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Global Macroeconomic Developments Drive Downturn in U.S. Agricultural Exports

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Abstract

Global demand for agricultural exports is tied closely to rising incomes in developing-country markets, and the U.S. share of this trade is sensitive to the value of the dollar relative to the currencies of U.S. export markets and competitors. U.S. exports of bulk commodities are particularly sensitive to the strength of the dollar, while consumer-oriented goods, which account for a large and growing share of U.S. agricultural exports, appear to be less sensitive. The macroeconomic outlook underlying the 2016 USDA agricultural projections calls for substantially slower global income growth and stronger dollar appreciation against the currencies of major U.S. agricultural markets and competitors than the 2015 USDA projections. Model simulations with these changed macroeconomic conditions demonstrate significant reductions in both the price and volume of projected U.S. exports. The largest price and volume impacts are on crops, with relatively smaller impacts on meats. Almost across the board, reductions to projected U.S. exports exceed corresponding reductions in world trade, implying declines in U.S. market share. The stronger dollar is a key factor in the projected U.S. export declines. A scenario that extends the period of dollar strengthening beyond that assumed in the 2016 USDA projections suggests further potential reductions in U.S. exports of major commodities, particularly corn and wheat.

Keywords: United States, agriculture, exports, macroeconomic outlook, income growth, exchange rates, markets, competitors, developing countries, model simulations, bulk commodities, intermediate goods, consumer-oriented goods.

Acknowledgments

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Introduction

Macroeconomic factors played a key role in the steady expansion of U.S. agricultural exports that began in the early 2000s and peaked at a record $152.3 billion in fiscal year (FY) 2014. Robust income gains, particularly in China and other developing countries, boosted import demand for foods, feeds, and fibers. An extended period of dollar depreciation during 2003-12 supported the increasing competitiveness of U.S. exports. Other factors, including declining global stocks of major commodities, rising demand for biofuel feedstocks, slowed growth in productivity, and weather-related production shortfalls also contributed to upward pressure on agricultural markets (Trostle, 2008; Trostle et al., 2011). Since 2014, however, a number of these market fundamentals have changed. Global income growth has slowed, the dollar has strengthened substantially against the currencies of many U.S. agricultural export markets and competitors, foreign competition has increased, and growth in biofuel markets has slowed. The net effect of these and other factors has been generally oversupplied markets and rising global stocks-to-use ratios for many major agricultural commodities.

As macroeconomic conditions, as well as other market fundamentals, have changed, U.S. agricultural exports fell more than 8 percent to $139.7 billion in FY2015, driven primarily by lower prices, and are forecast to fall an additional 10.5 percent to $125.0 billion in FY2016 (USDA/ERS, 2016). Further, the USDA agricultural projections released in February 2016 reflect substantially lower global real gross domestic product (GDP) growth and a stronger U.S. dollar in the near term (2016-17) and medium term (2018-2020) than did previous projections released in 2015 (USDA/OCE, 2015 and 2016). The current macroeconomic outlook implies weaker prospects for near- and medium-term global agricultural consumption and import growth and for U.S. agriculture's share of global exports. Recent instability in capital and exchange rate markets added to the uncertainty in the international economic outlook in early 2016, creating potential for further effects on U.S. agricultural trade.

This report examines the effects of changes in the global macroeconomic environment on the outlook for U.S. exports of major agricultural commodities. It summarizes the changes in the global macroeconomic outlook behind the USDA agricultural projections released in 2015 and 2016. It also reviews the historical link between macroeconomic variables and U.S. agricultural exports focusing on two key variables: global real GDP growth and the dollar exchange rate. The impacts of the changing macroeconomic outlook on U.S. exports are quantified in two model-based analyses. The first examines how the changes in macroeconomic variables between the 2015 and 2016 USDA agricultural projections affected the projections for U.S. commodity trade and prices. Acknowledging the key role of the dollar exchange rate in the trade outcome and uncertainty about the future value of the dollar, the second analysis explores the potential impacts on the 2016 USDA projections of a longer period of dollar strengthening than is assumed in those projections.

Changes in the Macroeconomic Outlook

Three major shifts in global macroeconomic trends beginning in late 2014 and continuing throughout 2015 supported the sharply different assumptions underlying the 2016 USDA projections and the 2015 USDA projections:[1] a stronger U.S. dollar, weaker income growth in developing countries, and declining oil prices. Together, these shifts led to a macroeconomic outlook characterized by weaker global demand for agricultural products, diminished U.S. competitiveness in export markets, and lower energy and other commodity prices relative to the 2015 projections. These three developments also have implications for the outlook beyond 2015.

The Stronger U.S. Dollar

The 2015 USDA projections were based on an assumption that the long period of depreciation and relative weakness of the U.S. dollar against major currencies during 2003-12 would be followed by a period of relative stability and small overall appreciation. However, the value of the agricultural trade-weighted dollar instead rose nearly 13 percent in real (inflation-adjusted) terms between mid-2014 and the end of 2015 (fig. 1) and is now expected to continue rising through 2016 and 2017. The appreciation of the dollar relative to a wide range of currencies largely reflects increased demand for dollars needed for investment and business activity in the United States. Stronger growth in the U.S. economy relative to other developed-country economies, along with geopolitical conflicts in the Middle East, the former Soviet Union, and elsewhere, attracts investors to the relative strength and safety of U.S. markets (app. I, table 1).

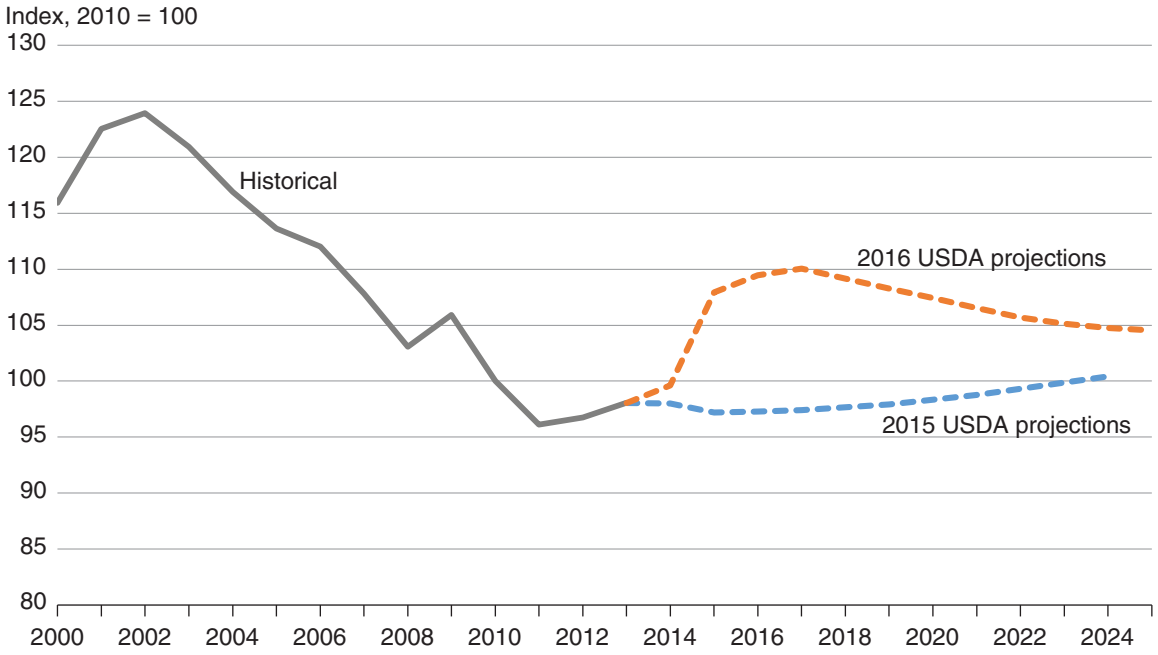
The 2016 USDA projections assume further strengthening of the dollar in the near term, with moderate and gradual depreciation beginning after 2017. This outlook is supported by the expectation that U.S. growth continues to outpace that of other developed countries throughout the projection period. An additional source of near-term upward pressure on the dollar is the expected divergence between U.S monetary policies and those of other developed countries. Favorable domestic economic conditions are expected to justify the U.S. Federal Reserve Board's announced intentions to raise interest rates further, tightening monetary policy while other countries in the developed world pursue more expansionary monetary and fiscal policies.

Weaker Developing-Country Income Growth

For the 2015 USDA projections, per capita GDP growth for developing countries in 2015 was forecast at 3.6 percent; for the 2016 USDA projections, the developing-country growth rate for 2015 dropped to 2.6 percent (app. I, table 1). By comparison, the average per capita GDP growth rate for developing countries during 2001-13 was about 4.2 percent. China's economy is projected to grow less rapidly as the country adjusts to a more consumer-oriented economy. Brazil and Venezuela are expected to remain in recession in 2016, and Argentina is expected to experience very slow growth. Lingering economic challenges are expected to constrain future growth in these countries. Recessions in Russia and Ukraine are also projected to continue in 2016. While growth in developing countries is projected to continue to exceed that in developed countries, both near- and medium-term growth assumptions are significantly lower for the current 2016 USDA projections than they were for the 2015 projections (app. I, table 1).

[1]The macroeconomic conditions underlying the annual USDA projections are made under the assumption that there are no policy changes that shift the trajectory of major macroeconomic variables. Additionally, long-term projections are smoothed and as such, do not incorporate fluctuations that may be expected with business cycles.

Figure 1
Agricultural export-weighted real exchange rate index for the U.S. dollar



Sources: USDA, Economic Research Service (ERS) using USDA Agricultural Projections to 2024; USDA Agricultural Projections to 2025; ERS International Macroeconomic Data Set.

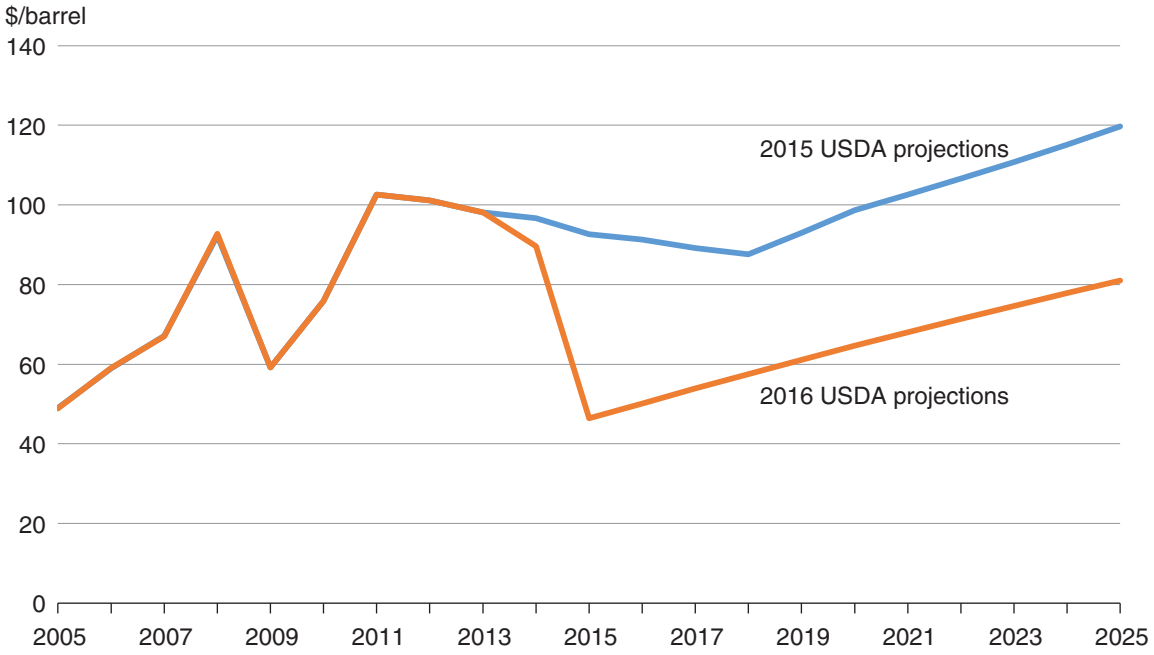
Declining Oil Prices

A third fundamental shift in global economic conditions in 2014-15 was a precipitous decline in the price of oil. The average refiner acquisition price of crude oil in 2015 was $46.39 per barrel, down nearly half from the $91.14 per barrel assumed in the 2015 USDA projections. Weakening demand from China and other commodity-importing countries put downward pressure on oil prices throughout 2015. Also contributing were supply-side factors, including resilient production in the United States, Russia, and Organization of Petroleum Exporting Countries (OPEC). The 2016 USDA projections assume that oil prices will remain in the low $50-per-barrel range during 2016 and 2017, rising slowly to roughly $80 per barrel by 2025, as recovering economic growth rates strengthen demand (fig. 2). Uncertainty on the supply side, particularly with respect to decisions made by OPEC and the impact of the 2015 removal of sanctions that had severely limited Iran's oil exports since 2011, may create further downward pressure on prices through 2016 and beyond.

Changes in the Macroeconomic Outlook for Major U.S. Markets and Competitors

The shifts in the value of the dollar, global income growth, and energy prices described here are reflected to varying degrees in the macroeconomic assumptions adopted for the 2016 USDA agricultural projections for major importers and exporters. Real per capita GDP growth, a measure that captures any changes in both GDP and population growth assumptions, is expected to slow in many of the top 10 U.S. agricultural export markets—both developed and developing countries—particularly in the near term. The strengthening of the U.S. dollar against the currencies in these markets has made U.S. products more expensive in terms of those local currencies. Table 1 summarizes

Figure 2
Historical and projected refiner acquisition costs of oil



Sources: USDA, Economic Research Service (ERS) using USDA Agricultural Projections to 2024 and USDA Agricultural Projections to 2025.

the differences in the per capita growth and exchange rate assumptions behind the 2015 and 2016 USDA projections for the top 10 U.S. agricultural export markets. Table 2 summarizes the changes in per capita GDP growth and real exchange rate projections between the 2015 and 2016 USDA projections for the United States and its major competitors in global agricultural trade. As with export markets, the U.S. dollar has appreciated sharply against the currencies of most key competitors, a significant shift from the 2015 USDA projections. This change has the effect of making foreign exporters more price competitive with U.S. products in foreign markets.

