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Theme Overview: The Economic Impacts of Trade Retaliation on U.S. Agriculture: A One-Year Review

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JEL Classifications: Q17, Q18, Q11, F13, F14

Keywords: Agriculture, Exports, Tariffs retaliation, Trade dispute, U.S.—China trade

Over the past year, U.S. agriculture has been impacted by unprecedented trade retaliation by China and other key trading partners. In total, over $30 billion of U.S. exports of oilseeds, grains, livestock, dairy, horticulture, and other products were subject to retaliatory tariffs imposed in 2018 by China, Canada, Mexico, the European Union (EU), and Turkey. While Canada and Mexico removed retaliatory tariffs in May 2019, India implemented retaliatory tariffs on U.S. apples, pulses, and tree nuts in June 2019, almost one year after India's initial list was published. These retaliatory tariffs were imposed in response to U.S. actions taken under domestic law to address certain Chinese trade practices for technology and intellectual property (Section 301) and to ensure sufficient domestic capacity of steel and aluminum for national security purposes (Section 232).

Bown and Kolb (2019) provide a comprehensive and up-to-date source for information and data on trade retaliation. To summarize, during 2018, the United States and China undertook several rounds of tariff increases related to the U.S. Section 301 action. The most recent increase in these tariffs took place on September 1, 2019. Separately, China imposed retaliatory tariffs on U.S. exports in April 2018 in response to U.S. tariffs on imports of Chinese aluminum and steel. As a result, some U.S. agricultural exports to China, such as pork, face multiple retaliatory tariffs. On Friday, December 13, 2019, the Office of the U.S. Trade Representative (USTR) announced that the United States and China had reached a Phase One Agreement, which includes commitments by China to implement structural reforms and make substantial additional purchases of U.S. goods and services, including agricultural products. A fact sheet on the Phase One agreement states that China's imports of U.S. goods and services over the next two years will exceed 2017 levels

Articles in this Theme:

by no less than $200 billion (USTR, 2019). The United States agreed to modify tariffs on imports from China that were imposed based on the findings of the Section 301 investigation. As of this writing, the Phase One Agreement is expected to be signed on January 15, 2020.

Last year, *Choices* published a theme examining possible economic outcomes of the U.S.–China trade dispute (Marchant and Wang, 2018). In that theme, the authors' employed various modelling techniques to estimate the *ex ante* potential impacts in a volume that was released just prior to the retaliatory tariffs being imposed. The purpose of this *Choices* theme is to examine the *ex post* actual effects of retaliatory tariffs on U.S. agriculture observed one year later. The contributing authors have compiled comprehensive datasets on market, trade, and price impacts of retaliatory tariffs for several key commodity sectors including, soybeans, cereal grains, cotton, tree nuts, fruits and vegetables, pork, and other food categories.

What has happened to U.S. agricultural markets, both domestic and export, since the imposition of retaliatory tariffs?

Grant et al. conduct a one-year, *ex post* econometric assessment of trade retaliation on monthly U.S. agricultural exports to quantify the direct effect of retaliatory tariffs and highlight some indirect effects on U.S. exports and competing suppliers' trade patterns. Their analysis covers a broad range of agricultural products subject to retaliatory tariffs imposed by China, the EU, Canada, Mexico, and Turkey and identifies significant negative trade flow impacts across markets and sectors due to retaliation.

Given the importance of the Chinese market for U.S. soybean exports, the impacts of retaliation on U.S. soybeans are the focus of two articles. Prior to 2018, U.S. soybean exports to China accounted for 31% of U.S. soybean production, up from just 5% in 2000, and nearly 60% of global U.S. soybean exports (USDA, 2019). In this theme, Hitchner, Menzie, and Meyer examine how global soybean trade patterns and U.S. planting decisions have been impacted since China imposed retaliatory tariffs. Adjemian et al. assess the effect of China's retaliation on U.S. soybean basis (i.e., the difference between a local cash price and a nearby futures price). Westhoff, Davids, and Min Soon consider the impact of these tariffs on major commodities including grains, oilseeds, and other crops; biofuels; livestock; dairy; and poultry on U.S. farm income and government outlays on U.S. farm programs.

Other U.S. agricultural products have also been impacted by trade retaliation. Muhammad, Smith, and MacDonald assess the effect of China's retaliatory tariffs on U.S. cotton. Sumner, Hanon, and Matthews provide an overview of the U.S. specialty crop sector and examine the impacts of trade retaliation on U.S. tree nut exports. Finally, Nti, Kuberka, and Jones estimate trade impacts on U.S. pork exports to Mexico and China to determine the extent to which other market factors, such as African Swine Fever (ASF), may have affected U.S. pork trade.

The recent retaliatory trade actions have received much attention in the media and policy world. However, a thorough understanding of actual economic impacts is complicated and requires detailed analysis of economic data to assess trade damage estimates, production and planting decisions, basis adjustments, changes in carryover stocks as a result of lost export markets, and price changes. This *Choices* theme provides a comprehensive first look at the economic impact of the 2018–2019 trade dispute.

For More Information

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The 2018–2019 Trade Conflict: A One-Year Assessment and Impacts on U.S. Agricultural Exports

Jason Grant, Shawn Arita, Charlotte Emlinger, Sharon Sydow and Mary A. Marchant

JEL Classifications: F14, F13, Q17, Q18

Keywords: Agricultural trade, China, Gravity model, Retaliatory tariffs, Trade dispute, United States

Background

International trade provides an important source of economic well-being. The free movement of goods across international borders allows producers to scale their operations, specialize in the production of lower cost goods for both domestic and foreign markets, and provides consumers with access to a greater variety of products throughout the year. The World Trade Organization (WTO) and its predecessor, the General Agreement on Tariffs and Trade (1947), were set up to promote the movement of goods across international borders and discourage the use of protectionist policies set unilaterally by individual countries.

Since the turn of the century, however, the global trading system has suffered its deepest impasse in modern history (Bown and Irwin, 2018; Baldwin, 2016; Grant and Boys, 2012). In 2018, U.S. agricultural exports to some of its largest and most significant trading partners—including China, Canada, Mexico, the EU, Turkey, and most recently, India—were hit with retaliatory tariffs (Crowley, 2019; Bown, 2018; Bown, 2019; Amiti, Redding, and Weinstein, 2019). While much has been written about the coverage and scope of retaliatory tariffs against U.S. agriculture (Regmi, 2019; Marchant and Wang, 2018), a one-year *ex post* empirical evaluation of actual trade impacts has received less attention.

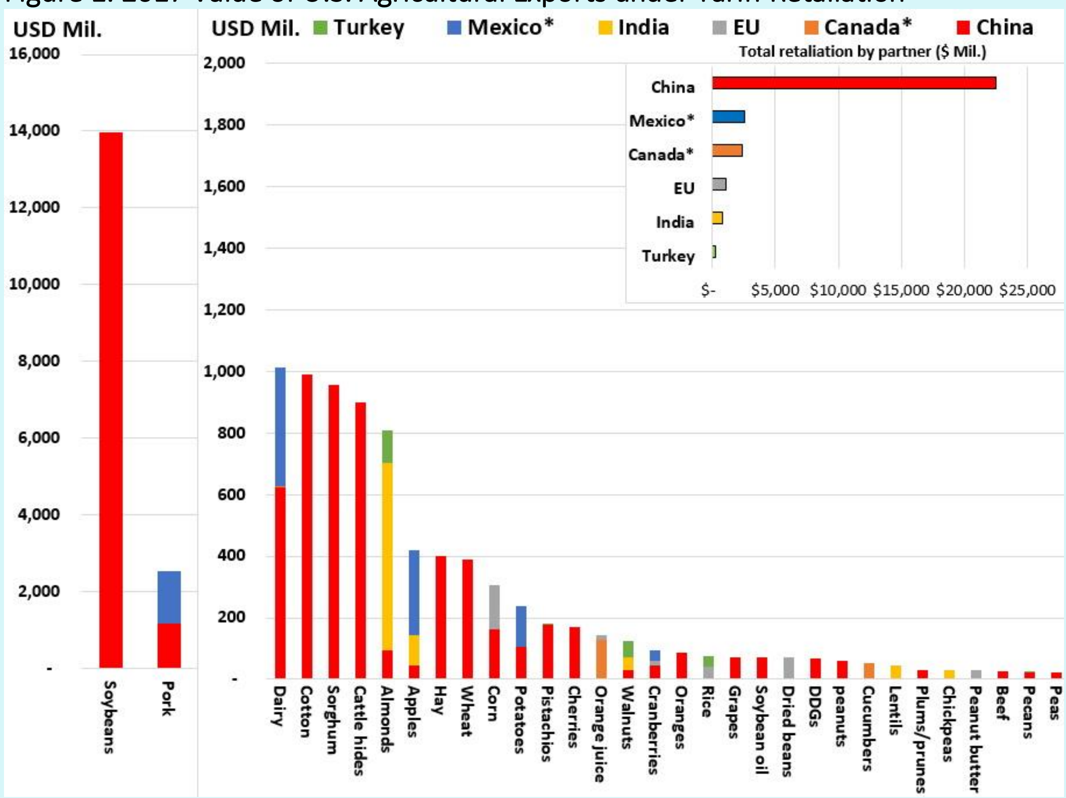
We evaluate the impacts of retaliatory tariffs on U.S. agricultural exports, given that we now have one full year of monthly bilateral trade data at the product line from which to conduct an *ex post* assessment. Specifically, we model U.S. bilateral export flows for most products hit by retaliatory tariffs to retaliating and nonretaliating markets in the years preceding and during the trade dispute. We provide a comprehensive first look at how retaliatory tariffs on agricultural product exports have altered major commodity exports to destination markets—including China, the EU, Mexico, Canada and Turkey—as well as potential export expansion in nontraditional markets. An *ex post* understanding of actual trade impacts in partner markets is important for agricultural policy makers, producers, consumers, and agribusiness stakeholders.

Scope of Retaliatory Tariffs on U.S. Agricultural Exports

In total, over 800 U.S. agricultural exports worth nearly $30 billion in 2017—including grains, livestock, dairy, horticulture, specialty crops, processed foods, beverages, tobacco and cotton—were hit by retaliatory tariffs in China, Canada, Mexico, the EU, Turkey, and most recently, India (June 2019). Figure 1 plots the 2017 value of U.S. agricultural exports subject to tariff retaliation in 2018/2019. To ease exposition, we focus on 32 U.S. export product groupings with nonzero exports to China, Canada, Mexico, the EU, Turkey and India, and omit a number of other important food categories including alcohol (i.e., whiskey), jams/jellies, ketchup, pizzas, tobacco, fruit juices, breakfast cereals. U.S. exports of soybeans and pork are listed on a separate scale due to their large export values.

Several results are worth emphasizing. First, the significance of China's tariff actions (shown in red) is evident and accounts for nearly 80% of total retaliatory tariffs against U.S. agricultural exports to these six countries. Second, China's retaliatory trade actions comprise a significant share of the top eight categories for which U.S. export values exceed $500 million in 2017—soybeans, pork, dairy, cotton, sorghum, almonds, hides/cattle, and apples. The exception is China's retaliation against almonds, for which U.S. exports to India are larger. India's retaliatory tariffs on tree nuts, pulses, and apples were delayed throughout 2018 and imposed in June 2019. For this reason, we do not include India in the empirical analysis. Third, among the top eight categories of U.S. agricultural exports, China is the only country that imposed duties on soybeans, cotton, sorghum, and cattle hides. Fourth, Mexico's retaliation was concentrated in pork (hams and shoulders), dairy (cheese), apples, potatoes, and relatively small amounts of U.S. cranberry exports. Finally, tariff retaliation by Canada and the EU are also concentrated among a few products including corn (EU), cranberries (EU), orange juice (EU and Canada), dried beans (EU), cucumbers (Canada), peanut butter (EU), and pecans (EU).

Figure 1. 2017 Value of U.S. Agricultural Exports under Tariff Retaliation



Notes:*Tariffs lifted May 19, 2019.
Source: Authors' calculations.

Overview of Methods and Data

Up until now, *ex post* assessment of the impacts of trade retaliation against U.S. agricultural exports have largely relied on descriptive trends in trade-flow data (Regmi, 2019). Such analyses examine the simple change, or "delta," of U.S. agricultural exports before and after the imposition of retaliatory tariffs. For example, U.S. soybean exports to China were $11.2 billion from July 2017 to June 2018, before falling 72%, to $3.1 billion between July 2018 to July 2019, when retaliatory tariffs were in place. Analogously, total agricultural exports from the United States to China fell by $10.7 billion, or 58% over the same period.

However, before and after comparisons do not account for confounding factors in addition to retaliatory tariffs. For example, in the 2018/2019 marketing year, excellent weather conditions led to a record soybean harvest in the United States—over 4.5 billion bushels (see Hitchner, Menzie, and Meyers in this issue of *Choices*). All else equal, a harvested supply of this magnitude would 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 impact of tariffs. Similarly, other confounding supply and demand shocks pervaded throughout the 2018/2019 trade conflict—African Swine Fever in China (ASF) (Nti, Kuberka, and Jones in this issue of *Choices*), record supplies of U.S. livestock production, and exceptionally poor U.S. planting conditions in Spring 2019—which collectively challenge identification of the causal impact of retaliatory tariffs.

We conduct a one-year, *ex post* econometric evaluation of the impact of 2018/2019 retaliatory tariffs on U.S. agricultural exports, including the direct effects of retaliatory tariffs and the indirect effects on U.S. agricultural exports to alternative markets and competing suppliers' trade patterns. The methodology employs a monthly gravity model (see Head and Mayer, 2014; Grant and Boys, 2012) of bilateral trade flows designed to isolate the effects of tariff retaliation. By exploiting bilateral variation in trade patterns across exporting and importing countries before and after the imposition of retaliatory duties and including other variables to control for supply and demand shocks as well as seasonality and product-level effects, we provide an initial assessment and ranking of the change in export values that can be attributed to retaliatory tariff measures.

Bilateral trade data are sourced from the Global Trade Atlas database (2019) which provides monthly bilateral trade values at the 6-digit level of the Harmonized System (HS) of product codes from January 2016 through to July 2019. The model includes HS 6-digit products in which U.S. exports totaled $50 million or more to the global marketplace in the 2016/2017 period preceding the trade dispute. 224 export products facing retaliation by China, the EU, Canada, Mexico, and Turkey are included. Tariff retaliation by India that occurred later in 2019 is omitted from the analysis. Agricultural goods include beef, pork, dairy, poultry and eggs, fruits, vegetables and tree nuts, cereals and cereal preparations, oilseeds, and a number of processed meat, food, alcoholic beverages, and byproduct (e.g., distiller dried grains (DDG), soybean meal and oil, corn syrup) categories.

To What Extent Have Retaliatory Duties Impacted U.S. Agricultural Exports?

We provide several *ex post* trade impact results estimated using the econometric gravity model.

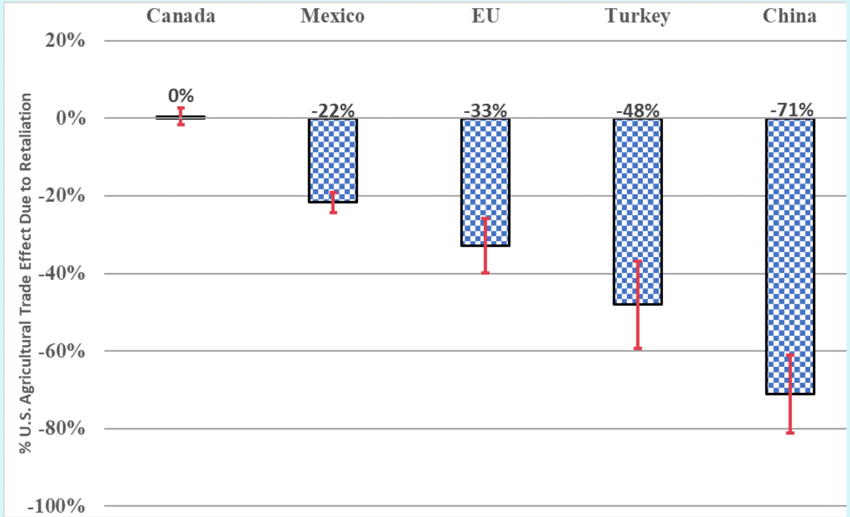
Product-Line Exports Down in All Retaliatory Markets Except Canada

Figure 2 presents a ranking of model estimated U.S. agricultural trade impacts (percentage trade effect) for each country imposing retaliatory tariffs in 2018/2019. Plotted are the model estimated percentage trade flow changes in U.S. product-line exports in the months in which U.S. agricultural exports faced retaliation by China, Mexico, Canada, the EU, and Turkey compared to the same months and product lines in 2016/2017, when these products were not subject to retaliation. Also shown are the upper- and lower-bound 95% confidence intervals.

Retaliatory tariffs imposed by China have resulted in the largest decline in U.S. agricultural product exports. On a monthly product-by-product basis, U.S. agricultural exports subject to China's retaliatory tariffs were down by 71% on average, compared to the same product–month periods in the 2016/2017 benchmark. Importantly, this result is significantly higher than a simple before-and-after comparison of trade flows. According to U.S. census data (see USDA, 2019), over the same time frame examined by the model, U.S. agricultural exports to China fell from $18.5 billion (July 2017–June 2018) to $7.8 billion (July 2018–June 2018)—a 58% decline in export value. The model-based findings, which control for other factors discussed previously, estimates what trade "should be" in the absence of retaliatory tariffs and identifies a much higher trade impact.

U.S. agricultural exports facing retaliation in Turkey and the EU ranked second and third, respectively, among retaliatory destination markets where U.S. agricultural exports suffered losses. Retaliation by Turkey and the EU reduced U.S. monthly product-line trade flows by an average of −48% and −33%, respectively. Export losses in Turkey and the EU, however, are roughly half those experienced in China. Finally, the impact of retaliatory tariffs by Mexico resulted in a 22% decrease in U.S. agricultural exports for those products subject to retaliation; interestingly, the impacts of Canadian retaliatory tariffs were statistically insignificant and not distinguishable from zero. The insignificant trade effect in Canada is likely due to the significantly integrated U.S. and Canadian agricultural market, the nature of products subject to retaliation in Canada (i.e., differentiated processed food categories), and the relatively smaller 10% retaliatory tariffs applied by Canada.

Figure 2. Effect of Retaliation on U.S. Agricultural Exports by Destination



Source: Authors' calculations from econometric model.

Product Sector Impacts are Largest in China, the EU, and Turkey

Figure 3 illustrates U.S. agricultural trade impacts at the sector level by graphing the percentage trade effect estimated by the model on the vertical axis and the average 2016/2017 value of U.S. sector-level exports preceding the trade conflict. The size of the bubble denotes the share of China, EU, Mexico, and Turkey imports sourced from the United States. Statistically significant results (i.e., bubbles) are reported. To ease exposition, nine agricultural sector groupings are included: (i) fruits, vegetables, and tree nuts (FV); (ii) beverages and tobacco (BT); (iii) oilseeds (OILS); (iv) cotton (COT); (v) dairy products (DAIR); (vi) animal products (MEAT); (vii) sugar and confectionary candy products (SGR); (viii) cereals and preparations (CER); and (ix) prepared and mixed processed foods, including fruit and vegetable preparations (PREP).

Several results emerge. First, cereals, meat, oilseeds, beverages and tobacco, cotton, and dairy product exports to China and cereal exports to the EU are the destination–product combinations with a greater than 50% reduction in U.S. agricultural exports during the months in which retaliatory tariffs were imposed. Second, seven out of nine sectors affected by retaliatory duties in China show negative trade flow effects, six of which are greater than 50% (DAIR, COT, BT, MEAT, CER, OILS). EU tariff actions had a noticeable impact on U.S. cereal (CER) and prepared foods (PREP) exports with reductions in U.S. exports of 69% and 50%, respectively. Note, however, that the share of U.S. exports of cereal and food preparations to the EU, as represented by the diameter of the bubbles, is relatively small, at 2% and 8%, respectively. Conversely, while the impact of EU retaliatory tariffs on U.S. beverages and tobacco (BT) exports is smaller (−20%) the relatively larger size of the BT bubble indicates the EU is a more important destination market for the U.S. exports in this product category (i.e., bourbon and other whiskey). Indeed, U.S. exports of BT products account for 23% of EU imports in this sector.

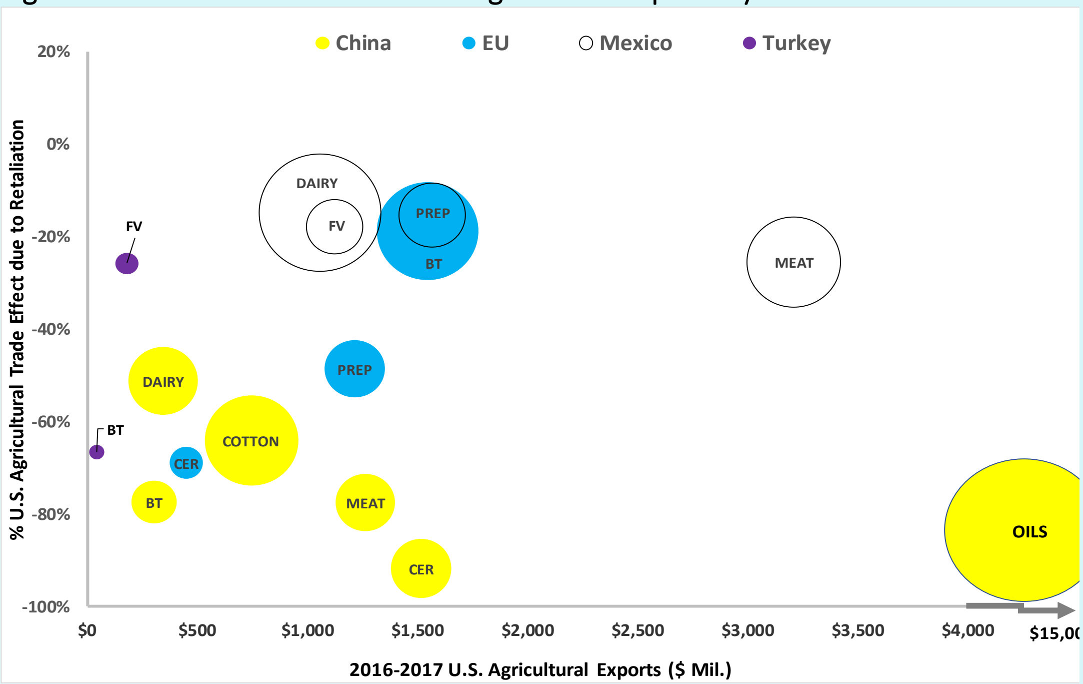
Third, retaliatory tariffs imposed by Turkey led to trade declines of 26% and 67% on U.S. exports of FV and BT products, respectively. U.S. export losses to Turkey in the BT sector are likely the result of very high retaliatory duties on certain alcoholic beverages. Turkey's additional tariffs range from 10% on tree nuts, 25% on rice, to 70% on certain alcoholic beverages including bourbon, vodka, and gin.

Fourth, within North America, Mexico's retaliatory tariffs impacted U.S. agricultural exports to a greater extent than was found in Canada. In particular, Mexican duties on U.S. pork and processed meats (MEAT) and dairy (DAIR) (particularly cheese) resulted in U.S.–Mexico trade flow reductions of 26% and 15%, respectively. Moreover, the relatively larger bubbles for dairy and meat exports to Mexico illustrate the importance of these two categories, where U.S. exports account for 20% and 34% of Mexico's total imports, respectively. As noted earlier, most U.S. agricultural exports to Canada were not statistically significant in the model. Canada's 10% retaliatory duties covered 41 U.S. agricultural product lines, including yogurt, coffee, cucumbers, and pizza.

Fifth, Figure 3 highlights the importance of U.S. oilseed exports to China. This product category is the only sector located in the lower right quadrant of Figure 3, indicating

(i) a very high level of exports to China before tariff retaliation (2016/2017),
(ii) a significant negative trade impact due to retaliatory tariffs, and
(iii) a sizeable share of China's oilseed import market (60%), reflected by the largest bubble in Figure 3.

