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Reforming Market Access in Agricultural Trade: Tariff Removal and the Trade Facilitation Agreement

Jayson Beckman





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Abstract

Twenty-five years after World Trade Organization member countries agreed to agricultural policy reforms embodied in the Uruguay Round Agreement on Agriculture of 1994 (URAA), multilateral efforts to reduce barriers to agricultural trade have largely stalled. This report estimates the potential gains in global trade and welfare (societal well-being) from two trade reform scenarios: elimination of agricultural tariffs, and a reduction in agriculture trade costs through implementation of the Trade Facilitation Agreement (TFA). Simulations reveal that reducing trade costs through the TFA could increase trade value by 7.27 percent. Removing agricultural tariffs could lead to an even larger global increase in trade value of 11.09 percent. Both scenarios would lead to an increase in societal well-being of \$42.9 billion and \$56.3 billion annually (respectively). This would represent gains to the global agricultural sector of a little more than 2 percent for each scenario. Although these gains represent an increase in agricultural market access, other market access barriers remain (e.g., nontariff measures).

Keywords: Trade, Computable General Equilibrium Model, CGE, tariffs, Gross Domestic Product, GDP, Tariff Facilitation Agreement.

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Errata

On June 25, 2021, text on South Korea's corn tariff and the accompanying data point on the global corn tariff in the second figure were revised to correct errors that occurred in data transmission. No other data was affected by the error.



Reforming Market Access in Agricultural Trade: Tariff Removal and the Trade Facilitation Agreement

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What Is the Issue?

The Uruguay Round Agreement on Agriculture (URAA) and the founding of the World Trade Organization (WTO) in 1995 led to new rules in the areas of market access, domestic support, and export subsidies. Despite substantial growth in agricultural trade since 1995 (243 percent in 2018, in nominal terms), market access is still limited, in particular by high agricultural tariffs (relative to nonagricultural products). The goal of further negotiations has been to continue the process of agricultural policy reform begun in the URAA, and some progress has been made in the Trade Facilitation Agreement (TFA). However, while the number of bilateral and regional trade agreements (RTAs) that grant market access on a preferential basis has increased, multilateral negotiations have slowed.

As an aid to understanding the potential benefits of improved market access, this report provides a quantitative analysis of two scenarios: completely removing all agricultural tariffs or reducing agricultural trade costs in the context of TFA implementation. For each of these reforms, we report resulting changes in trade, production, prices, and welfare (societal well-being).

What Did the Study Find?

The analysis of the two reform measures indicates that each scenario, if undertaken separately, would increase global agricultural trade. However, removal of agricultural tariffs would result in larger trade gains and welfare improvement than implementing the TFA agreement.

Scenario 1: Removal of Agricultural Tariffs

- Removing agricultural tariffs is projected to lead to a global increase in trade value of 11.09 percent. This is close to the average global tariff on agricultural products (10.33 percent).
- The removal of agricultural tariffs is estimated to lead to increases in the value of total agricultural exports and imports for all regions except the European Union. By commodity type, increases are projected for all sectors except live animals.
 - Rice, beef, and other meats (mainly poultry and pork) would experience the largest increase in export trade value, as removal of their relatively high average global tariffs would reduce the resulting larger barriers to trade.
 - A projected decrease in the EU's exports is largely due to an estimated increase in its imports of beef and other meats—commodities for which the EU has large tariffs in place. The increase in imports displaces domestic production, leading to less product to export.

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

- The region with the highest tariffs, India, is also the region with the largest estimated increase in agricultural imports.
- Changes in production due to tariff removal are mixed, with just over half of the regions projected to undergo a decrease as production shifts to more efficient producers. The regions that would experience production declines tend to be those with the highest tariffs in place; some regions cite protection of agricultural employment and food self-sufficiency as reasons for retaining their tariffs.
- Tariffs act as a tax on imports, and removing them leads to a reduction in the market price for many commodities. Of the 20 regions in the model, 12 are projected to see a reduction in the average price for all agricultural products, which would help bolster food security by reducing consumer prices.
- Global welfare is projected to increase by \$56.3 billion annually if all tariffs are removed (this is a little more than 2 percent of the global value of the agricultural sector). The EU would have the largest increase in welfare due to its reallocation of resources from commodities with high tariffs (and low productivity) to other uses. The results indicate some welfare improvements from nonagricultural sectors, but most of the increase is related to agriculture.

Scenario 2: Implementation of the Trade Facilitation Agreement for Agriculture (with nonagriculture not considered)

- All regions except for Argentina would have an increase in aggregate agricultural export trade values in the TFA scenario.
 - Reducing trade costs through the TFA could increase agricultural trade value by 7.27 percent.
 - The TFA scenario finds that low-middle-income regions would have the largest export gains from more streamlined release and clearance of agricultural goods.
 - Like the tariff-removal scenario, meats are projected to have the largest gains in export value, but milk products and rice also benefit. Trade in these commodities stands to increase because they tend to have high tariffs, and demand for meats and milk products is responsive to income growth resulting from falling commodity prices.
- A double-digit increase in aggregate imports is projected for all regions, above 20 percent for most.
- Most regions have a decrease in aggregate agricultural production. Increases only occur for Brazil, the non-EU part of Europe, Indonesia, and “AgExp” (which consists of countries among the top 20 global agricultural exporters as of 2014 that do not appear in another group). Each of these four regions specializes in the production/export of certain commodities, which leads to the increase of the commodities in aggregate production.
- The estimated increase in global societal welfare of \$42.9 billion annually is largely due to lower consumer prices for imports of commodities in the EU. A larger proportion of welfare gains from the TFA scenario accrue to nonagricultural sectors compared to the tariff-removal scenario.

How Was the Study Conducted?

The study analyzes two agricultural trade policy scenarios using a modified version of Global Trade Analysis Project’s (GTAP) static computable general equilibrium (CGE) model with the GTAP v.10 2014 database (the latest GTAP data available). A CGE model is a large system of equations and data that links commodities, regions, and economic agents together to calculate the potential impacts of a change in policy. To allow for more precise analysis of the agricultural sector, the analysis disaggregates agriculture into 16 commodities and 20 regions, some consisting of individual countries and others of a group of countries. The model is referred to as ERS-GTAP, and the results are given in percentage changes except for welfare, which is reported in dollars. Effects from trade are in terms of changes in relative values, not in volume.

Reforming Market Access in Agricultural Trade: Tariff Removal and the Trade Facilitation Agreement

Introduction

The Uruguay Round Agreement on Agriculture (URAA) and the subsequent founding of the World Trade Organization (WTO) in 1995 led to a change in trade rules for agriculture, with new disciplines in the areas of market access (tariffs and specific nontariff measures), domestic support, and export subsidies. As agreed in the URAA, the goal of further negotiations is to continue the process of agricultural policy reform begun in the Uruguay Round. However, further multilateral negotiations have slowed, and the incidence of bilateral and regional trade agreements (RTAs) that grant trade liberalization on a preferential basis has grown; as of September 2020, WTO notes that there are 306 RTAs in force (WTO, 2020). While these RTAs have led to some trade liberalization, the landscape of policies affecting agricultural trade is increasingly complex and complicated by other policies that may inhibit trade growth. In addition, the acceleration of regionalism through RTAs has changed the environment for multilateral trade reforms. That is, countries that are a part of an RTA can have preferential market access through lower tariffs. Global reforms have the potential to expand trade access to all countries.

The multilateral framework of agricultural trade rules established by the URAA remains the point of departure for most agricultural trade analyses. However, some trade policies have evolved in response to additional commitments established through WTO Ministerial declarations and other bilateral/regional trade agreements, as well as broader changes in the global economy. Nonetheless, even with these changes, distortions in agricultural trade remain. In particular, high tariffs and tariff-rate quotas (TRQs—instruments that set a lower tariff on a limited amount of imports) continue to impede market access for many products. While there have been some lower trends in the overall level of trade-distorting domestic support, some countries, including the BRIICs (Brazil, Russia, India, Indonesia, and China), have substantially increased domestic support to their farmers (Beckman et al., 2017). The third area of focus in the URAA, export competition, has undergone the most reform through the WTO Ministerial process, with export subsidies scheduled to be eliminated and new disciplines for international food aid, state trading enterprises, and export credits. However, the use of other export intervention measures, in particular, export restrictions—which were not disciplined in the URAA—has increased. (See Box: Export Interventions.) This report focuses on the potential impacts of increasing market access for several reasons: First, research has traditionally identified tariffs as the largest source of global economic costs from agricultural policy distortions (Anderson et al., 2006; Effland et al., 2006; Chang and Kazunobu, 2010), and second, export subsidies have largely been eliminated and domestic support presents modeling challenges (see Box: Modeling Domestic Support).¹

¹In addition, some domestic support programs are countercyclical, meaning that support levels are generally lower in years when commodity prices are higher. Therefore, the scenario results may vary depending on the base year used for the analysis. Tariffs are less variable, and the scenario results are therefore less sensitive to the base year.

Export Interventions

Governments generally encourage exports as a source of national income and production, which implies they are more likely to subsidize exports rather than tax them. However, export subsidies have faded in importance and are scheduled to be eliminated as part of the multilateral agreement reached at the 10th World Trade Organization (WTO) Ministerial Meeting in 2015. Under the Ministerial Decision, WTO-defined developed-country members agreed to immediately eliminate all export subsidies, with some developed countries afforded leeway to eliminate export subsidies by the end of 2020 for certain products (pork, processed food, and dairy) that they had notified in a specific prior period.*

Developing countries agreed to eliminate export subsidies by the end of 2018, with additional flexibility for certain types of transportation export subsidies, which must be eliminated by 2023—and by 2030 for Least Developed Countries (LDCs) and certain net food importing developing countries. By 2014, member countries reported \$175 million in total subsidies notified to the WTO, compared to \$6.5 billion in 1995 (Beckman et al., 2017). However, some countries do not report export subsidies to the WTO (perhaps maintaining that they are not a subsidy), such as India's export subsidy for sugar (Beckman et al., 2017).

Export taxes, the opposite of export subsidies, have received less scrutiny in multilateral trade negotiations than other, more visible trade instruments such as tariffs, tariff-rate quotas, and export subsidies. This is partly because they do not restrict market access, but rather the amount of products supplied on the world market (Beckman et al., 2019). Although export taxes are only used by 36 countries, those countries tend to be of two types: major grain exporters and lower-income importers of agricultural commodities. The commodities that typically have export taxes in place are rice and other grains. Argentina has used export taxes the most, with an export tax on almost all agricultural commodities. In 2015, Argentina reformed its system of export taxes, reducing or even eliminating them for some products. However, the Government suspended export tax reductions in 2018 and reintroduced additional tariffs on corn, wheat, and soybeans.

The Organization for Economic Cooperation and Development (2017) noted that export tax reform could have significant production and trade impacts for beef and grains with no export tax. Results by Beckman et al. (2019) show that global export tax removal would only impact a few goods—wheat, coarse grains, and beef—and it would not have a widespread impact on international agricultural prices or trade.

*Notifications are transparency obligations requiring WTO member governments to report trade measures to the relevant WTO body if the measures might have an effect on other members

While the URAA contains disciplines for market access, domestic support, and export competition, other measures that affect agricultural trade may be covered under separate WTO Agreements and provisions. These are typically referred to as nontariff measures (NTMs), and examples include regulatory measures (such as sanitary, phytosanitary, or technical regulations), import licensing, and customs procedures. Data on NTMs are limited, and the information sources available are difficult to quantify. Therefore, we did not include NTMs in the scenarios presented in this report. However, as noted in Beckman and Arita (2016), sanitary and phytosanitary measures are increasingly viewed as the most significant policy barriers for agricultural trade. Additionally, Jafari et al. (2018) noted that NTMs have increased in use, especially in trade between developed countries. Accordingly, we note that we are likely understating the gains from tariff removal for two reasons:

Modeling Domestic Support

Countries support agriculture with a variety of domestic instruments, including output subsidies, input subsidies, farm household income transfers, price support payments, and other payments that provide sectorwide support, such as extension and research. Domestic support has evolved over time, with developed countries moving toward providing partially or fully decoupled support (payments not tied to production or prices) and developing countries moving away from taxing agriculture to providing subsidies (Beckman et al, 2017).

Modeling the effects of changes in domestic support presents several challenges. First, there is a significant lag in World Trade Organization (WTO) notifications of domestic support. These notifications are often very outdated (Beckman et al., 2017), especially with respect to the 2014 base year for our economic model. Second, the data and information in these notifications are not easily translated into the economic model database. Rather, the model uses information from the Organization for Economic Cooperation and Development (OECD) in what is often called the “PSE” framework. This framework provides an indicator of the value of transfers from domestic consumers and taxpayers to agricultural producers (the producer support estimate, or PSE). The PSE includes measures that are traditionally viewed as domestic support: direct subsidies to outputs and inputs, along with measures that create price effects in a domestic economy such as tariffs, quotas, and other trade restrictions and licensing or other nontariff measures (Greenville, 2017). However, there is no direct translation from WTO notifications to OECD data since they use different measures (Beckman et al., 2017). In addition, OECD PSE data do not cover every country in the world; although they provide data on the largest economies, only about a third of all countries are covered.

Third, domestic support is very complex and is difficult to represent in an economic model, given the different types of programs countries have in place. Some recent work more accurately represents the EU domestic support program (Boulanger et al., 2019) and the move toward crop insurance programs such as those used by the United States (Gohin, 2019); however, these data efforts have not been readily adapted in the Global Trade Analysis Project (GTAP) framework for all regions.

First, due to the point made in Beckman and Arita (2016) that concomitant removal of both NTMs and tariffs could lead to an effect much larger than from each removal on its own (e.g., synergism in trade gains); and Second, many NTMs can result in prohibitive costs that lead to zero or small trade situations that may constrain trade gains captured in CGE models. The issues arise due to the modeling structure of standard GTAP frameworks, where gains are projected on volume-weighted shares (van Tongeren et al., 2007). When trade is small or zero prior to a liberalization scenario, elimination of tariffs—even very large tariffs—will likely result in limited gains.

However, it is possible to analyze the impacts of implementing the Trade Facilitation Agreement (TFA) from the 2013 Bali Ministerial Conference on agricultural trade. The agreement entered into force in 2017 after two-thirds of WTO countries ratified it. The TFA contains provisions to expedite the movement, release, and clearance of goods and establishes provisions for customs cooperation.

Using the Global Trade Analysis Project (GTAP) database and model (Appendix 1 and 2), this report provides a quantitative analysis of reducing market access barriers and trade costs, through the elimination of tariffs and TRQs, and through implementation of the TFA (see Appendix 2 for modeling information).² An ERS report in 2017, *The Global Landscape of Agricultural Trade, 1995-2014* (Beckman et al., 2017) provided information on these barriers, detailing how policies have changed since the URAA. Our work here provides the qualitative analysis of that report with some numbers, enabling us to explore which trade barrier removal could generate the most global trade.

²Most tariffs are ad valorem, that is, they are a percentage of the import value. (However, there are important exceptions (Beckman et al., 2017)). Thus, converting all types of tariffs and TRQs to ad valorem equivalents (AVEs) provides a uniform measure for analysis. Any reference to tariffs in the rest of the paper refers to the AVE estimates for both tariffs and TRQs.

Tariffs

A review of country tariff profiles (World Tariff Profiles 2019, WTO, 2019b) indicates that of the 114 countries that reported a trade-weighted tariff for 2016 or 2017, only 12 had a lower tariff for agriculture compared to nonagriculture. Of those 12, 10 either had very low tariffs (with the result that there was not much of a difference between tariffs on agricultural and nonagricultural goods)³ or they had a higher Most Favored Nation (MFN) rate⁴ for agriculture compared to nonagriculture.⁵ Argentina and the Bahamas were the only countries with a higher average tariff on agriculture versus nonagriculture that did not fall under any previous caveats. Further, countries with higher tariffs on agriculture tended to have tariffs that exceeded those on nonagriculture by dozens of percentage points. For example, Korea's tariff on agriculture averaged 79.3 percent compared to 3.9 percent for a nonagricultural tariff. In addition, some agricultural products are subject to TRQs, which set a lower in-quota duty for a specific quantity of imports, with additional trade facing a higher over-quota rate (Beckman et al., 2020).

