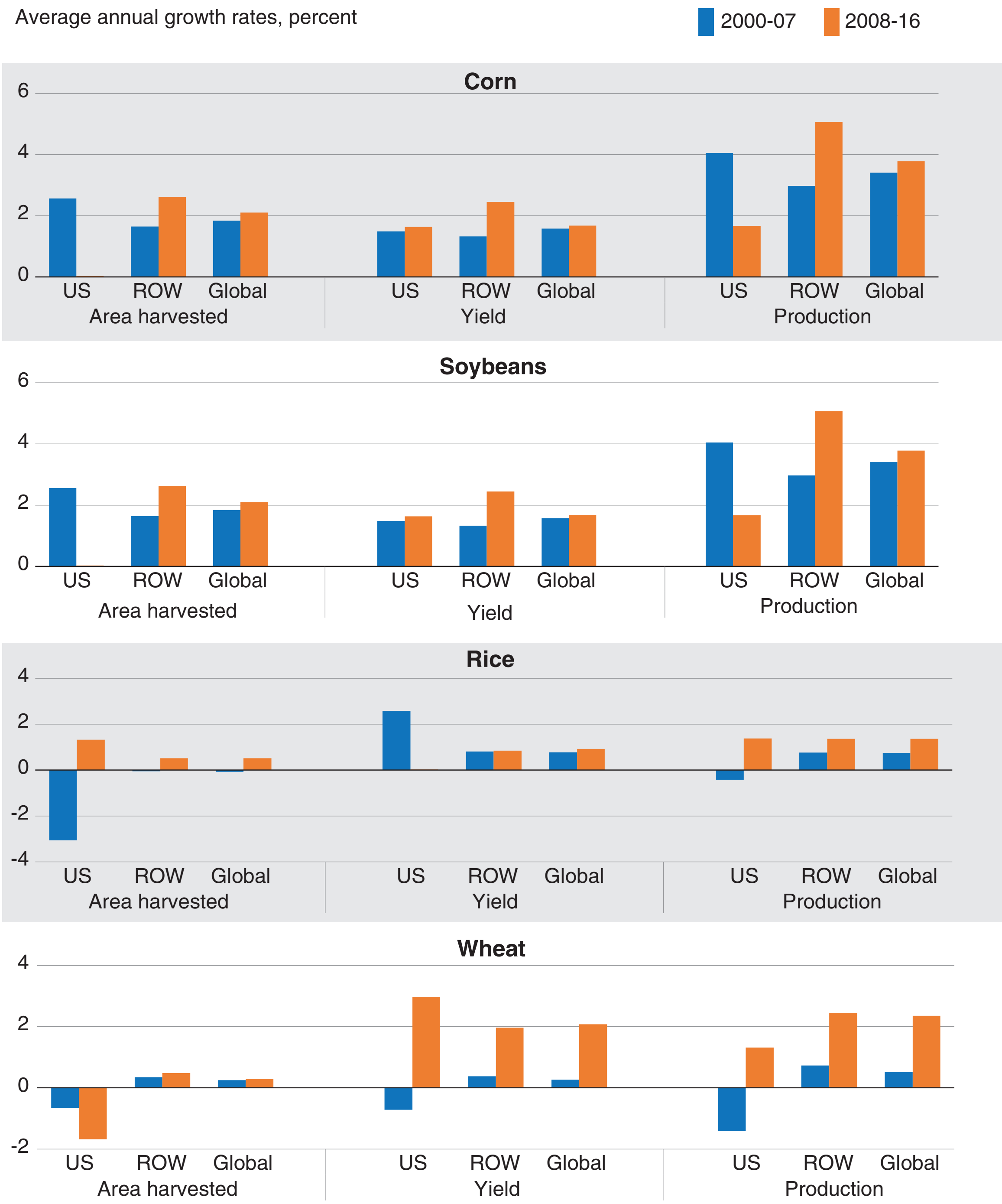
[6]Note that periods of good or bad weather can cross multiple seasons. For example, the recurring El Niño weather pattern caused supply disruptions in the Southern Hemisphere over 2015 to 2016 (World Bank, 2015).

[7]Agricultural Market Information System (AMIS), an interagency platform launched in 2011 by the G20 countries following the two global commodity price hikes, assesses global commodity supplies focusing on wheat, corn (maize), rice, and soybeans. AMIS was designed to enhance commodity market transparency and policy response for food security (AMIS, 2018). Our analysis also focuses on these four commodities.

[8]In the United States, acreage expansion in some crops was at the expense of other crops; the total amount of land in agriculture has been relatively stable since the 1990s (Wang et al., 2015).

Figure 5

Greater area harvested and improved yield resulted in increased production in recent years



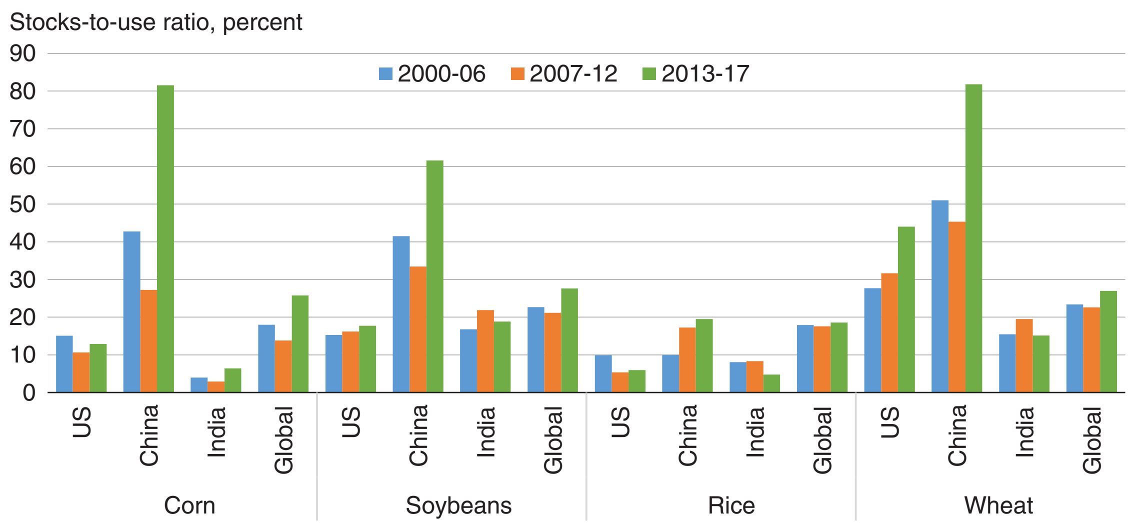
Note: ROW = rest of world (all countries other than the United States).

Source: USDA, Economic Research Service using data from USDA/Foreign Agricultural Service (2018a).

Global stocks-to-use ratio returning to pre-Great Recession levels

The stocks-to-use ratio captures the supply of commodities relative to demand and gives an overall signal of market price conditions (Schaffer and Ray, 2018).[9] During the price hikes of 2007-/08 and 2011-12, declining stocks-to-use ratios for major commodities reflected increases in demand relative to supply (Trostle et al., 2011; Baffes and Dennis, 2014). The most recent high global stocks-to-use ratios, particularly in the United States and China, reflect an increased supply relative to demand in the commodity market.[10] The stocks-to-use ratios for major commodities were higher in 2013-17 (a period of declining prices) than in 2007-12 (a period of price spikes) (fig. 6). China's stocks-to-use ratio for the four commodities, particularly corn and wheat, remained higher in 2013-17 than in 2000-06 and 2007-12.

Figure 6
Higher stocks-to-use ratios in 2013-17 reflect excess supply and moderate demand



Source: USDA, Economic Research Service using data from USDA/FAS (2018a).

Other Economic Factors That Affect Agricultural Commodity Prices

Agricultural commodity prices are strongly influenced by monetary exchange rates and other macroeconomic factors. Analysis linking exchange rates to commodity prices goes at least as far back as Schuh (1974). When the U.S. dollar appreciates, commodity prices measured in U.S. dollars decrease. On the other hand, a stronger U.S. dollar is linked with higher expected inflation, thereby driving up agricultural commodity prices (Rezitis, 2015).

[9]The stocks-to-use ratio is defined as stocks of the commodity at the end of a particular period divided by use (total consumption and exports) of the commodity during that period (Westcott and Hoffman, 1999).

