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The Economic Impacts of Retaliatory Tariffs on U.S. Agriculture

Stephen Morgan, Shawn Arita, Jayson Beckman, Saquib Ahsan, Dylan Russell, Philip Jarrell, and Bart Kenner

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Abstract

In 2018, the United States imposed Section 232 tariffs on steel and aluminum imports from major trading partners and separately Section 301 tariffs on a broad range of imports from China. In response to these actions, six trading partners—Canada, China, the European Union, India, Mexico, and Turkey—responded with retaliatory tariffs on a range of U.S. exports, including agricultural and food products. The agricultural products targeted for retaliation were valued at $30.4 billion in 2017, with individual product lines experiencing tariff increases ranging from 2 to 140 percent. This report provides a detailed look at the impact of retaliatory tariffs on farmers at the State level by estimating the direct export losses associated with the trade conflict. Using the product-line econometric estimates from Grant et al. (2021) and the USDA, Economic Research Service's State Exports, Cash Receipts Estimates, this report comprehensively assesses the direct effect of retaliatory tariffs on U.S. agricultural exports to these retaliating trading partners across States and commodities. From mid-2018 to the end of 2019, this study estimates that retaliatory tariffs caused a reduction of more than $27 billion (or annualized losses of $13.2 billion) in U.S. agricultural exports, with the largest decline in export losses occurring for exports to China. At the commodity level, soybeans accounted for the predominant share of total trade loss, making up nearly 71 percent ($9.4 billion of annualized losses) of the total, followed by sorghum (over 6 percent or $854 million in annualized losses), and pork (nearly 5 percent or $646 million in annualized losses). At the State level, losses were largely concentrated in the Midwest with Iowa ($1.46 billion in annualized losses), Illinois ($1.41 billion in annualized losses), and Kansas ($955 million in annualized losses), accounting for approximately 11, 11, and 7 percent, respectively, of the total losses. For soybeans, most of the trade lost by the United States was gained by Brazil. In 2020, U.S. agricultural exports to China significantly rebounded following the signing of the U.S.-China Phase One Economic and Trade Agreement (Phase One Agreement) and a separate retaliatory tariff waiver program; however, 1 year after the deal, U.S. market share still remained below pre-retaliatory tariff levels.

Keywords: U.S. agricultural exports, retaliatory tariffs, trade retaliation, trade dispute, China, State-level exports, trade agreements, international trade, soybeans, sorghum, pork, U.S. Department of Agriculture, USDA, Economic Research Service, ERS

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A report summary from the Economic Research Service January 2022

The Economic Impacts of Retaliatory Tariffs on U.S. Agriculture

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What Is the Issue?

In 2018, the United States imposed Section 232 tariffs on steel and aluminum imports from major trading partners and separately Section 301 tariffs on a broad range imports from China. In response, Canada, China, the European Union (EU), India, Mexico, and Turkey imposed retaliatory tariffs on many U.S. exports, including a wide range of agricultural and food products. Individual product lines experienced tariff increases ranging from 2 to 140 percent. The retaliatory tariffs increased the price of U.S. agricultural exports in these markets relative to alternatives that were either domestically produced or imported from other international sources. Despite opportunities for U.S. producers to sell their products to non-retaliating trade partners, the overall effect was a reduction in U.S. agricultural exports. Given that agricultural production for certain commodities is concentrated in certain States, retaliatory tariffs affected States differently. As of October 2021, many retaliatory tariffs were still in effect with the following exceptions—Canada and Mexico's tariffs were removed in May 2019, China announced tariff exemptions for some products after the U.S.-China Phase One Economic and Trade Agreement (Phase One Agreement) was signed on January 15, 2020, and in October 2021 the United States and EU reached arrangements to address global steel and aluminum excess capacity which include replacement of Section 232 tariffs with a tariff-rate quota and lifting of the EU's retaliatory tariffs.

What Did the Study Find?

The retaliatory tariffs led to a significant reduction in U.S. agricultural exports to retaliating partners. Nationally, direct U.S. agricultural export losses due to retaliatory tariffs totaled more than $27 billion during 2018 through the end of 2019. Across retaliatory partners, China accounted for approximately 95 percent of the losses ($25.7 billion), followed by the EU ($0.6 billion), and Mexico ($0.5 billion), with Canada, Turkey, and India having smaller shares. We estimated annualized losses for selected commodities from retaliatory tariffs were $13.2 billion from mid-2018 to the end of 2019.

At the commodity level, export losses were far reaching but highly concentrated. Soybeans accounted for the largest level of losses making up nearly 71 percent ($9.4 billion of annualized losses) of the share of estimated trade damages. In comparison, sorghum ($854 million in annualized losses) and pork ($646 million in annualized losses) trade losses were the next largest, accounting for over 6 percent and just under 5 percent, respectively, of the total. Overall, specialty crops represented around 6 percent of losses ($837 million in annualized losses) across fruits, vegetables, and tree nuts.

At the State level, losses were largely concentrated in the Midwest with Iowa ($1.46 billion in annualized losses), Illinois ($1.41 billion in annualized losses), and Kansas ($955 million in annualized losses), accounting for approximately 11, 11, and 7 percent, respectively, of the total losses. The State-level losses were uneven and not directly proportional to the size of State-level exports. States that produced more of the commodities most severely targeted by retaliation—soybeans, sorghum, pork, and cotton—experienced higher losses.

The U.S. market share of China's total agricultural imports, which had fallen from 20 percent in 2017 to 12 percent in 2018, remained significantly depressed in 2019 at 10 percent. This study examined changes in U.S. agricultural exports to China surrounding the signing of the Phase One Agreement in January 2020 and subsequent announcements of China's tariff exemptions starting in March 2020. U.S. exports of products with announced tariff exemptions grew by 118 percent relative to 2019. Other products that did not have announced exemptions also significantly grew—by 83 percent relative to 2019—suggesting that many of these products may also have been granted tariff waivers by request. U.S. agricultural exports to China rebounded and hit record levels in 2020; however, some of this increase was likely driven by factors unrelated to trade policy, including China's pig-herd recovery in the wake of African Swine Fever and resulting increased feed demand. However, U.S. market share has not fully recovered to pre-retaliatory levels 1 year out from the Phase One Agreement signing.

How Was the Study Conducted?

The USDA's Economic Research Service (ERS) was directed to assess the impact of foreign tariffs on U.S. agricultural products by the House Committee on Appropriations (P.L. 116-260). This report provides State-level effects of retaliatory tariffs to ultimately address this charge in response to the Committee's request. To do so, we first reviewed previous research on prospective and retrospective estimation of U.S. agricultural losses caused by retaliatory tariffs. We summarized key results by estimation method, commodity, and State regarding retaliatory tariffs. Trade and tariff data were also compiled to provide a descriptive analysis of the U.S. agricultural exports during the period of retaliatory tariffs.

Second, we drew on product-line estimates for the effect of 2018–2019 retaliatory tariffs from Grant et al. (2021) to investigate the distribution of export losses by State and commodity groups using the ERS State Exports, Cash Receipts Estimates. As such, our analysis provides a detailed look at the effect of foreign retaliatory tariffs on farmers at the State level. After the Phase One Agreement was implemented, the latest detailed trade and tariff exemption data were examined from March 2020 to February 2021.

As retaliatory tariffs are still in effect, the report's estimates do not represent a full account of all current and future economic losses resulting from these actions. Additionally, we estimated the direct losses in U.S. exports to retaliating partners and these estimates have not considered possible offsetting-sales increases to non-retaliating partners (i.e., trade deflection). However, previous research has suggested positive trade deflection effects caused by retaliatory tariffs are small compared with direct losses (Carter and Steinbach, 2020; Grant et al., 2021).

The Economic Impacts of Retaliatory Tariffs on U.S. Agriculture

Introduction

Although there has been a global effort to reduce tariffs, more recently, increasing tariffs under existing authorities has been used as a trade strategy. Beginning in 2017, the United States initiated two significant trade actions to investigate the impact of aluminum and steel imports on U.S. national security and determine if China's policies related to intellectual property were actionable under U.S. trade law. In April 2017, the U.S. Department of Commerce initiated an investigation under Section 232 of the Trade Expansion Act of 1962 to determine if steel and aluminum products were being imported in such quantities or under such circumstances to threaten or impair national security. In August 2017, at the direction of the President, the U.S. Trade Representative (USTR) initiated a Section 301 investigation to determine if China's policies with respect to intellectual property and technology transfer were unreasonable or discriminatory and burdened or restricted U.S. commerce.

As a result of a positive determination under the Section 232 investigation, the President applied tariffs of 25 percent on steel imports and 10 percent on aluminum imports from all suppliers, although exceptions were made for certain countries.[1] In response to these actions, six trading partners—Canada, China, the European Union, India, Mexico, and Turkey—responded with retaliatory tariffs affecting some U.S. agricultural exports to those countries.

Additionally, USTR's Section 301 investigation found that China's policies were actionable and proposed a 25-percent tariff on a broad range of goods from China. In response, China applied additional retaliatory tariffs ranging from 5 to 25 percent affecting thousands of agricultural products. Both soybeans and most pork products—the main products the United States exports to China—were at 25 percent each.

Between Section 232 and Section 301 retaliation, China's retaliatory tariffs affected approximately 98 percent of 2017 U.S. agricultural exports to China. Smaller shares of U.S. agricultural exports were targeted by Canada (16 percent), Mexico (14 percent), the European Union (7 percent), Turkey (18 percent), and India (43 percent) (Grant et al., 2021). In total, U.S. agricultural exports targeted for retaliation were valued at $30.4 billion in 2017 (Grant et al., 2021). Individual product lines experienced tariff increases up to 140 percent (Regmi, 2019).[2]

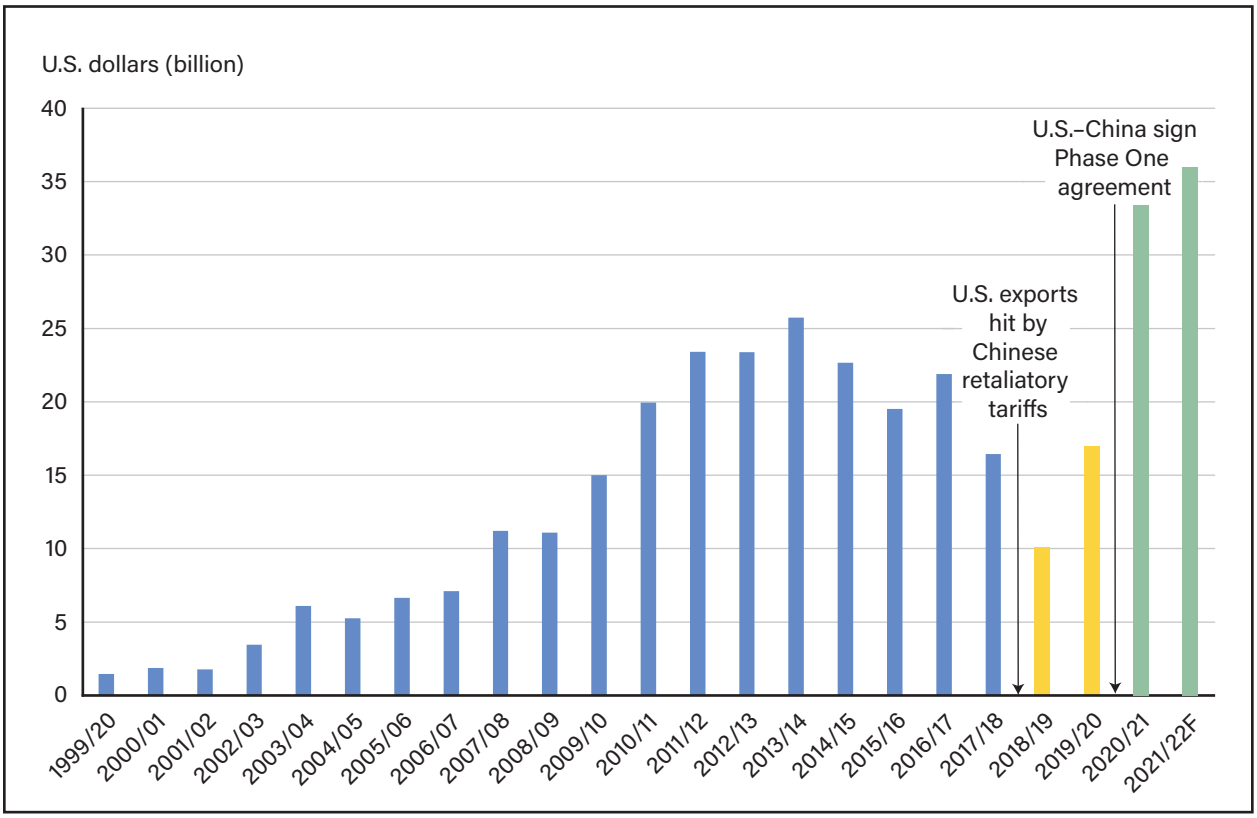
These retaliatory tariffs increased the imported prices of U.S. agricultural products relative to alternatives, either domestically produced or from other international sources. Economic theory predicts consumers in countries applying the tariffs will purchase fewer of these targeted commodities, and subsequently, U.S. agricultural exports to those countries will decrease. Although opportunities may exist for U.S. producers to sell their products to other non-retaliating trade partners, the overall effect has generated reduced trade

[1]For example, South Korea received a permanent exemption for steel but accepted a quota. Additionally, the United States announced exclusions for Argentina and Australia on Section 232 aluminum tariffs and exclusions for Argentina and Brazil regarding Section 232 steel tariffs.

[2]Appendix 1 provides a detailed discussion of the timeline associated with retaliatory tariffs on agricultural products, the range of tariffs applied, and the value of U.S. agricultural products targeted for retaliation.

flows since new contracts have had to be made with other countries, transportation arranged, and other factors. For example, in 2018, the value of U.S. agricultural exports to China declined by just over $10.3 billion with retaliatory tariffs affecting almost all U.S. agricultural commodities (figure 1). Soybeans, wheat, and corn appeared to have been the most severely affected by retaliatory tariffs with the value of U.S. exports to China declining by over 60 percent (figure 2). However, wheat ($351 million) and corn ($142 million) had relatively small U.S. export values to China in 2017 compared with soybeans ($12.2 billion). During the same period, the total value of U.S. agricultural exports to non-retaliating countries increased by $9.7 billion, which suggests some trade deflection occurred, at least in the aggregate effects.

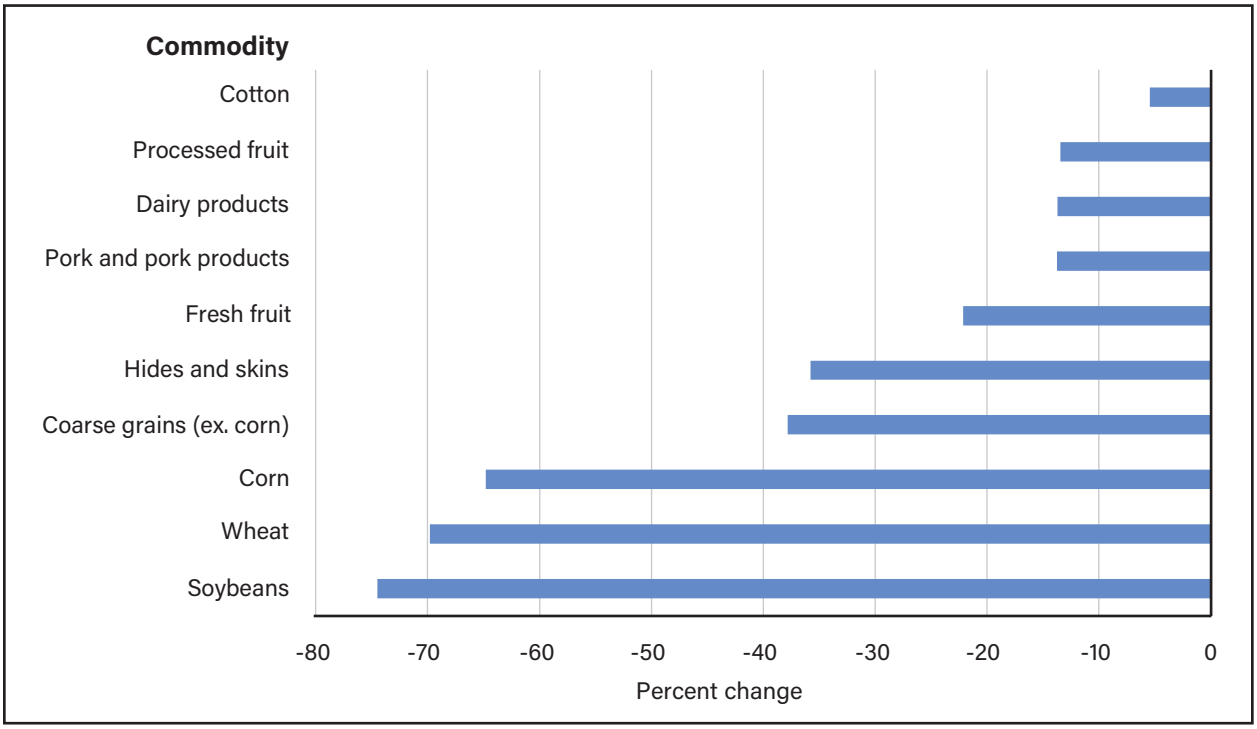
Figure 1
U.S. agricultural exports to China, by fiscal year, 1999–22 (year ending September 30)



Notes: F=forecast. Columns in yellow indicate the period covered by this analysis when most of China's retaliatory tariffs were in place. The green columns represent the period covering the U.S.-China Phase One agreement is in effect. In March 2021, the USDA adopted the World Trade Organization definition that adds ethanol, distilled spirits, and manufactured tobacco product categories to the definition of agricultural products (USDA, Foreign Agricultural Service, 2021). FY 2021/22 forecast from USDA, Economic Research Service, Trade Outlook Report, November 2021.

Source: USDA, Economic Research Service (ERS) using data from ERS's Trade Outlook Report, August 2021, and U.S. Department of Commerce, Bureau of the Census.