Figure 3. Effect of Retaliation on U.S. Agricultural Exports by Destination and Sector



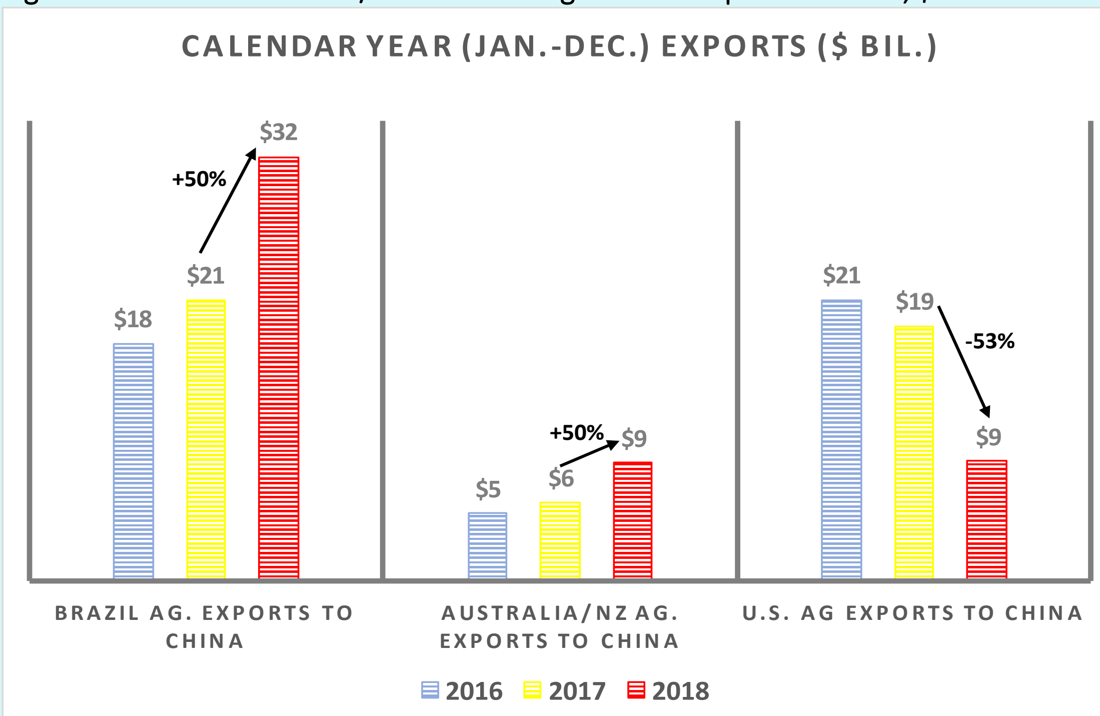
Notes: FV: Fruit and Vegetables, BT: Beverage and Tobacco, OILS: Oilseeds, Cotton, Dairy, MEAT: Meat and animal products, SGR: Sugar and candy products, CER: Cereals, PREP: Prepared and processed food including fruit and vegetable preparations. The area of the bubble is proportional to the country's share in U.S. exports for the sector in 2016/2017. For example, Mexico accounts for 20% of U.S. MEAT exports whereas China accounts for nearly 60% of U.S. OILS exports.

Picking Up the Slack: Export Gains by Competing Suppliers

Finally, an additional consequence of the 2018/2019 trade dispute is the potential reorientation of trade to alternative markets. Figure 4 illustrates the extent to which competing suppliers "picked up the slack" by plotting the value of agricultural exports by Brazil and Australia/New Zealand to China alongside U.S. agricultural exports to China. Both Brazil and Australia/New Zealand, which compete with U.S. exports in several product categories, experienced a 50% increase in their agricultural exports to China in 2018. Brazil's agricultural exports increased from $21 billion in 2017 to $32 billion in 2018 and Australia/New Zealand agricultural exports increased from $6 billion in 2017 to $9 billion in 2018. These countries were the largest beneficiaries of the U.S.–China trade dispute (other exporters experiencing trade flow gains in China include Argentina, Canada, and Mexico).

Second, an important question mark amid the U.S.–China trade dispute is whether U.S. agricultural exports were also able to find alternative destination markets. For example, despite several product sectors that experienced significant declines (Figure 3) due to retaliatory tariffs by the EU, overall U.S. agricultural exports to the EU were up by nearly $2.0 billion. U.S. agricultural exports were also up in certain product categories to South America and several other rest of world regions. This assessment does not address whether trade diversion to alternative markets compensated for losses experienced in China, Turkey, the EU, and Mexico. We leave this for further research, although preliminary analyses suggest that this is likely not the case (see Regmi, 2019).

Figure 4. Brazil and Australia/New Zealand Agricultural Exports to China, $billions



Notes: Agricultural export totals by Brazil and Australia/New Zealand (NZ) to China reflect 224 product lines included in our sample of monthly trade data. U.S. agricultural export totals reflect U.S. Census data (https://apps.fas.usda.gov/gats/default.aspx).

Conclusions

Trade disruptions due to tariff retaliation in 2018/2019 had a significant impact on U.S. agricultural exports. Over $30 billion in retaliatory tariffs was imposed on U.S. grains, livestock, dairy, horticulture, specialty crops, and other agricultural and food exports. Recent USDA estimates project $11 billion in agricultural exports to China for fiscal year 2020, half of the $21.8 billion in fiscal year 2017 exports.

Using a model of monthly bilateral trade flows to tariff imposing and non-imposing markets over the January 2016 through July 2019 period, this study found that U.S. agricultural exports subject to retaliation experienced a 71% decline in the Chinese market, on average. Significant declines in U.S. agricultural exports were also experienced in Turkey (−48%), the EU (−33%), and Mexico (−22%). Seven product sectors comprising U.S. agricultural exports hit by retaliatory tariffs experienced trade declines in China and in six of these sectors, trade reductions exceeded 50%.

The share of China in total U.S. agricultural exports peaked at 18% in 2012, gradually declined to 14% in 2017, and then fell precipitously to just 6.6% in 2018 when U.S. exports were subject to retaliation. While erosion of the share of U.S. agricultural exports to China since 2012 has other causes and may have continued in the absence of retaliation (Hejazi et al., 2019; Ning and Grant, 2019; Grant et al., 2019), our results suggest that China's use of retaliatory tariffs in 2018/2019 significantly contributed to this decline. Whether U.S. agricultural exports can regain their leading position in China remains to be seen and is likely to be the subject of a significant amount of future research.

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Tariff Impacts on Global Soybean Trade Patterns and U.S. Planting Decisions

Joanna Hitchner, Keith Menzie, and Seth Meyer

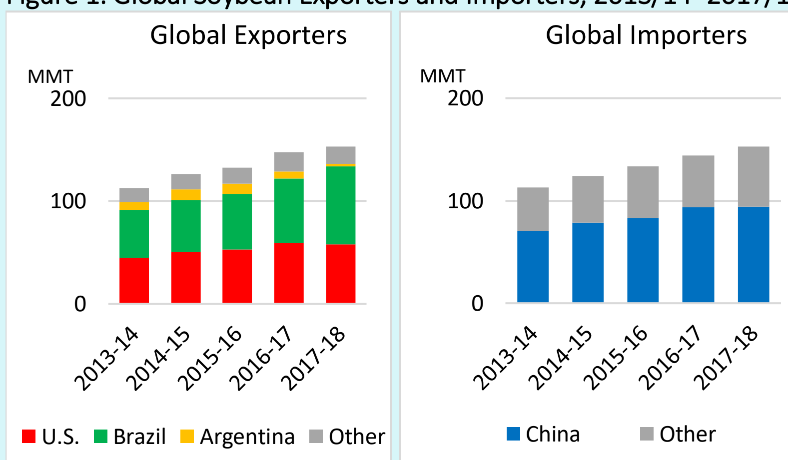
JEL Classifications: Q11, Q17, Q18

Keywords: China, Production, Retaliatory tariffs, Soybeans, Stocks, Trade, United States

Introduction

Rising U.S.–China trade tensions in 2018 resulted in the application of import duties by China on U.S. soybeans. In addition to influencing 2019 U.S. planting decisions, these import duties led to sharply lower U.S. soybean exports and significant changes in global soybean trade patterns and stock holding. Among the major bulk commodities, soybeans are one of the most concentrated segments of global agricultural trade, with three major exporters—Brazil, the United States, and Argentina—and one major importer, China (Figure 1).

Figure 1. Global Soybean Exporters and Importers, 2013/14–2017/18

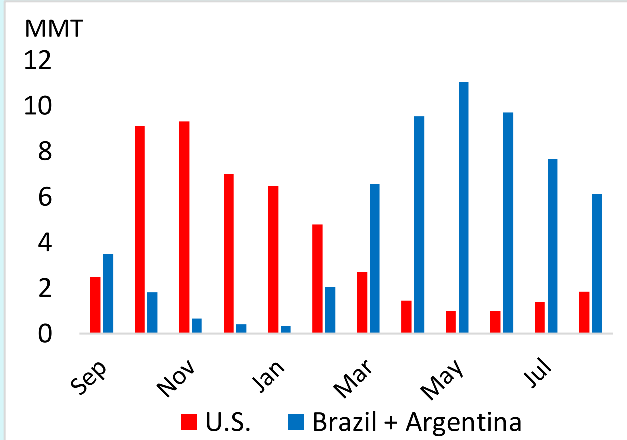


Note: MMT denotes million metric tons. U.S. marketing year for soybeans begins September 1.
Source: U.S. Department of Agriculture (2019d).

China's import demand grew over 11% annually starting in 2000, rising from 25% of global trade in the 2000/2001 marketing year (October–September) to 65% in 2016/2017. This demand growth was complemented by rapid production expansion in the United States, Brazil, and Argentina and rapid export expansion, primarily in the United States and Brazil. By 2016/2017, China's soybean imports from the United States accounted for 31% of U.S. soybean production, up from 5% in 2000.

Chinese imports of U.S. and South American soybeans are unique in that the bulk of the South American harvest occurs during February–April, while harvest in the United States is September–November. As seen in the last 10 years, prior to the U.S.–China trade tension, major exporters typically ship in six-month periods during and after harvest (Figure 2). The United States ships three-quarters of its soybean exports between September and February while South America ships over three-quarters of its soybean exports from March through August. China is dependent on each hemisphere during those periods to provide a constant supply of soybeans throughout the year.

Figure 2. U.S. and South American Soybean Exports, Five-Year Average, 2012/13–2016/17



Note: MMT denotes million metric tons.

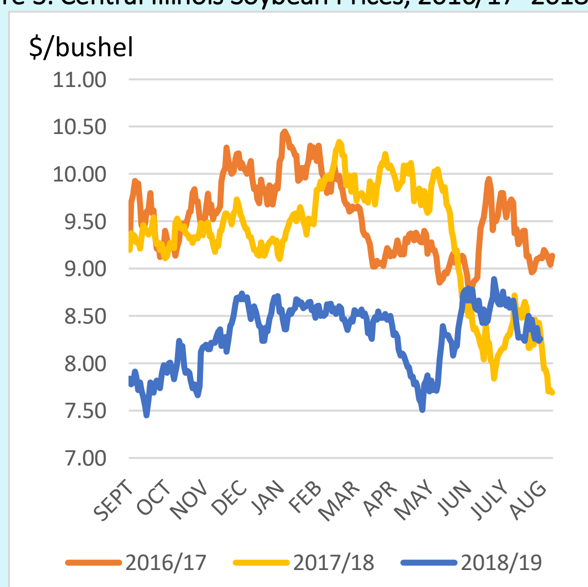
Source: U.S. Census and Secretary of Foreign Trade, Brazil (SECEX), 2019.

Prior to major U.S.–China trade tensions, U.S. soybean planting decisions in the spring of 2018 were influenced by a drought in Argentina that caused the smallest Argentine crop since 2009 and supported U.S. prices. The soybean-to-corn price ratio, an indicator of the incentive to plant soybeans or corn, leaned toward planting soybeans in April and May 2018. The Central Illinois new crop soybean-to-corn price ratio was nearly 2.7, compared to the prior five-year average of 2.5. With relatively high prices, soybean planting in 2018 was the second highest on record, with major implications later in the year when U.S.–China trade tensions escalated.

Imposition of Tariffs

By May 2018, the United States had imposed Section 232 steel and aluminum duties on Chinese imports; China retaliated with tariffs on $3 billion worth of U.S. goods. Continued U.S.–China talks failed to come to a resolution, and U.S. announcements of additional tariffs were countered with talks of Chinese tariffs on U.S. soybeans. In anticipation of a tariff, U.S. soybean prices weakened in early June (Figure 3). Further, the weather in the United States was favorable, enhancing yield prospects. It is difficult to separate the relative impact of above-average yield prospects and the impending tariff on the initial $2 price drop from June to July 2018. Although the trade dispute likely accounted for part of the price decline, expectations of a larger crop also contributed. For example, in a similar year, such as 2009, when yield prospects improved throughout the season, prices in Central Illinois fell 14% (−$1.69/bushel) from June 1 to July 15. Prices during this same period in 2018 fell 20% (−$2.02/bushel). Both the Chinese demand uncertainty and prospects of a larger crop likely played a role in the 2018 price decline.

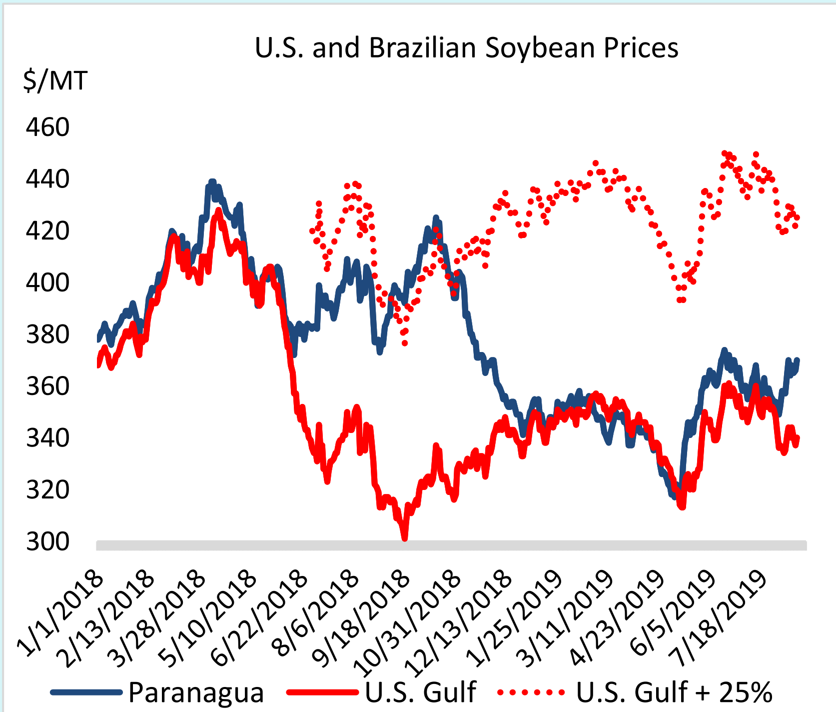
Figure 3. Central Illinois Soybean Prices, 2016/17–2018/19



Source: U.S. Department of Agriculture (2019g).

On July 6, 2018, China implemented an additional 25% tariff on U.S. soybeans. In anticipation of the tariffs, U.S. prices fell steeply in June and continued to fall throughout the summer as South American and U.S. port prices diverged (Figure 4). From July through December 2018, South America became nearly the sole supplier of soybeans to the Chinese market, accounting for 92% of total imports over the period. Although U.S. soybeans became price competitive (including the 25% tariff) in September and October, China refrained from purchasing from the United States. Moreover, ample Brazilian supplies from a record 2018 crop partially explain the lack of U.S. exports to China. Even companies such as Cofco (China Oil and Food Corporation) and Sinograin (China Grain Reserves Group Ltd), which could reportedly import without paying the import duty, did not import U.S. soybeans despite as much as a $90/ton price advantage.

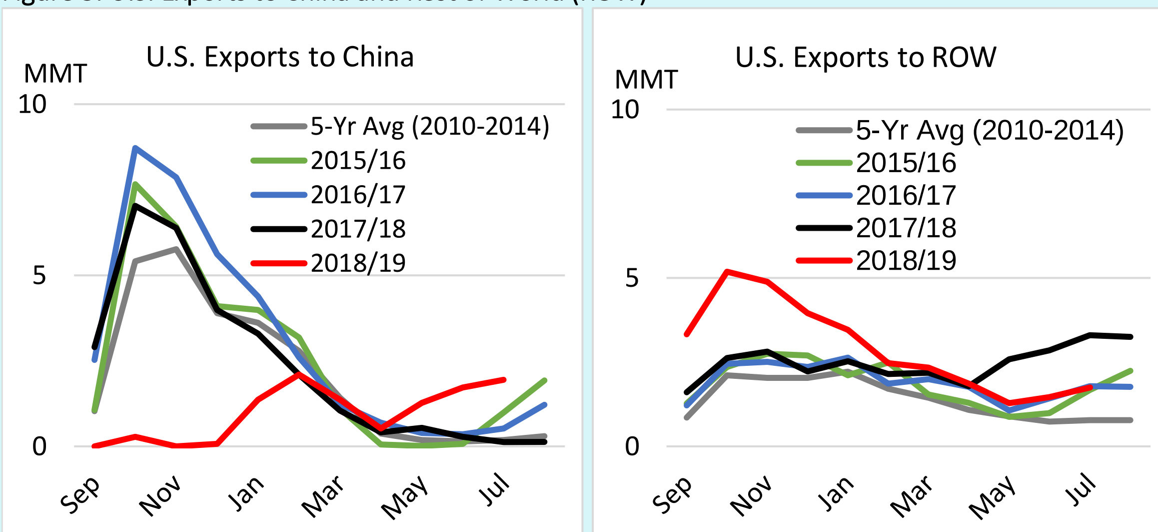
Figure 4. U.S. and South American Soybean Prices, January 2018–August 2019



Initial Trade Impacts

As U.S. prices declined, both in absolute terms and significantly against competing supplies, the U.S. share expanded to markets outside China (e.g., rest of world (ROW) markets). The United States shipped record amounts during the second half (March–August 2018) of the 2017/2018 marketing year (black line), with more shipments specifically to the European Union, Egypt, Pakistan, Taiwan, Vietnam, and Mexico (Figure 5). However, the growth in shipments to the ROW was not enough to offset the much lower level of exports to China, leading to a significant drop in overall U.S. soybean exports to a five-year low in the 2018/2019 marketing year. Given the relatively small markets in ROW, maintaining record monthly volumes in the 2018/2019 marketing year was unlikely without the Chinese market. The tariff implications were particularly important given that typically almost half of U.S. production is exported (49% from 2013-2018), with most of the shipments occurring soon after harvest. In the fall of 2018, the United States was about to harvest a record crop and the tariff-related shift in market dynamics would affect export patterns and stock holding in the short-term, while in the longer term the tariff would also affect producers' planting decisions.

Figure 5. U.S. Exports to China and Rest of World (ROW)



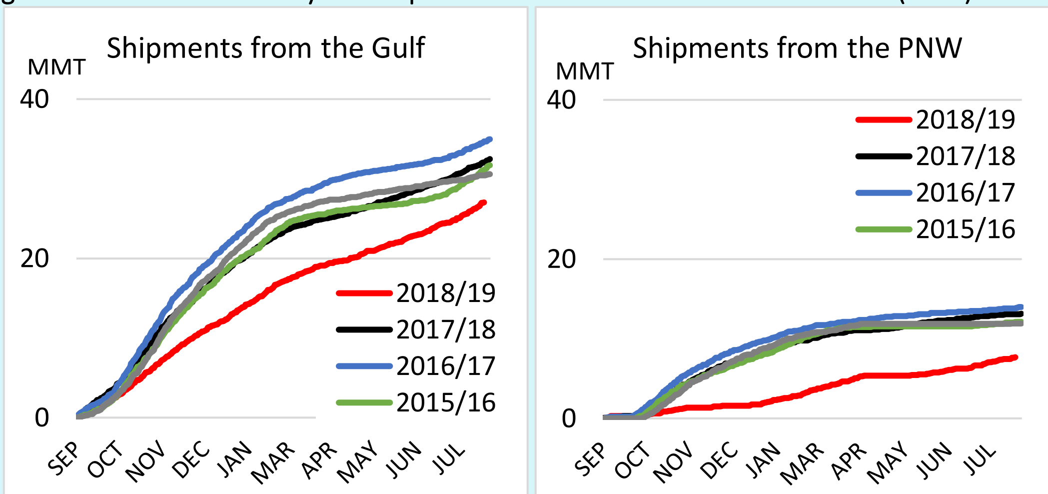
Source: U.S. Department of Agriculture (2019b).

In the short term, lower U.S. exports to China led to higher U.S. stocks in most states, particularly in the Northern Plains states that exported mainly to China out of ports in the Pacific Northwest (PNW). Shipments from the PNW, supplied by states like North and South Dakota, had grown over the years as the ports were logistically close to China's market. As PNW export demand declined in the absence of the Chinese market, prices in these states weakened compared to other producing states that export to other destinations through gulf ports (Figure 6).

As seen in Figure 7, lower U.S. exports in the fall of 2018 led to record U.S. March 1, 2019 soybean stocks as reported by the National Agricultural Statistics Service (USDA, 2019c). Stocks were relatively higher both on farm and in states that supplied the PNW for shipments to China. As a percentage of the 2018 crop, the year-over-year March 1 stock increase was the most pronounced in South Dakota, Michigan, North Dakota, and Illinois. Higher stocks in these areas weighed on prices. The basis levels, which reflect the relationship between cash and futures prices, were weaker in these areas compared to other states (see Adjemian et al. in this *Choices* theme). The high stocks also put downward pressure on 2019 soybean planting intentions (USDA, 2019e).

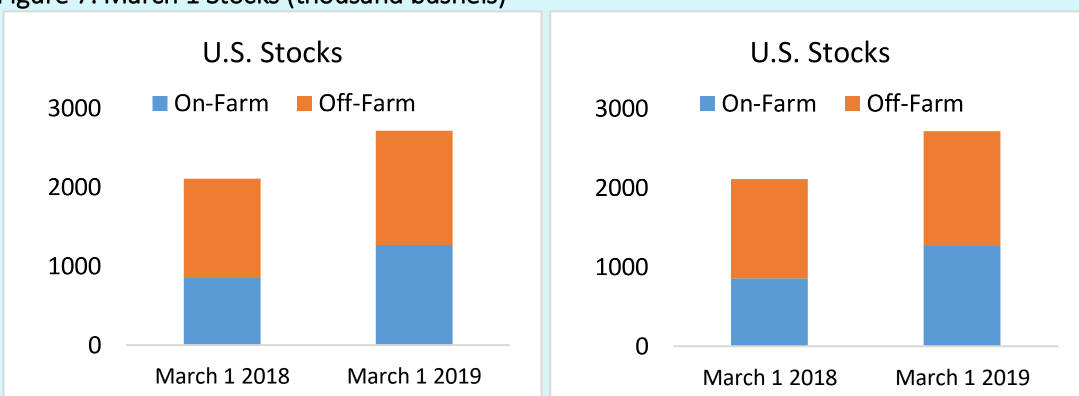
Increased sales to Argentina in 2018/19 helped to unwind some of these stocks. Argentina, the largest global soybean meal and oil exporter, lacked soybean supplies for crushing due to the 2018 drought, and the United States filled this demand. The United States shipped record amounts of soybeans totaling 2.2 million metric tons (mmt) to Argentina from June 2018 to February 2019. The incentive for Argentine crushers to import U.S. soybeans was to not only fill the deficit in supplies but also to increase crush margins as U.S. soybean prices were lower than domestic Argentine prices. U.S. soybean crush margins were also favorable, with rising demand and prices for U.S. soybean meal. U.S. soybean crush expanded significantly over the prior year starting in February 2018 and there were record soybean meal exports from April 2018 to January 2019, totaling 11.0 mmt.

Figure 6. Cumulative U.S. Soybean Exports from the Gulf and Pacific Northwest (PNW)



Source: U.S. Department of Agriculture (2019a).

Figure 7. March 1 Stocks (thousand bushels)



Note: N. + S. Dakota denotes North and South Dakota, respectively.
Source: U.S. Department of Agriculture (2019c).

Shifting Export and Marketing Patterns

Without the Chinese market, U.S. soybean exporters relied on ROW demand, which is more heavily weighted to the second half of the U.S. marketing year during March through August (Table 1), as U.S. stocks from the fall harvest compete with the start of the South American harvest. Moreover, the bulk of importers are in the Northern Hemisphere where domestically produced supplies are lower in the second half of the marketing year, requiring imports to fill the gap.