China's per capita GDP growth, while still among the strongest in the world, is now assumed to average about 1.5 percent slower in the medium term (2017-20) than in the assumptions made for the 2015 USDA projections. This reflects the larger-than-expected slowdown in 2015, as adjustments to a more consumer-oriented economy in China took a toll on the country's economic growth. The 2016 USDA projections also factor in additional near-term strengthening of the dollar relative to the yuan. The depreciation of the yuan that began in late 2014 was accelerated in the middle of 2015 and again at the end of 2015 by policy changes intended to allow an expanded role for market forces in determining the currency's value. Nonetheless, total real appreciation of the U.S. dollar against the yuan during 2015 was smaller than appreciation of the dollar against other key U.S. trading partners (table 1). Given China's exchange rate policy changes and their consequences observed in 2015, the 2016 USDA projections assume steady appreciation of the dollar relative to the yuan through 2017, rather than the modest depreciation assumed in the 2015 projections.

Income growth in other major Asian markets—South Korea, Hong Kong, Taiwan, Indonesia, and the Philippines—is expected to be strong relative to that in developed countries but still below their recent growth rates. Since these countries have tended to follow an export-led growth strategy,

Table 1

Change in per capita real GDP and real exchange rate outlook for top 10 U.S. agricultural markets between the 2015 and 2016 USDA projections[1]

	2016 USDA projections			Change from 2015 USDA projections		
	2015 estimate	2016	2017-20	2015 estimate	2016	2017-20
Real GDP per capita:		*Growth rate*			*Change*	
China	6.05	5.60	5.09	0.02	-0.72	-1.48
Canada	0.26	1.47	1.78	-1.77	-0.57	-0.04
Mexico	1.25	1.90	2.29	-1.71	-0.99	-0.68
Japan	1.10	1.72	1.23	0.03	0.30	0.18
EU-28	1.62	1.82	1.63	0.11	0.07	-0.17
South Korea	2.56	3.24	3.16	-1.30	-0.38	-0.05
Hong Kong	1.95	2.40	3.09	-2.62	-1.84	-0.21
Taiwan	1.32	3.16	2.81	-3.38	-1.29	-0.65
Indonesia	3.77	4.07	4.44	-1.64	-1.06	0.01
Philippines	3.68	3.91	3.83	0.12	0.70	0.76
Real exchange rate:		*Percent change[2]*			*Change*	
China	0.16	3.29	0.05	1.50	4.16	0.89
Canada	14.10	1.08	0.85	12.30	-0.55	0.09
Mexico	16.49	5.32	-0.52	17.39	4.70	-2.70
Japan	13.46	2.36	1.77	12.18	-0.12	-0.12
EU-28	2.68	1.69	-1.63	-2.39	1.38	-1.07
South Korea	7.10	2.41	-0.31	7.29	2.37	-0.03
Hong Kong	-3.05	-1.24	-0.68	-2.07	-0.99	-0.80
Taiwan	5.56	1.88	0.49	7.11	2.94	0.80
Indonesia	7.68	3.88	-0.65	-0.58	8.07	1.08
Philippines	0.86	0.76	-1.17	0.31	4.16	-0.61

GDP = Gross Domestic Product.

[1]Top 10 U.S. markets based on FY2013-15 average value.

[2]A positive number means depreciation, as more local currency is needed to purchase a U.S. dollar.

Sources: USDA, Economic Research Service using USDA Agricultural Projections to 2024; USDA Agricultural Projections to 2025; ERS International Macroeconomic Data Set.

incomes and currency values are highly vulnerable to the downturn in the external environment, principally the slowdown in China and the relatively weak economic growth in the developed world. With these conditions expected to persist, the 2016 USDA projections are based on a near-term outlook for slower income growth and further real dollar appreciation than was assumed in the 2015 projections, with stabilization and recovery in the medium term.

For North American Free Trade Association (NAFTA) members Canada and Mexico, the 2016 USDA projections assume slower income growth and weaker currencies, particularly in the near term, than the 2015 projections. This reflects the 14-percent and 16-percent appreciation of the U.S. dollar relative to the Canadian dollar and the Mexican peso, respectively, that occurred between 2014 and 2015 (table 1) and the effects of the steep drop in oil and other commodity prices. While economic growth in both NAFTA partners is vulnerable to further declines in commodity prices,

Table 2

Change in per capita real GDP and real exchange rate outlook for major U.S. agricultural competitors between the 2015 and 2016 USDA projections

	2016 USDA projections			Change from 2015 USDA projections		
	2015 estimate	2016	2017-20	2015 estimate	2016	2017-20
Real GDP per capita:		*Growth rate*			*Change*	
Argentina	-1.25	-0.80	-0.50	-0.11	-2.48	-3.16
Australia	1.34	1.53	1.86	-0.36	-0.09	0.29
Brazil	-3.48	-1.75	1.08	-3.39	-2.97	-1.54
Canada	0.26	1.47	1.78	-1.77	-0.57	-0.04
EU-28	1.62	1.82	1.63	0.11	0.07	-0.17
Russia	-3.97	-0.95	2.74	0.00	0.00	-0.23
Ukraine	-9.22	-3.48	3.38	-7.85	-5.14	0.32
Real exchange rate:		*Percent change*[1]			*Change*	
Argentina	-2.54	10.79	-3.43	14.59	21.76	-2.89
Australia	18.98	5.55	-2.10	18.71	1.46	-2.50
Brazil	31.76	21.92	-0.34	32.06	21.55	-0.68
Canada	14.10	1.08	0.85	12.30	-0.55	0.09
EU-28	2.68	1.69	-1.63	-2.39	1.38	-1.07
Russia	36.29	-5.37	0.03	32.70	-6.80	0.22
Ukraine	26.47	-0.04	-4.35	19.12	-3.58	-5.38

GDP = Gross Domestic Product.

[1]A positive number means depreciation, as more local currency is needed to purchase a U.S. dollar.

Sources: USDA, Economic Research Service using USDA Agricultural Projections to 2024; USDA Agricultural Projections to 2025; ERS International Macroeconomic Data Set.

the proximity of the two countries to the United States and its relatively strong income growth is a mitigating factor.

Relatively slow but steady income growth in Japan and the EU assumed in the 2015 projections is largely maintained for the 2016 projections, whereas slower growth is expected for Australia (table 2). The more subdued macroeconomic outlook for Australia reflects slowing demand for its exports, particularly from China. Real exchange rate assumptions have changed dramatically for all three countries. The 2016 USDA projections reflect the almost 18-percent real appreciation of the U.S. dollar with respect to the euro that occurred beginning in late 2014, the 13-percent real appreciation with respect to the yen during 2015 (see table 1), and the 19-percent real appreciation with respect to the Australian dollar (see table 2). The U.S. dollar is expected to remain strong relative to these currencies in the medium term as income growth in the respective countries is expected to be weak and near-term monetary policy loose relative to that in the United States.

Macroeconomic conditions and assumptions for the two largest U.S. competitors in Latin America—Argentina and Brazil—changed significantly between the 2015 and 2016 USDA projections (see table 2). Argentina and Brazil were projected to be in recession in 2015, with very slow growth or continued recession expected in the near term, followed by a slow recovery. Falling commodity prices and weakening demand from China and other foreign markets have diminished

the two countries' opportunities for export income, constraining their ability to balance external accounts and fund programs to stimulate growth.

The macroeconomic outlook for Russia and Ukraine also deteriorated between the 2015 and 2016 USDA projections, as oil prices sank and the political conflict that began in the Ukraine in 2014 persisted. On top of the economic sanctions imposed on Russia as a consequence of its role in the Ukraine conflict, the decline in oil prices since 2014 has had particularly severe consequences for Russian income growth and the value of the ruble. Table 2 illustrates the dramatic strengthening (36 percent) of the dollar relative to the ruble in 2015. The 2016 projections assume that both the ruble and the Ukrainian hryvnia will begin to stabilize in 2016, but this is highly uncertain. The value of the hryvnia depends on the path of Ukraine's domestic economic and political recovery, and the value of the ruble is closely linked to oil prices, which continued falling into early 2016.

Historical Links Between Income Growth, Exchange Rates, and U.S. Agricultural Trade

U.S. agricultural export growth is tied closely to rising incomes in overseas markets and to the value of the dollar relative to the currencies of U.S. export markets and competitors. Other factors, ranging from urbanization and other influences on consumer preferences, to productivity gains associated with technology adoption, to reforms in agricultural and trade policies, are also of key importance, but income growth and exchange rates have been major factors in the expansion of U.S. agricultural exports since 2000. And, in the current outlook, declining prospects for economic growth and the shift to a stronger U.S. dollar against many foreign currencies are creating a significant decline in U.S. agricultural exports and prices.

Global Income Growth and U.S. Agricultural Exports

Growth in demand for food, and by extension for agricultural imports, is particularly sensitive to growth in per capita incomes in developing countries, where relatively large shares of rising incomes are typically spent on increasing both the amount and diversity of foods consumed. In contrast, consumers in more developed countries, where per capita incomes and food intake are already relatively high, are less likely to spend as much of new income on increasing the amount of food they eat.

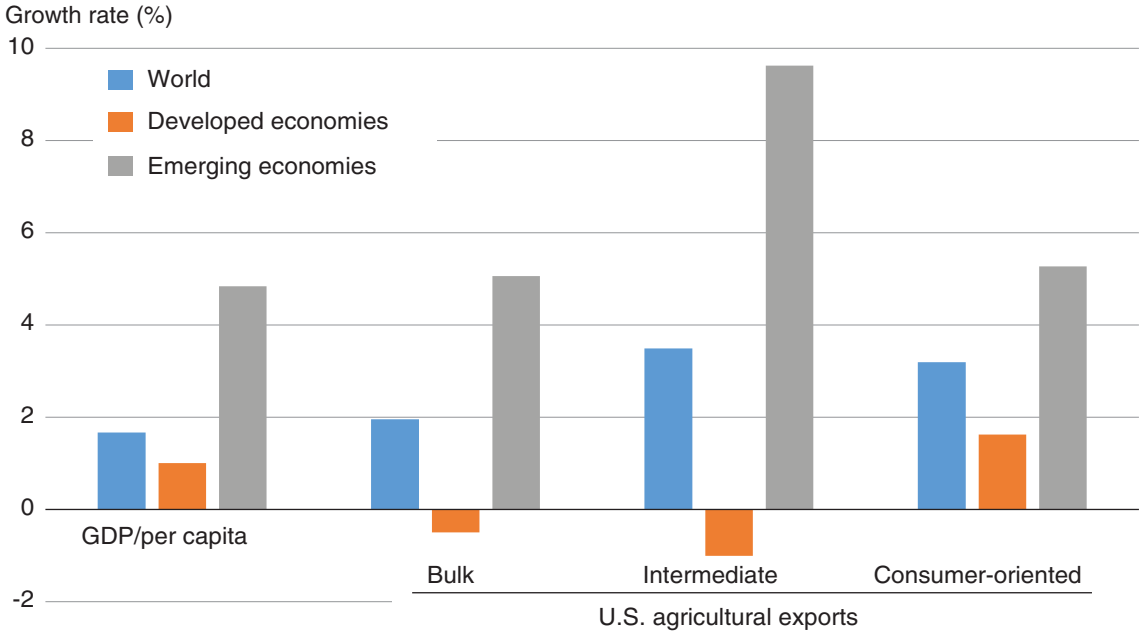
Developing and emerging markets averaged higher rates of real per capita GDP growth and accounted for all of the volume growth in U.S. exports of bulk and intermediate agricultural products and most of the growth in U.S. exports of consumer-oriented products during 2000-2015 (fig. 3).[2] The volume of U.S. exports of bulk and intermediate agricultural goods to developed countries actually declined during the period, while the growth rate in the U.S. exports of consumer-oriented goods was about a third that of developing countries. During FY2013-15, the value of U.S. agricultural exports comprised 35 percent bulk goods, 20 percent intermediate goods, and 45 percent consumer-oriented goods.

The pattern of high income growth in and high U.S. export growth to developing- and emerging-country markets is also evident when the data are broken out regionally (table 3). Income growth in Asian markets, especially China, has consistently outpaced that in other regions since 2000. In China, the largest market for U.S. agricultural exports in FY2015, GDP growth has corresponded with high rates of growth in U.S. agricultural export volumes, primarily for bulk and intermediate goods. Relatively high income growth in South and Southeast Asian markets has led to strong growth in imports of U.S. products. Meanwhile, Japan, the fifth largest U.S. agricultural export market in FY2015, has experienced slow economic growth over the past generation and with it, the volume of U.S. bulk and consumer-oriented goods exported to Japan has dropped since 2000.

The NAFTA region includes the second (Canada) and third (Mexico) largest destinations for U.S. agricultural exports as of FY2015. For these countries, proximity and preferential market access, in addition to income growth and exchange rates, are important drivers of U.S. trade. Both Canada and Mexico have continued to account for above-average rates of U.S. export growth for most

[2]Bulk commodities include unprocessed cereals, oilseeds, cotton, pulses, and tobacco. Intermediate goods include oil meals, vegetable oils, animal fats, hides and skins, feeds, seeds, and sugar and sweeteners. Consumer-oriented products include meats, eggs, dairy, fresh and processed fruits and vegetables, tree nuts, various prepared foods, beverages, and pet food.

Figure 3
Growth in real per capita GDP and U.S agricultural exports by region, 2000-2015



GDP = Gross Domestic Product.
Sources: USDA, Economic Research Service (ERS) using ERS International Macroeconomic Data Set; USDA, Foreign Agricultural Service, Global Agricultural Trade System database.

commodity categories since 2000, despite relatively low rates of income growth. Growth in U.S. exports to Canada has been largely in consumer-oriented goods, while there have been strong gains in exports of both intermediate and consumer-oriented products to Mexico.