Figure 2
Annual percentage decline in the value of U.S. exports to China, 2018 relative to 2017



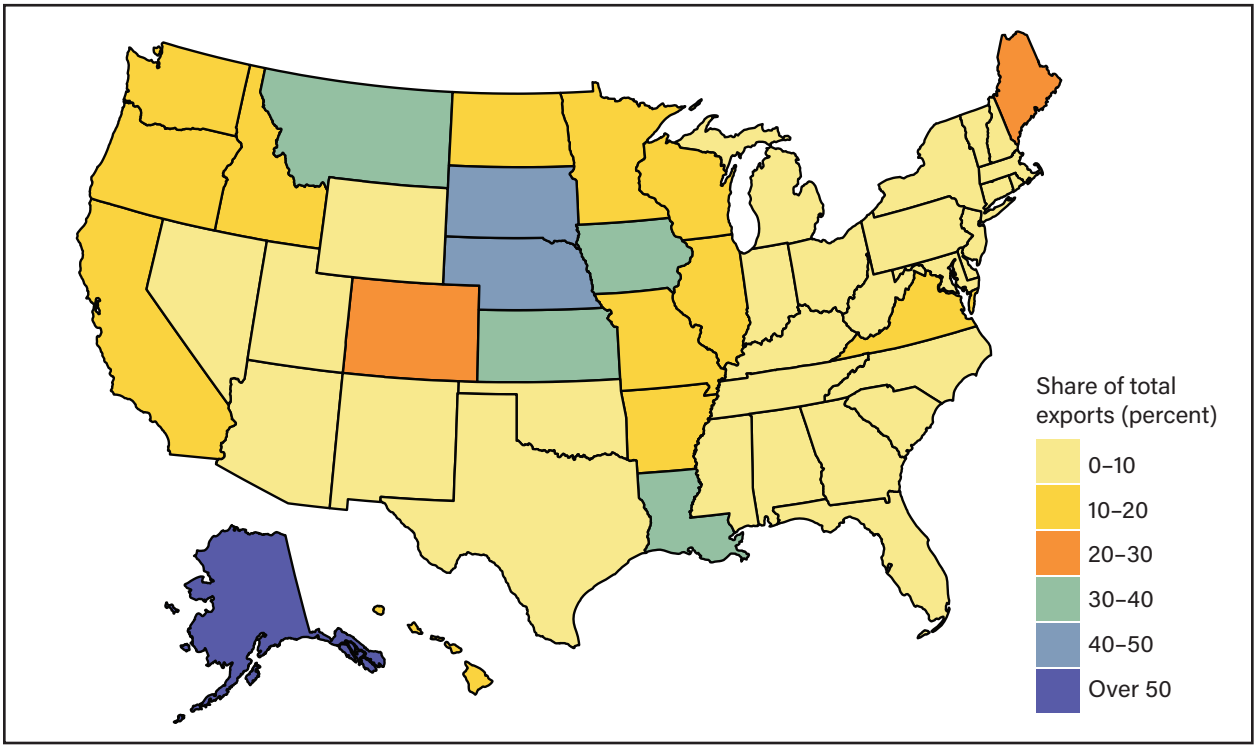
Source: USDA, Economic Research Service using data from USDA, Foreign Agricultural Service, Global Agricultural Trade System, 2021.

A number of studies published after the announcement of the retaliatory tariffs focused on estimating the tariffs' effects on U.S. agricultural trade flows and prices. Tariff-impact estimates vary by commodity and selected timeframe with overall annualized losses ranging from $13.5 to $18.7 billion (Grant et al., 2021). U.S. agricultural exports were $142.8 billion in 2017, thus the losses estimated in the literature represent at least 9 percent of the total U.S. export value. However, differences in the levels of retaliatory tariffs combined with differences in production patterns across States suggested the losses from these tariffs were not spread equally across U.S. producers. For example, China's retaliatory tariffs on soybeans were estimated to result in more than a 76-percent reduction in the value of U.S. soybean exports to China, compared with more than a 37-percent reduction in U.S. cotton exports due to retaliatory tariffs (Grant et al., 2021). The significance of the loss also depends upon how dependent the commodity is on products targeted by retaliation. For instance, prior to the retaliatory tariffs, approximately 30 percent of the soybeans produced in the United States went to China, whereas less than 1 percent of U.S. corn was exported to China.

The United States is the world's biggest agricultural exporter, and many States derive a large percentage of their total exports from agriculture. For 21 of the 50 States, agriculture contributes more than 10 percent of the total export value (figure 3), and for 7 States, it is more than 30 percent.[3] Given the importance of agriculture, this report provides State-level effects of retaliatory tariffs.

[3]This is based on the previous USDA definition of agricultural products, which did not include ethanol, distilled spirits, and manufactured tobacco products. In March 2021, the USDA adopted the World Trade Organization definition that adds these three product categories (USDA, FAS, 2021).

Figure 3
Agriculture's share of value of total State exports, 2017



Source: USDA, Economic Research Service using data from U.S. Department of Commerce, Bureau of the Census, 2021.

Previous Economic Studies Assessing Retaliatory-Tariff Impacts

Assessing the economic effects of recent retaliatory tariffs on U.S. agricultural exports is difficult given the series of events occurring in global agricultural markets and other confounding factors which may be affecting trade. For example, U.S. soybean exports to China were valued at $11.3 billion from July 2017 to June 2018, before falling by 72 percent to $3.2 billion between June 2018 and July 2019, or 12 months following the enacted retaliatory tariffs. Similarly, total agricultural exports from the United States to China fell by $10.9 billion, or 58 percent, over the same period.

However, before-and-after comparisons do not account for confounding factors that could be affecting U.S. exports outside of the retaliatory tariffs. For example, in the 2018/2019 marketing year, excellent weather conditions led to a record soybean harvest in the United States—more than 4.5 billion bushels (Hitchner et al., 2019). Usually, a harvested supply of this magnitude could result in larger-than-expected levels of U.S. soybean exports to China. In these situations, before-and-after comparisons are likely to underestimate the effect of tariffs. Similarly, other confounding global supply and demand shocks pervaded throughout the 2018/2019 retaliatory period, including African Swine Fever (ASF) in China (Nti et al., 2019), record supplies of U.S. livestock production, and exceptionally poor U.S. planting conditions in Spring 2019. These shocks collectively challenged identification of the causal impact of retaliatory tariffs.

Prospective (Ex-Ante) Tariff Analysis

When retaliatory tariffs targeting U.S. agricultural products were announced, several studies focused on estimating the ex-ante effects of tariffs on agricultural markets (see box, "Quantitative Strategies to Isolating the Effect of a Policy Shock"). Ex-ante studies focus on projecting future prices and trade flows using baseline data and known elasticities before any effects of retaliatory trade policies are realized.

Quantitative Strategies to Isolating the Effect of a Policy Shock

Generally, there are two quantitative strategies to isolating the effect of a policy shock (such as retaliatory tariffs) on trade. The first is called ex-ante trade modelling. This prospective analysis projects the impacts of a policy shock by simulating a trade model according to a pre-policy shock baseline and a system of structural parameters or elasticities. The elasticities are based on historical trade and market relationships that existed before the tariff. The model is then able to estimate the expected change in trade, given changes in the trade costs caused by the tariffs, isolating its effect. The advantage of this approach is that it may be conducted before the event occurs, so it does not need observational data from after the tariff increase. The disadvantage is that it depends upon parameters/elasticities that may or may not accurately affect the responsiveness of the shock. Furthermore, the de facto effect of the shock may also not be accurately simulated. For example, a country's retaliatory effect may encompass other factors beyond the tariff (e.g., non-tariff barriers, transactions costs, etc.).

Alternatively, ex-post econometric methods may be used to retrospectively identify the impact. These methods typically employ gravity-type trade models that econometrically estimate the effect of the tariffs while controlling for other market factors. Gravity models have a long history of empirical application in the literature (Yotov et al., 2016) and do not require externally estimated parameters that pre-date the trade shock. Methods allow control for other factors such as strong crop harvest and external demand shocks (e.g., African Swine Fever). Furthermore, by capturing the de facto impact of the policy measure, ex-post econometric approaches may reflect other factors imbued with the retaliatory actions beyond the tariffs. The drawback of ex-post econometric methods is that a sufficient period of data is required, which means estimation may not be conducted as timely as ex-ante methods. Further, econometric methods must ensure that other factors beyond the retaliatory actions are adequately controlled for.

The first set of studies used a computable general equilibrium (CGE) framework to model how announced retaliatory tariffs might affect U.S. commodity prices, exports, and producer surplus[4] (Elobeid et al., 2019; Sabala and Devadoss, 2019; Taheripour and Tyner, 2018; and Zheng et al., 2018). A CGE approach seeks to jointly determine the effects of trade retaliation on both targeted and related commodities, as well as incorporating retaliating and non-retaliating trading partners. For example, Zheng et al. (2018) modeled the short-run effects of the 25-percent retaliatory tariffs from China on soybeans, cotton, sorghum, and pork. In addition, Zheng et al. (2018) estimated losses to U.S. producers' surplus ranging from $1.8 billion for soybeans to $67.6 million for cotton. Similarly, Taheripour and Tyner (2018) simulated the effects of the same Chinese tariffs on U.S. soybeans, wheat, sorghum, corn, and beef over the medium- to long-run (3–5 years). They found the effects of retaliatory tariffs are largely concentrated in the soybean market with total U.S. soybean exports falling by 24 percent (14 million metric tons) and soybean exports to China falling by 48 percent (17 million metric tons). The economic impacts on corn, wheat, and sorghum were not found to be significantly affected.

Other research has used a partial equilibrium approach to project the effects of tariffs on specific economic sectors. Westhoff et al. (2019) simulated the removal of retaliatory tariffs in March 2019 to estimate how retaliatory tariffs affected U.S. farm income and government expenditures. This study suggested tariff removal would increase commodity prices and expand soybean and sorghum acreage. Considering price changes, trade diversion, government expenditures, and production expenses, lifting retaliatory tariffs was estimated to increase net farm income by an annual average of $5.1 billion during 2021–2023 (Westhoff et al., 2019). Elobeid et al. (2019) used a similar modeling approach to focus on retaliatory actions from China and Mexico with estimates that suggested declining prices and exports for pork, corn, soybeans, and wheat could reduce farm-level revenues between 8 percent for wheat producers and 15 percent for pork producers, assuming retaliatory tariffs continued.

Other ex-ante studies drew on previously estimated price elasticities or trade actions to estimate how U.S. trade flows could be affected by changes in tariff rates. This approach tends to consider a single commodity in isolation, ignoring potential substitution effects possibly occurring across different commodities or trading partners. Focusing on U.S. wine exports to China, Countryman and Muhammad (2018) estimated a 15-percentage-point tariff increase could result in a 16-percent decrease in China's imports of U.S. wine or an average loss of $9.6 million per year at baseline prices because of trade diversion. Hansen et al. (2018) focused on China's role as the largest sorghum importer and highlighted how steep tariffs may reduce U.S. sorghum export prices. Liu et al. (2018) predicted tariffs on U.S. cotton would result in a decrease in U.S. cotton futures prices while India, Australia, and Brazil may increase exports to China. Liu and Hudson (2018) quantified these effects and predicted Chinese tariffs would reduce U.S. cotton exports by an average 0.16 percent per year through the 2028/29 marketing year, while reducing prices by an average of 0.58 percent per year. Muhammad and Smith (2018) estimated a 25-percent retaliatory tariff on U.S. soybeans to China could reduce exports by $1.4 billion to $7.7 billion per year. USDA also estimated the trade damages from these tariffs (see box, "USDA Trade Damage Estimates From Retaliatory Tariffs").

[4]Producer surplus is the difference between the amount of money producers would be willing to accept for a given quantity of a good versus how much they can receive by selling the good at the market price.

USDA Trade Damage Estimates From Retaliatory Tariffs

In July 2018, the USDA announced a trade mitigation package to assist farmers experiencing negative effects caused by retaliatory tariffs imposed by trading partners. This package had three main parts: the Market Facilitation Program (MFP) to provide payments to commodity producers; the Food Purchase and Distribution Program (FPDP) to purchase commodities targeted by tariffs and distribute them through nutrition assistance programs; and the Agricultural Trade Promotion Program (ATP) to develop alternative foreign markets for U.S. commodities. In May 2019, USDA announced a second, larger package to support U.S. agricultural producers hit by continued retaliatory tariff actions. To implement the 2018 trade mitigation package and a subsequent package in 2019, the USDA developed ex-ante trade damage estimates for retaliatory tariffs to set commodity payments and purchase levels under the MFP and FPDP programs. Estimates were generated using an Armington-based partial equilibrium global trade model including bilateral import demand equations and supply functions for multiple countries. This approach sets actual import levels to a base year where the market is in equilibrium and then simulates a new equilibrium with the retaliatory tariff in place. The model was calibrated to the pre-retaliatory period. The estimated trade damages are the differences in exports with and without the tariffs.

Ex-Post (Retrospective) Tariff Analysis

After retaliatory tariffs were implemented, a growing body of literature began to evaluate the actual, rather than the projected, effects of tariffs on U.S. agricultural commodities. For soybeans, the largest U.S. commodity export, the consequences of retaliatory tariffs from China were noted to be particularly severe. Before retaliatory tariffs, the 2018 U.S. soybean planting was the second highest on record because of several factors, including a drought in Argentina (Hitchner et al., 2019). After the 25-percent retaliatory tariff was implemented, U.S. soybean basis[5] was approximately 60 cents below 2015–2017 values, on average, in September 2018 for next-delivery November futures (Adjemian et al., 2019). This change led to an increase in the demand for soybean storage across the country, especially in States that primarily produce for the Chinese market (Adjemian et al., 2019; Hitchner et al., 2019). Although soybean exports increased to other countries, the export volumes were not large enough to compensate for the decrease in Chinese demand (Adjemian et al., 2019; Hitchner et al., 2019). Low prices—combined with larger soybean stocks—led to a decline in intended 2019 soybean acreage of 4.6 million acres, a 5-percent decrease compared with 2018 levels (Hitchner et al., 2019).

Pork producers were affected by retaliatory tariffs ranging from 10 to 30 percent from Mexico and China, which together account for approximately 32 percent of U.S. pork exports (Nti et al., 2019). Nti et al. (2019) estimated, on average, U.S. pork exports to China decreased by 19 percent in volume and 23 percent in value because of retaliatory actions, whereas U.S. pork exports to Mexico decreased by 13 percent in volume and 21 percent in value. Compared with ex-ante simulations, changes in Mexican imports of U.S. pork products tended to be smaller due to effects of China's African Swine Fever outbreak and Mexico's lower-price sensitivity to U.S. fresh/chilled and variety meats (Nti et al., 2019).

Cotton exports were also affected by a 25-percent retaliatory tariff from China. During the 2018/19 marketing year, the value of U.S. cotton exports to China declined by $400 million and overall cotton exports by $600 million compared with the previous marketing year (Muhammad et al., 2019). Evidence suggested competing exporters (e.g., Brazil and Australia) could be replacing U.S. cotton exports to China, which may limit future opportunities for growth (Muhammad et al., 2019). Tree nuts experienced similar declines regarding U.S. exports to China. The share of U.S. tree nuts exported to China in marketing year 2018/19 declined for almonds, pecans, and walnuts by 8, 21, and 6 percent, respectively, based on quantity. (Sumner et al., 2019).

[5]Basis is the difference between the cash price paid for your grain and the nearby Chicago Board of Trade futures price.

Other studies provided estimates of how retaliatory tariffs and trade actions affected multiple commodities.[6] Using a country-pair, monthly, product line gravity model, Grant et al. (2019) found U.S. agricultural exports declined to China by 71 percent, the European Union by 33 percent, Mexico by 22 percent, and Turkey by 48 percent 1 year after tariffs were imposed. In a followup study, Grant et al. (2021) estimated U.S. agricultural producers experienced direct annualized losses of $13.5 to $18.7 billion, with the largest share of losses resulting from decreased trade with China. By commodity, soybean losses were largest ($10.7 billion), followed by coarse grains ($0.9 billion) and fruit, vegetables, and tree nuts ($0.7 billion). Carter and Steinbach (2020) included a wide variety of agricultural-related and Bulk, Intermediate, and Consumer Oriented (BICO) product codes in an event study design. Incorporating retaliatory tariffs from multiple countries in 2018, trade losses of $14.4 billion are estimated with the largest trade destruction losses occurring for soybeans ($7.07 billion), forest products ($1.41 billion), pork ($828 million), and coarse grains ($616 million). Additionally, although there is some evidence that U.S. exporters did increase exports to non-retaliating countries, these gains were significantly smaller than the direct losses caused by retaliation (Carter and Steinbach, 2020).[7]

State-Level Impacts

Despite the growing literature focused on the national losses from retaliatory tariffs, discussion of the State-level impacts of the trade disputes are relatively thin. However, evidence suggested the overall effects of retaliatory tariffs are highly State and crop specific.

Focusing specifically on Iowa, Balistreri et al. (2018) found trade retaliation would result in aggregate welfare losses of $1.68 to $2.22 billion in revenue across corn, soybean, and hog sectors, as well as a 2-percent drop in ethanol prices. But trade mitigation efforts through Market Facilitation Program (MFP) payments may have helped to offset some of the State-level losses (Balistreri et al., 2020; Janzen and Hendricks, 2020). For example, Balistreri et al. (2020) estimated welfare losses from trade retaliation may have been completely offset for several Midwest States including Iowa, North Dakota, Nebraska, and Kansas. However, it should be noted their study based its State-level information on origin of movement data. Origin of movement data reflect where the product was last obtained, not its origin (see box, "Measuring State Agricultural Exports"). As a result, Balistreri et al. (2020) is likely to have overestimated the impacts on port/coastal States (e.g., California and Texas) and underestimated States significantly impacted by tariffs such as Iowa and other Midwest States.

[6]Zahnhiser et al. (2016) use an autoregressive, distributed-lag, time series equation to estimate the effect of Mexico's retaliatory tariffs on multiple U.S. agricultural products from March 2009 through October 2011 finding sales of targeted products declined by 22 percent.

[7]Carter and Steinbach (2020) specifically investigated the trade deflection mechanism and found some statistically significant effects of trade deflection because of retaliatory tariffs. However, compared with the magnitude of direct trade destruction, the effects of diversion are 20 times smaller using a quantity measure and 10 times smaller using a value measure. Grant et al. (2021) also found generally limited evidence of offsetting gains to alternative markets. According to their estimates, trade deflection was insignificant in 44 out of the 54 of the product-level estimates.

Measuring State Agricultural Exports

Determining the value of agricultural export products produced by a State is complicated because agricultural products are often shipped to other States for export or for other consolidation and value-added activities before export. The U.S. Department of Commerce, Bureau of the Census estimates State-level exports for commodities using the Origin of Movement (OM) method, which records the "State from which the merchandise starts its journey to the port of export." In addition to farms, OM could also include silos, packers, factories, or warehouses. Thus, OM estimates differ from the USDA, Economic Research Service (ERS) State Exports, Cash Receipts Estimates method because OM estimates reflect shipments from industries or manufacturers, whereas the ERS State Exports, Cash Receipts Estimates are calculated from farm revenues.

State-export estimates using the OM method may lead to higher values and volumes of exports for States that manufacture or ship commodities traditionally exported in a more processed form. As a result, the value and volume of exports attributed to coastal States is greater than what is produced by those States, while the opposite is true for exports recorded for inland States. For example, in the OM series, Louisiana and Washington accounted for 77 percent of total soybean export value in 2010, even though neither State is listed in the top 10 States in the Cash Receipts series (USDA, ERS, 2021).

