The "Normal" Normal: Supply and Demand Drivers over the Next 10 Years

By Seth Meyer and Joe Glauber

From 2010 to 2015, farmers saw the longest period of sustained above-average farm income since World War II and its immediate aftermath (Chart 1). In the United States, real net cash and net farm income were above their 1960–2017 average for six consecutive years. By contrast, real net cash and net farm income were only above the 1960–2017 average for four consecutive years in the 1970s (from 1972 to 1975). The run-up in prices in the early 1970s—and the associated brief jump in farm income—originated in oil price shocks and inflationary pressure that set the stage for economic turmoil in the agricultural sector in the first half of the 1980s. The recent period of strong farm income was similarly driven by a surge in producers' crop and livestock prices. As food prices began to rise in 2007 and 2008 and peaked in 2011, U.S. corn, soybean, and wheat prices all hit record nominal prices for the 2012–13 crop year.

The rise in agricultural commodity prices was sparked by falling global grain stocks, weather-related shocks, and policy responses to those shocks. But the rise in prices was also attributed to systematic or nontransitory factors such as population and income growth, energy prices, and demand—including biofuels, falling agricultural productivity, market speculation, and a dated trade policy environment. As a

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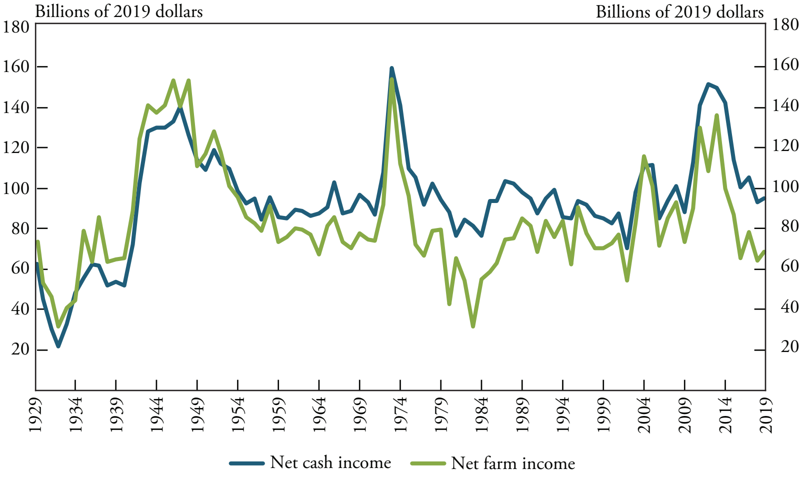
Chart 1
Real Net Farm and Net Cash Income



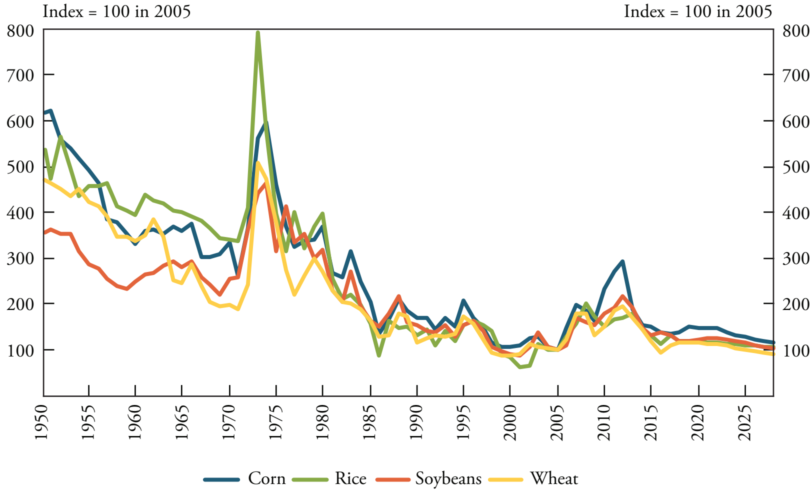
Source: USDA Economic Research Service (ERS).

result, there were widespread declarations that global food productivity growth was reaching its limits and that farmers were entering a new phase of prolonged price strength and volatility, perhaps even reversing the long-observed trend of steadily falling agricultural commodity prices (Chart 2).

Since that time, farm prices have moderated, global stocks have rebounded, and farm income has fallen. In the coming decade, in the context of the U.S. Department of Agriculture (USDA)'s long-term baseline—as well as other global scale baselines, such as that produced jointly by the Organisation for Economic Co-operation and Development (OECD) and the Food and Agricultural Organization of the United Nations (FAO)—there appears to be limited scope for such underlying supply constraints or an identifiable spark for demand that would lift farm incomes back to the levels seen in 2011–14.

Analysis of the 2010–15 price surge was extensive both at the time and in subsequent years, with several factors appearing repeatedly in the literature.[1] For example, food demand, particularly for meat, had grown as lower income regions experienced both income growth and population growth. In addition, food prices and energy prices had become more closely tied—and food prices had become more volatile