The United States shifted its soybean storage and trading patterns in response to the effects of China's retaliatory import duty. Lower export volumes were shipped after the 2018 harvest and shifted to the second half of the marketing year. As the China tariffs continued, the United States made two adjustments. First, exporters positioned supplies and stocks to spread more evenly over the year to meet ROW demand, adding costs to holding soybeans year-round. Second, with ROW demand growing at a slower pace than China's demand, year-over-year increases in U.S. exports would be expected to expand more slowly than seen in prior years. With slower growth in ROW demand, prices signaled U.S. producers to reduce soybean acreage.

Table 1. Global ROW Soybean Imports (million metric tons)

Marketing Year	September–February	March–August
2014/15	19	28
2015/16	22	30
2016/17	20	30
2017/18	20	40

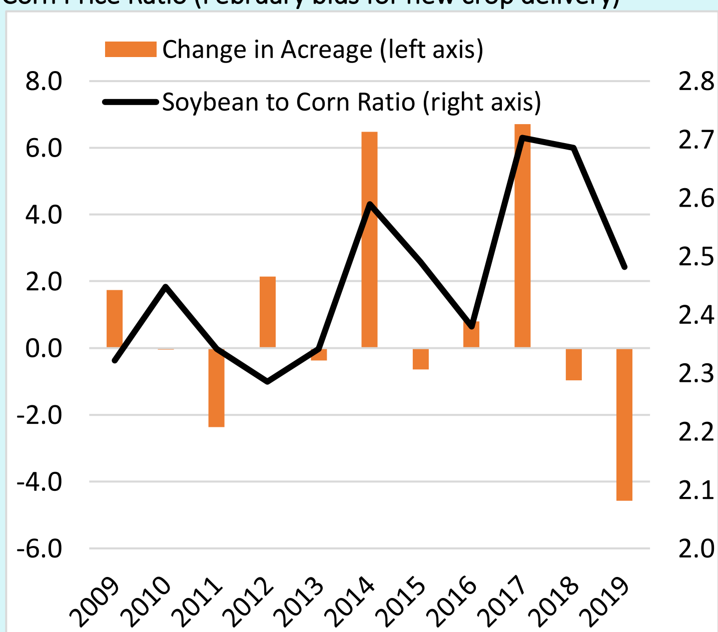
Source: Global Trade Atlas (2019).

Stock holding patterns will also have to change for South America. South America typically exports after harvest during March through August. If China's retaliatory tariff on U.S. soybeans continue, growth in soybean imports will largely depend on the capacity of South American producers to expand production to meet China's demand, which is currently higher than South America's exportable supply. Higher prices would signal South American producers to increase production, but with the added need to be able to store soybeans year-round.

Price Relationships Shift Again

The price wedge between U.S. and South America would likely have continued if China had not begun importing soybeans from the United States despite the 25% import tariff. However, by late December 2018, the price wedge began to disappear (Figure 4). Prices between the United States and South America converged for three primary reasons. First, South American weather was favorable, enhancing prospects for a large harvest in early 2019. Second, China agreed to purchase soybeans from the United States, causing U.S. prices to rise. On November 30, China publicly announced during negotiations that it would purchase 5 million tons of U.S. soybeans, followed by another 5 million tons on January 31, 2019, and 10 million tons on February 22, 2019.

Figure 8. Change in Acreage and Central Illinois Soybean-to-Corn Price Ratio (February bids for new crop delivery)



Note: Midpoint of high and low values for North and South-Central Illinois.

Last, Brazilian prices declined and converged with U.S. prices because China's soybean demand softened. China detected African Swine Fever (ASF) in the hog population in August 2018, which negatively affected pork production and thereby soybean meal demand. China also announced it would diversify feedstocks away from soybean purchases to help mitigate the impact of the tariff on U.S. soybeans. This included a possible shift in feed rations to more corn and alternative oilseed meals, such as rapeseed, peanut, and fishmeal. However, since soybean meal substitutes (rapeseed meal, peanut meal, cottonseed meal, etc.) only account for about a quarter of total protein meal demand and the soybean meal-to-corn price ratio still favored meal, a significant shift in rations seems unlikely.

By January 2019, these three factors had pressured U.S. and South American prices to return to a more typical historical relationship (Figure 4). Periodic reports of a potential trade agreement also supported U.S. prices, particularly during times when China made large one-off soybean purchases despite the tariff. For example, at the time when the USDA National Agricultural Statistics Service (NASS) surveyed farmers in late February and early March for planting intentions, the Central Illinois new crop contract's soybean-to-corn ratio was elevated near 2.5, which would not indicate a significant shift out of soybean acreage relative to prior years (Figure 8).

However, the NASS March 29, 2019, *Prospective Plantings* report showed that farmers intended to plant 84.6 million acres of soybeans in 2019, 4.6 million or 5% below the prior year. The uncertain environment over the tariffs, large stocks, and the convergence of U.S. and South American prices likely played a large role in the March 2019 *Prospective Plantings* report. Acreage declines were the most pronounced in Iowa, Minnesota, South Dakota, and North Dakota, which had been significant suppliers to the Chinese market. Producers in these states experienced larger price effects reflecting sharper basis adjustments out of the Pacific Northwest (PNW).

Conclusions

China's tariff on U.S. soybeans and a record 2018 crop contributed to lower U.S. soybean prices in 2018/2019. While stocks increased across most producing states, the states that relied on shipments to China through the PNW faced relatively higher stocks and lower prices. With high stocks, low prices, and uncertainty about the tariff, producers surveyed in March 2019 indicated their intention to plant 5% fewer acres than the prior season, resulting in the largest acreage decline since 2007/2008.

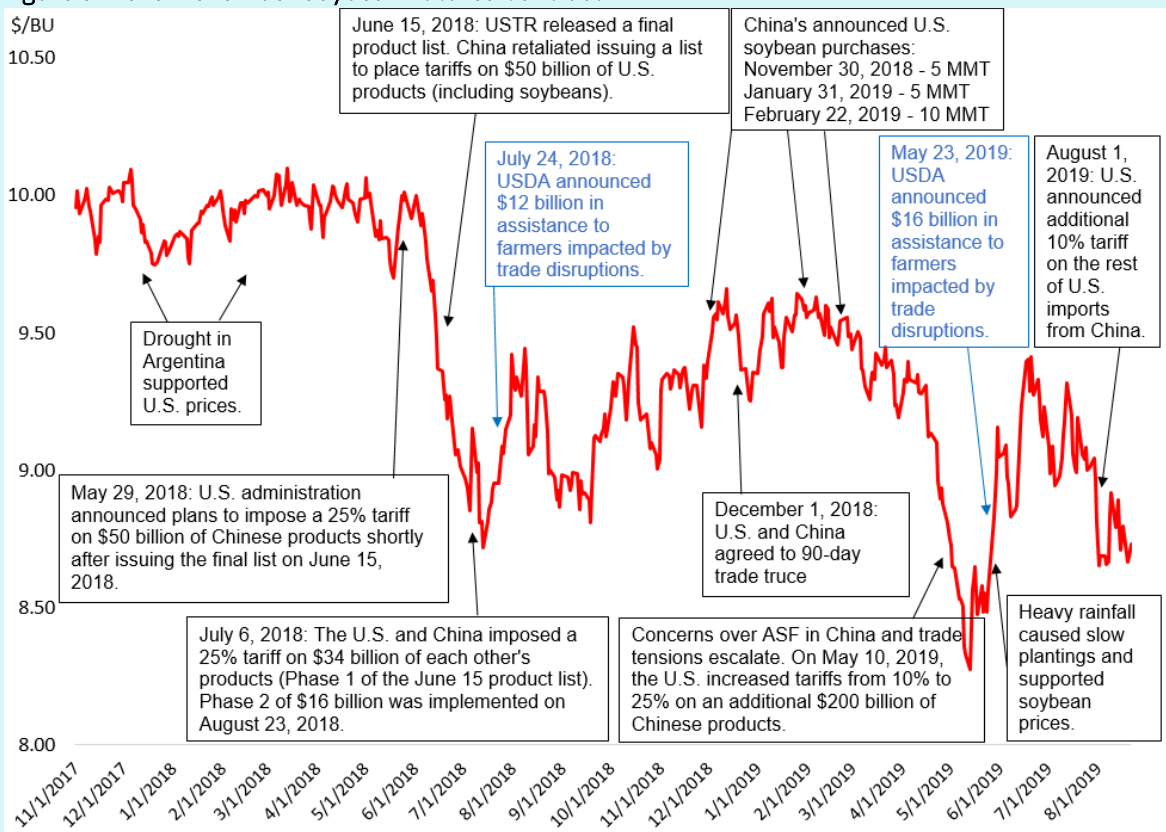
South America benefited from China's tariff on U.S. soybeans. Exports increased to record levels during the second half of their marketing year (August 2018–January 2019), when shipments normally decline. Higher exports led to historically low South American stocks. According to official Brazilian data, acreage expansion during planting in September–November 2018 only grew 2%, much lower than prior five-year average of 5%. This was possibly due to higher internal costs (freight rates) and limited availability of hedging mechanisms to capture the price premium over the United States due to the lack of a South American futures contract. Further, there was the risk that the United States and China could come to a resolution causing lower soybean prices in South America. Despite low acreage gains in Brazil, when combined with the return of Argentina's crop after the prior year's drought, South America would be able to continue to take advantage of market opportunities in China in 2019/2020.

Uncertainty over a trade deal continues to play a large role in soybean market dynamics. Anticipation of a possible U.S.–China trade resolution continued into the spring of 2019, supporting U.S. prices. As U.S. and South American prices continued to move together, South America became more competitive in ROW markets, hindering the competitive edge the United States had maintained when there was a price wedge. Downward pressure on U.S. exports was exacerbated by shrinking global demand as demand in China softened. With a resurgence of trade tension in the spring, U.S. soybean prices continued to fall, bottoming out with the announcement of higher tariffs on $200 billion worth of Chinese products on May 10 (Figure 9).

Over one year has passed, and there is still much uncertainty regarding future trade negotiations. Since the release of the 2019 NASS *Prospective Plantings* report (USDA, 2019e), U.S. farmers faced the slowest planting pace since 1996 due to heavy rainfall, resulting in lower total acreage, including soybean acreage. Lower production supported U.S. prices, but if the tariff remains in place and China ceases to make one-off purchases from the United States, South American and U.S. prices will again diverge (as observed in August 2019 when the United States initially announced a 10% tariff on the remainder of U.S. imports from China).

With diverging prices, the United States will continue to supply markets outside of China while South America exports to China. To satisfy year-round demand, major exporters require a continuous supply, adding costs to store soybeans for longer periods. The United States will face slower year-over-year export demand growth, with demand outside China growing at a slower pace. This would delay stock reductions in the near-term until the United States produces less. Further, U.S. producers that rely heavily on PNW exports to China (and currently have high soybean stock levels) would likely switch to other crops.

Figure 9. 2019 November Soybean Futures Contract



Source: Chicago Mercantile Exchange (2019) and authors' annotated descriptions.

With the continued Chinese tariff on U.S. soybeans, South American stocks will remain low over the time it takes to increase production capacity to meet China's demand. Global stock and trade patterns will become less seasonal and more uniform, adding costs to producers. Last, two prices will persist: a higher price for China, benefiting South American producers, and a lower price for the United States, benefiting ROW importers.

For More Information

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Tariff Retaliation Weakened the U.S. Soybean Basis

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JEL Classifications: Q11, Q13, Q17

Keywords: Basis, Soybeans, Retaliatory tariffs

Retaliatory Tariffs Displaced U.S. Soybean Exports, Raising Domestic Inventories

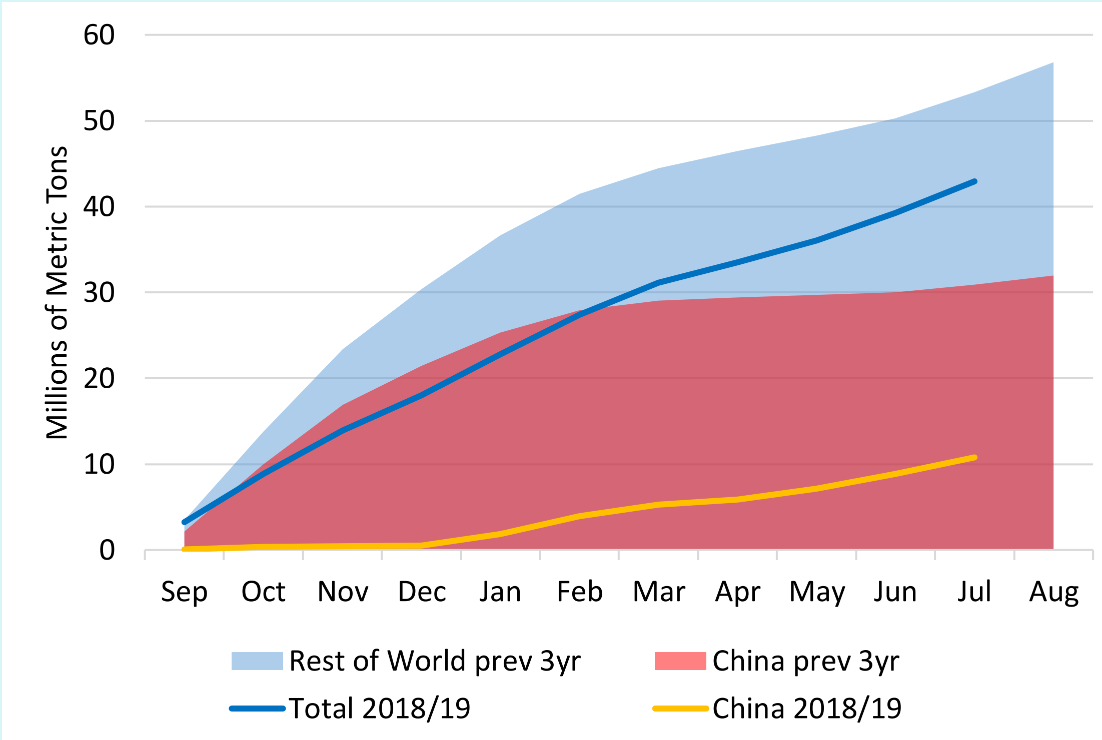
In response to U.S. Section 232 (national security) tariffs on imports of steel and aluminum on key trading partners and Section 301 (technological transfer) tariffs on Chinese products in 2018, several of major U.S. trading partners imposed retaliatory tariffs on U.S. exports (Bown and Kolb, 2019); agricultural goods in particular were disproportionately targeted. China imposed retaliatory tariffs on virtually all U.S. agricultural exports in July 2018, including a 25% additional tariff on soybeans, the single largest U.S. agricultural export. In 2016/2017, the value of soybeans exported by the United States ($23.8 billion) was 2.5 times greater than the next largest exported commodity, corn (U.S. Department of Agriculture, 2018a).

Normally, the United States exports about half of the soybeans that it grows, and well over half of those are purchased by Chinese buyers. For example, in 2016/2017—the last full marketing year prior to the trade tensions—U.S. exporters shipped 36 million metric tons (MMT) of soybeans to China, 61% of the total 59 MMT of U.S. soybean exports that year; that same year, exports accounted for 50.4% of the 117 MMT U.S. production (Gale, Valdes, and Ash, 2019). In sum, the United States exported to China nearly one out of three soybean rows its producers harvested during 2016/2017.

However, China's retaliatory tariffs led to drastic reductions in U.S. soybean exports, especially those destined for China. These changes are illustrated by the simple comparison shown in Figure 1. Over the three marketing years between 2015/2016 and 2017/2018, the United States exported an average 30.9 MMT of soybeans to China during the September–July period. During the same period in 2018/2019, U.S. soybean exports to China totaled just 10.78 MMT, a 65% drop.

At the same time, U.S. soybean exports to the rest of the world did not increase enough to make up for the amount displaced by China's tariff policy. From September 2018 to July 2019, U.S. soybean exports to China fell by 20.1 MMT from the previous three-year average, but the amount of soybeans purchased by other trading partners (e.g., Argentina, the European Union, and Egypt) increased by a much smaller amount (see also Hitchner, Menzie and Meyer in this *Choices* theme). Taken together, total U.S. exports of soybeans were 10.4 MMT lower in the September to July period compared to the average of the most recent three-year period, even though the U.S. harvest in the fall of 2018 was the largest on record (USDA, 2019b). Although the USDA (2019b) estimates a slightly higher crush in 2018/2019 year-over-year, many of the displaced U.S. soybean exports found their way into domestic storage facilities (Singh, Almeida, and Parker, 2018). Indeed, the latest USDA World Agricultural Supply and Demand (WASDE) estimates U.S. ending soybean stock levels for the 2018/2019 marketing year at nearly 25 MMT, compared to less than 12 MMT the year prior. It should be noted that following severe flooding and adverse planting conditions in the spring (Nafziger, 2019; Kennedy, 2019), the USDA (2019b) projects 2019/20 ending stocks of 12.9 MMT.

Figure 1. Cumulative U.S. Soybean Exports during the Marketing Year, by Destination



Notes: Author calculations based on U.S. census data.

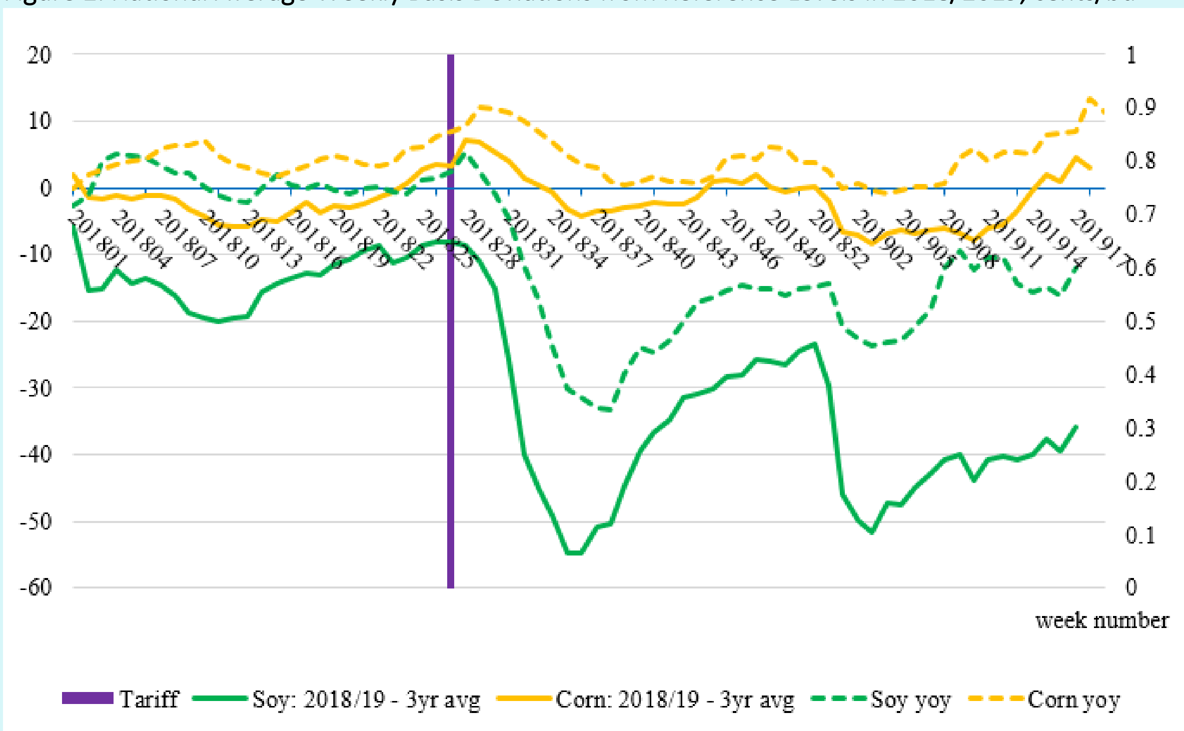
Tariff Displacement Widened the Basis, Especially in the Upper Midwest

As export opportunities evaporated amid the largest-ever soybean harvest, soybean cash market prices fell. In many areas the basis—the difference between the price paid to producers in a local market and the price of (usually the nearest-to-expire) futures contracts listed at the Chicago Board of Trade (CBOT)—widened considerably. In economic terms, the soybean basis represents the difference between local supply and demand conditions and a liquid, globally influenced price benchmark. As the cash price increases relative to futures, the basis is said to "narrow" or "strengthen"; as the cash price falls, the basis is said to "widen" or "weaken." Local commodity prices are often quoted in terms of basis, and producers compare the basis against its historical levels as an indicator that influences marketing decisions.

The basis is affected by many factors, including transportation costs (the more expensive it is to transport grain, the weaker the basis gets in exporting areas), crop quality (higher quality generally supports a stronger basis), seasonality (basis tends to be weakest when supply is greatest—at harvest), and storage price/availability (more expensive or scarce storage lowers the commodity price today relative to the future). A tariff that displaces exports can weaken the basis if it puts pressure on storage facilities or re-routes transport chains and increases shipping costs, leading purchasers to reduce their cash market bids. But large harvests also tend to weaken the basis, especially in areas where currently available supplies are sufficient to meet demand. Around the same time that China imposed its soybean tariff, the USDA (2018b) began to increase its projections for the 2018 harvest of both soybeans and corn.

Figure 2 plots the national average weekly basis deviations observed during 2018/2019 against both the 2015/2017 average and the prior year alone; corn is included in the chart as a graphical control, since it was not expected to be as sensitive to China's retaliatory tariff and corn production in the United States was also unexpectedly large in the fall of 2018—the third-highest on record. The U.S. corn crop is less sensitive to exports (comprising just 17% of production in 2017/2018, compared to 48% for soybeans), and U.S. corn exports to China are fractional compared to soybeans (U.S. Department of Agriculture, 2018b, 2019b), mostly due to government policies that raised China's domestic planted area and limited its import competition (Hansen et al., 2017). Figure 3 shows that—unlike soybeans—total U.S. corn exports in 2018/2019 were not meaningfully reduced as a result of the trade disruptions, compared to the prior year. The soybean basis did appear to strengthen towards the end of 2018, which may have been attributed in part to seasonal factors and a pickup of exports to alternative markets.

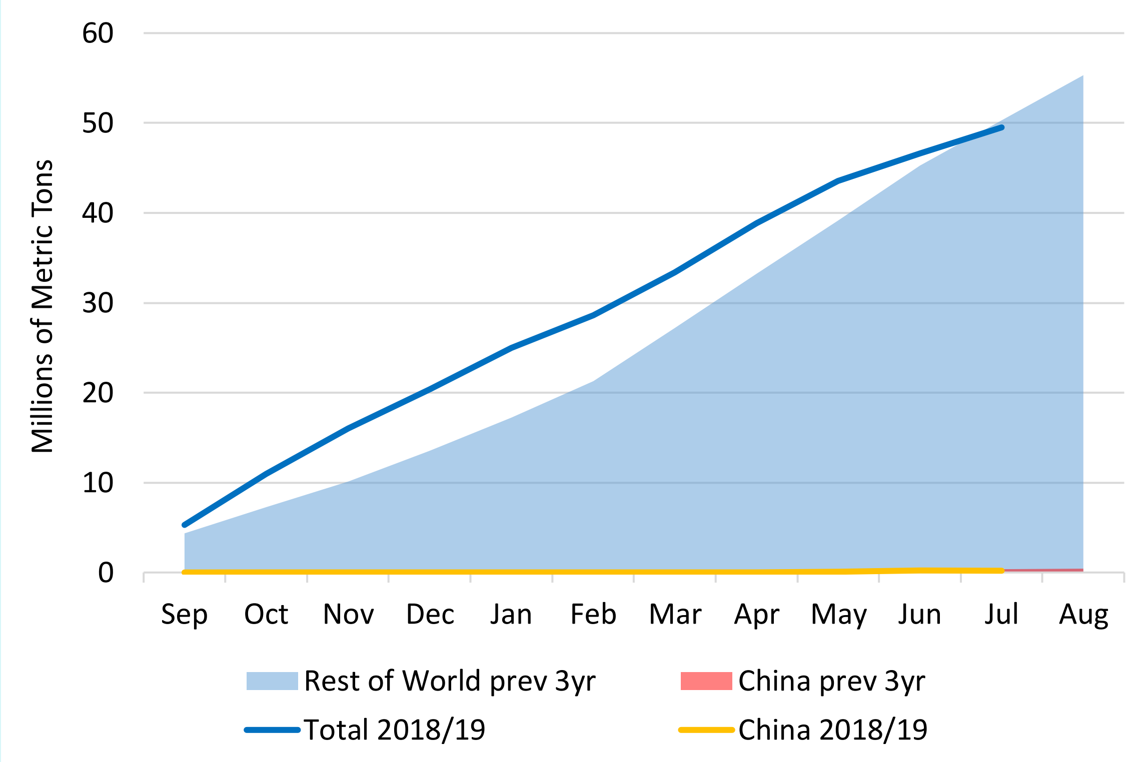
Figure 2. National Average Weekly Basis Deviations from Reference Levels in 2018/2019, cents/bu



Notes: Geograin.com price bids are aggregated to the county level and then used to generate an unweighted average; only those counties with sufficient observations are included. "yoy" denotes year-over-year. The *x* axis indicates the week of the year (e.g., "201801" is first week of 2018).

