



Economic Research Service
U.S. DEPARTMENT OF AGRICULTURE

Economic
Research
Service

Economic
Research
Report
Number 310
August 2022

China's Import Potential for Beef, Corn, Pork, and Wheat

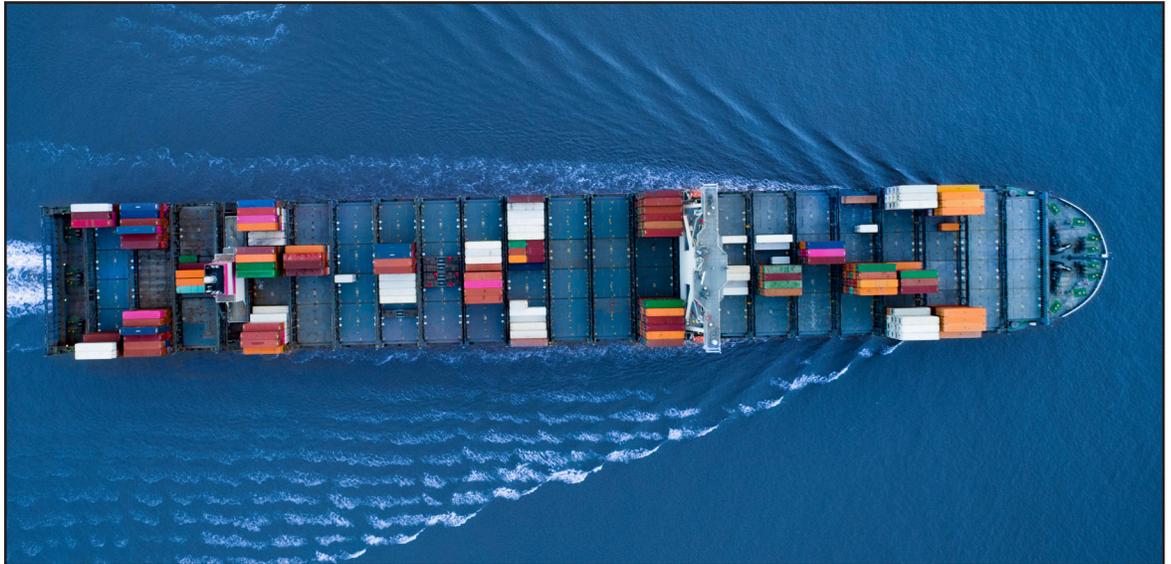
Jayson Beckman, Fred Gale, Stephen Morgan, Ethan Sabala, Danielle Ufer, Adriana Valcu-Lisman, Wendy Zeng, and Shawn Arita





Recommended citation format for this publication:

Beckman, Jayson, Fred Gale, Stephen Morgan, Ethan Sabala, Danielle Ufer, Adriana Valcuisman, Wendy Zeng, and Shawn Arita. August 2022. *China's Import Potential for Beef, Corn, Pork, and Wheat*, ERR-310, U.S. Department of Agriculture, Economic Research Service.



Cover photo from Getty Images.

Use of commercial and trade names does not imply approval or constitute endorsement by USDA.

To ensure the quality of its research reports and satisfy governmentwide standards, ERS requires that all research reports with substantively new material be reviewed by qualified technical research peers. This technical peer review process, coordinated by ERS' Peer Review Coordinating Council, allows experts who possess the technical background, perspective, and expertise to provide an objective and meaningful assessment of the output's substantive content and clarity of communication during the publication's review.

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at [How to File a Program Discrimination Complaint](#) and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by: (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410; (2) fax: (202) 690-7442; or (3) email: program.intake@usda.gov.

USDA is an equal opportunity provider, employer, and lender.



China's Import Potential for Beef, Corn, Pork, and Wheat

Jayson Beckman, Fred Gale, Stephen Morgan, Ethan Sabala, Danielle Ufer, Adriana Valcu-Lisman, Wendy Zeng, and Shawn Arita

Abstract

China is one of the top importers of agricultural products, but it has nontariff measures that prevent its imports from growing even larger. In this report, the authors develop a quantitative framework to examine China's import market potential using a price wedge approach—the difference between domestic and imported prices—for commodities that are imported by China. The report estimates the impact of removing these barriers for the four highest wedges using a global economic model. Domestic prices in China exceeded foreign prices (using the United States as an example) by large margins for the four commodities we considered, as follows: beef (58 percent), corn (64 percent), pork (213 percent), and wheat (42 percent). Estimates reveal that removing these price wedges could lead to more imports into China. Benefits would be widespread, increasing sales for producers in the United States and other exporting countries and yielding lower food prices for China's consumers.

Keywords: China, trade, non-tariff measures, beef, corn, pork, wheat, USDA, U.S. Department of Agriculture, Economic Research Service, ERS

Acknowledgments

The author thanks Jennifer Bond, Jeremy Jelliffe, and Utpal Vasavada of USDA, Economic Research Service (ERS) for insightful comments and advice, as well as four anonymous reviewers. Thanks also to Angela Brees, Jeff Chaltas, Courtney Knauth, and Grant Wall of ERS for editing and Xan Holt for design.

About the Authors:

Jayson Beckman, Fred Gale, Stephen Morgan, Ethan Sabala, Danielle Ufer, Adriana Valcu-Lisman, Wendy Zeng are economists with the USDA, Economic Research Service, (ERS); Shawn Arita is an economist with the USDA, Office of the Chief Economist.

Contents

Summary	iii
Introduction	1
China's Agricultural Imports	4
China–U.S. Trade	8
Methods	10
Measuring Nontariff Measures (NTMs)	10
Computable General Equilibrium Model	13
Impacts of Removing China's Price Wedges: Medium/Longrun Impacts	14
Beef	14
Corn	18
Pork	21
Wheat	25
Effects of Removing China's Price Wedges: Shortrun Impacts	30
Recent Pork Prices	31
Conclusions	33
References	34



China's Import Potential for Beef, Corn, Pork, and Wheat

Jayson Beckman, Fred Gale, Stephen Morgan, Ethan Sabala, Danielle Ufer, Adriana Valcu-Lisman, Wendy Zeng, and Shawn Arita

What Is the Issue?

China's agricultural imports grew dramatically over the past two decades, and China became the largest importer in the world. Nevertheless, market access for some agricultural products was hindered by tariffs and nontariff measures. Economic theory suggests that a country would import products when foreign prices are lower than domestic prices, decreasing domestic prices and narrowing the "wedge" between domestic and international prices. This report develops a methodological framework to assess China's import potential for agricultural products. We examine differentials between domestic and import prices to assess the presence of trade barriers or frictions that may prevent imports from reaching their potential. We use information on foreign versus domestic prices to evaluate this wedge, estimating the potential for further agricultural imports of several key commodities.



What Did the Study Find?

The research revealed that Chinese domestic prices consistently exceed import prices for four key commodities:

- China's beef prices were about 80–90 percent higher than U.S. imported beef prices in 2020 despite rapid growth in imports.
- Even with China's record-level corn imports in 2020, the country's domestic prices were still 60 percent above average imported U.S. corn prices.
- The margin between China's and imported U.S. pork prices soared to 200–300 percent of U.S. prices, due largely to a disease-driven reduction in China's domestic pork supplies in 2020.
- China's wheat prices were about 40 percent higher than the average price of imported U.S. wheat in 2020.

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

Removing these trade barriers could lead to an increase in China's imports. We provide results from two scenarios: (1) a shortrun scenario (i.e., a year) where production and trade responses are somewhat limited as resource mobility is restricted and (2) a medium/longrun scenario (i.e., 5–10 years) where agricultural producers can shift land, labor, and capital. For each commodity, the results from these scenarios are as follows:

- For beef, the shortrun scenario indicates a 25.2-percent increase in China's imports. The medium/longrun scenario yields a larger increase (46.3 percent).
- For corn, the shortrun increase in China's imports is 12.5 percent, while the medium/longrun scenario shows a 90.9-percent increase. This would exceed China's tariff-rate quota (TRQ), with imports beyond the quota subject to a 65-percent tariff—thus, if the over-quota tariff is applied, results could be overestimated. For 2021, China's imports exceeded the quota, and the over-quota rate was not applied.
- For pork, the large price wedge implies substantial constraints on imports, and the model estimates triple-digit increases in China's imports (117 percent for the shortrun, 402 percent for the medium/longrun). China's pork prices were unusually high during the 2020 base year, so we also consider smaller price wedges from more typical years. But even these smaller price wedges suggest double-digit increases in imports are possible if trade barriers are eliminated.
- China's wheat imports are estimated to increase by 48.2 percent in the shortrun and 248.9 percent in the medium/longrun. Like corn, wheat has a TRQ, and imports could be constrained by the high over-quota 65-percent over-quota tariff.

How Was the Study Conducted?