Figure 1 provides information on the average tariff for agriculture across the regions in our model (see Box: Tariff Calculations). Three regions have an average tariff greater than 20 percent: Mexico, India,⁶ and an aggregation of top agricultural importing countries referred to as AgImp,⁷ which collectively represent 15.67 percent of global agricultural imports. (See Appendix 2 for information on sectoral and regional classifications). In total, half of the 20 regions in the model have an average tariff greater than 10 percent. These regions represent 34 percent of global agricultural imports. The regions with the largest imports in our model, the European Union (EU), China, and the United States, all have an average tariff of less than 10 percent. The average global tariff on agricultural imports is 10.33 percent.

³Those countries are Australia, Brunei, New Zealand, and Peru

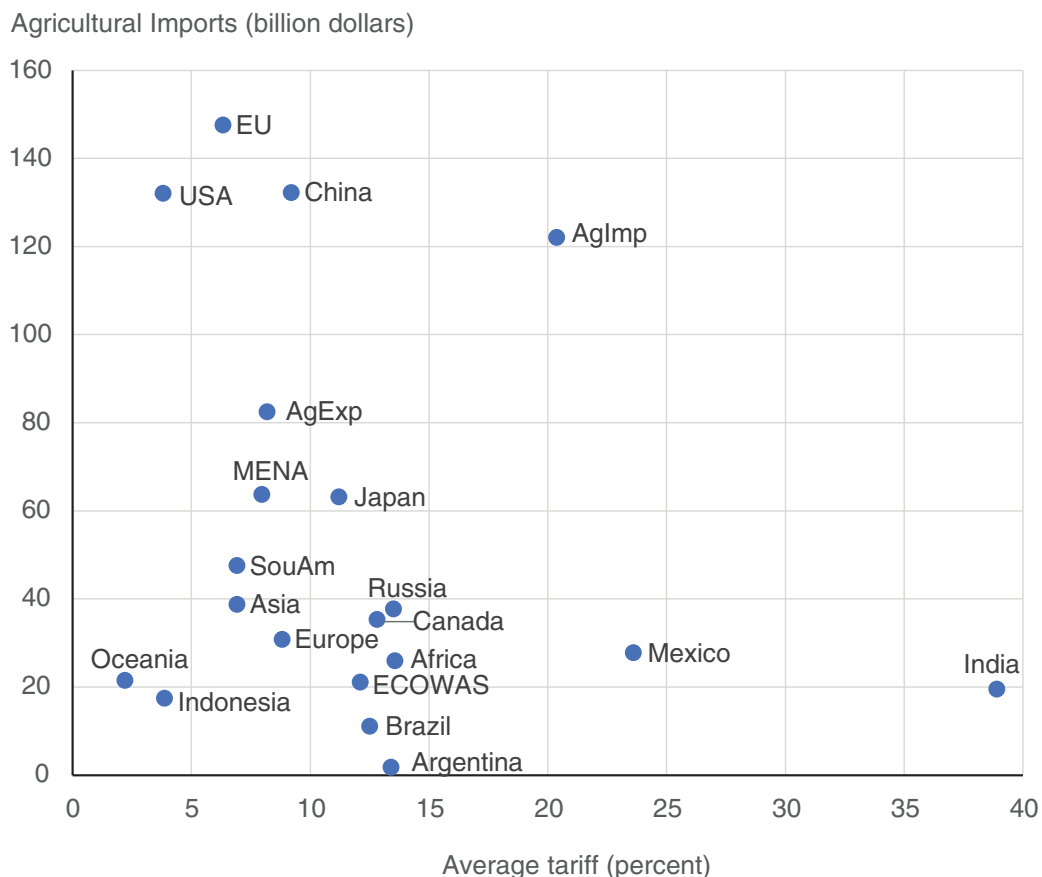
⁴The MFN rate is the tariff rate that applies to all members of the WTO.

⁵Those countries are Algeria, Madagascar, Pakistan, Sao Tome, Sudan, and Zimbabwe. A country could have a higher MFN rate than a trade-weighted tariff due to the presence of RTAs (that is, it is a matter of the composition of what they are importing, rather than lower rates).

⁶As a reviewer points out, India's high tariffs could be related to the measurement of nominal tariffs. See OECD (2018) for more information.

⁷AgImp are countries among the top 20 global agricultural importers as of 2014 that do not appear in another group. Similarly, AgExp are countries in the top 20 global agricultural exporters as of 2014 and do not appear elsewhere (Beckman et al., 2017). If a country is eligible for both lists, its category is determined based on the larger of its imports or exports.

Figure 1
Average tariff and imports on agriculture by region, 2014



Note: AgImp consists of countries in the top 20 global agricultural importers in 2014 that do not appear elsewhere; AgExp consists of countries in the top 20 global agricultural exporters in 2014 that do not appear elsewhere; SouAM includes South American Countries not described by another group; MENA is the Middle East and North Africa; ECOWAS is the Economic Community of West African States; and Africa includes all African countries not described by another group. See Appendix Table 1 for more information on the regions.

Source: USDA, Economic Research Service.

Figure 2 describes the global average tariff by agricultural sector used in our model, with sectors arranged from left to right in the figure according to the size of their global imports. Note that the largest tariff in the model is for corn. Most regions have small (5 percent or less) or no tariff on corn; however, Korea (a part of AgImp) has tariffs on corn that average 328 percent (FAS, 2019).⁸

Of the other agricultural commodities, other meats have the second-highest average tariff (16.77 percent), followed by oilseeds (16.11 percent, and again due to Korea).

⁸Given the large tariffs on corn, one target of trade negotiations with Korea is this commodity. In KORUS (United States-Korea Free Trade Agreement), the U.S. received duty-free access. Korea still applies very high out-of-quota tariffs for corn for other countries—the most recent MFN tariff on cereals & preparations was 187.1 percent (WTO, 2019b).

Tariff Calculations

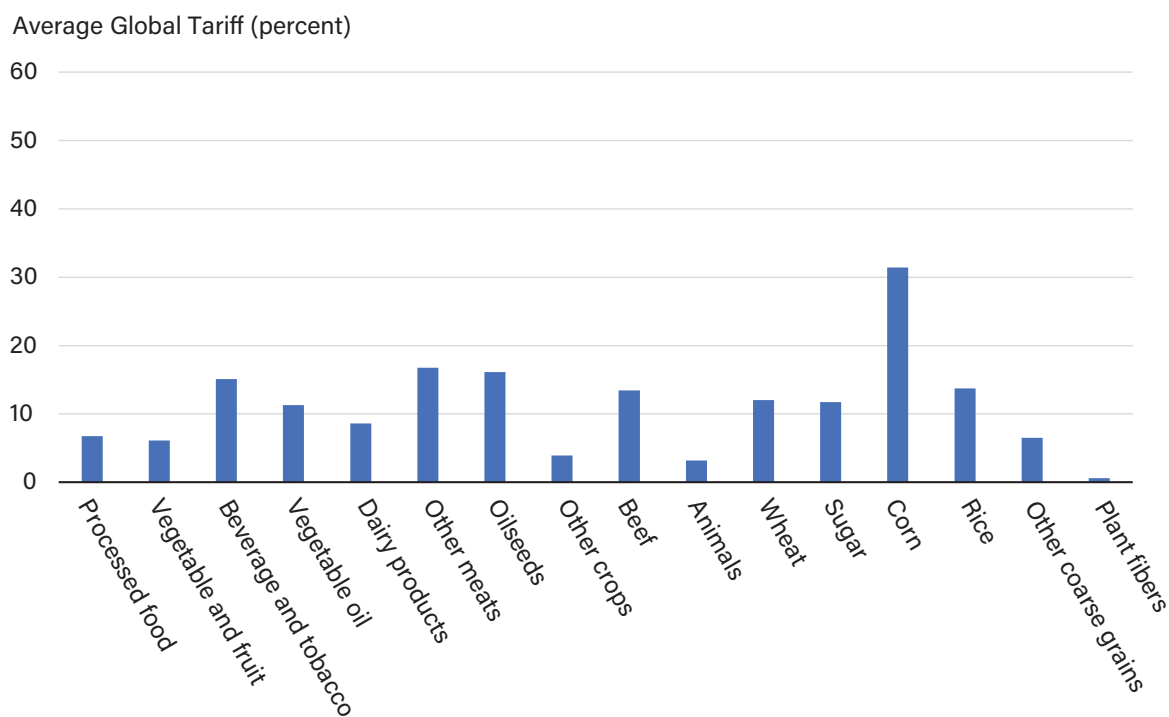
Tariff information in the Global Trade Analysis Project (GTAP) database is from MAcMaps and is reported in ad-valorem equivalent (AVEs) for applied tariffs. MAcMaps tariffs include estimated AVEs for specific tariff rates and Tariff Rate Quotas (TRQs).

For TRQs, MAcMaps applies the following assumptions:

1. If the fill rate (the percentage of the quota that is filled) of the quota is less than 90 percent, an in-quota tariff rate is used.
2. If the fill rate of the quota is above 98 percent, an out-of-quota rate is used.
3. If the fill rate is between 90 and 98 percent, a simple average of the in- and out-of-quota rates are used.

Figure 2

Average tariff on agriculture by sector, 2014*



*The sectors are ordered from left to right according to the value of imports of each sector.

Note: The calculations do not include intra-European Union trade.

Source: USDA, Economic Research Service.

Model Results: Impacts of Scenario To Remove All Tariffs

Using a global economic model, this report details the projected changes to agricultural trade, production, prices, and welfare from removing all tariffs on agricultural commodities.

Exports

Table 1 projects changes in exports for each region and agricultural commodity if all tariffs were removed. Nearly all regions are expected to increase their agricultural exports (the 'all agriculture' row on the bottom; the exception is the EU with a projected 1.31-percent decrease). In fact, projected exports increase by double-digits for most regions (14 of the 20). Seven regions increase exports by more than 20 percent (Oceania, China, Japan, AgImp, AgExp, India, and Brazil), despite many of these regions having higher tariffs relative to others. As will be shown later, most of these regions also have large increases in imports. India, the region with the highest tariffs, has the second-largest increase in aggregate exports. Later results will show that India has the largest increase in aggregate imports, and for exports, it has large increases for all commodities except wheat, with triple-digit increases in exports of oilseeds and milk products.

Globally, the estimated increase in agricultural exports from removing all tariffs is 11.09 percent. Across all agricultural exports, AgImp, followed by India, is projected to experience the largest percentage increase if all tariffs are removed, but these countries are relatively small exporters (fig. 3). The EU, the United States, and AgExp are the three largest agricultural exporting regions, and of these, AgExp has the largest estimated percentage increase in exports. This is due to a projected increase in other meats exports and double-digit increases for rice, vegetable oil, and dairy products. AgExp is estimated to have a decline in global exports of many commodities in this scenario, as resources flow to those with large export increases. The United States is projected to increase exports of many products by double-digits, but the increases are somewhat offset by projected declines in corn and wheat exports due to land reallocation. Meanwhile, the EU is the only region projected to have an overall decrease in exports, largely due to a decrease in those of beef and other meats. Although these two commodities contribute to only 12 percent of EU exports, their decrease outweighs any gains in exports of other agricultural commodities.

The results in table 1 indicate that not all regions would experience export growth for each commodity. Specifically, the export of at least one commodity decreases for nearly all regions (except Japan), while Indonesia and Africa have decreased exports of at least half of their commodities. These decreases could be because of global competition for exports and the constraint on resources. That is, if production increases for one commodity, it can be expected to pull resources from another. The modeling framework used in this analysis redistributes these resources based on the profitability of each commodity (and labor and capital resources could flow to nonagriculture).

Table 1

Projected percent change in exports for the tariff removal scenario

	AgImp	India	AgExp	Brazil	Japan	Oceania	China	Indonesia	Asia	MENA
Rice	56.16	31.92	24.03	-2.73	51.71	182.30	11.73	-8.13	66.67	10.04
Wheat	14.39	-12.02	2.52	-23.13	117.85	-14.33	-30.75	-36.89	-1.76	-9.11
Corn	4.35	11.14	-3.77	19.96	33.61	232.64	-13.18	-10.77	2.59	-3.49
Other coarse grains	7.19	32.91	-15.01	-18.14	10.60	0.33	5.00	14.12	5.58	-5.42
Vegetables and fruit	18.04	9.70	-3.81	1.37	28.79	-1.80	16.94	7.79	10.79	9.98
Oilseeds	68.69	212.21	-22.48	-0.64	16.55	-20.00	180.95	-33.28	5.46	-1.37
Sugar	46.17	50.48	7.69	33.64	61.39	1.44	25.80	-8.32	4.03	190.43
Plant fibers	2.86	6.44	-7.22	-11.75	20.42	-8.57	25.13	-7.80	6.33	2.68
Other crops	21.31	29.28	-1.40	-16.52	34.94	-16.74	21.42	0.18	25.60	15.55
Animals	19.68	11.67	-9.39	-8.74	31.13	-17.60	7.60	-11.34	4.30	-5.57
Beef	-18.37	52.02	-20.38	54.85	183.81	62.50	-37.59	-35.26	-29.11	-33.87
Other meats	26.80	85.56	549.15	97.85	14.89	8.15	47.50	-34.58	-15.62	5.65
Vegetable oil	217.29	49.59	21.68	24.88	13.64	-13.88	-8.28	29.43	6.23	111.81
Milk products	17.99	248.37	17.00	0.72	89.51	40.58	50.02	9.51	21.63	2.93
Processed food	38.82	14.46	5.95	46.18	22.57	14.17	20.72	-5.20	8.98	3.23
Beverages & tobacco	28.22	71.87	5.69	17.11	0.76	4.71	12.21	0.74	-1.66	-3.47
All agriculture	39.24	35.67	26.16	25.78	23.55	21.73	20.80	16.98	16.01	15.63

	Europe	USA	SouAm	Canada	Mexico	Russia	ECOWAS	Africa	Argentina	EU
Rice	36.80	80.15	24.86	1.23	0.95	-2.82	-10.21	-14.93	-0.12	-15.15
Wheat	125.39	-3.35	-0.24	10.94	1.28	7.91	-14.45	-27.56	-24.82	26.68
Corn	1.22	-1.85	1.35	-2.84	9.14	90.18	-0.21	5.13	7.81	2.16
Other coarse grains	35.66	21.11	-4.62	5.57	5.45	-5.14	-0.81	-0.92	-1.27	1.44
Vegetables and fruit	-2.71	7.73	19.83	19.26	3.80	40.25	-12.00	-3.52	7.85	0.51
Oilseeds	11.51	-1.00	-3.95	-0.64	17.08	-5.12	7.64	1.60	3.28	1.95
Sugar	83.25	6.43	45.69	8.01	2.75	66.26	-18.09	-22.19	103.53	-18.46
Plant fibers	6.12	-2.55	3.32	-7.36	1.49	0.86	5.81	5.99	-4.28	4.16
Other crops	26.77	12.16	-2.49	-4.57	7.24	-8.31	8.72	16.42	8.36	3.02
Animals	4.02	2.13	4.53	0.38	16.45	5.56	9.17	-4.97	-0.92	-0.04
Beef	21.08	59.87	101.94	4.74	11.53	-11.46	-30.19	-36.37	168.29	-42.21
Other meats	-30.43	25.78	0.59	60.05	227.45	-35.29	-12.83	-24.40	34.33	-22.15
Vegetable oil	16.76	10.74	0.58	-3.22	-2.36	-9.44	14.97	9.81	-14.95	0.17
Milk products	-4.40	58.65	19.35	69.94	1.94	-6.37	13.68	-8.78	0.51	3.79
Processed food	6.75	9.87	-0.04	8.88	0.80	1.23	1.56	-2.38	1.82	0.20
Beverages & tobacco	3.10	16.02	6.23	-0.14	0.01	-3.62	7.87	7.99	2.79	5.73
All agriculture	13.04	12.66	12.54	10.76	7.36	4.46	3.32	2.06	1.26	-1.31