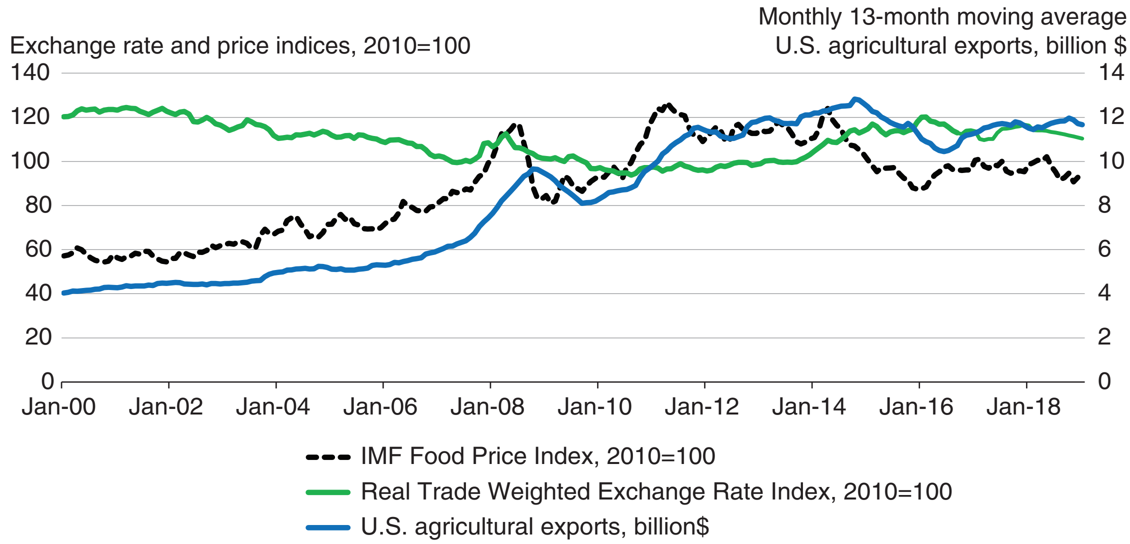
[10] In the United States, private market participants (such as farmers and packers) keep commodity stocks where they are readily accessible for selling to domestic and international markets. In China, however, the government is primarily responsible for commodity stocks, and it releases stocks to the market through government policy decisions in a way that may differ from how the private sector releases stocks into the market. Hence, the global market perceives 5 million metric tons of U.S. stocks differently from the way it perceives the same volume of stocks in China.

The rapid pace of globalization further enhanced the impact of exchange rates on commodity and asset trade (Chinn, 2006). The steady expansion of U.S. agricultural exports from $63 billion to $140 billion between 2006 and 2011 occurred as underlying macroeconomic factors, in particular, an extended period of a relatively weak dollar, supported the competitiveness of U.S. exports (Cooke et al., 2016; USDA/ERS, 2019b).

Between July 2012 and December 2016, the U.S. dollar appreciated by approximately 35 percent against the currencies of a broad group of major U.S. trading partners (FRED, 2018b), and the U.S. real agricultural trade-weighted exchange rates appreciated 25 percent (USDA/ERS, 2018b). On the other hand, the value of U.S. agricultural exports declined 9 percent from 141.1 billion in 2013 to 129.6 billion in 2016 (USDA/ERS, 2019c). Recent U.S. trade data suggest a negative impact of the strengthening of the U.S. dollar on U.S. agricultural export competitiveness beginning in late 2014 (fig. 7). In addition, according to Frankel (2014), U.S. dollar appreciation contributed to the decline in global agricultural commodity prices in 2012-14.

Figure 7

A stronger U.S. dollar leads to decreases in commodity prices and U.S. agricultural exports

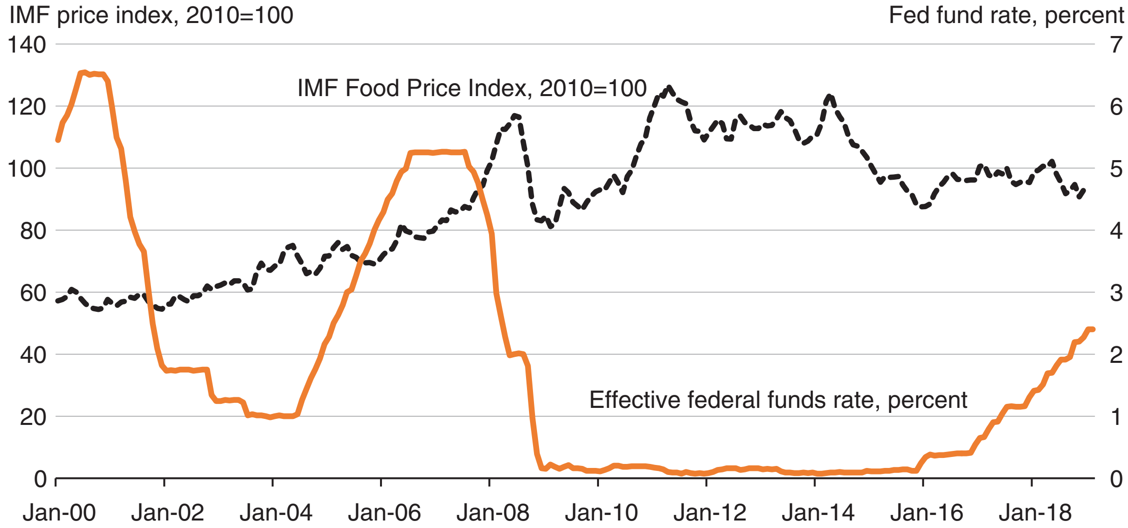


Source: USDA, Economic Research Service using data on agricultural trade-weighted exchange rates from USDA/ERS (2018b); monthly U.S. agricultural exports (13-month moving average) from USDA/ERS (2019c); and International Monetary Fund (IMF) food price index (2019).

After the Great Recession of 2008-09, the Federal Reserve (Fed) used the U.S. Federal funds rate (interest rate) as the main monetary tool to regulate the U.S. economy.[11] The funds rate dropped more than 97 percent from 5.26 percent in February 2007 to 0.15 percent in January 2009 (fig. 8). The funds rate stayed near zero, a historic low level, for an extended period between January 2009 and November 2015 before the Fed reversed its policy in December 2015. The Fed again frequently revised the rate (e.g., December 2016, March 2017, June 2017, December 2017, March 2018, June 2018). The Federal funds target rate in June 2018 was in the range of 1.75 to 2.00 percent (FRED, 2018a).

[11]The Federal funds rate is the interest rate at which depository institutions trade Federal funds (balances held at Federal Reserve Banks) with each other overnight. More information on this rate can be found at FRED (2018a).

Figure 8
Commodity prices have shown some co-movement with non-zero interest rates



Source: USDA, Economic Research Service using data from Effective Federal Fund Rates (FRED, 2018a) and International Monetary Fund food price index (2019).

Lower real (adjusted for inflation) interest rates reduce farm borrowing costs for farm investment and operation. Moreover, lower interest rates further increase the incentive to invest in agriculture directly as well as in research and development, which affects productivity growth in subsequent years (Wang et al., 2015). Depending on expectations about future prices and, hence, profitability as well as opportunity costs, low capital costs along with declining inputs and energy costs can make agricultural operation attractive in times of declining commodity prices if strong institutions (including financial institutions) exist to provide the capital. Even though low real interest rates tend to raise U.S. and world economic growth, thus far, commodity markets have experienced a situation where existing commodity demand falls short of existing supplies and stocks, thus keeping commodity prices below their long-term trends (Heerman, 2018).

Agricultural Policies That Affect Agricultural Commodity Prices

Due to the 2007-08 and 2010-11 global commodity price spikes, a number of countries implemented policies designed to restrict agricultural trade flow, and some exporting countries made trade policy changes designed to discourage or limit exports (Trostle, 2008; Trostle et al. 2011). For example, Argentina raised export taxes on wheat, corn, and soybeans and products; Russia and Kazakhstan raised taxes on wheat; and Malaysia and Indonesia raised taxes on palm oil. India and Vietnam, the world's second- and third-largest exporters of rice in 2017, also put quantity restrictions on rice exports. Around the end of 2007, India banned the export of basmati rice. Three weeks later, it replaced the ban with a series of higher minimum export prices until it once again reverted to an outright ban. Later in the period of the agricultural commodity price crisis, the Thai Government kept almost all of its rice stock off the market and stopped exporting rice. In addition, commodity-importing countries took protective policy measures to combat rising agricultural commodity prices. Rice market turbulence that impacted world food security resulted from government policies and misinformation but not from market fundamentals (Dawe and Slayton, 2010).