To consider how much China could be importing, we use a computable general equilibrium (CGE) model to estimate the removal of price wedges—which occur because of trade barriers—for beef, corn, pork, and wheat. To calculate the price wedge, we used monthly price data—the import unit value (IUV), which is China's reported price that also includes transportation costs. We calculated a 3-month moving average to reduce volatility in the ratios. All price wedges also include the Most-Favored Nation (MFN) tariff for beef and pork, which was 12 percent, and the in-quota tariff rate of 1 percent for corn and wheat. Retaliatory tariffs on U.S. products were not included, nor was the over-quota rate considered, since there is evidence that this has not been applied. The base year of the CGE model is 2017. To update the model to 2021, we used exogenous shocks to population, GDP, labor, and capital. In addition, we used information from the *World Agricultural Supply and Demand Estimates (WASDE)* to update changes in production for the four commodities of interest. Information from Trade Data Monitor (TDM) was used to estimate changes in China's imports of these products from 2017–2021. Assessments depend upon the ability for producers to respond to economic conditions. For each commodity, we considered two scenarios that differ based on the time horizon while the price wedges stayed the same. One scenario considers a shortrun setup where resource production and trade responses are somewhat limited as mobility is restricted. The other scenario considers a medium/longrun setup where agricultural producers can shift land, labor, and capital. For pork, we do consider sensitivity in the price wedge, given the volatile market. For each scenario, price wedges were removed independently.

China's Import Potential for Beef, Corn, Pork, and Wheat

Introduction

Countries often use a variety of trade instruments to protect their domestic agricultural producers and food security interests.¹ Tariffs are one way, but countries also use nontariff measures (NTMs). These NTMs are typically in the form of regulations and administrative procedures or sanitary and phytosanitary (SPS) measures, and they often discriminate against imported commodities. These NTMs tend to be less visible than tariffs, but they are estimated to be a larger barrier to more trade (Arita et al., 2017).² Beckman and Arita (2017) noted that these NTMs are often used in conjunction with tariff-rate quotas (TRQs)—a two-tier tariff system that often creates a high over-quota rate—that could further restrict trade. These TRQs are almost exclusively in place on agricultural products (Beckman et al., 2021) and are designed to allow for a minimal amount of market access through lower in-quota rates, while a high over-quota rate often limits further imports.⁴

NTMs represent a longstanding concern that has been targeted for reform in multilateral trade negotiations, but this concern persists. In January 2020, the United States and China signed an Economic and Trade Agreement (Phase One) that committed China to increase purchases of U.S. products. According to U.S. Department of Commerce data, U.S. agricultural exports to China reached nearly \$33 billion in 2021—up from \$19.6 billion in 2017—but this total fell short of the target set by the Phase One agreement. Besides the purchase commitments, the agreement also included dozens of measures meant to address structural issues (i.e., NTMs) that impeded trade in farm products (see box, “Phase One Agreement”).⁵ The U.S. Trade Representative’s 2021 Report to Congress on China’s World Trade Organization (WTO) Compliance highlighted market interventions, industrial policies, and nontariff measures as policies that had impeded trade during the two decades since China became a World Trade Organization (WTO) member.

Phase One Agreement

The Economic and Trade Agreement Between the Government of the United States of America and the Government of the People’s Republic of China (Phase One agreement) was signed on January 15, 2020, and entered into force on February 14, 2020. The agreement called for China to increase its purchases of U.S. agricultural goods by importing, on average, at least \$40 billion of U.S. food, agricultural, and seafood products annually during 2020–21. The agreement specified that China

¹ Domestic support, either through payments to producers or input subsidies, can also be used, but the authors do not consider that in this report.

² Research has also pointed out differences in the use of tariffs and NTMs in agriculture compared with nonagriculture. Beckman (2021) noted that tariffs on agriculture are higher than those for nonagriculture for more than 90 percent of the countries in the world. Li and Beghin (2012) noted that NTMs impede trade flows for agricultural commodities more than for nonagricultural goods.

³ As noted in Santeramo and Lamonaca (2019), research has indicated that NTMs could actually lead to increased trade, as consumers might be willing to purchase products with more information attached to them.

⁴ In addition, some TRQs have low fill rates that may be attributable to administration of the quotas, another example of an NTM.

⁵ China cut agricultural tariffs and removed many NTMs when it joined the World Trade Organization (WTO) in 2001. Despite this reform, certain trade barriers remained. The Phase One agreement reflects longstanding concerns that China maintains trade barriers that are inconsistent with its WTO commitments and prevents its agricultural imports from reaching their potential.

would strive to import an additional \$5 billion per year in the 2 years following implementation of the agreement.

Besides the purchase commitments, the agreement addressed structural barriers to U.S. agricultural products. The parties agreed to implement food safety, sanitary, and phytosanitary regulations that are science- and risk-based to the extent necessary to protect human life or health. In this vein, China also agreed to implement a transparent, science- and risk-based regulatory process for the evaluation and authorization of products of agricultural biotechnology.

China made commitments to partially eliminate a ban on U.S. poultry that had been in place since 2014, to open its market to U.S. rice, and to finalize protocols that would allow the import of several U.S. fruits and potatoes, barley, and hay. China agreed to expand the scope of beef products imports by eliminating age restrictions on cattle slaughtered, eliminating unnecessary cattle traceability restrictions, and establishing maximum residue levels for three hormones legally used in the United States. China also agreed to broaden the list of pork products eligible for import and to conduct a risk assessment for the veterinary drug ractopamine, which may be used in U.S. beef and pork production.

This study uses a concept known as a price wedge to evaluate the presence of trade barriers in agriculture using China's agricultural imports as an example.⁶ The analysis presumes that the “law of one price—that a good will have the same price in different markets” would result in equalization of commodity prices in China and international markets (net of transportation cost and tariffs after adjusting for currency differences) through an arbitrage process.⁷ Currently, domestic prices in China are observed to far exceed foreign prices—using U.S. prices to represent world prices—for a number of agricultural products. For example:

- China's beef prices were about 80–90 percent higher than the price of U.S. imports in 2020 despite rapid growth in China's imports.
- Even with China's record-level corn imports, the country's domestic prices are still 60 percent above imported U.S. corn prices.
- The margin between China and U.S. pork import prices soared to 200–300 percent after an epidemic curtailed China's domestic pork supplies.
- China's wheat prices were about 40 percent higher than the price of imported U.S. wheat in 2020.

China imported more than \$157 billion of agricultural products in 2020, including more than \$35 billion from the United States, yet China appears to remain short of its full import potential, especially for certain commodities. Strong demand and wide differentials between the prices of commodities in China and imported commodities signal that China could import more. To investigate this issue further, this report measures the price differentials and estimates the volume of imports that would equilibrate Chinese domestic and import prices of the four commodities that were the focus of the study: beef, corn, pork, and wheat. China has become a significant importer of each of these commodities in recent years. Trade in each one

⁶ The price wedge is discussed in more detail later, but it can be thought of as an indirect measure of the level of distortions in a given market (Andriamananjara et al., 2003). A cross-country evaluation of TRQs by Beckman, Gale, and Lee (2021) used the price wedge concept to classify China's TRQs for wheat, corn, and rice as “underutilized” based on the observation of large price wedges and persistent unfilled quotas.

⁷ Miljkovic (1999) discussed how tariffs, NTMs, and other factors prevent market arbitrage from equalizing prices. In addition, we note that price wedges could occur when there are differences in costs of production—for example, if it is costlier to produce a product in China, the country will naturally start out with a price wedge relative to countries that could produce it cheaper.