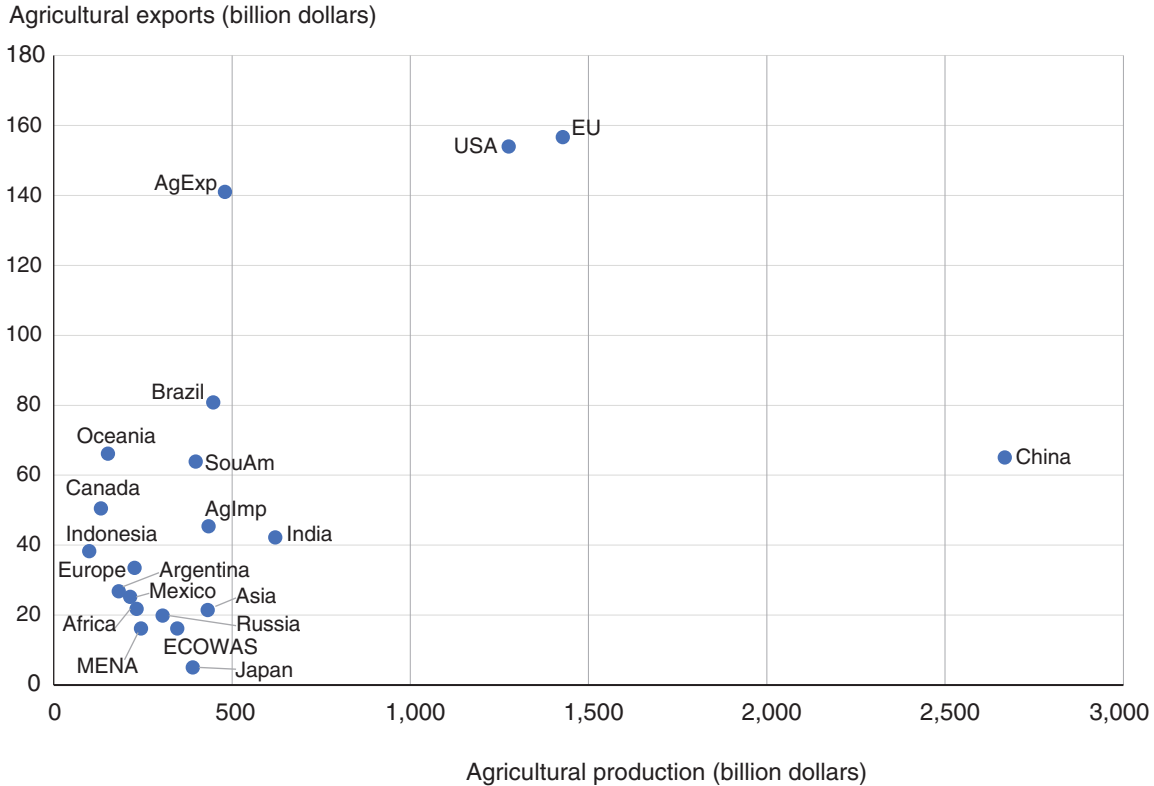
Note: Results are presented from left to right in order of largest to smallest export gains.

AgImp consists of countries in the top 20 global agricultural importers in 2014 that do not appear elsewhere; AgExp consists of countries in the top 20 global agricultural exporters in 2014 that do not appear elsewhere; SouAM includes South American Countries not described by another group; MENA is the Middle East and North Africa; ECOWAS is the Economic Community of West African States; and Africa includes all African countries not described by another group. See Appendix Table 1 for more information on the regions.

Source: USDA, Economic Research Service analysis using ERS-GTAP (Global Trade Analysis Project) data.

Figure 3

Value of agricultural production and agricultural exports, 2014



Note: The definition of agriculture used here includes processed foods and beverages and tobacco. All products within these categories are not included in the United States Department of Agriculture's definition of agriculture. European Union (EU) trade excludes intra-EU trade.

AgImp consists of countries in the top 20 global agricultural importers in 2014 that do not appear elsewhere; AgExp consists of countries in the top 20 global agricultural exporters in 2014 that do not appear elsewhere; SouAM includes South American Countries not described by another group; MENA is the Middle East and North Africa; ECOWAS is the Economic Community of West African States; and Africa includes all African countries not described by another group. See Appendix Table 1 for more information on the regions.

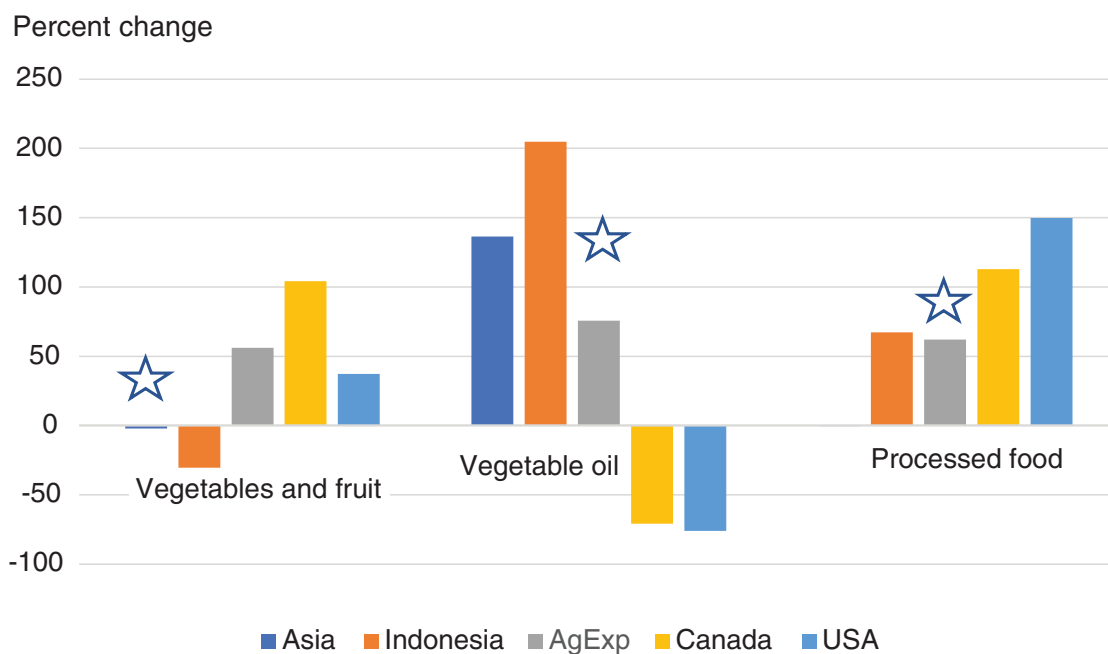
Source: USDA, Economic Research Service.

Imports

If all agricultural tariffs are removed, the projected increase in agricultural exports is matched by an increase in agricultural imports (table 2). All regions increase their aggregate agricultural imports, though the largest change is for India. India has an average tariff of almost double the region with the next largest tariff (fig. 1), so removing tariffs on imports into India leads to an estimated 90.46 percent increase in imports. Japan and Russia have the second- and third-largest increase in imports—both regions remove tariffs higher than the average, with Japan having implemented a large increase in commodities with high tariffs (rice, beef, other meat, and milk products). Russia has a large increase in imports of meat products, milk products, and processed food. The regions with the second- and third-highest tariffs (after AgImp and Mexico) increase their imports close to the global average. Most of the increase in imports for Mexico would be from countries with which they have a RTA (Canada and the United States).

Figure 4 examines India’s projected change in agricultural imports from tariff removal in more detail. Three groups of commodities make up 81 percent of India’s imports; in order of import value, they are vegetable oil, vegetables and fruit, and processed food. Vegetable oil is the main commodity, at half the value of India’s agricultural imports. India’s tariff on vegetable oil is quite high; WTO (2017) notes that the MFN tariff on oilseeds and fats and oils is 35.1 percent. Thus, the combination of the existing high tariff and large base imports drives the increase in India’s imports if tariffs are removed. As figure 4 indicates, India would experience an increase in vegetable oil imports from most of its primary sources (Canada and the United States are the exceptions). For its second-highest group of commodity imports, India has a projected decrease in vegetables and fruit imported from Asia, its primary source for them. Conversely, India’s imports of processed foods, its third-largest import category, increase from their largest source (AgExp) and other main sources (including the United States and Canada).

Figure 4
India’s percent change in bilateral imports of key commodities under the agricultural tariff removal scenario



Note: The star indicates the region providing the largest share of India’s imports of that commodity in the base year.

Source: USDA, Economic Research Service analysis using ERS-GTAP (Global Trade Analysis Project) data.

Table 2

Percent change in imports for the tariff removal scenario

	India	Japan	Russia	AgExp	Brazil	Africa	AgImp	Europe	ECOWAS	Mexico
Rice	83.63	662.74	9.42	50.87	12.11	57.45	30.64	5.70	18.44	-2.45
Wheat	163.55	1.69	18.93	6.68	18.69	7.51	31.81	130.91	0.92	2.11
Corn	0.44	-2.02	4.12	5.73	10.29	-1.44	29.39	2.85	4.68	-2.28
Other coarse grains	0.90	-0.61	2.87	5.30	1.94	3.39	6.67	36.05	3.81	-3.50
Vegetables and fruit	35.99	1.09	2.33	30.06	16.63	13.81	16.77	10.89	20.51	-2.90
Oilseeds	28.26	-4.12	-5.29	48.84	17.27	4.97	75.55	16.08	8.60	-1.46
Sugar	179.21	25.07	36.16	35.79	52.68	40.30	3.47	19.73	10.08	3.00
Plant fibers	4.26	-1.50	0.31	1.31	18.33	6.19	-0.75	1.19	10.62	-0.93
Other crops	219.88	-8.06	-0.79	10.71	37.52	6.51	5.85	45.18	42.21	3.22
Animals	26.44	-15.59	-0.63	20.00	26.33	2.82	-3.86	5.02	14.80	-2.28
Beef	46.97	56.76	51.75	43.26	23.38	35.98	24.84	33.24	67.35	0.43
Other meats	107.61	72.39	95.37	77.05	60.26	36.60	18.54	43.67	81.14	101.02
Vegetable oil	103.83	3.13	13.29	28.38	39.76	10.97	-5.06	6.97	17.14	1.20
Milk products	115.40	104.88	33.85	17.21	36.75	30.95	25.60	34.49	11.62	8.96
Processed food	80.61	11.79	14.56	11.97	21.82	17.42	12.17	14.05	15.18	8.32
Beverages & tobacco	129.29	6.53	19.44	27.25	21.94	25.11	35.82	3.15	15.09	1.74
All agriculture	90.46	30.32	23.32	23.23	23.16	22.26	21.13	20.96	17.23	15.99

	Asia	Argentina	SouAm	MENA	Indonesia	Oceania	EU	China	Canada	USA
Rice	92.91	8.62	24.62	-1.13	25.81	3.58	6.33	-9.34	-3.66	1.40
Wheat	2.62	14.86	3.91	12.01	-1.95	11.77	4.42	-1.46	13.49	-1.22
Corn	0.65	2.29	5.58	6.89	5.29	20.74	-2.98	-0.62	1.72	0.41
Other coarse grains	2.13	4.56	-0.17	1.43	0.33	11.73	-1.33	0.01	3.16	2.65
Vegetables and fruit	11.55	3.26	10.80	13.75	7.97	6.12	0.19	1.36	1.23	1.40
Oilseeds	-1.61	-2.87	3.75	4.52	34.04	11.00	-2.58	0.24	1.05	2.88
Sugar	9.56	35.63	36.39	4.77	10.10	12.89	13.11	32.34	-0.59	22.26
Plant fibers	1.28	4.79	5.30	3.27	-0.73	5.77	-0.23	0.95	3.23	2.35
Other crops	26.45	14.44	12.48	14.87	12.94	3.42	-1.86	6.95	1.62	2.03
Animals	4.57	18.31	5.82	5.64	3.08	10.58	-10.43	7.96	4.09	3.08
Beef	23.62	29.00	18.37	20.51	10.11	12.62	62.61	9.72	2.65	-1.89
Other meats	87.22	12.81	55.62	21.98	15.55	18.00	60.58	27.82	2.50	2.96
Vegetable oil	5.61	31.31	6.93	10.42	17.85	4.58	0.56	23.30	3.42	2.66
Milk products	20.10	51.77	28.09	13.47	13.17	18.47	8.98	9.76	140.72	43.92
Processed food	9.59	16.75	9.51	15.21	19.20	8.67	2.35	14.18	2.72	4.71
Beverages & tobacco	6.98	13.58	19.70	19.90	6.00	6.60	0.87	9.79	0.97	1.72
All agriculture	15.84	15.15	14.46	12.23	11.67	8.96	8.22	7.89	4.28	3.91

Note: Results are ordered in terms of largest gains.

AgImp consists of countries in the top 20 global agricultural importers in 2014 that do not appear elsewhere; AgExp consists of countries in the top 20 global agricultural exporters in 2014 that do not appear elsewhere; SouAM includes South American Countries not described by another group; MENA is the Middle East and North Africa; ECOWAS is the Economic Community of West African States; and Africa includes all African countries not described by another group. See Appendix Table 1 for more information on the regions.

Source: USDA, Economic Research Service analysis using ERS-GTAP (Global Trade Analysis Project) data.

Production

The projected changes in exports and imports would impact agricultural production if tariffs were removed (table 3). Globally, a slight decrease (0.10 percent) in agricultural production occurs in this scenario. This would happen because the removal of tariffs would shift production to more efficient producers. Production may not decrease in all regions, however. Eleven of the 20 regions could experience a reduction in their total agricultural output. These regions tend to be either net agricultural importers (China, Japan, Asia, Europe, Russia, MENA, ECOWAS, and Africa) or have high initial tariffs (EU, India, and Mexico). The production decreases would tend to be of a smaller magnitude than the production increases (the simple average of the decreases is 2.46 percent, while the simple-average increase is 3.77). Note also that Japan has the biggest projected decrease (7.18 percent), but Oceania (10.41 percent) and AgExp (7.61 percent) have larger increases. Much of the estimated increase in AgExp is driven by an increase in production of other meats (to fulfill a projected increase in exports); production increases in Oceania are projected for grains (other than wheat), beef, and dairy products.

Prices

Table 4 projects changes in market prices for this scenario. Tariffs act as a tax on imports, and removing them leads to a reduction in the market price for many commodities. This is because tariff removal effectively lowers global prices, which transmits to lower domestic prices. Of the 20 regions in the model, 12 experience a reduction in the average price for all agricultural products. The regions with price increases tend to be ones who also have an increase in production (and exports). This is due to increases in the price of inputs into production (shown in the next section) and the increase in demand for products on the global market.