Chart 2
Real Agricultural Commodity Prices



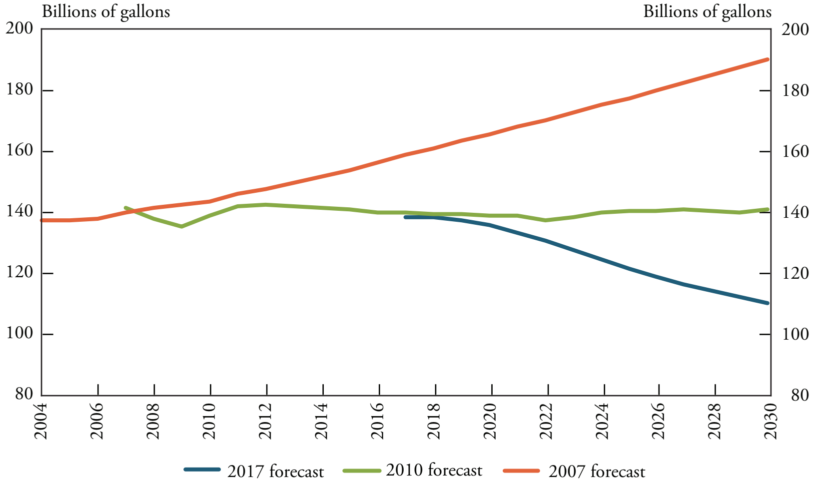
Source: USDA World Agricultural Outlook Board (WAOB).

through their diversion into biofuel production. Stagnating or more volatile crop production also featured prominently in discussions of the time. These factors combined with tight stocks and weather-related production shortfalls to set the stage for the observed price surge.

Energy prices and demand as a source of commodity price growth

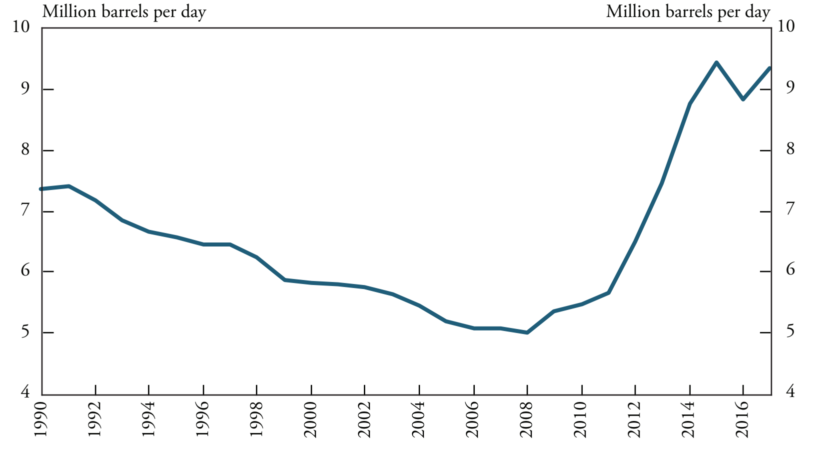
Rising energy prices coincided with rising grain and oilseed prices and sharp growth in biofuel production. Oil prices, which had been relatively low and stable, began to rise sharply in 2002 and had nearly tripled by 2007. West Texas Intermediate (WTI) prices averaged $72.34 a barrel in 2007, which coincided with a relatively steady weakening of the U.S. dollar over the 2002–07 period. U.S. motor gasoline consumption had risen to over 140 billion gallons per year and was expected to increase steadily by 1.3 percent annually for the next two decades (Chart 3). At the same time, U.S. field oil production had fallen 47 percent since its peak in 1970 and as a result, dependence on foreign oil was rapidly rising (Chart 4). Ethanol production capacity, supported by a blenders tax credit of $0.51 per gallon, reached 6.3 billion gallons by June 2007, with another 6.3 billion gallons of capacity under construction (NEO 2019). Of the corn crop harvested that

Chart 3
U.S. Motor Gasoline Transportation Consumption Forecasts



Source: Energy Information Administration (EIA).

Chart 4
U.S. Field Production of Crude Oil



Source: EIA.

fall, over 3 billion bushels, or 23 percent of production, went into the ethanol corn grind (USDA Office of the Chief Economist 2010). In this setting, the Energy Independence and Security Act of 2007 (EISA) was passed, which envisioned 36 billion gallons of domestic biofuel use by 2022, the bulk of it from feedstocks other than ethanol from corn starch.

The expansion of biofuel production envisioned under the EISA turned out to be short-lived. Corn ethanol production growth continued to provide a strong direct demand for corn, but the promise of cellulosic ethanol, and its need for agricultural crops and residues, failed to materialize. Biofuel consumption slowed as the Environmental Protection Agency (EPA) began waiving blending requirements for larger volumes. With corn ethanol supported by EISA provisions, industry production capacity has reached 16.1 billion gallons (NEO 2019). In part due to improved fuel efficiency, motorfuel gasoline consumption in the United States also began to stagnate and has begun to modestly decline, with the latest forecast predicting a sharp reduction over the next decade, pulling the blend wall lower and making expansion of ethanol, outside of a growth in mandates, more difficult.

Within the mandated volume structure, the EPA has drastically increased the number of small refinery exemptions granted. By lowering Renewable Identification Number (RIN) prices, these exemptions have reduced the incentives to blend and consume higher level ethanol blends such as E15 and E85 (EPA 2019). Motorfuel ethanol inclusion rates have stagnated as a result. The USDA's World Agricultural Supply and Demand Estimates (WASDE) report for May 2019, the first look at the 2019–20 crop year, forecast that corn and sorghum consumption for the production of ethanol would fall for the first time since 2012 (a year affected by drought), even before the size of the 2019–20 U.S. corn crop was cut in subsequent reports due to delayed plantings under adverse weather conditions. In a look beyond 2019–20, the *USDA Long-Term Projections to 2028* projects that falling motor gasoline use, along with limited mandate pressure, will lead to flat to falling corn-for-ethanol use over the coming decade (USDA OCE 2019a).