Other developing regions, including South America, the Middle East, and North Africa, also have generally higher rates of growth for U.S. exports, particularly of intermediate and consumer-oriented products, than developed- and transition-economy regions, such as the EU and the Former Soviet Union (FSU), respectively.

The Dollar Exchange Rate and U.S. Agricultural Exports

The dollar exchange rate affects both the volume and value of U.S. agricultural exports. As the dollar becomes stronger relative to other currencies, the price of U.S. products in those local currencies rises relative to products of other suppliers. When the dollar appreciates against the currency of a competitor, the higher local currency price can stimulate production and additional exports. Figure 4 illustrates the historic link between the dollar exchange rate and the value of U.S. agricultural exports. The growth in U.S. exports between 2000 and 2014 was associated with a weakening dollar over much of that period, while periods of decline in exports in the early 1980s and the late 1990s were associated with a strengthening dollar. Other economic and policy factors also shaped the path of U.S. agricultural export growth during this period, but the dollar exchange rate played a large role (Shane et al., 2008; Gong and Kinnucan, 2015).

Additionally, dollar movements affect the international price for many products because many agricultural commodities are priced in U.S. dollars. Exchange rate movements thus affect global

Table 3

Growth in real GDP and U.S. agricultural export volume by region, 2000-15

Country and region	Real GDP/ capita	Bulk	Intermediate	Consumer-oriented
	Growth rates			
World	1.7	2.0	3.5	3.2
Developed economies[1]	1.0	-0.5	-1.0	1.6
Emerging economies[2]	4.8	5.1	9.6	5.3
NAFTA				
Canada	1.3	2.9	3.3	6.5
Mexico	1.0	2.0	8.4	5.7
Asia	3.8	4.1	9.4	2.3
Japan	0.9	-0.7	6.7	-2.0
China	9.0	18.3	52.9	13.4
Southeast Asia	3.8	3.3	9.8	8.2
South Asia	5.0	8.2	15.5	19.6
India	5.5	38.7	34.8	18.4
South America	2.0	9.1	7.0	8.1
Colombia	3.1	20.2	17.6	11.7
Peru	4.0	23.3	28.7	13.9
European Union-28	1.1	6.7	-2.1	-0.6
Former Soviet Union-12	4.5	33.3	-9.6	-3.1
Middle East	2.3	1.1	4.9	9.7
Africa	2.1	-3.3	1.8	10.7
North Africa	1.8	-2.3	5.6	19.0
Sub-Saharan Africa	2.5	0.8	-2.3	11.4

Note: Bulk commodities include unprocessed cereals, oilseeds, cotton, pulses, and tobacco. Intermediate goods include oil meals, vegetable oils, animal fats, hides and skins, feeds, seeds, and sugar and sweeteners. Consumer-oriented products include meats, eggs, dairy, fresh and processed fruits and vegetables, tree nuts, various prepared foods, beverages, and pet food. GDP = Gross Domestic Product.

[1]U.S., Canada, EU, Iceland, Norway, Switzerland, Japan, Australia, and New Zealand.

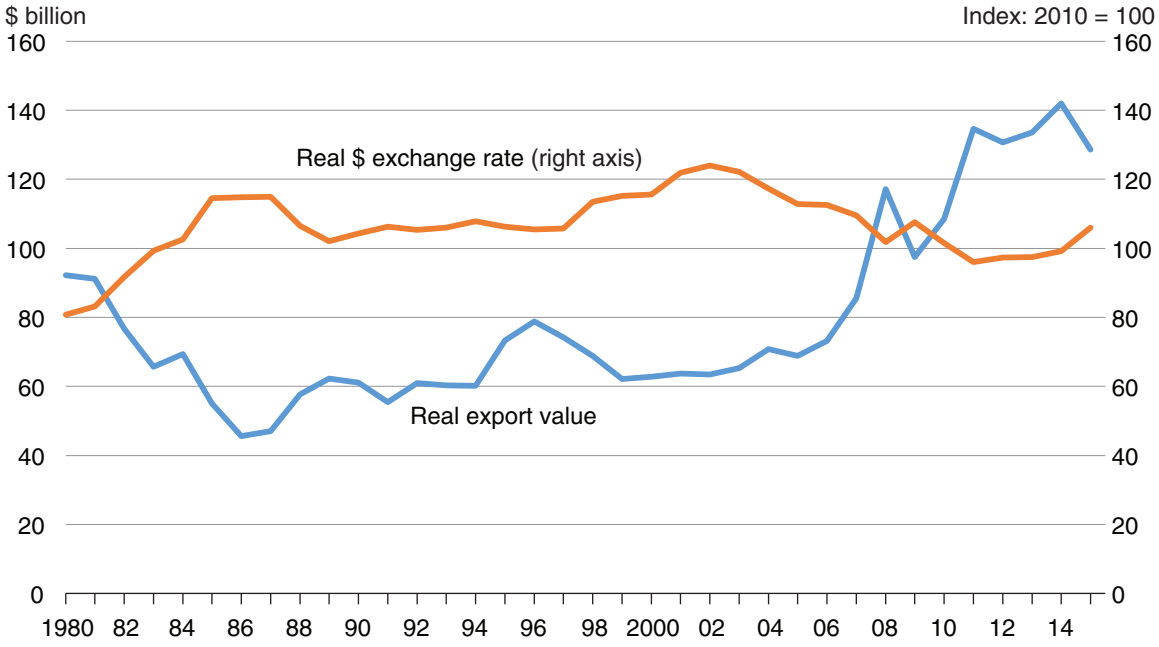
[2]Mexico, Brazil, Chile, Czech Republic, Hungary, Poland, Slovakia, Russia, China, India, South Korea, Taiwan, Indonesia, Malaysia, Philippines, Thailand, Vietnam, and Singapore.

Source: USDA, Economic Research Service baseline data files; USDA, Foreign Agricultural Service, Global Agricultural Trade System database.

commodity prices and, therefore, influence the quantities produced and consumed in overseas markets. These effects are evident in the significant inverse relationship between the exchange rate for the dollar and the general level of global food commodity prices (fig. 5). Although other supply and demand factors played a role, periods of a declining dollar, such as 2002-2012, corresponded with rising prices, while periods of a strengthening dollar, such as 2014-15, have usually been associated with declining world prices.

Figure 4

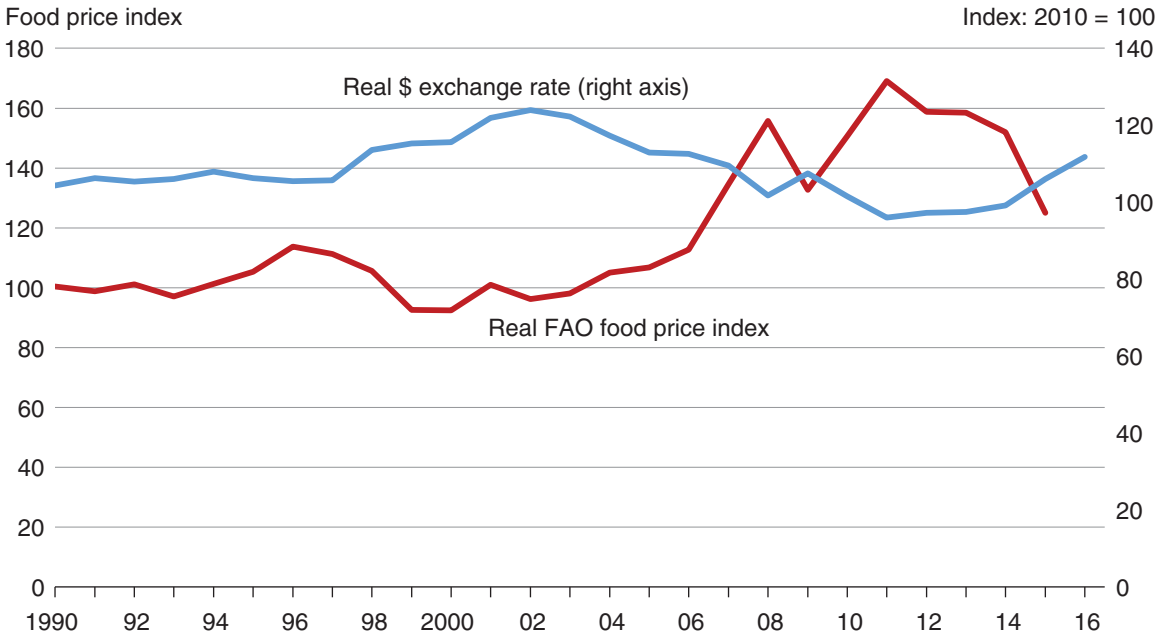
Real U.S. export value and export-weighted dollar exchange rate: All agricultural products



Note: Fiscal years. Exchange rates weighted by 2009-11 average total U.S. agricultural exports by country.
Source: USDA, Economic Research Service (ERS) using USDA, Foreign Agricultural Service, Global Agricultural Trade System; ERS Agricultural Exchange Rate Data Set.

Figure 5

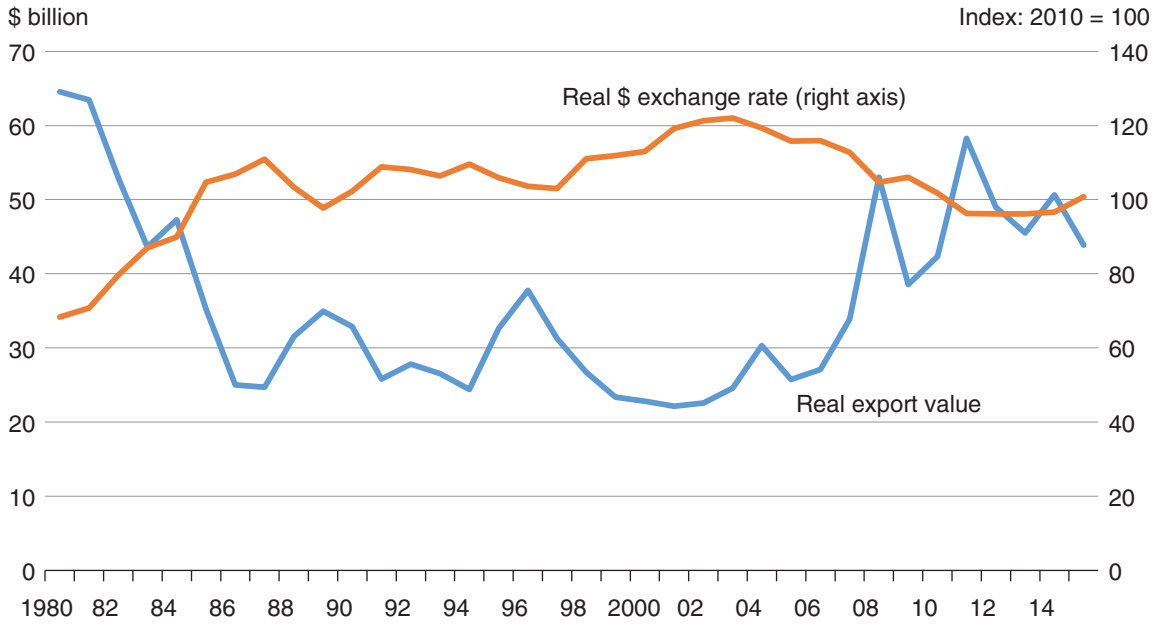
Real world food prices and export-weighted exchange rate for the U.S. dollar



Source: USDA, Economic Research Service using data from Food and Agriculture Organization of the United Nations (FAO).

The impact of the dollar exchange rate on U.S. exports is evident for each of the three broad categories of agricultural goods—bulk, intermediate, and consumer-oriented—but appears to be strongest for bulk and intermediate goods (figs. 6, 7, and 8; box "Quantifying the Relationship Between Income Growth, Exchange Rates, and U.S. Agricultural Exports"). The different relationship across commodity types is consistent with the different demand characteristics of these products. Bulk commodities and intermediate goods tend to be relatively standardized products. U.S. and foreign products in these categories are more readily substituted for each other as changes in exchange rates alter relative prices among suppliers. In contrast, consumer-oriented products are more likely to be differentiated by factors such as brand, quality, or sanitary and phytosanitary standards. As a result, they may be less likely to be substituted across origins on the basis of price. Consumer-oriented goods may also be more likely to be demanded by higher income consumers, who tend to be less responsive to changes in prices than lower income consumers (Seale et al., 2013).

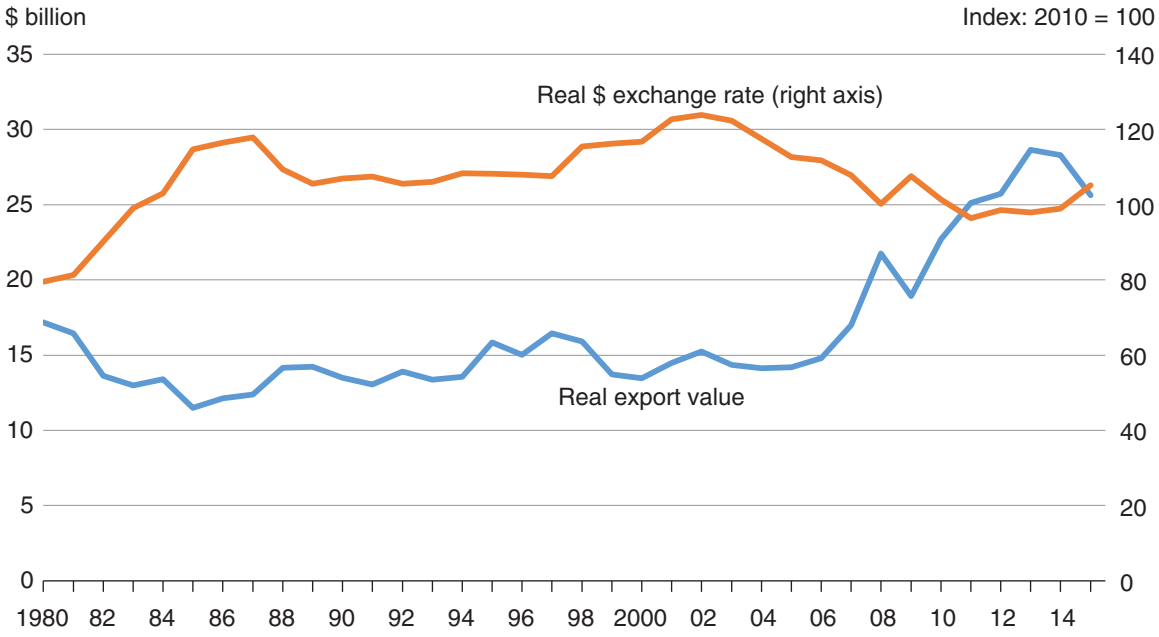
Figure 6
Real U.S. export value and export-weighted dollar exchange rate: Bulk agricultural products



Note: Fiscal years. Exchange rates weighted by average 2009-11 U.S. bulk agricultural exports by country.
Source: USDA, Economic Research Service (ERS) using USDA, Foreign Agricultural Service, Global Agricultural Trade System; ERS Agricultural Exchange Rate Data Set.