Table 3

Percent change in agricultural production for the agricultural tariff removal scenario

	Oceania	AgExp	Brazil	Canada	Indonesia	USA	AgImp	Argentina	SouAm	China
Rice	38.80	4.71	-0.37	1.15	-0.97	27.47	-3.30	0.09	-0.72	0.35
Wheat	-10.18	1.99	-13.07	9.88	-7.06	-1.34	-17.11	-6.81	-6.70	-0.35
Corn	72.12	2.40	8.66	1.52	-1.95	1.07	-21.06	4.75	-2.48	0.00
Other coarse grains	5.65	0.82	-16.66	4.22	14.12	16.62	-3.39	-0.50	-2.75	0.16
Vegetables and fruit	-0.87	-3.32	1.81	12.41	-0.72	1.70	0.28	2.10	5.11	0.36
Oilseeds	-5.90	-8.20	1.66	-1.00	8.67	0.35	-61.45	-9.07	-3.89	0.51
Sugar	0.77	-1.81	8.88	1.47	-5.54	-2.39	10.91	6.32	4.22	-1.13
Plant fibers	-6.26	-2.81	-7.80	0.14	-4.04	-1.71	0.61	-2.58	-1.33	0.17
Other crops	-14.35	-4.75	-7.01	-2.90	-1.51	1.23	3.18	-0.50	-1.94	1.24
Animals	15.35	22.31	9.66	3.24	-1.03	2.44	-0.34	9.62	0.78	-0.41
Beef	40.67	-10.51	7.68	3.83	-1.45	3.66	-5.28	21.24	12.56	-3.15
Other meats	-2.98	112.44	41.13	21.34	-0.53	3.23	-2.63	2.65	-5.43	-0.34
Vegetable oil	-9.28	5.30	6.49	-2.24	18.77	3.50	94.87	-13.34	-3.30	-2.39
Milk products	21.31	-0.18	-0.72	-2.95	-4.16	2.48	-0.72	-0.38	-2.25	-1.38
Processed food	1.58	3.40	3.82	2.92	-2.02	0.65	6.06	0.60	-1.52	0.73
Beverages & tobacco	0.49	-1.48	0.89	-0.09	-0.10	0.96	-1.10	0.07	-0.89	-0.10
All agriculture	10.41	7.61	6.28	3.74	1.99	1.76	1.00	0.90	0.26	-0.03

	Asia	ECOWAS	India	Mexico	Europe	MENA	Africa	Russia	EU	Japan
Rice	-0.18	-4.02	4.17	2.11	-1.84	2.97	-19.99	-6.11	-13.59	-22.66
Wheat	-1.46	-9.13	0.61	-4.73	-5.02	-8.82	-20.09	4.07	10.13	-45.93
Corn	-0.93	0.02	1.61	-0.96	-0.38	-2.11	-0.47	34.36	-1.27	-6.56
Other coarse grains	-1.32	0.01	2.28	-0.93	4.15	-2.08	-0.61	-2.28	-2.19	-11.59
Vegetables and fruit	0.40	-0.30	-1.38	2.14	-1.64	-1.16	-1.08	-2.17	-0.17	-0.14
Oilseeds	-1.11	-0.71	-8.83	1.81	0.26	3.02	-0.10	-2.93	1.65	9.34
Sugar	-2.28	-7.11	-3.14	0.04	27.09	12.15	-14.75	-2.71	-12.74	-6.17
Plant fibers	0.99	1.48	1.06	1.01	1.26	0.25	2.67	0.01	3.57	11.76
Other crops	-0.32	1.99	-3.00	1.08	-8.08	-5.37	5.86	-7.53	0.59	1.54
Animals	-1.69	-1.87	0.72	-3.46	-1.45	-1.99	-1.93	-1.25	-7.53	-23.37
Beef	-3.75	-0.25	37.28	1.62	-0.96	-6.10	-4.32	-3.13	-18.80	-32.42
Other meats	-6.75	-9.60	0.08	-19.72	-15.36	-6.51	-12.48	-26.82	-18.68	-50.19
Vegetable oil	-5.73	-15.58	-36.91	-1.03	3.79	8.77	-11.44	-4.98	-1.44	-2.86
Milk products	-2.05	-12.58	3.49	-0.76	-1.71	-2.71	-4.16	-5.03	-0.91	-6.18
Processed food	-0.56	-5.14	1.20	-0.63	-1.52	-2.91	-3.43	-2.35	-1.57	-1.56
Beverages & tobacco	-1.28	-2.53	1.86	0.00	0.32	-3.52	-1.10	-2.92	1.51	-0.27
All agriculture	-1.09	-1.21	-1.34	-1.46	-1.55	-2.43	-3.36	-3.48	-3.88	-7.18

Note: Results are ordered by largest impact (change percentage).

AgImp consists of countries in the top 20 global agricultural importers in 2014 that do not appear elsewhere; AgExp consists of countries in the top 20 global agricultural exporters in 2014 that do not appear elsewhere; SouAM includes South American Countries not described by another group; MENA is the Middle East and North Africa; ECOWAS is the Economic Community of West African States; and Africa includes all African countries not described by another group. See Appendix Table 1 for more information on the regions.

Source: USDA, Economic Research Service analysis using ERS-GTAP (Global Trade Analysis Project) data.

Table 4

Percent change in market prices for the agricultural tariff removal scenario

	Brazil	Oceania	Indonesia	AgExp	Argentina	Canada	USA	SouAm	China	Mexico
Rice	2.55	2.55	2.69	5.40	0.38	0.59	1.84	-0.09	-0.05	0.06
Wheat	2.25	3.37	1.50	2.54	0.31	2.01	0.96	-0.36	-0.07	-0.92
Corn	4.42	9.54	2.52	3.47	1.97	1.43	1.13	0.45	0.00	-0.60
Other coarse grains	2.04	4.05	2.10	2.38	1.23	1.57	2.90	0.32	0.03	-0.59
Vegetables and fruit	3.79	4.57	3.11	2.81	1.81	2.98	1.38	1.71	0.08	-0.05
Oilseeds	3.80	4.35	6.71	2.00	-0.05	1.53	1.25	0.20	0.09	-0.11
Sugar	3.15	1.76	0.70	1.41	0.84	0.26	-1.13	0.44	-0.19	-0.21
Plant fibers	2.86	1.93	1.57	1.24	0.91	1.45	0.82	0.47	-0.02	-0.16
Other crops	2.97	3.66	2.52	3.73	1.42	1.64	1.77	0.62	0.28	-0.27
Animals	4.33	4.84	1.52	4.42	2.93	1.34	0.89	0.63	-0.16	-0.81
Beef	3.40	3.28	0.86	1.47	2.09	0.78	0.48	0.17	-0.32	-0.46
Other meats	3.10	2.17	0.60	2.81	1.21	0.63	0.47	0.20	-0.24	-0.61
Vegetable oil	2.67	1.50	2.58	-1.39	0.09	0.77	0.65	-0.44	-0.22	0.39
Milk products	2.95	2.75	0.76	0.87	1.26	0.43	0.28	0.05	-0.27	-0.33
Processed food	2.55	1.40	0.64	-0.54	0.42	0.26	0.09	-0.42	-0.20	-0.31
Beverages & tobacco	2.39	1.29	-0.14	-0.09	0.36	0.18	0.01	-0.30	-0.20	-0.23
All agriculture	3.19	2.84	2.08	1.62	1.02	0.84	0.44	0.21	-0.11	-0.35

	Russia	EU	Asia	ECOWAS	MENA	India	Africa	Europe	Japan	AgImp
Rice	-1.62	-0.88	-0.98	-1.83	-0.93	-0.40	-3.44	-1.73	-5.55	-4.23
Wheat	0.47	-0.83	-1.71	-2.30	-1.85	-1.02	-3.25	-3.63	-11.80	-3.47
Corn	5.90	-1.48	-1.40	-1.56	-1.25	-1.13	-1.81	-1.47	-5.23	-2.74
Other coarse grains	-0.69	-1.48	-2.19	-1.56	-1.20	-1.01	-1.87	-0.89	-6.13	-1.35
Vegetables and fruit	-0.66	-1.77	-1.16	-1.58	-1.25	-2.30	-1.92	-2.01	-4.03	-4.52
Oilseeds	-0.75	-1.32	-1.67	-1.63	-1.04	-4.19	-1.78	-1.70	-4.51	-11.88
Sugar	-1.47	-1.34	-1.31	-1.79	-1.05	-1.32	-2.05	-1.40	-1.33	-3.73
Plant fibers	-1.34	-1.01	-0.97	-1.24	-1.09	-1.26	-1.41	-1.37	-2.21	-1.00
Other crops	-2.03	-1.04	-1.37	-1.33	-1.61	-2.10	-1.30	-3.13	-3.78	-2.47
Animals	-1.06	-2.00	-1.75	-1.84	-1.79	-2.26	-2.12	-2.45	-4.34	-5.05
Beef	-1.10	-1.25	-1.14	-1.42	-1.21	-0.93	-1.40	-1.57	-2.47	-3.14
Other meats	-1.05	-1.23	-1.40	-1.52	-1.12	-2.12	-1.43	-1.73	-3.57	-3.11
Vegetable oil	-0.65	-0.41	-1.18	-2.18	-1.72	-5.26	-2.14	-3.56	-1.00	-19.49
Milk products	-0.92	-1.15	-1.27	-1.64	-1.62	-1.08	-1.31	-1.27	-4.26	-3.21
Processed food	-1.31	-0.89	-1.05	-2.17	-2.31	-2.33	-2.37	-1.97	-2.85	-7.84
Beverages & tobacco	-1.04	-0.62	-0.85	-1.71	-1.44	-1.20	-1.76	-1.88	-1.06	-4.12
All agriculture	-0.99	-1.10	-1.23	-1.61	-1.68	-1.98	-1.98	-2.00	-3.00	-5.41

Note: Results are ordered by largest impact (change percentage).

AgImp consists of countries in the top 20 global agricultural importers in 2014 that do not appear elsewhere; AgExp consists of countries in the top 20 global agricultural exporters in 2014 that do not appear elsewhere; SouAM includes South American Countries not described by another group; MENA is the Middle East and North Africa; ECOWAS is the Economic Community of West African States; and Africa includes all African countries not described by another group. See Appendix Table 1 for more information on the regions.

Source: USDA, Economic Research Service analysis using ERS-GTAP (Global Trade Analysis Project) data.

Macrofactors

The final table of results projects changes under the tariff removal scenario for macrofactors that include a measure of certain macroeconomic changes (such as exchange rates) and results for more aggregate variables (such as welfare). Although some of these factors and variables are not “macroeconomic” in nature as conventionally defined and understood, we use that term for convenience to distinguish these more aggregate results from commodity-specific results. The first three rows of table 5 detail the projected percent change in endowments used in agricultural production. The estimated change in land prices is mixed across regions. In general, a decrease in land price is projected to occur if a region has a larger increase in imports compared to exports, as the demand for land for agricultural production is expected to decline. The price of labor and capital are largely projected to decline as these endowments move across commodities (including nonagriculture). The exchange rate calculation in the model comprises changes in the land, labor, and capital endowments (Beckman et al., 2018).

The final piece of non-commodity-specific impacts in table 5 concerns welfare changes. These are measured in millions of U.S. dollars and calculated using the equivalent variation (EV) measure. The equivalent variation is the change in income, at current prices, that would have the same effect on consumer welfare as would the change in prices with income unchanged. The results provide a decomposition of the total economy-wide welfare measure, allocating the change in welfare to three activities (which can be summed to equal total welfare change). The first is allocative efficiency—an optimal distribution of goods and services—which involves the redistribution of resources to other sectors. That is, if a policy change occurs, resources such as labor will move based on the relative profitability of each sector. A move from a less-efficient to a more-efficient sector will generate an increase in welfare based on allocative efficiency. The second component involves the terms of trade,⁹ which is the ratio of export prices to import prices for a region. If a region has an increase in the price it receives for its exports on the global market relative to the price of products it imports, it will have a gain in welfare from terms of trade.

The third component involves investment, that is, how well a region is able to attract foreign investment, based on the profitability of the region given the change in scenario.

⁹This is not (at least directly) a measure of changes in a region's export/import trade volumes.

Table 5

Macroimpacts for the agricultural tariff removal scenario

	EU	AgExp	Brazil	Oceania	AgImp	Japan	India	USA	Russia	Canada
	Prices (% change)									
Land	-15.34	17.92	20.15	33.18	-12.89	-40.84	-5.10	9.01	0.66	22.38
Labor	-0.31	0.88	2.49	1.55	0.01	-0.43	-0.05	0.03	-0.49	0.29
Capital	-0.26	0.70	2.49	1.28	0.07	-0.38	-0.10	0.05	-0.49	0.27
Exchange rate (% change)	-0.37	1.11	2.57	1.48	-0.04	-0.50	-0.36	0.06	-0.39	0.32
	Welfare (\$ million) Agriculture only									
Allocative efficiency	16,662	3,037	968	373	7,964	5,621	4,570	283	1,314	213
Terms of trade	-2,636	1,963	2,997	2,297	-3,526	-158	-1,045	1,147	-26	550
Total	14,027	5,000	3,965	2,670	4,438	5,463	3,525	1,430	1,288	763
	Welfare (\$ million) All of the economy									
Allocative efficiency	19,967	2,454	1,008	892	8,312	6,956	5,133	-110	3,009	295
Terms of trade	-8,920	6,609	6,286	4,748	-3,410	-3,176	-1,500	2,988	-654	1,407
Investment	-290	84	1,026	-134	38	-112	-163	574	272	122
Total	10,757	9,147	8,320	5,506	4,939	3,669	3,471	3,453	2,627	1,824

	Mexico	Indonesia	Europe	MENA	SouAm	Argentina	ECOW-AS	Africa	Asia	China
	Prices (% change)									
Land	-1.82	7.39	-7.88	-10.07	5.46	7.59	-3.62	-8.33	-3.20	0.55
Labor	-0.14	0.55	-0.28	-0.40	0.05	0.32	-1.53	-1.32	-0.35	-0.12
Capital	-0.15	0.24	-0.16	-0.19	0.01	0.26	-0.54	-0.92	-0.24	-0.12
Exchange rate (% change)	-0.16	0.65	-0.32	-0.27	0.12	0.39	-1.17	-1.06	-0.46	-0.09
	Welfare (\$ million) Agriculture only									
Allocative efficiency	1,858	429	1,189	553	638	-220	687	1,037	562	1,528
Terms of trade	-265	670	-236	297	-109	290	-331	-290	-279	-1,312
Total	1,593	1,099	954	851	529	70	356	746	283	215
	Welfare (\$ million) All of the economy									
All of the economy										
Allocative efficiency	2,041	373	1,382	644	685	-165	602	1,055	622	1,360
Terms of trade	-544	1,131	-400	-146	-63	161	-574	-988	-892	-2,233
Investment	-19	-70	-39	145	21	-29	-81	-217	-158	-986
Total	1,478	1,433	942	644	644	-33	-53	-150	-428	-1,859

Note: Results are ordered by largest impact (change percentage).

AgImp consists of countries in the top 20 global agricultural importers in 2014 that do not appear elsewhere; AgExp consists of countries in the top 20 global agricultural exporters in 2014 that do not appear elsewhere; SouAM includes South American Countries not described by another group; MENA is the Middle East and North Africa; ECOWAS is the Economic Community of West African States; and Africa includes all African countries not described by another group. See Appendix Table 1 for more information on the regions.

Source: USDA, Economic Research Service analysis using ERS-GTAP (Global Trade Analysis Project) data.

Model results indicate that global welfare is projected to increase by \$56.3 billion if all tariffs on agricultural commodities are removed, although some regions would experience a loss in welfare—China (-\$1.9 billion), Asia (-\$428 million), Africa (-\$150 million), and ECOWAS (-\$53 million). However, all regions are projected to have an increase in welfare for the portion of the economy attributable to the agricultural sector (thus, their nonagricultural sector has a negative welfare impact, and this outweighs the gain to agriculture).

China's projected economy-wide decrease in welfare occurs because the country's loss in terms of trade is greater than the gains from allocative efficiency. The majority of regions, in fact, are projected to experience a decrease in terms of trade, but their allocative efficiency gains outweigh those losses. For example, the EU (the only region with a reduction in agricultural exports) has a projected loss in welfare from terms of trade, but it has a larger gain in welfare from allocative efficiency. This is because the removal of agricultural tariffs is projected to lead to a reallocation of resources, allowing for imports of certain products that the EU is less efficient in producing and enabling resources used in the production of those products to move to more efficient sectors (thus, their nonagricultural sector has a negative welfare impact, and this outweighs the gain to agriculture).

For China, the results identify the commodities for which welfare changes are predicted to occur. Although China may experience a decline in its terms of trade for most agricultural commodities, a large part of this decrease (\$578 million) is from oilseeds. The terms of trade effect can be further broken down into effects of the change in world prices, import prices, and export prices. China is expected to experience a welfare loss from its oilseeds trade (imports) due to the increase in the world oilseed price of 1.26 percent.

The regions estimated to experience the largest welfare gains are the EU (+\$10.8 billion), AgExp (+\$9.1 billion), and Brazil (+\$8.3 billion). For AgExp and Brazil, most of the increases are attributable to gains in terms of trade; comparing “agriculture only” to “all of the economy” (table 5) reveals that these gains are mainly from nonagriculture sectors. EU estimated welfare gains are from allocative efficiency, mainly from the agriculture sector. Although the EU was the only region with a projected decrease in exports, the removal of tariffs leads to large estimated gains in efficiency (primarily from shifting resources out of beef and other meats production). As table 5 indicates, the projected global, economy-wide welfare gains are largely due to agriculture.¹⁰ Welfare from agriculture is expected to increase by \$49.3 billion, meaning that nonagriculture has an increase of \$7 billion. For agriculture, the projected global welfare increase is due to gains in allocative efficiency (welfare from terms of trade has a slight decrease for agriculture); all regions have an estimated increase in welfare from allocative efficiency. This is because removing tariffs on agriculture leads to regions pulling resources away from commodities that might have been inefficient to produce to commodities that can be produced more efficiently (that is, tariffs have likely been protecting industries in a region from global competition). Recall that India has the highest average tariff on agriculture, and this scenario reveals it as one of the three countries/regions that—if all agricultural tariffs were eliminated—are projected to gain the most in welfare from improvement in allocative efficiency for agriculture.