Figure 2 clearly shows that the average U.S. soybean basis fell considerably after China imposed its 25% retaliatory tariff in July 2018. By the beginning of September, U.S. producers were quoted an average price of 95 cents per bushel under the next-delivery November futures, nearly 60 cents lower than they were in 2015/2017, on average. And the price quotes they received were over 30 cents lower per bushel (relative to futures) than they were the previous year, which saw the second-largest U.S. harvest ever. In Figure 2, the average corn basis also weakened beginning in July 2018, relative to its mean value from 2015/2017, as well as its value in 2017 alone. But by early September 2018, corn bids reflected basis levels just 4 cents per bushel wider than average levels from 2015/2017 and 3 cents *narrower* than they were in 2017. Clearly, although both crops were historically large in 2018, soybeans suffered historically weak basis levels following China's tariff retaliation, while corn did not.

Figure 3. Cumulative U.S. Corn Exports during the Marketing Year, by Destination

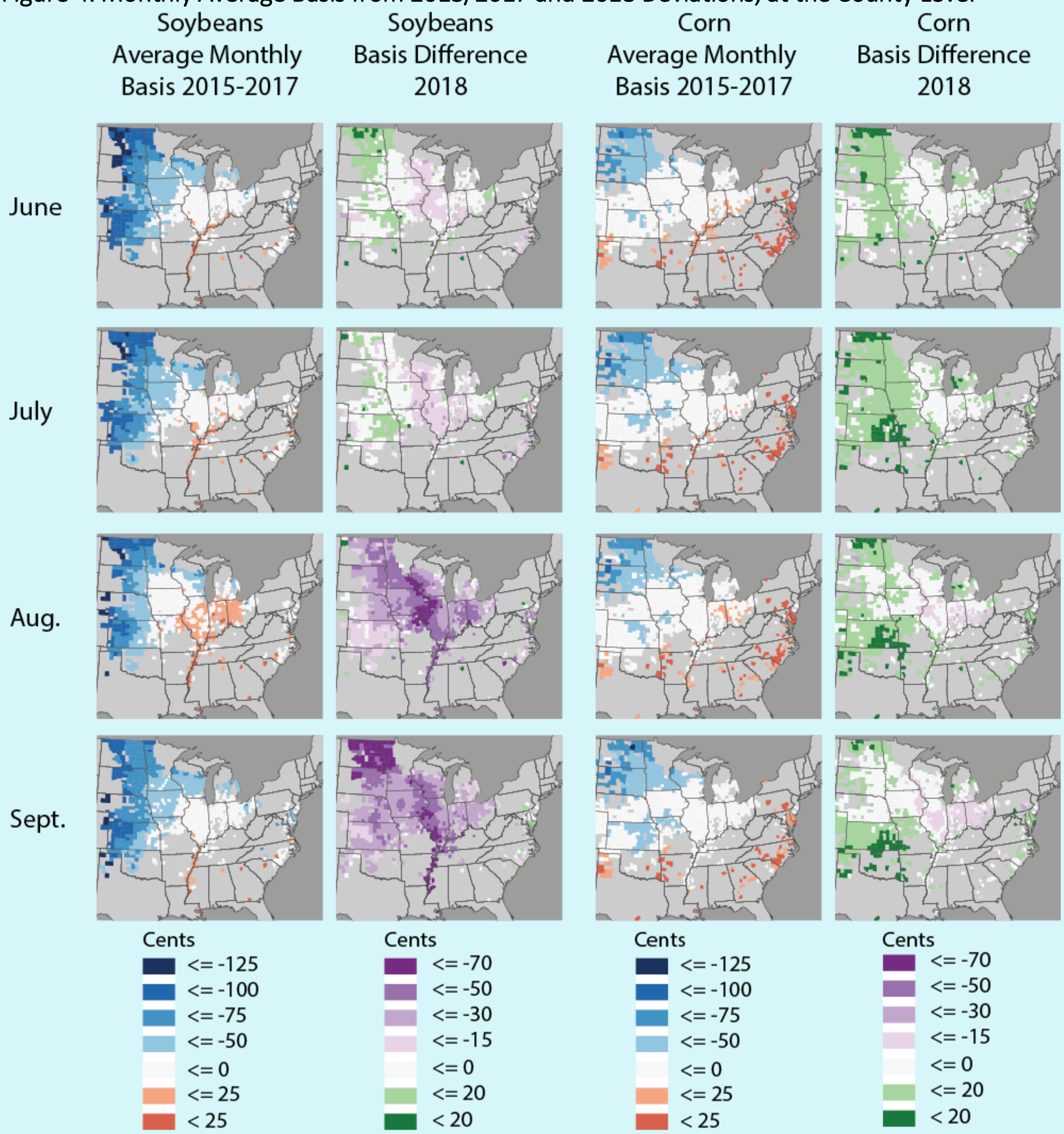


Notes: Author calculations based on U.S. census data.

The soybean tariff impacted some regions more than others. Figure 4 maps the June–September monthly average soybean and corn basis over the three-year period from 2015/2017 and the 2018 deviations from those values at the county level. For both commodities, basis normally tends to be weakest in the Upper Midwest and Plains states, particularly in areas distant from navigable waterways (note the dark blue locations), which lack easy access to futures contract delivery points and/or Gulf export opportunities. As 2018 progressed, corn basis did not deviate much from its historical levels over space, but the soybean basis began to widen significantly after China retaliated in July—especially in the Upper Midwest as the new crop began to come in.

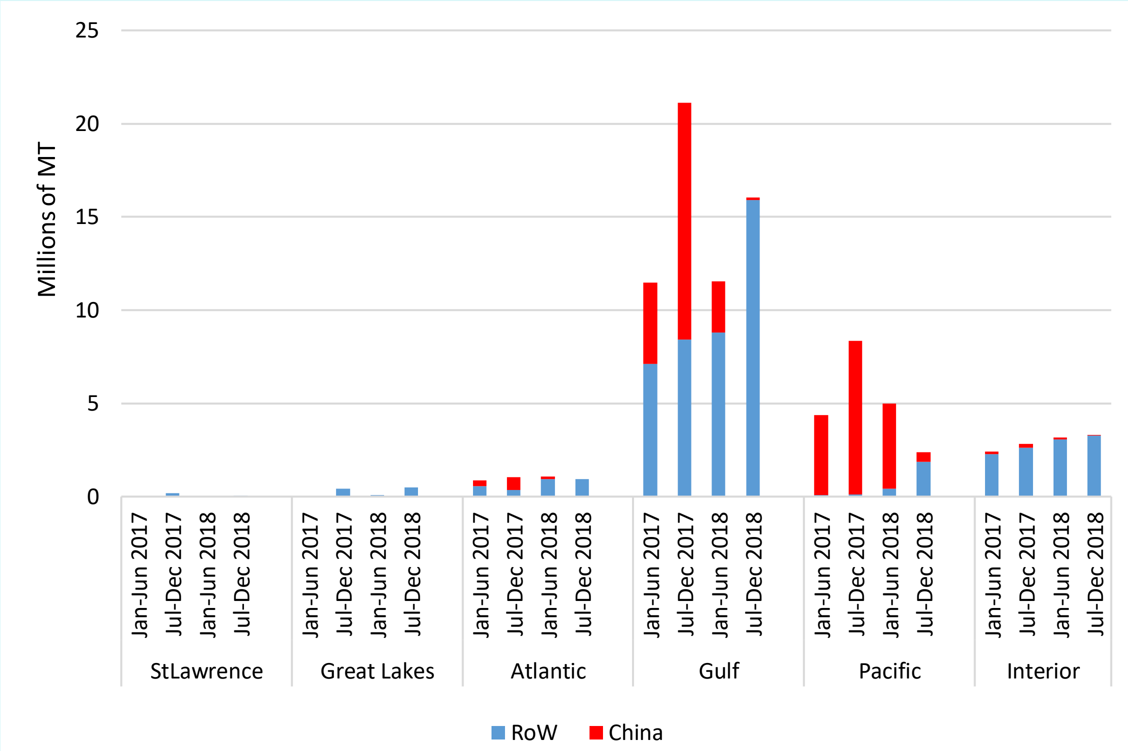
The spatial heterogeneity in basis surfaces depicted in Figure 4 is at least partially explained by disruption of traditional export routes. In normal years, most of the soybeans grown in the Upper Midwest are transported west by rail for eventual export to Asia (especially China) from U.S. ports on the Pacific (Hitchner, Menzie and Meyers, 2019): For North Dakota, around 70% of production is exported from those Western ports (Singh, Almeida, and Parker, 2018). While China's retaliatory tariff slashed Chinese purchases of U.S. soybeans from all U.S. ports over the second half of 2018 (as shown in Figure 5), it especially drove down soybean exports from the West Coast. Soybeans inspected or weighed for export at Pacific ports during the second half of 2018 fell by over 70% compared to the same timeframe one year earlier, and the amount destined for China fell by 94%. Losing an export market of that size was especially damaging to producers in the Upper Midwest, since those areas lack the crushing capacity to address the local surplus and transport to the Gulf (and alternative foreign destinations) from the region is very costly (Kennedy, 2018; McNew, 2018; Clayton, 2018). As a result, producers there were offered very low prices by local buyers. For example, by September 20, the average bid for soybeans in Burke County, North Dakota, was more than $2 per bushel under the November futures price—nearly a full dollar lower than local producers were offered one year earlier, relative to futures. Famers in the hardest-hit areas could have stored their beans, waiting it out until the local situation improved, but financial constraints and lack of on-farm storage facilities likely forced many producers to exchange their soybean crop for lower cash prices.

Figure 4. Monthly Average Basis from 2015/2017 and 2018 Deviations, at the County Level



Notes: Geograin.com price bids are aggregated to the county level; only those counties with sufficient observations are included.

Figure 5. Soybeans Inspected and/or Weighed for Export by U.S. Port and Destination



Notes: Author calculations based on USDA Foreign Grain Inspection Service data.

Soybean Convergence Worsened after China Imposed Its Retaliatory Soybean Tariff

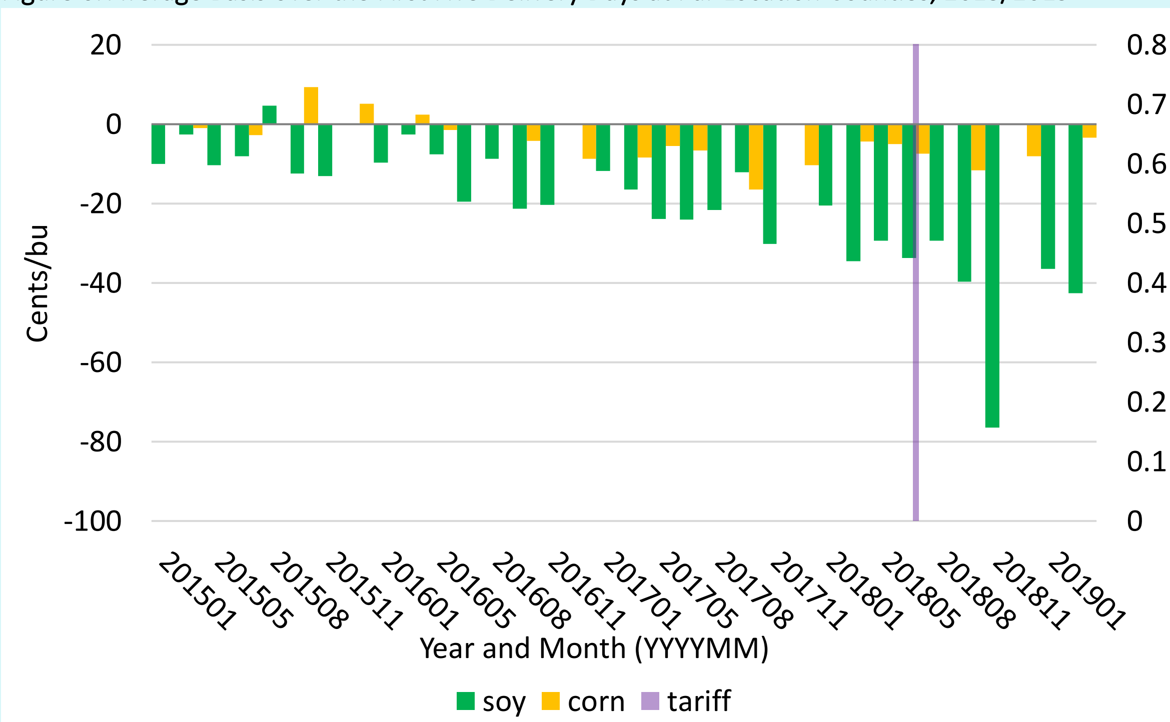
Ordinarily, the basis converges to (near) zero in delivery territories as a futures contract expires. Soybean futures can be satisfied via physical delivery of the commodity in specified cash markets so (even the threat of) buying and selling to arbitrage the difference should force the cash and futures prices to equilibrate (within a range allowing for transactions costs). This convergence is important if

1. the futures price is perceived to signal expected future cash market prices,
2. the spreads the market discovers between sequential contract expirations are to represent the price of storage (the "carry"),
3. the futures market is to offer effective hedging opportunities. If convergence doesn't occur, and if the cash-futures basis widens as it did in late 2018 (Figure 2), then even hedged producers aren't effectively protected from price downturns.

Convergence is not a given. During the second half of the 2000s, the CBOT soft red wheat (SRW) contract (but also the CBOT corn, soybean, and KC HRW Wheat Futures contracts) repeatedly failed to converge, with cash prices in delivery territories well below the price of expiring futures contracts. As explained by Irwin (2018) and Adjemian et al. (2013), this nonconvergence episode was most likely the product of artificially low storage fees for delivery instruments. Rather than requiring the transfer of actual physical grain, the delivery process for these futures contracts actually obliges the seller to provide the buyer with transferable delivery instruments (shipping certificates in the case of soybean futures) that permit the holder the right to load physical grain out of a warehouse. The futures exchange mandates that the holder of a certificate pay a storage fee. When these exchange-set storage fees become less expensive than the market price of physical storage, holding these instruments becomes more attractive, causing the futures price to rise higher and widen the basis. The futures price decouples from the expected cash market price, and the futures market fails to converge.

The market price of storage rises as the demand for storage grows, all else equal. And the demand for storing soybeans in the United States grew to historic levels after China imposed its retaliatory tariff ahead of the largest U.S. soybean harvest on record. Media reports indicate that space for storing soybeans became very tight in the latter half of 2018: Some farmers resorted to storing them in plastic bags and piling them on the ground, risking deterioration (Singh, Almeida, and Parker, 2018; Clayton, 2018). The CBOT announced that it intends to raise its storage fee for CBOT soybean and corn futures contracts from 5 cents to 8 cents per bushel per month beginning in late 2019 (CME, 2018). However, these changes did not apply to the contracts traded during the tariff disruption.

Figure 6. Average Basis over the First Five Delivery Days at Par Location Counties, 2015/2019



Notes: Geograin.com price bids are aggregated to the county level.

Figure 6 plots the average basis over the first five delivery days in counties that include standard delivery locations (i.e., "par," or areas where the commodity can be physically delivered in return for the futures contract price) for the CBOT soybean and corn futures contract expirations, from 2015 to the present. Corn convergence at these locations was healthier over the period, generally falling within about 10 cents/bushel of the expiring futures contract price. But the difference between soybean cash prices at these locations relative to futures widened notably after China imposed its retaliatory tariff in July 2018. The average basis over the first five delivery days for the following September, November, January, and March soybean contract expiries was −40 cents/bu, −76 cents/bu, −37 cents/bu, and −43 cents/bu in par locations, respectively, well outside the range observed over the previous several years. Even though the 2018 U.S. corn harvest was similarly very large, the weakest per-county delivery basis for the CBOT corn contract was observed in September 2018, averaging −12 cents/bu over the first five delivery days. Although both commodities have the same futures contract storage fee, only soybean convergence at these locations worsened in late 2018, likely as a result of China's tariff retaliation. The bottom line is that soybean producers in these areas, even if they had hedged around planting time and before China imposed tariffs, were not protected against their impact on U.S. soybean prices.

Producers responded to the retaliatory tariff, in part, by shifting away from soybean production in 2019 (Wilde, 2019). Soybean planted acreage in the United States fell by 14%, while acreage planted to feed grains like corn increased by 1% (USDA, 2019b). In addition, severe flooding and adverse planting conditions for soybeans contributed to a smaller crop and tighter stock conditions this year (Nafziger, 2019; Kennedy, 2019), strengthening the basis and improving convergence conditions compared to what was observed in 2018.

Conclusions

China's retaliatory tariff effectively shut off Pacific ports as a major export channel for U.S. soybeans. Alternative foreign markets did not make up the difference. As a result, U.S. soybean inventories spiked in late 2018. Many U.S. producers, especially in the Upper Midwest, received lower prices for their crop than they would have without the tariff retaliation. And the additional inventory demand likely weakened the effectiveness of hedging strategies—even hedging at planting time could not shield U.S. producers that year. But adverse planting conditions, a smaller crop, and tighter inventory conditions contributed to a stronger soybean basis in 2019.

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Impacts of Retaliatory Tariffs on Farm Income and Government Programs

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JEL Classifications: F13, Q17, Q18

Keywords: Bilateral trade, Crop insurance, Farm commodity programs, Farm income, Tariffs

Introduction

Retaliatory tariffs imposed by trading partners have had major impacts on U.S. commodity markets. As detailed in other articles in this theme issue, these tariffs have reduced U.S. exports and resulted in lower domestic commodity prices. These changes have important implications for farmers, taxpayers, and others with a stake in U.S. agriculture.

We use estimates of the commodity market impacts of retaliatory tariffs to estimate implications for farm income, government farm program outlays, and other indicators. The results highlight the importance of considering effects that extend across markets, such as how a change in soybean exports and prices may affect producers of corn, chickens, and other commodities. They also provide a reminder that the current suite of farm policies includes a mix of countercyclical and procyclical programs.

Commodity Market Impacts

The point of comparison for the analysis is a set of baseline projections for U.S. agricultural markets (FAPRI, 2019) that assumes a continuation of policies in place in February 2019. Those policies include the retaliatory tariffs imposed by China and other countries in response to U.S. tariffs on steel, aluminum, and other products. The baseline includes projections of production, prices, and use of grains, oilseeds, and other crops; biofuels; livestock; dairy; and poultry. At the sector level, the baseline includes estimates of farm income, the farm balance sheet, government program costs and consumer food prices and expenditures.

The alternative scenario assumes that retaliatory tariffs were lifted on March 1, 2019, midway through the 2018/2019 marketing year for U.S. soybeans, corn, and sorghum. To estimate the market impacts, a combination of modeling approaches was used. We used a bilateral trade model for the soybean sector to estimate the impact on U.S. trade and prices of the elimination of China's 25% retaliatory tariff on U.S. soybeans (Westhoff, Davids, and Soon, 2019). The soybean sector trade equations in the FAPRI-MU baseline model (Meyers et al., 2010) were then adjusted to reproduce the soybean price impacts estimated by the bilateral trade model.

For wheat, sorghum, cotton, corn, pork, and dairy products, we also made adjustments to trade equations. The magnitude of the adjustments was intended to reflect shifts in demand for U.S. exports that were broadly consistent with those used in USDA's calculations of 2018 Market Facilitation Program (MFP) payment rates per unit (USDA, 2018). The MFP was designed to assist farmers adversely impacted by market disruptions, and payments made under the 2018 MFP were based on harvested production of the affected commodities. Note that this analysis was completed before the second round of MFP payments was announced in May 2019.

The USDA's MFP rate calculations were based on estimates of the reduction in U.S. bilateral exports to countries imposing retaliatory tariffs, not on expected price impacts. As such, the estimates did not incorporate the net effect of the trade disruptions on U.S. exports to all markets as trading patterns were rearranged. China's soybean tariff, for example, has sharply reduced U.S. soybean exports to China, but some of this lost trade has been diverted as the U.S. backfills in other markets that previously imported from Brazil and other suppliers that are now selling more to China. This analysis takes trade diversion into account, so the marginal impact of tariff elimination of a particular commodity on U.S. prices for that commodity is less than the USDA's gross trade damage estimates.

Crop price impacts are reported in Table 1. For any given commodity, the reported change in prices reflects both the direct and indirect impacts of removing tariffs. In the case of corn, for example, the direct effect of tariff removal is likely small, as China remains unlikely to import much U.S. corn, even if retaliatory tariffs were eliminated, given other long-standing trade barriers. However, in this analysis, corn prices exceed baseline levels by about 3% in the 2019/2020 marketing year, primarily because higher soybean and sorghum prices would cause some U.S. producers to shift away from corn production and some livestock feeders to use more corn and less sorghum.

Table 1. Impact of Eliminating Retaliatory Tariffs on U.S. Marketing-Year Average Crop Prices (percentage change from baseline)

Marketing Year	2018/19	2019/20	2020/21–2022/23 Average
Soybeans	5.1	9.4	8.7
Corn	1.0	3.1	3.5
Wheat	0.6	2.6	4.1
Sorghum	3.0	10.0	9.8
Upland cotton	0.7	2.6	3.3
Hay	0.1	0.6	1.1

Note: The baseline continues tariffs that were in place in February 2019. The scenario assumes that retaliatory tariffs were lifted on March 1, 2019.

The proportional impacts on soybean and sorghum prices are larger than for other crops, consistent with China's importance in U.S. trade for those commodities. For cotton and wheat, the price changes can be attributed both to the direct effects of lower tariffs for those commodities and cross-price effects. Prices of hay and other crops increase primarily due to substitution effects.

Table 2. Impact of Eliminating Retaliatory Tariffs on U.S. Crop Area (million acres)

Crop Year	2019 Baseline	2019 Change	2020-2022 Average Change
Soybeans	85.01	0.82	1.50
Corn	91.66	-0.32	-0.22
Wheat	46.47	-0.24	-0.54
Sorghum	5.94	0.01	0.10
Upland cotton	14.07	-0.01	-0.02
Hay	53.10	-0.03	-0.08
Seven other modeled crops[a]	13.19	-0.07	-0.20
Total (13 modeled crops)	309.44	0.16	0.54

Note: [a]Rice, barley, oats, sunflowers, peanuts, sugar cane, and sugar beets.

Because the assumed tariff removal occurs midway through the 2018/2019 marketing year, effects on annual average prices are muted. Likewise, many farmers had already made 2019 acreage decisions by that time, so impacts on 2019 planted area (Table 2) are also fairly small. Full effects of the tariff removal are felt in 2019/2020 and subsequent years. Given the changes in relative prices, soybean and sorghum acreage expand, while area devoted to other crops declines relative to the baseline. Total acreage for 13 modeled crops increases only marginally, as the total amount of land used for crop production is not very sensitive to output price levels.

Hog and milk prices increase because of shifts in export demand when retaliatory tariffs are eliminated (Table 3). In addition, higher prices for grain, soybean meal, and hay increase livestock production costs. All else equal, those higher costs tend to reduce production, contributing to higher prices. Finally, as pork prices increase, the price of competing meats also increases as consumers adjust their consumption levels.

Table 3. Impact of Eliminating Retaliatory Tariffs on U.S. Livestock Prices (percentage change from baseline)

Calendar Year	2019	2020	2021-2023 Average
Fed cattle (five-area direct steers)	0.5	0.8	0.8
Hogs (51%–52% lean)	1.6	2.3	2.0
Chickens (wholesale broilers)	0.6	1.4	1.7
All milk	0.2	1.2	1.9

Farm Income Impacts

Eliminating retaliatory tariffs increases estimated net farm income by about $4 billion in 2019 and about $5 billion in subsequent years, relative to the current-policy baseline (Table 4). Higher prices and production of soybeans account for most of the increase in the value of crop production, with oilseed receipts increasing by about $3 billion in 2019 and $4 billion in 2020. For some other crops, higher prices are partially offset by slightly lower production. Total crop receipts increase by more than $6 billion above baseline levels in 2020.