Since 2012, some of the biggest commodity exporters have taken steps to eliminate or lower their export tariffs or lift export bans, thus increasing exports. For example, the Indian Government eased a partial export ban on nonbasmati rice, and exports increased significantly, growing from 2.7 million metric tons in 2011 to 10.4 million metric tons in 2012 (USDA/FAS, 2018a). The change in rice export policy helped India become the leading global rice exporter in the years since 2013. Wheat exports from Russia, Ukraine, and Kazakhstan increased during the past 5 years and are projected to reach 55 million tons in 2018-19, accounting for 37 percent of the projected increase in the global wheat exports. In 2015, the Government of Argentina eliminated export taxes on all crop commodities (corn went from 20 percent to zero), except for the soybean complex, for which it reduced tariffs by 5 percentage points (beans dropped from 35 to 30 percent, and oil and meal dropped from 32 to 27 percent) (USDA/FAS, 2018b). Argentina's export tariff on biodiesel was substantially below that on unprocessed soybeans, soy meal, and soy oil, as Argentina favored biodiesel exports over exports of soybeans and soybean products (Naylor and Higgins, 2017).

The recent low commodity prices have attracted relatively little attention from multilateral organizations and major media compared to reactions following the 2007-08 and 2010-11 global commodity price spikes.[12] However, that does not mean that groups representing farm interests have not taken notice of the price changes, given that the decline in commodity prices has adversely affected producers by decreasing their revenues and exerting downward pressure on farmland values and rents.

[12]This is unlike the global agricultural commodity price spike of 2011, which was responsible for establishing the Agricultural Market Information System (AMIS) to enhance food market transparency and policy response for improving food security (AMIS, 2018).

Implications for Consumers and Producers of Changing Agricultural Commodity Prices

Changing commodity prices directly affect the incomes of farmers and ranchers. With sustained lower commodity prices and potentially lower profits, farmers and ranchers might need to make certain short-term agricultural practice adjustments (such as cutting wage rates, postponing machine repair and maintenance, or limiting borrowing for farm operations) and reduce onfarm investment in the long term. On the other hand, declining commodity prices could lead to discounted food prices that would benefit urban consumers, especially in developing countries where urban consumers spend a greater portion of their income on food. In developed and emerging economies, however, food accounts for a smaller share of the household budget, while a greater share is spent on housing and health care (Muhammad et al., 2011). Hence, the effect of lower commodity prices is marginal for urban residents in most developed and emerging countries. Many rural households in developing countries are net buyers of staple retail foods, and, thus, low commodity prices benefit these households in the short run.

In the long run, however, declining agricultural commodity prices could increase poverty among rural households and, in the aggregate, increase global food insecurity (Glauber, 2015). The export earnings of more than 100 developing countries rely heavily on a narrow set of agricultural commodities (example, rice in many Asian countries, cocoa beans in Ghana, cotton in Burkina Faso, soybeans in Paraguay) (FAO, 2016b).[13] Moreover, poor rural households in most of the developing world lose income from selling their agricultural products at lower prices, and this effect may be less than offset by decreases in the cost of production or retail food prices (Aksoy and Isik-Dikmelik, 2008). Hence, a decline in commodity prices has implications for economic growth and poverty (Baffes et al., 2015). A study by the International Monetary Fund on Sub-Saharan Africa finds that a 30-percent decline across all commodity prices could reduce that region's GDP by 0.5 percent (IMF, 2013). In the long run, lower commodity prices discourage investment and production, leading to low farm household income and low wages. Lack of investment could, in turn, hurt agricultural productivity.

[13]According to the UNCTAD (2014), commodity dependency is defined as the ratio (percentage) of the value of commodity exports to the value of merchandise exports. A country or a region is considered to be commodity dependent when this ratio exceeds 60 percent of the country's or region's merchandise export value.

Prices Over the Next 10 Years: USDA's Agricultural Commodity Projections

On an annual basis, USDA issues 10-year projections covering agricultural commodity production, demand, prices, and trade, and aggregate indicators for the agricultural sector, such as farm income. The projections are based on specific assumptions about macroeconomic conditions, existing policy (for the United States, for example, the farm bill), weather, and international developments. The projections are one representative scenario for the agricultural sector for the next decade and reflect a composite of model results and judgment-based analyses. To facilitate the development of the projections, ERS maintains the Country-Commodity Linked System (CCLS) modeling framework (see box "ERS's Country-Commodity Linked System Model").

USDA projects that over the next several years, the agricultural sector will continue to adjust to lower prices for most farm commodities and reduced energy prices (USDA, 2019). Although reduced energy prices have decreased energy-related agricultural production costs, the combination of lower costs and lower crop prices provides incentives to retain relatively stable harvested acreage while inducing some shifts in plantings.

Prices for most crops have fallen from the peaks reached in 2011-12 as production in the United States and globally increased in response. Prices are expected to rise over the first half of the projection period up to 2024 and thereafter decline moderately, reflecting long-term growth in global demand for agricultural products and continued biofuel feedstock demand.

ERS's Country-Commodity Linked System Model

ERS's Country-Commodity Linked System (CCLS) model is used to generate economically consistent supply, demand, trade, and price projections under baseline and alternative scenarios. It is one of the primary modeling tools used to support the USDA interagency process that produces the Department's 10-year agricultural projections. The system comprises 44 country- and region-specific models and 24 major agricultural commodities, for which it generates estimates of supply, demand, trade, and market-clearing world prices over the 10-year projection period. Each country or regional model includes relevant income and own- and cross-price relationships in supply and demand, price linkages to world markets (including exchange rate and price transmission relationships), and major domestic and trade policies affecting commodities (for detailed information about CCLS model, refer to Hjort et al., 2018).

Commodity coverage: Wheat, rice, corn, sorghum, barley, other coarse grains, soybeans and products, rapeseed and products, sunflower seed and products, other oilseeds and products, cotton, sugar, beef and veal, pork, and poultry.

Country and regional coverage: Argentina, Australia, Bangladesh, Brazil, Burma, Cambodia, Canada, China, Cuba, Egypt, European Union, Hong Kong, India, Indonesia, Iran, Iraq, Japan, Malaysia, Mexico, Morocco, New Zealand, Nigeria, Pakistan, Philippines, Russia, Saudi Arabia, South Africa, South Korea, Taiwan, Thailand, Turkey, Ukraine, United States, Vietnam, Other Asia and Oceania, Other Central America and Caribbean, Other Economic Community of West African States (ECOWAS), Other Europe, Other Former Soviet Union, Other Middle East, Other North Africa, Other South America, Other Sub-Saharan Africa, and rest of world.

Relatively low feed costs continue to improve livestock-sector net returns, providing economic incentives for expansion. Nominal prices for beef cattle and broilers are projected to decline through most of the next decade as production rises while hog, turkey, and egg prices (after an initial drop) tend to remain steady or increase slowly. Nominal farm-level milk prices are expected to increase over the upcoming decade.

Long-run developments for global agriculture reflect expected steady but slow world economic growth and global demand for biofuel feedstocks, factors that combine to support long-run increases in consumption, trade, and prices of agricultural products. Although a stronger valued U.S. dollar is expected to constrain growth in U.S. agricultural exports somewhat, the United States is expected to remain competitive in global agricultural markets and its export values will grow over the next 10 years (see box "U.S. Agricultural Trade Projections to 2028"). U.S. farm sector net cash income and net farm income are expected to stabilize over the coming 10 years from recent record highs before increasing over the latter part of the projection period.

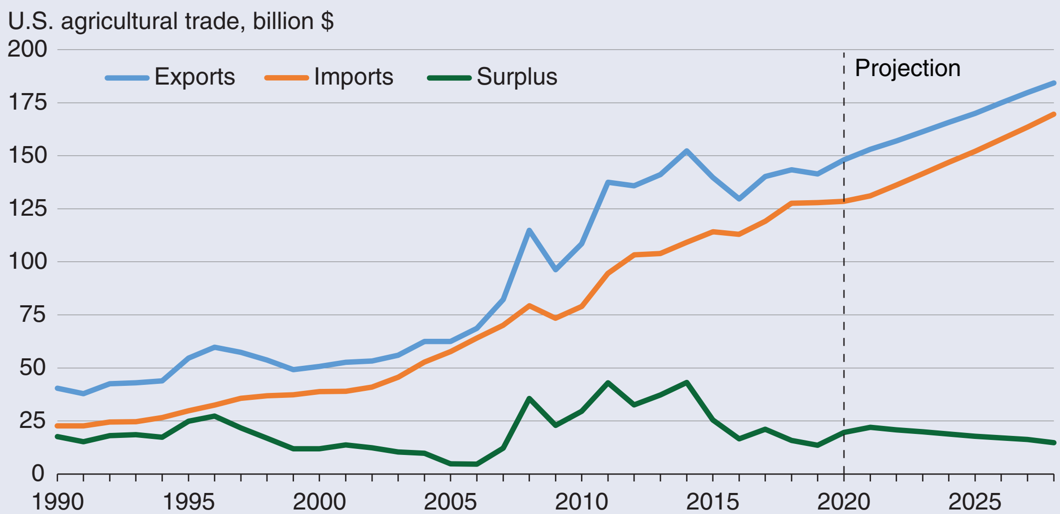
As livestock prices fall more than feed and other costs, livestock cash receipts are expected to decline throughout the first half of the decade. Crop cash receipts, however, are expected to grow throughout the decade. After 2019, gross cash income (before expenses) begins to rise at almost 0.9 percent per year on average.