¹⁰As should be expected, since the model scenario does not reform nonagriculture sectors

The Trade Facilitation Agreement (TFA)

At the 2013 WTO Ministerial Meeting in Bali, member countries signed the Trade Facilitation Agreement (TFA), which commits them to pursue a range of border management policies that are currently considered best practice. Trade facilitation refers to policies and measures aimed at easing trade costs by improving efficiency at each stage of the international trade chain. (See Box: Trade Facilitation.) The TFA came into force February 22, 2017, following its ratification by two-thirds of the WTO membership. As of October 2019, 80 countries have provided notification of their date to implement the agreement (WTO, 2019a).¹¹

Trade Facilitation

The World Trade Organization definition of trade facilitation (WTO, 1999) refers to the simplification of trade procedures, understood as the “activities, practices, and formalities involved in collecting, presenting, communicating, and processing data required for the movement of goods in international trade.” The work of the Organization for Economic Cooperation and Development (OECD) on trade facilitation is also based on this definition. Wider definitions, such as those used by the United Nations Conference on Trade and Development (UNCTAD) or the Asia-Pacific Economic Cooperation (APEC), may include customs, transport, and transit issues, banking and insurance, business practices, and telecommunications. Whatever the definition and scope, existing economic analysis of trade facilitation usually draws on the notion of trade transaction costs and seeks to assess the benefits of efficiency-enhancing, trade-facilitating measures by estimating the costs of inefficiency in the various policy areas that influence the movement of goods.

Numerous indicators of trade facilitation exist to reflect the different scope of what is involved in the definition of trade facilitation (e.g., if border procedures are easier or if paperwork is reduced). The two main sources of information on these, as noted in WTO (2015), are Hillberry and Zhang (2015) and Moise and Sorescu (2013).^{*} Hillberry and Zhang look at the impact of full implementation on the time required to import and export in each country, measured in days. The second study, by Moise and Sorescu, is more comprehensive in scope and estimates reductions in total trade costs from full implementation of the Agreement. As the Hillberry and Zhang study considers time in transit as the main indicator of trade facilitation, and transit time is not as relevant for agricultural products as to manufactured ones, we follow WTO (2015) and use the trade cost reductions estimated by Moise and Sorescu. Note that these analyses do not consider the costs of implementing the programs.

^{*}WTO (2015b) notes that there are additional papers that model trade facilitation assumptions, but these also largely consider time in trade, something not very relevant to agriculture, where most items are transported by rail or sea versus by air transit for manufacturing.

As in the WTO report (2015), we model the impacts of the TFA by reducing trade costs for agriculture using the estimates by Moise and Sorescu (2013) (see Appendix 2 for modeling information). The OECD launched the Moise and Sorescu work to gather information on trade facilitation indicators and match them to the TFA. The 97 variables they consider are mapped to 16 indicators. Moise and Sorescu estimate the relevance of each indicator to agriculture and manufacturing and for developed versus developing countries. The reduction in trade costs ranges from 9.6 to 23.1 percent, with the average reduction equal to 14.5 percent. The average decrease in trade costs for manufactured goods was estimated at 18 percent, versus 10.4 percent for agricultural goods.

¹¹Developed countries were required to implement all provisions of the TFA when it came into force. Developing countries have a longer time period to implement the agreement.

Model Results: Impacts of the Scenario To Implement the Trade Facilitation Agreement

We now report the projected impacts of full implementation of the TFA, that is, reducing trade costs (e.g., paperwork, border controls) for agricultural goods, using the estimates by Moise and Sorescu. Note that this scenario assumes that tariffs are still in place and there is no change in trade costs for nonagricultural goods. For this scenario, we use the breakdown of trade costs reduction by income group. Those estimated reductions are 14.5 percent for low-income countries, 15.5 percent for lower-middle-income countries, 13.2 percent for upper-middle-income countries, and 10 percent for high-income countries. Appendix 2 describes how the trade cost reductions are implemented in the model. Appendix table 1 provides the country classification in the last column. Unfortunately, Moise and Sorescu's work (and that of all others) does not consider individual commodities; thus, the trade costs reductions are applied uniformly across agriculture.¹²

Exports

Globally, agricultural exports are projected to increase by 7.27 percent in the trade facilitation scenario (table 6). Every region is projected to have an increase in its aggregate agricultural export value, except for a 2.24 percent overall decrease in Argentina's exports. The increases for the other regions are all greater than 2 percent, and 13 of the remaining 19 regions have increases greater than 5 percent.

Despite the projected increase in aggregate exports for almost every region, there are 73 (of 320) instances of commodity/region pairs that are estimated to have a decrease in exports. Oceania, EU, and the United States account for 41 of those instances, while Asia, Indonesia, and South America are not projected to decrease exports for any agricultural commodity. Oceania, EU, and the United States are all classified as high-income; thus, they are estimated to have the smallest reduction in trade costs globally, based on information from Moise and Sorescu. However, AgImp, Canada, Japan, and MENA, also had a 10 percent reduction, but those regions collectively have only 24 instances of a projected decrease in the export of a commodity.

Oceania is the region with the most commodity sectors (13) projected to experience an export decline under TFA, but it is also expected to have an increase in aggregate agricultural exports. This is largely because of the estimated 9 percent increase in beef exports. Dairy and other meats are also projected to have export increases, but the largest share of exports in Oceania is for beef. Argentina will have fewer declining exports; however, its decrease in grain and vegetable oil exports leads to an aggregate decline. Asia, Indonesia, and South America are not projected to decrease exports for any agricultural commodity. Asia and Indonesia are lower-middle-income regions, which have a greater decrease in trade costs than low-income regions, according to Moise and Sorescu. Europe, which includes a number of former Soviet Union countries and is another lower-middle-income region, is projected to have a slight decrease in corn exports but the largest increase in aggregate agricultural exports. After Asia, India—the final lower-middle-income region—has the third-largest increase in aggregate exports. The low-income regions increase their estimated aggre

¹² The TFA could, however, have quite differentiated impacts within the agricultural sectors, especially when considering the impacts of “time” in trading costs (the length of time to get from point A to point B). Fruits and vegetables (and other perishables) should be the most impacted commodities, while nonperishables could be less impacted.

Table 6

Percent change in projected exports for the trade-facilitation scenario

	Europe	Asia	India	Indonesia	AgExp	China	SouAm	AgImp	Africa	ECOW-AS
Rice	19.02	24.79	16.31	23.60	18.90	22.50	24.80	23.92	22.40	29.61
Wheat	51.44	92.47	27.67	68.61	16.52	25.29	39.68	18.41	40.23	40.40
Corn	-0.27	5.95	0.30	0.94	-3.99	-2.33	1.58	-6.55	3.36	0.61
Other coarse grains	-1.51	8.68	-4.50	3.43	-5.68	-2.00	0.64	-5.82	1.44	-0.23
Vegetables and fruit	6.06	13.52	7.40	10.44	1.75	4.69	0.14	2.17	5.85	5.81
Oilseeds	8.05	18.03	16.50	5.78	1.74	5.47	1.37	-2.53	0.34	1.25
Sugar	27.12	27.97	14.94	22.87	10.35	15.65	13.72	5.09	19.46	18.33
Plant fibers	7.90	18.91	13.09	31.84	9.00	11.40	9.48	-3.58	7.46	6.69
Other crops	22.27	24.67	11.95	11.17	7.88	7.34	4.48	6.93	10.71	9.81
Animals	21.94	29.00	16.63	25.68	14.94	14.39	17.50	13.28	11.48	16.50
Beef	56.06	54.37	31.85	58.48	40.37	37.27	41.96	27.75	36.97	42.32
Other meats	61.65	76.92	62.38	50.45	38.86	40.69	52.11	28.69	51.87	54.87
Vegetable oil	37.86	26.48	18.39	14.52	12.56	19.94	14.72	26.70	5.85	7.25
Milk products	47.19	63.24	47.48	59.75	40.57	41.37	39.65	23.98	43.23	29.68
Processed food	15.89	18.19	12.73	14.92	13.96	9.07	11.73	10.16	13.46	13.60
Beverages & tobacco	5.59	3.99	2.50	4.48	1.54	1.37	2.04	1.03	3.71	3.36
All agriculture	21.82	20.67	16.14	14.33	11.50	11.20	10.73	9.98	9.87	9.74

	Mexico	EU	Brazil	MENA	Oceania	Japan	Russia	Canada	USA	Argentina
Rice	25.00	-6.20	17.61	5.14	-5.73	10.40	17.70	1.91	8.06	0.82
Wheat	25.06	7.99	32.86	24.75	-2.55	17.84	4.99	-0.92	3.13	1.31
Corn	2.99	-5.65	-6.30	-4.46	-10.21	-1.09	-4.90	-5.27	-6.26	-4.72
Other coarse grains	-4.39	-4.27	-5.67	-5.70	-8.72	-3.81	-5.23	-7.60	-4.80	-6.00
Vegetables and fruit	0.70	-4.08	-3.38	-4.05	-3.33	0.49	3.26	0.10	-1.41	-2.04
Oilseeds	12.10	-8.62	-5.77	-5.49	-12.49	5.81	6.21	-9.98	-4.37	-6.29
Sugar	9.63	2.25	7.27	3.24	-3.22	7.54	10.17	6.81	9.06	5.13
Plant fibers	8.21	-5.38	-0.91	-3.38	-8.04	0.86	71.60	1.79	-1.35	-5.64
Other crops	4.89	-2.54	1.09	0.05	-5.07	-0.40	10.82	-4.10	7.25	-1.30
Animals	19.24	6.06	9.01	6.86	-0.38	9.44	10.19	6.62	4.68	5.25
Beef	63.01	21.01	25.86	22.12	9.00	21.46	18.28	21.18	14.21	16.47
Other meats	34.98	25.11	28.20	17.17	10.21	40.77	13.59	19.60	17.46	24.40
Vegetable oil	68.29	2.07	1.09	-0.44	-8.49	2.98	-6.31	0.71	-1.43	-5.79
Milk products	41.57	20.90	29.14	24.72	12.82	25.58	20.34	19.65	20.00	17.02
Processed food	10.61	3.63	6.74	7.58	-0.78	3.27	3.95	4.18	0.79	0.59
Beverages & tobacco	1.75	0.09	0.21	0.05	-1.69	-2.91	-2.56	-0.78	-1.13	-0.93
All agriculture	8.45	6.18	5.55	4.30	3.26	3.19	2.41	2.34	2.13	-2.24

Note: Results are ordered by largest impact (change percentage).

AgImp consists of countries in the top 20 global agricultural importers in 2014 that do not appear elsewhere; AgExp consists of countries in the top 20 global agricultural exporters in 2014 that do not appear elsewhere; SouAM includes South American Countries not described by another group; MENA is the Middle East and North Africa; ECOWAS is the Economic Community of West African States; and Africa includes all African countries not described by another group. See Appendix Table 1 for more information on the regions.

Source: USDA, Economic Research Service analysis using ERS-GTAP (Global Trade Analysis Project) data.

We can calculate a trade-weighted average increase in projected agricultural export value across the four income groups. Those calculations are:

High-income: 5.57 percent

Upper-middle income: 10.70 percent

Lower-middle income: 18.54 percent

Low-income: 9.82 percent

The preceding data suggest that the full implementation of the TFA could have strong distributional impacts. High-income regions tend to have easier access to trade, which is why they are estimated to have the smallest reduction in trade costs from the TFA. This smaller reduction leads to the high-income group having the smallest projected increase in agricultural exports once trade costs are removed. Upper-middle-income regions are projected to nearly double the high-income group's increase in exports, but the largest estimated increase occurs in lower-middle-income regions. Finally, low-income regions are projected to have lower exports than upper-middle-income regions (despite the greater reduction in trade costs) as they are not major exporters.

Imports

According to the model, with the TFA the rise in agricultural export value will be matched by an increase in the value of global agricultural imports (table 7). All regions increase their aggregate imports by at least double digits, most by more than 20 percent. There are also increases in most of the commodities imported by a region. The model found only five instances of decreased imports, four of them for Japan's grain imports other than rice. The TFA leads to a large increase in Japan's rice imports, which have the highest tariff in Japan.

Production

The model results indicate that through TFA effects most regions lower their aggregate agricultural production (table 8), with only AgExp, Brazil, Europe, and Indonesia showing an increase. Most regions would see decreases in the production of many commodities, and globally there would be decreases in 253 of the 320 commodity/region occurrences. However, AgExp, Brazil, Europe, and Indonesia specialize in the production/export of certain highly traded commodities, which leads to a projected increase in aggregate production value for those regions. For example, AgExp and Brazil are major producers/exporters of other meats, a commodity that has a large increase in estimated production. Europe's projected increase in aggregate production is due to plant fibers and Indonesia's to vegetable oil.

Prices

Aggregate agricultural price changes across regions are all expected to be negative, as should be the case since TFA trade cost reductions are applied across all agricultural commodities (table 9). Across all regions, those that tend to have the largest estimated percentage decrease in aggregate price are those with a large vegetable oil production.

Macrofactors

The final table of results presents projected changes in macrofactors (table 10). Most regions would experience an increase in the price of endowments, although the increases would be small. For several regions, the price of land decreases by more than 10 percent. The decreases most often occur in high-income regions, except for Argentina, Oceania, and Russia, which would have smaller decreases in land price. This is due to smaller decreases in production for Argentina and Oceania compared to the EU and the United States (as production declines, the stream of income from also agriculture declines, leading to decreases in what buyers would be willing to pay for land). Russia is estimated to experience a large decrease in production, but this occurs mainly for processed agricultural commodities that do not use land. The price of labor and capital is estimated to increase for many regions as the reduction in trade costs shifts resources away from agriculture, increasing the demand for those endowments.

In terms of welfare, an increase in global welfare of \$42.9 billion is projected, although only 61 percent of the increase is due to agriculture; recall that in the tariff-removal scenario, 87 percent of the welfare increase is due to agriculture. Note that many projected global welfare increases occur in the EU, both for agriculture and nonagriculture. The EU's \$11 billion projected increase in welfare from agriculture is 42 percent of global welfare from agriculture, even with the EU decrease in terms of trade for agriculture. That is, the EU members are gaining in allocative efficiency, but they have a \$1.1 billion projected decrease in agricultural terms of trade (mainly from reduced prices for their exports of meats and milk products). China and Japan would also see large gains in agricultural welfare from the TFA. China, the EU, and Japan represent three-fourths of the global projected gain in welfare from agriculture. China and Japan benefit from the reduction in global prices for commodities. The United States has a slight decrease in welfare because it does not have the large gains in allocative efficiency that many regions receive, even when they have a decrease in welfare from terms of trade. Change in terms of trade occurs from changes in either global, export, or import prices; the majority of the U.S. decrease (69 percent) is in U.S. export prices and for nonagricultural sectors.