On the livestock side, the effect of higher prices dominates, so total receipts from sales of dairy, meat, and poultry products exceed baseline levels by about $2 billion in 2020. Note, however, that the estimated increase in feed costs is almost as large as the increase in livestock receipts, suggesting little net impact on profitability for the livestock sector as a whole.

Increased returns to crop production drive an increase in land rental rates. Higher rents increase costs to the many operators who lease part of the land they operate, but they also reflect a benefit to landowners. Other costs also increase slightly because of shifts in production and profitability. The increase in other costs may be understated, as the model holds the prices of some inputs fixed in the scenario. Overall production expenses exceed baseline levels by more than $1 billion in 2019, $2 billion in 2020, and $3 billion in later years, with higher costs for both crop and livestock producers.

In addition to higher production expenses, the impact of higher commodity prices on farm income is moderated by a reduction in government payments, as described below. “Other net farm income” includes a variety of components, including changes in the value of inventories and crop insurance indemnity payments. It increases slightly in 2020 and later years, in part because of an uptick in crop insurance indemnity payments resulting from higher commodity prices.

These estimates of farm income impacts are sensitive to the estimates of commodity market impacts, which are quite uncertain. It should also be noted that the estimates are limited to a subset of commodities; there may well be important implications for other commodities not examined here.

Table 4. Impact of Eliminating Retaliatory Tariffs on U.S. Farm Income ($billions, change from baseline)

Calendar Year	2019	2020	2021-2023 Average
Oilseed receipts	3.1	4.1	4.1
Other crop receipts	1.4	2.4	2.6
Total crop receipts	4.6	6.4	6.8
Livestock receipts	1.0	1.9	2.3
Government payments	-0.4	-1.2	-1.3
Feed expenses	1.0	1.8	1.8
Rent to landlords	0.0	0.3	0.7
Other production expenses	0.1	0.4	0.9
Total production expenses	1.2	2.4	3.4
Other net farm income	-0.1	0.6	0.7
Net farm income	3.9	5.3	5.1

Note: Other net farm income includes crop insurance indemnity payments, the value of inventory changes, and other adjustments to farm income.

Government Program Impacts

A variety of government programs make payments to farmers when they are faced with adverse conditions. The Price Loss Coverage (PLC) program makes payments on program base acreage when marketing year average prices fall below fixed reference prices. The Agriculture Risk Coverage (ARC) program makes payments on base acreage when county-level revenues per acre for a given crop fall below a trigger tied to past prices and yields. The marketing loan program provides benefits when an indicator of local prices falls below a loan rate. Crop insurance programs make indemnity payments when yields or revenues fall below an insured level.

The countercyclical design components of these programs generally mean that program outlays will fall when there is an unanticipated increase in prices. As shown in Table 5, estimated commodity program outlays are reduced by over $400 million in fiscal year 2020 and by $1.2 billion in fiscal year 2021. Given the timing of ARC and PLC payments, those are costs primarily associated with the 2018 and 2019 crop years, respectively.

In fiscal year 2020, the drop in ARC/PLC payments on soybean base acres accounts for almost half of the overall change in commodity program spending, but in later years, the change in ARC/PLC payments on corn base acres is comparable or even larger. Given the much larger estimated change in soybean prices than in corn prices, this result might appear odd. Two factors can explain this result. First, there are more corn than soybean base acres and corn program yields are higher than soybean program yields per acre. Second, average baseline corn prices are below or near the reference price, while average baseline soybean prices are generally above the reference price. If we were looking at the question considering only a single point estimate of future outcomes, there would be zero PLC payments on soybean base in both the baseline and in the scenario, as both the baseline and scenario have prices above the reference price. However, given the uncertainty of agricultural markets, the model considers a distribution of possible prices. In the case of corn, much of that distribution is below the reference price, so increasing corn prices by even a modest amount results in significant PLC program savings. In the case of soybeans, a smaller portion of that distribution is below the reference price, so the expected value of PLC payments on soybean base is relatively small in the baseline. With a higher average price, the portion of the distribution generating payments is even smaller, so there is some modest reduction in expected PLC payments relative to the baseline. A similar logic applies to ARC payments and marketing loan benefits.

While the commodity program results are consistent with the notion that the basic programs are countercyclical with respect to prices, Table 5 indicates that crop insurance outlays are largely unchanged in fiscal year 2020 and actually exceed baseline levels in fiscal year 2021 and later years. While an unexpected price increase can reduce crop insurance outlays in the short run, higher prices increase the value of insured crops in the longer run. Since premium subsidies are largely proportional to the value of crops insured, those subsidies increase when commodity prices and crop values increase.

Table 5. Impact of Eliminating Retaliatory Tariffs on U.S. Government Outlays ($millions, change from baseline)

Fiscal Year	2020	2021	2022–2024 Average
Soybeans	-195	-427	-363
Corn	-66	-384	-452
Wheat	-50	-136	-195
Sorghum	-33	-90	-82
Upland cotton	-92	-129	-134
Other commodity programs	14	-34	-64
Total commodity programs	-421	-1,200	-1,289
Crop insurance	3	205	245

Note: Payments under the Agriculture Risk Coverage (ARC) and Price Loss Coverage (PLC) programs apply to base acres of listed crops, not to production of those crops. ARC/PLC payments are made beginning October 1 of the year after marketing year price and production data are available, which places them in the following fiscal year (e.g. payments associated with marketing year 2018/2019 are paid in fiscal year 2020, which runs October 1, 2019 to September 30, 2020). Payments for other programs may affect outlays in more than one fiscal year.

These estimates of government outlays do not include any payments from a trade mitigation program, since both the baseline and the scenario assume no such program for 2019 and later years. In any case, outlays under such a program presumably would not contribute to variations in government outlays, since they would not be affected by changes in prices and production resulting from the lifting of tariffs. In fact, assuming the existence of trade mitigation payments in the baseline would have presented some difficulties with the scenario, since had tariffs been lifted in March 2019, presumably trade mitigation would not have been implemented. The MFP payments for both 2018 and 2019 exceed our estimated impacts of retaliatory tariffs on farm income. However, MFP was not designed to offset the farm income impacts of those tariffs. As discussed earlier, MFP payment rates do not consider the impact of the tariffs on sales to other markets, nor do they consider cross-commodity effects.

How Recent Events Might Affect the Analysis

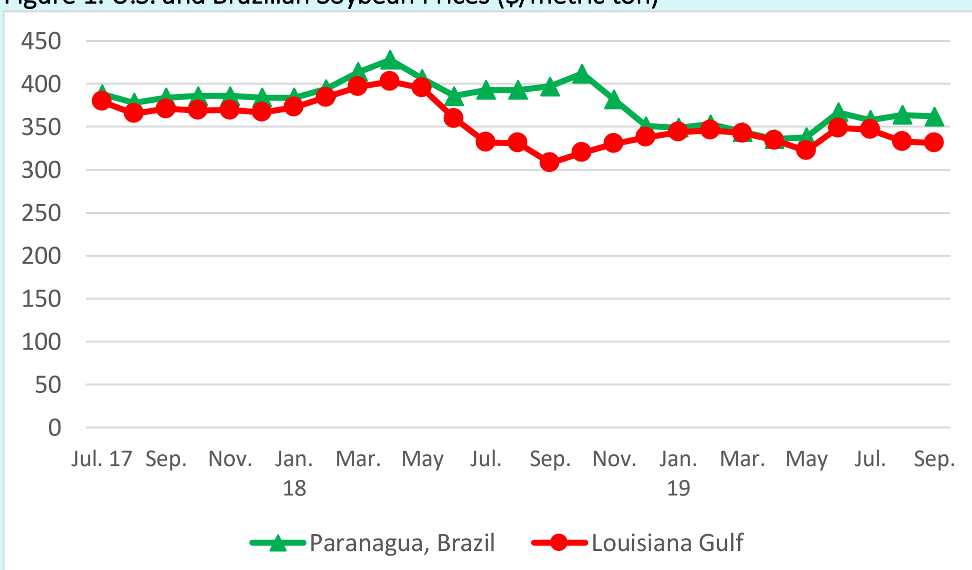
The estimates reported here utilize a baseline prepared in February 2019, based on conditions at that time. Much has happened in recent months, some of which might result in different estimates of the impact of tariff elimination if the analysis were updated to use a baseline reflecting the market situation in the fall of 2019.

For example, the February baseline assumed the impacts of African Swine Fever (ASF) on pork production would be fairly modest. More recent information suggests that ASF may have a larger negative impact on pork production in China. By the end of September 2019, the year-over-year decline in China's pig inventory for 2019 had reached 41% (Patton, 2019) and is expected to increase further toward the end of the year. This means there are fewer hogs to feed in the country and in the world as a whole. The result is a reduction in China's demand for soybeans for soybean meal production. This implies lower soybean imports than reflected in the analysis reported here.

Reduced total demand in China for soybean imports will result in lower prices for soybeans in all markets. It also becomes easier for South America to satisfy almost all of China's import needs when tariffs are in place. With a lower level of total imports by China, South America can meet a very high proportion of China's import requirements and still maintain some sales to third-country markets. Given all the parameters of the model, this would imply a smaller gap between prices in the United States and in other countries when the retaliatory tariffs are in place. In turn, that implies that lifting the tariff would have had a smaller positive impact on U.S. soybean market prices than suggested here.

Some evidence for this comes from observed prices of U.S. and Brazilian soybeans over the past year. There was a wide gap between U.S. and Brazilian export prices in the fall of 2018, very little difference between prices in the two countries in early 2019, and only a modest gap in August and September 2019 (Figure 1). In addition to ASF, other factors may have contributed to this observed behavior. Rumors of a possible trade deal may have made market participants unwilling to pay a large premium for South American soybeans. Also, reports suggest that China often waived tariffs on the limited imports of U.S. soybeans that did occur (Bloomberg News, 2019). Thus, contrary to the assumptions of the model used here, the marginal cost of U.S. soybeans in China's market may have been less than the U.S. price plus the tariff.

Figure 1. U.S. and Brazilian Soybean Prices ($/metric ton)



Source: U.S. Department of Agriculture (2019a, September issue); Louisiana Gulf price from U.S. Department of Agriculture (2019b).

Concluding Comments

Retaliatory tariffs on U.S. farm products have large impacts on a wide range of stakeholders. Our estimates indicate that eliminating those tariffs would result in higher farm commodity prices, shifts in production, increased net farm income, and lower government payments. The magnitude of these various impacts is uncertain, and the estimates reported here are based on a long series of assumptions. While any given estimate should be treated with caution, the analysis does provide some indication of how various factors interact. Results confirm the notion that indirect effects should not be ignored. Changes in China's imports of U.S. soybeans eventually impact the price of corn, the production of livestock, and broader spending on income support programs. Analysis focused on a single commodity can miss some critical parts of the story.

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How Has the Trade Dispute Affected the U.S. Cotton Sector?

Andrew Muhammad, S. A. Smith, and Stephen MacDonald

JEL Classifications: Q17, Q18

Keywords: China, Cotton, Policy, Retaliatory tariffs, Trade dispute, United States

Introduction

Discourse on the implications of the U.S.–China trade dispute on agriculture has primarily focused on the soybean sector. Given that soybeans are the largest U.S. agricultural export (valued at $21.6 billion in 2017) and China is the primary destination, it is understandable why this sector has received so much attention. The impact of the U.S.–China trade dispute on the U.S. cotton sector has received considerably less attention. Albeit smaller than U.S. soybean exports, cotton is a leading agricultural export for the United States. In 2017, U.S. cotton exports totaled $5.8 billion, with 17%, nearly $1.0 billion, exported to China. Additionally, cotton is one of China's most important agricultural import from the United States. The Chinese government imposed 25% tariffs on U.S. soybeans and cotton, as well as many other agricultural products. For cotton, the final tariff is as high as 65% for out-of-quota imports when added to the existing tariff (40%), which has put the United States at a disadvantage relative to other exporting countries (Hopkinson, 2018).

We discuss the implications of the U.S.–China trade dispute on the U.S. cotton sector and developments in global cotton markets over the last decade, such as the increase in global yarn trade and China's demand for primary processing by foreign countries. It appears that global trends over the last decade might have lessened the impact of China's retaliatory tariffs on the U.S. cotton sector. However, recent data suggest that the U.S. cotton sector has still been disadvantaged relative to other cotton exporting countries.

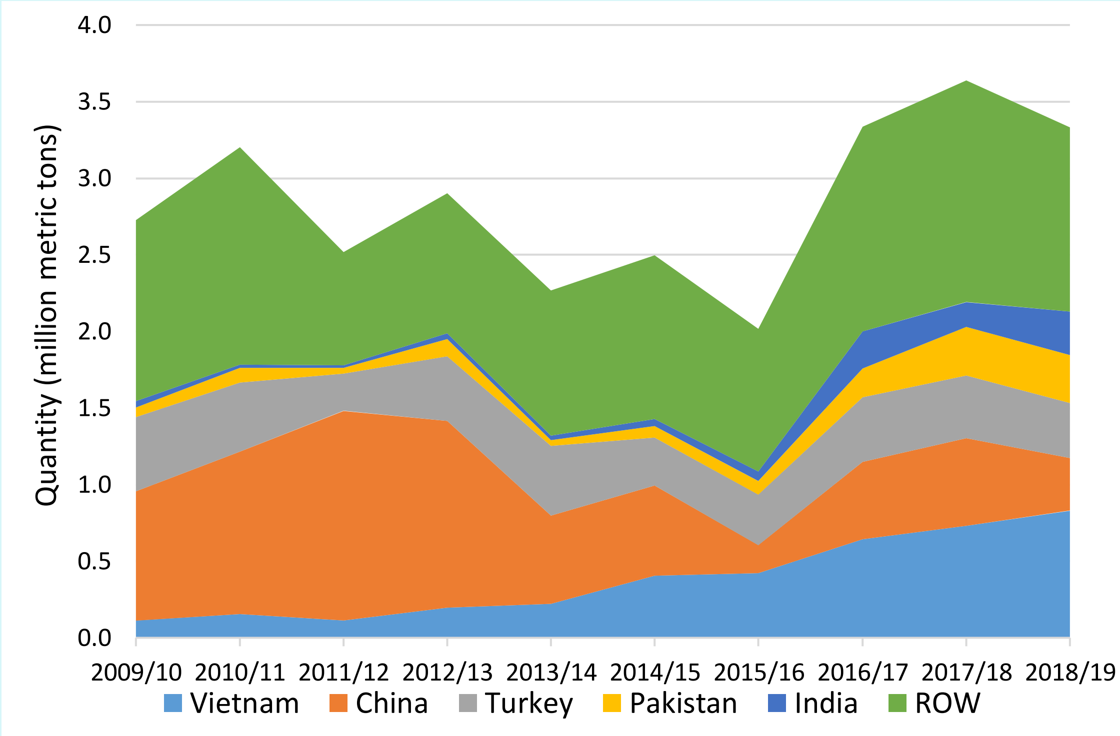
In this article, we limit cotton to raw cotton, as defined by the Harmonized System (HS) classification 5201 (cotton, not carded or combed). Yarn is limited to yarn manufactured from cotton for use in commercial production, as defined by HS 5205 (cotton yarn, other than sewing thread containing ≥ 85% cotton, not used for retail).

U.S. Cotton Exports

Figure 1 reports U.S. cotton exports since the 2009/10 marketing year (August–July). The data indicate that the trade dispute has had a negative impact on U.S. cotton exports. Since reaching a low of 2 million metric tons (MMT) in 2015/16, exports have recovered significantly, reaching a decade high of over 3.5 MMT in 2017/18. The current marketing season (2018/2019), however, which started when the tariffs were first implemented in August, shows a decline. In 2018/19, U.S. exports were down 0.31 MMT, which is an 8% decline and $600 million loss in value compared to the previous marketing year.

Figure 1 also reports U.S. cotton exports by destination market. U.S. cotton exports to China declined significantly since peaking in 2011/12 (1.4 MMT), falling to a low in 2015/16 (0.19 MMT). Since 2015/2016, the Chinese market was showing signs of recovery for U.S. cotton, primarily due to declining stocks and increasing domestic demand (USDA, 2019b). During this period, Vietnam emerged as the leading market for U.S. cotton exports. Vietnam also emerged as a major supplier of yarn to China. The data suggest that U.S. cotton shipped to Vietnam is being processed and then exported as yarn to China. We discuss this in more detail later. The recent decline in U.S. cotton exports is primarily due to a decrease in exports to China. In the 2018/19 marketing year, U.S. cotton exports to China were down by 0.23 MMT, a 40% decline and $400 million loss in value compared to the previous marketing year. This decline was only partially made up by an increase in exports to Vietnam and India, which were up by 14% and 76%, respectively.

Figure 1. U.S. Cotton Exports by Importing Country, 2009/2010 to 2018/2019



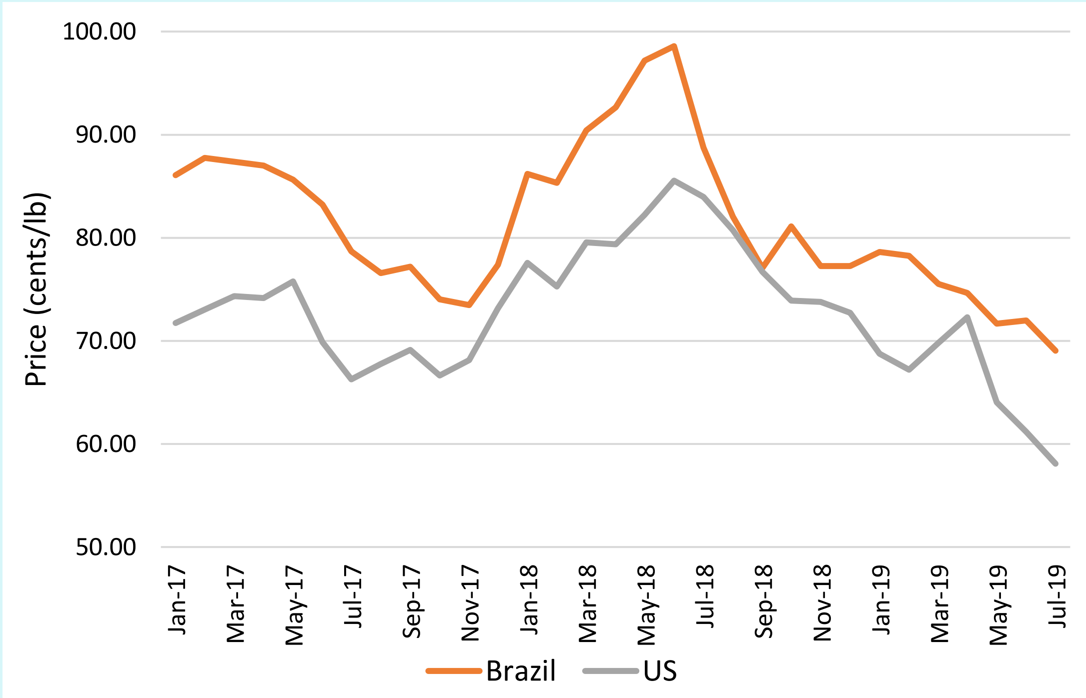
Note: Marketing year starts August 1. Cotton: HS 5201 (cotton, not carded or combed). ROW is rest of world, which is an aggregation of all remaining countries.
Source: U.S. Department of Agriculture (2019c).

U.S. and Global Cotton Prices

The decline in U.S. cotton exports in 2018/19 suggests that the trade dispute has negatively impacted this sector. We reach a similar conclusion when examining U.S. cotton prices, particularly relative to global cotton prices. We first compare U.S. cotton prices to prices in Brazil, a major competitor of the United States in global cotton markets. Both countries are export-oriented producers of high-quality machine-picked cotton. Shifts in relative prices for these two countries is a good indication of how China's retaliatory tariffs have affected U.S. prices. Figure 2 shows monthly cotton prices in Brazil (University of São Paulo, 2019) and the U.S. monthly average spot price from January 2017 to July 2019 (USDA, 2019a). Note that prices in both countries have been declining since June 2018. Since September 2018, when prices were relatively equal, U.S. prices have declined at a much faster rate (77 cents/lb to 58 cents/lb) compared to Brazil (77 cents/lb to 69 cents/lb). Declining global prices can be partially attributed to Brazil increasing production to 12.5 million bales in the 2018/19 marketing year, compared to 9.2 million bales in 2017/18 (USDA, 2019d).

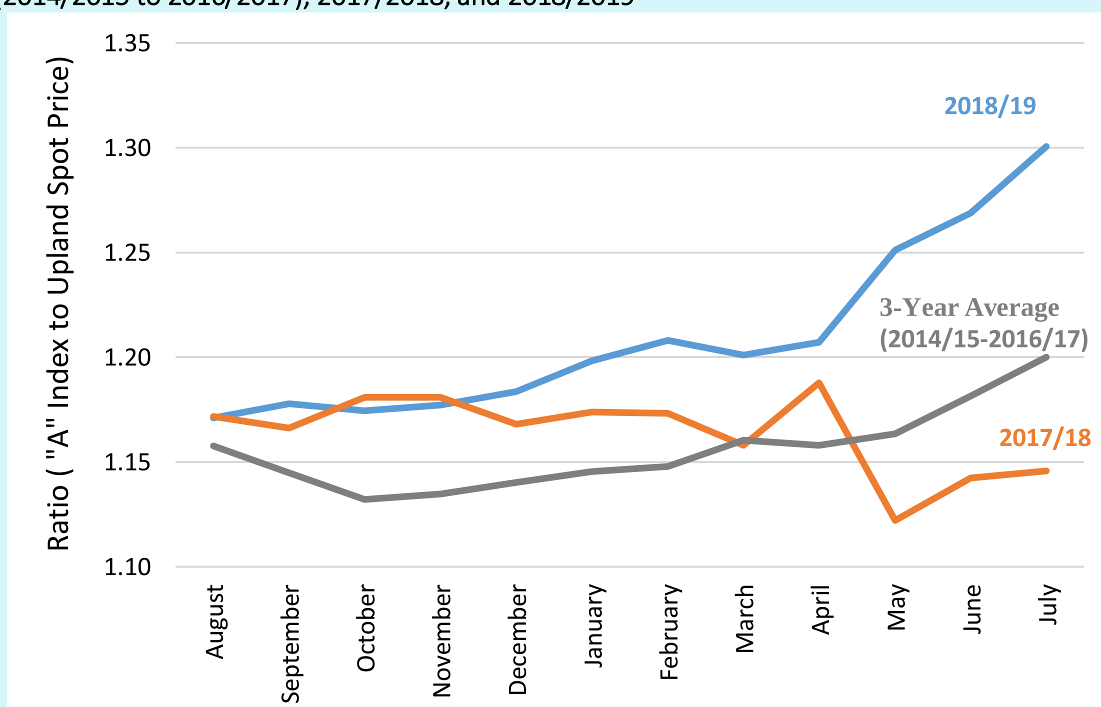
Figure 3 shows the ratio between the average Cotlook "A" Index, which is considered to be representative of raw cotton prices on the international market (NCC, 2019), and the monthly U.S. farm price; observed differences in the two price series in recent months may be an indication of how China's retaliatory tariffs shifted U.S. prices. From 2014 to 2017, the ratio between the two prices averaged about 1.16 (Cotlook "A" Index divided by U.S. farm price). In 2018/19, the ratio persistently increased to around 1.3, indicating an increase in the disparity between "global prices" and U.S. prices. The relatively higher ratio in 2018/19 suggests that U.S. prices were depressed relative to global prices during this period.

Figure 2. Monthly Brazil to U.S. Price, January 2017–July 2019



Source: USDA (2019a), University of São Paulo (2019).