These decisions have a large effect on estimating the State-level impacts of retaliatory tariffs. For example, in the analysis conducted by Balesteri et al. (2020), the State-level export information is based on an OM dataset and estimated the largest losses from tariffs accrued to States with significant ports including California, Texas, Michigan, North Carolina, and Florida. These estimates likely significantly overstate the trade dispute burden on coastal States and understate the burden on inland States because of how the value of exports is attributed to States in the OM dataset.

The ERS State Exports, Cash Receipts Estimates avoid the issue of distorting export data toward port States by using farm cash receipts of a specific commodity to attribute each State with a share of export value of a given commodity. Once a State's share of total U.S. production of a commodity is calculated, that proportion is applied to the total U.S. exports of that commodity, and that value is recorded as the estimated value of exports produced by that State. For this application, the use of the ERS State Exports, Cash Receipts Estimates provides the best available estimate of the value of commodities produced by each State that are sold to other countries, providing appropriate data to evaluate the revenue lost by agricultural producers because of retaliatory tariffs by State and commodity. However, while cash receipts-based estimates help address problems associated with coastal ports, they could still over or underestimate State-level exports based on other factors including the depth of State-level markets for specific commodities and geography. In 2017, the value of export-related cash receipts in our sample of commodities included 67 percent of total U.S. agricultural exports.

For more information on the USDA, ERS State Exports, Cash Receipts Estimates for a comparison of the estimation methods and discussion of the strengths and limitations of this approach, see USDA's State export data online.

Using similar estimates to Iowa, the Nebraska Farm Bureau (NFB) estimated declines in prices because of retaliatory tariffs would translate to a decline in 2018 farm revenues between $695 million and $1 billion across corn, soybean, and pork exports (NFB, 2018). In a 2019 update, the NFB study used MFP estimates of trade damages across a broader range of commodities to project losses of $943 million, excluding any MFP payments (NFB, 2019).

Carter and Steinbach (2019) focused on products largely supplied by California, including tree nuts, grapes, oranges, and wine, to assess how China's retaliatory tariffs affected exports. Declines in Chinese imports of wine and walnuts were countered by significant import growth in pistachios and walnuts (Carter and Steinbach, 2019). Despite this growth, average U.S. market shares in all product categories declined, suggesting that the United States lost some trade gains as a result of retaliatory tariffs (Carter and Steinbach, 2019). In Illinois, comparisons between expected and actual 2018 commodity prices revealed small price declines, including less than a 5-percent decline for corn, hogs, and cattle, with a nearly 12-percent decline for soybeans (Swanson et al., 2019). Total value losses across these four commodities to Illinois' producers were projected to be $976.7 million in 2018 (Swanson et al., 2019).

Data and Estimation Methods

To estimate the State-level losses associated with retaliatory tariffs, we drew on three different data sources: product-line changes in the value of exports due to the trade conflict from Grant et al. (2021), pre-retaliation commodity-level export shares (Trade Data Monitor, 2021), and the USDA, ERS State Exports, Cash Receipts Estimates.

First, we obtained product-line estimates for the effect of 2018–2019 trade retaliation on the value of U.S. agricultural exports from Grant et al. (2021).[8] As described above, Grant et al. (2021) used a retrospective, monthly, product line gravity model to estimate U.S. losses from trade retaliation by trading partner. These losses estimate the direct reduction in the value of U.S. exports to retaliating partners and did not capture any trade deflection effects. Econometrically, these estimates were generated while also controlling for external market shocks that may have occurred during the trade dispute period (e.g., African Swine Fever). Trade values in Grant et al. (2021) included both wholesale markup as well as export transportation costs.

Grant et al. (2021) employed a binary variable as an indicator for retaliation for each country and product line. They used a binary variable as opposed to a continuous measure (i.e., tariff changes) because some periods of China's retaliatory trade actions often went beyond tariffs to include announced prohibitions on purchases of U.S. agricultural products.[9] For example, on August 5, 2019, China announced its state-owned enterprises (SOEs) would "halt" further purchases of U.S. agricultural products (Lawrence et al., 2019). Thus, the estimates in Grant et al. (2021) captured both the effect of retaliatory tariffs as well as non-tariff related retaliatory actions that may have been put into place.[10] This also means this report's estimates of the effects of retaliatory tariffs have only considered direct trade flows between trading partners and did not reflect products that were trans-shipped.

Table 1 presents the Grant et al. (2021) estimates for 17 major commodity groups that are also available in the ERS State Exports, Cash Receipts Estimates. Estimates have ranged from a nearly 20-percent reduction in the value of U.S. pork exports to Mexico to an over 99-percent reduction in the value of U.S. rice exports to Turkey. Across commodities, retaliation from China has had the largest negative effect on the value of U.S. exports.

[8]The econometric results from Grant et al. (2021) and Carter and Steinbach (2020) were quantitatively similar in magnitude across commodities and retaliatory partners.

[9]Using monthly panel data from January 2016 through December 2019 of bilateral product-month relationships (*ijkm*), Grant et al. (2021) quantified the trade effect of the retaliatory tariffs on agricultural products using the following econometric specification:

$$X_{ijkmt} = exp\{\mu_{ijkm} + \pi_{it} + \varphi_{jt} + \kappa_{kt} + \xi_{mt} + \gamma_1 retaliation_{ijkmt}\} + \varepsilon_{ijkmt}$$

Where exporting (importing) countries are denoted as *i (j)* and products, months, and years as *k, m,* and *t,* respectively, *exp* denotes the exponential function, X_{ijkmt} as the value of bilateral trade between exporting country *i*, importing country *j*, 6-digit product code *k* of the Harmonized System (HS), month *m* (*m* = 1, 2, … 12), and year *t* (*t* = 2016, 2017, … 2019). This equation contains a comprehensive set of exporter-importer-product-month specific fixed effects, μ_{ijkm} , designed to absorb all time-invariant, product-and-month specific bilateral trade cost or promoting. In addition to μ_{ijkm} , they also include importer-year (φ_{jt}), exporter-year (π_{it}), product-year (κ_{kt}), and month-year (ξ_{mt}) fixed effects. Retaliation *ijkmt* is a time-varying dichotomous variable equal to one if exporter *i* is the United States and importer *j* imposes retaliatory measures on product *k* in month *m* and year *t*, and zero otherwise.

[10]There had also been reported instances in which China had allowed ad-hoc exemptions of retaliatory tariffs to state-owned enterprises (SOEs) during different periods of the trade disputes. Grant et al.'s (2021) identification strategy of using binary variables also captured these de facto effects of the retaliatory actions.

Table 1

Percent reduction in U.S. export value by commodity and trading partner due to 2018–2019 retaliation

Grant et al. (2021) commodity	Cash receipts commodity	Canada	China	EU	Mexico	Turkey	India
Crops							
Coarse grains	Sorghum	—	-94.6	—	—	—	—
Corn	Corn	—	-60.5	-83.1	—	—	—
Cotton	Cotton	—	-37.4	—	—	—	—
Oilseeds	Other oilseeds and products	—	-93.1	—	—	—	—
Rice	Rice	—	—	-58.7	—	-99.6	—
Soybeans	Soybeans	—	-76.5	—	—	—	—
Tobacco	Tobacco	—	-99.6	—	—	—	—
Wheat	Wheat	—	-87.9	—	—	—	—
Livestock							
Beef	Beef and veal	—	-34.2	—	—	—	—
Dairy	Dairy products	-20.2	-35.1	—	—	—	—
Pork	Pork	—	-67.0	—	-19.7	—	—
Specialty Crops							
Fresh fruit	Fruits, fresh	—	-57.2	—	—	—	-63.6
Fresh veg.	Vegetables, fresh	—	-52.4	—	—	—	—
Proc. fruit	Fruits, processed	—	-48.3	-35.1	—	—	—
Tree nuts	Tree nuts	—	-33.2	—	—	-46.0	—
Other							
Soymeal	Soybean meal	—	-84.7	—	—	—	—
Veg. oils	Vegetable oils	—	-21.6	—	—	—	—

Notes: EU=European Union. — = no negative and statistically-significant retaliation for a specific trading partner-commodity pair. We presented only the gravity model coefficient estimates, which are negative and significant ($p<0.10$) for at least one retaliating trade partner. To be as consistent as possible, we matched the Grant et al. (2021) coarse grain estimates with the Harmonized System (HS) codes corresponding to grain sorghum from the "Feeds and other feed grains" category in the USDA, Economic Research Service State Exports, Cash Receipts Estimates.

Source: USDA, Economic Research Service table adapted from Grant et al. 2021. "Agricultural Exports and Retaliatory Trade Actions: An Empirical Assessment of the 2018/2019 Trade Conflict," *Applied Economic Perspectives and Policy* 43:619–640.

We matched the Grant et al. (2021) commodity groups with the closest corresponding commodity group in the USDA, ERS State Exports, Cash Receipts Estimates. We noted, however, that because the commodity groupings are compiled at the Harmonized System 6-digit (HS6) level, the correspondence between products in the two commodity groups may not be exact. For the coarse grain estimates in Grant et al. (2021), we created a new cash receipts category with the Harmonized System (HS) codes corresponding to sorghum from the "Feeds and other feed grains" category in the USDA, ERS State Exports, Cash Receipts Estimates.

Second, we used data from Trade Data Monitor (2021) to calculate trade shares by commodity group for calendar year 2017 pre-retaliation U.S. exports (table 2). The impact of the retaliatory tariffs is generally proportional to both the amount of exports to a given market as well as the level of retaliatory tariff. For example, in 2017, nearly 57 percent of U.S. exported soybeans were shipped to China, as compared with nearly 8 percent shipped to the European Union.

Table 2
Share of value U.S. agricultural exports by trading partner and commodity, calendar year 2017

Commodity	Canada	China	EU	Mexico	Turkey	India
	Share of U.S. agricultural exports (percent)					
Crops						
Corn	—	1.6	1.4	—	—	—
Cotton	—	16.7	—	—	—	—
Other oilseeds and products	—	1.9	—	—	—	—
Rice	—	—	2.4	—	1.3	—
Sorghum	—	80.9	—	—	—	—
Soybeans	—	57.0	—	—	—	—
Tobacco	—	16.1	—	—	—	—
Wheat	—	5.8	—	—	—	—
Livestock						
Beef and veal	—	0.4	—	—	—	—
Dairy products	12.0	13.8	—	—	—	—
Pork	—	7.9	—	23.7	—	—
Specialty Crops						
Fruits, fresh	—	4.8	—	—	—	2.2
Fruits, processed	—	8.0	18.4	—	—	—
Tree nuts	—	2.8	—	—	3.6	—
Vegetables, fresh	—	0.0	—	—	—	—
Other						
Soybean meal	—	0.2	—	—	—	—
Vegetable oils	—	2.4	—	—	—	—

Notes: EU=European Union. — = no negative and statistically-significant retaliation for a specific trading partner-commodity pair.

Source: USDA, Economic Research Service using data from Trade Data Monitor (2021) and 6-digit Harmonized System (HS6) codes from Grant et al. 2021. "Agricultural Exports and Retaliatory Trade Actions: An Empirical Assessment of the 2018/2019 Trade Conflict," *Applied Economic Perspectives and Policy* 43:619–640.

Third, we measured State-level exports using the USDA, ERS State Exports, Cash Receipts Estimates. These estimates, updated annually, included State and commodity-specific data starting with calendar year 2000. The ERS State Exports, Cash Receipts Estimates attributes to each State a share of production of a given export commodity based on the farm cash receipts of that commodity. USDA's National Agricultural Statistics Service (NASS) estimates the production volume, prices, and value of agricultural commodities in each State from farm survey data. ERS uses data on farm cash receipts to estimate the sales revenue received by U.S. farmers for their commodities. These receipts are calculated from production quantities and prices received by farmers—or from production values—in each U.S. State during the calendar year. Farm cash receipts provide the base value for agricultural production sold, whether in domestic or to the international markets. Once a State's share of total U.S. production of a commodity is calculated, that proportion is applied to the total U.S. exports of that specific commodity, and that value is recorded as the estimated value of exports produced by the respective State. The use of the cash receipts estimates of State agricultural exports has provided the most accurate measure of the value of commodities produced by each State sold to other countries (see box, "Measuring State Agricultural Exports").

Table 3 presents the cash receipt-based estimates for the value of total U.S. exports for the pre-tariff (i.e., 2017) and post-tariff (i.e., 2018–2019) calendar years. Note that this is a simple before-and-after comparisons and not an assessment of the direct effect of retaliatory tariffs on export cash receipts. Most retaliatory tariffs were imposed in mid-2018 (Appendix 1). This report focused on the commodities from Grant et al. (2021) that experienced negative and statistically-significant effects from retaliatory action and were also contained in the cash receipt-based estimates. After the imposition of tariffs across these 17 commodities, total cash receipts increased by $951 million (1 percent) in 2018 and decreased by $2.91 billion (just over 3 percent) in 2019.

Timing of the tariffs is one reason for the increase in total cash receipts for these commodities during 2018. Except for China's Section 232 retaliation against grain products, most tariff increases went into effect in July 2018 or later, and 2019 was the first, full calendar year with imposed retaliatory tariffs. However, for specific commodities, 2018 retaliatory tariffs coincided with a part of the year associated with higher export volumes, resulting in more severe declines in cash receipt levels. For example, U.S. cash receipts from soybean exports declined by $4.4 billion (over 20 percent) and wheat by $669 million (11 percent) in 2018.

Table 3
State exports, cash receipt estimates for selected targeted commodities, 2017–2019

Commodity	U.S. agricultural exports cash receipts (U.S. dollars, million)			Percentage change		
	2017	2018	2019	2017–18	2018–19	2017–19
Crops	48,407	47,341	44,279	-2.2	-6.5	-8.5
Corn	9,112	12,467	7,651	36.8	-38.6	-16.0
Cotton	5,845	6,557	6,148	12.2	-6.2	5.2
Other oilseeds and products	2,087	2,110	1,898	1.1	-10.0	-9.1
Rice	1,723	1,694	1,866	-1.7	10.2	8.3
Sorghum	1,116	1,012	1,089	-9.3	7.5	-2.4
Soybeans	21,456	17,063	18,663	-20.5	9.4	-13.0
Tobacco	1,010	1,049	732	3.9	-30.2	-27.5
Wheat	6,058	5,389	6,232	-11.0	15.6	2.9
Livestock	19,125	20,261	20,970	5.9	3.5	9.6
Beef and veal	7,263	8,360	8,094	15.1	-3.2	11.4
Dairy products	5,377	5,498	5,924	2.3	7.7	10.2
Pork	6,485	6,403	6,952	-1.3	8.6	7.2
Specialty Crops	19,848	19,716	19,889	-0.7	0.9	0.2
Fruits, fresh	4,725	4,649	4,358	-1.6	-6.3	-7.8
Fruits, processed	4,121	3,975	3,779	-3.5	-4.9	-8.3
Tree nuts	8,464	8,506	9,067	0.5	6.6	7.1
Vegetables, fresh	2,539	2,586	2,685	1.9	3.8	5.8
Other	6,860	7,872	7,142	14.8	-9.3	4.1
Soybean meal	3,897	5,105	4,390	31.0	-14.0	12.7
Vegetable oils	2,964	2,766	2,752	-6.7	-0.5	-7.2
Selected commodity total	94,240	95,190	92,280	1.0	-3.1	-2.1

Notes: USDA, National Agricultural Statistics Service stopped reporting sorghum production for a number of States in 2019 that represented a small share of production.

Source: USDA, Economic Research Service (ERS) using data from USDA, ERS, State Exports, Cash Receipts Estimates

To estimate the State-level effects of retaliatory tariffs, this report first constructed aggregate estimates of the effect of retaliation from multiple trading partners on U.S. agricultural exports. To calculate the overall reduction in the value of U.S. exports because of retaliation, we weighted the effect of each trading partners' retaliatory tariffs by the share of U.S. exports flowing to that trading partner in the baseline pre-tariff period and totaled the retaliatory effects by commodity group.

$$ATR_i = \sum_{j=1}^{6} \beta_{ij} s_{ij,2017} \quad (1)$$

Equation 1 presents the weighting procedure where ATR_i is the total percentage reduction in the value of U.S. exports of commodity i because of retaliation. βij is the estimated percent reduction in the value of U.S. exports for commodity i because of retaliation from country j—this value is taken from the Grant et al. (2021). In addition, $S_{ij,\ 2017}$ is the share of U.S. exports of commodity i flowing to country j in 2017 before any retaliatory tariffs were implemented. Note that the report found ATR is broadly consistent if 2016 shares are used as well.[11] For each commodity group, this report summed the weighted estimates across all six retaliating trade partners to get the aggregate effect of retaliatory tariffs on U.S. agricultural commodities.

This report then projected annualized losses due to tariff retaliation using the 2017 ERS State Exports, Cash Receipts Estimates. This report selected 2017 because this year is the most recent calendar year preceding the start of the trade war and provides the best estimates of what U.S. agricultural exports may have been in the absence of retaliatory tariffs.

[11]As an added robustness check, we also used a 3-year moving average trade share from 2015 through 2017 ($s_{ij,2015–2017}$) to calculate the *ATR*. These results are consistent with the report's main findings. This change would increase total estimated losses by less than 1 percent.

Results

This report documented the effects from retaliatory tariffs at the national level to provide an overall perspective for the United States. We then provided impacts at the commodity level, highlighting those most affected. Finally, this report presented the impacts by State.

Aggregate/National Level

Table 4 reports the overall estimated losses of the retaliatory tariffs from mid-2018 through the end of 2019. The estimated losses are based on the estimates by Grant et al. (2021) for the aggregate U.S. agricultural exports percentage reductions because of retaliatory tariffs by trading partners. These estimates are then projected—based on pre-retaliatory trade levels in 2017 and weighted according to the number of months in which the tariffs were in effect—on agricultural trade levels to reflect the duration of retaliation by each trading partner during this period.[12] However, because of the seasonality of some targeted U.S. exports, including soybeans to China, this report recognizes these estimates may represent a lower bound on estimated aggregate losses where the implementation of tariffs in 2018 coincided with the peak export season.[13] We also note that these aggregate estimates include all commodities analyzed in Grant et al. (2021), which is larger than the 17 selected commodities discussed in the State-level estimates. Most of these tariffs were initiated in mid-2018. Losses are projected until the end of 2019 to be consistent with the sample of data estimated in Grant et al. (2021).

Table 4
Percent reduction in U.S. export agricultural value by trading partner due to retaliation from mid-2018 to end of 2019

Retaliatory partner	Dates tariffs imposed	Percent estimated U.S. export reduction due to retaliatory tariff	Value of U.S. products targeted by retaliation in 2017 (USD) billions	Estimated U.S. agriculture export losses 2018–2019 U.S. losses (USD) billions
China	Section 232 imposed April 2018*; Section 301 July 2018	-76	$22.5	-$25.7
Mexico	Imposed July 2018, removed May 2019	-20	$2.6	-$0.5
Canada	Imposed July 2018, removed May 2019	-4	$3.3	-$0.1
European Union	Imposed June 2018	-42	$0.9	-$0.6
Turkey	Imposed June 2018	-22	$0.3	-$0.1
India	Imposed June 2019	-27	$0.8	-$0.1
Total				-$27.2

Notes: Estimated percent reduction are from Grant et al. (2021). *Totals do not include the trade losses on U.S. exports to China occurring from April 2018 to June 2018 due to 232 tariffs on approximately $2 billion of products.