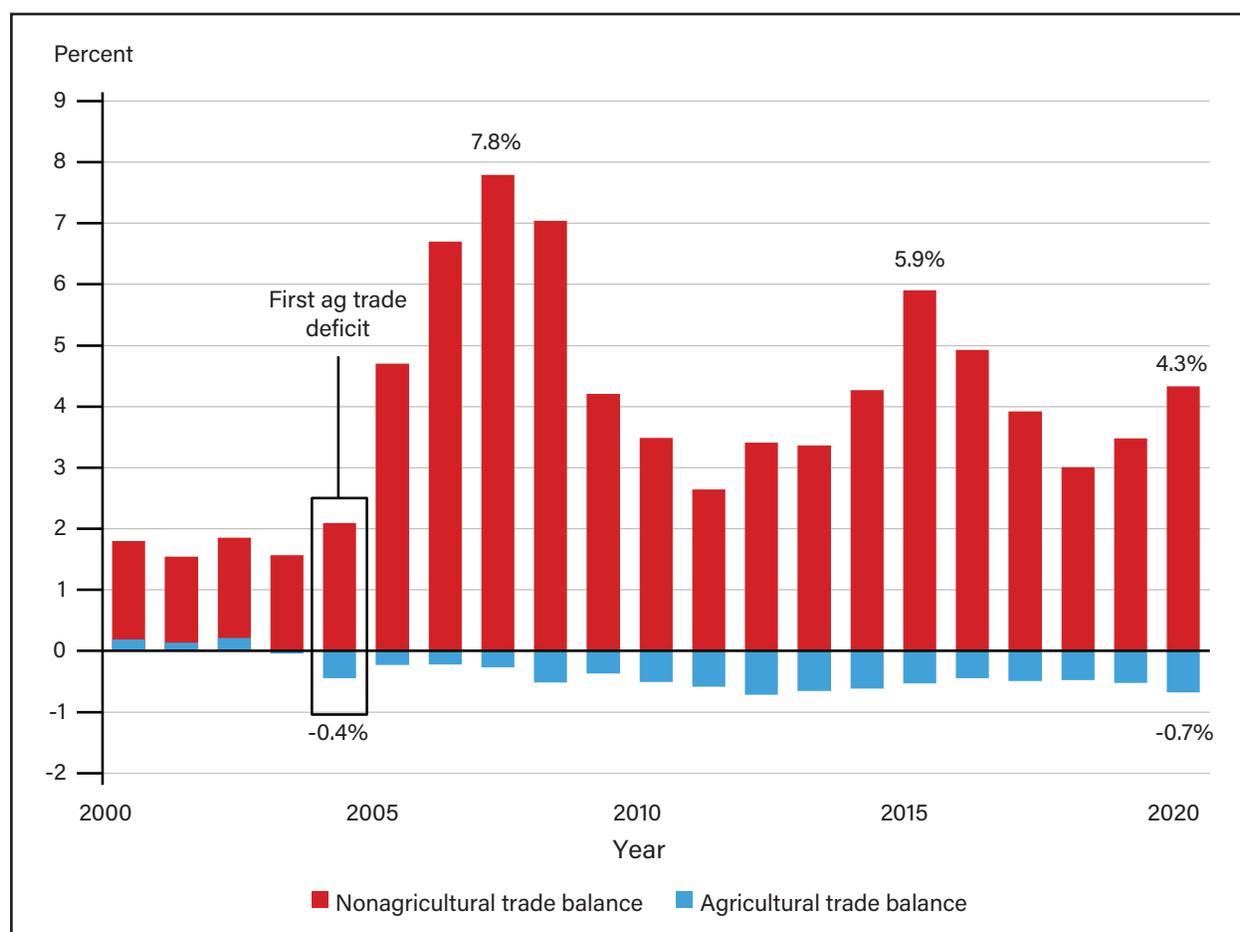
offers distinct challenges, but China can potentially import more of each. Beef imports grew rapidly over the past decade, due to growing demand and slow growth in domestic supplies. China first became a significant pork importer in 2007 when a disease epidemic reduced domestic supplies. Since then, China's pork imports have risen at a varying pace until a much bigger disease epidemic reduced its domestic pork supply dramatically, causing prices to soar and resulting in record imports. Corn and wheat are grain commodities that Chinese authorities view as critical to food security. China's imports of corn and wheat fell short of quotas set in 2001 until imports of both surged to record levels in 2020. This report does not address soybeans and cotton—two commodities that are among China's leading agricultural imports and exhibit relatively narrow differences between domestic and foreign prices.

China's Agricultural Imports

After joining the WTO in 2001, China became the world's largest exporter of industrial and consumer goods and one of the largest importers of agricultural products. China's total exports rose from \$250 million to \$2.59 trillion between 2000 and 2020, while the country's agricultural imports grew from under \$10 billion to \$158 billion over the same period. China's trade surplus in industrial and consumer goods grew from less than 2 percent of its gross domestic product (GDP) in 2000 to a peak of 7.8 percent in 2007. Since then, the share has fluctuated between 3 and 6 percent of its GDP. In 2020, China's nonagricultural trade surplus accounted for 4.3 percent of its GDP.

China became a net importer of agricultural products for the first time in 2004 as rising consumer incomes facilitated more consumption of high-value food products, while the country's capacity to increase farm production was limited by the withdrawal of land and labor from agriculture, soil erosion, and environmental costs. China's first agricultural trade deficit in 2004 equaled 0.4 percent of their GDP (figure 1). The deficit grew in dollar value in subsequent years, but the size of the deficit relative to the overall economy remained less than 1 percent of China's GDP. The country's agricultural trade deficit was 0.7 percent of the GDP in 2020—much less than the 4.3-percent nonagricultural trade surplus share of the GDP that year.

Figure 1
China's trade balance as a share of its GDP, 2000-20



Note: GDP = gross domestic product; trade balance = exports minus imports.

Source: USDA, Economic Research Service analysis of Chinese customs data accessed through Trade Data Monitor (2021).

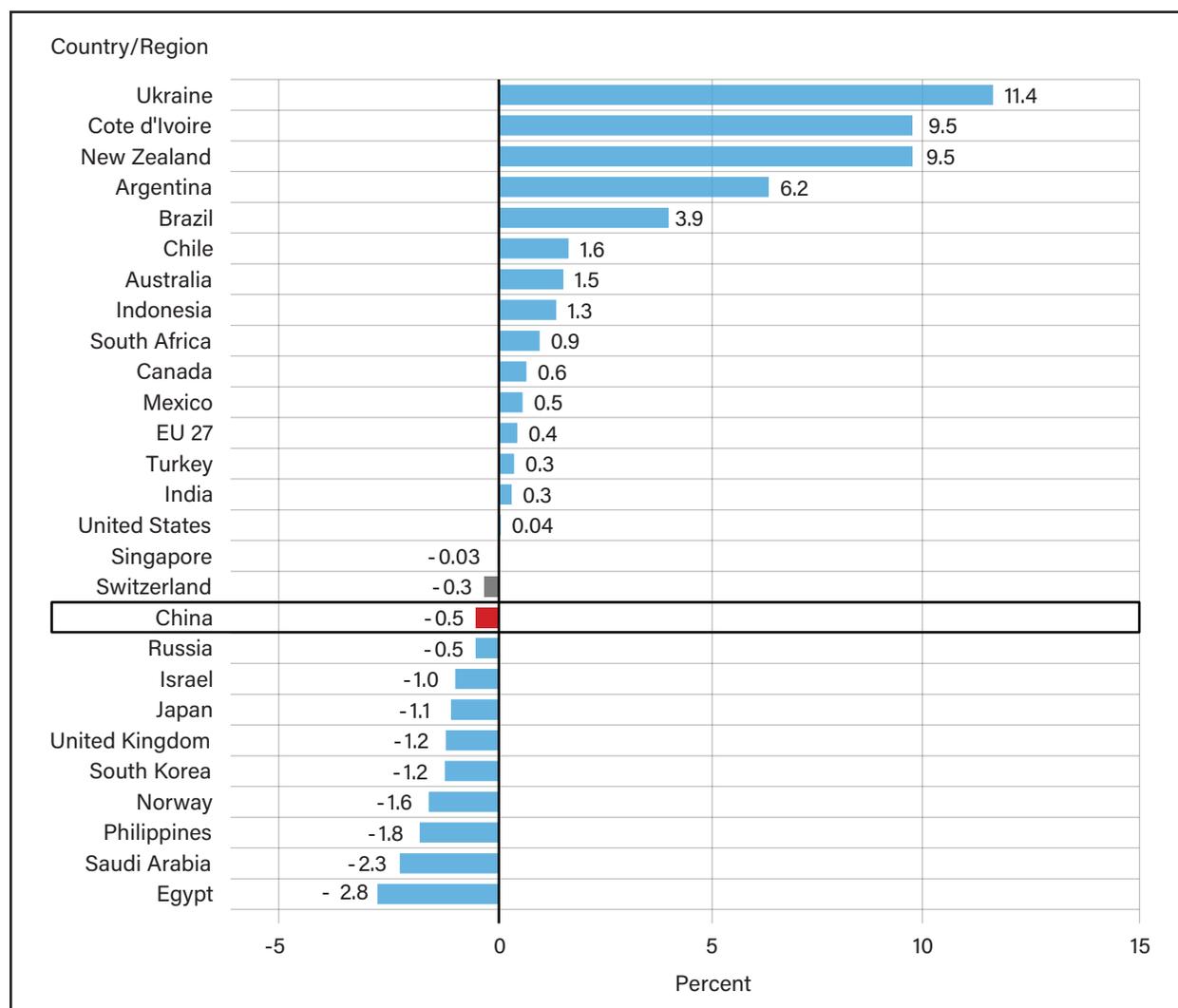
Figure 2 puts China's agricultural trade deficit in perspective by comparing it with agricultural trade balances of 26 other country/regional economies during 2016–20. The agricultural trade balance is between 2 and -2 percent of the GDP for most countries. Land-abundant exporting countries and commodity-exporting developing countries—such as Ukraine, Cote d'Ivoire, New Zealand, and Brazil—reached trade surpluses ranging from 3.9 to 11.4 percent of their GDP. India, a less-developed country with a high degree of protection, reached an agricultural export surplus of 0.3 percent (similar to China's in the early 2000s), and the European Union (EU), a region that protects its agricultural sector and maintains high food prices, attained an agricultural trade surplus of 0.5 percent of its GDP. The United States both exports and imports agricultural products, and its agricultural trade balance was near zero.