Figure 7

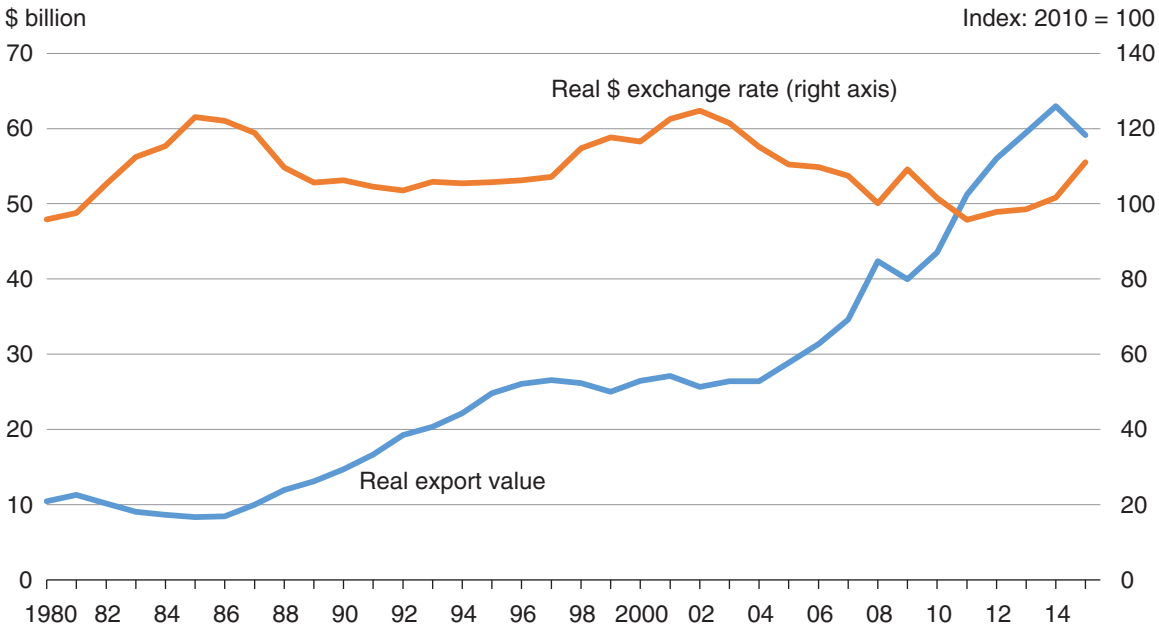
Real U.S. export value and export-weighted dollar exchange rate: Intermediate agricultural products



Note: Fiscal years. Exchange rates weighted by average 2009-11 U.S. intermediate agricultural exports by country.
Source: USDA, Economic Research Service (ERS) using USDA, Foreign Agricultural Service, Global Agricultural Trade System; ERS Agricultural Exchange Rate Data Set.

Figure 8

Real U.S. export value and export-weighted dollar exchange rate: Consumer-oriented agricultural products



Note: Fiscal years. Exchange rates weighted by average 2009-11 U.S. consumer-oriented agricultural exports by country.
Source: USDA, Economic Research Service (ERS) using USDA, Foreign Agricultural Service, Global Agricultural Trade System; ERS Agricultural Exchange Rate Data set.

Box 1

Quantifying the Relationship Between Income Growth, Exchange Rates, and U.S. Agricultural Exports

The significance of the relationship between the value of U.S. agricultural exports, foreign income growth, and the value of the dollar can be established statistically. This analysis uses inflation-adjusted (real) 1990-2015 annual data for U.S agricultural exports by category, foreign income growth, and dollar exchange rates. To ensure alignment between the trade, income, and exchange rate variables, annual income and exchange rate data are averages weighted by the value of U.S. exports of a product category to each country. (See app. II for more information on the data and methods.)

Findings (box table 1-1) indicate that the exchange rate for the dollar has a statistically significant inverse relationship with exports of each product category, but the strength of the relationship varies. U.S. bulk commodity exports are found to be most sensitive to the dollar exchange rate. All else held constant, a 1-percent real appreciation of the U.S. dollar decreases the real value of U.S. bulk agricultural exports by 3.14 percent. Intermediate and consumer-oriented products are less sensitive to exchange rate movements. The larger response for bulk products is consistent with the expectation that these goods are more uniform in quality and are more readily substituted for goods from other origins. Importers of consumer-oriented products, in contrast, may be more concerned with factors such as quality, branding, or phytosanitary standards and be less likely to substitute products from other origins. Findings suggest that the relatively low exchange rate sensitivity of exports of consumer-oriented products, whose share of U.S. exports has been steadily increasing and reached 46 percent in FY2015, will tend to mitigate declines in U.S. exports as the dollar strengthens.

Box table 1-1

Regression estimates of relationsip between U.S. agricultural exports, foreign GDP growth, and the exchange rate of the U.S. dollar

	U.S. agricultural export category			
	Bulk	Intermediate	Consumer-oriented	Total
Exchange rate growth	-3.140*** (-0.701)	-1.444*** (-0.414)	-1.063*** (-0.185)	-2.025*** (-0.340)
Lag foreign GDP growth	2.585* (-1.44)	2.101 (-1.726)	1.550*** (-0.506)	2.619*** (-0.81)
Observations	24	24	24	24
Adjusted R-squared	0.446	0.397	0.506	0.649

Notes: Standard errors are given in parentheses. *,**,*** indicate significance at 10, 5, and 1 percent levels, respectively. GDP = Gross Domestic Product.

Source: USDA, Economic Research Service.

The findings also indicate a generally strong positive relationship between foreign income growth and U.S. agricultural exports. Other things being equal, a 1-percent increase in real foreign income (GDP) growth increased the real value of U.S. agricultural exports by about 2.6 percent. Although not all estimated relationships are statistically significant, the results strongly suggest that U.S. exports of bulk commodities tend to be more responsive to foreign income growth than U.S. exports of consumer-oriented goods. This pattern is consistent with the tendency for food demand by lower income consumers and, hence, imports by lower income countries that account for most bulk commodity imports to be more responsive to changes in income than is food demand by higher income consumers. In contrast, import demand for generally higher value consumer-oriented foods tends to be concentrated in higher income countries and market segments where food demand tends to be relatively less responsive to changes in income.

Impacts of the Current Macroeconomic Outlook on the 2016 USDA Projections

This section provides estimates of the impacts of the changing macroeconomic outlook, specifically the slowdown in global economic growth and the stronger U.S. dollar, on the 2016 USDA agricultural projections for U.S. exports and prices of major commodities. The analysis was conducted using the ERS Country-Commodity Linked System (CCLS)—a multicommodity, multiregion global partial equilibrium modeling system used to develop USDA's 10-year agricultural projections. To isolate the impacts of the new macroeconomic outlook on the 2016 USDA projections, the CCLS was run using the 2015 and 2016 macroeconomic assumptions while holding all other variables at the levels used for the 2016 projections. All macroeconomic variables in the model—including domestic and foreign country income growth, exchange rates, inflation rates, and oil prices—were subject to change. Thus, the results are estimates of the changes in projected U.S. and global trade and prices due to the changed macroeconomic outlook between the 2015 and 2016 USDA projections. The analysis focuses on the impacts in the near term (defined as 2015/16 and 2016/17) and medium term (2017/18-2019/20 average). (See box "The ERS Country-Commodity Linked System Model and Scenarios Examined" for more details on the CCLS.)

It is important to note that, in this model-based analysis, several income- and price-driven impacts are accounted for simultaneously. For any particular commodity or country, these effects can move the price and trade results in either the same direction or in opposite directions.

- *Income effects:* With other factors unchanged, lower income growth rates tend to reduce demand and net imports, while higher income growth rates increase demand and net imports. The income elasticities that underlie the magnitudes of these changes are generally highest in lower income countries, and for higher value products.
- *Exchange rate effects:* With other factors unchanged, local currency depreciation against the U.S. dollar tends to increase the local currency prices faced by producers and consumers in a foreign country, raising quantities produced, reducing quantities demanded, and reducing net imports. Local currency appreciation against the dollar tends to have the opposite effect. The size of these impacts for a particular commodity and country depend on the extent to which world prices are transmitted into the domestic market, and the responsiveness of producers and consumers to price changes (price elasticities of supply and demand).
- *Price effects:* Price effects on production and consumption arise through the exchange rate effects noted earlier but also through changes in world and domestic prices that occur as supply and demand equilibrate and markets clear. In this process, the relative prices of commodities differ under alternative macroeconomic assumptions as disequilibria are resolved in each market. Exchange rate and price effects can move prices in the same direction or offset one another. For example, a lower market clearing price may offset some or all of the effects of a depreciating exchange rate.

Box 2

The ERS Country-Commodity Linked System Model and Scenarios Examined

ERS's Country-Commodity Linked System (CCLS) is a global, multicountry, multicommodity agricultural market model used to generate economically consistent supply, demand, trade, and price projections under alternative scenarios (box table 2-1). 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 42 country or regional 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 accounts for 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 the agricultural commodities.

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, Central America and Caribbean, China, Economic Community of West African States (ECOWAS), Egypt, European Union, Hong Kong, India, Indonesia, Iran, Iraq, Japan, Malaysia, Mexico, Morocco, New Zealand, Pakistan, Philippines, Russia, Saudi Arabia, South Africa, South Korea, Taiwan, Thailand, Turkey, Ukraine, United States, Vietnam, Other Asia and Oceania, Other Europe, Other Former Soviet Union, Other Middle East, Other North Africa, Other South America, Other Sub-Saharan Africa, Rest of World.

Box table 2-1

Macroeconomic scenarios analyzed

	Description	Impacts studied
Scenario 1	Examines the impacts of the changes in the macroeconomic outlook between the 2015 and 2016 USDA agricultural projections on the 2016 projections.	Income, exchange rates, oil prices, inflation rates, and population data are all updated. Both price and income effects are examined.
Scenario 2	Examines the potential impacts of an extended period of dollar strenghtening, beyond what is assumed in the 2016 USDA agricultural projections, on the 2016 projections.	Only exchange rate data and assumptions are changed. Only the impacts of changes in exchange rates and related price effects are examined.

Source: USDA, Economic Research Service.

Impacts on U.S. Commodity Market Projections

The macroeconomic outlook underlying the 2016 USDA projections leads to substantial reductions in the near- and medium-term projections of global consumption and trade, thereby lowering world prices and U.S. exports for most commodities, compared with the macroeconomic outlook underlying the 2015 USDA projections. Declines in world prices range between 3 and 16 percent in the near term (2015/16-2016/17) and 5 and 19 percent in the medium term (2017/18-2019/20). The largest price impacts are for crops, particularly soybeans, with relatively smaller impacts on meats, particularly beef and poultry (table 4).