U.S. Agricultural Trade Projections to 2028

USDA Agricultural Projections to 2028 includes data on the value of projected U.S. agricultural exports. The value of U.S. agricultural exports is expected to increase slightly in fiscal year 2019 and then grow over the rest of the decade at 2.5 percent per year and could reach $184 billion in 2028 from the current $141 billion (see box figure). Sustained growth in agricultural exports reflects strengthening foreign demand and steady global economic growth. The top U.S. export commodities are projected to continue to be bulk items such as soybeans, corn, and wheat. However, exports of high-value products, including horticultural and animal products, will continue to grow as a share of total exports, up to nearly 70 percent (by value) by 2028. These projections assume that export markets will not be hindered by escalating tariffs or other unexpected shocks.

Box figure 4.1

Historical and projected U.S. agricultural trade value, by fiscal year



Note: Fiscal years run from October 1 to September 30 of the following year.

Source: USDA, Economic Research Service using USDA (2019).

Growing consumer incomes coupled with demand for a wide variety of retail food drives increases in U.S. agricultural imports over the projection period. Throughout the next 10 years, the value of imports rises, reaching nearly $170 billion by fiscal year 2028, up from $128 billion in 2018. The commodity sector with the highest growth is expected to be horticultural products, largely driven by fresh fruit and vegetable sales. The United States largely imports agricultural products that are not widely grown domestically or are out of season, as well as high-value products for which demand tends to respond less to changes in the value of the dollar.

Fiscal year 2018 ended with an agricultural trade surplus of $15.8 billion. In the long term, the trade balance is expected to decrease, as the growth rate of U.S. agricultural imports starts to slightly outpace agricultural exports.

The Impacts of Demand- and Supply-Side Changes—An Empirical Analysis

We simulate the impacts of demand- and supply-side changes using ERS's CCLS partial equilibrium agricultural market model (see box "ERS's Country-Commodity Linked System Model"). The results can offer insights into the magnitude of the effects of changes in demand- or supply-side drivers on global and country/region specific agricultural market outcomes such as commodity price effects, substitution effects across crops, and trade effects. By varying demand and supply conditions in a global agricultural market model, the analysis can generate real-world outcomes that can help explain the responsiveness of prices and trade to changes in these market conditions. The 10-year USDA agricultural projections serve as our baseline (reference) scenario, and we present the results for the near term (2018-19) and medium term (3 years out, 2019-20 to 2021-22). The analysis follows three scenarios relative to the baseline; the first and second scenarios will focus on the global demand- and supply-side changes, respectively, and the third scenario will focus on a U.S. agricultural production change. We choose the magnitude of the changes to fall within historical limits. Commodities of focus are corn, wheat, soybeans, rice, poultry, beef, and pork. Our three scenarios[14] are:

I. Weakening of global demand in developing and emerging economies

II. Reduction in global crop supply from major agricultural producing countries

III. Expansion of U.S. crop production

Scenario I represents a negative demand-side change that could result from declining economic growth in developing and emerging economies. We implement scenario I by changing annual baseline GDP growth rates (income levels affect demand, and, hence, the choice of adjusting GDP growth rates to demonstrate demand-side shocks). We choose GDP growth rates that are 2.3 percentage points lower than those projected in the baseline for the period 2018-22 to simulate further weakening of global commodity demand relative to the baseline.[15] What this means is that the baseline GDP growth rate for a country, g(c), becomes g(c)-0.023 in our scenario. We choose an annual 2.3-percentage-point decline to stay within an annual average range of economic decline that those countries experienced during 2007-09, the period covering the global recession.[16] Further, we keep all other factors, such as oil prices, exchange rates, and population growth rates, to their baseline levels to isolate the effects of income on agricultural markets.

The first scenario assumes a decreased global growth and demand relative to the baseline is possible if, for example, global trade stalls due to various trade policy changes, adverse changes in the financial markets, or military conflicts that could disrupt further global growth and subsequent trade. As a result, weaker global demand would put further downward pressure on global commodity prices.

[14]We acknowledge that both demand and supply could shift simultaneously (for example, a stronger oil price, which could raise the cost of production and put downward pressure on supply, coupled with stronger biofuel demand). Our goal is to understand (isolate) individual factors and their individual impacts on the markets, ceteris paribus.

[15]Emerging and developing economies comprise all countries except the United States, Europe, Australia, New Zealand, Japan, Canada, South Korea, Taiwan, and Hong Kong.

[16]The changes simulated here could be extrapolated by the reader to smaller or larger changes than the 2.3-percentage-point change presented in the text. For example, table 4 shows the change in prices and trade volumes for a 2.3-percentage-point decline in GDP. A 1.15-percentage-point change in GDP would have roughly half the impact, and a 4.6-percentage-point change in GDP would have roughly double the impact, ceteris paribus. Furthermore, the impacts on prices and volumes for an increase in GDP could be treated as the reverse of the values in the table. These same basic principles apply to scenario II.

Scenario II examines the impacts of a reduction in global crop supply. In this scenario, we assume no changes to the baseline global demand levels but only a supply-side decline in major agricultural producing countries consisting of the United States, Brazil, the EU, Argentina, Australia, India, China, Russia, Ukraine, and other former Soviet Union. In the CCLS model, we implement the supply-side change by adjusting the area harvested, which is a direct change to production, given that the latter is area multiplied by yield. Yields per acre stay fixed at their baseline levels. We assume that the area harvested for corn, soybeans, rice, and wheat will decline by 3 percentage points for the 2018-22 period. For example, supply/production could tighten due to new pests, crop diseases, unforeseen weather events such as (prolonged) droughts, and possibly unexpected rising input costs such as fuel and fertilizer costs (see Marshall et al. (2015) for a study on the effects of energy prices on U.S. agriculture). We choose the 3-percentage-point value to model a change in the supply of these major agricultural producing countries consistent with recent historical data.

Scenario III analyzes the impact of an unexpected short-term expansion in U.S. crop production on global commodities' prices and trade, assuming no changes to the remaining countries' production in the CCLS model. We base the magnitudes of production changes on historical U.S. production data spanning 2011-16, which shows production increasing despite falling commodity prices. Agricultural investments are typically costly and take years to pay off, time in which commodity prices could swing up or down. Regardless, production may expand as planting decisions and investments were already made. Therefore, in this scenario, we increase crop production by adjusting the area harvested, keeping yields per acre at their baseline levels. Adjusting area harvested is not done as a result of price changes (or demand induced) but as a result of a fundamental supply change.[17] We assume that U.S. soybeans, corn, and wheat area harvested will increase about 2.5, 0.8, and 0.3 percentage points higher, respectively than baseline projections for the period 2018-21.[18, 19] That is, we assume that the actual historical annual growth rates in area harvested from 2011 to 2016 continue over 2018-21. We focus our simulation on the short and medium terms and therefore base this scenario on actual results over 2011-16 when average area increased and commodity prices fell. We simulate an extension or continuation of what happened during these years.

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[17]Scenario II and III are designed to illustrate the effects of simple, stylized production changes. We change area rather than yield because varied functional forms for yield would make changing the yield equations more difficult mechanically. Despite the applied shocks, the endogenous area equations continue to respond to prices, so they exhibit second-round effects that partly offset the changes.

[18]U.S. rice area harvested has shown substantial variation over time. For example, rice area harvested increased by about 15 percent in 2010-11 but dropped by about 32 percent in 2011-12. U.S. rice production is very sensitive to weather conditions, and producers could switch to alternative crops (such as soybeans) during periods of declining prices. We exclude changes in U.S. rice area harvested in this scenario.