Other industrialized economies, such as Japan, South Korea, Israel, and Norway—all with relatively scarce land and water resources—had agricultural trade deficits exceeding 1 percent of their GDP during 2016–20, higher than China's 0.5-percent average deficit during the same period. China's deficit is the same as that of Russia, which imports fruit, cheese, wine, and coffee, products that cannot be easily produced in its climate or are demanded by consumers.

Based on China's 2020 GDP, an agricultural trade deficit of 1.1 percent—similar to Japan's or South Korea's—would imply an agricultural trade deficit of \$162 billion. That would exceed the actual \$100 billion agricultural trade deficit in 2020 by \$62 billion.

Figure 2

Net agricultural trade balance as a share of GDP by country/region, 2016–20

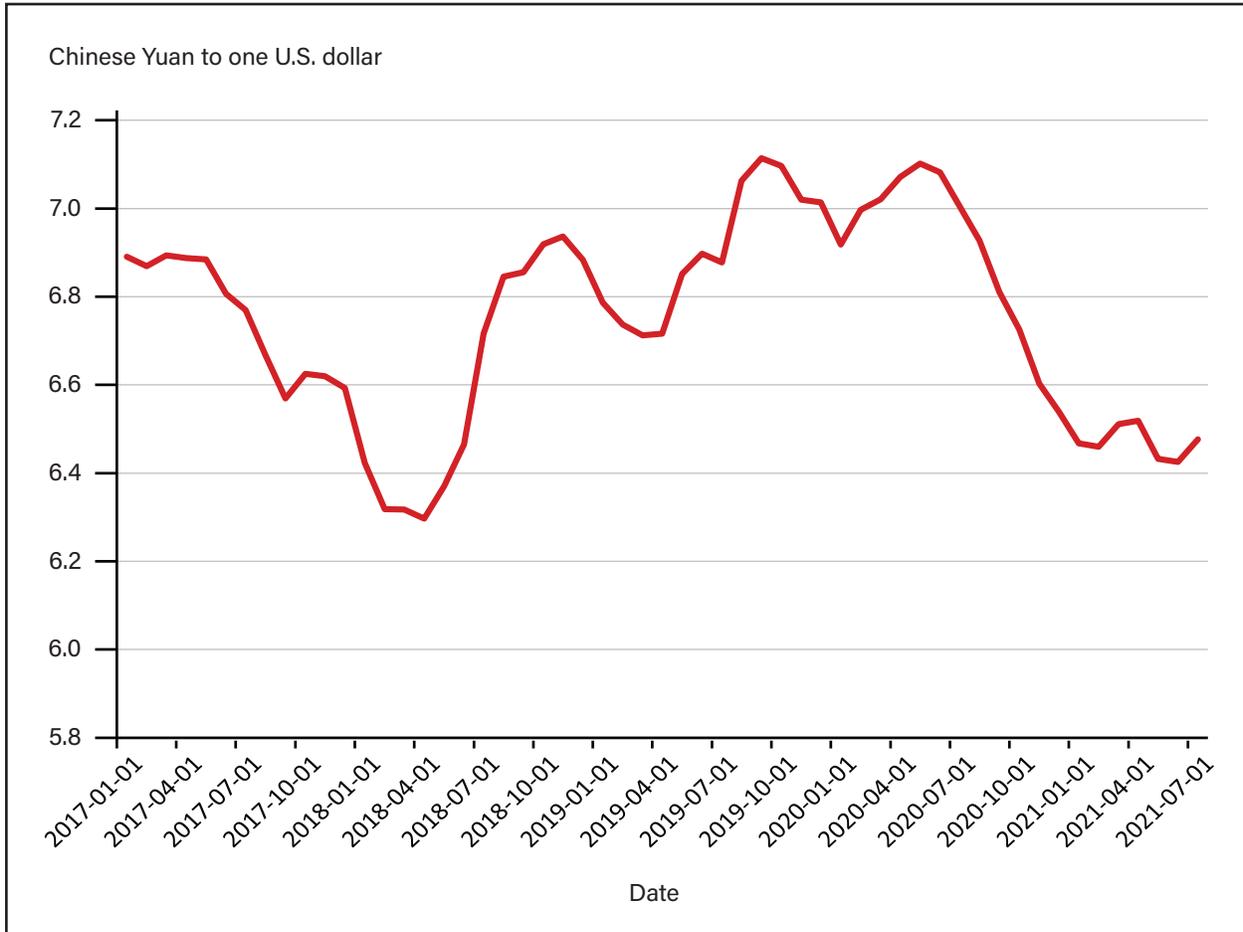


Notes: EU = European Union. The chart shows the ratio of cumulative agricultural trade balance to cumulative gross domestic product (GDP) during 2016–20 with no adjustment for inflation.

Source: USDA, Economic Research Service calculations using data from The World Bank’s World Development Indicators database and import data accessed through Trade Data Monitor.

A stronger Chinese currency—reflected by a decline in the number of Chinese yuan exchanged for a U.S. dollar—potentially could increase the country’s agricultural imports by reducing the effective cost to Chinese importers of commodities priced in dollars. The China-U.S. exchange rate has fluctuated since 2017 (figure 3). The Chinese currency strengthened against the dollar, reaching a peak of 6.3 yuan per dollar in April 2018, just before China and the United States imposed tariffs on each other’s goods in April and July 2018. China’s currency weakened to 7.1 yuan per dollar in September 2019 when trade talks began between the United States and China and led to the Phase One agreement in January 2020 (which took effect on February 14, 2020). China’s currency strengthened again to 6.4 yuan per dollar in June 2021 with the implementation of Phase One and China’s recovery from its initial Coronavirus (COVID-19) outbreaks. By mid-2021, China’s currency was nearly as strong as at its peak in 2018.

Figure 3
China-U.S. exchange rates (monthly), January 2017–July 2021



Note: A lower value indicates a stronger value of the Chinese yuan.

Source: USDA, Economic Research Service using data from the Federal Reserve Bank of St. Louis (2021).