Figure 3. Monthly Average "A" Index Price Divided by U.S. Upland Spot Price: Three-Year Average (2014/2015 to 2016/2017), 2017/2018, and 2018/2019

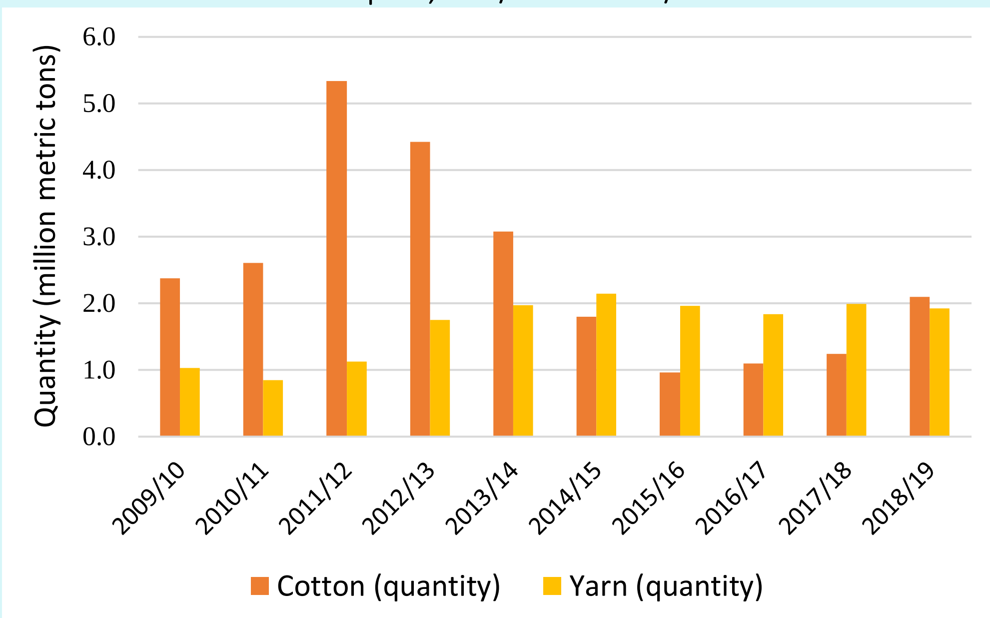


Source: USDA (2019a), NCC (2019).

China's Cotton and Yarn Imports

Figure 4 reports China's cotton and yarn imports since 2009/10. Since peaking at nearly 5.3 MMT in 2011/12, Chinese cotton imports declined significantly, reaching a low of 1.0 MMT in 2015/16. Since 2015/16, cotton imports have shown signs of rebounding, increasing by over 10% each year. This rebound is further evidenced by cotton imports this current marketing year (2018/19), which are up 80% from the previous year, despite reductions in imports of U.S. cotton. China's yarn imports have also remained strong, increasing from about 0.8 MMT in 2010/11 to an average of 2 MMT per year over the last half-decade.

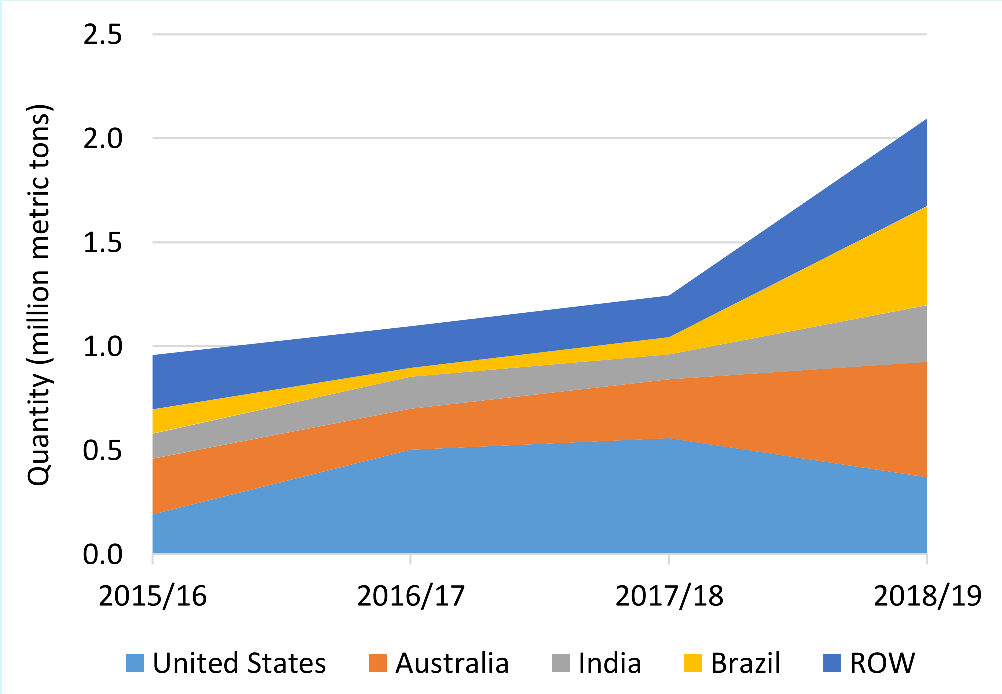
Figure 4. China Cotton and Yarn Imports, 2009/2010 to 2018/2019



Note: Marketing year starts August 1. Cotton: HS 5201 (cotton, not carded or combed); Yarn: HS 5205 (cotton yarn, other than sewing thread containing ≥ 85% cotton, not used for retail).
Source: Global Trade Atlas (2019).

The decrease in cotton imports in China over the 2011/12 to 2016/17 marketing period came as China increased its State Reserve stocks early in the transition period and then began selling domestically produced cotton from the reserve starting in 2015/16. With the introduction of high price supports in 2011, much of China's domestic production flowed into the reserve, and a large expansion in import quotas allowed imports to achieve an unprecedented level in 2011. In 2014, China reduced its guaranteed producer target price, which helped domestic and world prices to partially converge. In 2015, as auctions to China's mills and traders from the State Reserve began in earnest, China's cotton imports were largely confined to its minimum obligations under its WTO accession agreement, the 894,000-ton tariff-rate quota (TRQ) (MacDonald, Gale, and Hansen, 2015). In recent years, China's domestic use has increased as State Reserve sales have grown, with ending stocks falling by 50% since peaking in 2014/2015 (USDA, 2019b). Consequently, Chinese cotton imports have been steadily increasing since 2015/2016, and it appears that this benefited U.S. exports to China until the onset of the trade dispute (see Figure 5). In 2018/19, China's imports of U.S. cotton decreased by 0.19 MMT, a decline of about 34% compared to the previous year. Note that the import data reported by Chinese Customs is somewhat smaller than U.S. reported exports. In contrast, China increased imports from Australia by 97%, India by 127%, and Brazil by 480% compared to the previous year.

Figure 5. China Cotton Imports by Source, 2015/2016 to 2018/2019



Note: Marketing year starts August 1. ROW is rest of world, which is an aggregation of all remaining countries. Cotton: HS 5201 (cotton, not carded or combed).
Source: Global Trade Atlas (2019).

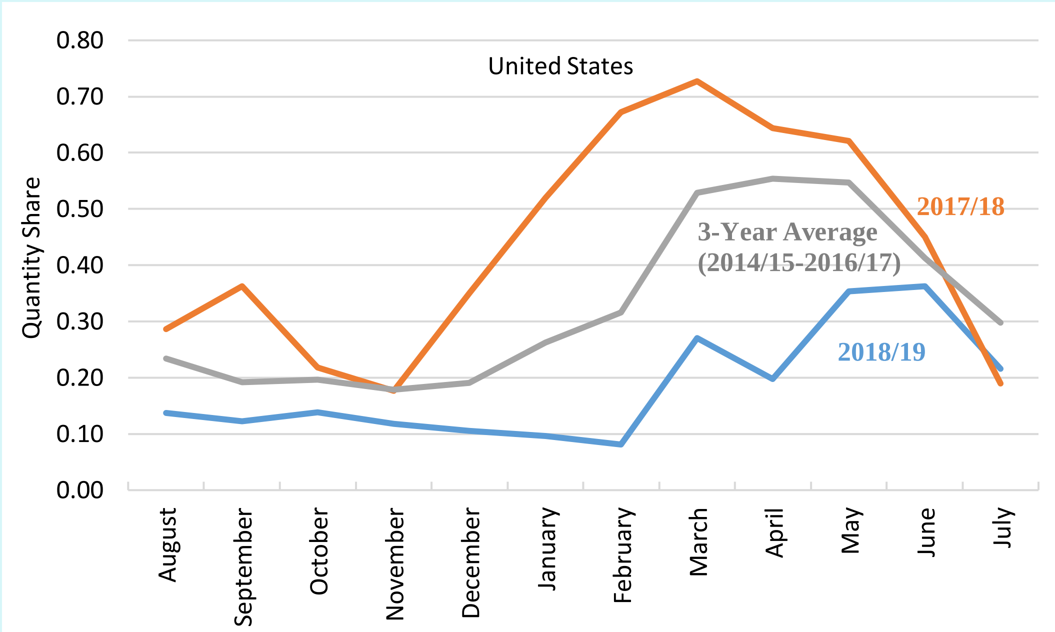
Trade Dispute Implications

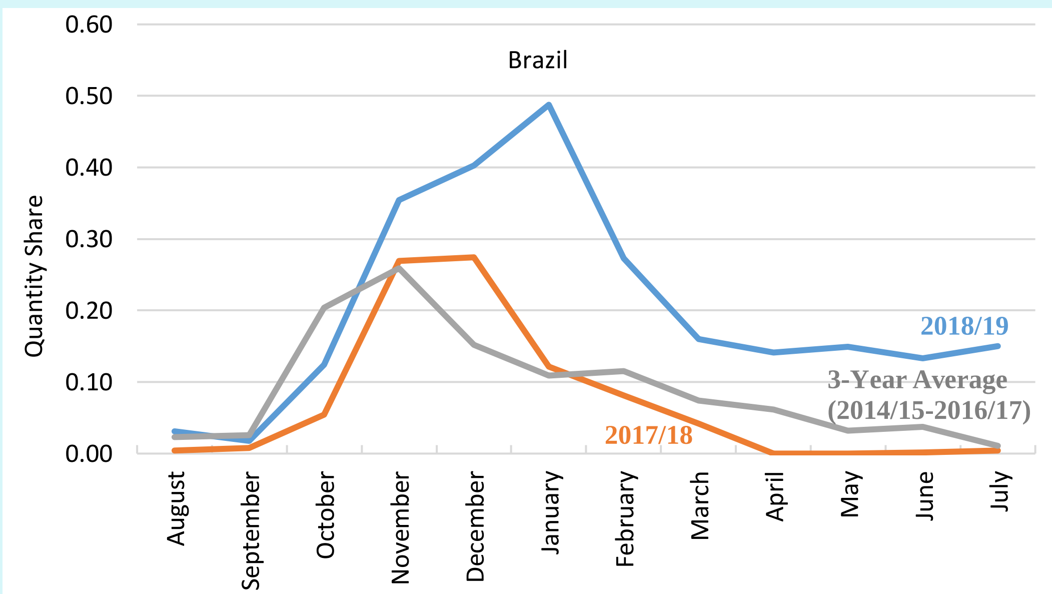
Figure 6 shows U.S., Brazil, and Australia shares of China's cotton imports in the current marketing year (2018/19) compared to the previous year (2017/18) and a three-year average (2014/15 to 2016/17). The U.S. share of China's cotton imports is lower compared to the previous marketing year and three-year average. With the exception of November 2018 and July 2019, there is not a single month in which the U.S. share of China's cotton imports exceeded the previous year or three-year average. The most notable differences are in February and March, which were peak periods in 2017/18. In February and March of the previous year, the U.S. share peaked at around 70% of all cotton imports in China; the three-year average for these months ranged from about 30% to 50%. In February and March 2019, however, the U.S. share was less than 10% and 30%, respectively.

While the U.S. share of China's cotton imports in 2018/19 are comparably lower, Brazil and Australia's shares are higher compared to previous years. Note that in January 2019, Brazil accounted for nearly half of all cotton imports in China, while in years prior Brazil only accounted for about 10%. Australia's share of China's cotton imports has averaged less than 5% during the winter and spring months in previous years but averaged around 20% in the current marketing year.

Although China's cotton imports have been recovering since 2015/16, current trade tensions are limiting U.S. cotton recovery and benefiting major competitors such as Brazil and Australia. This was particularly evident during the first few months of the 2019 calendar year as large purchases by the State Reserve of Brazilian cotton drove China's imports from Brazil sharply higher.

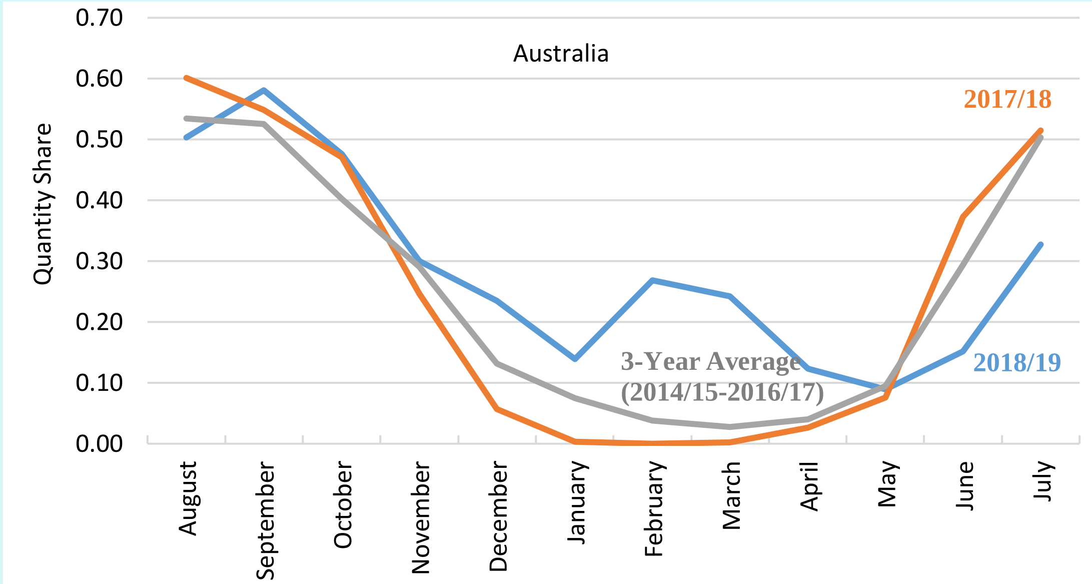
Figure 6. U.S., Brazil, and Australia Share of China Cotton Imports: Three-Year Average (2014/2015 to 2016/2017), 2017/2018, and 2018/2019





Note: Cotton: HS 5201 (cotton, not carded or combed). 25% tariff imposed in July 2018.
Source: Global Trade Atlas (2019).

Figure 6. U.S., Brazil, and Australia Share of China Cotton Imports: Three-Year Average (2014/2015 to 2016/2017), 2017/2018, and 2018/2019



Note: Cotton: HS 5201 (cotton, not carded or combed). 25% tariff imposed in July 2018.
Source: Global Trade Atlas (2019).

Potential Transshipments from United States to China via Vietnam

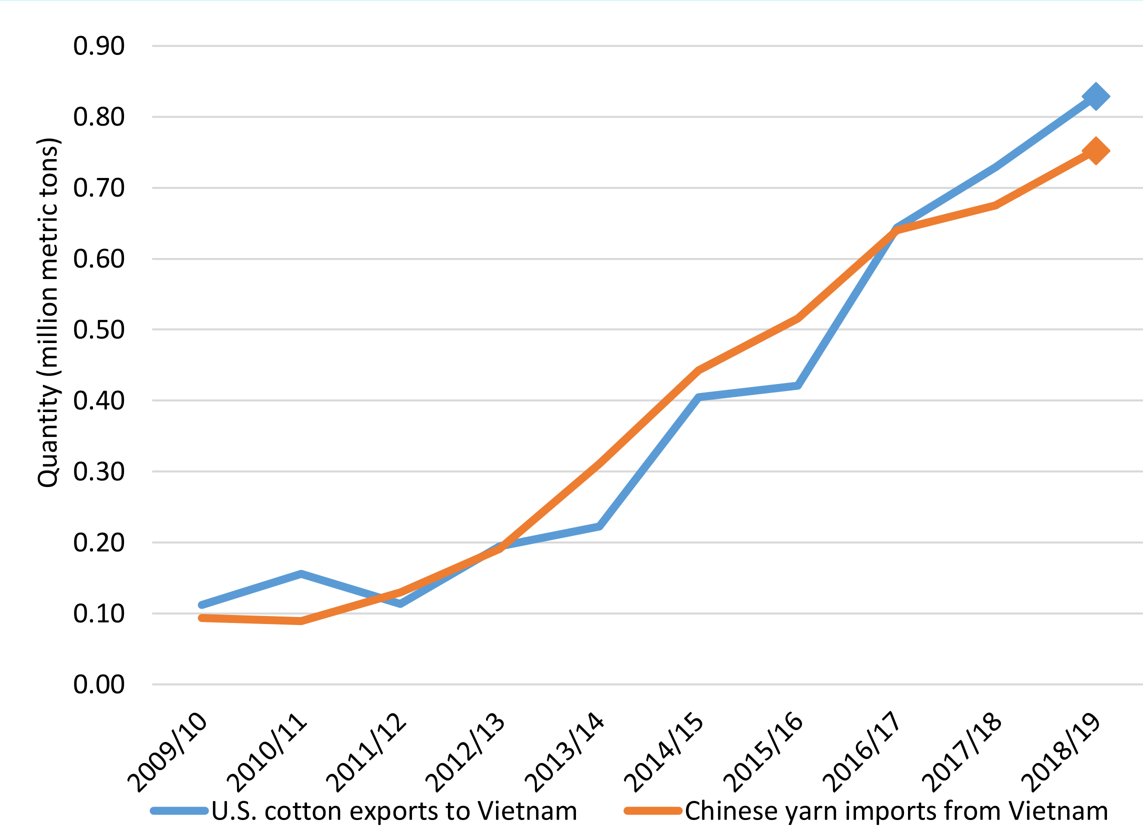
In recent years, Vietnam has emerged as the leading supplier of yarn to China. Vietnam's geographic proximity, beneficial trade arrangements, and a competitive cost structure have supported importing cotton and exporting yarn (USDA, 2019e). In 2009, Vietnam accounted for 10% of China's yarn imports. In the years that followed, Vietnam's yarn exports to China steadily increased and now account for about 40% (Global Trade Atlas, 2019). During this period, Vietnam's cotton imports more than tripled, with the United States accounting for an increasing share. In 2012, for instance, the United States accounted for 27% of Vietnam's cotton imports, rising to 50% by 2017 (United Nations, 2019).

Figure 7 shows U.S. cotton exports to Vietnam and China's yarn imports from Vietnam from 2009/10 to 2018/19. Note that there is a near perfect relationship between the two, which could indicate that the United States is supplying cotton to the Chinese market through Vietnam's yarn manufacturing sector.

Discussion and Conclusion

Because of the broad scope of U.S. agricultural products subject to the retaliatory tariffs and the importance of China to U.S. agricultural exports, many farmers are likely to experience negative effects, such as lower prices and/or lost market opportunities (see Grant et al. in this issue of *Choices*). The negative effects of retaliatory tariffs on U.S. soybeans have been discussed extensively (see Hitchner, Menzie and Meyers and Adjemian et al. in this issue of *Choices*). Cotton, another important U.S. export, has received significantly less attention. The USDA's long-run projections show China's total imports doubling in the four years after 2019, so constraints on U.S. cotton sales to China could become increasingly important. Further, the current retaliatory tariffs facing U.S. cotton exports could be stimulating additional cotton production in Brazil, potentially limiting the ability for the United States to regain market share in China if trade tensions are resolved.

Figure 7. U.S. Cotton Exports vs. Vietnam and China Yarn Imports from Vietnam, 2009/2010 to 2018/2019



Note: Marketing year starts August 1. Cotton: HS 5201 (cotton, not carded or combed); Yarn: HS 5205 (cotton yarn, other than sewing thread containing ≥ 85% cotton, not used for retail).

Overall, global trade and price data suggest that the U.S.–China trade dispute is having a negative impact on U.S. cotton prices and exports. It appears that China is replacing U.S. cotton with imports from Brazil, Australia, and other competing exporters to a lesser degree. This has occurred even as China's cotton imports have been increasing. The makeup of China's cotton and yarn imports has been changing over the last seven years, with the rise of Vietnam as the leading destination for U.S. cotton and subsequent exporter of yarn to China. The retaliatory tariffs may have a secondary effect of further reorienting/accelerating this global supply chain adjustment process.

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Implication of Trade Policy Turmoil for Perennial Crops

Daniel A. Sumner, Tristan Hanon, and William A. Matthews

JEL Classifications: Q17, Q18, Q11
Keywords: Agricultural trade policy, Tariff impacts, Trade retaliation, Tree nuts, Farm prices

Background

Continuing trade turmoil among the United States, China, and several other countries has led to retaliatory tariffs targeting U.S. agricultural exports, including tree and vine crops (also called perennial crops) (Regmi, 2019). Specifically, China imposed retaliatory tariffs on U.S. fruits, including apples, cherries, oranges, and grapes (including raisins and wine). Apple exports to India and Mexico were also subject to retaliatory tariffs, although Mexico removed these tariffs in May 2019 and India did not impose retaliation until June 2019. Starting in 2018, all major U.S. tree nuts—including almonds, pistachios, walnuts, and pecans—also faced significant retaliatory tariffs in China and (to a lesser extent) Turkey. India imposed retaliatory tariffs on almonds and walnuts in June 2019.

We summarize the complex pattern of retaliatory tariff increases across tree nut products and review how these trade barriers affect U.S. exports to these markets and the complex economic relationships that complicate isolating the economic impacts of retaliation. We offer preliminary assessments of market impacts using data on export quantities and values in relation to U.S. domestic production.

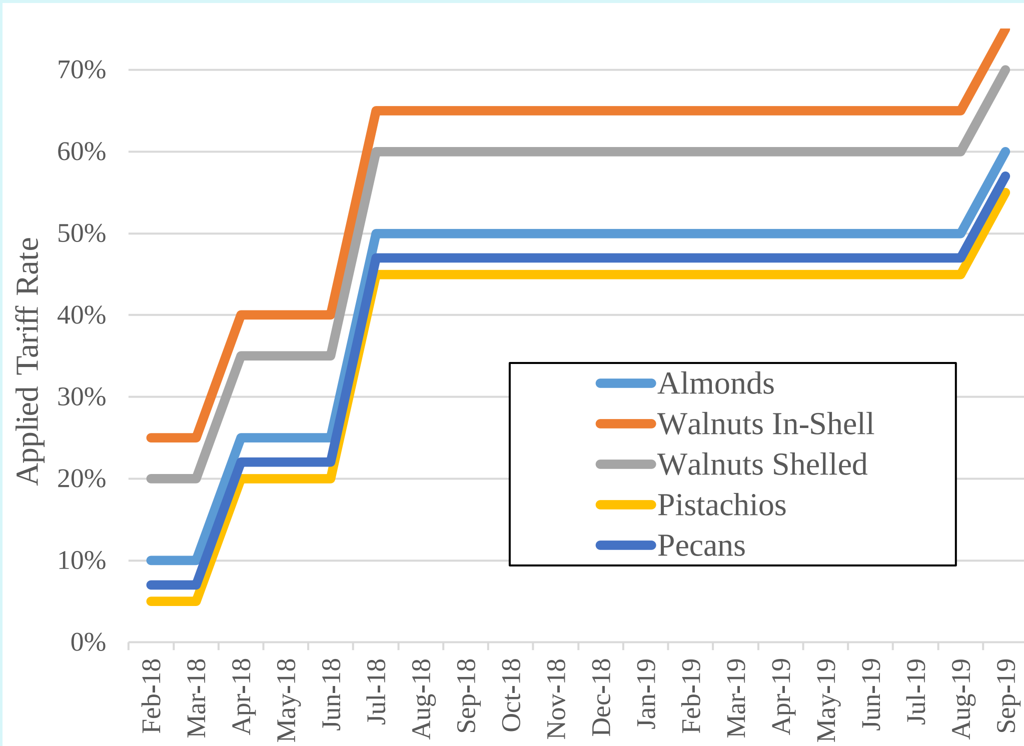
Changes in Tariffs on U.S. Tree Nuts

Figure 1 shows the timeline for China's retaliatory tariff increases on tree nuts. Prior to retaliation, the applied tariff rates were 5% for pistachios, 7% for pecans, 10% for almonds, 20% for shelled walnuts, and 25% for in-shell walnuts. The relatively high applied tariffs for walnuts are related to the fact that China has a large domestic walnut industry that competes with imports. As of November 2019, U.S. tree nuts faced an additional 50% retaliatory tariff compared to other exporters to China. In 2017, prior to the implementation of retaliatory tariffs, China and Hong Kong were the third largest regional export market for U.S. tree nuts (USDA, 2019a, USDA 2019e, USDA 2019f).