Source: USDA, Economic Research Service using estimates from Grant et al. 2021. "Agricultural Exports and Retaliatory Trade Actions: An Empirical Assessment of the 2018/2019 Trade Conflict," *Applied Economic Perspectives and Policy* 43:619–640.

[12]Note the table does not include trade losses on U.S. exports to China occurring from April 2018 to June 2018. Approximately $2 billion of products were affected at this time.

[13]The authors explored alternate weighting procedures based on the monthly value of targeted exports shipped by a trading partner in calendar year 2017 to account for peak-export months (USDA, FAS, 2021). We only considered the value of commodities by trading partner with negative and significant reductions in the value of trade (table 1). The results are similar for all trading partners except for China where projected aggregate losses during the mid-2018–2019 period were approximately $2 billion higher.

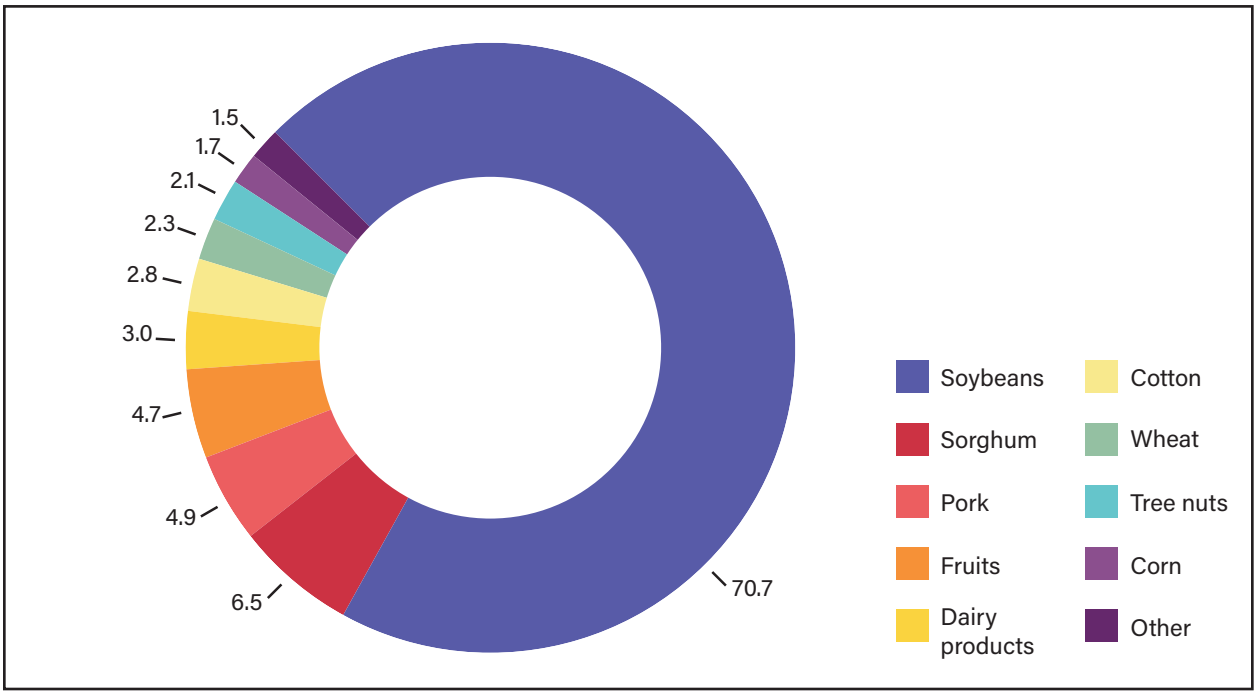
Overall, the total estimated U.S. agricultural export losses from mid-2018 to the end of 2019 were more than $27 billion. China, by far, accounts for most of the trade losses, with $25.7 billion in reduced exports or 95 percent of total losses. The European Union and Mexico come in at second and third with $600 million and $500 million, respectively. Trade losses to Canada, Turkey, and India were estimated to be about $100 million each.

Commodity-Level Results

Across the 17 commodity groups we considered, estimated annualized U.S. losses from retaliation total $13.2 billion (Appendix 2). This finding is consistent with the range of annualized losses estimated by Grant et al. (2021) of $13.5 to $18.7 billion. The estimates were smaller partly because of the selected sample of commodities included in the ERS State Exports, Cash Receipts Estimates database, as noted in the box, "Measuring State Agricultural Exports."

Several key patterns emerged for estimated losses. Figure 4 presents the share of estimated annualized losses accounted for by different commodity groups. Soybeans accounted for nearly 71 percent ($9.35 billion) of estimated losses caused by retaliatory tariffs. This finding was not surprising since soybeans have the highest export value for a single commodity for the United States, accounting for around 13 percent of total U.S. exports in value terms (USDA, FAS, 2020). Additionally, China traditionally has been the largest market for U.S. soybeans. China targeted soybeans for retaliation with a 25-percent tariff in July 2018, which resulted in sharp declines in Chinese purchases. For example, in January 2018, China imported $2.5 billion of U.S. soybeans; this number declined to $140 million in July 2018 and then declined to $0 by November 2018 (Regmi, 2019). China resumed purchasing soybeans in early 2019, but purchasing levels were less than pre-2018. Soybean losses were economically devastating given both the size of the value of U.S. production and the level of dependence on the Chinese market. Prior to the tariffs approximately 30 percent of U.S. soybean production was shipped to China. In comparison, corn, which is economically a larger crop than soybeans, experienced much less damages because less than 1 percent of production was exported to China. Similarly, China also targeted sorghum for retaliation and accounted for over 6 percent ($854 million) of annualized losses. China imposed a 25-percent tariff on sorghum.

Figure 4
Percent share of annualized losses caused by retaliatory tariffs by commodity



Notes: Estimates reflect annualized losses calculated using data from mid-2018 through the end of calendar year 2019. Shares calculated over selected commodities reported in Appendix 2. Data may not equal 100 due to rounding.

Source: USDA, Economic Research Service (ERS) estimations using data from USDA, ERS, State Exports, Cash Receipts Estimates, Trade Data Monitor (2021), and Grant et al. 2021. "Agricultural Exports and Retaliatory Trade Actions: An Empirical Assessment of the 2018/2019 Trade Conflict," *Applied Economic Perspectives and Policy* 43:619–640

U.S. cash receipts from pork represented nearly 5 percent ($646 million) of losses. Both China and Mexico issued retaliatory tariffs against U.S. pork exports. However, some of the losses from Mexico's retaliation may have been mitigated by a quota of 350,000 tons of pork legs and shoulders that was implemented alongside retaliatory tariffs. As figure 4 indicates, pork had the third largest share of annualized losses; however, figure A1 shows pork was the second most affected commodity in terms of commodities targeted. The difference between the two is likely because of African Swine Fever (ASF) that affected China's import demand for U.S. pork (i.e., China imported pork despite the high tariffs). Beef and veal products only accounted for a small share of losses (nearly one-tenth of a percent), but mainly because of small initial trade as U.S. beef had been banned from China since 2003 and China only agreed to improve market access in 2017. U.S. beef exports began to increase in late 2017 through the first half of 2018 before declining and leveling off, following the imposition of retaliatory tariffs.

There have also been losses in products considered as specialty crops. The largest loss has been $618 million in the fruits category (over 4 percent)—including $424 million in processed (just over 3 percent) and $194 million in fresh (over 1 percent) fruits—followed by $219 million in losses for tree nuts (nearly 2 percent). For processed fruit, China and India both imposed tariffs, but exports to India have been historically small. For fresh vegetables, retaliatory tariffs were estimated to have experienced the smallest losses ($0.4 million) from the set of commodities focused on in this report.

Retaliatory tariffs on dairy were imposed by Canada and China, which represented just under 3 percent ($391 million) of the losses. Canada and China were the second and third largest destinations for U.S. dairy product exports in 2017, accounting for 24 percent of total exports.

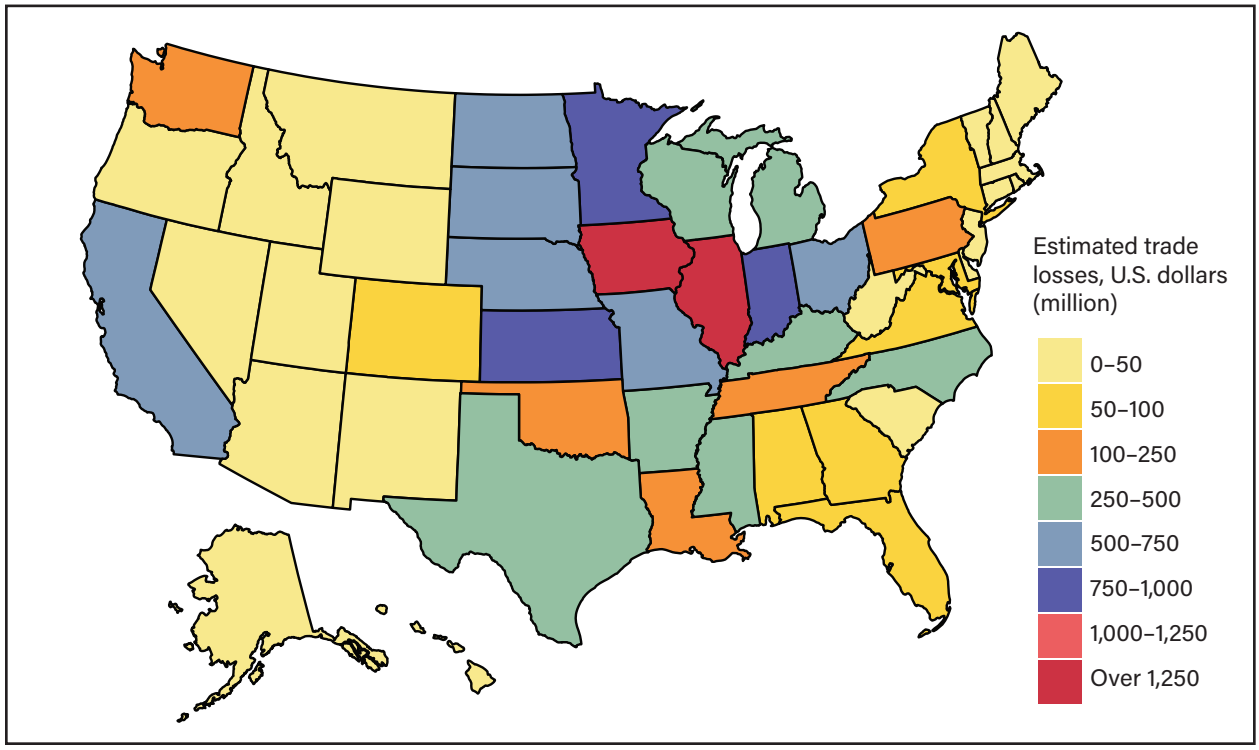
Cotton represented just under 3 percent ($366 million) of the total amount of export losses; China was the only country that placed tariffs on cotton.

Retaliation against wheat and corn accounted for over 2 percent ($309 million) and over 1 percent ($198 million) of losses, respectively. Wheat products and corn were targeted by China's imposed tariffs. The European Union and Turkey imposed tariffs on U.S. rice exports, which amounted to less than 1 percent ($46 million) of total losses.

State-Level Results

Each State's share of losses from retaliatory tariffs for the selected commodities was calculated using the 2017 ERS State Exports, Cash Receipts Estimates. Figure 5 presents the distribution of estimated losses caused by retaliatory tariffs at the State level. Losses were largely concentrated in the Midwest with Iowa, Illinois, and Kansas experiencing annualized losses of $1.46 billion, $1.41 billion, and $955 million, respectively. As noted in figure 6, Iowa and Illinois' estimated cash receipts from exports tended to represent a larger share of cash receipts from production—at 39 and 51 percent, respectively—compared with the national average of 36 percent. Iowa and Illinois are also the two largest producers of soybeans, providing 25–30 percent of the U.S. supply. Complete estimates of annualized losses by State and commodity are presented in Appendix 2.

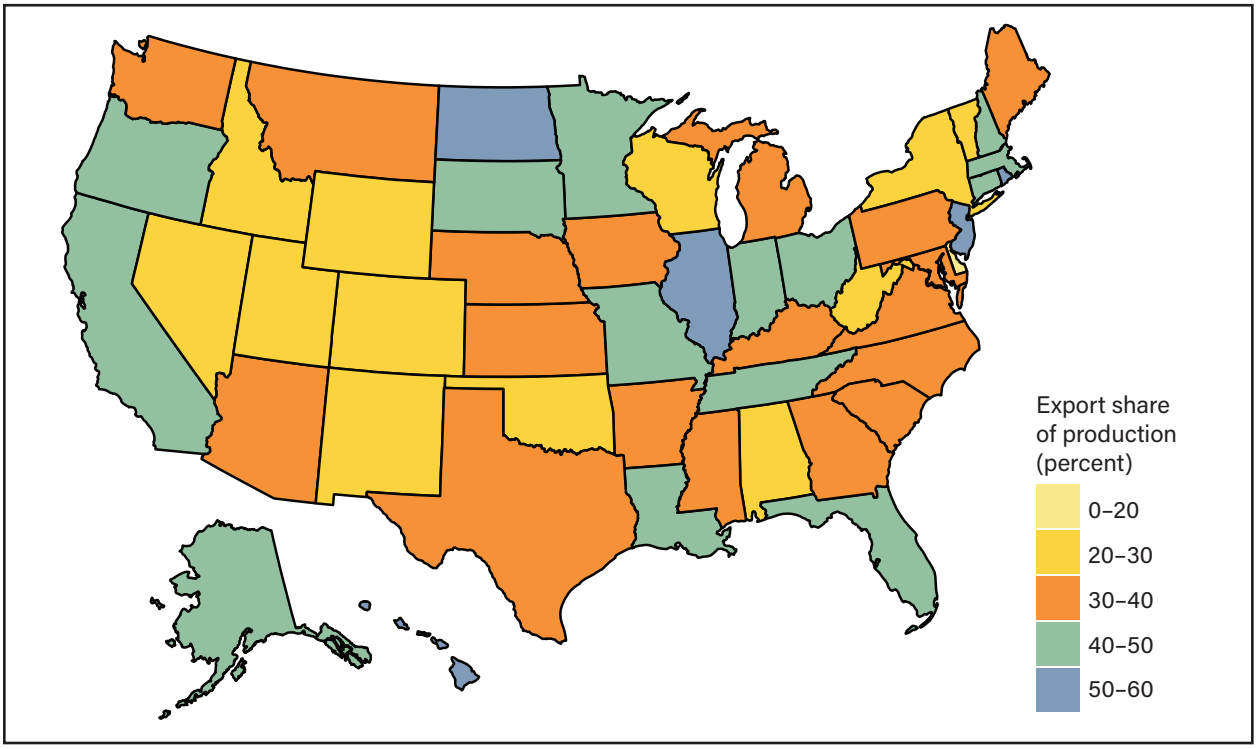
Figure 5
Distribution of estimated annualized losses from retaliatory tariffs



Notes Estimates reflect annualized losses calculated using data from mid-2018 through the end of calendar year 2019. Totals calculated over selected commodities reported in Appendix 2.

Source: USDA, Economic Research Service (ERS) estimations using data from USDA, ERS State Exports, Cash Receipts Estimates, Trade Data Monitor (2021), and Grant et al. 2021. "Agricultural Exports and Retaliatory Trade Actions: An Empirical Assessment of the 2018/2019 Trade Conflict," *Applied Economic Perspectives and Policy* 43:619–640.

Figure 6
State agricultural exports as a share of production, 2017



Source: USDA, Economic Research Service (ERS) using data from USDA, ERS State Exports, Cash Receipts Estimates, and USDA, ERS Farm Income and Wealth Statistics.

Figure 7 illustrates the geographic distribution of estimated tariff losses by commodity to identify how different States were affected. For example, Iowa experienced large losses not only from soybean tariffs ($1.2 billion) but also pork ($218 million) and corn ($35 million) tariffs. Kansas experienced large losses because of tariffs on sorghum ($478 million), soybeans ($391 million), and wheat ($50 million). Texas experienced losses in cash receipts for sorghum ($244 million) and cotton ($166 million) exports. While overall U.S. losses for beef were small ($11 million), Texas accounted for over 13 percent of these losses. Although soybeans had a larger dollar loss, cotton and sorghum had larger percentage losses. This is because the importance of individual crops differs among States. Although soybeans are important to Illinois, they are not as important to Texas. Figure 7 also illustrates how retaliatory tariffs affected States that export commodities with smaller trade volumes in value terms. For example, losses from retaliatory tariffs in Washington were driven by processed and fresh fruits ($102 million combined) and wheat ($25 million); losses from tobacco accrued largely to North Carolina ($81 million) and Kentucky ($40 million). California's trade losses were concentrated in processed/fresh fruits ($374 million combined), tree nuts ($199 million), and dairy products ($68 million).