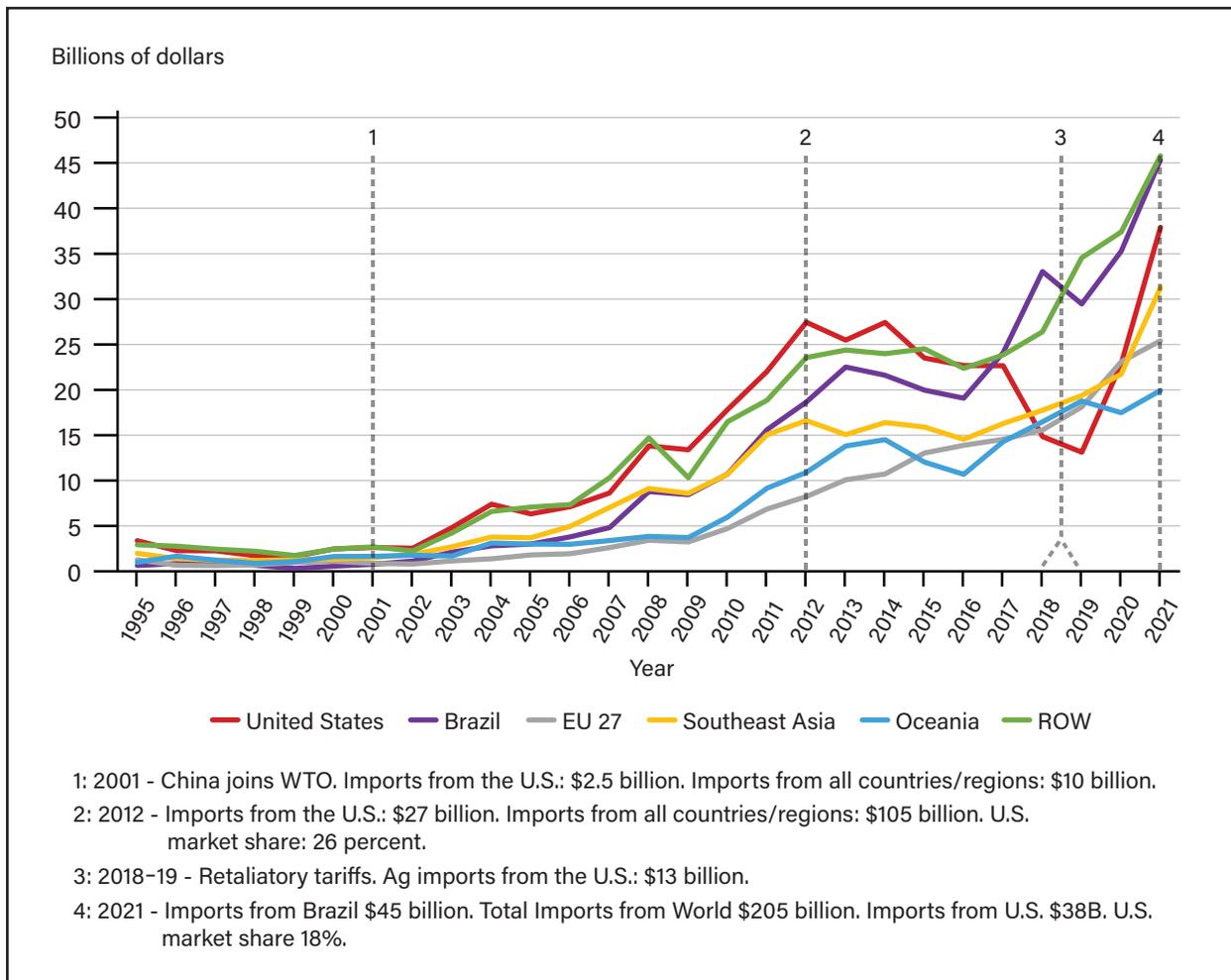
China-U.S. Trade

China's imports of U.S. agricultural products increased from \$2.6 billion in 2001 to a peak of \$27 billion in 2012. About one-fourth of China's agricultural imports came from the United States during those years. Since then, China's imports of U.S. agricultural products have declined in many years—especially with the onset of trade tensions in 2018—while China continued increasing its agricultural imports from most other regions (figure 4). The U.S. share of China's agricultural imports fell from 26 percent in 2012 to 10 percent in 2019 after China imposed retaliatory tariffs on U.S. goods. The share of imports rebounded to 14.5 percent in 2020, coinciding with the Phase One agreement, the COVID-19 pandemic, and an outbreak of African Swine Fever (ASF) in China that began in 2018. During 2020, China imported a record \$158 billion of agricultural imports, and the U.S. share rebounded to 14.5 percent. In 2021, China's agricultural imports grew to \$205.6 billion, and the U.S. share grew to 18 percent. The recovery of China's economy from its initial COVID-19 outbreaks, along with strong animal feed and protein demand and Phase One commitments, contributed to the country's agricultural import boom. China was one of a few countries in the world that reported an increase in GDP in 2020, with its exports of consumer products and medical equipment booming and its currency strengthened, boosting its purchasing power on world markets.

Market access barriers and policy interventions possibly contributed to the decline in the U.S. share of China's agricultural imports after 2012. Wheat, corn, and rice import quotas went unfilled for many years, despite strong internal demand (Gale, 2021b; Orden et al., 2019). China began shifting its purchases of soybeans to Brazil, whereas corn purchases were shifted to Ukraine. Delays on approval of new genetically modified seeds constrained the release of new varieties in the United States, and during 2013–14, China rejected nearly all U.S. corn shipments due to traces of an unapproved variety. During 2015–19, demand for imports of feed grains and cotton was curbed by China's release of excess Government reserves in the domestic market. China assessed antidumping and countervailing duties on U.S. poultry in 2010 and on distillers dried grains with solubles (DDGS) in 2016. China banned U.S. poultry for 5 years on disease concerns. Beef and pork sales were impeded by SPS barriers that included disease-related bans, zero tolerances on feed additives, requirements on cattle age at slaughter, and traceability (Gale et al., 2015). Other market barriers and distortions may have affected trade in specialty products, processed foods, and other agricultural products. These impediments constrained China's imports and led to higher domestic prices for Chinese consumers.

Figure 4 also highlights the decline in China's imports of U.S. agricultural products after the implementation of retaliatory tariffs. In 2018, the United States imposed Section 232 tariffs on steel and aluminum imports from major trading partners and, separately, imposed Section 301 tariffs on a broad range of imports from China. In response to Section 232 and Section 301 actions, China applied retaliatory tariffs targeting approximately 98 percent of U.S. agricultural imports (targeting those imported in 2017) to China. Estimates suggest U.S. agricultural export losses from mid-2018 through the end of 2019 due to retaliatory tariffs implemented by China exceeded \$25 billion, with the largest losses concentrated in soybean exports (Morgan et al., 2021). However, retaliatory tariffs are not considered in this analysis of price-wedge removal.

Figure 4
China's agricultural imports from countries/regions, 1990-2021



Notes: U.S. = United States; WTO = World Trade Organization; EU = European Union; ROW = rest of the world. Oceania comprises Australasia (Australia, New Zealand, and neighboring islands), Melanesia, Micronesia, and Polynesia.

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

Methods

This section provides information on the methods used to quantify the price wedges and estimates the impacts of their removal.

Measuring Nontariff Measures (NTMs)

In terms of quantifying NTMs, there are generally three approaches: (1) the price wedge approach, which infers NTM costs by comparing the imported price of a commodity facing an NTM with a reference price (e.g., Calvin and Krissoff, 1998; Bradford, 2003); (2) the gravity model approach, which estimates foregone trade (e.g., Berden et al., 2009; Bureau, 2014); and (3) the supply-chain approach, which tracks price markups along the value chain (e.g., Ferrantino, 2012; Beckman et al., 2020).

All the above approaches benefit from being able to estimate the magnitude of an NTM. In terms of weaknesses, both the first and second approaches estimate the cost using a single point of incidence. In practice, gravity models are estimated exclusively at the border by using cost, insurance, and freight (CIF) or free on board (FOB) values; price wedges are calculated using import prices or retail prices but not both. The supply-chain approach considers more price incidences but requires a large amount of data that makes estimates beyond a single commodity difficult. Comparing the price wedge approach with the gravity approach, Ferrantino (2006) noted that gravity estimates are dependent on the quality of the specification and require assumptions of the elasticity of substitution to indirectly estimate tariff equivalents. Given the data and the modeling constraints, the price wedge approach is used in this report.⁸

The price wedge approach is an all-inclusive estimate for possible barriers impacting trade—some of which could be legitimate in the view of the WTO (e.g., quotas or NTMs that provide legitimate protection). A wedge between prices could also be due to quality differences (e.g., the protein quantity of wheat) or differences in demand (e.g., organic versus nonorganic).⁹ The price wedge could also be influenced by where it is measured (i.e., wholesale versus border prices) and lead to an upward bias in the wedge. We added in costs of transportation to China to the price wedge, but internal transportation costs in China were not included.

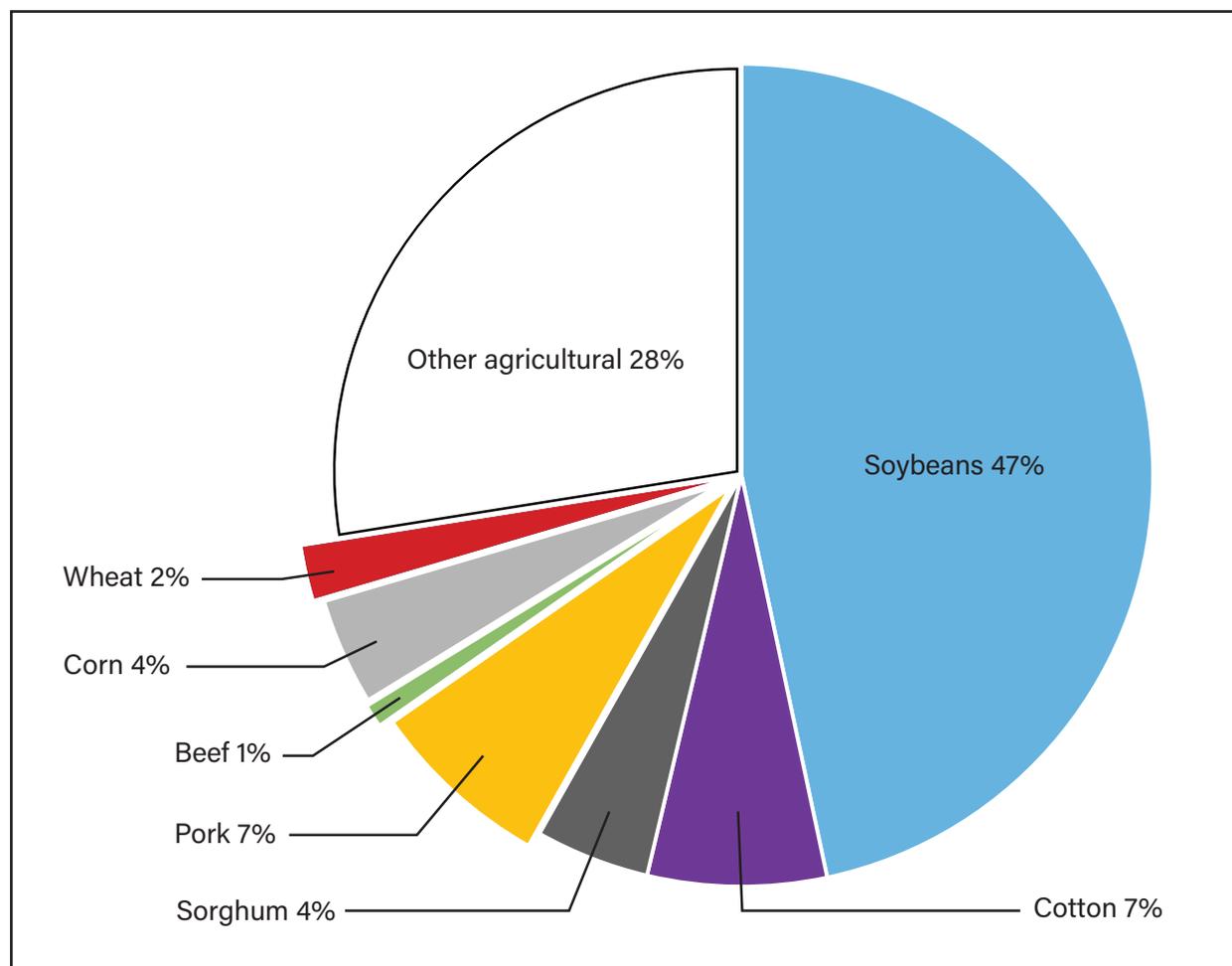
As noted, as part of the study, the four commodities we chose to investigate were beef, corn, pork, and wheat. These are major farm commodities produced by both the United States and China that are relatively homogeneous, have Chinese and international price data available, and may be vulnerable to barriers meant to protect Chinese producers. Together, these four commodities accounted for 14 percent of China's agricultural imports from the United States in 2020. Two other commodities—soybeans and cotton—have been the top Chinese agricultural imports from the United States since the 1990s and accounted for over half of 2020 imports from the United States; we excluded these (as will be noted later, the price wedge is relatively small) and other commodities. Commodities such as sorghum, barley, alfalfa, and DDGS were excluded because China's production is small, and Chinese price data for them are not consistently available. Chicken prices are not easy to compare because China's imports are primarily of particular parts such as paws and wing tips. Fruit, nuts, and processed products are more heterogeneous, so domestic and international prices are not easily compared.