Figure 2 shows that applied tariff rates on U.S. tree nut exports to Turkey prior to retaliation were 15% for walnuts and almonds and 43.2% for pistachios. In June 2018, Turkey imposed a 10% retaliatory tariff on U.S. tree nuts, which increased to 20% in August 2018. By May 2019, the tariff was halved (10%). Turkey has been a smaller, but steady, market for U.S. tree nut exports, with exports valued at $308.4 million in 2017 (USDA 2019g, USDA 2018b, USDA 2018c).

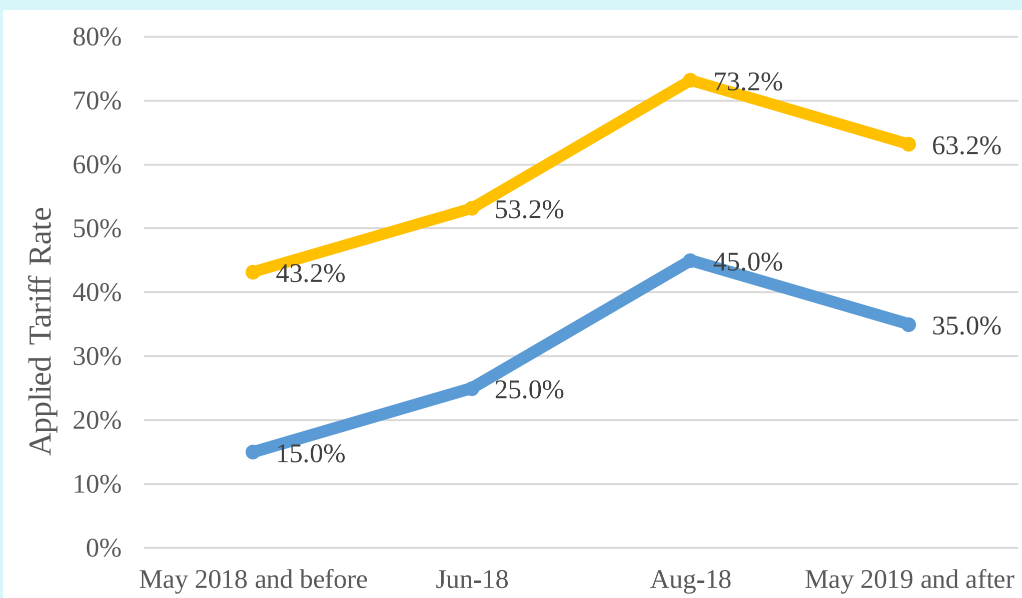
After announcing increases in almond and walnut tariffs in 2018, India did not apply these changes until June 16, 2019 (Table 1), after which India's walnut tariff rose from 100% to 120%. The tariff change applicable to India's almond imports is specified in Indian rupees per kilogram (i.e., a specific tariff), which is illustrated in Table 1, converted to U.S. dollars per kilogram using market exchange rates and the approximate *ad valorem* percentage tariff based on recent export prices of U.S. almonds to India. The specific per kilogram tariff was relatively low initially and rose by 20% for both in-shell and shelled almonds. In *ad valorem* equivalent terms, the tariff rose from 10% to 12% for in-shell almonds and from 26% to 31% for shelled almonds. India is a growing market for U.S. tree nuts and is currently the second largest single country market (USDA 2019b, USDA 2018a).

Figure 1. Timeline of Applied Tariff Rates on U.S. Tree Nut Exports to China



Source: U.S. Department of Agriculture, Global Agricultural Information Network (GAIN) Reports, multiple years.

Figure 2. Applied Tariff Rates on U.S. Tree Nut Exports to Turkey



Note: Blue is almonds and walnuts; Gold is pecans and pistachios.
Source: USDA 2019g. USDA 2018b and USDA 2018c.

Table 1. Applied Tariff Rates on U.S. Tree Nut Exports to India

	Almonds In Shell	Almonds Shelled	Walnuts In Shell
Before June 16, 2019	$0.50/Kg	$1.43/Kg	100%
Approximate tariff	10%	25%	n/a
June 16, 2019 and after	$0.60/Kg	$1.72/Kg	120%
Approximate tariff	12%	30%	n/a

Source: USDA 2019b, USDA 2018a
Note: Tariff rate changes were for almonds were calculated using the exchange rate for Indian rupees per dollar on June 16, 2019, the day new applied tariff rates went into effect.

In addition to tariffs, governments may use other measure to discourage imports from disfavored sources. For example, much research deals with the differential application of sanitary or phytosanitary measures that limit imports. Other impediments may be less legalistic or transparent. For example, in some countries (such as those with many state-owned firms or regulations that may be enforced differentially) government announcements about trade conflict may be sufficient to reduce imports from less favored sources. Less transparent trade impediments are difficult to quantify but may coincide with retaliatory tariffs. It would be a mistake, however, to attribute all policy-induced changes in trade patterns to changes in tariffs alone.

Characteristics of Perennial Crops and Likely Impacts of Trade Turmoil

To assess the likely impacts of retaliatory trade measures on U.S. perennial crop exports, it is instructive to consider four supply/demand and trade characteristics. First, acreage of perennial crops adjusts slowly. Because quantities are difficult to adjust, negative demand shocks may cause large declines in prices of perennial crops.

Second, for many major perennial crops, U.S. exports represent a large share of total world exports. For example, U.S. exports represent between 85% and 90% of world exports of almonds and typically account for 50% or more of world exports of pecans, pistachios, and walnuts (USDA 2019e, USDA 2019f). These high trade shares suggest that U.S. tree nut growers may experience larger market impacts caused by trade shocks.

Third, unlike grains and oilseeds, many relatively small and specialized firms handle the export of tree and vine crop products from the United States. As a result, tree nuts and other perennial crops may face higher costs and delays in reorienting exports to other markets.

Fourth, U.S. tree nut and tree fruit exports may also enter China via re-exports through Hong Kong and Vietnam, which means many of these sales are not captured in official trade data. For example, subtracting official re-exports to China and other countries from exports into Hong Kong leaves implausibly high per capita use if those nuts were to remain in Hong Kong. Similarly, according to USDA’s production, supply, and distribution tables (USDA 2019d), there is very little domestic consumption of almonds, pistachios, and walnuts in Vietnam. For the 2015/2018 marketing years, we find that 30,400, 6,800, 4,600, and 21,500 metric tons of U.S. almonds, pecans, pistachios, and walnuts were exported to Vietnam (USITC Dataweb 2019). These quantities represent about 180% of the almonds, pecans, pistachios, and walnuts combined that were exported officially to China over the same period. The population of Vietnam is only 7% of the population of China, suggesting that per capita imports are inconsistent with consumption in Vietnam. We estimate that about 90% of the tree nuts imported into Vietnam were likely re-exported to China. Thus, for this analysis, we include exports to Hong Kong and Vietnam in total U.S. exports that likely entered China prior to the imposition of retaliatory trade impediments.

Impacts of Trade Retaliation on the Share of Production Exported

The price impact of trade retaliation for a product depends, in part, on the importance of the affected markets in total demand for that product. Table 2 provides average U.S. tree nut production and export data for 2016/2018 for almonds, pecans, pistachios, and walnuts. Since these are fall-harvested crops, much of the quantity produced in one year is exported in the subsequent calendar year. Therefore, we refer to ratios of exports to production rather than to export share of production. Using a three-year average helps smooth production and export data. Second, harvested area for almonds and pistachios has been expanding rapidly, so average "export shares" are likely to exceed the ratio of exports to production shown in Table 2. Third, certain tree nuts, such as pistachios, experience significant variation in yield (known as alternate bearing), so even a three-year average needs to be interpreted with care. In the case of pistachios, the 2016–2018 period includes a very large crop produced in 2018, most of which had not yet been exported in these data.

Table 2: U.S. Production and Exports of Tree Nuts, Average 2016/2018

	Almonds	Pecans	Pistachios	Walnuts
Value of production ($millions)	5,375	610	1,712	1,241
Ratio of average quantity exported to average quantity produced	65%	75%	48%	70%
Ratio exported to countries applying retaliatory tariffs	19%	23%	26%	15%
Exported to China	10%	23%	24%	6%
Exported to India	7%	0%	1%	2%
Exported to Turkey	2%	0%	2%	8%

Source: Production data comes from USDA NASS QuickStats. Trade data comes from USITC DataWeb, based on U.S. Department of Commerce, Census Bureau data.
Notes: These data are annual calendar-year production and exports and much export of each crop occurs in the following calendar year. Reported shares of exports to China include exports to Hong Kong and Vietnam.

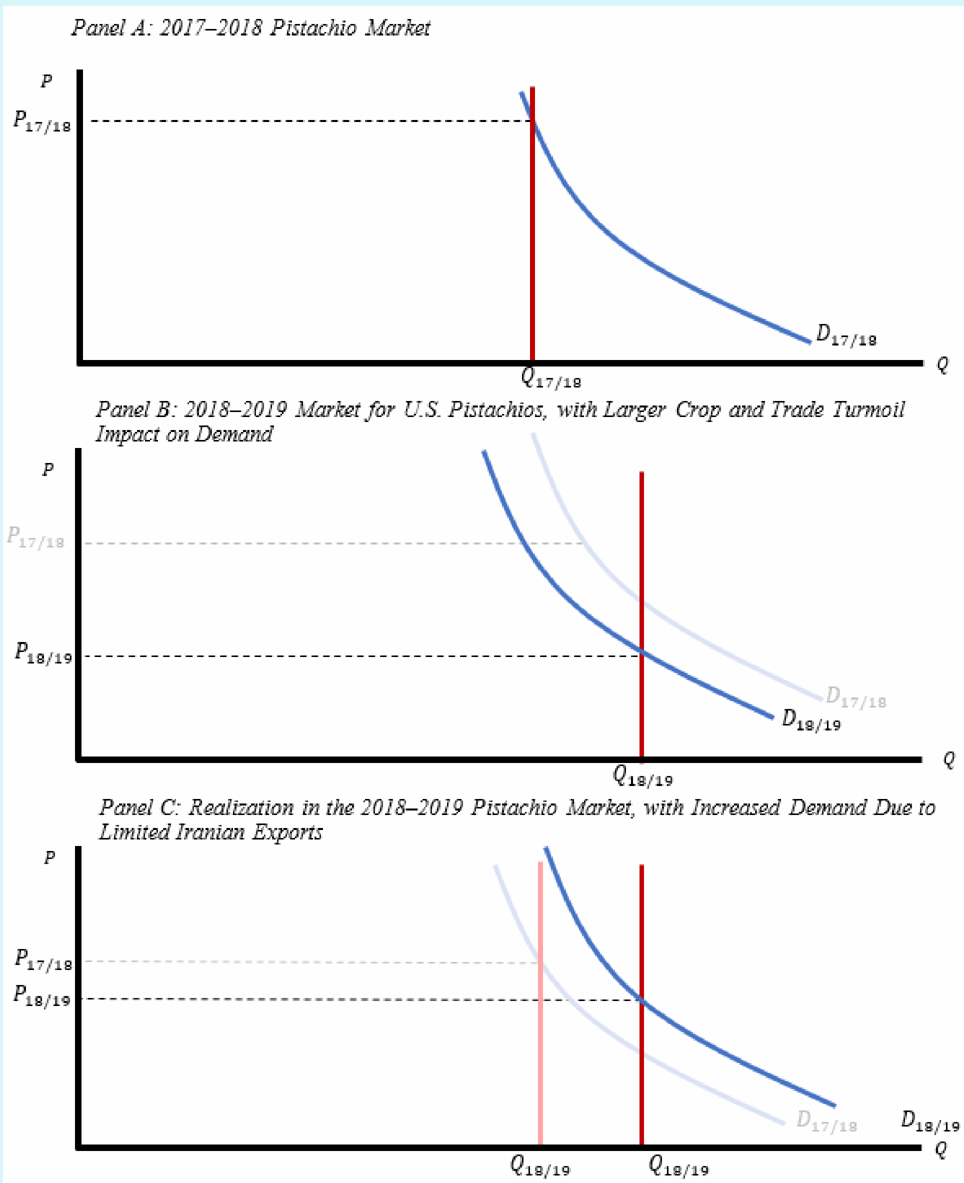
For almonds, which have a larger value of production than the other three tree nuts combined, 65% of the crop is exported, on average, and 19% was shipped to the countries that have applied retaliatory tariffs (China, Turkey, India). Exports to China, which has the highest retaliatory tariffs on almonds (see Figure 1), accounted for 10% of U.S. production. Exports to China account for 23% of pecan production, 26% of pistachio production, and 6% of walnut production. For walnuts, exports to Turkey (8% of production) were higher.

Supply and Demand Variability Complicates Isolating the Impacts of Trade Retaliation

Retaliatory tariffs do not occur in isolation. Supply or demand shifts often occur simultaneously, which can make it challenging to sort out impacts. Here, we use an example of recent pistachio market variation to illustrate the effects of the retaliatory trade measures in the context of year-to-year changes in U.S. and foreign pistachio production.

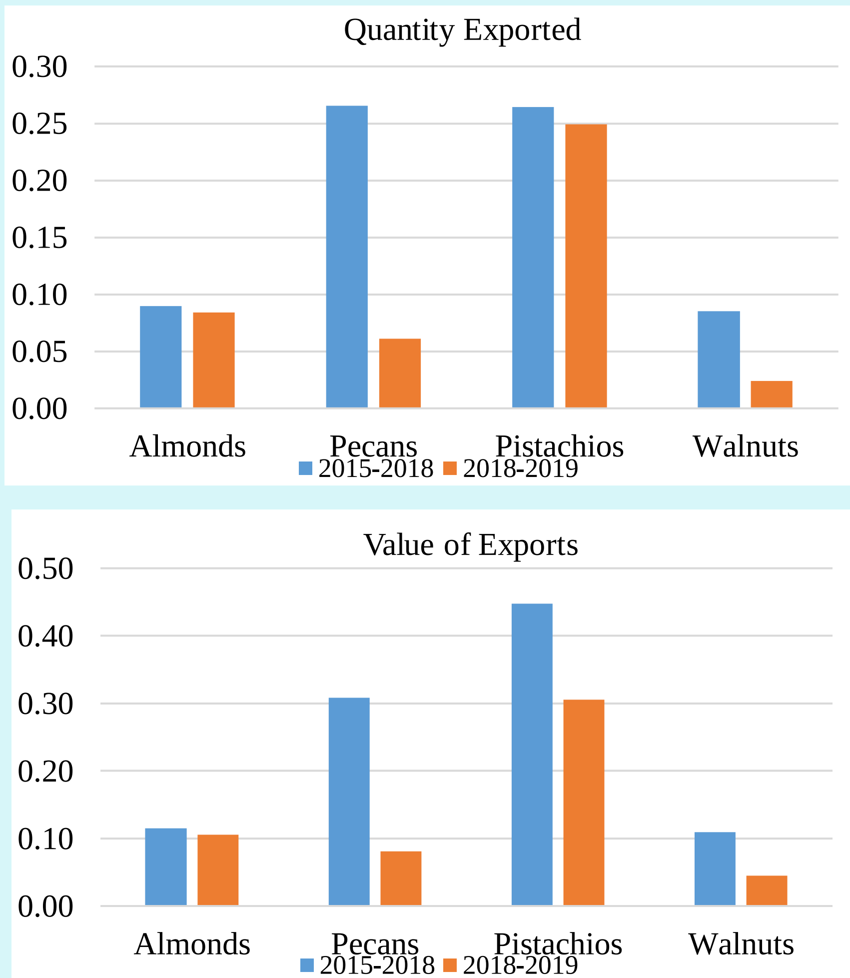
Panel A of Figure 3 represents a stylized version of the market for U.S. pistachios for the 2017/2018 marketing year. This was the period in which the pistachio crop harvested in the fall of 2017 was marketed, mostly before tariff retaliation was underway. $D_{17/18}$ and $D_{18/19}$ represent downward-sloping pistachio demand and $Q_{17/18}$ and $Q_{18/19}$ represent fixed short-run pistachio supply in the 2017/2018 and 2018/2019 marketing years, respectively. Equilibrium prices in each marketing year are determined by the intersection of demand and supply represented by $P_{17/18}$ and $P_{18/19}$. In Panel B, we see that equilibrium prices are compounded not only by the effects of the retaliatory trade measures represented by a leftward shift in demand to $D_{18/19}$ but also by a larger U.S. crop, represented by a rightward shift in U.S. supply ($Q_{18/19}$). This suggests that the price of pistachios has fallen even more than would have been the case due to retaliatory tariffs alone.

Figure 3. Stylized Representations of Supply of and Demand for U.S. Pistachios



Finally, Panel C of Figure 3 adds a world market perspective to the U.S. pistachio supply and demand situation. In fall 2018, Iran, the only significant competitor to U.S. pistachios in the world market, experienced an extreme weather shock. The collapse of Iranian pistachio production and exports ($Q_{18/19}$) led to an increase in export demand for U.S. pistachios, approximately equivalent to the quantity that would have been supplied by Iran in a normal year. Thus, the lack of exports from Iran allowed U.S. exports to expand without a significant collapse in the market price due to retaliatory tariffs.

Figure 4. Quantity and Value of Exports to China as a Share of Total Production



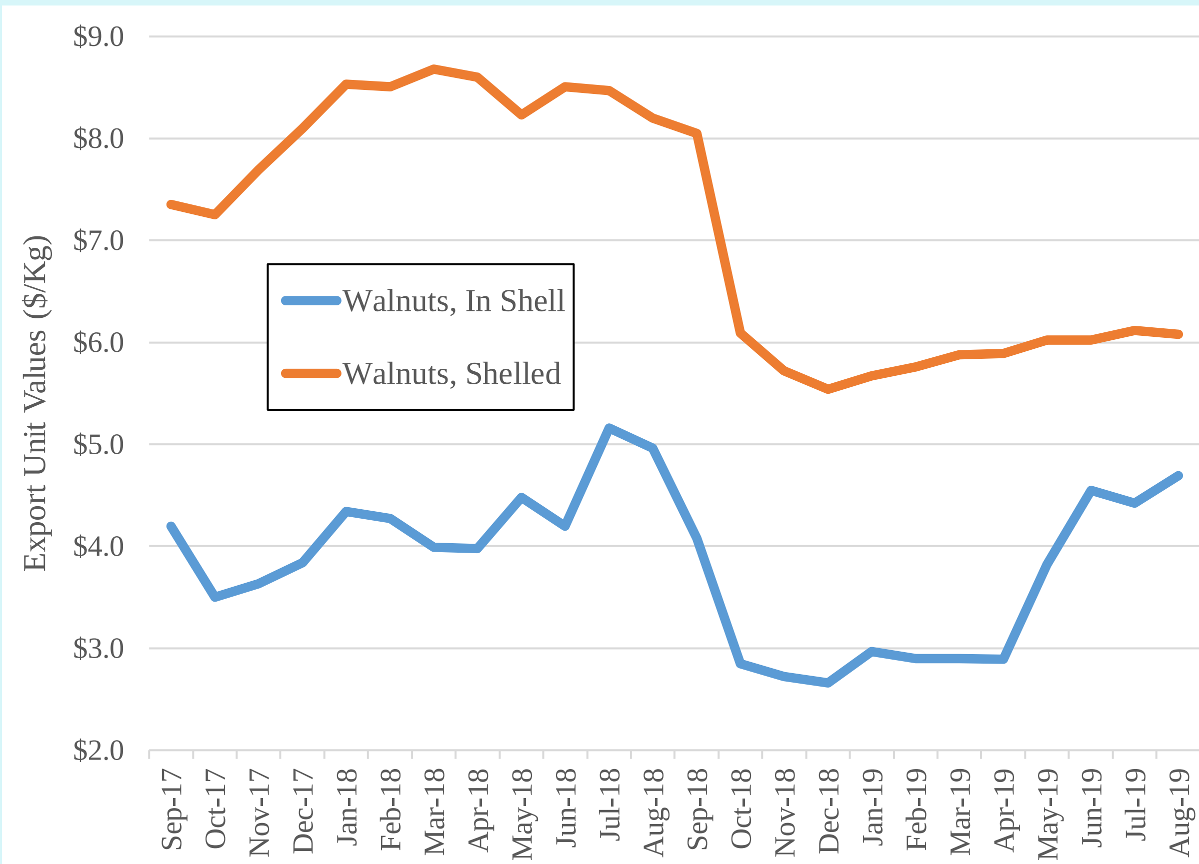
Source: Production data comes from USDA NASS QuickStats. Trade data comes from USITC DataWeb, based on U.S. Department of Commerce, Census Bureau data.
Note: 2015/2018 represents the average share of export for marketing years 2015/2016 through 2017/2018.

Trade Retaliation and the Pattern of Production, Exports and Prices for Tree Nuts

Tree nut acreage has grown significantly in recent decades, and China is a significant market for these products (Table 2). Figure 4 shows that the quantity and value of exports as a share of production to China fell in the marketing year 2018/2019, which was affected by retaliatory tariffs, compared to the base period comprised of average exports as a share of production in marketing years 2014/2015 through 2017/2018.

For almonds, the U.S. share exported to China was only 8% lower by quantity and 10% lower by value in 2018/2019. For pecans, the story is dramatically different, with a collapse in shipments to China from 26% on a quantity basis to 5% and from 30% to 7% on a value basis. The result was an extreme decline in the U.S. export per unit price of pecans. China continued to take a little over 20% of the quantity of U.S. pistachios, but the price premium in China fell substantially such that the share of exports to China by value of production fell from 39% to 26%. For walnuts, the China export share of both quantity and value fell substantially, from 8% to 2% by quantity and from 10% to 4% by value.

Figure 5. Monthly Export Unit Values for U.S. Walnuts, over Two Crop Years



Source: Trade data comes from USITC DataWeb, based on U.S. Department of Commerce, Census Bureau data.

To further illustrate impacts of trade turmoil, Figure 5 examines month-by-month export prices of walnuts to all destinations. Walnuts are sold both in shell and shelled and tariff rates rose for both. Shelled walnuts command a premium price and per unit export prices were above $8/kg through the end of the 2017/2018 marketing year in August 2018. During that period, the per unit export price of in-shell walnuts climbed to reach $5/kg. Then, as new trade barriers were implemented, the per unit export price of walnuts collapsed by more than 40% for both shelled (to $5.50/kg) and in-shell walnuts (to $2.70/kg). Prices of shelled walnuts to all destinations (the higher valued export category) have risen only gradually, while in-shell walnut prices rose rapidly beginning in April 2019. Thus, some of the short-term impacts of trade turmoil for less storable crops, such as shelled walnuts, can be observed in export prices rather than in export quantities.

Final Remarks

Recent U.S. tariffs spawned retaliatory trade measures across many products. This article has documented some of the consequences of the resulting trade turmoil for perennial crops, especially tree nuts. These crops are especially export dependent, acreage does not adjust quickly and shifting to new export destinations is costly and slow. Therefore, the industries discussed have faced low market prices relative to what would have occurred.

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Impact of Retaliatory Tariffs on the U.S. Pork Sector

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JEL Classifications: F10, F13, F14, Q17, Q18

Keywords: China, Pork exports, Retaliatory tariffs, African swine fever, Mexico, United States

Overview

In 2018, the U.S. agricultural sector was hit by retaliatory tariffs that China and other major trading partners implemented in response to U.S. actions undertaken in Section 232 investigations on steel and aluminum and Section 301 investigation of China's policies related to technology transfer and intellectual property. The U.S. pork sector was especially hard hit, as China and Mexico imposed retaliatory tariffs of 25% and 20%, respectively, in response to U.S. Section 232 actions and an additional 25% in response to U.S. Section 301 action. As a result, total applied tariffs on selected U.S. pork products to these two markets ranged from 20% to 80%.

China and Mexico are major importers of U.S. pork, accounting for nearly 32% of U.S. pork and pork product exports, valued at over $1.98 billion. In 2017, China sourced nearly 13% of its pork and pork product imports by value from the United States, while U.S. pork and pork products accounted for 89% of Mexico's pork imports (Trade Data Monitor, 2019).