Rapid growth in U.S. oil production through fracking has moderated the Organization of the Petroleum Exporting Countries (OPEC)'s control on oil production and prices and is projected to turn the U.S. into a net energy exporter in 2020 (EIA 2019). Corn-for-ethanol use would likely have declined further in the USDA projections if not for the underlying expectation that ethanol exports, supported by policies abroad, will pick up some of the declining domestic consumption. Ethanol will continue to be a significant use for U.S. corn; however, without growth in mandates, reductions in the number of small refinery exemptions granted, or a sustained increase in energy prices, ethanol production is unlikely to be a major driver in the *growth* of corn demand over the next 10 years. The prospects for biodiesel may be somewhat better given the more stable outlook for distillate consumption in the future, but biodiesel faces similar pressures from small refinery exemptions and stagnant mandates.

Income and population growth

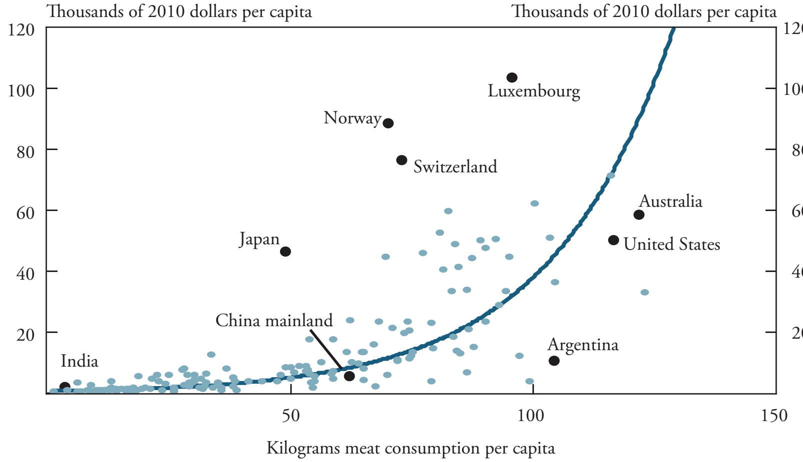
Income and population growth are clear underlying, nontransitory sources of demand growth for food, feed, and fiber from the agricultural sector. While periodic economic downturns can and will shock demand and prices in the future, these two factors have been presented alongside long-run land and water resource constraints as a potential source of future commodity price increases.

The United Nations (UN) Population Division, in its median population growth variant, predicts global population will rise through 2100. Although the pace of this rise is projected to slow throughout the period, the world population is forecast to reach 10.9 billion people, with the population of Africa more than tripling to 4.3 billion people. While the population of Asia is expected to peak in 2055 and then decline, Asia will remain the most populous region at 4.7 billion people.

Strong population growth rates, together with rising meat demand, suggest strong long-run growth in demand for agricultural commodities. From a 2005–07 base, the FAO projects global meat consumption to increase 27 percent by 2050 and 43 percent by 2080 (Alexandratos and Bruinsma 2012).

However, population projections are presented with a significant range of possible outcomes. For example, the range in population estimates for 2100 between the UN high-growth and low-growth scenarios

Chart 5
Meat Consumption per Capita and GDP per Capita, 2013



Sources: FAO and authors' calculations.

is about 3.3 billion people, with global population levels actually declining after 2060 under the low-growth scenario. Likewise, while the positive relationship between meat consumption and per capita GDP is compelling, consumption varies widely across countries depending on geography, tastes, and religious and cultural preferences (Chart 5).

Will China continue to drive agricultural trade?

Chinese commodity demand, and soybean trade in particular, have provided significant underlying support to the U.S. agricultural sector over the last decade, with agricultural trade growing to 21.2 billion annually for fiscal years 2015–17. Over the last decade, the USDA's annual baseline projections consistently underestimated the sharp and persistent growth in Chinese soybean imports and underlying soybean crush demand for feed.[2] In 2017, China was among the largest export markets for U.S. agricultural products (Anderson 2017; Cooke, Jiang, and Heerman 2018).

China's rapidly growing economy spurred growth in protein consumption, particularly in pork. The growth in pork production was coupled with increasingly industrialized production methods relying on commercial feed rations high in protein meal.

Over the 2000–15 period, China's soybean demand grew at an annual rate of 8.5 percent—over twice the rate of global soybean demand growth over the same period. China met that demand through imports. By 2015, China soybean imports accounted for about two-thirds of the world trade and about 90 percent of the growth in trade over the 2000–15 period. The growth in soybean meal and equivalent (SME) demand grew at a rate well above the growth rate in production of pigs, the dominant animal fed and protein consumed by the Chinese. The divergence in the two growth rates has continued for more than two decades (Chart 6).

The growth in SME use reflected both modest growth in the world's largest pig herd and the steady shift from small-scale, on-farm feeding, including waste feeding to a feed system more appropriate at scale, primarily including soybean meal, corn, and other grains. In addition, the Chinese policy environment enforces "absolute security" as a key factor in rice and wheat supplies and operates a less-than-transparent trade in corn. This distorts grain and oilseed meal prices, and implied meal consumption in animal rations relative to corn appears higher than in the United States as a result.