Table 4

Scenario 1: Impacts of macroeconomic assumptions on differences between the 2015 and 2016 USDA projections of U.S. commodity prices and trade

	Change in world $ price			Change in U.S. trade volume					
	Percent			*Percent change*			*Quantity change (1,000 tons)*		
Commodities\ crop years	2015/16	2016/17	2017/18 - 2019/20	2015/16	2016/17	2017/18 - 2019/20	2015/16	2016/17	2017/18 - 2019/20
					Exports				
Corn	-9.8	-9.4	-9.0	-12.3	-14.1	-15.4	-6,405	-8,207	-8,774
Sorghum	-10.3	-10.1	-9.2	-7.9	-4.5	-4.7	-709	-240	-190
Wheat	-10.6	-11.3	-10.3	-15.1	-9.9	-8.0	-3,867	-2,966	-2,349
Rice	-12.1	-12.4	-11.5	-5.6	-10.3	-10.6	-184	-410	-430
Cotton	-9.9	-10.0	-11.0	-4.0	-4.6	-7.4	-93	-121	-214
Soybeans	-11.6	-13.4	-15.9	-4.7	-4.4	-6.7	-2,302	-2,257	-3,425
Soymeal	-9.8	-10.2	-11.2	-7.7	-8.1	-8.6	-893	-857	-1,052
Soyoil	-13.1	-15.7	-18.5	14.2	15.9	9.1	130	130	85
Beef & veal	-4.9	-5.1	-5.4	-5.3	-5.2	-4.1	-61	-65	-53
Pork	-8.7	-9.4	-9.4	-1.5	-1.5	-1.3	-35	-38	-33
Poultry	-3.2	-4.2	-4.9	-3.1	-3.7	-3.4	-115	-151	-150
					Imports				
Beef & veal	-4.9	-5.1	-5.4	5.1	5.8	6.0	67	66	57
Pork	-8.7	-9.4	-9.4	1.7	2.1	2.4	8	8	8

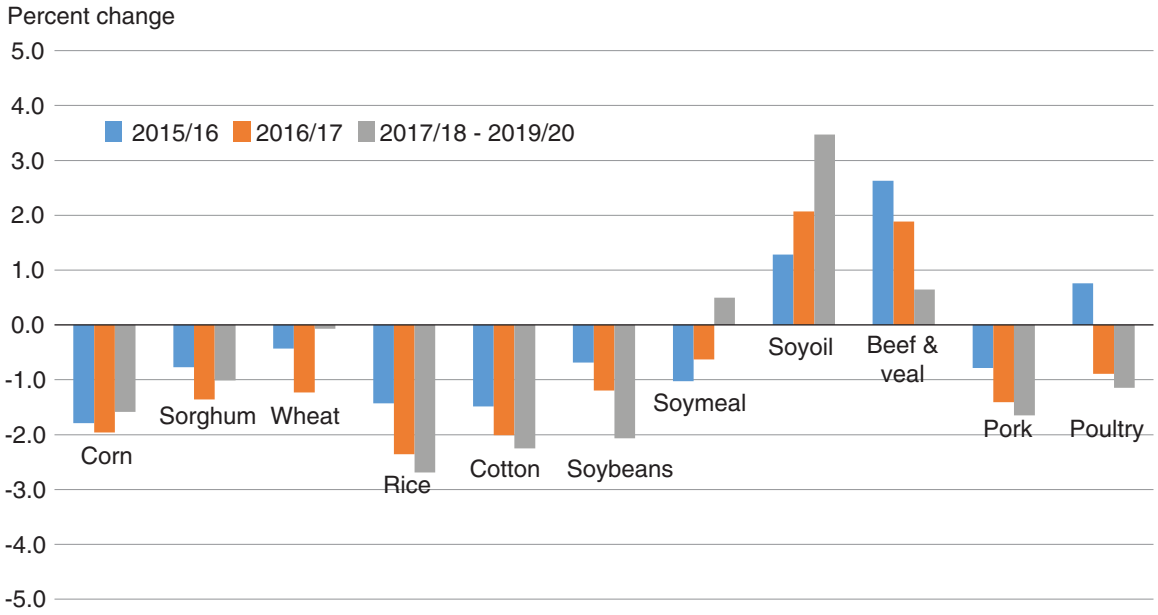
Notes: Impacts of replacing the 2015 USDA macroeconomic assumptions with the 2016 assumptions. U.S. crop price differences are based on world prices. U.S. meat price changes are based on domestic prices.

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

The largest percentage reductions in U.S. exports by volume are in the projections for corn, wheat, and rice in both the near and medium terms (table 4). These commodities are hit hardest by a combination of lower income growth and higher local currency costs of U.S products in import markets and increased competition from exporters with currencies depreciating against the dollar. Almost across the board, the reductions in projected U.S. exports are larger than the reductions in world trade (fig. 9), implying a smaller projected U.S. share of global exports. Market shares for U.S. exports of corn, wheat, and soybeans see the largest losses, while market shares for U.S. rice, cotton, and soyoil are relatively unchanged.

In terms of volume, U.S. soybean exports are not affected by the changed macroeconomic outlook as much as other major crops. This result is, in part, because the changes in income growth and exchange rate assumptions for China, the world's dominant soybean importer, between the 2015 and 2016 USDA projections had relatively minor impacts on China's import demand. In addition, China's imports are supported by a sharp estimated decline in the world soybean price—linked to the sharp depreciation of the Brazilian real—that more than offsets the price impact of the relatively small depreciation of the Chinese yuan. In a similar fashion, global and U.S. soyoil trade projections see comparatively small impacts because of relatively unchanged demand by China and an improved outlook for India, the two largest edible oil importers in the world. Note, however, that the 2016 USDA macroeconomic assumptions do not capture the impact of the recent reductions of Argentine export taxes and sharp depreciation of the Argentine peso, changes that can be expected to strengthen Argentina's position as a soybean exporter in the future.

Figure 9
Scenario 1: Impact of 2016 USDA macroeconomic outlook changes on global trade[1]



[1]Change in global trade volumes under 2016 macroeconomic assumptions compared with 2015 macroeconomic assumptions.
Source: USDA, Economic Research Service.

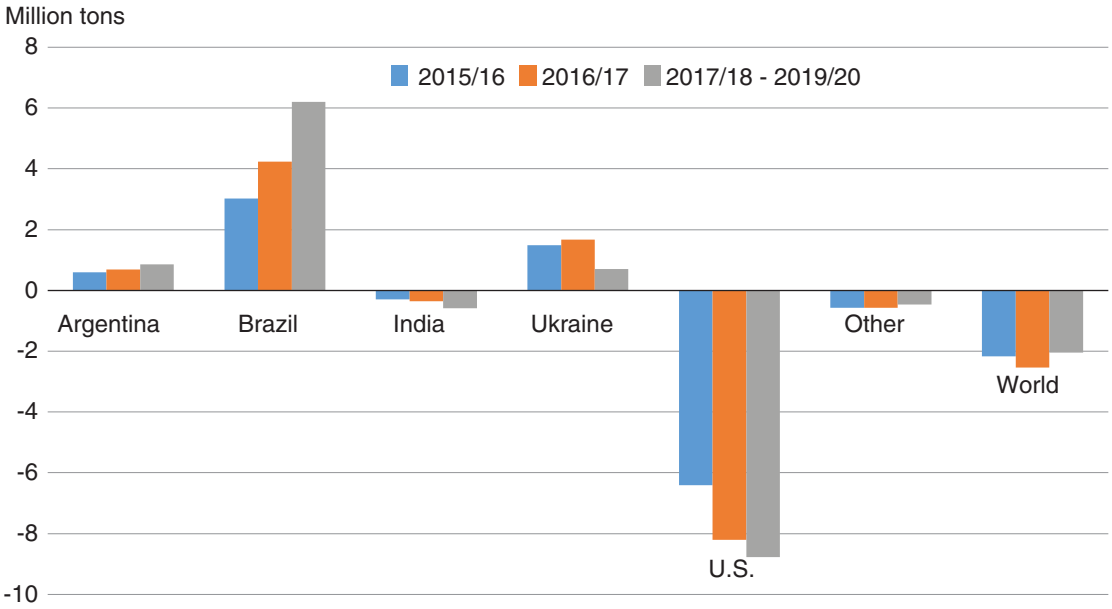
Global Commodity Market Impacts

- *Corn:* With the changed macroeconomic outlook, the projections of annual world imports decline 2.2-2.5 million tons (1.8-2.0 percent) in the near term and 2.0 million tons (1.6 percent) in the medium term. Lower incomes combined with higher local currency prices reduce import demand across developing Asian and North African markets. Major corn exporters, including Argentina, Brazil, and Ukraine, respond to currency depreciation and higher local currency prices with increased exports. In Brazil and Ukraine, severe recessions contribute to excess supplies. In contrast, India, a marginal exporter undergoing modest currency depreciation and robust economic growth, reduces corn exports in response to lower world prices and strengthening domestic demand (fig. 10). The U.S. market share of global corn exports during 2015/16-2019/20 drops from an average of 41 percent to 35 percent.

- *Wheat*: The projections of global wheat imports decline 0.7-1.9 million tons (0.4-1.2 percent) in the near term but are negligible in the medium term. Impacts on markets are mixed, with lower incomes and weaker currencies reducing import demand in markets such as Brazil, Indonesia, and Mexico, while relatively stable currencies and lower world prices contribute to increased imports in markets such as Egypt and Bangladesh. Most major exporters, including Argentina, Australia, Canada, Russia, and Ukraine, respond to currency depreciation and higher local currency prices (and, in the case of Russia and Ukraine, weaker domestic demand) by boosting exports. Only the EU sees lower world and local currency prices and reduces exports (fig. 11). The average U.S. share of global wheat exports during 2015/16-2019/20 falls from 18 percent to 16 percent.

Figure 10

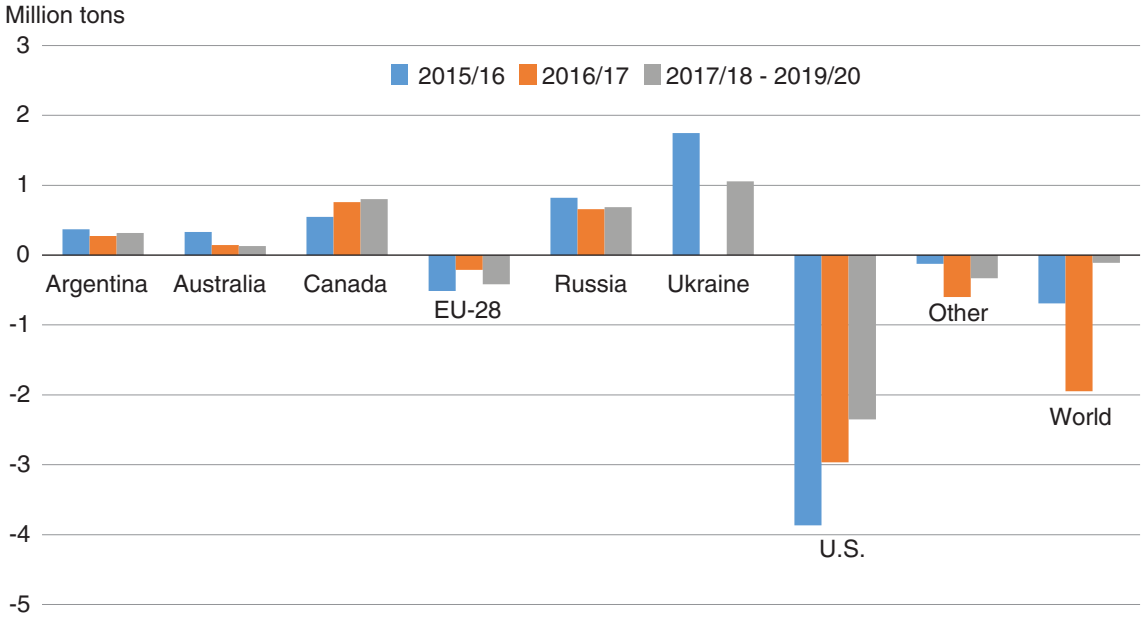
Scenario 1: Impact of 2016 USDA macroeconomic outlook changes on corn exporters[1]



[1]Change in global trade volumes under 2016 macroeconomic assumptions compared with 2015 macroeconomic assumptions.
Source: USDA, Economic Research Service.

Figure 11

Scenario 1: Impact of 2016 USDA macroeconomic outlook changes on wheat exporters[1]



[1]Change in export volumes under 2016 macroeconomic assumptions compared with 2015 macroeconomic assumptions.
Source: USDA, Economic Research Service.

- *Rice*. Annual global import projections decline 0.6-1.0 million tons (1.2-2.4 percent) in the near term and 1.2 million tons (2.7 percent) in the medium term, as weaker demand and depreciating currencies reduce demand by large importers, such as Indonesia, the Philippines, and West Africa (ECOWAS). Responses by rice exporters are driven by movements in local currency prices. Argentina, Brazil, and Thailand boost exports as depreciation leads to higher local currency prices, while Burma, India, and Vietnam lose market share as their currencies remain more stable against the dollar. U.S. rice exports decline an average of 9.5 percent annually during 2015/16-2019/20, and the U.S. market share of global rice exports falls to under 8 percent.

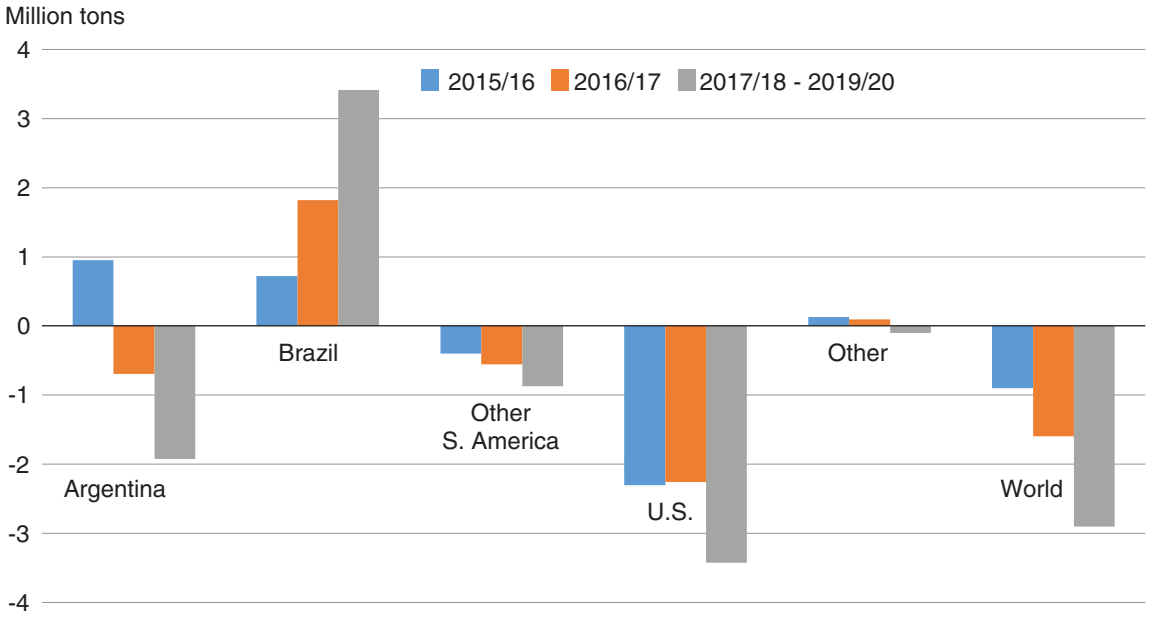
- *Cotton*: Both near- and medium-term declines in projected annual demand for cotton imports are relatively small. Changes in the macroeconomic assumptions for the major cotton importer, China, are minor, and China's cotton trade is expected to be governed primarily by commodity policies aimed at reducing a large stock overhang. Exports by India, the second-largest cotton exporter after the United States, decline with stronger domestic demand, lower world prices, and a relatively stable currency against the dollar. Other exporters with depreciating currencies, such as Brazil and Australia, see higher local currency prices and gain market share.