Figure 7

Distribution of estimated annualized losses for selected commodities due to retaliatory tariffs, by commodity

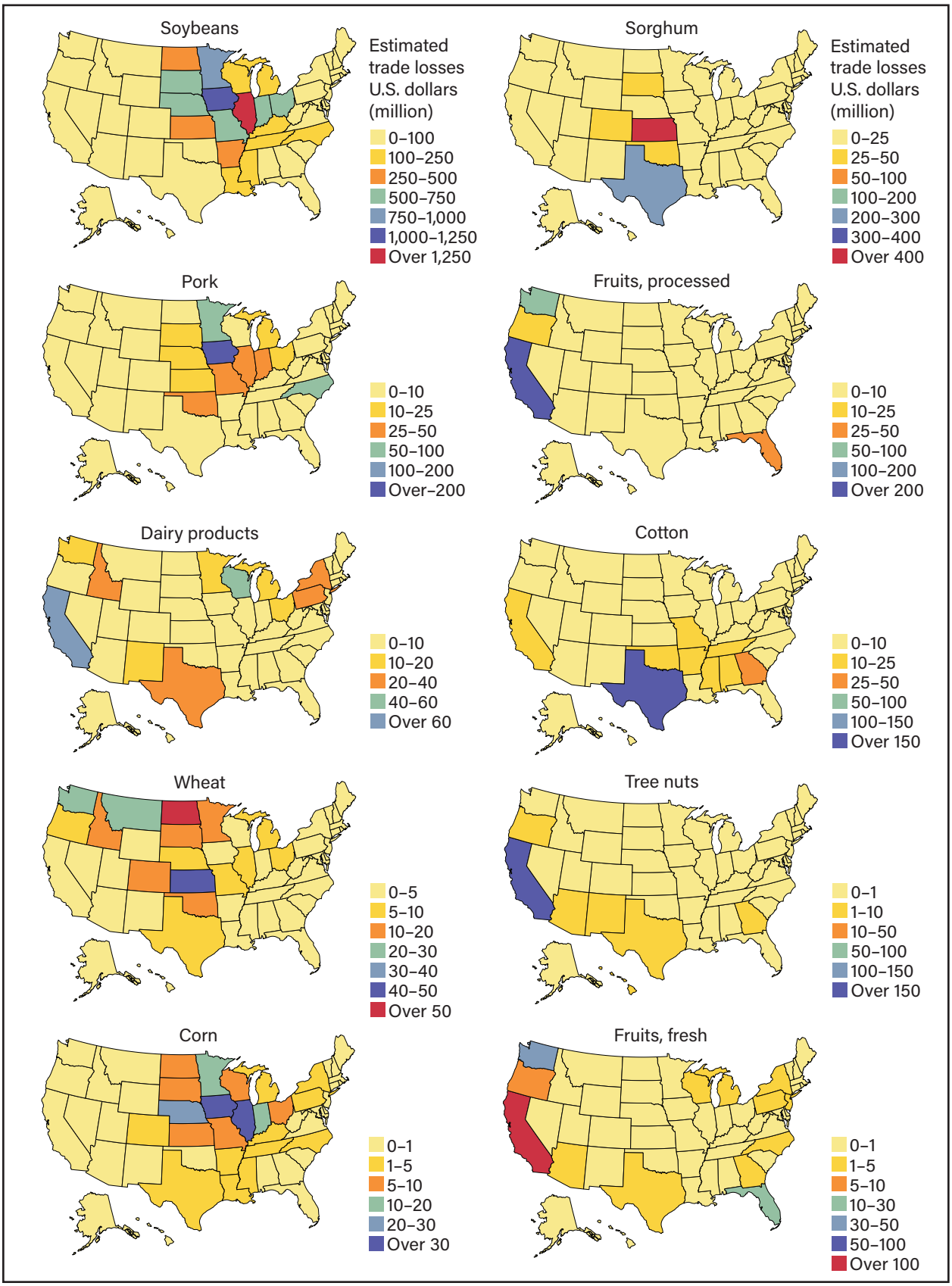


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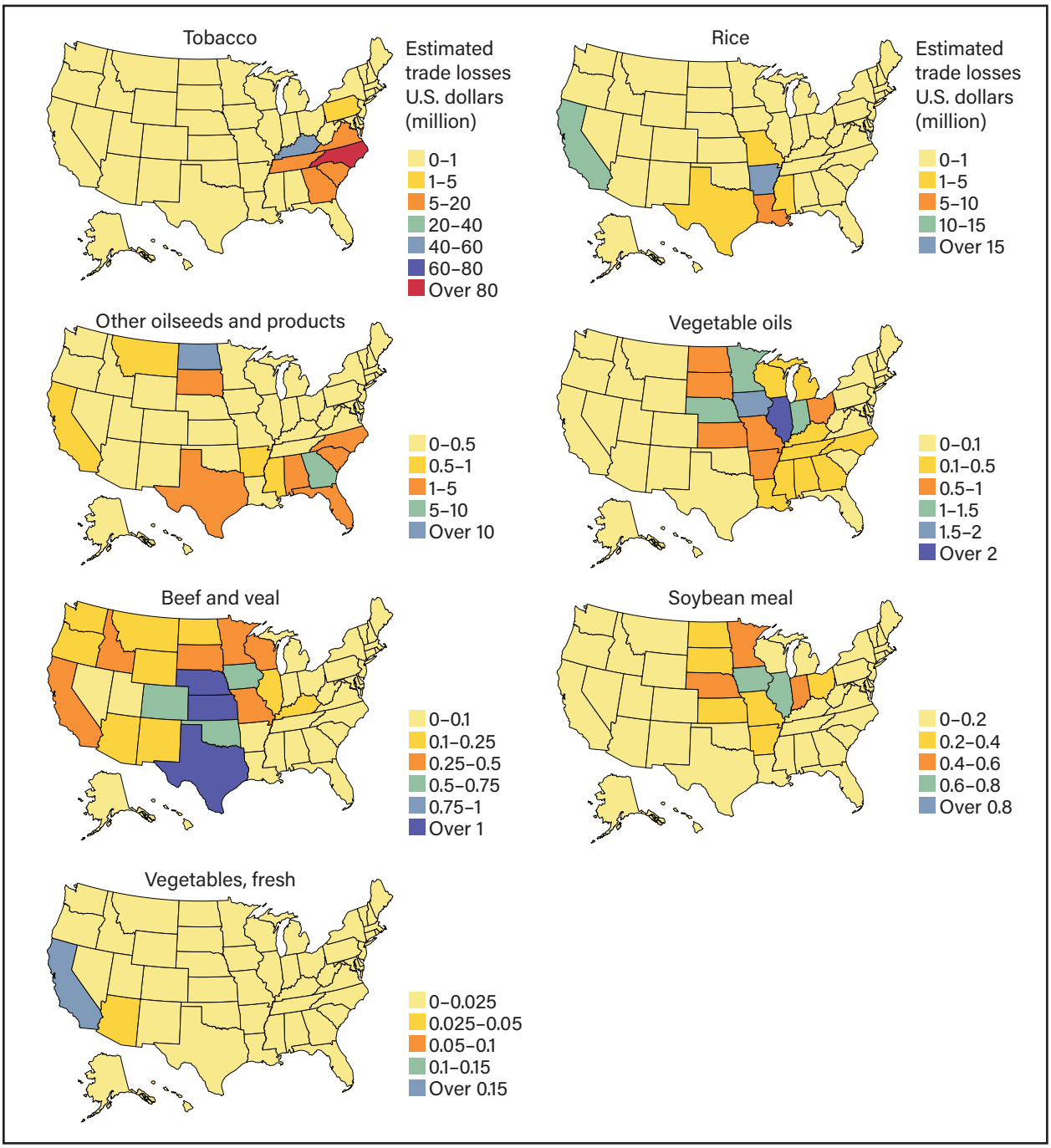
Figure 7

Distribution of estimated annualized losses for selected commodities due to retaliatory tariffs, by commodity



Note: Estimates reflect annualized losses calculated using data from mid-2018 through the end of calendar year 2019.

Source: USDA, Economic Research Service (ERS) estimations using data from USDA, ERS State Exports, Cash Receipts Estimates, 2021 Trade Data Monitor, and Grant et al. 2021. "Agricultural Exports and Retaliatory Trade Actions: An Empirical Assessment of the 2018/2019 Trade Conflict," *Applied Economic Perspectives and Policy* 43:619–640.

Table 5 shows how States are ranked by the share of estimated losses and by the share of total U.S. agricultural exports from 2017. In general, we found States with higher shares of losses have higher shares of total U.S. agricultural exports. For example, Iowa and Illinois were the States most affected by losses and had the second and third largest share of total U.S. exports, respectively, as they are the United States' major soybean

producers. Kansas and Indiana also had a disproportionate share of losses compared with their share of exports, due to the impact on soybeans, and in the case of Kansas, sorghum. California had the largest share of exports, and the retaliatory tariffs targeted tree nuts, dairy products, and fresh fruits, which are California's major production commodities and exports; however, it is only eighth for the share of U.S. export losses—the small overall levels of impacts is due to relatively low share of oilseed, grain, and hog sectors.

Table 5
Ranking States' shares of agricultural export losses from retaliatory tariffs

Rank	State	Share of losses (percent)	Share of 2017 U.S. agri-cultural exports (percent)	Rank	State	Share of losses (percent)	Share of 2017 U.S. agri-cultural exports (percent)
1	Iowa	11.1	7.5	26	New York	0.5	1.0
2	Illinois	10.6	5.8	27	Colorado	0.5	1.3
3	Kansas	7.2	3.5	28	Florida	0.5	2.5
4	Minnesota	7.1	5.0	29	Maryland	0.4	0.5
5	Indiana	5.9	3.4	30	Alabama	0.4	0.9
6	Nebraska	5.6	4.6	31	South Carolina	0.4	0.6
7	Missouri	5.2	2.9	32	Idaho	0.3	1.5
8	California	5.2	16.4	33	Oregon	0.3	1.4
9	Ohio	4.7	2.7	34	Montana	0.2	0.9
10	South Dakota	4.4	2.6	35	Arizona	0.2	1.1
11	North Dakota	4.0	3.2	36	New Mexico	0.2	0.6
12	Texas	3.6	5.0	37	Delaware	0.1	0.2
13	Arkansas	3.2	2.3	38	New Jersey	0.1	0.4
14	North Carolina	2.5	2.7	39	Utah	0.1	0.3
15	Wisconsin	2.2	2.1	40	Vermont	0.0	0.1
16	Mississippi	2.1	1.4	41	West Virginia	0.0	0.1
17	Michigan	2.1	2.0	42	Wyoming	0.0	0.2
18	Kentucky	1.9	1.5	43	Massachusetts	0.0	0.2
19	Tennessee	1.6	1.1	44	Maine	0.0	0.2
20	Louisiana	1.3	1.1	45	Hawaii	0.0	0.3
21	Washington	1.1	2.7	46	Nevada	0.0	0.1
22	Oklahoma	1.0	1.3	47	Connecticut	0.0	0.2
23	Pennsylvania	0.8	1.5	48	New Hampshire	0.0	0.1
24	Georgia	0.7	2.1	49	Rhode Island	0.0	0.0
25	Virginia	0.6	0.8	50	Alaska	0.0	0.0

Notes: Estimates reflect annualized losses calculated using data from mid-2018 through the end of calendar year 2019. Share of U.S. agricultural exports calculated using all exported agricultural commodities for 2017 using USDA, ERS State Exports, Cash Receipts Estimates.

Source: USDA, Economic Research Service, State Exports, Cash Receipts Estimates.

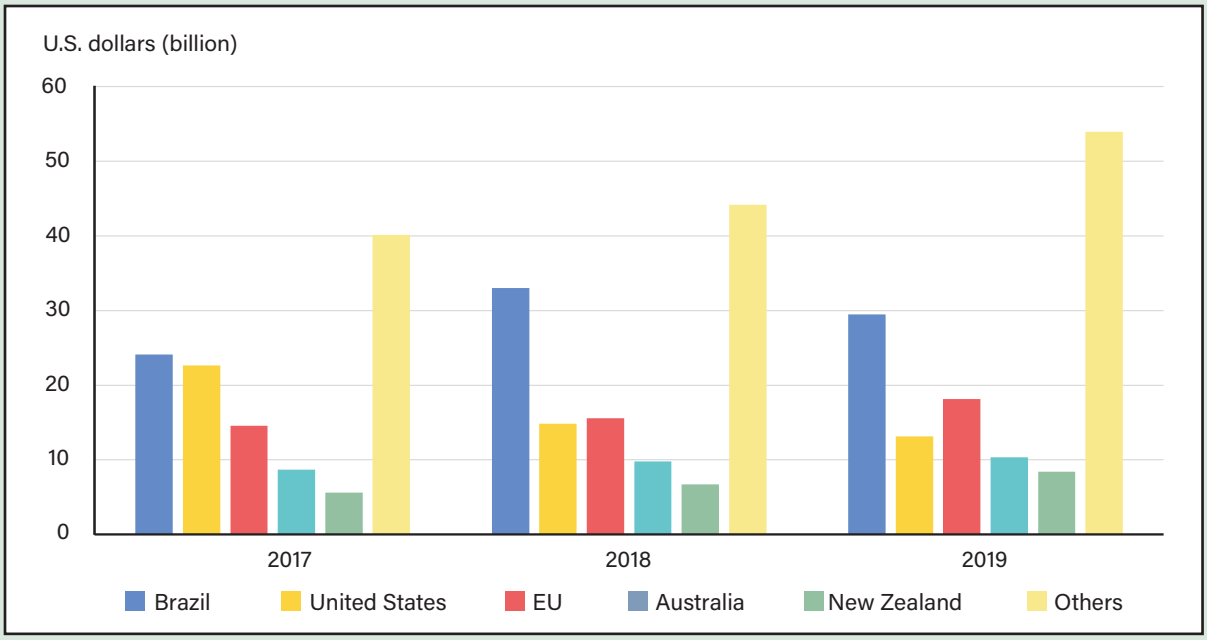
Changing Landscape of Retaliatory Tariffs in 2020

The analysis above focused on the tariff effects throughout 2018 and 2019. This was the height of the trade dispute and was also consistent with the timeframe of the econometric estimates conducted (see box, "Who Captured the U.S. Losses?"). On January 15, 2020, the United States and China signed the Phase One trade deal. Starting in March 2020, China began announcing a series of tariff exemptions on U.S. products that had been initially targeted by retaliatory action. The section below examines U.S. agricultural exports to China following the Phase One Agreement. Given the focus of this study, we did not assess the effects of the Phase One deal, which are broad and complex; however, we did examine the extent China's announced retaliatory-tariff exemptions afforded reprieve for U.S. exporters and the observed levels of trade occurring following these announcements.

Who Captured the U.S. Losses?

Other countries likely benefitted from the U.S.'s trade losses. Given that most of the losses (95 percent) were to China, we only examined these changes. Figure 8 shows China's 2017 agricultural imports from its five largest sources, grouping the rest of the world into an "others" category. In 2017, Brazil was the largest exporter, providing 21 percent of China's imports followed by the United States at 20 percent. The United States, traditionally the largest source of China's agricultural imports, was surpassed by Brazil in 2017. Brazil grew its exports to China through soybeans. Brazil's soybean exports to China increased from less than $1 billion in 2002 to $20 billion in 2017, accounting for 88 percent of its total 2017 exports to China.

Figure 8
Changes in China's agricultural imports



Note: EU=European Union.

Source: USDA, Economic Research Service using data from 2021 Trade Data Monitor.

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Once the retaliatory tariffs were imposed, China increased its imports from Brazil and other countries, except for the United States. In 2018, China imported $8 billion more of agricultural products compared with 2017; however, it imported $8 billion less from the United States. Thus, China increased its imports from all other countries by $16 billion. Half of the $8-billion increase was from Brazil, and it was almost entirely soybeans. In 2018 alone, China decreased its imports of soybeans from the United States by almost $7 billion. China also increased its imports from the European Union (EU), Australia, and New Zealand by $1 billion each in 2018. In 2019, soybean imports for China may have been also limited by African Swine Fever (ASF), thus Brazil's imports decreased compared with 2018. Brazil's soybeans exports to China decreased by $6 billion in 2019, but total agricultural exports only declined $4 billion because of Brazil's exports of meat products and cotton to China, perhaps diverting trade from the United States. U.S. exports to China for 2019 were $1.7 billion lower than in 2018 because of losses in sorghum ($0.6 billion), soybeans ($0.4 billion), and cotton ($0.3 billion). The losses in sorghum and soybeans were not entirely replaced by another country—because of less demand from ASF—but China increased its imports of meats, dairy products, and vegetable oils—all products that had retaliatory tariffs in place in 2019.

U.S.-China Phase One Agreement

On January 15, 2020, the United States and China signed the Phase One Agreement to address structural barriers and to further open China's market to U.S. agricultural products. As part of the agreement, China committed to annually purchasing an average of $40 billion of agricultural goods, including seafood, from the United States over calendar years 2020 and 2021, which is twice the amount of pre-trade dispute levels. Several commitments (non-exhaustive) are included below (see, U.S. Trade Representative, 2020).

- Purchase commitments on average of at least $40 billion annually for U.S. food, agricultural, and seafood products for a total of at least $80 billion in 2020 and 2021.
- For biotech, China agreed to implement a transparent, predictable, efficient, science- and risk-based regulatory process for the evaluation and authorization of products of agricultural biotechnology. China's timeframe for review and authorization of products for feed or further processing will be an average of 24 months.
- For food safety, China agreed to improve sanitary and phytosanitary (SPS) measures affecting various agricultural products, including meats, fruits, and vegetables.
- For beef and poultry, China agreed to broaden the list of products eligible for importation. In addition, China agreed to review its SPS issues related to beef and poultry products. On November 14, 2019, China agreed to reopen its market for U.S. poultry.
- For rice, China committed to authorize the importation of U.S. rice from any USDA-approved rice facility within 20 business days of China's receipt of notification from the United States.

China Announces Retaliatory-Tariff Exemptions on Selected Products

Following the signing of the Phase One deal, China announced it would grant exemptions of retaliatory tariffs on a range of U.S. goods. China's State Council's Customs Tariff Commission issued an official notice on February 18, 2020, listing 696 U.S. goods that would be exempt from retaliatory tariffs, including key

agricultural and energy products such as soybeans, pork, liquified natural gas, and crude oil.[14] The notice stated the exclusions were intended for "market-based procurement of commodities." Importers could begin submitting their applications for exemptions on March 2, 2020, and any exemptions granted would be valid for up to 1 year. The notice also stated, "applications for the addition of excluded products for products not on the list have also been approved," indicating tariff exemptions are not necessarily confined to the products listed. Throughout 2020, China provided subsequent announcements extending a rolling application deadline.

Table 6 lists the products that are and are not included on the tariff exemption list. The list presents the commodities according to the volume of the imports in 2017. Given that China has more than a thousand ag-related Harmonized System (HS) tariff codes, the tariff lines are aggregated into product groups. Although products listed on the announced exemptions list only included 39 agricultural tariff lines, these tariff lines accounted for the largest agricultural import sectors including soybeans, pork, sorghum, cotton, and others making up more than 90 percent of China's imports of U.S. agricultural commodities in 2017.[15] In contrast, there are 1,156 individual agricultural-tariff lines not included in the announced tariff exclusion list. However, these products make up less than 10 percent of U.S. exports to China.

Several key U.S. commodities had limited exports to China in 2017 because of non-tariff related restrictions. Following the implementation of the Phase One Agreement, many of these U.S. exports experienced rapid growth. For example, U.S. beef and poultry exports were previously restricted because of SPS measures. Beef was on the exemption list while poultry was not; both increased substantially.

Table 6
Chinese tariff exemptions intended for "market-based procurement of commodities"

Agriculture commodities on China's tariff exclusion list			
Product group	Value of imports from U.S. in 2017, U.S. dollars (million)	Value of imports under Phase One (March 2020 to February 2021), U.S. dollars (million)	Phase One percent change relative to 2017 (percent)
Soybeans (ex. seed)	13,941	13,779	-1
Pork and pork products	1,160	2,115	82
Cotton	983	1,989	102
Sorghum and seed	957	1,318	38
Cattle hides and skins	893	393	-56
Soup/food preparations	400	849	112
Hay	399	447	12
Wheat (ex. seed)	391	569	46
Whey	281	231	-18
Pistachios	177	313	76
Corn (ex. seed)	160	1,544	866
Other dairy products	140	179	27
Dried distillers grains	66	52	-22
Beef and beef products	25	322	1,187

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[14]A public announcement of the exemptions can be found online at China's State Council's Custom and Trade Commission website. Note, in addition to the tariff exemptions announced on the 696 list, China had also announced a series of tariff exclusions for other selected products starting in the latter half of 2019, primarily non-agricultural products, but also including agri-food related products such as alfalfa meal, shrimp, and prawn seedlings.