[19]Although U.S. wheat area has been declining at an average annual rate of about 0.6 percent since 2011, in this scenario, we subjectively choose to implement an increase of 0.3 percent to stay consistent with our scenario, which looks at an overall production increase in the United States across the commodities of interest. We desire an average rate of area harvested increase of about 1 percent in the United States across wheat, soybeans, and corn; hence, we increase wheat area, which is opposite the historical trend. The scenario rates for corn and soybeans equal actual historical annual growth rates in area harvested from 2011 to 2016.

Results of the Empirical Analysis

We present our results at the global and U.S. level, noting that at an individual country/commodity level, these impacts could sometimes diverge from global levels. For example, countries differ in their endowment of natural resources, agricultural policies, technology, levels of skilled labor, education levels, etc. At the individual commodity level, cross-price effects and substitution effects could influence market outcomes. Additionally, our results are to some extent sensitive to the functional form specifications of equations and the price and cross-price responsiveness to market changes (elasticities) embedded in the country models of the CCLS system. This is the case for any empirical model, and our results are in line with economic theory. Any peculiarities in our results are explained as necessary.[20]

We use CCLS models and express the impacts on prices, consumption, volume of trade, and stocks (the latter in the appendix) relative to the baseline for the near term (2018-19) and medium term (2019-20 to 2021-22). Both the near- and medium-term baseline projections indicate that most commodity prices do not display an increasing trend and will continue to stay around current levels (table 3). The United States is projected to export more than a quarter of the global trade in corn, soybeans, pork, and poultry. Between the near and medium terms, global trade is projected to increase by an average rate of 7 percent (the percentage difference between the totals of columns (5) and (6) of table 3) while global consumption is projected to increase by an average rate of 3 percent (the percentage difference between the totals of columns (7) and (8) of table 3).

Table 3
Baseline snapshot for the near term (2018/19) and medium term (2019/20 to 2021/22)

	Price		Volume				Total Consumption	
			2018/19	2019/20-2021/22	2018/19	2019/20-2021/22	2018/19	2019/20-2021/22
Commodity	2018/19	2019/20-2021/22	US Exports		Global Trade*		Global	
	Real 2010 $ per ton				*Million metric tons*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Corn	131.9	129.4	48	55	143	154	1,050	1,079
Wheat	180.5	184.9	20	23	167	175	749	768
Rice	354.0	347.3	3.6	3.8	43	44	484	492
Soybeans	345.4	333.5	55	56	146	156	350	370
Soymeal	297.3	296.9	12	12	72	76	242	256
Soyoil	788.0	776.7	1.3	1.4	13	13	57	61
Beef & veal	1,129.0	1,028.7	1.2	1.2	10	11	71	73
Pork	1,259.0	1,180.0	2.5	2.7	8.7	8.9	118	121
Poultry	1,637.0	1,560.0	3.7	3.9	13	13	114	119

Note: * Volume of global trade is global exports or imports.

Source: USDA, Economic Research Service simulation using Country-Commodity Linked System.

[20]Most of the equations in the CCLS have linearized growth or linear forms. The linearized growth equations are in effect linear within a given year (although they exhibit compounding effects across years). As a result, outcomes are generally proportional to variable changes; that is, doubling of a variable change would lead to a doubling of the result. Exceptions occur for a small number of exponential equations and for policy equations that depend on absolute price or quantity levels. In addition, results are not sensitive to the choice of USDA's Agricultural Baseline Projections to 2027 or 2028.

Scenario I – Weakening of global demand in developing and emerging economies

Key results for a weakening of global demand in developing and emerging economies by an average of 2.3 percent for the period 2018-19 to 2021-22 are as follows:

- Commodity prices would decline by an average of 4 percent
- U.S. exports and global trade would decline by an average of less than 1 percent

We implement a scenario with GDP growth rates in developing and emerging economies that are 2.3 percentage points lower than the rates projected in the baseline for the period 2018-19 to 2021-22 to simulate a further weakening of global commodity demand. Our results show that commodity prices could decline by an average of 4 percent during the study period relative to the baseline. The volume of projected U.S. exports and global trade would decrease by less than 1 percent. Among the major crops, prices would decline the most for soybeans and wheat (table 4). These two commodities are the main components for livestock feed. With lower incomes, consumers might move away from diversified diets (for example, away from meats and toward more staple crops such as rice and wheat). This is evident from falling livestock consumption as well as a relatively greater consumption decrease for corn and soybeans (fig. 9). As a result, the demand for feed grains falls, pushing prices down. In line with feed prices, as consumption falls, livestock prices also decline in the near term by an average of 2.4 percent, in the medium term by an average of 6.5 percent, and over both terms by 4 percent because of lower consumption or demand.

Table 4
Scenario I: Impacts of a 2.3-percentage-point decrease in GDP growth rate in developing and emerging economies on commodity prices and trade (changes relative to the baseline)

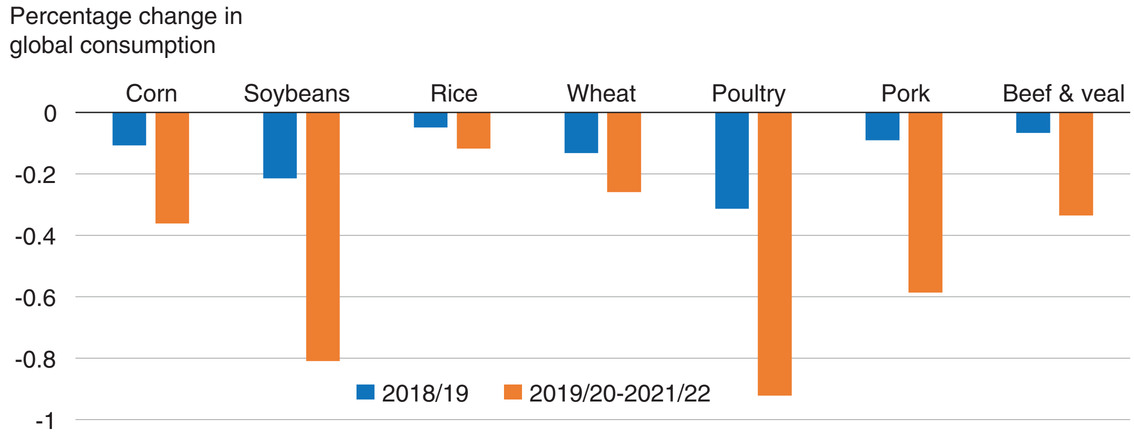
	Global price					Global trade volume				
Commodities	2018/19	2019/20-2021/22	2018/19	2019/20-2021/22	2018/19-2021/22	2018/19	2019/20-2021/22	2018/19	2019/20-2021/22	2018/19-2021/22
	Real 2010 $ per ton		*Percent change*			*Change (1,000 tons)*		*Percent change*		
Corn	130.5	118.1	-1.08	-5.80	-3.44	-384	-240	-0.27	-0.16	-0.21
Wheat	177.8	171.9	-1.51	-5.54	-3.52	-329	-588	-0.20	-0.33	-0.27
Rice	348.0	323.0	-1.63	-4.79	-3.21	146	473	0.34	1.07	0.70
Soybeans	336.2	301.1	-2.66	-6.86	-4.76	-923	-3,252	-0.63	-2.08	-1.35
Beef & veal	1,095.0	901.3	-3.05	-7.85	-5.45	25	42	0.24	0.39	0.32
Pork	1,161.0	1,111.0	-1.81	-4.91	-3.36	-45	-117	-0.52	-1.29	-0.90
Poultry	1,597.0	1,424.3	-2.47	-6.76	-4.61	-121	-466	-0.94	-3.44	-2.19
Average*					-4.05					-0.56

Note: For the global commodity market, commodity imports and exports are in equilibrium and trade refers to either exports or imports. *Average is calculated for 2018/19 to 2021/22 periods for the commodities shown in the table, and it is not a weighted average.

Source: USDA, Economic Research Service simulation using Country-Commodity Linked System.

Figure 9

Scenario I: Impacts of a 2.3-percentage-point decrease in GDP growth rate in developing and emerging economies on global consumption of major commodities (changes relative to the baseline)



GDP = Gross Domestic Product.

Source: USDA, Economic Research Service simulation using Country-Commodity Linked System.