- *Soybeans*. The projections of world import demand for soybeans fall 0.9-1.6 million tons (0.8-1.3 percent) annually in the near term and 2.9 million tons (2.3 percent) annually in the medium term. Declines in soybean imports are linked broadly to lower income growth, and consequent drops in animal product and feed demand, rather than changes in exchange rates and local currency prices. Import demand by China, by far the largest importer, is largely sustained as the impacts of weaker income growth and moderate depreciation of the yuan are mostly offset by lower world prices. Brazil's exports and market share expand in the near and, especially, medium term, driven by weaker internal demand and sharp depreciation of the *real*, contributing to sharply lower world prices. Argentina's exports rise in the near term, but additional impacts are likely because the 2016 USDA macroeconomic outlook did not include the recent peso devaluation and reduction of export taxes (fig. 12). The U.S. share of world soybean exports during 2015/16-2019/20 falls from 40 percent to 38 percent.

- *Soymeal.* Projected annual demand for global soymeal imports falls 0.4-0.7 million tons (0.7-1.1 percent) in the near term but increases 0.4 million tons (0.5 percent) in the medium term. While income and exchange rate changes weaken demand in developing-country markets such as Egypt, Indonesia, and Thailand, developed-country markets such as the EU increase imports of soymeal as prices decline. Among exporters, Brazil and Argentina, both with weaker domestic demand and weaker currencies against the dollar, expand exports and gain market share. In contrast, India, Other South America, and the EU, with more stable currencies, see lower local currency prices and reduce their exports. The U.S. share of world soymeal exports during 2015/16-2019/20 slips marginally from about 17 percent to 16 percent.

- *Soyoil.* In contrast to projected imports of most other major commodities, projected global soyoil imports increase in the near and medium term. Strong income growth and relatively stable currencies in India and China, the world's two largest soyoil importers, sustain their demand, more than offsetting the effects of weaker demand and depreciating local currencies in other developing markets. Overall, world soyoil trade increases an average of 2.8 percent per year during 2015/16-2019/20, and the U.S. share of global soyoil exports remains at about 11 percent.

Figure 12
Scenario 1: Impact of 2016 USDA macroeconomic outlook changes on soybean exporters[1]



[1]Change in export volumes under 2016 macroeconomic assumptions compared with 2015 macroeconomic assumptions.
Source: USDA, Economic Research Service.

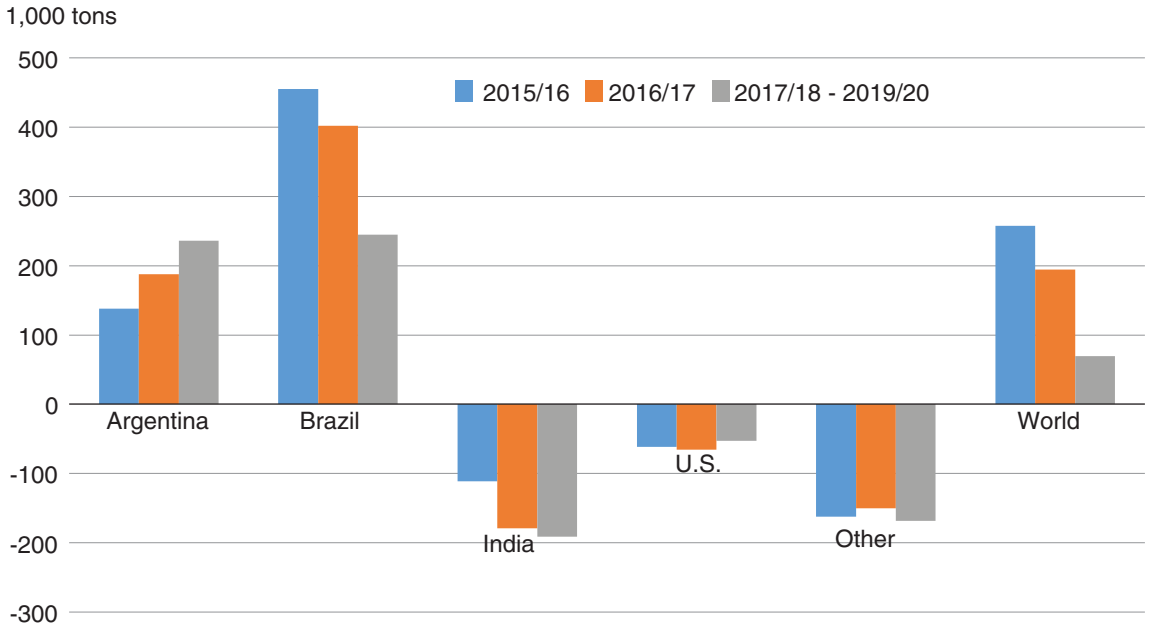
- *Beef and veal.* The projections of annual world imports of beef increase 0.2-0.3 million tons (2.1-2.9 percent) in the near term and negligibly in the medium term. Higher import demand is driven primarily by lower world prices stimulating demand in a number of developing regions, such as Egypt, the Middle East, and South America, where demand for beef is relatively price sensitive. Demand in these regions more than offsets reduced imports by other markets due to lower incomes (Russia) or depreciating currencies (Mexico). Argentina and Brazil, both with weaker domestic demand and weaker currencies against the dollar, expand exports and gain market share. India, the world's largest beef exporter, has a more stable currency, and its producers and exporters respond to lower local currency prices by reducing exports (fig. 13). The U.S. share of world beef exports during 2015/16-2019/20 slips marginally from about 14 percent to 13 percent.

- *Pork*. Projections of annual world pork imports are lower by an average of 0.1 million tons (1.4 percent) in the near and medium term as higher import prices and weaker demand reduce imports in developing-country markets such as Argentina, Mexico, and Taiwan, more than offsetting stronger demand in China and other markets benefiting from lower world and local currency prices. Brazil, with lower domestic demand and a sharply depreciated currency, expands exports, while the EU and Canada respond to lower world prices with lower exports. The U.S. share of world pork exports during 2015/16-2019/20 remains at about 35 percent.

- *Poultry.* The projections of global poultry imports decline marginally—about 0.6 percent annually—in the near and medium term. There are largely offsetting adjustments in markets having weaker demand and facing higher import prices in local currency terms, such as Mexico and West Africa, and in other markets, such as those in Central America and the Caribbean, that benefit from lower world prices and increase imports. Poultry is typically the lowest cost meat

Figure 13

Scenario 1: Impact of 2016 USDA macroeconomic outlook changes on beef exporters[1]



[1]Change in export volumes under 2016 macroeconomic assumptions compared with 2015 macroeconomic assumptions.
Source: USDA, Economic Research Service.

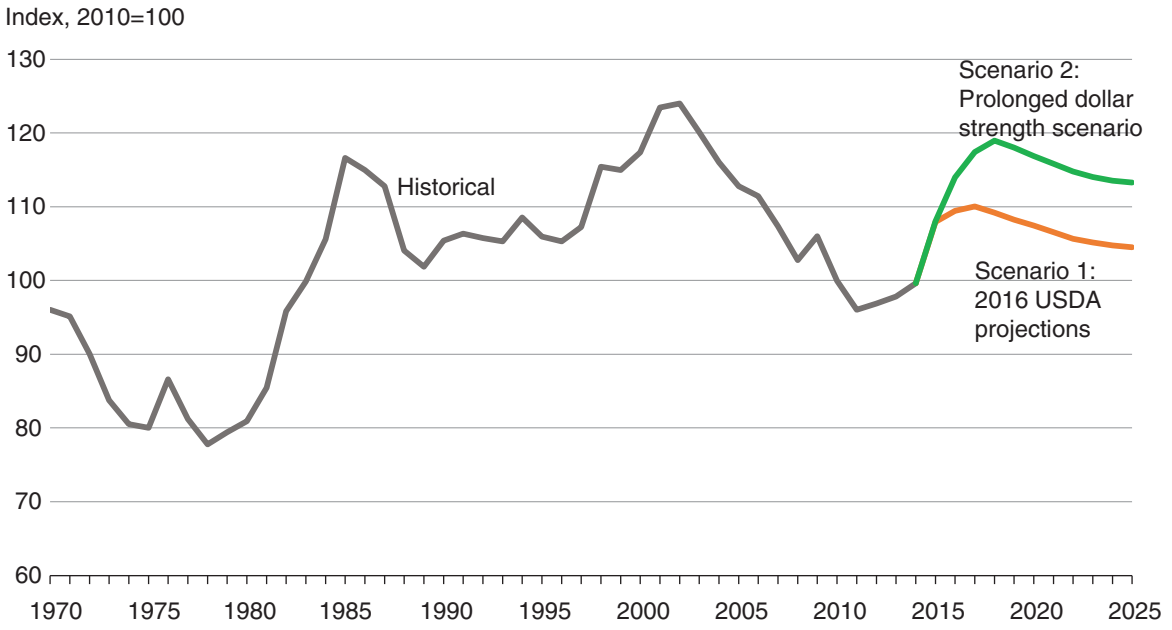
and faces relatively income- and price-elastic demand in developing-country markets. Brazil and Thailand, both major exporters with depreciating currencies against the dollar, increase exports in response to higher local currency prices, while exporters such as the EU and China respond to lower world prices with reduced exports. The average U.S. export market share during 2015/16-2019/20 declines from about 37 percent to 36 percent.

Impacts of Extended Dollar Strengthening on the 2016 USDA Projections

Unlike the previous scenario, which included both income and price effects associated with changes to income and exchange rate assumptions between the 2015 and 2016 USDA projections, this scenario examines only the effects on the 2016 USDA projections of a longer period of dollar appreciation than is included in the assumptions behind the 2016 projections. The degree and length of the period of dollar appreciation is a key uncertainty in the outlook for U.S. agricultural trade and prices. In the macroeconomic scenario underlying the 2016 USDA projections, dollar appreciation tapers off after 2017, followed by gradual depreciation through the end of the projection period (fig. 14). However, current economic conditions facing some key markets and competitors suggest that dollar appreciation may continue for a longer period. Moreover, historically, adjustments in the dollar's value have tended to occur over fairly long cycles.

For this scenario, we first adjusted near-term exchange rate assumptions to accommodate recent changes that occurred since the assumptions underlying the 2016 USDA projections were established in late 2015. Most notably, dollar appreciation relative to China and Argentina has been stronger than was assumed for the 2016 USDA projections. Next, following the same pattern of dollar strengthening against various currencies used in the 2016 USDA projections, we extended the period of dollar strengthening, at declining rates, through 2019. In aggregate, the resulting real trade-weighted exchange rate of the dollar is higher than that used in the 2016 USDA projections by 0.1 percent for 2015 (aligned for modeling purposes with the 2014/15 crop marketing year), 4.1 percent in 2016, 6.7 percent in 2017, and an average of 8.9 percent for 2018-20.

Figure 14
Historical real agricultural export-weighted dollar exchange rates and alternative projections



Note: Exchange rates weighted by 2009-11 average total U.S. agricultural exports by country.
Source: USDA, Economic Research Service (ERS) using ERS Agricutural Exchange Rate Data Set; and USDA Agricultural Projections to 2025.

To isolate the impacts of this extended dollar-strengthening scenario on the 2016 USDA projections, ERS's Country-Commodity Linked System (CCLS) was run using these alternative exchange rate assumptions, while holding all other variables at the levels used for the 2016 USDA projections. Thus, the results are estimates of the changes in U.S. and global trade and prices that are due to a scenario of extended dollar strength beyond that assumed for the 2016 USDA projections. While the previous scenario analyzed changes to both the income and exchange rate assumptions between the 2015 and 2016 USDA projections, this scenario examines only changes in exchange rate assumptions and related price effects. The impacts in this scenario are relatively straightforward; further dollar depreciation tends to raise local currency prices in other countries and either increase their exports or reduce their imports. The size and pattern of impacts depends on variation in the size of the exchange rate changes across countries and in the responsiveness of their markets to the resulting changes in domestic prices.

Impacts on U.S. Commodity Market Projections

As was the case during 2013-15, this alternative exchange rate scenario features relatively higher rates of currency depreciation for major commodity exporters than for commodity importers. The highest rates of depreciation in this scenario occur in Russia, Ukraine, and Other FSU (12), with lower, but still significant, rates of depreciation in Brazil, Argentina, Australia, and South Africa. With a prolonged period of dollar strengthening, foreign exporters become more competitive, and the results generally show foreign exporters expanding output and exports, leading to both lower world prices and lower U.S. market share. Although the Argentine exchange rate data have been updated, Argentina's competitive response is likely to be stronger than shown in this analysis because the data do not account for the impacts of the recent changes in export tax policy implemented by Argentina's new government.

The extended period of dollar appreciation leads to further projected reductions in world prices and U.S. exports of major commodities than those in the published 2016 USDA projections. Near-term (2015/16-2016/17) changes in world prices range from -0.9 to -4.9 percent for meats and from -2.4 to -7.8 percent for crops. In the medium term (2017/18-2019/20), price changes tend to be larger, ranging from -3.7 to -6.0 percent for meats and from -5.7 percent to -8.8 percent for crops (table 5). Percentage reductions in U.S. exports are largest for corn and wheat in both the near and medium terms and smallest for meats. Corn and wheat are hit hardest by the continuation of relatively high rates of depreciation against the dollar by competing Black Sea region exporters.

Almost across the board, percentage losses in projected U.S. exports are larger than the declines in world trade (table 5, fig. 15), implying a loss of U.S. market share. The overall impact on global commodity import demand is generally small, and actually positive for a number of commodities because, at a lower world price, countries with relatively stable exchange rates increase imports, more than offsetting declines by countries with greater depreciation. However, because the depreciation is strongest among commodity exporters, including those in the Black Sea region, Argentina, and Brazil, the impact on world prices and U.S. exports is larger than the impact on world trade volumes.