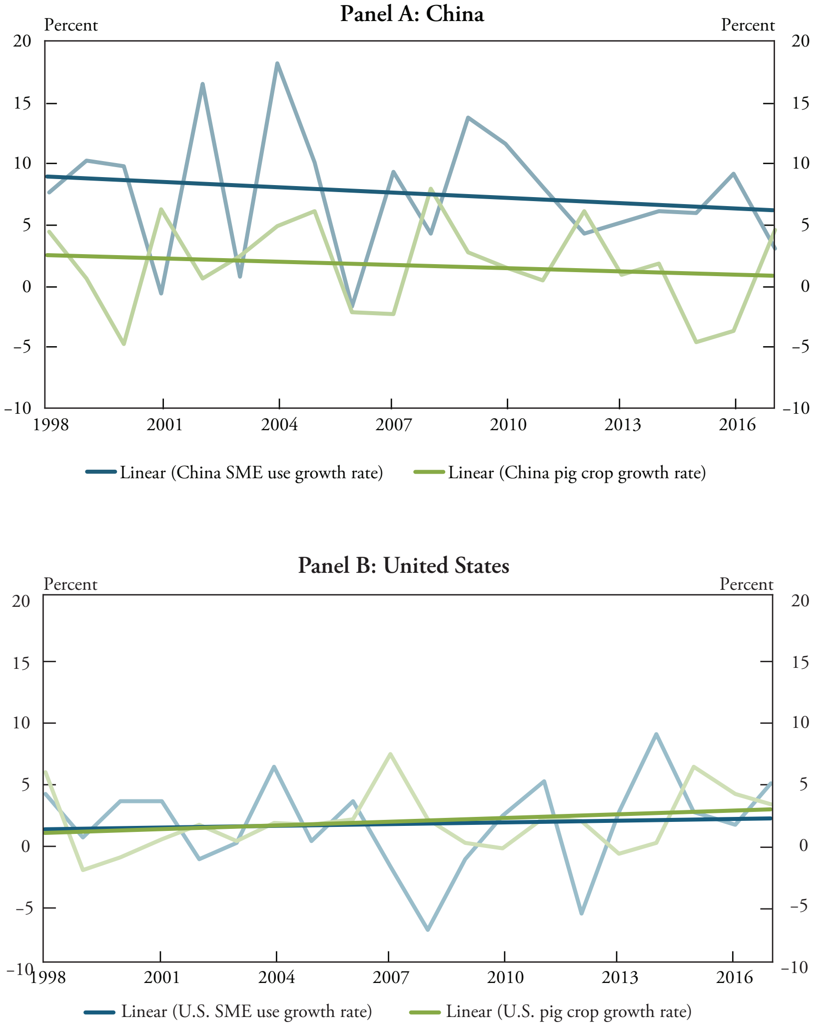
However, growth in the pig herd has slowed as the Chinese pork sector has continued to consolidate—in 2017, more hogs were on large-scale farms than small-scale ones (Inouye 2018). As a result, China's soybean crush, and thus its need for imports, is expected to slow (USDA Office of the Chief Economist 2019a).[3] The USDA projects that China's soybean consumption will grow at an annual rate of 2.7 percent over 2018–28, about one-third the rate of growth seen over 2000–15. More recently, the spread of African swine fever in China, which has primarily affected small producers, may lead to further consolidation, completing the transition to commercial feeding and improving feed efficiency. African swine fever may also result in a shift to other meat production such as poultry, which has greater feed efficiency than pork. As a result, the growth rate in SME use relative to pork production could move more quickly to that observed in the United States (Chart 6).

Could other regions spark a growth in demand in the coming decade?

The strength of Chinese demand was not fully anticipated, raising questions about whether demand from another region might also surge

Chart 6

Annual Pig Crop Growth Rate versus SME Use Growth Rate



Sources: FAO and authors' calculations.

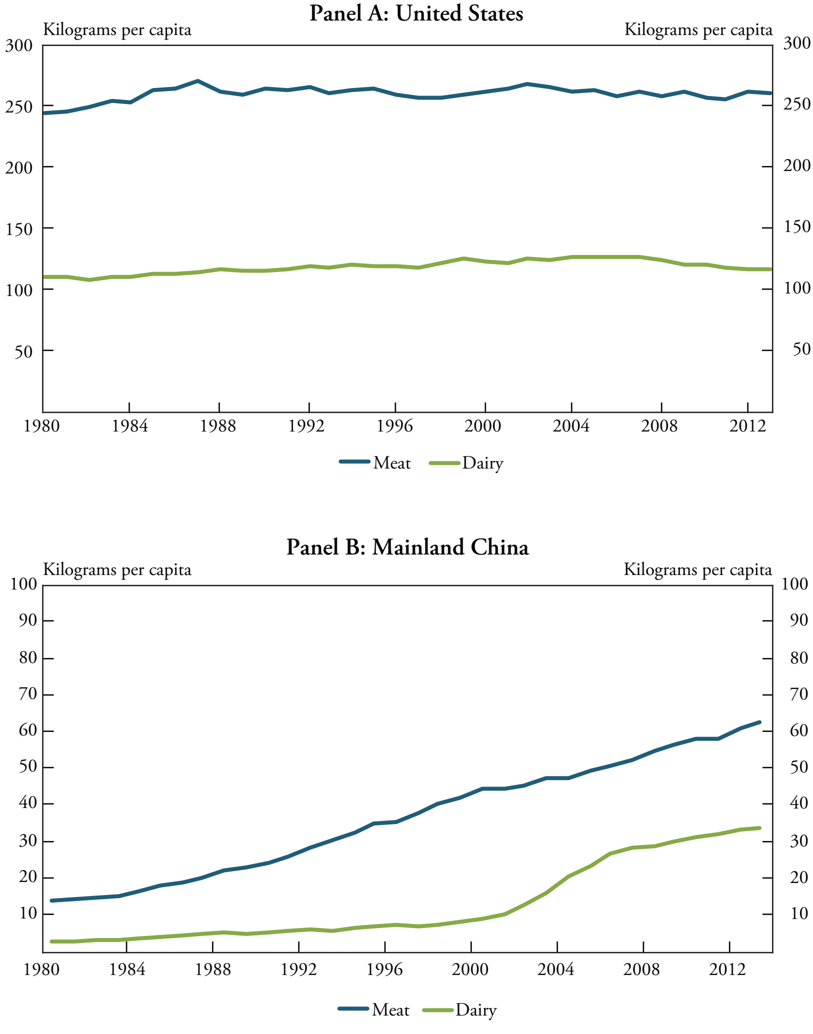
and underpin prices over the next decade. India, for example, seems like a prime candidate: the country's GDP growth has averaged more than 7 percent annually from 1998 to 2017, and its population is projected to exceed China's by 2027.