With lower incomes in developing and emerging economies, global trade (demand) slows for most commodities except for rice and beef and veal (table 4). Global stocks are projected to increase in anticipation of higher (or rebounding) futures prices (appendix table 2). Soybean trade would experience the largest decline compared to the baseline: 0.9 million tons in the near term and 3.3 million tons in the medium term. Among the major staple agricultural commodities, only rice would experience an increase in trade over the projected levels and a relatively smaller gain in ending stocks.

With negative income elasticities in some large rice-consuming and rice-trading Asian countries and rice being a staple agricultural commodity, this outcome may be expected.[21] For example, although global consumption of rice falls (due to lower incomes), the consumption of rice and the demand for rice imports increase in India, China, the Philippines, Indonesia, and other Asian countries. In addition, population growth, urbanization, and an expanding middle class all contribute to increases in rice consumption in many developing countries. Therefore, during periods of lower economic growth characterized with lower incomes, lower prices and negative income elasticity, it would not be surprising that some countries continue to consume rice and might import rice relatively more as a way to maintain or increase food security.

Based on our empirical results, as incomes (GDP) grow less than the baseline levels, livestock consumption slows below baseline levels, with poultry experiencing the greatest decline, followed by pork, and then beef (fig. 9). Global trade also slows below baseline levels for both poultry and pork but rises slightly for beef and veal (table 4). Furthermore, in the same scenario, inspection of table 4 shows that beef and veal prices fall more than poultry and pork prices. As beef becomes relatively cheaper than pork and poultry, higher real incomes lead to relatively higher beef demand,

[21]In their article "Rice in Asia: Is It Becoming an Inferior Good?" Ito et al. (1989) found that rice in most Asian countries is becoming an inferior good. That is, as incomes fall, demand rises; and income elasticities have declined and, in some cases, become negative, where a negative income elasticity means that as incomes rise, demand for the product falls. CCLS models also adopt the trend in rice consumption in major countries. Some of the per capita rice income elasticities used in CCLS include Japan, -0.42; Taiwan, -0.35; the Philippines, -0.20; and Thailand, -0.15.

as illustrated by the relatively smaller changes in beef consumption and more trade (fig. 9, table 4). Recall that in our scenario setup, we do not impose negative income growth but a smaller increasing rate of growth relative to the baseline. Baseline GDP growth rates still increase, as do consumption and trade, but at slower rates—which is our scenario I.

The cross-commodity and cross-country results are driven by differences in income elasticities, as explained for rice, for example. Livestock has higher income elasticities than do crops, as changes in consumption are greater for livestock (fig. 9). Corn and soybeans have higher income elasticities than rice and wheat as they are used more intensely as feed grains. Therefore, decreases in livestock consumption will lead to greater impacts on corn and soybean consumption relative to rice and wheat consumption (fig. 9).

For the United States, near-term exports fall for all commodities, while ending stocks increase (table 5). As the United States is one of the largest global producers and exporters of soybeans, lower demand from emerging and developing economies leads to U.S. soybean exports declining more in the medium term relative to other crop exports, and, similarly, soybean prices dropping more than those of other crop prices (table 4). For U.S. corn, lower global demand will have a larger impact on near-term U.S. corn exports than on medium-term exports (table 5). Adjustments in the medium term include more U.S. domestic corn food and feed use that help to absorb the export loses. Hence, the decline in global demand would have a negligible impact on U.S. corn exports in the medium term.

Table 5

Scenario I: Impacts of a 2.3-percentage-point decrease in GDP growth rate in developing and emerging economies on the U.S. commodity trade (changes relative to the baseline)

		U.S. trade volume			
Trade	Commodities	2018/19	2019/20-2021/22	2018/19	2019/20-2021/22
		Percent change		*Quantity change (1,000 tons)*	
Exports					
	Corn	-1.12	-0.02	-543	-6
	Wheat	-0.23	4.63	-45	1,087
	Rice	-0.79	0.19	-29	8
	Soybeans	-0.53	-3.17	-288	-1,766
	Beef & veal	-0.83	-1.89	-10	-23
	Pork	-0.32	-0.44	-8	-12
	Poultry	-0.55	-1.40	-21	-54
Imports					
	Corn	-2.08	-11.29	-27	-143
	Wheat	1.09	4.00	37	139
	Beef & veal	0.77	1.93	10	25

Note: No effects to report for imports of rice, soybeans, pork, and poultry.

Source: USDA, Economic Research Service simulation using Country-Commodity Linked System.

U.S. corn imports would likely decrease at higher rates than corn exports during times of economic slowdowns in developing and emerging countries because U.S. corn imports are relatively small compared to U.S. corn exports. For example, during 2013-15, the United States imported 1.3 million tons of corn mainly from Argentina, Chile, and Canada but exported 50.7 million tons, so any changes to corn imports translate to higher percentage rates than changes to corn exports (in table 5, a 543,000-ton quantity change in exports translates to a 1.12-percent change in exports, and a 27,000-ton quantity change in imports translates to a 2.08-percent change in imports). On the other hand, U.S. wheat exports and imports would increase over 2019-20 to 2012-22. It could be that if wheat is used relatively more than corn in food production in the United States and around the world, it may not be surprising that imports and exports of wheat would rise with falling world prices. At the same time, lower transportation costs and a favorable exchange rate between Canada and the United States strongly encourage U.S. imports of wheat from Canada (USDA, 2019).[22] Lower global commodity prices also affect the U.S. livestock market. All else constant, as global commodity prices decline, the export market becomes less profitable and U.S. livestock exports decrease while U.S. livestock imports increase, as buyers take advantage of the lower global prices.

Scenario II—Decline in area harvested in major agricultural producing countries

Key results for the decline of 3 percent in area harvested from major agricultural producing countries for the period 2018/19 to 2021/22 are as follows

- Commodity prices increase by an average of 12 percent
- U.S. exports and global trade decline by an average of 11 and 2 percent, respectively

Here, we impose a decrease in area harvested of 3 percentage points less than the baseline for corn, soybeans, rice, and wheat across major agricultural producing countries consisting of the United States, Brazil, the EU, Argentina, Australia, India, China, Russia, Ukraine, and other former Soviet Union. As expected, with tighter supply, commodity prices increase, and global stocks and trade decrease for all commodities relative to the baseline (table 6 and appendix table 2). Our results show that commodity prices increase by an average of 12 percent over the study period (table 6). Given a 3-percent decline in global area harvested over the study period, corn, wheat, and soybeans experience the greatest price increases among field crops, while poultry experiences the greatest price increase among livestock products (table 6). The volume of projected U.S. exports and global trade would decline by an average of 11 percent and 2 percent, respectively (table 7 and table 6).

As crop area harvested contracts and given the assumption of stable per acre yields, total production will also decline. This, in turn, leads to a declining amount of the total commodity used for consumption, as prices increase and consumers' purchasing power decreases (for food as well as feed use) (fig. 10). Compared with the baseline, wheat has the largest decline in consumption among food grains. Wheat also has the second-largest increase in price among all commodities in the near term, exceeded only by corn (table 6, column 4). This result is not surprising as consumers might move away from diversified diets, which include meats, toward other staple crops, such as rice, as their purchasing power falls (among all food crops, rice had the smallest increase in price, smallest decline in trade, and smallest reduction in consumption).

[22]Wheat quality and supplier sub-specialization are not explicitly modeled here, which could lend additionally explanation to the two-way trade results between Canada and the United States, for example.

Table 6

Scenario II: Effects of a 3-percent decline in area harvested from major agricultural producing countries on commodity prices and trade (changes relative to the baseline)

Commodities	Global price					Global trade volume				
	2018/19	2019/20-2021/22	2018/19	2019/20-2021/22	2018/19-2021/22	2018/19	2019/20-2021/22	2018/19	2019/20-2021/22	2018/19-2021/22
	Real 2010 $ per ton		*Percent change*			*Change (1,000 tons)*		*Percent change*		
Corn	146	177	10.68	36.59	23.64	-1,848	-7,363	-1.18	-4.47	-2.83
Wheat	201	251	11.42	35.78	23.60	-3,299	-9,702	-1.81	-5.11	-3.46
Rice	363	376	2.44	8.38	5.41	-175	-756	-0.38	-1.59	-0.99
Soybeans	375	423	8.58	26.81	17.69	-973	-3,109	-0.62	-1.86	-1.24
Beef & veal	1,154	1,097	2.15	6.68	4.42	-17	-27	-0.16	-0.25	-0.21
Pork	1,201	1,266	1.54	7.26	4.40	4	-76	0.04	-0.84	-0.40
Poultry	1,709	1,748	4.39	12.06	8.22	-169	-244	-1.34	-1.82	-1.58
Average*					12.48					-1.53

Note: *Refer to table 4.