⁸ Beckman et al. (2020) also noted that the gravity approach is more suitable for dealing with cases of zero trade and aggregation of different commodities; however, the authors do not have those issues with the commodities considered in this work.

⁹ Also, as a reviewer points out (and the authors of this report note later), it is a strong assumption that non-tariff measures can be fully removed. Under the WTO Uruguay Round Agreement on Agriculture, market access has been negotiated and is beyond these commitments (i.e., some protection is legal). As such, this report's results likely represent an upper bound of the export potential for U.S. agricultural exports to China.

Figure 5

China's agricultural imports from the United States by major category, 2020



Source: USDA, Economic Research Service analysis of China customs data accessed through Trade Data Monitor (2021).

We illustrate the price wedge analysis using data from 2020 (table 1). The table shows the average value of U.S. commodities arriving in China inclusive of tariffs and the average domestic price of the same commodities in China. The cost of U.S. commodities is representative of international prices since the United States is one of the main international suppliers of corn, wheat, soybeans, cotton, and pork. While prices of commodities from different countries vary, competition prevents wide cross-country variation in prices.¹⁰ Domestic prices for grades and locations that are widely used help assess market conditions in China for this report. We used unit values of imported commodities—without any adjustment for grades or quality—which were not reported in the import data.¹¹ These include the in-quota tariff for wheat, corn, and cotton, and the Most-Favored Nation (MFN) tariff for soybeans, pork, and beef. The domestic price for soybeans (used for

¹⁰ The authors generally found that the price wedges using prices from other countries were similar. For example, the price wedge for corn was 64 percent for China-United States and 72 percent for China-Ukraine.

¹¹ The quality of imported versus domestic commodities can vary from year to year, depending on the varying quality of domestic commodities and the changing composition of imports. No data are available to measure quality or grades in aggregate.

crushing) reflects the price of imported soybeans in a major processing region of China because few domestic soybeans are used for crushing due to their higher price.¹²

The Chinese domestic price exceeded the import price for each commodity to varying degrees. The price wedge is the difference between the domestic price and the cost of imported U.S. commodities. A larger price wedge implies the presence of an NTM that impedes the flow of imports. In table 1, the price wedge varied across commodities. The Chinese corn price, on average, exceeded the cost of imported U.S. corn by 48 percent in 2020.¹³ The wedge was 38 percent for U.S. wheat, 43 percent for beef, and 181 percent for pork. (The wedge was unusually high for pork due to high Chinese pork prices that year because of the previous year’s African Swine Fever epidemic that sharply reduced pork supplies.) In contrast, the price wedge was much narrower for soybeans (15 percent) and cotton (13 percent). The varying magnitude of the wedges suggests that NTMs may constrain imports of pork, beef, corn, and wheat—preventing equilibration of domestic and international prices—while NTMs are less of a concern for soybeans and cotton.

Table 1
China price wedges for selected commodities, 2020

	Corn	Wheat	Beef	Pork	Soybeans	Cotton
Dollars per metric ton						
China domestic price	331	392	12,221	7,584	488	1,876
U.S. commodities arriving in China + tariff	223	285	8,524	2,704	424	1,659
Percent						
Wedge	48	38	43	181	15	13

Notes: Data are for calendar years. China domestic price is the average for domestic corn and wheat at Guangzhou, imported soybeans at Qingdao, the average national wholesale prices of beef and pork, and the average raw material purchase price for cotton. China’s imported price from the United States is based on the unit value of imported U.S. commodities from China customs data. Tariffs are in-quota (corn, wheat, cotton) or Most-Favored Nation (MFN) tariffs.

Sources: USDA, Economic Research Service analysis of data from China National Grain and Oils Information Center, China Ministry of Agriculture and Rural Affairs, China National Bureau of Statistics, and U.S. foreign trade data accessed through Trade Data Monitor (2021).

In the following analysis, we estimated similar price wedges using monthly price data from several years. The price used for each commodity is the import unit value (IUV), China’s reported price that includes transportation costs.¹⁴ We calculated 3-month moving averages to reduce volatility in the ratios. All price wedges also include the tariff—MFN for beef and pork (12 percent) and the in-quota tariff rate for corn and wheat (1 percent).

¹² China’s domestic soybeans are nongenetically modified, and nearly all are used for food products like tofu products and soybean milk. Nearly all soybeans used for crushing are imported.

¹³ Chinese prices vary across regions for some commodities. For corn, prices are lowest in major production areas in northeastern regions and highest in southern regions. The authors used corn and wheat prices at Guangzhou, a southern port where the price wedge is highest and where a large proportion of corn and wheat imports arrive.

¹⁴ The authors use the import unit value because it is a consistent dataset. The quality of agricultural products can differ across countries and with imports and domestically produced products, which could affect the price calculations. But these differences are, in general, small and should not affect the estimated economic impacts.

Computable General Equilibrium Model

Given the complex links and interactions between agricultural commodities and competition among these commodities for limited economic resources—as well as interactions between production, consumption, and trade activities—an economy-wide computer general equilibrium (CGE) modeling approach provides an appropriate framework to analyze the impacts of removing price wedges. To do so, we used the Global Trade Analysis Project (GTAP) model and database to analyze the impacts of removing the price wedges on China’s imports of certain agricultural products (see box, “Creating and Updating Computer General Equilibrium (CGE) Data”). The removals were performed one at a time.

Creating and Updating Computer General Equilibrium (CGE) Data

The Global Trade Analysis Project (GTAP) database shows some agricultural products specified at a highly aggregated level; thus, some work is required to explicitly account for the desired commodities. Beef and wheat are explicit in the database, but corn (aggregated with other coarse grains) and pork (aggregated with other meats) are not. We followed the work of Arita et al. (2017) to disaggregate them from the larger grouping. This involved using external data on production and trade by commodity to calculate the share of corn and pork in each larger grouping, then splitting out each commodity.

There are 141 regions in the GTAP database. Researchers often aggregate these regions into approximately 10–20 total regions to make the results digestible. For this report, we aggregated regions into 10 regions, which include major producers and exporters of the 4 target commodities. They are Argentina, Australia, Brazil, Canada, the European Union (EU), Russia, Ukraine, the United States, China, and a rest of the world (ROW) aggregate. Results are presented for China, the United States, and the ROW, which includes all the major producer/exporters. For the ROW, individual regions are mentioned in the discussion.

The base year of the model is 2017. To update the model to 2021, shocks were applied to population and Gross Domestic Product (GDP)—taken from the USDA, Economic Research Service (ERS) International Macroeconomic Dataset—and to labor and capital—as projected by Foure et al. (2016). In addition, we also used information from the *World Agricultural Supply and Demand Estimates (WASDE)* to update changes in production for the four commodities of interest (following the work by Beckman and Countryman, 2021). Information from Trade Data Monitor (TDM) helped estimate changes in China’s imports of the four commodities from 2017–21.