However, in the context of future agricultural commodity demand, comparing India's growth to China's growth over 2000–15 becomes more tenuous (Chart 7). Despite a three-fold increase in real GDP per capita in India from 1980 to 2013, per capita meat consumption remains low, constrained by cultural factors unlikely to change rapidly over the next decade (for example, Hindu restrictions on beef and Muslim restrictions on pork). In contrast, India has seen rapid growth in dairy product consumption over the same period; moreover, per capita dairy consumption remains lower than in countries such as the United States, suggesting additional room to grow. However, the direct consumption of grains and legumes, and feed efficiency gains in the production of dairy products and even poultry relative to pork and beef, may temper grain and oilseed demand relative to the feed growth observed by China over the last decade (Shepon and others 2016).

Africa represents another potential source of strong demand, as the country has the second largest population base and the fastest population growth rate. But income stagnation has stymied demand in Africa in the past two decades. Sub-Saharan Africa GDP advanced an anemic 3.5 percent per year over the last decade, while the population increased by 2.5 percent per year. Accordingly, per capita income grew by less than 1 percent annually over the last 10 years. In fact, population growth has exceeded GDP growth for the last four consecutive years, reducing per-capita GDP. Near-term forecasts for the region do not suggest significantly brighter prospects that would, combined with population growth, spur a surge in demand (World Bank 2019a). The World Bank notes that structural factors such as public debt and debt risk will continue to pose risks to growth over the coming decade, limiting income growth and its potential contributions to growth in meat consumption (World Bank 2019b). Although aggregate statistics mask the better economic performance of countries such as Kenya, the region as a whole may be a limited driver of demand over the next decade.

Chart 7

Growth in Meat and Dairy Consumption



Sources: FAO and authors' calculations.

High prices of the last decade have invited production competition

Due to the jump in Chinese soybean import demand, the domestic use of corn for ethanol production, and, more broadly, higher prices for agricultural commodities, U.S. grain and soybean harvested areas have increased modestly. At the same time, harvested area growth outside of the United States has increased significantly given the more stagnant growth in global planted area over the previous two decades (Chart 8).

U.S. planted area increased through a combination of market- and policy-driven declines in Conservation Reserve Program (CRP) area and land conversion; however, output gains were also achieved through a change in the mix of crops (Chart 9). With the U.S. comparative advantage in corn and soybean production, areas on the fringe of the Corn Belt, such as North Dakota, South Dakota, and Kansas, have shifted acres out of wheat and minor feed grains and into corn and soybeans. Over the 18-year period from 2000–01 to 2018–19, U.S. production of corn, soybeans, and wheat rose by a combined 166 million metric tons on a harvested area increase of 4.7 million hectares (Chart 10).

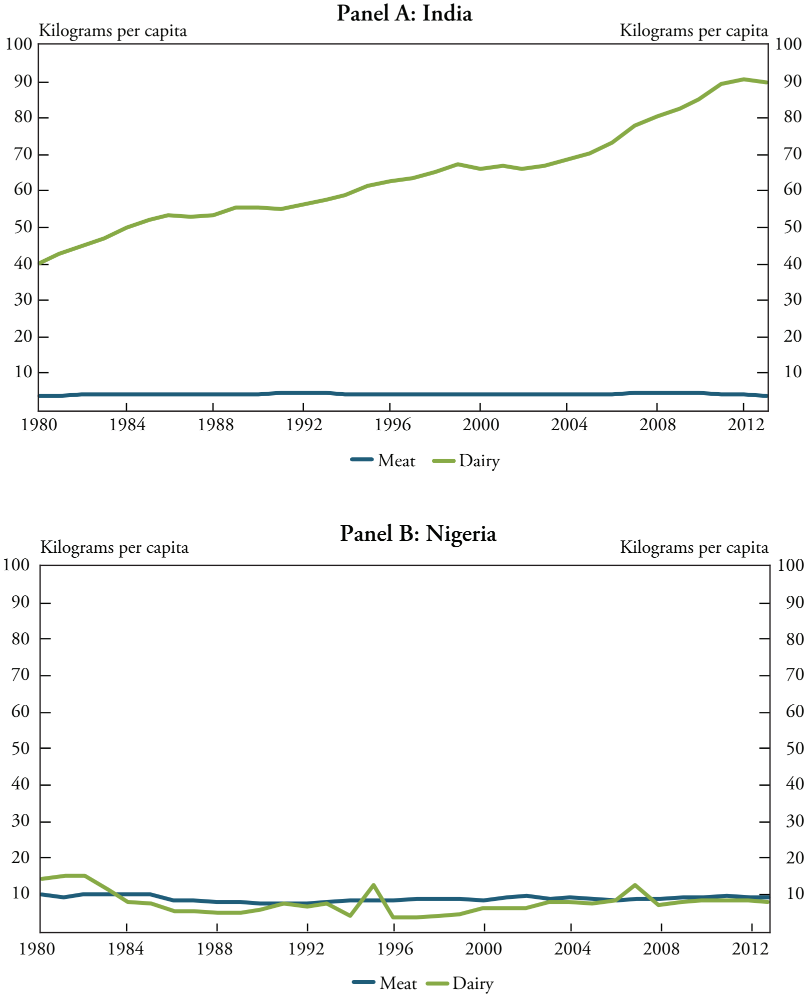
Elsewhere in the world, growth in harvested area and steady growth in yields added significantly to global supplies over the same period. In particular, Argentina and Brazil increased their harvested area for corn, soybeans, and wheat by 39 million hectares and raised production of the three major crops by nearly 200 million metric tons.