Source: USDA, Economic Research Service simulation using Country-Commodity Linked System.

Table 7

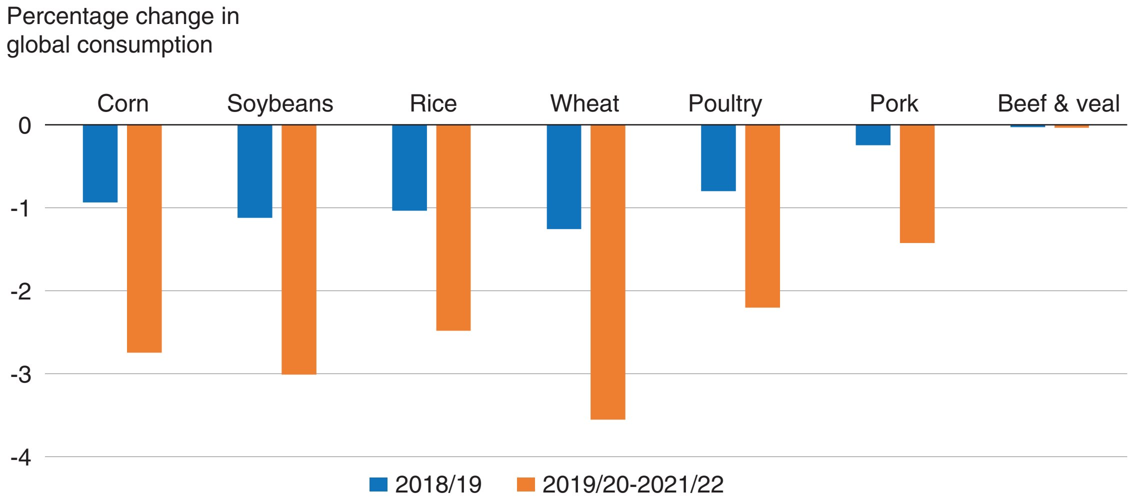
Scenario II: Impacts of a 3-percent decline in area harvested from major agricultural producing countries on U.S. commodity trade (changes relative to the baseline)

Trade	Commodities	U.S. trade volume			
		2018/19	2019/20-2021/22	2018/19	2019/20-2021/22
		Percent change		*Quantity change (1,000 tons)*	
Exports					
	Corn	-9.20	-32.68	-4,442	-16,546
	Wheat	4.71	-5.89	1,218	-1,545
	Rice	-4.65	-26.71	-160	-940
	Soybeans	-3.93	-10.93	-2,484	-7,089
	Beef & veal	0.51	1.27	6	16
	Pork	-0.29	-2.25	-8	-64
	Poultry	0.80	1.49	29	56
Imports					
	Corn	2.09	7.35	27	93
	Wheat	3.24	11.32	119	401
	Beef & veal	-0.49	-1.29	-7	-17

Source: USDA, Economic Research simulation using Country-Commodity Linked System.

Figure 10

Scenario II: Effects of a 3-percent decline in area harvested from major agricultural producing countries on global consumption of major commodities (changes relative to the baseline)



Source: USDA, Economic Research Service simulation using Country-Commodity Linked System.

For the United States, given declining production, stocks and exports of crops decrease as expected during 2018/19, except for wheat. The 2018/19 price increase for wheat was relatively higher than that for other crops in this scenario (table 6), and with lower ending stocks and consumption offsetting the lower production, more U.S. wheat would be available for export. In terms of the volume of exports, U.S. corn exports would be affected the most, followed by soybeans, compared with the baseline (table 7). With the United States being a major corn producer and coupled with a relatively stronger U.S. currency, we would expect U.S. corn exports to fall (table 7). The world price for corn rises more than that for soybeans (table 6), and this impact is evident in terms of global trade; less corn is traded. Additionally, as commodity prices change, global feed demand responds (i.e., more soybeans used for feed than corn). This impact is evident for the United States as well (i.e., less exported corn relative to exported soybeans) (table 7). U.S. corn and wheat imports (mainly from Canada) increase, but imports of these crops are small relative to exports. In addition, a decrease in crop area has a smaller effect on livestock exports than on crop exports.

Scenario III—Increase in U.S. area harvested

Key results for an increase in U.S. area harvested by an average of 1 percent across major crops for the period 2018-19 to 2021-22 are as follows:

- Commodity prices decline by an average of 2 percent
- U.S. exports increase by 3 percent while global trade increases by less than 1 percent

In this scenario, we impose an expansion in U.S. crop area harvested relative to the baseline for corn, soybeans, and wheat to explore how a United States-only supply-side shock affects global commodity markets. We assume that U.S. soybeans, corn, and wheat area harvested will increase by about 2.5, 0.8, and 0.3 percentage points higher, respectively, than baseline projections for the period 2018-21. As the U.S. commodity supply increases, we see a decline in average commodity prices of 2 percent and an average global trade increase of less than 1 percent relative to the baseline (table 8). The largest expansion in area harvested among these three crops is in soybean production by design, and soybeans have the largest expected price drop relative to the baseline (table 8). With lower prices, global and U.S. stocks increase as expected (appendix table 2). As farmers hold inventory, lower prices coupled with lower quantities sold lead to lower revenues; therefore, it is not surprising for stocks to increase during these times. When prices recover and/or rise, farmers release inventory or stocks to capture higher agricultural revenues.

Global consumption increases given the lower commodity prices, as consumers see purchasing power increase and move to diversify their diets through intake of more meats relative to staple commodities such as rice (fig. 11). Corn, soybeans (feed grains), poultry, and pork account for the largest increases in consumption. This is because as long as there are cheap and readily available feedstocks in the market, farmers and ranchers will find it easier to establish poultry and pig farms in a short period rather than cattle farms. Not surprisingly, global trade in these commodities increases the most relative to other commodities (table 8).

The volume of U.S. commodity exports increases by an average of 3 percent (table 9). Corn and soybean exports experience the biggest increases, at more than 8 percent compared with the baseline, as the quantity demanded for exports rises due to lower commodity prices and increased global production and consumption of pork and poultry. Beef and poultry exports decrease, while pork exports increase due to possibly relative differences in feed costs among these meat products. The world price for beef is lower than the base price in 2018-19, so U.S. beef imports are expected to increase, but U.S. beef exports are expected to decrease. A decrease in the price for livestock will lead to a reduction in U.S. production. The world price for livestock products is lower in 2018-19, but the U.S. hog feed cost drops by 2.2 percent (as opposed to a 1.4-percent decline for beef). Therefore, U.S. pork production increases, lowering the domestic price more than the world price, so exports increase and imports fall. In 2018-19, feed costs for U.S. poultry meat fall by 2.1 percent, inducing production increases and putting downward pressure on the domestic price. Poultry exports decline and poultry imports rise because the domestic price falls less than the world price. At the same time, U.S. poultry consumption increases because of the lower domestic price, with demand increasing at a faster pace than production.

Table 8

Scenario III: Impacts of an increase in U.S. area harvested by an average of 1 percent across major crops on commodity prices and trade (changes relative to the baseline)