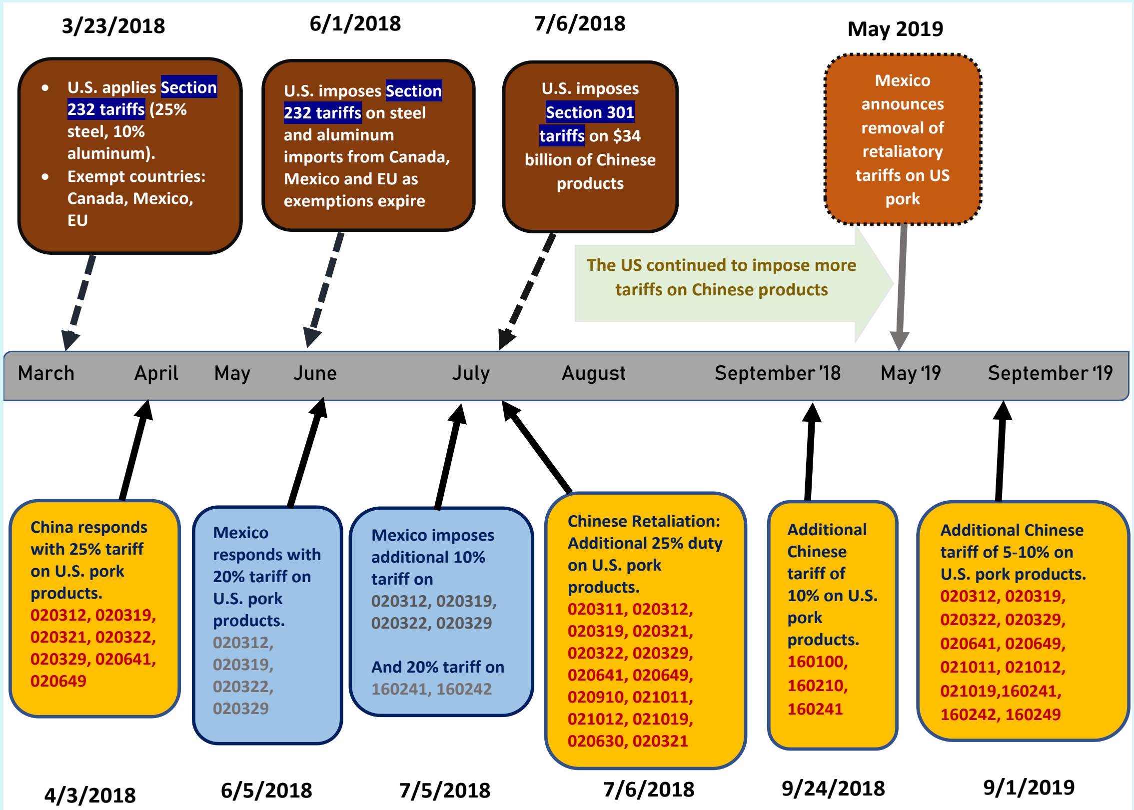
U.S. pork and pork products in all the major categories were affected by the retaliatory tariffs. Figure 1 presents a timeline for the imposition and retaliation activity by the United States, Mexico and China. Eighteen pork products (using the Harmonized System 6-digit (HS-6) code) were affected. China imposed retaliatory tariffs of 25% on April 3 and additional tariffs on July 6, 2018, September 24, 2018, and September 1, 2019. In some instances, the same products were hit either twice or thrice by China's retaliatory tariffs.

Mexico responded with tariffs on pork ranging from 10% to 20% on June 5, 2018 and established a tariff rate quota (TRQ) of 350,000 metric tons for Harmonized System (HS) Codes 0203.12.01, 0203.19.99, 0203.22.01, and 0203.29.99. One month later, on July 5, 2018, those products with a 20% tariff then faced an additional 10% tariff.

In addition to the retaliatory tariffs, global pork markets were affected by another major shock: the outbreak of African Swine Fever (ASF) in China. ASF is a severe, highly contagious viral disease affecting domestic and wild pigs. The first outbreak of ASF was confirmed on August 3, 2018. Since then, China has reported 158 outbreaks to the World Organization for Animal Health (as of October 3, 2019), with official losses of 1.2 million animals reported (FAO, 2019). However, the reported losses are small relative to China's total herd size of over 400 million head; according to a Reuters news report, culling may have been far heavier than reported (Patton and Gu, 2019). Accounting for nearly half of the world's hogs, and the top pork producer and consumer (USDA, 2019), expectations of higher Chinese demand for imports have driven growth in global pork prices.

This paper takes an in-depth look at how retaliatory tariffs have affected U.S. and global pork trade over the past year. Assessing the impacts of tariffs is challenging given the import demand shock in China resulting from ASF. To provide some insights, we examine changes in U.S. pork exports to China and Mexico, referred to as "trade deltas," following the imposition of the tariffs. We then perform an *ex ante* analysis using an Almost Ideal Demand System estimation. This empirical assessment provides evidence of the impact of the tariffs prior to the outbreak of ASF, thereby isolating its impact from the tariffs. We then compare the *ex ante* estimates to trade deltas that have since been observed following the tariffs, which are however confounded by ASF.

Figure 1. Timeline of U.S. Sections 232 and 301 and Ensuing Retaliations



Source: Authors' compilation.

Observed Changes in U.S. Pork Exports to China and Mexico

We first examine changes in U.S. pork exports to retaliatory partners that occurred following the imposition of the retaliatory duties. We use a simple calculation of the before and after change in U.S. pork exports, or trade delta, by comparing average monthly pork exports to China and Mexico for the 15 months prior to the retaliatory tariffs with the 15-month period after imposing the tariffs. We recognize that examining trade deltas only provides a simple before and after statistic that does not account for other factors, namely ASF. We further note that the trade deltas are sensitive to the period defined under the before and after change.

Table 1 shows the before and after change in U.S. pork and pork product exports to China post-retaliation. On average, all U.S. pork and pork product exports to China declined 23% by value. Declines were seen in all the product groups except fresh and chilled pork. U.S. variety meat exports saw the largest percentage decline in quantity (−35%) and value (−41%), followed by processed meats (−35% and -36%, respectively), and frozen meat exports (−6% and −1%, respectively). Despite the tariffs, export quantities of U.S. fresh and chilled pork (representing less than 0.1% of U.S. pork exports to China) increased by 10% but saw a decline of 6% in value.

Brazil appeared to be the likely beneficiary of these retaliatory tariffs, especially frozen pork (+125%) and variety meats (+237%). Canada also showed a slight increase in value of exports to China for its frozen (27%), variety (2%), and processed meats (2%). Interestingly, the value of exports to China from the rest of the world also declined (−73%) under retaliatory tariffs, while exports from the European Union (EU), the top global exporter of pork to China, increased by 11%. Tariffs on U.S. pork were introduced at a time when Chinese domestic production was expanding and hog prices were low. However, pork imports from the United States have always shown a long-term uptrend. The outbreak of ASF in China in August 2018 saw the culling and destruction of segments of the domestic pig population. Despite this animal disease outbreak, import demand was muted and actually fell during 2018.

Table 1. Trade Delta: Before and After Change in All Pork and Pork Product Exports to China Post Retaliation, April 2018–June 2019

Products	Export Value (%) U.S.	Brazil	Canada	EU	ROW	Total	Export Quantity (%) U.S.	Brazil	Canada	EU	ROW	Total
Fresh/chilled	−6	--	--	2	30	12	10	--	--	5	−30	1,794
Frozen	−6	125	27	11	−23	17	−1	131	19	12	−23	23
Variety meats	−41	237	2	8	−85	−23	−35	149	−8	4	−81	−56
Processed meats	−35	--	2	122	10	103	−36	--	12	85	109	36
All pork products	−23	125	21	11	−73	1	−19	131	13	10	−67	−14

Source: Authors' calculations using Trade Data Monitor (2019).
Note: For ease of analysis we group these products into four broad categories —fresh/chilled (0203.11, 0203.12, 0203.19), frozen (0203.21, 0203.22, 0203.29), variety meats (0206.30, 0206.41, 0206.49) and processed meats (0209.10, 0210.11, 0210.12, 0210.19, 1601.00, 1602.41, 1602.41, 1602.42, 1602.49). ROW indicates rest of world.

Table 2. Trade Delta: Before and After Change in All Pork and Pork Product Exports to Mexico Post Retaliation, June 2018–July 2019

Products	Export Value (%) U.S.	Canada	ROW	Total	Export Quantity (%) U.S.	Canada	ROW	Total
Fresh/chilled	−23	38	−76	−17	−11	29	−100	−7
Frozen	−21	82	212	−16	−15	67	3	−5
Variety meats	−25	6	13	−15	−12	−1	−7	−10
Processed meats	−14	13	7	−14	−24	−5	76	−18
All pork products	−21	33	12	−15	−13	19	21	−9

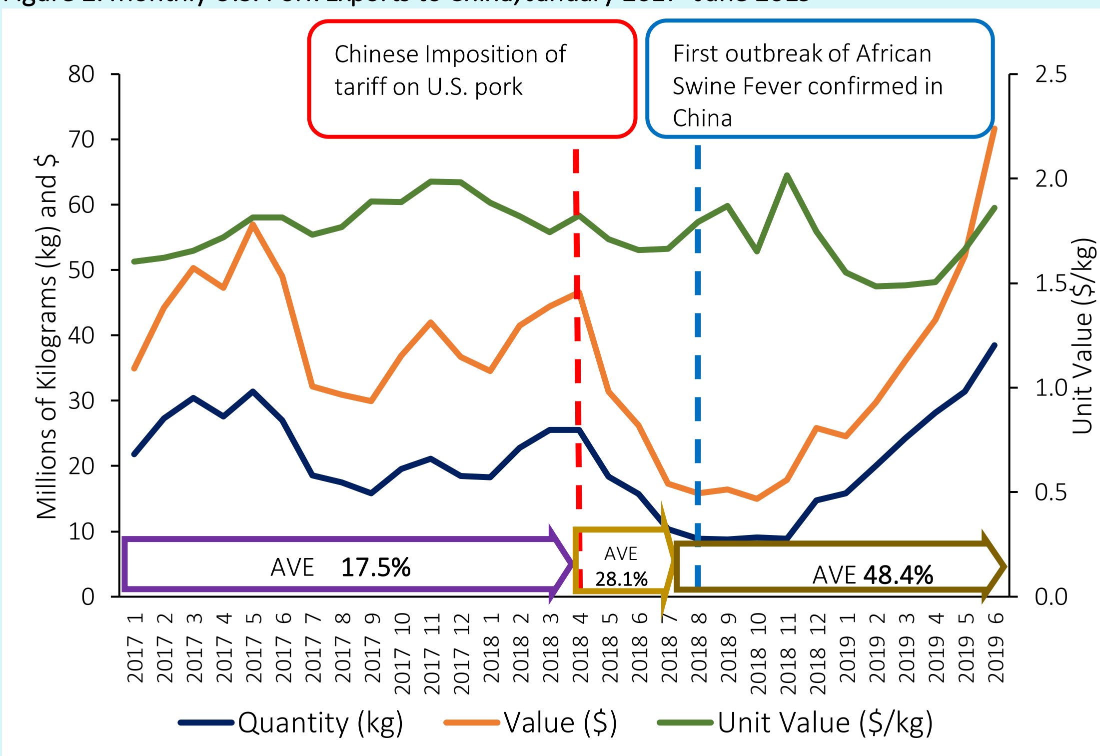
Source: Authors' calculations from Trade Data Monitor (2019).
Note: ROW indicates rest of world.

Table 2 presents the before and after change in pork and pork product exports to Mexico post-retaliation. On average, U.S. exports of all pork products to Mexico declined 15% in value but only 9% in quantity. This would suggest that Mexico imported a greater mix of lower-value meat after imposing retaliatory tariffs. The declines in value of U.S. exports to Mexico were evenly distributed across pork product varieties. Fresh/chilled and frozen meat exports declined in value by 23% and 21%, respectively, while variety meat exports declined 25%. Processed meat saw a 14% decline in exports from the United States. Canada was the biggest beneficiary from Mexico's retaliatory tariffs. Canada's overall pork exports to Mexico expanded by 33% in value, with fresh/chilled (38%) and frozen (82%) pork categories showing the largest increases.

It is important to note that "before and after" trade change does not account for other exogenous factors that can influence trade. Further, trade change calculations are highly sensitive to time frame. For instance, comparing a 12-month rolling average prior to tariffs to the 12 months post-tariff imposition, U.S. pork exports to China fell by 35% and 40% in quantity and value, respectively. However, using a 15-month time frame, U.S. pork exports to China fell by 23% and 19% in quantity and value, respectively. This suggests that other factors beyond the tariff, particularly ASF, may have impacted the decline in exports to China even in the face of prohibitive retaliatory tariffs on U.S. pork products. The 15-month time frame included three additional months of culling due to the spread of ASF and clearly resulted in a greater need for imported pork. As shown in Figure 2, monthly U.S. pork exports to China during months when it was impacted by retaliatory tariffs were relatively weak, but after ASF was confirmed, monthly U.S. exports to China accelerated during the latter part of 2018 and the first half of 2019.

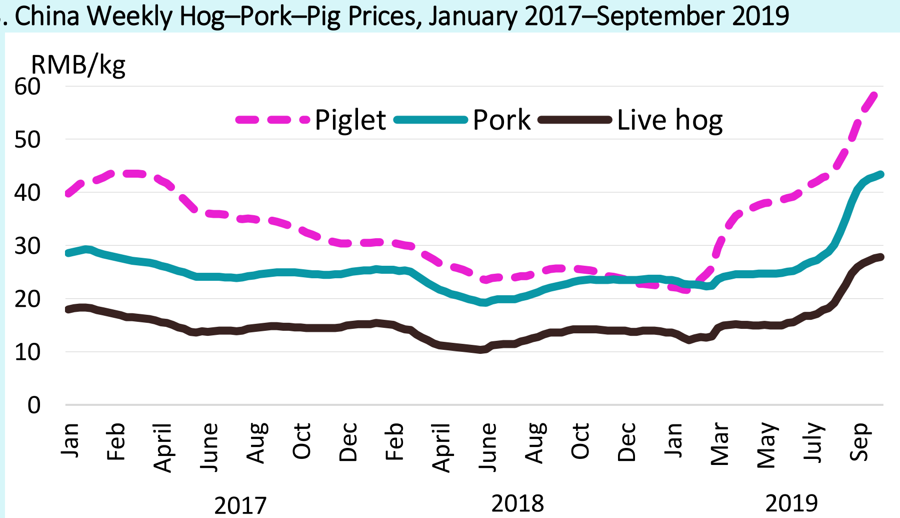
This increase in U.S. pork exports to China occurred despite the tariffs and reflects the significant impact ASF had on Chinese pork production and prices. As culling from ASF continued and Chinese pork supply tightened, domestic prices trended upwards. Figure 3 shows an inflection point in China's pig, pork, and live hog prices in February 2019, which almost doubled by September 2019. While retaliatory tariffs on U.S. pork limited shipments during

Figure 2. Monthly U.S. Pork Exports to China, January 2017–June 2019



Source: Authors' calculations using data from International Trade Centre (2019) Market Access Map.
Note: AVE is estimated as the simple average *ad valorem* equivalent of Chinese tariffs on U.S. pork products; April 2018, 28.1%; July 2018, 48%; and September 2019, 54.9%.

Figure 3. China Weekly Hog–Pork–Pig Prices, January 2017–September 2019



Source: Ministry of Agriculture and Rural Affairs China (2019).

2018 and the beginning of 2019, steep gains in Chinese pork prices have increased the price competitiveness of U.S. pork, even with retaliatory tariffs in place.

How Do Trade Deltas Compare with *Ex Ante* Simulated Changes?

A number of studies have looked at the *ex ante* impact of retaliatory tariffs on U.S. agricultural commodities (Muhammad and Smith, 2018; Taheripour and Tyner, 2018; Zheng, et al., 2018; Elobeid et al., 2019), all of which have shown some level of U.S. exports decline. To gain further insights into Chinese and Mexican demand for U.S. pork after exposure to retaliatory tariffs, we employ the nonlinear Almost Ideal Demand System (NAIDS) model specified by Deaton and Muellbauer (1980). We estimate China and Mexico's short-run pork import demand parameters, compute corresponding source-based elasticities, and assess the impacts of the retaliatory tariffs on pork trade. The analysis does not directly address the range of supply issues that may impact the ability of any source country to export pork products. Instead, we assume that supply from each model country/region is perfectly elastic and that Chinese and Mexican importers (wholesalers) determine the quantities to be imported from individual countries based on product market prices and consumer preferences.

Chinese and Mexican importers are expected to pay a higher price for imported U.S. pork and pork products when retaliatory duties are in place. Higher prices make U.S. pork and pork products less competitive relative to imports from other countries. Higher prices of imported products from the United States are expected to result in "real" expenditure decreases of China and Mexican pork products. Since all competing countries will likely have a relative price advantage from the tariff increase on U.S. pork, we must consider both own- and cross-price effects. Cross-country competitiveness assumes that similar products are differentiated by country of origin. The elasticity of demand for aggregate imports is derived from the share of the imported products in the market. We derive the impacts of retaliatory tariffs for imported pork in China and Mexico by multiplying the calculated own- and cross-price elasticities by the corresponding specified tariff increases.

We obtained export quantities and expenditures for each HS-6 pork product from Trade Data Monitor (2019) (https://www.tradedatamonitor.com/). All import expenditures are on a free on board (FOB) basis. Using expenditures and quantities, we calculated per unit values ($/kg) for each commodity. Due to the persistence of zero imports of some of the HS-6 commodities for several months, we summed the data across all HS-6 products to derive total pork exports to Mexico and China from all trading partners.

Tables 3 and 4 present the own- and cross-price elasticities for imported pork products in China and Mexico, respectively. China is relatively price responsive to pork imports, with own price elasticities ranging from −0.790 to −3.375, but it is the least responsive to price changes in U.S. pork product

Table 3. Price Elasticities for China Pork Imports, 2001–2017

	Own-Price and Cross-Price Elasticities for Each Exporters				
Exporter	**Canada**	**U.S.**	**EU**	**Brazil**	**ROW**
Canada	**−1.024*** **	−0.257	−0.522	0.093	−0.235
U.S.	−0.023	**−0.790***	1.515**	0.407***	−0.919***
EU	−0.006	0.173	**−3.375*** **	−0.527***	0.803**
Brazil	0.978	3.593***	−14.854***	**−1.606** **	2.112
ROW	−0.028	−0.770**	4.324***	0.474**	**−1.357**

Source: Authors' calculations using the Trade Data Monitor (2019).
Note: Single, double, and triple asterisks (*, **, ***) denote significance at the 10%, 5%, and 1% levels, respectively. ROW indicates rest of world.

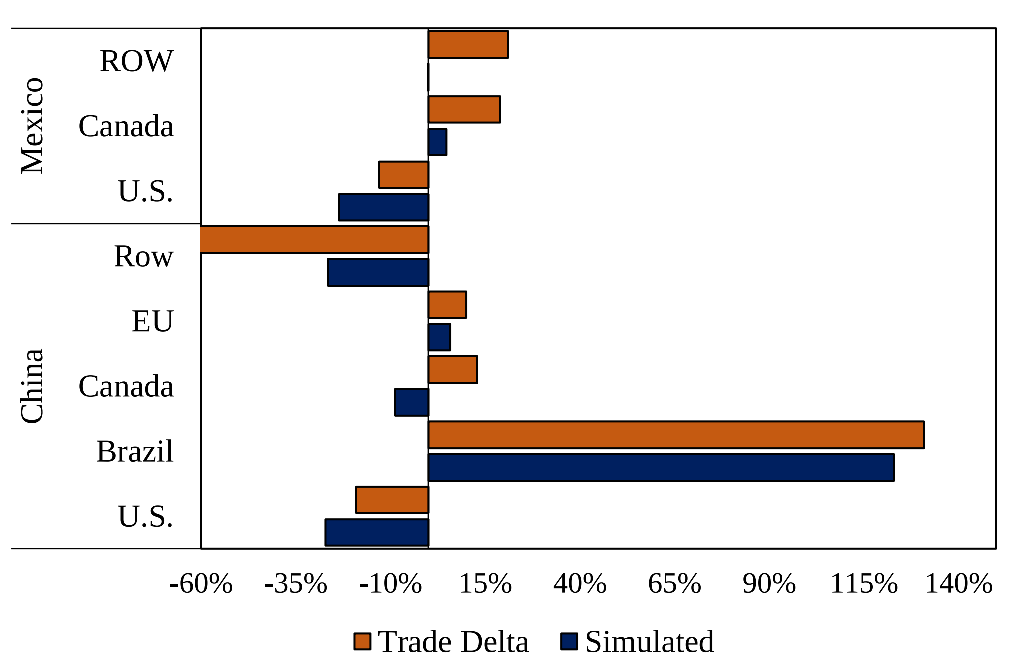
Table 4. Price Elasticities for Mexico Pork Imports, 2001–2017

	Own-Price and Cross-Price Elasticities for Each Exporter		
Exporter	**Canada**	**U.S.**	**ROW**
Canada	**−0.870*** **	0.208	−0.002
U.S.	−0.012	**−1.020*** **	0.002**
ROW	−0.058	−0.004	**−1.074*** **

Source: Authors' calculations using Trade Data Monitor (2019).
Note: Single, double, and triple asterisks (*, **, ***) denote significance at the 10%, 5%, and 1% levels, respectively. ROW indicates rest of world.

imports. However, China is highly responsive to price changes in imports from the European Union and Brazil. Mexico's price response to imports from the United States, on the other hand, is more muted, with almost equal percentage changes in price resulting from a change in pork imports from all trading partners.

Figure 4. Trade Delta versus Simulated Change in Pork and Pork Products Import Quantity by China and Mexico Post Retaliation



Source: Authors' calculation using Trade Data Monitor (2019).

Figure 4 compares the before and after change in pork product quantity imported by Mexico and China with the *ex ante* simulated change in import quantity. The *ex ante* model provided reasonable predictions of the directional changes in imports but in many cases underestimated the before and after change in imports. For instance, the *ex ante* simulated changes in Mexico's import quantity from the rest of the world (+ 0.1%) and from Canada (+4.8%) were lower than the before and after estimated average change in imports of +21% and +19%, respectively. Likewise, the average changes in China's imports from the rest of the world (−67%), EU (+10%), Canada (13%), and Brazil (131%) were also higher (in absolute value) than the *ex ante* simulated changes in import quantity: −26.4, +5%, −8.8%, and +123%, respectively. The higher-than-expected increase in imports observed *ex post* is likely attributed to increasing China import demand stemming from ASF.

However, in the case of imports from the United States, the before and after trade delta tends to be lower than the *ex ante* model simulated changes in imports. For example, the before and after changes in China's and Mexico's imports of U.S. pork are −19% and −13% in quantity, respectively, and are smaller, in absolute value, than the *ex ante* simulated decreases in the quantity imported of −27.1% and −23.6%, respectively. The higher-than-expected model estimated Chinese imports from the United States suggests that U.S. pork exports under the confounding influence of China's ASF outbreak would likely result in significantly higher exports had the retaliatory tariffs not been in place.

In the case of Mexico, the higher percentage change in trade delta compared to the *ex ante* model result likely reflects high substitutability between Canadian and U.S. pork. Canadian processors were able to expand market share in Mexico but remained limited by supplies relative to U.S. processors. Other exporters to Mexico, mainly the European Union, benefited from the establishment of a duty-free tariff rate quota for pork which lowered the effective duty from a most favored nation rate of 20% to 0%. However, the smaller-than-expected decrease in Mexico's imports of U.S. pork is likely because Mexico is less price sensitive to U.S. fresh/chilled and variety meats.

Summary

We employed the NAIDS model and estimated China and Mexico's short-run pork import demand parameters, the corresponding source-based elasticities, and assessed the impacts of the retaliatory tariffs on pork trade. Based on our analysis, both Mexico and China's quantities of imports from the United States were lower because of the retaliatory tariffs. However, the decrease in Chinese imports from the United States was confounded by the outbreak of ASF, which led to a significant drop in Chinese pork production. Declining domestic hog supply in China due to losses from ASF resulted in an increase in demand for imported pork. While this may have had the effect of supporting U.S. exports, the amount of U.S. pork exported to China would have been higher had the retaliatory tariffs not been in place.

The USDA forecasts that China's swine production will decline 28% by the end of 2019 and a further 11% by the end of 2020 due to losses from ASF and the exit of producers from the industry (USDA, 2019). China's Ministry of Agriculture and Rural Affairs reported that the sow herd fell 38% year-over-year in August 2019 (MARA, 2019). The continued decline of the sow herd implies a reduction in pig supply for the remainder of 2019 and 2020. Although recent gains in hog and pork prices will encourage producers to begin restocking herds, ASF remains a significant hurdle as efforts to contain the disease appear to be unsuccessful. It may take several years, or the introduction of an effective vaccine for the disease, to be fully controlled. Imports of pork products from the United States or other countries may bolster supply in China and lessen internal price pressure. However, China's pork imports from the United States will be constrained as long as retaliatory tariffs remain in place.

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