[15]The tariff exemptions may not fully apply to all retaliatory tariff actions. For example, it is not clear whether the 232 tariff components are also being exempt along with the 301 tariff components.

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Agriculture commodities not on China's announced tariff exclusion list			
Product group	Value of imports from U.S. in 2017, U.S. dollars (million)	Value of imports under Phase One (March 2020 to February 2021), U.S. dollars (million)	Phase One percent change relative to 2017 (percent)
Fruit, fresh	391	169	-57
Tobacco	168	0	-100
Animal products	150	209	40
Planting seeds NESOI	130	104	-19
Essential oils	129	167	30
Fruit, prepared	108	62	-43
Potatoes	105	57	-45
Almonds	92	230	149
Composite animal feed	87	98	13
Soybean oil	70	22	-68
Sausages, guts, and bladders	70	175	151
Dextrins and peptones	68	88	29
Miscellaneous nuts and preparations	63	187	198
Cheese	60	38	-36
Peanuts	60	225	277
Animal skins and hair	47	3	-93
Plant material NESOI	36	30	-17
Oilseed oil NESOI	36	48	33
Walnuts	30	10	-66
Fruit, dried/frozen	29	14	-54
Industrial alcohols	29	24	-18
Non-alcoholic beverages	29	94	228
Dog and cat food	28	120	325
Rice bran	28	21	-26
Sheep skins and wool	25	5	-79
Pulses	25	59	137
Chocolate	25	21	-14
Bakers wares	24	22	-8
Dry whole milk and cream	23	5	-79
Coffee	22	18	-22
Vegetables, frozen	19	14	-29
Tropical nuts	19	3	-81
Condiments and sauces	18	16	-12
Breakfast cereal	18	19	5
Poultry feathers	18	4	-76
Sugars and sweeteners	18	4	-75
Fruit juice	17	14	-22
Bovine semen	16	57	258
Flours and meals, pulses	14	1	-93
Oilseeds NESOI	13	3	-80

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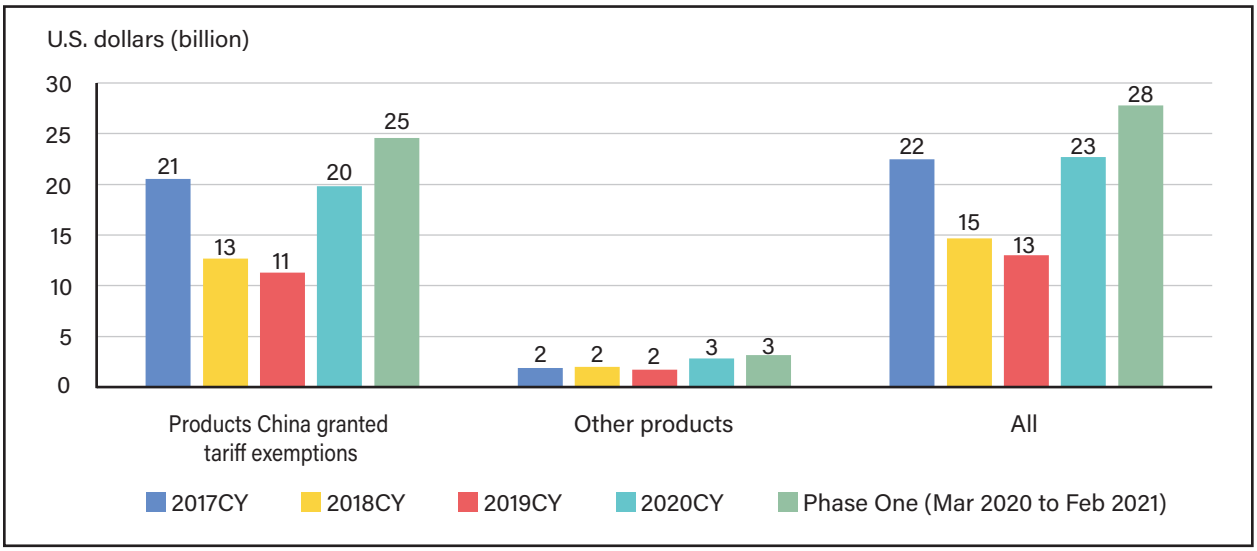
Agriculture commodities not on China's announced tariff exclusion list			
Product group	Value of imports from U.S. in 2017, U.S. dollars (million)	Value of imports under Phase One (March 2020 to February 2021), U.S. dollars (million)	Phase One percent change relative to 2017 (percent)
Distilled spirits	13	15	17
Chewing gum and candy	13	43	241
Live swine	10	10	2
Broiler meat	0	881	n/a
All other agricultural commodities	86	182	110

Notes: NESOI = Not Elsewhere Specified or Included. n/a = not available.

Source: USDA, Economic Research Service using data from Trade Data Monitor (2021) and tariff exemptions announced in the People's Republic of China (2020).

Has China's announced tariff exemptions led to U.S. agricultural-export recovery? It is difficult to isolate the effects of the tariff exemptions from other factors included in the Phase One Agreement and further non-policy market factors. The following figures examined recent trends in the data pre- and post-tariff exemption period. Figure 9 shows China's imports of U.S. agricultural commodities from 2017 through the Phase One period. While the Phase One period is ongoing, we focused on March 2020 through February 2021 in figure 9. Overall imports of U.S. products increased by more than 110 percent ($28 billion) after the Phase One Agreement was signed and China announced retaliatory-tariff exemptions. Compared with a 2019 baseline, products receiving announced-tariff exemptions grew by 118 percent. Products not granted exemptions also significantly grew compared with 2019—83 percent—which suggests many of these products may also have been granted tariff waivers, possibly by request. However, this may not be confirmed through the data alone. China's imports of U.S. products, after the Phase One Agreement was signed, were also significantly higher than the pre-retaliatory period—24 percent higher than in 2017. This holds for both products on the tariff exemption list and products not included on the tariff exemption list.

Figure 9
Value of China's imports of U.S. agricultural product



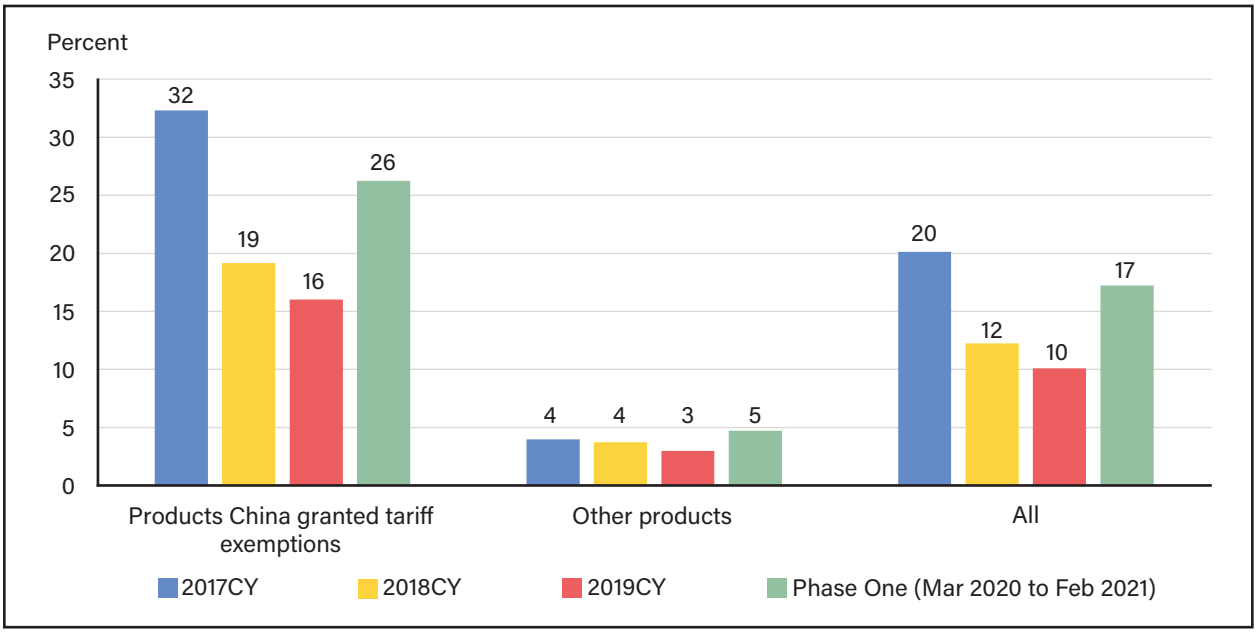
Notes: CY= calendar year. In January 2020, the United States and China signed the Phase One Agreement to address structural barriers and to further open China's market to U.S. agricultural products. As part of the agreement, China committed to annually purchasing an average of $40 billion of agricultural goods, including seafood, from the United States over calendar years 2020 and 2021.

Source: USDA, Economic Research Service using data from the 2021 Trade Data Monitor.

In addition to changes related to retaliatory tariff-exemptions and the U.S.-China Phase One Agreement, the record expansion of U.S. exports to China could be driven by several non-policy factors outside of trade issues. First, overall U.S. exports into China may have slowed with the coronavirus (COVID-19) and the subsequent broader effects of the pandemic.[16] Nevertheless, in 2020, China's agricultural imports increased by over $20 billion. This was fueled in large part by China's ongoing pig herd recovery, which had previously been affected by African Swine Flu (ASF). The rebuilding of the herd, which included consolidation to more grain-fed operations, led to a surge in China's import demand for grains and oilseeds. Corn and coarse grain imports also surged on possible tightening of corn stocks and the larger sized pig herd. Wheat imports also increased as China used large amounts of domestic wheat stocks for feed and imported more to replenish stocks and meet demand for affordable wheat supplies. All these products were included on China's tariff exemption list and experienced significant expansion for U.S. product imports.

While U.S. exports of agricultural commodities to China hit record numbers following the signing of the Phase One Agreement, market shares still have not recovered to pre-retaliatory tariff period. Figure 10 illustrates that following the Phase One Agreement, U.S. market shares increased from 10 percent in 2019 to 17 percent (March 2020 to February 2021). However, this increase was still short of the 20 percent market share from 2017. U.S. market shares for products on the announced tariff exemption list were observed to be significantly lower than in 2017. In contrast to the products on the tariff exemption list, the recovery of the U.S. market shares of products not receiving tariff exemptions exceed the market share levels of 2017. This may suggest tariff exemptions overall are provided unevenly across goods for products, whether the products are on or off the tariff exemption announcements.

Figure 10
U.S. agricultural market shares in China



Notes: CY=calendar year. In January 2020, the United States and China signed the Phase One Agreement to address structural barriers and to further open China's market to U.S. agricultural products. As part of the agreement, China committed to annually purchasing an average of $40 billion of agricultural goods, including seafood, from the United States over calendar years 2020 and 2021.

Source: USDA, Economic Research Service using data from the 2021 Trade Data Monitor.

[16]Arita et al. (2021) econometrically estimated the effects of the global coronavirus (COVID-19) pandemic and found moderate evidence that COVID-19 slowed down trade. However, agricultural trade was found to be broadly resilient.

Conclusions

In 2018, the United States imposed tariffs on nearly all imports of steel, aluminum, and on a broad range of other products from China under domestic legal authorities to address national security concerns and China's unfair intellectual property and technology transfer policies. In response to these actions, six trading partners—Canada, China, the European Union, India, Mexico, and Turkey—responded with retaliatory tariffs on a range of U.S. agricultural exports, including agricultural and food products.

This study reviewed previous research on the impact of tariff retaliation on U.S. agriculture. Based on Grant et al. (2021) estimates of export losses by commodity, this report estimates State-level export losses by commodity using the USDA, ERS State Exports, Cash Receipts Estimates. From mid-2018 to the end of 2019, U.S. agricultural exports were reduced by over $27 billion because of retaliatory tariffs, with the steepest reduction in exports to China. This report found annualized losses for 17 selected commodity groups totaling $13.2 billion. Several key patterns emerged for estimated losses. At the commodity level, soybeans accounted for the largest share of total export losses, accounting for nearly 71 percent of losses ($9.4 billion), while sorghum accounted for over 6 percent ($854 million) and pork just under 5 percent ($646 million). Overall, specialty crops represented around 6 percent of losses ($837 million in annualized losses) across fruits, vegetables, and tree nuts, which are on par with losses in sorghum. However, it is important to highlight that some specialty crops (e.g., sweet cherries) had relatively higher losses due to export reliance (a lack of alternative markets) and product perishability.

At the State level, estimated losses were largely concentrated in the Midwest region with Iowa, Illinois, and Kansas experiencing just over 11 percent, 11 percent, and 7 percent, respectively, of the total damages. California experienced losses because of tariffs targeting exports of fruits, tree nuts, and dairy. Texas had relatively high losses due to targeting of sorghum and cotton. U.S. agricultural exports experienced a gradual increase after the United States and China signed the Phase One Agreement. China granted exemptions on retaliatory tariffs for some agricultural products after the Phase One Agreement was signed; however, U.S. market shares for these products, including those that have received announced tariff exemptions, remain lower than pre-retaliatory tariffs (figure 10).

This report also highlights the need for continued research and analysis on the impacts of retaliatory tariffs. First, while this report analyzed the State-level impacts of retaliatory tariffs from mid-2018 through the end of 2019, it is important to highlight that many of these tariffs remain in place and are affecting U.S. producers. Continued analysis of the issue is needed to assess the total costs to U.S. producers over time. Second, future research may be needed to assess not only the trade losses associated with retaliation but also the long-run effects of trade-distorting retaliation on U.S. export competitiveness and market shares. For example, given that Brazil increased soybean exports to China during the trade dispute, it is important to investigate how competitive U.S. soybeans will be should the tariffs remain in place or if they are removed.

Third, relatively little is known about how the duration over which tariffs are in place may affect key outcomes. For example, Canada and Mexico both removed retaliatory tariffs in 2019, which may result in a different impact from tariffs that were left in place longer. Finally, retaliatory tariffs have overlapped with several other significant market events (e.g. African Swine Fever, the COVID-19 pandemic, etc.). Future research and methods may be able to help identify the causal effects of these different events and better understand how they may have interacted with retaliatory tariffs to affect global markets.

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Appendix 1: Background on Tariffs

Starting in 2018, the United States imposed a series of tariffs and restrictions on imports to address national security and trade concerns (Williams et al., 2020). Specifically, the United States imposed tariffs on washing machines and solar panels under Section 201 of the Trade Act of 1974, on steel and aluminum under Section 232 of the same act, and on various imports from China under Section 301 of the Trade Act of 1962. According to the Congressional Research Service, the United States imposed tariffs on $309 billion of the United States' annual imports, using 2019 trade values (Williams et al., 2020).

Several U.S. trading partners claimed some of these tariffs were inconsistent with the trade rules under the World Trade Organization. As such, six regions imposed retaliatory tariffs on U.S. exports including Canada, China, the European Union, India, Mexico, and Turkey. Canada and Mexico initially implemented retaliatory tariffs but removed them in May 2019. Additionally, the United States exempted increased tariffs on imports from Canada and Mexico while the three countries worked to ratify the United States-Mexico-Canada Agreement (USMCA). The total retaliatory tariffs imposed on U.S. exports was $76.8 billion, and the tariffs covered a range of goods, including agricultural products (Williams et al., 2020). Retaliatory actions began in April 2018 with China's response to U.S. Section 232 actions. Table A1 presents the timeline of when retaliatory tariffs affecting agriculture went into effect from trading partners, as well as the duration of the tariffs throughout the global trade dispute.

Table A1
Timeline of retaliatory tariffs affecting U.S. agricultural exports

	2018											
Section 232 Retaliation	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Canada												
China												
European Union												
India												
Mexico												
Turkey												
Section 301 Retaliation												
China												
	2019											
Section 232 Retaliation	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Canada												
China												
European Union												
India												
Mexico												
Turkey												
Section 301 Retaliation												
China												

Notes: The turquoise boxes indicate retaliatory tariffs implemented during 2018–2019 that continued into 2021. The blue boxes indicate retaliatory tariffs implemented and removed during 2018–2019. See U.S. Department of Commerce, International Trade Administration (2020), Williams et al. (2020), and Bown and Kolb (2021) for a detailed timeline of all actions related to the trade conflict. In October 2021, the United States and the European Union (EU) reached arrangements to address global steel and aluminum excess capacity which include replacement of Section 232 tariffs with a tariff-rate quota and lifting of the EU's retaliatory tariffs.

Source: USDA, Economic Research Service using data from U.S. Department of Commerce, International Trade Administration, 2020.

Retaliation to U.S. Section 232 Tariffs

In response to U.S. Section 232 steel and aluminum tariffs, Canada, China, the European Union, India, Mexico, and Turkey have or had imposed retaliatory tariffs on U.S. agricultural products.[17] Table A2 summarizes the average retaliatory tariff imposed by commodity group and trading partner. These averages represent the total average retaliatory tariff imposed throughout the 2018–2019 trade dispute and—in the case of China—cover multiple rounds of retaliatory tariffs. Figure A1 illustrates the value of U.S. commodities targeted by retaliatory tariffs, by trading partner.

Table A2
Average retaliatory tariff, by trading partner and commodity group

BICO product groups	Retaliatory tariff rates (percent)					
	Canada	China	EU	India	Mexico	Turkey
Alcohol	10.0	5.0–40.0	25.0	—	25.0	70.0–140.0
Beef	10.0	2.5–30.0	—	—	—	—
Biodiesel	—	25.0	—	—	—	—
Cheese	—	27.5	—	—	20.0–25.0	—
Coarse grains	—	5.0–25.0	—	—	—	—
Cocoa beans	—	25.0	—	—	—	—
Cocoa products	10.0	5.0–25.0	—	—	—	—
Coffee (raw/ unroasted)	—	25.0	—	—	—	—
Coffee (roasted/ processed)	10.0	5.0–25.0	—	—	—	—
Condiments	10.0	2.5–25.0	—	—	—	—
Corn (not for seed)	—	25.0	25.0	—	—	—
Cotton	—	25.0	—	—	—	—
Dairy (excl. cheese)	10.0	5.0–27.5	—	—	—	—
Distiller dried grains (DDGs)	—	25.0	—	—	—	—
Eggs	—	5.0–20.0	—	—	—	—
Essential oils	—	5.0–27.5	—	—	—	—
Ethanol	—	25.0–40.0	—	—	—	—
Fats	—	5.0–25.0	—	—	—	—
Fodder	—	5.0–25.0	—	—	—	—
Food preparations	10.0	2.5–25.0	25.0	—	15.0	10.0–20.0
Fresh fruit	—	30.0–45.0	—	20.0	20.0	—
Fresh vegetables	—	27.5–30.0	—	—	—	—
Fruit/vegetable juice	10.0	2.5–25.0	25.0	—	—	—
Gums	—	5.0–25.0	—	—	—	—
Hay	—	25.0	—	—	—	—
Hides and skins	—	5.0–25.0	—	—	—	—
Honey/sugars	10.0	5.0–30.0	—	—	—	—
Nursery	—	2.5–30.0	—	—	—	—

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[17]Russia also retaliated, but these were directed against non-agricultural products.