Table 5

Scenario 2: Additional impacts of a prolonged period of dollar strength on the 2016 USDA projections of U.S. commodity prices and trade

	Change in world $ price			Change in U.S. trade volume					
	Percent			*Percent change*			*Quantity change (1,000 tons)*		
Commodities\ crop years	2015/16	2016/17	2017/18 - 2019/20	2015/16	2016/17	2017/18 - 2019/20	2015/16	2016/17	2017/18 - 2019/20
					Exports				
Corn	-4.1	-6.5	-6.7	-5.1	-9.2	-14.1	-2,329	-4,593	-6,792
Sorghum	-5.4	-7.8	-7.5	-2.7	-4.2	-5.4	-225	-215	-205
Wheat	-3.8	-7.1	-8.1	-4.8	-7.6	-5.8	-1,046	-2,057	-1,559
Rice	-2.4	-4.6	-5.7	-1.9	-2.3	-3.2	-59	-82	-117
Cotton	-3.3	-5.3	-6.2	-3.0	-2.4	-3.2	-66	-61	-84
Soybeans	-4.1	-6.8	-8.6	-1.7	-2.2	-1.9	-795	-1,080	-920
Soymeal	-3.9	-6.0	-7.0	-0.7	-2.0	-4.3	-80	-193	-476
Soyoil	-3.4	-6.0	-8.8	-3.4	-6.9	-9.3	-35	-65	-96
Beef & veal	-0.9	-1.9	-3.7	-1.0	-2.0	-2.2	-10	-23	-27
Pork	-2.2	-4.9	-6.0	-1.0	-1.4	-1.7	-24	-36	-42
Poultry	-1.7	-3.0	-3.7	-1.3	-1.9	-1.9	-46	-76	-84
					Imports				
Beef & veal	-0.9	-1.9	-3.7	1.1	2.6	3.6	16	31	36
Pork	-2.2	-4.9	-6.0	1.2	1.9	2.7	5	8	10

Notes: Impacts on 2016 USDA projections of a scenario that extends the period of gradually declining dollar strength against major global currencies into 2019/20. China and Argentina exchange rate assumptions are also updated to account for recent policy changes. U.S. crop price changes are based on world prices. U.S. meat price changes are based on domestic prices.

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

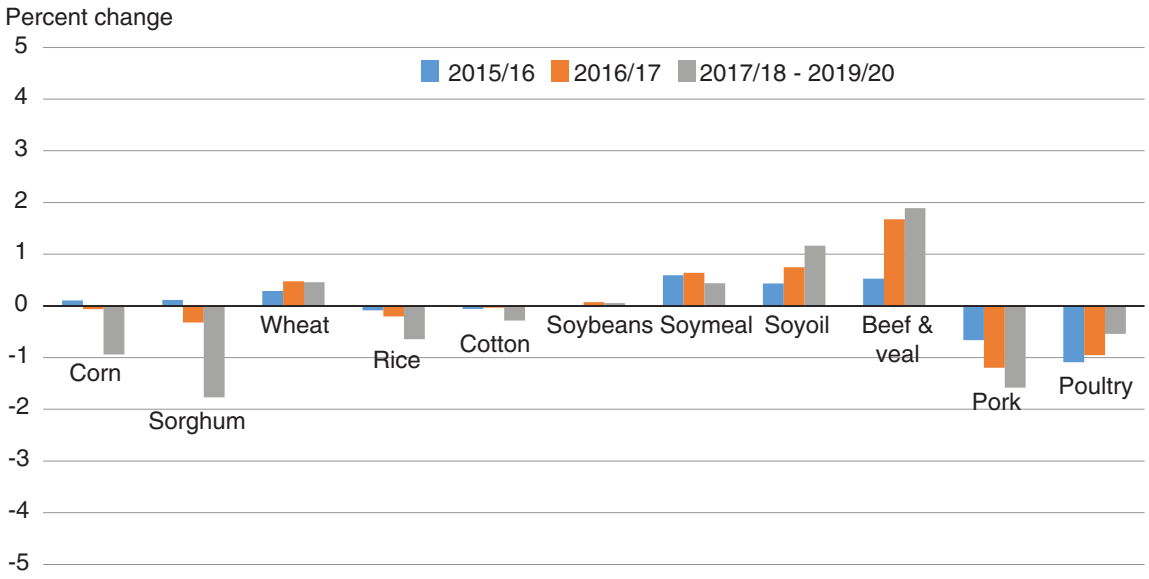
Global Commodity Market Impacts

- *Corn:* While projected world corn prices decline further, near-term impacts on corn import demand are negligible, as the changes in markets with appreciating and depreciating currencies are largely offsetting. In the medium term, the additional decline in import demand and prices becomes more significant as depreciation raises local currency prices, lowers consumption, and reduces import demand, particularly in relatively price-responsive developing-country markets, such as North Africa and Turkey. Exporters with relatively high rates of depreciation—and increases in local currency prices—such as Ukraine and Argentina, expand exports and market share relative to Brazil and the United States (fig. 16).

- *Wheat:* In the wheat market, lower projected import demand in countries undergoing further depreciation is more than offset by increased imports by other countries with more stable currencies that import more wheat at lower world prices. Bangladesh and Egypt, for example, respond with increased wheat imports, while Morocco, Other North Africa, and West Africa reduce imports. With an extended period of dollar strengthening, most foreign exporters further expand exports at the expense of U.S. wheat, with the largest gains in Ukraine and Other FSU (fig. 17). Again, the export response by Argentina is likely underestimated because the analysis does not account for the recent removal of wheat export taxes.

Figure 15

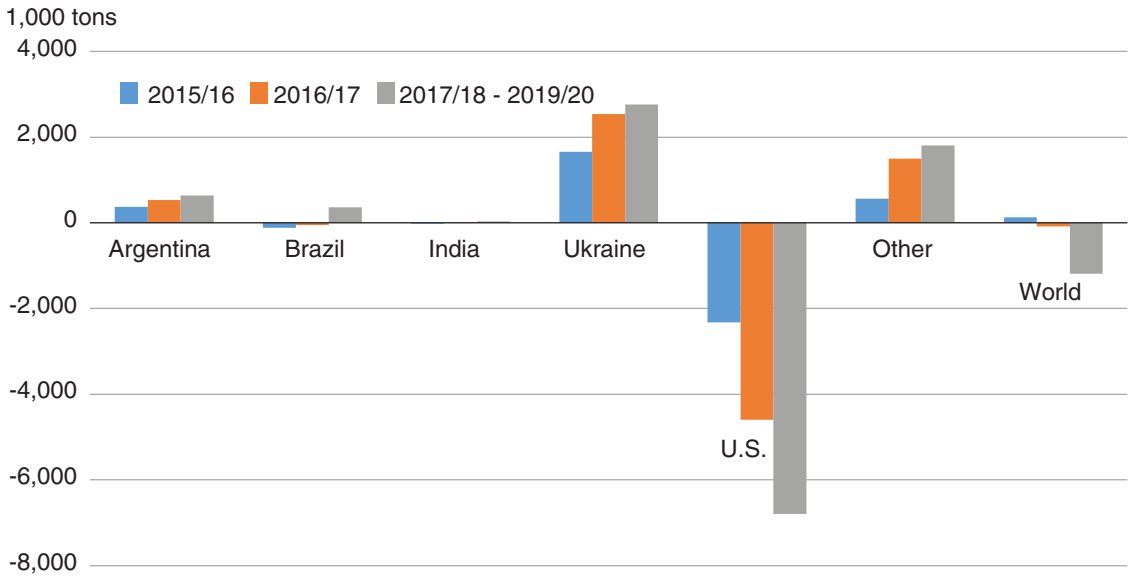
Scenario 2: Impact of extended period of dollar strengthening on 2016 USDA projections of global trade[1]



[1]Change in 2016 USDA global trade volume projections in a scenario that extends the period of gradual dollar strengthening into 2019.
Source: USDA, Economic Research Service.

Figure 16

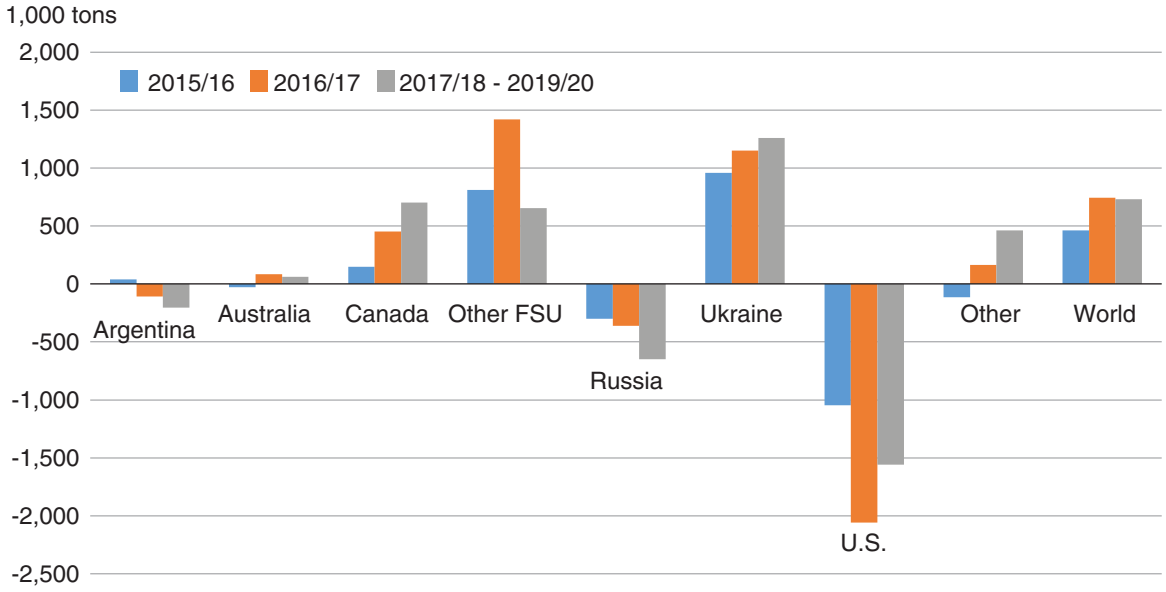
Scenario 2: Impact of extended period of dollar strengthening on 2016 USDA projections of corn exports[1]



[1]Change in 2016 USDA global export volume projections in a scenario that extends the period of gradual dollar strengthening into 2019.
Source: USDA, Economic Research Service.

Figure 17

Scenario 2: Impact of extended period of dollar strengthening on 2016 USDA projections of wheat exports[1]



FSU = Former Soviet Union.

[1]Change in 2016 USDA global export volume projections in a scenario that extends the period of gradual dollar strengthening into 2019.

Source: USDA, Economic Research Service.

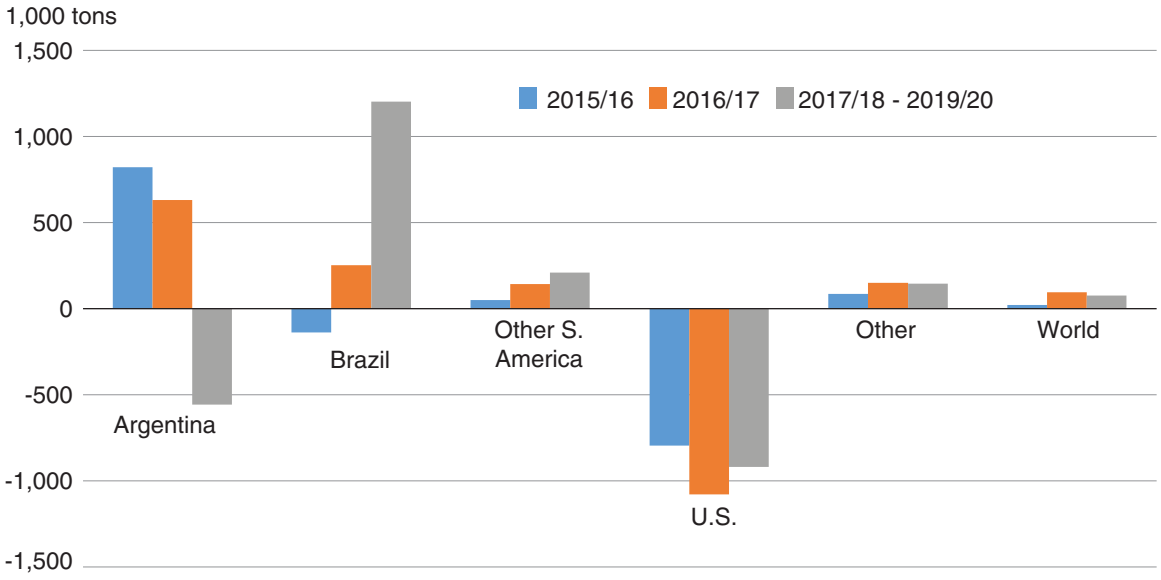
- *Rice:* Projected rice market impacts are found to be relatively small as reduced import demand in markets with additional depreciation (like West Africa) are offset by increased demand in markets with more stable currencies (Indonesia, Philippines). The responses of foreign exporters are relatively small, with countries such as Burma and India, which have relatively stable currencies, reducing exports as they see lower local currency prices, and others, such as Brazil and Argentina, seeing higher prices in local currency terms and expanding exports.

- *Cotton:* Overall impacts on projected demand for cotton imports are relatively small, with largely offsetting impacts from importers with depreciating currencies (such as Turkey) and those with more stable currencies (China, Indonesia). For China, recently the world's largest cotton importer, changes in its exchange rate are likely to be a less significant factor in its cotton imports in the near and medium term than its policies for managing its large cotton reserves. Reponses of most foreign exporters are small except for Other FSU, which responds to relatively sharp depreciation with a large increase in exports.

- *Soybeans and products*: Impacts on projected demand for soybean imports are relatively small, as declines in markets with higher rates of depreciation (such as China, Mexico, and South Africa) offset increases in markets with more stable currencies. Demand for soymeal and soyoil imports increases as meal importers such as Indonesia, the EU, and Other South America and oil importers such as India and Bangladesh respond to falling prices by expanding imports. With relatively high rates of depreciation against the dollar, Argentina and Brazil expand their shares of the soybean market, while the United States sees its share decline (fig. 18).