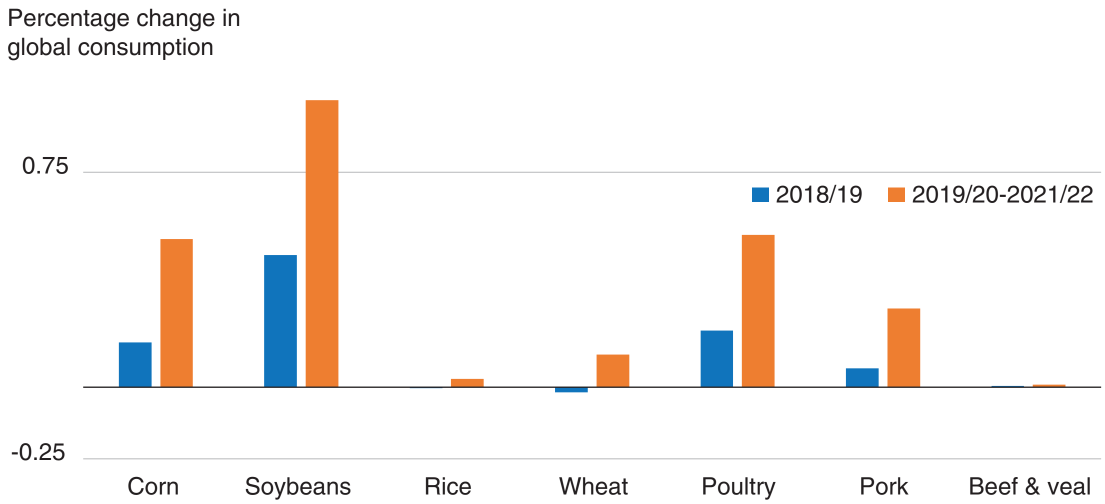
Commodities	Global price					Global trade volume				
	2018/19	2019/20-2021/22	2018/19	2019/20-2021/22	2018/19-2021/22	2018/19	2019/20-2021/22	2018/19	2019/20-2021/22	2018/19-2021/22
	Real 2010 $ per ton		*Percent change*			*Change (1,000 tons)*		*Percent change*		
Corn	130	121	-1.83	-6.52	-4.18	992	3,837	0.63	2.33	1.48
Wheat	182	178	-0.46	-2.96	-1.71	108	928	0.06	0.49	0.27
Rice	354	343	-0.10	-1.06	-0.58	1	122	0.00	0.26	0.13
Soybeans	330	302	-4.37	-9.35	-6.86	617	1,429	0.39	0.85	0.62
Beef & veal	1,124	1,014	-0.46	-1.40	-0.93	3	6	0.03	0.05	0.04
Pork	1,179	1,163	-0.36	-1.49	-0.92	0	18	0.00	0.19	0.09
Poultry	1,620	1,518	-1.04	-2.68	-1.86	53	102	0.42	0.76	0.59
Average*					-2.43					0.46

Note: *Refer to table 4.

Source: USDA, Economic Research Service simulation using Country-Commodity Linked System.

Figure 11

Scenario III: Impacts of an increase in U.S. area harvested by an average of 1 percent across major crops on global consumption of major commodities (changes relative to the baseline)



Source: USDA, Economic Research Service simulation using Country-Commodity Linked System.

Table 9

Scenario III: Impacts of an increase in U.S. area harvested by an average of 1 percent across major crops on U.S. commodity trade (changes relative to the baseline)

Trade	Commodities	U.S. trade volume			
		2018/19	2019/20-2021/22	2018/19	2019/20-2021/22
		Percent change		*Quantity change (1,000 tons)*	
Exports					
	Corn	4.23	15.79	2,042	7,991
	Wheat	1.28	8.65	332	2,271
	Rice	-0.06	3.60	-2	127
	Soybeans	4.13	10.28	2,616	6,669
	Beef & veal	-0.11	-0.26	-1	-3
	Pork	0.08	0.59	2	17
	Poultry	-0.17	-0.30	-6	-11
Imports					
	Corn	-0.36	-1.31	-5	-17
	Wheat	-0.13	-0.94	-5	-33

Source: USDA, Economic Research Service simulation using Country-Commodity Linked System.

Conclusion

Global incomes (demand), energy prices, and production capabilities (for example, driven by the costs of production and/or changing weather) affect commodity prices and trade. Weak global economic growth, low energy and oil prices, the continued expansion of cropland, and improved yields contributed to recent higher global agricultural supply relative to demand, leading to lower commodity prices. On the other hand, rapid or higher economic growth coupled with relatively slower expansion in agricultural production, adverse weather conditions, rising energy prices, and increases in the costs of production contributed to higher commodity prices in 2007-08 and 2011-12 (Trostle, 2008; Trostle et. al., 2011; Tadasse et. al., 2016).

This study provides an overview of the factors that affect agricultural markets and describes how changes in these factors can affect commodity prices and global trade. We augment our discussion by analyzing how changes in demand or supply conditions could affect global and U.S. commodity market outcomes, using a global agricultural market model. Given the recent decline in global commodity prices, this simulation provides a measure of the sensitivity of markets to further weakening of demand in developing and emerging economies, reduction in global supply from major agricultural producing countries, as well as an expansion in U.S. agricultural production.

Our empirical analysis includes three modeling scenarios. The first scenario implements GDP growth rates in developing and emerging economies that are slower by an average of 2.3 percent of USDA projected rates over the next 4 years (holding all other factors constant). Results suggest that this could lead to average commodity prices declining by about 4 percent and average global trade declining by about 1 percent, compared with baseline projections over 2018-19 to 2021-22. In the second scenario, if crop production in major producing countries were to decline by 3 percent over the next 4 years compared with the baseline projections over 2018-19 to 2021-22 (holding all other factors constant), this could lead to average commodity prices rising about 12 percent on average and global trade falling by about 2 percent on average. When we change only U.S. crop production by an average of about 1 percent in our third scenario (holding all other factors constant), we see a decline in average commodity prices by about 2 percent on average and a global trade increase by less than 1 percent relative to baseline projections over 2018-19 to 2021-22.

Expected commodity prices play an important role in the production decisions of farmers and ranchers, including planted/harvested acreage of crops or inventory of livestock and, thus, the supply of agricultural commodities. Sustained periods of low commodity prices increase food security for consumers but also reduce farm revenue, and they cause farmers to rely increasingly on credit, making them vulnerable to changing economic conditions such as higher interest rates. Periods of sustained high commodity prices contribute to increases in farm revenues and resilience to changes in economic conditions but with possible adverse effects on food security, particularly in developing countries. A better understanding of the factors and changes in these factors that can cause periods of low and high agricultural commodity prices can inform and enhance decision making on issues relating to the agricultural market at the farm, policy, and consumer level.

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Appendix 1—Changes in both demand and supply sides of the commodity market have resulted in declining commodity prices since 2014

Both demand- and supply-driven factors contributed to agricultural commodity price spikes in 2007/08 and 2011/12, as well as commodity price drops since 2014. Except for the modest growth in global population in both price episodes, all other factors were occurring at the exact reverse level, or combination of, during the price hikes and decline (appendix table 1). Since 2014, the interaction between decreasing demand (sluggish global economic growth, limited expansion of biofuels) and increasing supply (extensive area expansion, falling farming production costs, declining oil prices below long-term average) resulted in falling commodity prices.

Appendix table 1

Summary of contributing factors to high and low periods in commodity prices over 2007-17

Factors	2007/08 and 2011/12 price spikes	Low prices starting in 2014	Demand (D)- or supply (S)- side factors
Global GDP growth	Strong, especially in China	Sluggish, including China	D
Global population growth	Modest	Modest	D
Oil price	Escalated and remained above the average long-term price of $60 a barrel	Subsides and remains below the average long-term price of $60 a barrel	D, S
U.S. interest rate	Rose and stayed higher	Declines and stays near 0	D, S
U.S. dollar	Weak, devaluation	Strong, appreciation	D, S
Area expansion	Limited	Extensive	S
Agricultural yield	Stable	Improving	S
Agricultural production	Grew slow	Moderate growth	S
Stocks–to-use ratio	Low	High	S
Biofuels	Rapid expansion	Limited expansion	S
Farm production costs	Rising	Falling	S
Financialization of commodities	Increasingly financialized	Slow pace of financialization	D, S

The right-hand column identifies whether the factor tends to affect price primarily through demand- (D) or supply-side (S) changes or both.

Source: USDA, Economic Research Service.

Appendix table 2

The three scenarios' impact on the U.S. and global commodities' stocks (changes relative to the baseline)

Crop year/ commodities	Percentage change						Quanity change (1,000 tons)					
	2018/19			2019/20-2021/22			2018/19			2019/20-2021/22		
	Scenario											
	I	II	III	I	II	III	I	II	III	I	II	III
U.S. Stocks												
Corn	0.60	-6.02	1.03	4.64	-29.45	5.27	372	-3,988	682	2,834	-19,705	3,525
Wheat	1.04	-10.77	0.44	1.50	-14.46	1.41	197	-2,384	97	292	-2,809	275
Rice	1.66	-4.00	0.16	7.87	-18.47	2.15	28	-51	5	120	-240	28
Soybeans	1.56	-4.27	2.18	4.75	-17.56	6.22	141	-437	223	420	-1,571	558
Global Stocks												
Corn	0.50	-5.98	0.55	3.84	-20.54	3.00	999	-11,263	1,032	6,873	-33,444	4,870
Wheat	0.29	-2.54	0.10	0.83	-4.45	0.39	745	-6,921	259	2,192	-12,746	112
Rice	0.14	-1.99	0.01	0.19	-4.25	0.14	184	-2,858	21	273	-6,623	225
Soybeans	0.54	-1.64	0.83	1.43	-4.77	1.73	422	-1,583	804	1,113	-4,812	1,739

Source: USDA, Economic Research Service simulation using Country-Commodity Linked System.