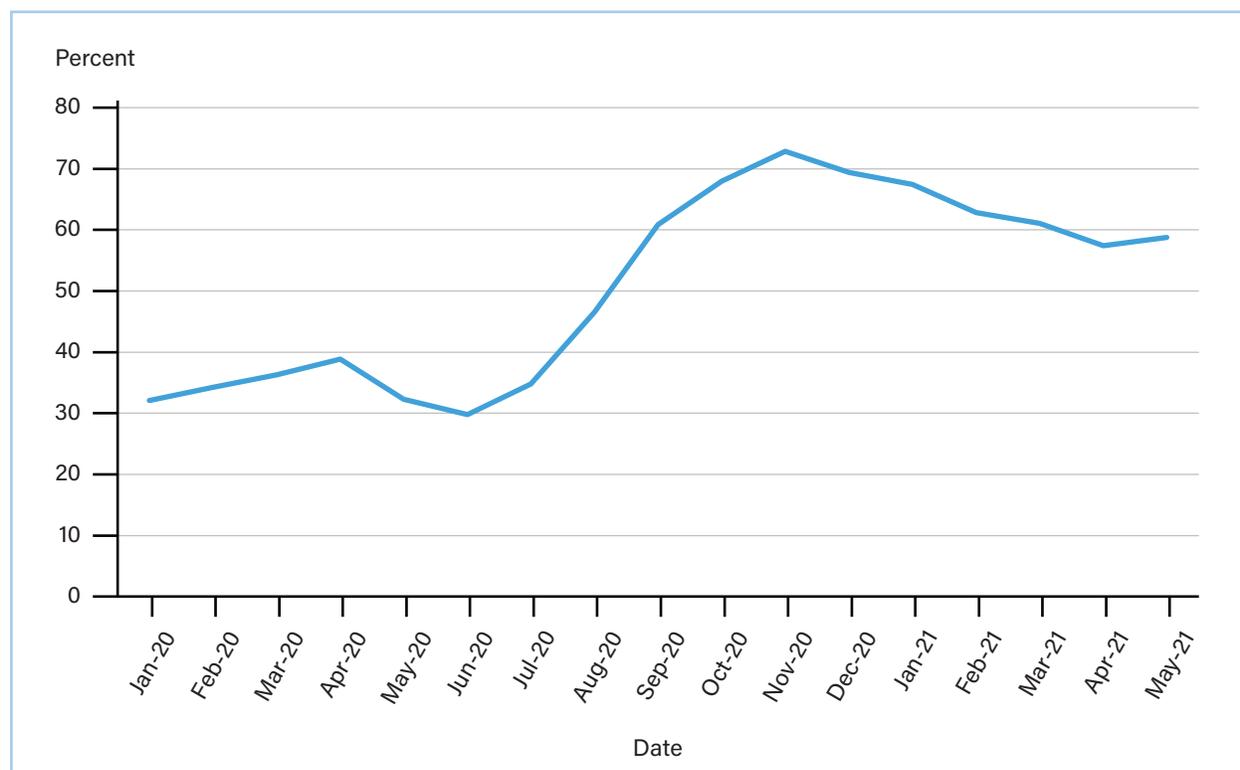
Impacts of Removing China's Price Wedges: Medium/Longrun Impacts

First, we calculated price wedges to help estimate the economic impacts of removing each wedge—one at a time—using a medium/longrun setup of the CGE model. For this time horizon, we assumed that resources are free to move across sectors.

Beef

China's per capita beef consumption grew steadily over the past decade as incomes rose and consumers diversified diets away from pork, traditionally the predominant meat consumed in China. Increased beef consumption was encouraged by exposure to the product through popular foodservice outlets, availability through e-commerce platforms, and dietary guidelines issued by Government health authorities (USDA, FAS, 2020a; USDA, FAS, 2021c). USDA (2021) projected that consumption will grow from 9.5 to 11.6 million metric tons between 2020 and 2030. Domestic supply is not growing fast enough to meet increasing demand, as most of China's beef herd lacks access to land and forage (USDA, FAS, 2021c). Increasing demand and constrained supply are causing high beef prices in China, increasing the size of the price wedge (figure 6) (USDA, FAS, 2020a). The USDA Baseline (USDA, 2021) projected that China's beef imports would rise from 2.75 to 3.8 million metric tons between 2020 and 2030. A recent strategic plan for China's beef and sheep production set a production target of 6.8 million metric tons for 2025 (about the same as the output in 2020), called for boosting the share of beef from above-scale farms (farms with annual slaughter rates of 500 head or more) to 30 percent, and aimed to limit imports to 15 percent of the country's beef supply (China Ministry of Agriculture and Rural Affairs, 2021). China's beef consumption possibly accelerated during 2019–20 due to reduced supplies of pork and a narrowed price spread between beef and pork (USDA, FAS, 2020a).

Figure 6

China-U.S. beef price wedge by percentage, January 2020–May 2021

Notes: The price wedge equals the China domestic beef price minus the U.S.-landed beef price in China divided by Chinese domestic beef price.

Source: USDA, Economic Research Service using average wholesale price from the China Ministry of Agriculture and Rural Affairs, and the unit value of imported beef data from Trade Data Monitor (2021).

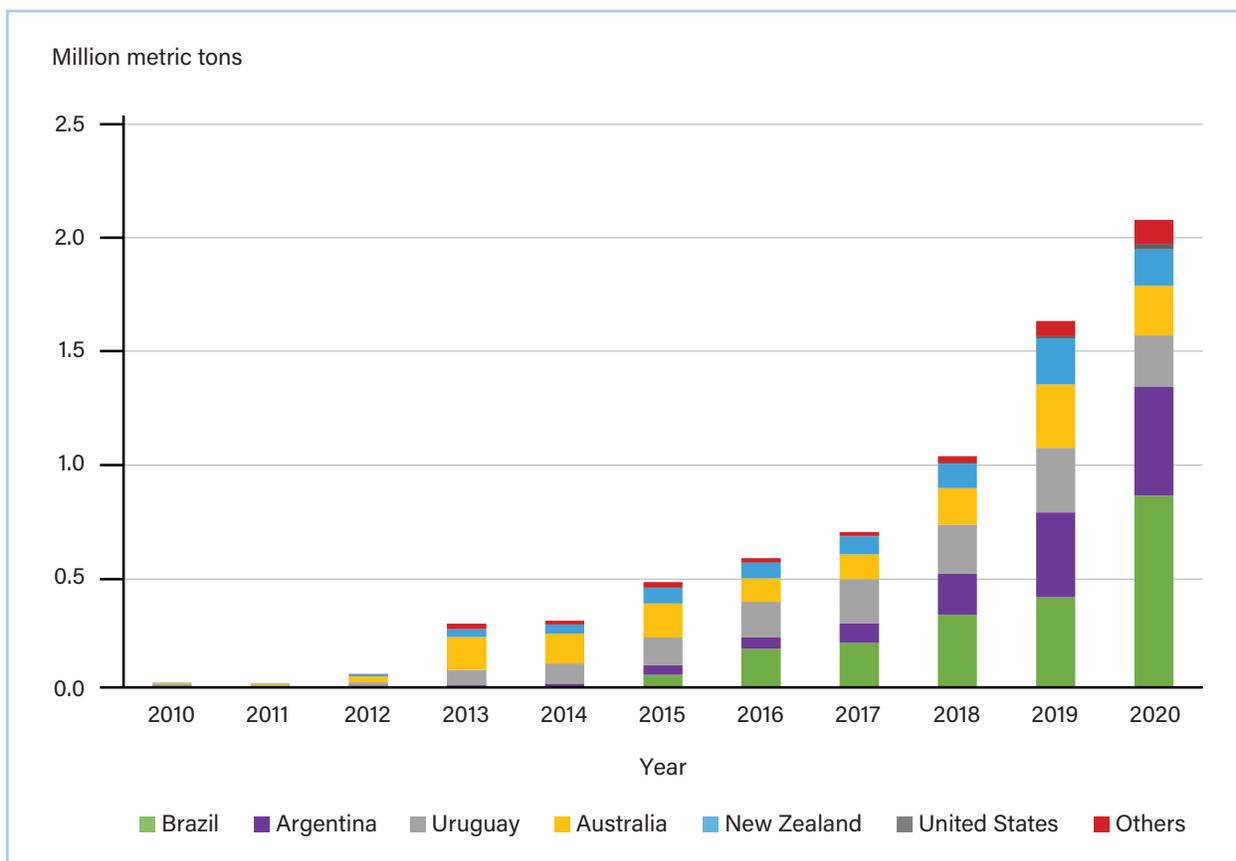
A major impediment to beef trade with China was the country's ban on U.S. beef imports for 14 years after the discovery of several cases of bovine spongiform encephalopathy (BSE) in the United States during 2003. The ban was officially lifted in September 2016, and U.S. beef shipments to China resumed in June 2017 (USDA, FAS, 2018). Several other countries—including the United Kingdom (UK), France, Ireland, Brazil, and South Africa—also had their beef exports banned by China over BSE concerns in recent years for varying lengths of time (USDA, FAS, 2018). While China has established a diverse array of countries from which to source beef, BSE bans remain a threat to exporters, as evidenced by recent bans on beef from Brazil and the UK over cases of BSE discovered in these countries in September 2021 (BBC, 2021; Patton and Figueiredo, 2021).