From 2019–20 to 2028–29, a nine-year period in which real crop prices are expected to remain flat or fall, global harvested area expansion is expected to slow outside the United States and contract modestly in the United States for corn, wheat and soybeans. Argentina and Brazil are expected to add a combined 13.6 million hectares of harvested area and 96 million metric tons of production over the same period, with the majority of the area and production changes coming from Brazil.

Harvested area in Brazil is expected to expand by 10 million hectares over the nine-year period, a significantly slower pace than over the prior 18 years. The primary factor in the slowing of Brazil's forecast area growth is the softening of real prices restraining land conversion. However, Brazil has the ability to expand its harvest area even without land conversion. Brazilian farmers have achieved notable area expansion by planting second crops following soybean production in the key

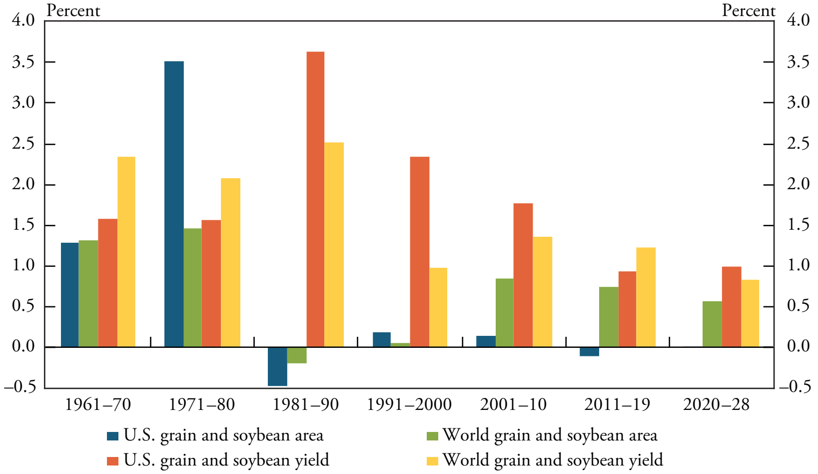
Chart 8

Growth in Meat and Dairy Consumption



Sources: FAO and authors' calculations.

Chart 9
World and U.S. Grain and Soybean Area and Yield Growth



Note: Bars for 2020–28 represent projections.
Source: USDA ERS.

soybean-producing states of Mato Grosso, Mato Grosso do Sul, Goias, and Parana. Within these states, soybeans have pushed out much of the first crop corn. Shorter-season soybean varieties with seemingly minimal yield drag have opened up area for a second crop corn (the *safrina* crop) along with expanding cotton area. Expanding double cropping on existing soybean area in these four states could add the equivalent of nearly 10 million hectares of additional harvestable land (Conab 2019). While this potential increase is equal to the predicted growth in harvested area in the country, the growth is expected to come from a mix of double cropping and new land. The availability of additional land provides a buffer against rising commodity prices.

Although land constraints and drops in productivity through land degradation or climate change may constrain supplies over the next 10 to 15 years, there seems to be sufficient growth in yields, brought on through investment during high-price periods, as well as harvested area for expansion to partially offset any slowdown.