Table 7

Percent change in projected imports for the trade facilitation scenario

	Brazil	India	Argentina	Asia	SouAm	Africa	Russia	ECOW-AS	Oceania	Europe
Rice	55.16	68.29	58.64	53.48	37.61	31.31	22.60	41.58	22.48	25.57
Wheat	19.68	78.21	67.30	22.08	10.69	7.64	73.48	4.58	30.08	46.53
Corn	19.09	16.65	13.39	11.61	9.05	17.52	4.07	17.45	8.65	12.29
Other coarse grains	8.63	17.48	15.39	5.96	4.56	15.57	7.78	17.15	11.87	14.76
Vegetables and fruit	16.53	22.61	19.36	20.51	20.91	24.07	7.25	20.45	16.89	19.45
Oilseeds	35.04	24.21	28.33	13.84	17.57	31.13	7.18	31.43	22.69	27.50
Sugar	34.67	36.61	33.35	27.01	34.41	27.32	27.18	21.13	31.94	15.37
Plant fibers	20.73	35.22	26.97	32.12	19.52	35.07	6.48	40.60	27.98	37.92
Other crops	51.13	51.43	33.56	37.87	36.66	47.98	-0.11	51.50	2.77	27.76
Animals	34.36	30.43	28.34	24.84	25.65	29.15	14.27	28.51	23.59	26.21
Beef	63.26	60.82	52.42	45.38	48.35	53.48	51.02	48.55	44.77	44.30
Other meats	71.21	70.19	62.34	52.52	51.38	42.23	44.24	51.46	40.22	42.81
Vegetable oil	50.91	30.07	45.72	15.62	23.02	15.76	39.60	18.19	20.29	12.56
Milk products	51.32	54.66	52.33	35.35	41.27	41.98	47.31	17.73	42.94	47.39
Processed food	25.52	29.03	26.13	23.12	20.28	22.19	19.58	16.72	21.82	18.25
Beverages & tobacco	13.77	14.53	13.46	12.63	13.07	13.91	12.25	11.50	12.05	9.90
All agriculture	29.59	29.33	27.30	24.93	24.00	23.75	23.29	22.67	22.27	22.13

	Indonesia	USA	AgExp	China	MENA	Japan	EU	Mexico	Canada	AgImp
Rice	55.25	29.73	50.89	51.20	4.33	39.79	13.63	8.95	42.14	28.63
Wheat	1.09	28.91	21.63	45.33	19.91	-1.55	26.02	8.34	52.38	15.62
Corn	13.23	12.59	8.90	12.72	3.45	-2.46	5.17	6.79	4.52	1.50
Other coarse grains	1.73	3.57	10.65	3.23	3.13	-1.14	7.97	11.19	9.47	5.68
Vegetables and fruit	22.76	13.55	17.44	21.11	16.57	18.03	5.91	3.77	3.87	14.70
Oilseeds	41.05	15.42	21.02	4.94	7.18	-4.45	1.60	3.23	16.73	4.99
Sugar	16.69	23.75	32.87	31.02	12.54	22.81	18.78	19.94	24.28	13.47
Plant fibers	0.48	23.81	8.84	19.46	18.28	7.24	7.42	11.48	18.72	18.84
Other crops	30.41	11.72	16.26	21.77	21.13	18.09	19.72	5.35	7.65	4.47
Animals	11.73	24.21	22.15	22.54	18.41	13.07	17.87	20.83	17.25	15.56
Beef	35.62	43.26	37.59	34.02	32.56	20.51	34.22	18.23	40.50	24.61
Other meats	69.58	56.03	53.19	56.18	40.35	24.03	37.75	31.72	40.26	35.38
Vegetable oil	39.89	22.63	22.81	37.90	18.96	22.51	12.75	11.57	22.17	7.54
Milk products	30.53	46.17	38.39	33.71	29.46	34.80	32.12	39.18	43.04	27.92
Processed food	24.83	24.45	18.46	24.81	16.05	22.03	16.80	22.10	15.66	16.03
Beverages & tobacco	9.55	11.86	12.85	13.39	10.73	12.11	10.66	11.16	10.61	8.78
All agriculture	22.09	21.45	21.45	20.79	17.82	17.75	17.68	16.99	15.68	14.18

Note: Results are ordered in terms of impact (change percentage).

AgImp consists of countries in the top 20 global agricultural importers in 2014 that do not appear elsewhere; AgExp consists of countries in the top 20 global agricultural exporters in 2014 that do not appear elsewhere; SouAM includes South American Countries not described by another group; MENA is the Middle East and North Africa; ECOWAS is the Economic Community of West African States; and Africa includes all African countries not described by another group. See Appendix Table 1 for more information on the regions.

Source: USDA, Economic Research Service analysis using ERS-GTAP (Global Trade Analysis Project) data.

Table 8

Percent change in projected agricultural production for the trade facilitation scenario

	Brazil	Indonesia	AgExp	Europe	India	Oceania	Mexico	ECOWAS	Argentina	SouAm
Rice	-0.84	-0.74	2.74	-3.45	2.31	-9.60	-9.90	-8.26	-0.22	-2.03
Wheat	-20.79	-14.70	-3.07	-0.88	2.39	-3.64	-1.73	-23.25	-0.08	-7.59
Corn	-0.83	-1.07	-3.27	-0.90	0.33	-3.75	-3.91	0.36	-2.15	-3.17
Other coarse grains	-5.94	3.43	-2.98	-0.28	0.04	-4.73	-1.44	0.26	-4.86	-4.52
Vegetables and fruit	-0.81	-0.95	-1.23	-1.78	-0.72	-3.83	0.01	0.36	-2.07	-1.08
Oilseeds	-4.63	1.37	-3.81	-0.72	-5.53	-6.74	-10.74	-0.58	-5.28	-3.50
Sugar	1.83	-5.62	-0.89	4.88	-0.20	-2.56	-0.24	-10.47	-0.08	-0.06
Plant fibers	-1.27	-8.29	-11.53	1.25	0.32	-5.96	-6.39	1.66	-1.91	-4.40
Other crops	-0.48	0.62	-1.07	-4.59	-0.47	-6.87	-1.72	2.38	-3.08	0.05
Animals	3.12	-0.74	0.32	0.59	0.34	2.34	-1.01	-0.91	1.89	-0.83
Beef	3.20	-3.43	-6.94	0.94	22.77	5.29	5.97	0.43	2.39	3.21
Other meats	11.78	0.11	5.42	-1.47	0.14	-7.12	-8.58	-5.53	1.76	-3.41
Vegetable oil	-1.54	7.03	1.23	11.16	-12.01	-14.67	0.76	-17.40	-5.42	-4.96
Milk products	-0.39	-7.78	0.11	2.35	0.84	5.17	-2.89	-16.56	2.43	-1.82
Processed food	-0.18	0.90	2.76	0.62	1.65	-3.27	-0.19	-2.08	-0.64	-0.57
Beverages & tobacco	-0.17	0.31	-0.55	-0.71	0.06	-1.07	0.08	-1.46	-0.31	-0.41
All agriculture	0.77	0.69	0.42	0.25	-0.05	-0.22	-0.80	-0.84	-0.88	-1.05

	China	USA	Asia	Canada	Africa	EU	AgImp	Russia	Japan	MENA
Rice	-0.58	-2.50	-0.33	-6.27	-10.45	-16.78	-4.23	-6.19	-2.56	-20.22
Wheat	-1.94	-0.84	-6.64	-1.31	-16.67	-4.21	-13.15	1.76	-15.50	-13.70
Corn	-0.57	-1.84	-1.79	-2.73	-0.28	-6.08	-4.28	-3.01	-11.33	-1.12
Other coarse grains	-4.36	-5.27	-2.66	-4.49	-0.71	-4.09	-6.46	-2.13	-8.41	-5.13
Vegetables and fruit	-0.57	-4.80	0.32	-4.50	-0.29	-7.44	-2.50	-4.27	-3.91	-2.83
Oilseeds	-7.84	-5.88	-3.76	-9.19	-0.44	-13.81	-11.91	-8.42	-18.04	-13.64
Sugar	-1.24	-3.07	-4.27	-2.83	-3.92	-6.48	-6.30	-2.87	-5.95	-11.31
Plant fibers	-5.60	-1.63	-0.74	-2.79	1.75	-7.10	-3.01	9.18	-8.88	-0.28
Other crops	-1.10	-9.05	-1.51	-11.35	2.35	-11.22	-5.78	2.11	-15.69	-9.40
Animals	-1.08	-0.09	-0.83	0.34	-0.81	-1.48	-3.47	-0.64	-9.55	-3.71
Beef	-4.64	-0.43	0.41	-0.14	-1.28	-1.81	-5.71	-2.59	-13.04	-7.01
Other meats	-1.31	1.64	-2.51	1.04	-12.34	0.10	-7.80	-12.30	-18.10	-10.91
Vegetable oil	-2.99	-6.92	-10.33	-4.39	-16.77	-8.00	-1.50	-6.08	-13.93	-11.53
Milk products	-5.05	0.62	-2.74	-0.49	-4.10	0.47	-1.62	-6.18	-2.21	-4.67
Processed food	-0.31	-1.66	-0.88	-1.86	-2.35	-2.10	-1.00	-2.40	-2.52	-2.40
Beverages & tobacco	-0.11	-0.56	-1.37	-1.36	-0.11	-0.78	-0.90	-1.63	-0.58	-1.03
All agriculture	-1.10	-1.23	-1.36	-1.91	-1.95	-2.38	-3.01	-3.19	-3.85	-4.85

Note: Results are ordered in terms of impact (change percentage).

AgImp consists of countries in the top 20 global agricultural importers in 2014 that do not appear elsewhere; AgExp consists of countries in the top 20 global agricultural exporters in 2014 that do not appear elsewhere; SouAM includes South American Countries not described by another group; MENA is the Middle East and North Africa; ECOWAS is the Economic Community of West African States; and Africa includes all African countries not described by another group. See Appendix Table 1 for more information on the regions.

Source: USDA, Economic Research Service analysis using ERS-GTAP (Global Trade Analysis Project) data.

Table 9

Percent change in projected market prices for the trade facilitation scenario

	Brazil	India	Oceania	ECOW-AS	Indo-nesia	Africa	Europe	Mexico	SouAm	China
Rice	0.04	0.30	-0.45	-1.15	-0.63	-1.32	-0.84	-1.60	-1.75	-1.54
Wheat	-2.03	0.38	-0.97	-2.64	-3.17	-1.80	-0.99	-0.83	-2.80	-1.09
Corn	-0.06	-0.08	-0.68	-0.50	-0.89	-0.52	-0.51	-1.56	-1.51	-1.04
Other coarse grains	-0.67	-0.14	-0.71	-0.51	-1.83	-0.59	-0.41	-1.13	-2.32	-2.16
Vegetables and fruit	-0.03	-0.51	-1.02	-0.50	-0.90	-0.55	-0.83	-0.98	-1.10	-1.21
Oilseeds	-0.35	-1.75	-1.51	-0.59	0.10	-0.53	-0.77	-2.88	-1.50	-2.62
Sugar	0.12	0.00	-0.40	-0.98	-1.22	-0.68	-1.68	-0.39	-0.67	-1.02
Plant fibers	-0.08	-0.10	-0.33	-0.33	-3.85	-0.30	-0.27	-1.18	-1.61	-1.43
Other crops	-0.01	-0.23	-2.18	-0.33	-0.25	-0.33	-1.39	-1.35	-1.09	-1.48
Animals	-0.01	-0.32	-0.38	-0.81	-1.41	-0.82	-1.13	-1.82	-1.66	-1.59
Beef	0.01	-0.13	-0.29	-0.48	-0.95	-0.61	-0.86	-2.22	-1.28	-1.04
Other meats	0.06	-0.33	-0.33	-0.62	0.04	-0.47	-1.04	-1.28	-1.04	-1.17
Vegetable oil	-0.44	-1.73	-1.80	-1.44	-0.87	-1.58	-4.06	-7.80	-2.02	-3.55
Milk products	0.02	-0.21	-0.36	-0.78	-0.71	-0.44	-0.64	-0.66	-0.86	-1.15
Processed food	-0.47	-0.37	-0.64	-1.50	-0.78	-1.39	-1.21	-1.01	-1.50	-1.13
Beverages & tobacco	0.06	-0.06	-0.48	-1.00	-0.87	-0.72	-1.46	-0.45	-0.58	-0.55
All agriculture	-0.13	-0.32	-0.54	-0.63	-0.73	-0.81	-1.02	-1.20	-1.26	-1.33

	AgExp	USA	Canada	Argentina	Asia	Japan	Russia	EU	MENA	AgImp
Rice	-0.12	-1.21	-0.66	-0.80	-0.99	-1.67	-3.27	-0.88	-5.21	-3.97
Wheat	-0.37	-2.12	-1.13	-1.87	-3.57	-3.92	-1.89	-1.77	-2.94	-3.10
Corn	-0.83	-2.00	-1.15	-2.06	-1.88	-2.82	-2.61	-1.88	-1.92	-1.72
Other coarse grains	-0.37	-2.42	-1.30	-2.40	-3.58	-3.06	-2.46	-1.60	-2.07	-1.73
Vegetables and fruit	-0.59	-2.59	-1.91	-2.22	-1.55	-1.89	-2.70	-2.49	-2.09	-3.07
Oilseeds	-1.69	-2.87	-1.85	-2.41	-2.94	-3.97	-4.31	-2.51	-2.86	-3.24
Sugar	-0.40	-2.02	-2.12	-1.01	-1.69	-1.93	-2.67	-1.31	-2.11	-2.46
Plant fibers	-1.95	-1.99	-1.51	-1.94	-1.78	-1.37	-11.09	-1.47	-1.84	-1.24
Other crops	-1.09	-4.24	-2.51	-2.46	-2.07	-2.75	-3.09	-1.60	-2.65	-3.90
Animals	-1.65	-1.73	-1.78	-1.79	-2.12	-2.81	-2.79	-2.45	-2.88	-3.80
Beef	-1.34	-1.38	-1.14	-1.54	-1.33	-1.67	-1.48	-1.85	-2.00	-2.69
Other meats	-1.20	-1.16	-1.15	-1.29	-1.65	-2.55	-0.90	-2.33	-1.56	-2.51
Vegetable oil	-2.47	-2.38	-2.63	-1.85	-2.49	-3.58	-2.46	-3.70	-3.50	-6.67
Milk products	-1.19	-1.04	-1.05	-1.02	-1.48	-1.88	-0.96	-1.96	-2.46	-2.30
Processed food	-2.27	-1.04	-1.62	-0.94	-1.61	-1.77	-2.02	-2.14	-3.37	-3.70
Beverages & tobacco	-0.69	-0.81	-0.99	-0.88	-0.54	-0.74	-0.85	-1.61	-1.88	-2.13
All agriculture	-1.35	-1.40	-1.50	-1.51	-1.62	-1.72	-1.89	-2.10	-2.64	-3.20

Note: Results are ordered in terms of impact (change percentage).

AgImp consists of countries in the top 20 global agricultural importers in 2014 that do not appear elsewhere; AgExp consists of countries in the top 20 global agricultural exporters in 2014 that do not appear elsewhere; SouAM includes South American Countries not described by another group; MENA is the Middle East and North Africa; ECOWAS is the Economic Community of West African States; and Africa includes all African countries not described by another group. See Appendix Table 1 for more information on the regions.

Source: USDA, Economic Research Service analysis using ERS-GTAP (Global Trade Analysis Project) data.

Table 10
Projected macroimpacts for the trade facilitation scenario

	EU	China	Japan	Russia	India	AgExp	Europe	MENA	AgImp	ECOWAS
	Prices (% change)									
Land	-17.32	-6.26	-17.27	-10.09	-1.18	-3.08	-3.58	-20.30	-17.15	-2.09
Labor	0.12	0.19	-0.01	-0.19	0.32	0.41	0.33	-0.29	0.09	-0.41
Capital	0.19	0.29	0.02	-0.11	0.29	0.44	0.34	0.02	0.15	-0.01
Exchange rate (% change)	0.06	0.05	-0.04	-0.17	0.22	0.34	0.23	-0.17	0.02	-0.31
	Welfare (\$ million) Agriculture only									
Allocative efficiency	12,139	3,859	2,185	793	1,154	891	551	17	-342	860
Terms of trade	-1,158	1,617	867	42	167	-1,003	252	720	486	139
Total	10,982	5,476	3,052	835	1,321	-112	804	737	144	999
All of the economy										
Allocative efficiency	19,692	7,491	2,783	1,960	1,007	1,259	784	505	376	961
Terms of trade	-816	1,679	207	3	648	279	740	543	833	136
Investment	-47	-620	4	60	243	78	-30	194	-107	-11
Total	18,828	8,549	2,994	2,022	1,898	1,616	1,494	1,242	1,102	1,086

	Africa	SouAm	Brazil	Asia	Mexico	Indonesia	Oceania	Canada	Argentina	USA
	Prices (% change)									
Land	-3.91	-5.85	-1.33	-5.47	-5.05	-1.71	-4.81	-16.93	-8.81	-14.96
Labor	-0.10	0.15	0.24	0.31	0.06	0.54	0.03	-0.01	-0.64	-0.10
Capital	0.03	0.17	0.20	0.48	0.07	0.48	0.04	-0.03	-0.55	-0.12
Exchange rate (% change)	-0.07	0.05	0.20	0.02	0.02	0.36	0.02	-0.05	-0.70	-0.15
	Welfare (\$ million) Agriculture only									
Allocative efficiency	639	622	362	441	284	449	506	536	-400	678
Terms of trade	182	-156	98	53	142	-30	19	-272	-610	-1,444
Total	821	466	461	493	426	419	525	265	-1,010	-765
	Welfare (\$ million) All of the economy									
Allocative efficiency	822	911	430	652	506	521	553	696	-497	1,485
Terms of trade	95	-60	298	86	298	288	-16	-272	-881	-4,090
Investment	-8	54	128	97	30	-13	-6	14	13	-74
Total	909	905	856	834	834	796	532	437	-1,365	-2,679

Note: Results are ordered in terms of impact (change percentage).