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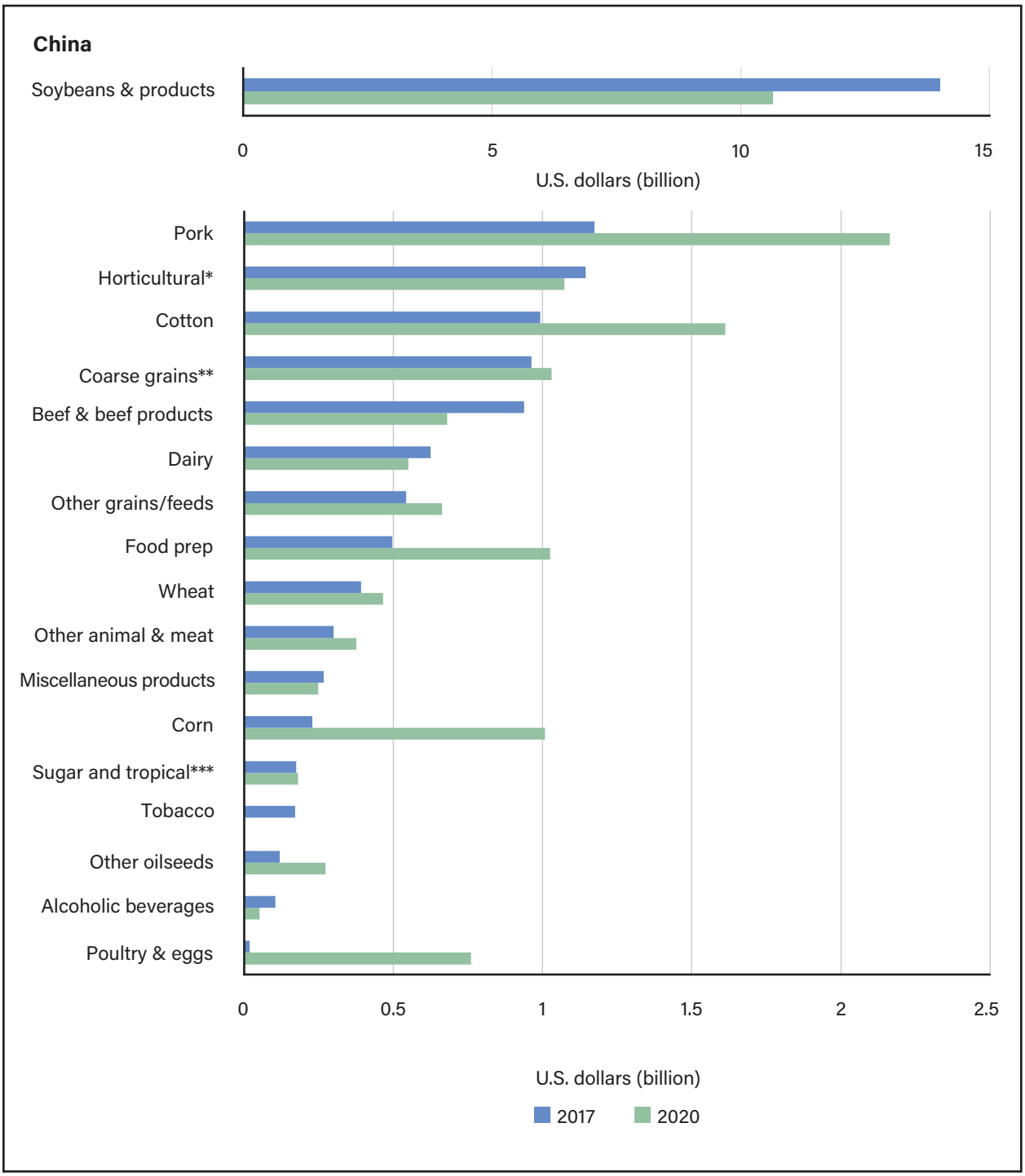
BICO product groups	Retaliatory tariff rates (percent)					
	Canada	China	EU	India	Mexico	Turkey
Oilseed and corn meal/cake (ex. soybeans)	—	5.0–25.0	—	—	—	—
Oilseeds	—	5.0–25.0	—	—	—	—
Other bulk	—	5.0–25.0	—	—	—	—
Other intermediates (i.e., flours, yeasts, saps, waxes, hairs)	—	2.5–27.5	—	—	—	—
Other meat	—	2.5–30.0	—	—	15.0	—
Palm oil	—	5.0	—	—	—	—
Peanuts/ groundnuts	—	10.0–25.0	—	—	—	—
Petfood	—	25.0–30.0	—	—	—	—
Pork	—	2.5–55.0	—	—	20.0	—
Poultry	10.0	2.5–30.0	—	—	—	—
Processed fruit	10.0	2.5–45.0	25.0	—	20.0	—
Processed vegetables	10.0	2.5–30.0	25.0	—	20.0	—
Pulses	—	25.0–30.0	25.0	10.0–20.0	—	—
Rapeseed	—	5.0	—	—	—	—
Rice	—	25.0	25.0	—	—	25.0–50.0
Seed	—	5.0	—	—	—	—
Snack food	10.0	2.5–25.0	—	—	—	—
Soy meal	—	5.0–25.0	—	—	—	—
Soy oil	—	25.0	—	—	—	—
Soybeans	—	5.0–27.5	—	—	—	—
Spices	—	12.5–25.0	—	—	—	—
Tea	—	25.0	—	—	—	—
Tobacco	—	25.0	—	—	—	30.0–60.0
Tree nuts	—	2.5–45.0	—	1.7–20.0	—	10.0–20.0
Vegetable oil	—	5.0–25.0	—	—	—	—
Wheat	—	25.0	—	—	—	—

Notes: EU=European Union. — = no retaliation for a specific trading partner-commodity pair. Table shows the average retaliatory tariff implemented across product lines using the Bulk, Intermediate, and Consumer Oriented (BICO) product groups as defined by the USDA. For China, multiple rounds of retaliatory tariffs (i.e. Section 232 and Section 301) are included. Only lines with positive retaliatory tariffs are included.

Source: USDA, Economic Research Service calculations using data from foreign finance ministries of retaliating trading partners.

Figure A1

Value of U.S. agricultural exports subject to Section 232 and 301 retaliatory duties, in U.S. dollars



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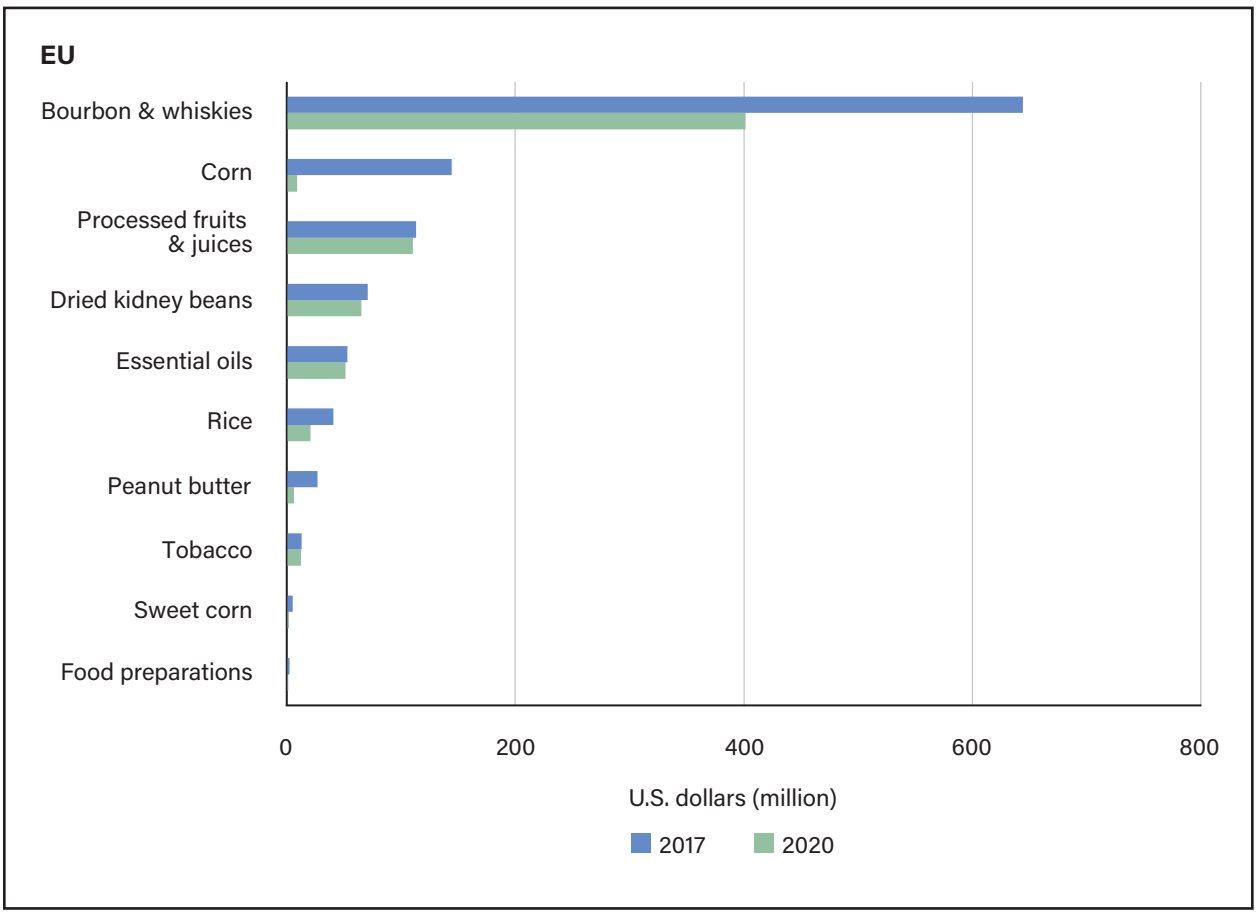

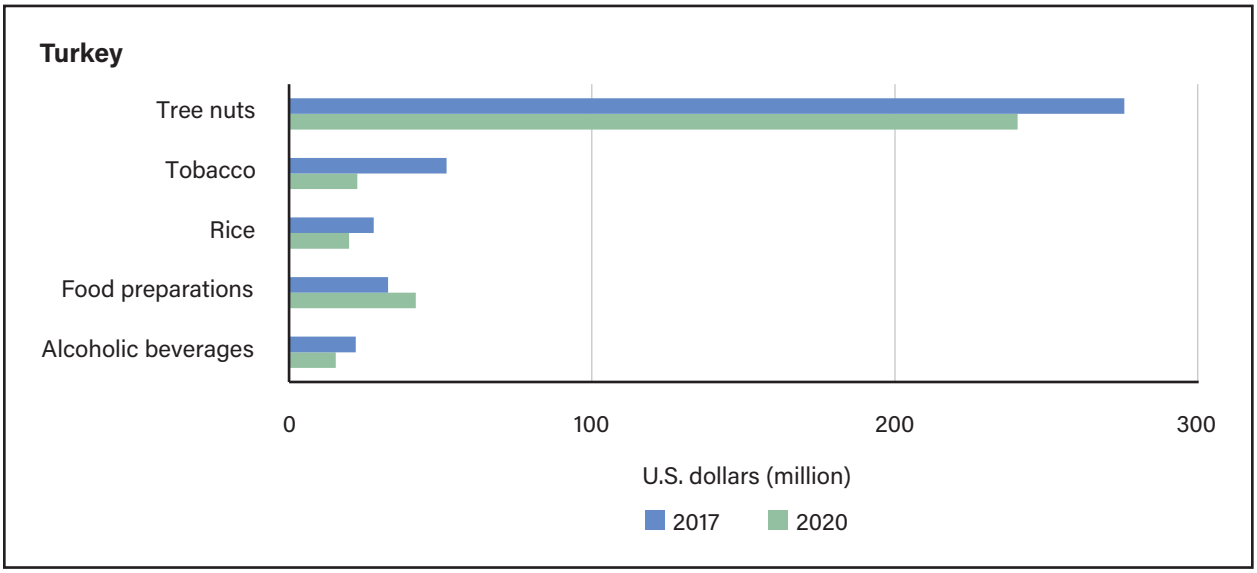

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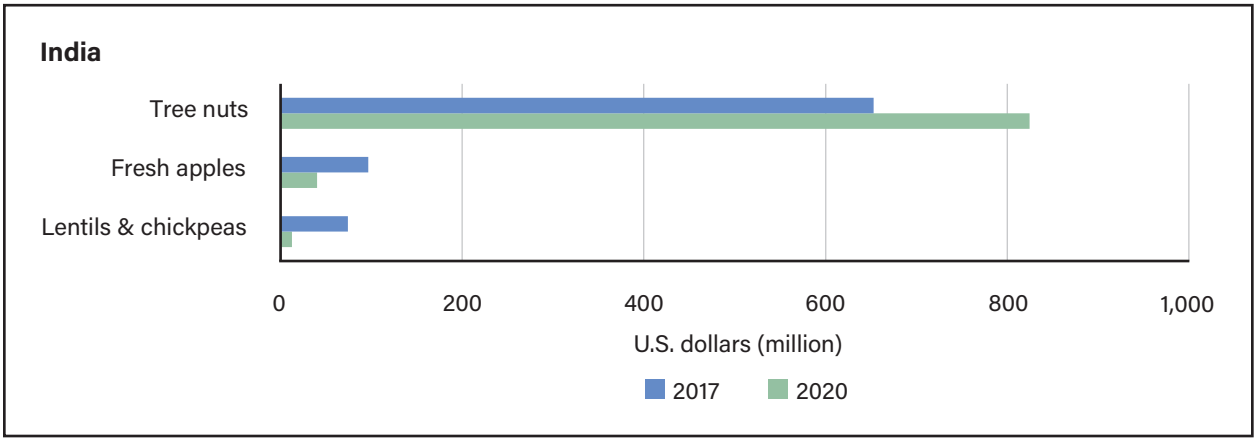

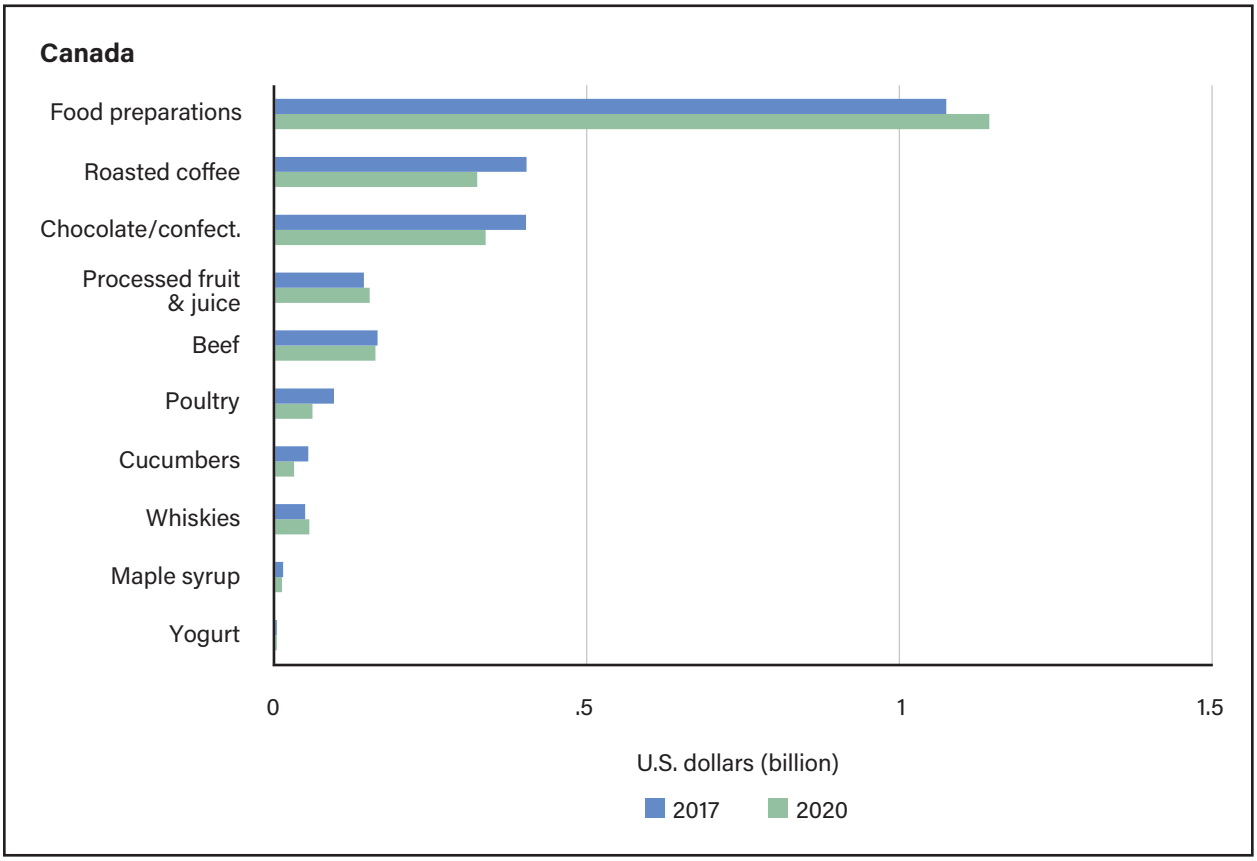

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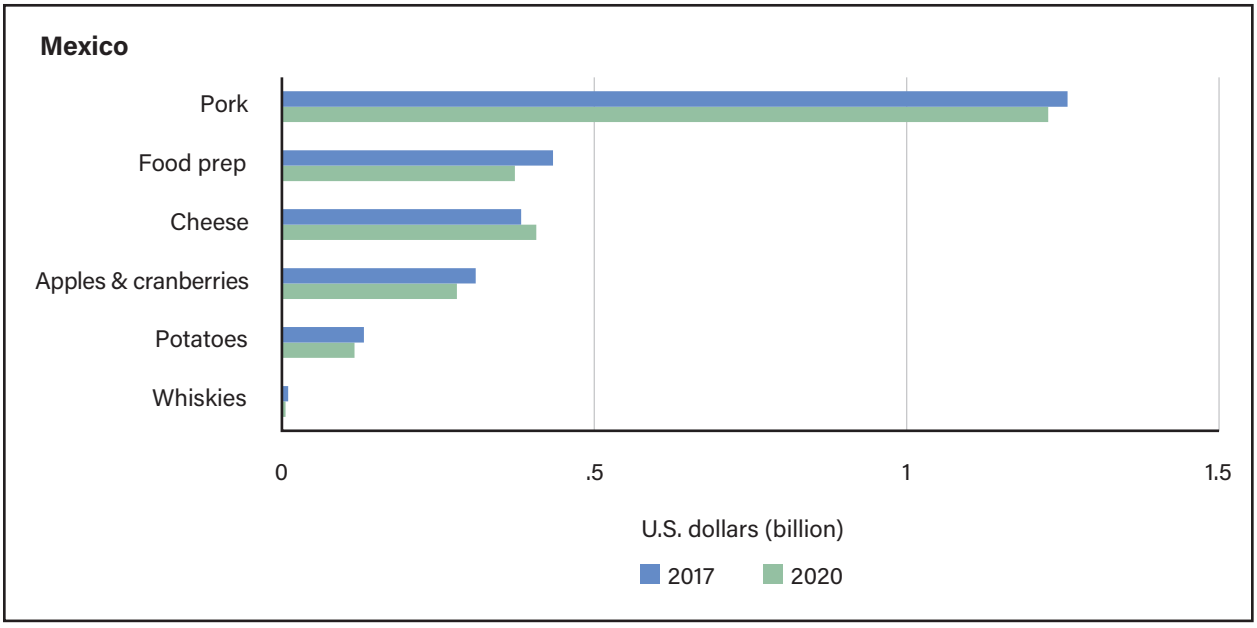

Notes: EU = European Union, UK = United Kingdom, * Includes fruits, vegetables, tree nuts, juices, pulses, and chocolate & confectionary. ** Includes sorghum & small feed grains (e.g. barley, rye, oats). *** Includes sugar, sweeteners, tea, coffee, and essential oils.