Chart 10

Harvested Area and Production Growth in Key Trading Countries

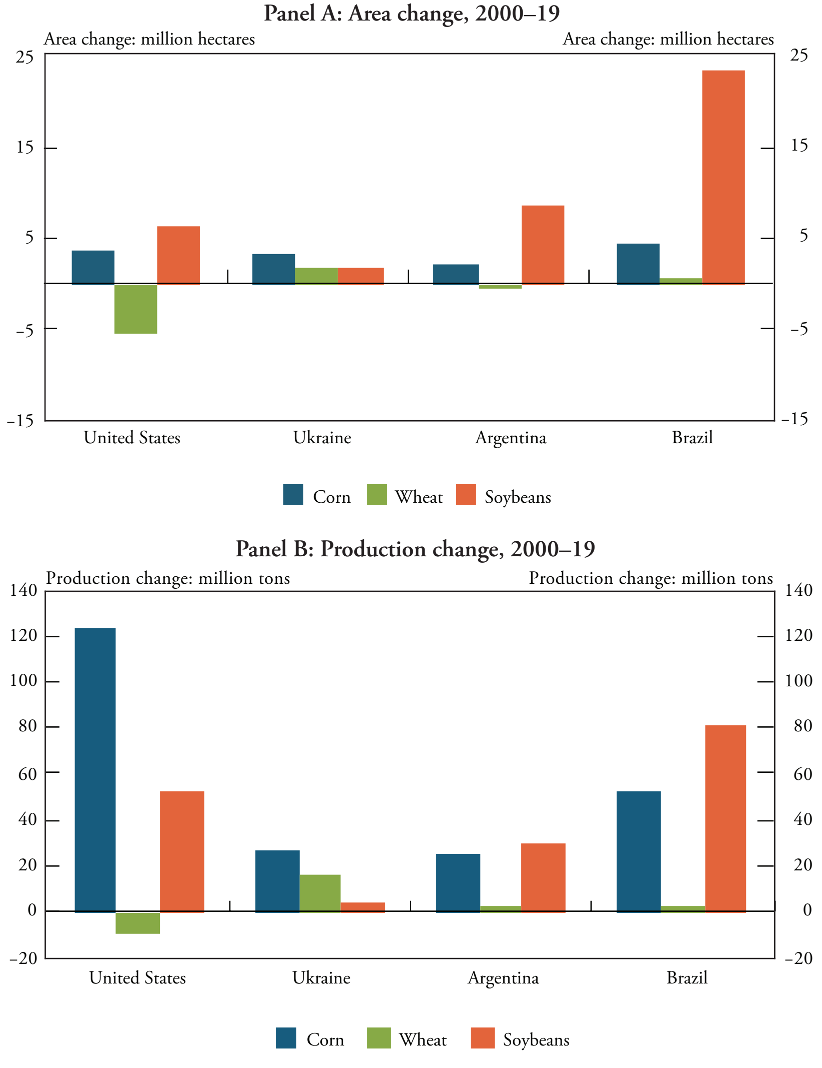
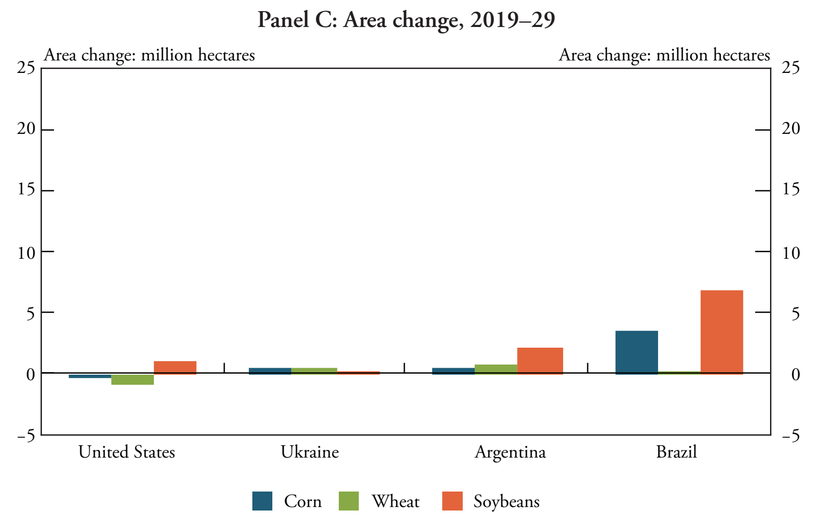
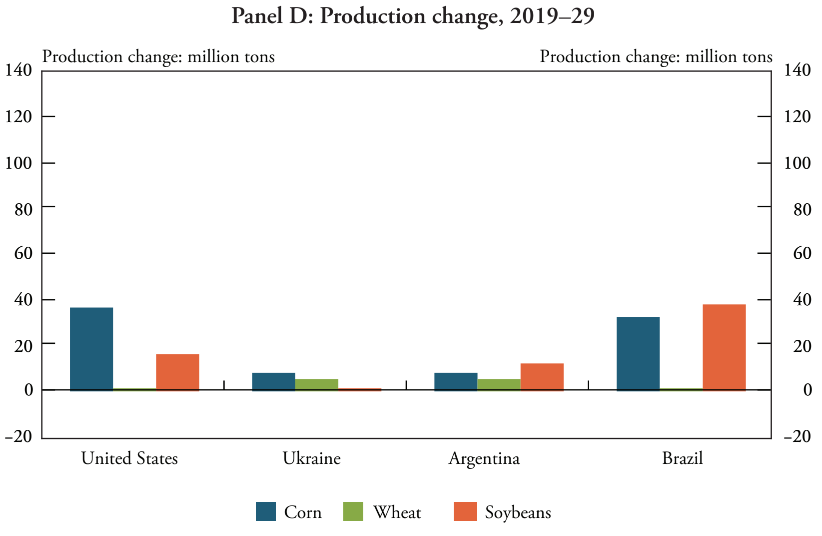


Chart 10 (continued)





Source: USDA ERS.

The changing role of the United States as a residual supplier

With planted area in the United States projected to be flat over the next decade, growth in production will likely come from gains in yield productivity. The share of production overseas is expected to continue to grow and will put steady pressure on U.S. export market share. Within the last two decades, U.S. export shares for corn and soybeans fell below 50 percent, and the share for wheat fell below 25 percent.

The rise in South American soybean production and the lack of farmer storage in the region has created a distinct six-month pattern in China: importers buy U.S. soybeans September through February and soybeans from the southern hemisphere from March through August. The rise of Brazil—and, to a lesser extent, Argentina, which tends to export soybean products—has also altered U.S. export patterns and carry for soybeans and even had modest influence on U.S. corn export patterns at harvest. The other catalyst for this global "just in time" delivery system for soybeans is a common and dominant destination market in China. China accounts for over 60 percent of global soybean imports and depends on imports for more than 90 percent of its soybeans, resulting in significant year-round demand.

With South America accounting for more than 50 percent of global exports and growing, potential importers are increasingly in a position of being only six to eight months from a new global soybean crop or even corn crop, tempering the need for U.S. producers to store and potentially reducing their gains from exploiting carry in the market. The reliance on a dominant single market has also become a source of concern given recent trade friction between the United States and China.

Impacts of trade friction may linger

China's imposition of tariffs on soybeans and other agricultural imports from the United States has had a large influence on U.S. trade, with the value of U.S. soybean sales to China falling by nearly 75 percent year over year for 2018. Trade in soybeans has remained weak throughout the first half of 2019, with other markets not fully offsetting lost trade with China (U.S. Census 2019).