AgImp consists of countries in the top 20 global agricultural importers in 2014 that do not appear elsewhere; AgExp consists of countries in the top 20 global agricultural exporters in 2014 that do not appear elsewhere; SouAM includes South American Countries not described by another group; MENA is the Middle East and North Africa; ECOWAS is the Economic Community of West African States; and Africa includes all African countries not described by another group. See Appendix Table 1 for more information on the regions.

Source: USDA, Economic Research Service analysis using ERS-GTAP (Global Trade Analysis Project) data.

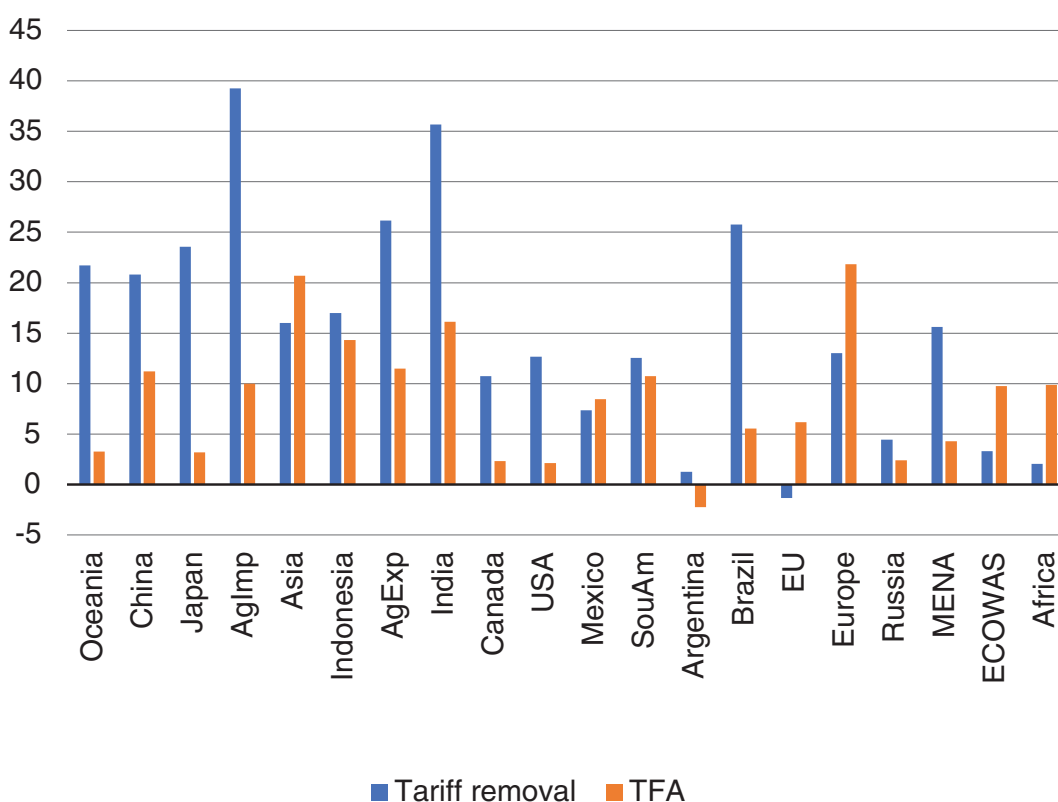
Comparing the Results of the Two Scenarios

Aggregate Trade Results

Figure 5 compares aggregate agricultural impacts across the two scenarios. The tariff-removal scenario generates the largest global gains, and the largest region peaks are also for tariff removal. As the figure shows, 14 of the 20 regions had larger impacts from the tariff-removal scenario; the difference for Brazil, Japan, and AgImp is more than 20 percentage points.

Figure 5
Aggregate agricultural export changes across two scenarios

Aggregate agricultural exports (percent change)



Notes: TFA=Trade Facilitation Agreement.

AgImp consists of countries in the top 20 global agricultural importers in 2014 that do not appear elsewhere; AgExp consists of countries in the top 20 global agricultural exporters in 2014 that do not appear elsewhere; SouAm includes South American Countries not described by another group; MENA is the Middle East and North Africa; ECOWAS is the Economic Community of West African States; and Africa includes all African countries not described by another group. See Appendix Table 1 for more information on the regions.

Source: USDA, Economic Research Service analysis using ERS-GTAP (Global Trade Analysis Project) data.

Aggregate Commodity Results

Exports

The model results indicate that the removal of all agricultural tariffs leads to increases in exports in all agricultural commodities except live animals (table 11). For global exports, other meats (e.g., pork and poultry) could see the largest increase, followed by rice and beef. The other meats category has the largest increase due to the removal of the high EU tariff (64 percent), leading to an increase in exports, especially from the AgExp region. Brazil also has a large estimated increase in other meats exports, almost all of which are destined for Mexico (Brazil is facing a 114-percent tariff in that market). Both of these trading pairs—EU-AgExp and Brazil-Mexico— have high tariffs in place because of Tariff Rate Quotas (TRQs).

The model scenario projected rice export increases for many regions: Oceania, Japan, AgImp, Asia, AgExp, and the United States each increase exports more than 50 percent. This leads to rice having the second-largest increase in exports by commodity. Recall that corn is the commodity with the highest tariff; yet most commodities have bigger export gains under the scenario. This happens because there is limited global demand for corn, which is mainly fed to livestock. Live animals, the one commodity showing a decline (-0.45 percent) in exports, are traded in small numbers since they are protected under numerous SPS issues (Sanitary and Phytosanitary Measures; see Appendix 3 on base trade). Note that a large (nearly 30 percent) increase in global beef exports is projected (table 11). This is primarily due to the TRQ that the EU has in place on beef, with the Ad Valorem custom duties (i.e., levied proportionate to the estimated value of the goods concerned) of the TRQ averaging more than 40 percent.¹³ Even though corn had the highest estimated tariff in 2014, these results make it clear that the impacts of removing all tariffs depend on global demand and existing bilateral tariffs.

¹³ See Arita et al. (2014) for more information on EU TRQs for meats

Table 11

Percent change in global exports by commodity across tariff removal and TFA scenarios

Exports	Tariff removal	Trade facilitation
Rice	33.32	16.31
Wheat	11.38	6.95
Corn	4.49	-5.20
Other coarse grains	1.40	-5.14
Vegetables and fruit	5.27	-0.02
Oilseeds	4.85	-4.57
Sugar	16.83	8.18
Plant fibers	1.04	3.24
Other crops	4.49	4.55
Animals	-0.45	8.18
Beef	29.40	21.80
Other meat	40.35	26.05
Vegetable oil	13.38	6.37
Milk products	15.73	21.52
Processed food	7.02	6.89
Beverages & tobacco	7.95	0.40

Note: TFA = Trade Facilitation Agreement.

Source: USDA, Economic Research Service analysis using ERS-GTAP (Global Trade Analysis Project) data.

Comparing commodity export results from the two scenarios, large increases in the export of most commodities would likely not occur under the TFA. However, the commodities with the largest export increases for the TFA scenario are similar to the tariff-removal scenario. Other meat has the highest increase, followed by beef and milk products and then by rice. Again, these commodities tend to be among those with the highest tariffs. TFA projections indicate that reducing trade costs may lower the price of those commodities. It is also likely, however, that the commodities could have a projected increase in exports because of shifting diets. Rice is an important staple in the Asia Continent, and the projected decrease in trade costs for Asia and Indonesia would make rice more affordable. Research has shown that rising incomes usually lead regions to consume more meat and milk products (along with eating out more) (Regime, 2001). The lowering of trade costs and increase in income from exports could also lead to the projected increase in global demand for these products.

The TFA scenario also projects lower global exports of more commodities, with corn, oilseeds, other coarse grains, and vegetables and fruit all experiencing decreases. Commodities that have a larger estimated increase in exports under the TFA scenario are milk products, animals, other crops, and plant fibers. Milk products and animals are commodities the lower-middle and low-income regions tend to import, and implementation of the TFA would lead to more income for importing them. Other crops and plant fibers are commodities for which lower-middle-income and low-income regions are major exporters; ECOWAS and Africa represent 16 percent of other crop exports, and India exports 18 percent of plant fibers. The TFA leads to lower trade costs, which lead to increases in exports. Note that processed food, the commodity with the largest value of global trade for agriculture (29 percent), has similar results across the two scenarios.

Imports

Similar to the export results, removing all tariffs is estimated to increase global imports for other meats, rice, and beef (table 12) the most (in percentage terms). Nearly all commodities increase their estimated imports; the exception is the 0.81-percent decrease for animals. Processed food, the commodity with the largest amount of trade, would have a 7.10-percent increase in global imports. Matching the export results for the TFA scenario, the largest increases in imports from tariff removal are for milk products, animals, other crops, and plant fibers.

Table 12

Percent change in global imports by commodity across tariff removal and TFA scenarios

Commodity	Tariff removal	Trade facilitation
Rice	33.44	16.38
Wheat	11.33	6.89
Corn	4.60	-5.21
Other coarse grains	1.41	-5.14
Vegetables and fruit	5.22	-0.01
Oilseeds	4.58	-4.58
Sugar	17.04	8.20
Plant fibers	1.03	3.33
Other crops	4.53	4.52
Animals	-0.81	8.01
Beef	29.93	21.77
Other meat	41.15	26.05
Vegetable oil	13.21	6.39
Milk products	15.93	21.52
Processed food	7.10	6.92
Beverages & tobacco	7.88	0.40

Note: TFA = Trade Facilitation Agreement.

Source: USDA, Economic Research Service analysis using ERS-GTAP (Global Trade Analysis Project) data.

Production

Table 13 shows global decreases in the production of most agricultural commodities when tariffs are removed. This is because the removal of production from regions that were not the most efficient producers—but that had tariffs or other protections that enabled them to keep producing and selling—shifts to more capable producers. However, there are production increases for corn, vegetables and fruit, plant fibers, animals, milk products, processed food, beverages, and tobacco. For the trade facilitation scenario, table 13 indicates a decrease in global production for all commodities. This is because the reduction in trade costs basically reorganizes the places where production is taking place globally. These projected decreases are all larger than those that occur under the tariff-removal scenario.

Table 13

Percent change in global production by commodity across tariff removal and TFA scenarios

Commodity	Tariff removal	Trade facilitation
Rice	-0.71	-0.93
Wheat	-0.81	-3.84
Corn	0.16	-1.55
Other coarse grains	-0.39	-2.65
Vegetables and fruit	0.10	-1.51
Oilseeds	-2.39	-5.46
Sugar	-0.57	-2.01
Plant fibers	0.17	-1.99
Other crops	-0.73	-3.76
Animals	0.58	-0.73
Beef	-0.24	-0.70
Other meat	-0.68	-0.89
Vegetable oil	-0.41	-4.00
Milk products	0.01	-0.74
Processed food	0.14	-1.06
Beverages & tobacco	0.19	-0.51

Note: TFA = Trade Facilitation Agreement.

Source: USDA, Economic Research Service analysis using ERS-GTAP (Global Trade Analysis Project).

Prices

The tariff removal scenario leads to a small increase in the global price of most agricultural commodities.¹⁴ As mentioned, tariffs act as a tax on imports, and removing them could lead to a reduction in the price for many commodities. However, commodities with the largest price increases tend to be those with the largest increase in exports (e.g., rice). That is, the increase in prices from increased competition for exports outweighs the decrease from the tariff reduction, largely because production is also decreasing for many commodities.

In the TFA scenario, all commodities decrease in price, indicating that the trade costs reduced under this scenario have a greater influence on prices than tariffs. Recall that vegetable oil seemed to have the largest decreases among regions (table 9), and it is the commodity with the largest projected global price decrease (2.24 percent), followed by processed food (1.76 percent) and animals and oilseeds (both with a 1.67-percent decrease). These commodities tend to be ones with the largest share of their production exported, especially vegetable oil, which has the highest export percentage.

¹⁴The global price referenced here is a global price index based on the import prices of all commodities from each region.

Table 14

Percent change in global prices by commodity across tariff removal and TFA scenario

Commodity	Tariff removal	Trade facilitation
Rice	1.36	-0.37
Wheat	0.45	-1.35
Corn	1.39	-1.38
Other coarse grains	0.81	-1.35
Vegetables and fruit	0.04	-1.50
Oilseeds	1.26	-1.67
Sugar	0.37	-0.74
Plant fibers	-0.05	-0.90
Other crops	0.14	-1.14
Animals	-0.26	-1.67
Beef	1.08	-0.98
Other meat	0.49	-1.61
Vegetable oil	-0.36	-2.24
Milk products	-0.30	-1.48
Processed food	-1.00	-1.76
Beverages & tobacco	-0.61	-1.23

Note: TFA = Trade Facilitation Agreement.

Source: USDA, Economic Research Service analysis using ERS-GTAP (Global Trade Analysis Project) data.

Conclusions

This study demonstrates the benefits to agricultural trade from further market access liberalization and the reduction of trade costs. In each scenario, global agricultural trade increases when the tariffs are removed or trade costs are reduced. Results, however, differ across each scenario. Removing agricultural tariffs leads to larger increases in exports than the implementation of the Trade Facilitation Agreement for agriculture.

By commodity, meats, milk products, and rice tend to generate the largest gains in export values across the two scenarios. This is due to the large global demand for these products and larger tariffs relative to other agricultural commodities. Some commodities have small gains in export values, or even decreases, such as live animals in the tariff removal scenario and corn, oilseeds, and other coarse grains in the TFA scenario. The tariff-removal scenario also generates the largest welfare gains (a measure of well-being) globally, and the gains tend to be more broadly distributed across regions compared with gains that occur in the TFA scenario.

One issue with the TFA that has not been much discussed is the cost of implementing the programs, in both resources and time. Meanwhile, governments have agreed to numerous steps to make trade smoother. Those noted by the WTO include:

- Publishing a wide range of customs-specific information relating to trade procedures, including duty rates and taxes, forms and documents, rules for goods classification and valuation, rules of origin, transit procedures, and penalties and appeals rules;
- Consulting traders and interested parties before introducing new or amended laws related to the movement, release, and clearance of goods;
- Coordinating to facilitate trade, including alignment of working hours, alignment of procedures and formalities, sharing of facilities, and one-stop border post controls; and
- Reviewing formalities and documentary requirements for import, export, and transit, including using international standards and single-window systems, and prohibiting the mandatory use of customs brokers.

Modeling the impacts of simultaneously removing all agricultural tariffs and fully implementing the TFA would likely lead to projected trade and welfare gains smaller than those that would occur from this study's summing of the isolated effects from each scenario, since finite resources limit the ability for agricultural production to adjust. However, the results presented in this report also likely understate the trade gains that could occur under each separate scenario. Many agricultural commodities are thinly traded so that the model could be limiting trade expansion. That is, the "small number" problem in a CGE model may make the model less apt to adequately capture opportunities to increase a small number than to grow a number that is already large.

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Appendix 1: Computational General Equilibrium (CGE) Data

We utilize the most recent Global Trade Analysis Project (GTAP) database for our analyses, v. 10, which has a base year of 2014. The disaggregated GTAP base data contains over 130 regions and 65 sectors; researchers often aggregate these to make the results easier to comprehend and interpret. For this project, we aggregate the regions to 20 markets. Ten of these encompass single countries that are major players (both exporters and importers) in agricultural trade: Argentina, Brazil, Canada, China, India, Indonesia, Japan, Mexico, Russia, and the United States (Appendix Table 1).