Figure 18

Scenario 2: Impact of extended period of dollar strengthening on 2016 USDA projections of soybean exports[1]



[1]Change in 2016 USDA global trade volume projections in a scenario that extends the period of gradual dollar strengthening into 2019.
Source: USDA, Economic Research Service.

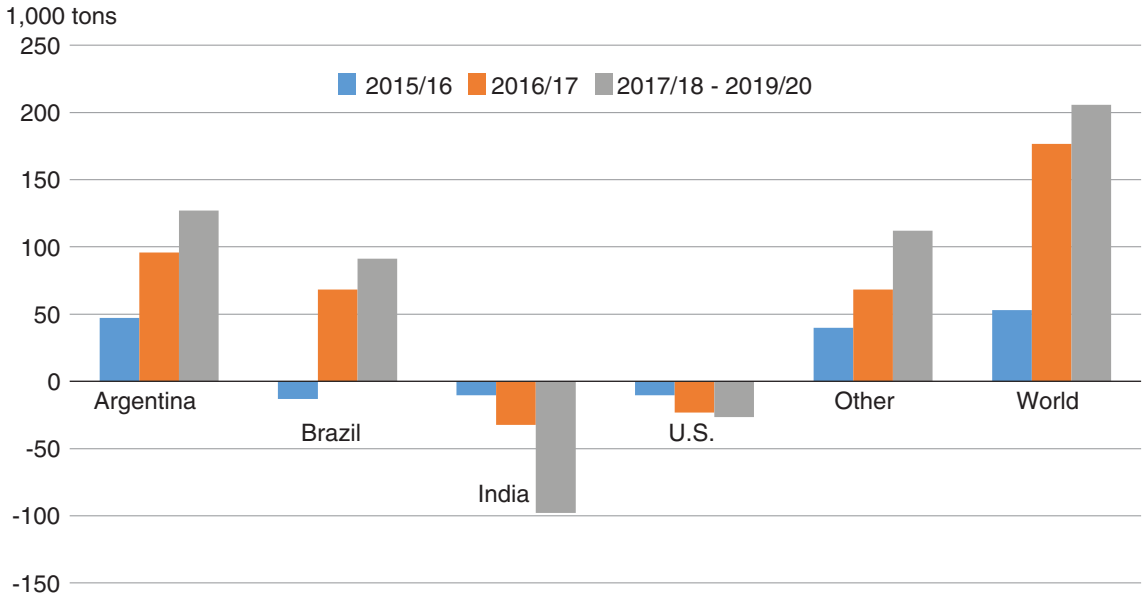
- *Beef & veal:* Overall impacts on projected demand for beef imports are relatively small, although an array of importers with relatively stable exchange rates, including China, Other Asia, and Other Middle East, respond to lower prices by importing additional quantities of beef. With relatively high rates of depreciation against the dollar, Argentina and Brazil further expand exports and gain market share relative to India, the world's largest beef exporter (fig. 19).

- *Pork:* Impacts on global import demand and price projections for pork are large compared with those for beef, primarily because of large estimated declines in pork imports by Russia and Argentina in response to the further depreciation of their currencies. Other pork importers, including China, Mexico, and South Korea, import more pork in response to lower world prices. The United States, the EU-28, and Canada reduce exports in response to lower world and domestic prices.

- *Poultry:* Impacts on projected demand for poultry imports are relatively large compared with those for beef, primarily because of large estimated declines in Russian poultry imports in response to the depreciation of the ruble. Declines in Russian imports are only partially offset by increases by other importing regions, such as Central America, the Caribbean, Egypt, Mexico, Other Middle East, and Japan, that respond to lower world and local currency prices by expanding imports. With a relatively strong drop in global import demand and prices, most major poultry exporters, including Brazil, the EU-28, Thailand, and the United States, respond by reducing exports.

Figure 19

Scenario 2: Impact of extended period of dollar strengthening on 2016 USDA projections of beef exports[1]



[1]Change in 2016 USDA global trade volume projections in a scenario that extends the period of gradual dollar strengthening into 2019.
Source: USDA, Economic Research Service.

Conclusions

Global and U.S. agricultural export growth is tied closely to rising incomes in developing-country markets in Asia, Latin America, the Middle East, and Africa. In these regions, consumers tend to spend a larger share of additional income on food than do consumers in higher income countries. During FY2000-2015, U.S. export volumes to developing countries grew 3.4 percent annually while exports to developed markets declined 0.7 percent annually.

U.S. agricultural exports are also tied closely to the value of the dollar relative to the currencies of U.S. export markets and competitors. Since 2014, the appreciation of the dollar against most currencies, including a pattern of relatively strong appreciation against the currencies of major competitors, has generally reduced the demand for and competitiveness of U.S. agricultural commodities. U.S. exports of bulk commodities are particularly sensitive to changes in the value of the dollar. Consumer-oriented goods, which account for a large (about 46 percent) and growing share of U.S. agricultural exports, appear to be less sensitive to the changes in the dollar's value.

The current near-term (2016-17) and medium-term (2018-20) macroeconomic outlook, reflected in the 2016 USDA projections, includes substantially slower global GDP growth and a stronger dollar against the currencies of major U.S. agricultural markets and competitors than in the macroeconomic scenario underlying the previous USDA projections released in 2015. Changes in the macroeconomic outlook are substantial and have significant implications for both global import demand and competition faced by U.S. agricultural exporters.

The changes in the macroeconomic outlook underlying the 2016 USDA projections led to estimated reductions in projected world prices ranging from 3 to 16 percent in the near term and 5 to 19 percent in the medium term, compared with the 2015 USDA projections. The largest price impacts are for crops, with relatively smaller impacts for meats. Percentage reductions in projected U.S. export volumes are largest for corn, wheat, and rice. Almost across the board, percentage declines in U.S. exports are larger than those in world trade, indicating reduced U.S. market shares.

In a scenario that explores only the impact of an extended period of dollar appreciation beyond that assumed in the 2016 USDA projections, results indicate further reductions in projected world prices and U.S. exports of major commodities. Declines in U.S. exports are again larger for crops than for meats. U.S. exports of corn and wheat are hit hardest by continued dollar appreciation against competing Black Sea region exporters. Again, most estimated percentage losses in U.S. exports are larger than those in world trade, indicating further losses in U.S. export market shares.

An important feature of recent global exchange rate developments, reflected in both the 2016 USDA projections and the scenario of extended dollar strengthening analyzed in this report, is that the currencies of major foreign commodity exporters continue the recent pattern of relatively high rates of depreciation against the dollar. Thus, in a global economic environment where slowed income growth and weakening currencies is slowing import demand in many agricultural markets, U.S. exporters also become less competitive and lose export market share.

China, the largest U.S. agricultural export market as of FY2015, shows relatively minor impacts from macroeconomic changes in this analysis for two reasons. First, the underlying assumptions of slowed income growth and modest exchange rate depreciation for China during 2015-20 are similar in both the 2015 and 2016 USDA projections. Second, with China currently accumulating excess stocks of major commodities under current domestic and trade policies, import demand is expected to be relatively unresponsive to changes in world prices until policies are modified and stocks reduced.

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Appendix I—Comparison of Assumptions Used in 2015 and 2016 USDA Projections

Appendix table 1-1

Per capita real GDP growth: Comparison of assumptions used in 2015 and 2016 USDA projections

	2016 USDA projections			Change from 2015 projections		
	2015	2016	2017-20	2015	2016	2017-20
	Growth rate			*Change in growth rate*		
World	1.34	1.90	2.08	-0.71	-0.37	-0.32
United States	1.56	2.21	1.87	-1.22	0.03	-0.02
Latin America	-1.26	-0.07	1.62	-2.30	-2.15	-1.19
European Union-28	1.62	1.82	1.63	0.11	0.07	-0.17
Former Soviet Union	-3.33	-0.45	2.77	-1.19	-0.85	-0.35
East Asia	3.62	3.78	3.43	-0.23	-0.38	-0.82
Southeast Asia	3.39	3.63	3.97	-0.94	-0.58	-0.04
South Asia	5.82	6.33	6.45	1.08	1.15	0.53
Middle East	0.96	1.64	2.59	-1.47	-1.18	-0.17
North Africa	1.50	1.70	3.03	-2.56	-3.14	0.14
Sub-Saharan Africa	1.02	1.68	2.38	-2.04	-1.80	-0.71
Oceania	1.36	1.49	1.75	-0.40	-0.08	0.25
Developed	1.36	1.85	1.62	-0.55	0.05	-0.01
Developing	2.56	3.02	3.50	-1.00	-0.97	-0.69

Sources: USDA, Economic Research Service (ERS) using USDA Agricultural Projections to 2024; USDA Agricultural Projections to 2025; ERS International Macroeconomic Data Set.

Appendix table 1-2

Real exchange rate: Comparison of assumptions used in 2015 and 2016 USDA projections

	2016 USDA projections			Change from 2015 projections		
	2015	2016	2017-20	2015	2016	2017-20
	Growth rate			*Change in growth rate*		
United States[1]	8.34	1.41	-0.47	8.23	1.31	-0.73
Latin America	11.13	4.32	-0.48	12.34	3.79	-2.20
European Union-28	2.68	1.69	-1.63	-2.39	1.38	-1.07
Former Soviet Union	33.01	-5.17	-0.67	29.79	-6.57	-0.49
East Asia	6.41	2.45	0.73	6.27	1.46	-0.06
Southeast Asia	5.62	2.93	-0.75	-0.16	5.72	0.34
South Asia	-1.26	-0.17	-0.07	-0.62	0.48	0.41
Oceania	18.24	5.68	-1.40	17.72	0.95	-2.45
Middle East	6.62	2.45	-3.28	9.42	3.97	-2.10
North Africa	4.73	-2.32	-3.17	9.01	1.97	-0.30
Sub-Saharan Africa	9.89	-0.74	-1.09	12.12	1.19	-1.77

Note: For foreign countries, a positive number means depreciation vs. dollar.
[1]U.S. agricultural trade-weighted exchange rate. Positive number means dollar appreciation.

Sources: USDA, Economic Research Service (ERS) using USDA Agricultural Projections to 2024; USDA Agricultural Projections to 2025; ERS International Macroeconomic Data Set.

Appendix II—Data and Methods for Estimating Relationship Between U.S. Agricultural Exports, Foreign Income Growth, and the Exchange Rate of the U.S Dollar

Based on literature reviews, the following model is specified to relate U.S. real agriculture export growth (ΔEX_t) to the real effective agricultural trade- weighted exchange rates ($\Delta REEX_t$) of the dollar and real foreign income growth ($\Delta Y_{i,t}$).

$$\Delta EX_t = \Delta REEX_t + \Delta Y_{i,t} + \varepsilon_t$$

The literature suggests different ways to measure foreign income growth. For instance, Shane et al. (2008) used trade-adjusted foreign real GDP minus exports. Bernard and Jenson (2004) and Nie and Taylor (2015) used a trade-weighted foreign real GDP growth measured as

$$Y_{i,t} = \sum_{k=1}^{K} \left(\frac{x_{i,t}^{k}}{x_{i,t}} \right) GDP_t^k$$

where $x_{i,t}^{k}$ is U.S. exports to country k of commodity type i and $x_{i,t}$ is total U.S. exports of commodity type i. Bernard and Jenson examined the relationship between firm-level export growth, industry-level foreign demand as defined above, the industry export-weighted real exchange rate, and firm-level productivity. Nie and Taylor (2015) studied the economic growth and exchange rate effecting U.S. export growth at the country and regional level. In estimating the factors affecting Chinese exports, Oxford Economics (OE, 2015) used lag values of foreign real demand.

Here, we specify commodity, i, consisting of bulk, intermediate, consumer-oriented, and total agricultural exports; and formulate the foreign income growth demand based on these agricultural commodities. For each aggregate, we specify a commodity-specific trade-weighted lagged foreign real Gross Domestic Product growth variable and a commodity specific trade-weighted real U.S. dollar exchange rates as:

$$\Delta EX_t = \beta_0 + \beta_1 \Delta REEX_t + \beta_1 \Delta Y_{i,t-1} + \varepsilon_t$$

The data for estimating the above regression come from multiple sources. U.S. agricultural export value data are from the Global Agricultural Trade System (USDA, FAS). Real U.S. dollar export-weighted exchange rates are from the Agricultural Exchange Rate Data Set (USDA, ERS, 2015a). Export weights used in computing the exchange rates are derived using 2009-11 data from the Global Agricultural Trade System (USDA/FAS) and FAOSTAT (Food and Agriculture Organization). Foreign real Gross Domestic Product (GDP) data are from International Macroeconomic Data Set (USDA, ERS, 2015b). Foreign GDP and U.S. exchange rate data are export-weighted using the same trade weights. U.S. agricultural trade and exchange rate are converted to real values using the U.S. GDP deflator obtained from the Bureau of Economic Analysis, with a 2010 base year. All data are on a U.S. October/September fiscal year basis.

To check for robustness, the literature suggests including other factors such as lags of U.S. real GDP growth, measures of trade openness, and real oil prices in the regression model (Nie and Taylor, 2013). In this case, we included oil price growth rate as a potential influence on U.S. exports when oil price inflation is significantly different from the general rate of inflation:

$$\Delta EX_t = \beta_0 + \beta_1 \Delta REEX_t + \beta_2 \Delta Y_{i,t-1} + \beta_3 \Delta oil_t + \varepsilon_t$$

The results indicate that changes in oil prices Δoil_t do not have a significant impact on U.S. agricultural exports. And, with the exception of bulk commodities, inclusion of the oil price variable does not significantly change the results for either the GDP or exchange rate variables. For bulk commodities, inclusion of the oil price reduces the exchange rate effect by about 25 percent, but bulk commodities remain more sensitive to exchange rate movement than with intermediate or consumer-oriented goods.