Source: USDA, Economic Research Service using data from Trade Data Monitor, LLC.

Canada imposed 10-percent retaliatory tariffs on condiments and jams, bottled water, coffee, prepared meat, prepared food products, orange juice, whiskeys, chocolate, and confectionary products that went into effect on July 1, 2018. Canada removed these measures in May 2019.

On April 2, 2018, China imposed tariffs on horticulture, tree nuts, American ginseng, wine, and denatured ethanol. These products were subject to a 15-percent tariff increase over the current rate. Additionally, pork products were subject to an additional 25 percent. Most products targeted by China in retaliation for Section 232 tariffs were also targeted in retaliation for Section 301 tariffs, except for ginseng and wine. Different retaliatory tariffs on the same commodity were cumulative. For instance, U.S. fresh strawberries tariff rate totaled 59 percent after adding the most-favored nation rate[18] of 14 percent, 15 percent from retaliation for Section 232, 25 percent from retaliation for Section 301, and 5 percent from the $75 billion Section 301 retaliatory-tariff list. China's retaliatory tariffs were the most extensive, covering almost all agricultural commodity groups (table A2).

Since June 22, 2018, the European Union (EU) imposed annex I tariffs of 25 percent on U.S. agricultural products, and the European Union also proposed a second list of delayed tariffs (annex II). The annex I tariffs covered U.S. bourbon and whiskeys, corn, sweet corn, rice, orange juice, peanut butter, essential oils, and tobacco products. The annex II tariffs, which were to cover U.S. preserved cranberries and whiskey, have been suspended because of ongoing talks regarding steel and aluminum issues. In October 2021, the United States and EU reached arrangements to address global steel and aluminum excess capacity which include replacement of Section 232 tariffs with a tariff-rate quota and lifting of the EU's retaliatory tariffs (USTR, 2021).

[18]The tariff rate applied to all World Trade Organization members.

India imposed tariffs on U.S. almonds, walnuts, apples, chickpeas, lentils, and brine shrimp. The additional tariff rates ranged from 10 to 20 percent. India's retaliation did not take effect until June 2019 after the United States removed its eligibility for the Generalized System of Preferences (GSP), which eliminated India's duty-free access to the U.S. market for a wide range of products.[19]

Mexico imposed tariffs on chilled and frozen pork cuts, hams, sausages, cheeses, fresh apples, frozen french fries, cranberries, and bourbon beginning on June 5, 2018. The additional tariff rates ranged from 15 to 25 percent. At the same time, Mexico also established a duty-free tariff-rate quota (TRQ) for 350,000 metric tons of fresh pork for which U.S. imports were eligible (USDA, FAS, 2018). Leading up to the signing of the United States-Mexico-Canada Agreement (USMCA), the three trading partners agreed to have an import monitoring mechanism for steel and aluminum, which then led to Canada and Mexico lifting their retaliatory tariffs in May 2019.

Turkey imposed tariffs on tree nuts, rice, prepared foods, whiskey, and tobacco products. The additional tariffs—ranging from 10 to 17 percent—have been in effect since June 21, 2018. On August 15, 2018, Turkey temporarily increased its retaliatory tariffs responding to U.S. tariff increases on Turkish steel. However, in May 2019, both the United States and Turkey withdrew these additional tariff increases, leaving the initial retaliatory tariffs in place.

[19]On March 4, 2019, then-President Donald Trump informed Congress he intended to remove India's Generalized System of Preferences (GSP) benefits following India's failure to provide access to its markets in numerous sectors. Lentils and chickpeas are examples of products affected by this move, which experienced an almost 50-percent decline in exports to India—from $30.5 million in 2019 to $15.8 million in 2020.

Chinese Retaliation to Unilateral U.S. Section 301 Tariffs

China's Section 301 retaliatory tariffs affected thousands of agricultural products, with additional tariff rates ranging from 5 to 25 percent, with both soybeans and most pork products—the main products the United States exports to China—at 25 percent each. According to the U.S. Congressional Research Service, China's retaliation accounted for the largest share of all retaliatory tariffs, affecting $68.4 billion of total U.S. exports (Williams et al., 2020). The European Union's retaliation that affected $4 billion of U.S. exports was the second largest share. China imposed tariffs related to Section 301 in four stages from July 2018 to September 2019. After the four stages, starting on June 2019, China initiated a review panel considering petitions case by case. The review panel specifically measured which petitioners and imported products promoted Chinese national economic interests. Successful petitioners were granted temporary exclusion from retaliatory tariffs.

Appendix 2: Annualized Losses from Retaliatory Tariffs by State and Commodity

Table B1: Row Crops

Estimated annualized losses in U.S. agricultural export cash receipts due to foreign retaliatory tariffs by State and selected commodities, U.S. dollars (million)

State	Soybeans	Sorghum	Cotton	Wheat	Corn	Tobacco	Rice	Other oil-seeds and products
	U.S. dollars (million)							
Alabama	32.38	0.00	12.91	1.40	0.61	0.00	0.00	2.08
Alaska	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Arizona	0.00	0.00	9.43	2.61	0.17	0.00	0.00	0.00
Arkansas	379.39	1.43	17.65	1.04	1.80	0.00	18.71	0.63
California	0.00	0.00	24.62	2.59	0.32	0.00	13.26	0.56
Colorado	0.00	40.33	0.00	11.39	2.18	0.00	0.00	0.20
Connecticut	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Delaware	15.59	0.00	0.00	0.68	0.45	0.00	0.00	0.00
Florida	1.45	0.00	3.49	0.05	0.09	0.00	0.00	2.02
Georgia	15.08	1.80	40.23	0.51	0.80	6.26	0.00	9.41
Hawaii	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Idaho	0.00	0.00	0.00	14.92	0.35	0.00	0.00	0.19
Illinois	1,321.25	3.36	0.00	5.94	30.71	0.00	0.00	0.00
Indiana	718.46	0.00	0.00	3.09	14.44	0.00	0.00	0.00
Iowa	1,198.71	0.00	0.00	0.10	34.50	0.00	0.00	0.00
Kansas	390.86	478.46	2.00	49.63	8.86	0.00	0.00	0.35
Kentucky	199.84	0.00	0.00	4.19	3.03	40.48	0.00	0.00
Louisiana	155.27	3.70	6.82	0.10	1.38	0.00	5.80	0.00
Maine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maryland	48.84	0.00	0.00	2.17	0.97	0.00	0.00	0.00
Massachusetts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Michigan	223.11	0.00	0.00	5.74	4.20	0.00	0.00	0.00
Minnesota	801.76	0.00	0.00	14.98	19.23	0.00	0.00	0.40
Mississippi	246.12	1.37	23.10	0.25	1.65	0.00	2.46	0.64
Missouri	622.15	6.25	11.78	6.01	7.64	0.00	2.90	0.00
Montana	0.00	0.00	0.00	29.00	0.08	0.00	0.00	0.58
Nebraska	674.99	0.00	0.00	7.70	22.53	0.00	0.00	0.17
Nevada	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
New Hampshire	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
New Jersey	8.55	0.00	0.00	0.18	0.15	0.00	0.00	0.00
New Mexico	0.00	5.88	2.17	0.56	0.09	0.00	0.00	0.13
New York	25.98	0.00	0.00	1.37	1.10	0.00	0.00	0.00
North Carolina	154.69	3.35	9.28	3.22	2.09	80.66	0.00	1.53
North Dakota	459.07	0.00	0.00	54.11	5.46	0.00	0.00	10.57
Ohio	567.12	0.00	0.00	7.20	7.31	0.00	0.00	0.00

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State	Soybeans	Sorghum	Cotton	Wheat	Corn	Tobacco	Rice	Other oil-seeds and products
	U.S. dollars (million)							
Pennsylvania	59.03	0.00	0.00	1.81	1.75	4.70	0.00	0.00
Oklahoma	34.83	33.97	14.97	14.37	0.53	0.00	0.00	0.48
Oregon	0.00	0.00	0.00	8.60	0.15	0.00	0.00	0.08
Rhode Island	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Carolina	30.54	0.00	6.02	0.49	0.73	5.75	0.00	1.19
South Dakota	511.02	29.70	0.00	11.80	9.54	0.00	0.00	2.31
Tennessee	172.63	0.00	12.70	3.34	1.66	10.96	0.00	0.00
Texas	12.22	244.15	166.46	7.05	4.39	0.00	2.80	2.53
Utah	0.00	0.00	0.00	1.12	0.07	0.00	0.00	0.03
Vermont	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Virginia	50.61	0.00	2.47	1.54	0.74	12.78	0.00	0.34
Washington	0.00	0.00	0.00	25.49	0.37	0.00	0.00	0.32
West Virginia	2.87	0.00	0.00	0.04	0.07	0.00	0.00	0.00
Wisconsin	216.01	0.00	0.00	1.98	5.69	0.00	0.00	0.00
Wyoming	0.00	0.00	0.00	0.45	0.13	0.00	0.00	0.00
Total	9,350.43	853.75	366.09	308.99	198.01	161.59	45.93	36.73

Notes: Estimates are only available for commodities included in the USDA, Economic Research Service, State Exports Cash Receipts Estimates, which does not include all U.S. agricultural commodities. Estimates reflect annualized losses calculated using data from mid-2018 through the end of calendar year 2019.

Source: USDA, Economic Research Service (ERS) estimates using USDA, ERS State Exports, Cash Receipts Estimates, 2021 Trade Data Monitor, and Grant et al. 2021. "Agricultural Exports and Retaliatory Trade Actions: An Empirical Assessment of the 2018/2019 Trade Conflict," *Applied Economic Perspectives and Policy* 43:619–640."

Table B2: Livestock and other

Estimated annualized losses in U.S. agricultural export cash receipts due to foreign retaliatory tariffs by State and selected commodities, U.S. dollars (million)

State	Pork	Fruits, processed	Dairy products	Tree nuts	Fruits, fresh	Vegetable oils	Beef and veal	Soybean meal	Vegetables, fresh
	U.S. dollars (million)								
Alabama	0.59	0.08	0.17	0.09	0.04	0.10	0.08	0.02	0.00
Alaska	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Arizona	1.00	4.23	8.64	1.70	1.93	0.00	0.13	0.00	0.03
Arkansas	1.75	0.00	0.15	0.00	0.00	0.59	0.09	0.23	0.00
California	0.77	256.82	67.61	199.13	117.39	0.01	0.42	0.00	0.18
Colorado	5.13	0.40	7.77	0.00	0.18	0.01	0.55	0.00	0.01
Connecticut	0.01	0.37	0.80	0.00	0.17	0.00	0.00	0.00	0.00
Delaware	0.11	0.16	0.17	0.00	0.08	0.02	0.00	0.01	0.00
Florida	0.06	32.65	5.52	0.00	14.93	0.05	0.09	0.00	0.02
Georgia	1.23	3.59	3.59	6.24	1.64	0.27	0.06	0.01	0.01
Hawaii	0.02	0.32	0.11	1.31	0.15	0.00	0.01	0.00	0.00
Idaho	0.33	0.28	25.88	0.00	0.13	0.01	0.26	0.00	0.02

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Illinois	39.36	0.42	3.61	0.00	0.19	2.01	0.12	0.79	0.00
Indiana	37.77	0.67	7.71	0.00	0.30	1.09	0.06	0.43	0.00
Iowa	217.93	0.00	9.63	0.00	0.00	1.82	0.65	0.72	0.00
Kansas	16.63	0.00	6.07	0.00	0.00	0.60	1.33	0.23	0.00
Kentucky	3.43	0.00	2.02	0.00	0.00	0.30	0.12	0.12	0.00
Louisiana	0.03	0.23	0.30	0.00	0.11	0.24	0.03	0.09	0.00
Maine	0.03	0.64	1.26	0.00	0.29	0.00	0.00	0.00	0.00
Maryland	0.21	0.51	1.74	0.00	0.23	0.07	0.01	0.03	0.00
Massachusetts	0.05	1.47	0.40	0.00	0.67	0.00	0.00	0.00	0.00
Michigan	11.45	9.03	18.92	0.00	4.13	0.34	0.09	0.13	0.01
Minnesota	79.87	0.39	17.91	0.00	0.18	1.23	0.32	0.48	0.01
Mississippi	1.82	0.11	0.26	0.00	0.05	0.39	0.03	0.15	0.00
Missouri	28.08	0.42	2.35	0.00	0.19	0.95	0.31	0.37	0.00
Montana	1.65	0.00	0.51	0.00	0.00	0.01	0.24	0.00	0.01
Nebraska	24.98	0.00	2.70	0.00	0.00	1.03	1.62	0.41	0.00
Nevada	0.01	0.00	1.30	0.00	0.00	0.00	0.05	0.00	0.00
New Hampshire	0.02	0.00	0.52	0.00	0.00	0.00	0.00	0.00	0.00
New Jersey	0.02	3.17	0.22	0.00	1.45	0.01	0.00	0.01	0.00
New Mexico	0.01	0.00	13.72	5.36	0.00	0.00	0.13	0.00	0.00
New York	0.16	8.50	27.89	0.00	3.88	0.04	0.05	0.02	0.01
North Carolina	71.93	2.59	1.83	0.00	1.18	0.27	0.05	0.09	0.01
North Dakota	1.74	0.00	0.62	0.00	0.00	0.97	0.16	0.28	0.01
Ohio	21.50	0.73	10.60	0.00	0.33	0.86	0.10	0.34	0.00
Oklahoma	27.99	0.00	1.43	0.59	0.00	0.07	0.55	0.02	0.00
Oregon	0.05	12.79	5.12	1.79	5.84	0.00	0.13	0.00	0.01
Pennsylvania	9.45	3.24	20.73	0.00	1.48	0.09	0.10	0.04	0.00
Rhode Island	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
South Carolina	0.76	0.94	0.48	0.00	0.43	0.08	0.02	0.02	0.00
South Dakota	16.39	0.00	5.06	0.00	0.00	0.84	0.42	0.31	0.00
Tennessee	2.61	0.00	1.34	0.00	0.00	0.26	0.09	0.10	0.00
Texas	6.00	3.84	22.80	2.67	1.75	0.08	1.42	0.01	0.01
Utah	5.29	0.24	4.02	0.00	0.11	0.00	0.08	0.00	0.00
Vermont	0.03	0.43	5.20	0.00	0.20	0.00	0.01	0.00	0.00
Virginia	1.42	1.38	3.45	0.00	0.63	0.09	0.07	0.03	0.00
Washington	0.07	69.68	12.21	0.00	31.85	0.01	0.12	0.00	0.02
West Virginia	0.02	0.46	0.23	0.00	0.21	0.00	0.03	0.00	0.00
Wisconsin	3.77	3.48	56.10	0.00	1.59	0.33	0.29	0.13	0.01
Wyoming	2.10	0.00	0.25	0.00	0.00	0.00	0.14	0.00	0.00
Total	645.67	424.26	390.91	218.88	193.93	15.15	10.67	5.61	0.40

Table B3: Total losses

Estimated annualized losses in U.S. agricultural export cash receipts due to foreign retaliatory tariffs by State and selected commodities, U.S. dollars (million)

State	Total trade losses
	U.S. dollars (million)
Alabama	50.55
Alaska	0.03
Arizona	29.87
Arkansas	423.45
California	683.68
Colorado	68.14
Connecticut	1.36
Delaware	17.27
Florida	60.44
Georgia	90.73
Hawaii	1.92
Idaho	42.36
Illinois	1,407.78
Indiana	784.02
Iowa	1,464.06
Kansas	955.02
Kentucky	253.53
Louisiana	174.10
Maine	2.23
Maryland	54.78
Massachusetts	2.61
Michigan	277.16
Minnesota	936.76
Mississippi	278.40
Missouri	689.40
Montana	32.08
Nebraska	736.12
Nevada	1.52
New Hampshire	0.54
New Jersey	13.78
New Mexico	28.05
New York	69.00
North Carolina	332.80
North Dakota	532.99
Ohio	616.09
Oklahoma	129.78
Oregon	34.54
Pennsylvania	102.42
Rhode Island	0.03
South Carolina	47.44
South Dakota	587.38
Tennessee	205.69
Texas	478.18
Utah	10.96

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Vermont	5.86
Virginia	75.56
Washington	140.15
West Virginia	3.93
Wisconsin	289.37
Wyoming	3.08
Total	13,227.01

Notes: Estimates are only available for commodities included in the USDA, Economic Research Service, State Exports Cash Receipts Estimates, which does not include all U.S. agricultural commodities. Estimates reflect annualized losses calculated using data from mid-2018 through the end of calendar year 2019.

Source: USDA, Economic Research Service (ERS) estimates using USDA, ERS State Exports, Cash Receipts Estimates, 2021 Trade Data Monitor, and Grant et al. 2021. "Agricultural Exports and Retaliatory Trade Actions: An Empirical Assessment of the 2018/2019 Trade Conflict," *Applied Economic Perspectives and Policy* 43:619–640.