Early in the China-U.S. trade tariff and retaliatory tariff episode, comparisons were drawn to the 1980 U.S.-Soviet wheat embargo, which had limited period effects as trade was rerouted (USDA ERS 1986).

However, the two episodes have some key differences. First, while the United States represented 40 percent of the wheat export market when the 1980 embargo was imposed, much as it does now for soybeans, the Soviet Union represented less than 25 percent of import demand and was transient in its demand from year to year. Moreover, at the time, there were numerous competing suppliers of wheat. The U.S. soybean export ban of 1973 is also cited as the impetus for Japanese investment in soybean production in South America (Almeida 2018).

The current Chinese tariff on soybean imports has left the United States with nearly 1 billion bushels of ending stocks for the 2018–19 crop year (USDA Office of the Chief Economist 2019b). The lingering effects of this trade disruption, if any, will be hard to quantify without a counterfactual. However, if China remains cut off from the U.S. soybean market, the U.S. share in world soybean markets will decline, if for no other reason than that the soybean crush in the rest of the world is growing at a slower rate than in China.

In the fall of 2018, the effective ban by the Chinese on commercial imports of U.S. soybeans led to a sizable price premium for Brazilian soybeans in the global market. The premium on Brazilian soybeans peaked at more than $90 a metric ton before narrowing again as tensions with the U.S. waned and the Chinese made verbal agreements to buy 20 million metric tons of soybeans for the 2018–19 season. The imbalance between Chinese import demand and the availability of non-U.S. soybeans lessened further as Brazilian and Argentine crops progressed well and African swine fever was reported in China, reducing Chinese import demand.

Argentine and Brazilian farmers saw some improvement in prices during this period but had limited opportunities to hedge the coming crop to lock in the price wedge at the time. The Chicago Board of Trade soybean contracts did not reflect the Brazilian and Argentine price premium. Brazil lacks a liquid soybean futures market and thus does not allow its farmers to fully hedge sales, capturing those premiums relative to U.S. markets, or for forward buyers to shed risk from those forward purchases. As a result, it has been difficult for Brazilian farmers to fully incorporate current price premiums into future receipts, blunting the incentive to expand. Under prolonged tensions, Brazilian and Argentine producers would likely capitalize on demand growth by investing in expanding harvested area, an investment unlikely to quickly fade with an eventual trade agreement.

With the wide spread of African swine fever in China and a tariff on U.S. pork products, the Chinese have also been reported to be opening new import channels for beef, pork, and poultry products around the world. New business relationships may strengthen ties to other exporters even if or when the U.S. trade relationship with China normalizes. At the same time, the effects of African swine fever are likely to be felt for multiple years: China will need to rebuild its breeding stock and sow herd, farrow and finish the resulting pig crop, and bring them to market, all of which can only effectively occur when African swine fever is reasonably contained. The result is a multi-year recovery cycle that may further hinder global soybean demand but enhance Chinese meat trade.

Retaining domestic competitiveness

While it is difficult to identify a persistent demand or supply-side factor in the next decade that would return farm income to the levels seen from 2010 to 2015, other unforeseen factors might still emerge. Transient factors such as short crops in competitor nations may boost farm income, and action in the areas of technology, trade, and competition may be unproductive. Furthermore, factors that have encouraged consolidation among U.S. agricultural producers appear likely to continue.

U.S. producers have historically been active adopters of new technology and practices resulting in higher yields and lower production costs (Brookes and Barfoot 2017). The strength of farm income from 2010 to 2015 in particular drew in additional agricultural sector investment that will likely boost productivity over the coming decade (Alston and others 2000). The cost of production per acre of corn and soybeans is higher in the United States than in Brazil largely due to land costs (Meade and others 2016). However, adjusting for differences in relative corn yields on the farm and inland transportation costs at the port levels the two countries' competitiveness in the export market. Inland transportation costs for locations such as Mato Grosso, Brazil, are significantly higher than for the heartland of the United States. Inland transportation improvements in Brazil could challenge the margins of U.S. producers, requiring them to maintain trucking, rail, and inland waterway infrastructure as well as consider policy changes to improve distribution (for example, the Jones Act).

Advances in bioengineered products, including both crops and livestock, present an opportunity to increase productivity while improving the sustainability of production by limiting losses and improving input efficiencies. In addition, gene-editing technologies present an opportunity to reduce producer costs and even moderate commodity price fluctuations: the process can be used to protect animals from infectious diseases and make crops more resistant to the vagaries of weather (Zhang and others 2018; Tait-Burkard and others 2018). However, the political regulatory and policy environment may have to change significantly to address technologies that are not well covered under the existing structure.

Given the changes in regional population growth, trade and trade access will continue to be critical in supporting U.S. producer income. As a consequence, the United States has to engage in bilateral and multilateral trade agreements that ensure that access restrictions and controls are scientifically based on internationally agreed-upon terms, such as international agreements on sanitary and phytosanitary measures. Widespread adoption of non-tariff barriers may also present impediments to international competitiveness (Office of the U.S. Trade Representative 2019). While consolidation in the farm sector is likely to continue unabated, it is critical for remaining producers to ensure market access by engaging customers abroad in bilateral and multilateral trade based on these principles.

Endnotes

[1]See, for example, Trostle (2008); Headey and Fan (2008); and Abbot, Hurt, and Tyler (2008).

[2] In addition, the projected surge in Chinese corn imports failed to materialize. Other global forecasters, such as the OECD and FAO, made similar projections.

[3]The 2019 USDA Baseline was completed prior to the outbreak of African swine fever in China.

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