Appendix Table 1
Region aggregation scheme

No.	Country/region	Description	Included GTAP country/regions	World Bank Classification
1	Oceania	Oceania	aus, nzl, xoc	High-income
2	China	China and Hong Kong	chn, hkg	Upper middle-income
3	Japan	Japan	jpn	High-income
4	AgImp	Agricultural importers ¹	kor, twm, sgp, che, irn, sau, are, egypt	High-income
5	Asia	Rest of Asia	mng, xea, brn, khm, lao, phi, xse, bgd, npl, pak, lka, xsa	Lower middle-income
6	Indonesia	Indonesia	idn	Lower middle-income
7	AgExp	Agricultural exporters ²	mys, tha, vnm, chl, ukr, tur, zaf	Upper middle-income
8	India	India	ind	Lower middle-income
9	Canada	Canada	can	High-income
10	USA	United States	usa	High-income
11	Mexico	Mexico	mex	Upper middle-income
12	SouAm	Rest of South America and the Caribbean	xna, bol, col, ecu, pry, per, ury, ven, xsm, cri, gtm, hnd, nic, pan, slv, xca, dom, jam, pri, tto, xcb	Upper middle-income
13	Argentina	Argentina	arg	Upper middle-income
14	Brazil	Brazil	bra	Upper middle-income
15	European Union (EU)	European Union	aut, bel, cyp, cze, dnk, est, fin, fra, deu, grc, hun, irl, ita, lva, ltu, lux, mlt, nld, pol, prt, svk, svn, esp, swe, gbr, bgr, hrv, rou	High-income
16	Europe	Rest of Europe and Former USSR	nor, xef, alb, blr, xee, xer, kaz, kgz, tjg, xsu, arm, aze, geo	Lower middle-income
17	Russia	Russia	rus	Upper middle-income
18	MENA	Middle East and Northern Africa	bhr, isr, jor, kwt, omn, qat, xws, mar, tun, xnf	High-income
19	ECOWAS	Economic Community of West African States	ben, bfa, civ, gha, gin, nga, sen, tgo, xwf	Low-income
20	Africa	Rest of Africa	cmr, xcf, xac, eth, ken, mdg, mwi, mus, moz, rwa, tza, uga, zmb, zwe, xec, bwa, nam, xsc, xtw	Low-income

¹Countries that were among the top 20 agricultural importers in the world (Beckman et al., 2017) and not defined in another group.

²Countries were among the top 20 agricultural exporters in the world (Beckman et al., 2017) and not defined in another group. If a country appears on both lists, its classification is based on the larger of its imports or exports. The World Bank classification refers to the income status of a country (World Bank, 2019). When several countries in a region have different statuses, we classify the region by the status that had the highest number of occurrences.

Other regions are the European Union (EU), Oceania (Australia and New Zealand), Agricultural Importers and Exporters (countries not defined in other groups that are among the top 20 importers (AgImp) or exporters (AgExp) as of 2014), South America (all other South American countries not defined in another group), Europe (all other European countries not defined in another group), MENA (Middle East and Northern Africa), ECOWAS (the Economic Community of West African States), and Africa (all other African countries not defined in another group). Our sector aggregation scheme is heavily weighted toward agricultural commodities (Appendix table 2). To that end, we keep any GTAP base data agricultural commodity disaggregated, e.g., wheat and processed rice are treated as distinct commodities. Unfortunately, there are only 20 commodities that can be considered as agricultural commodities in the base data; thus, we use the SplitCom utility to create several commodities of interest in global trade. As a result, our final aggregation is 16 agricultural commodities, with 21 total sectors. Agricultural commodities 1-10 are raw products in agricultural production; commodities 13-18 are the processed products of these raw products.

Appendix Table 2

Sector aggregation scheme

No.	Name	Description	GTAP sector code
1	Rice	Paddy and milled rice	pdr, pcr
2	Wheat	Wheat	wht
3	Corn*	Corn	gro
4	Other coarse grains*	Barley, oats, sorghum	gro
5	Vegetables and fruit	Vegetables and fruit	v_f
6	Oilseeds	Oilseeds	osd
7	Sugar	Raw and processed sugar cane and beet	c_b
8	Plant fibers	Plant-based fibers	pfb
9	Other crops	Other crops	ocr
10	Animals	Live animals and raw milk	ctl, oap, rmk, wol
11	Natural resources	Fishery, forestry, minerals	frs, fsh, omn
12	Energy	Energy products	coa, oil, gas, gdt, p_c, ely
13	Beef	Beef	cmt
14	Other meats	Other meats	omt
15	Vegetable oil	Vegetable oils and fats	vol
16	Milk products	Milk products	mil
17	Processed food	Processed foods	ofd
18	Beverages & tobacco	Beverages and tobacco products	b_t
19	L_Mfg	Labor-intensive manufacturing	tex, wap, lea, lum, ppp, fmp, mvh, otn, omf
20	H_Mfg	Capital-intensive manufacturing	crp, nmm, i_s, nfm, ele, ome
21	Other services	All other services	wtr, cns, trd, otp, wtp, atp, cmn, ofi, isr, obs, ros, osg, dwe

Note: *represents a commodity disaggregated using SplitCom. GTAP = Global Trade Analysis Project.

SplitCom

We completely disaggregate the coarse grains sector into subsectors using the SplitCom utility developed by Horridge (2008). SplitCom is a matrix-balancing program that allows the user to subdivide the rows and columns of a commodity from a balanced social accounting matrix (SAM). The user provides data to disaggregate a GTAP sector's input demands, uses in intermediate and final demand and trade, and tax and tariff payments. SplitCom then uses methods similar to maximum entropy to balance the disaggregated SAM and to satisfy accounting identities. The utility manipulates only the disaggregated sectors, which can be re-aggregated to restore the original values in the GTAP SAM. Those items with an asterisk in table 2 are split; the original aggregated commodity is represented in the fourth column.

Data for the SplitCom procedure are drawn from multiple sources. Bilateral trade and tariff data are disaggregated using TASTE (Tariff Analytical and Simulation Tool for Economists), a software developed by Horridge and Laborde (2010) and based on the Market Access Maps (MacMap) HS-6 trade and tariff database (Guimbard et al., 2012). We use the version from May 2018, which is compatible with the GTAP v. 10 database. TASTE disaggregates the GTAP sectors into HS-6 data for trade and tariffs. These disaggregated data are then re-aggregated into the sectors defined in the CGE model, using the HS2002 concordance developed by Hutcheson (2006). Data for the disaggregation of subsectors' inputs and demands for their output are drawn from multiple sources, including FAOSTAT, USDA's Production, Supply and Distribution (PS&D) Database, USDA's Global Agricultural Information Network (GAIN) reports, and Energy Information Administration energy statistics, and national statistics.

Appendix 2: Computational General Equilibrium (CGE) Model

Given the complex links and interactions between agricultural commodities, competition among these commodities for limited economic resources, and interactions between the production, consumption, and trade activities, an economy-wide computational general equilibrium (CGE) modeling approach provides an appropriate framework to analyze the impacts of reforming global trade policies. For both the CGE data and model, we rely on GTAP resources.

In the standard static GTAP model, producers are described as perfectly competitive cost-minimizers, with technology defined as a nested production function. Producers' demand for intermediate inputs responds to prices for inputs and outputs, subject to a Leontief intermediates production function. A CES production function over value-added allows producers to substitute among primary factors as their relative prices change. Consumer demand is described by a Constant Difference of Elasticity (CDE) demand system, a nonhomogeneous function that allows income growth to affect consumer preferences. Cobb-Douglas functions describe government and investment demand, which imply constant budget shares in total expenditure. Import demand is described by nested Armington functions, in which demand is first allocated between the domestic good and the composite import and then among national sourcing of the composite import. Countries (or regions) are linked through their bilateral trade flows, which explicitly account for transportation and marketing costs in moving goods from port to port. Factors are assumed to be fixed in national supply, fully employed, and mobile across commodities, except for land, which is assumed to have limited substitutability across crops. The model closure fixes the trade balance and allows the exchange rate to adjust.

Implementing Scenarios

This section provides a brief description of how scenarios are implemented in the model.

Scenario 1: The removal of tariffs and TRQs on agriculture is relatively straightforward. The model has a variable 'tms' that represents the ad-valorem tariff for tariffs and TRQs. The amounts on this variables are reduced to zero.

Scenario 2: To implement trade facilitation, we use the exogenous variable in the model 'ams,' which represents changes in transportation costs in trade. In formal terms, changes in the value of this variable capture the impact of trade costs on the price of imports from a particular exporter due to destination-specific reduced costs for production and delivery. This approach has primarily been used to consider the trade-cost impacts of NTMs (nontariff measures) that can be lowered through trade facilitation (Hertel et al., 2001; Minor and Tsigas, 2008).

Appendix 3: Base Trade

Base trade is important for understanding how the model determines changes from a scenario. All things being equal, the model would want to follow historical patterns in changing trade, and it is difficult to grow trade from a small initial number. This happens both in the model and in reality, as establishing trade with another country is time-consuming and costly.

Appendix Table 3

Aggregate exports

	Oceania	China	Japan	AgImp	Asia	Indonesia	AgExp	India	Canada	USA
Rice	295	627	40	381	3,515	84	9,982	9,819	15	2,423
Wheat	6,848	94	9	70	50	1	3,171	1,300	8,845	9,707
Corn	141	13	0	7	82	16	6,367	806	417	14,469
Other coarse grains	2,116	80	5	74	14	6	1,989	420	1,250	2,797
Vegetables and fruit	4,257	10,331	331	5,259	6,410	909	25,233	2,934	5,233	18,014
Oilseeds	1,821	2,050	15	129	366	63	2,314	2,088	7,838	29,715
Sugar	1,733	893	28	1,770	609	216	4,273	1,633	475	1,949
Plant fibers	1,929	423	22	236	1,027	16	278	3,311	11	4,629
Other crops	1,017	3,287	144	1,555	1,615	2,633	6,724	3,168	880	2,959
Animals	7,737	6,301	315	1,654	908	397	3,209	719	3,922	5,560
Beef	17,606	1,185	100	330	481	11	589	5,736	1,909	7,929
Other meats	724	3,497	35	808	181	56	6,469	34	4,670	15,295
Vegetable oil	1,267	2,099	197	2,067	1,627	25,483	26,042	3,142	4,293	9,163
Milk products	16,752	325	65	3,954	179	86	2,288	457	341	6,680
Processed food	8,705	38,454	3,427	23,662	6,772	8,120	54,940	11,130	14,305	36,791
Beverages & tobacco	4,574	4,045	1,095	9,093	1,098	1,107	10,276	1,543	1,200	11,906
All agriculture	77,522	73,704	5,829	51,048	24,934	39,203	164,146	48,241	55,605	179,987

	Mexico	SouAm	Argentina	Brazil	EU	Europe	Russia	MENA	ECOWAS	Africa
Rice	2	1,275	303	435	1,759	38	133	44	94	88
Wheat	466	568	685	36	18,106	1,507	6,814	167	26	34
Corn	69	407	2,949	4,748	5,362	256	1,432	24	10	168
Other coarse grains	191	601	2,654	2,095	4,883	953	1,039	152	69	300
Vegetables and fruit	11,328	16,419	1,826	986	51,928	2,414	387	5,549	2,543	3,449
Oilseeds	66	5,290	4,786	27,069	8,374	704	400	89	786	2,067
Sugar	1,290	3,544	114	11,252	9,525	821	307	522	40	1,591
Plant fibers	76	70	131	1,316	1,518	1,004	4	358	1,639	708
Other crops	599	10,254	286	6,703	19,851	471	38	631	6,122	5,890
Animals	1,049	1,541	552	1,921	28,667	790	388	768	70	1,938
Beef	1,026	4,339	1,701	7,041	17,022	602	137	243	39	429
Other meats	759	647	689	12,506	51,660	964	240	301	22	88
Vegetable oil	242	5,589	18,349	8,704	30,893	1,222	3,375	1,090	659	731
Milk products	186	1,926	1,512	414	58,199	2,504	418	1,101	89	129
Processed food	7,124	18,973	5,396	7,251	190,841	11,993	7,243	6,346	4,847	3,859
Beverages & tobacco	5,270	3,561	1,453	3,277	93,730	2,207	1,442	881	500	3,456
All agriculture	29,743	75,004	43,387	95,756	592,319	28,451	23,797	18,265	17,555	24,924

Note: AgImp consists of countries in the top 20 global agricultural importers in 2014 that do not appear elsewhere; AgExp consists of countries in the top 20 global agricultural exporters in 2014 that do not appear elsewhere; SouAM includes South American Countries not described by another group; MENA is the Middle East and North Africa; ECOWAS is the Economic Community of West African States; and Africa includes all African countries not described by another group. See Appendix Table 1 for more information on the regions.

Source: Aguiar et al., 2019.

Appendix Table 4

Aggregate imports

	Oceania	China	Japan	AgImp	Asia	Indonesia	AgExp	India	Canada	USA
Rice	378	1,702	949	5,472	2,468	499	1,718	12	388	963
Wheat	332	867	3,397	9,935	2,826	2,452	3,952	13	41	1,012
Corn	43	997	4,252	12,051	448	855	2,978	6	423	649
Other coarse grains	67	3,355	741	5,951	177	19	479	12	112	994
Vegetables and fruit	1,403	12,965	4,460	12,019	3,854	1,500	9,495	6,620	7,740	20,318
Oilseeds	88	45,250	3,538	9,889	1,429	1,454	5,987	273	633	2,285
Sugar	536	2,166	1,138	4,759	2,252	1,589	2,156	1,199	792	2,694
Plant fibers	22	5,742	212	1,262	1,909	1,444	4,266	763	23	153
Other crops	652	2,259	4,118	6,415	1,439	748	3,915	1,272	1,721	10,694
Animals	469	11,954	1,498	4,878	1,379	1,349	3,379	880	1,236	6,011
Beef	403	6,410	5,266	7,859	693	461	5,693	19	1,367	6,882
Other meats	1,168	7,832	11,977	6,902	1,427	57	1,840	32	2,181	2,926
Vegetable oil	1,833	10,093	2,702	11,075	8,432	2,400	12,732	15,697	1,558	7,550
Milk products	1,315	9,191	2,375	8,318	2,892	1,446	3,590	79	634	2,502
Processed food	11,269	21,045	25,693	35,649	9,761	3,251	26,907	1,471	15,630	52,421
Beverages & tobacco	3,469	9,307	5,098	16,016	3,620	868	8,024	827	5,004	22,575
All agriculture	23,447	151,136	77,414	158,447	45,003	20,391	97,112	29,176	39,483	140,629

	Mexico	SouAm	Argentina	Brazil	EU	Europe	Russia	MENA	ECOWAS	Africa
Rice	412	1,579	10	325	3,443	306	212	2,871	5,182	2,463
Wheat	1,382	3,587	2	2,017	9,114	1,628	110	10,075	2,628	3,133
Corn	2,428	2,962	10	122	7,635	267	146	1,079	7	385
Other coarse grains	108	1,551	6	168	3,536	152	165	3,515	138	443
Vegetables and fruit	1,712	2,796	358	1,383	67,828	4,291	8,326	6,135	596	1,942
Oilseeds	3,117	1,119	31	317	17,022	606	1,427	1,321	120	123
Sugar	721	1,331	18	80	10,673	975	1,220	4,266	1,563	2,460
Plant fibers	446	418	12	87	1,302	71	171	294	29	80
Other crops	743	1,152	146	310	33,017	1,334	2,165	1,976	128	624
Animals	723	2,030	83	217	25,720	977	1,014	3,589	196	828
Beef	1,495	1,984	19	594	21,536	831	3,655	2,449	189	650
Other meats	3,996	3,418	55	88	44,076	2,007	3,719	2,869	1,004	2,070
Vegetable oil	2,334	7,457	116	1,116	43,938	3,095	1,304	6,076	3,105	3,624
Milk products	1,938	3,672	40	522	43,482	1,781	3,936	7,084	1,449	1,360
Processed food	6,012	16,077	934	4,663	183,812	12,835	10,983	16,096	7,223	8,449
Beverages & tobacco	1,584	4,747	214	911	59,744	4,922	3,627	5,795	1,972	3,389
All agriculture	29,150	55,880	2,054	12,918	575,878	36,079	42,181	75,489	25,529	32,023

Note: AgImp consists of countries in the top 20 global agricultural importers in 2014 that do not appear elsewhere; AgExp consists of countries in the top 20 global agricultural exporters in 2014 that do not appear elsewhere; SouAM includes South American Countries not described by another group; MENA is the Middle East and North Africa; ECOWAS is the Economic Community of West African States; and Africa includes all African countries not described by another group. See Appendix Table 1 for more information on the regions.

Source: Aguiar et al., 2019.