China began to open its market more widely to beef imports in 2012 while U.S. beef was still banned. Additional beef-exporting countries were recognized by Chinese authorities; inspection and quarantine facilities and processes were expanded at points of entry; and China entered free trade agreements with Australia and New Zealand that cut tariffs on their beef. China's beef imports increased dramatically from around 20,000 metric tons to over 2 million metric tons between 2010 and 2020 (figure 7). In 2020, China imported 41 percent of its beef from Brazil. The next largest sources were Argentina (23 percent), and Uruguay and Australia with 11 percent of China's beef imports each. Despite the expanded access, the strong demand for beef motivates merchants and smugglers to evade the strict requirements for imported beef. Chinese border inspectors commonly report refusing shipments of beef from unapproved countries, and the Chinese regularly report intercepting smuggled beef (Gale, 2021b).

After China reopened its borders to U.S. beef in 2016, exports were slow to resume due to the strict conditions placed by China on entering beef (figure 7). Only a few U.S. beef suppliers were eligible for export, keeping total export volumes low in the first years of restored access (USDA, FAS, 2017a). In addition, the complexity of the process generated considerable uncertainty among Chinese buyers as to how to import U.S. beef, also limiting the volume of trade (USDA, FAS, 2017b). The Phase One agreement lifted many of these restrictions by recognizing the U.S. traceability system, easing restrictions on the age of cattle slaughtered, and registering more exporting facilities with Chinese authorities (USTR/USDA, 2020)—all of which improved access for U.S. beef into China. China also dropped the 30-month age limit for cattle and recognized the USDA, Food Safety and Inspection Service (FSIS) oversight of U.S. beef processing and storage facilities (USDA, FAS, 2020b). But, USTR (2022) noted that China has failed to take action on some of the Phase One commitments, including requiring a risk assessment for the use of ractopamine in beef and pork production.

In addition to trade barriers, imports of U.S. beef to China were hampered by the demand impacts of the 14-year BSE ban on U.S. beef. The age restrictions and traceability requirements heavily contributed to low initial import numbers upon U.S. re-entry to the Chinese markets, but consumer demand factors also slowed imports in the years immediately following the lifting of the previous ban. During U.S. beef's absence in the Chinese market, other competitors, particularly Australia, established their beef in the consumer's mind as a high-quality imported product and established supply chains, leaving U.S. beef at a disadvantage upon re-entry to the market. However, the political volatility of trade relationships with China can dramatically affect trade opportunities, as tensions with Australia in late 2021, in conjunction with drought impacts on Australian beef production, led to drastic decreases in Australian beef imports, bolstering substantial growth in U.S. beef exports to China (Patton and Polansek, 2021).

Figure 7
China's beef imports by country, 2010–20



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

For the CGE analysis, we estimated a price wedge of 57.5 percent for May 2020–April 2021. As a result of using import unit values from the United States, prices likely reflect some of the compliance cost required to import beef from the United States. This would include China's requirement of U.S. beef being hormone-free and the traceability requirements, which are likely to make a U.S. beef product shipped to China more expensive compared with another product that doesn't face similar restrictions. Together, these factors likely cause a downward bias on the estimated price wedge. For instance, using Australian beef prices (Australia does not employ beef hormones in their production), the price wedge would be 122 percent and would provide a much larger trade impact in the model. The price wedge was even larger for beef from Brazil, Argentina, and Uruguay.

The impacts estimated by the model are presented in table 2. For China, the removal of the price wedge on beef leads to a 46.3-percent increase in the country's aggregate beef imports. Other regions in the model (the ROW and United States) also show a slight increase in imports, as these regions export more of their domestic production.¹⁵ The model estimates that the increase in beef imports in China leads to a decrease in the country's imports of other agricultural products. This model indicates that beef replaces a portion of other

¹⁵ The model allocates export expansion to competing exporters as well, based on initial shares per exporter, and these expand for all existing exporters to China.

agricultural products—in particular, pork and chicken—in Chinese diets as the removal of the price wedge lowers the price of beef in China.¹⁶

Table 2

CGE results from removing the price wedge on beef (percent changes)

	Aggregate imports		Exports to China		Aggregate exports		Production	
	Beef	Other ag	Beef	Other ag	Beef	Other ag	Beef	Other ag
China	46.3	-2.4	-	-	2.4	0.8	-8.5	0.2
ROW	0.2	0	47	-2.6	16.1	-0.4	3.2	0
United States	0.3	0.1	44.8	-2.5	25.9	-0.8	3.1	0

Note: CGE = computable general equilibrium; ROW = Rest of the world; ag = agricultural (imports, exports, production).
Source: USDA, Economic Research Service calculations based on estimated impacts from the economic model.

The model estimates that both the ROW and the United States will increase their exports of beef to China at a pace that nearly matches the growth in China’s aggregate beef imports. The ROW shows a slightly larger increase compared with the United States, mainly because the United States only held a 1-percent share of China’s beef imports in 2020. Exports to China of all other agricultural products decrease, which is mainly a result of the switch in consumption (e.g., U.S. pork exports to China decrease by 11.3 percent). All regions in the model show an increase in aggregate exports; the increase in China is basically a result of the large increase in ROW exports reshaping where beef trade is occurring. In other words, the ROW is exporting more to China, which diverts products away from other regions and causes these regions to export more of their own domestic production. As a result, China shows a slight increase in aggregate beef exports, although the country is a small exporter. The ROW shows an increase in aggregate exports of 16.1 percent, which is smaller than the change for the United States (25.9 percent), as some trade is diverted from other markets in the ROW to China. The ROW and the United States show a decrease in aggregate exports of other agricultural products because the removal of the price wedge leads to more demand for beef in China, but the removal also reduces demand for other products. The United States, for example, shows a reduction in aggregate pork exports of 5.9 percent—a result largely due to the reduction in pork exports to China. Finally, table 2 presents changes to beef production. China is estimated to show a decrease of 8.5 percent, while the ROW and the United States exhibit estimated increases of 3.2 and 3.1 percent, respectively. These estimated changes are largely a result of the increase in exports for the ROW and the United States and the increase in imports for China. There are small changes in production for other agricultural products—China’s production is estimated to increase as resources previously allocated to beef are freed, while the ROW and the United States are estimated not to change.

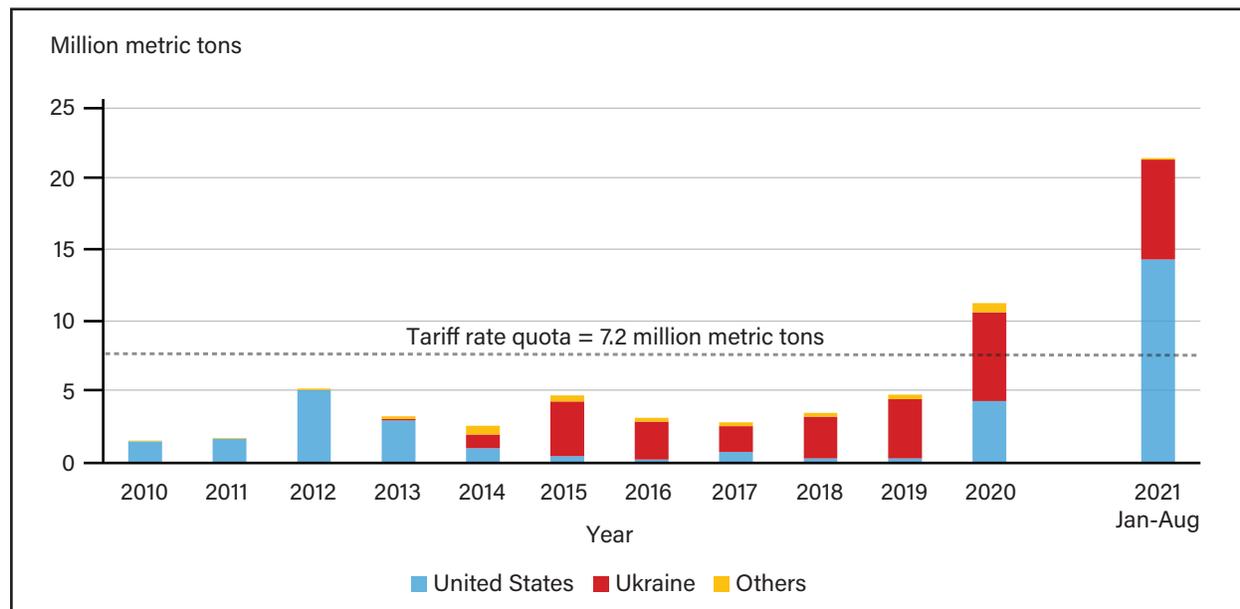
Corn

Since the 1990s, economists have projected that China’s demand for corn as livestock feed would outpace its supply (Gale et al., 2015). USDA (2021) projected that China’s corn use would increase by 43.8 million metric tons (15.7 percent) during 2020–30. China was a moderate importer of 3-to-5 million metric tons of corn during 2010–19, and then became the fourth-largest corn importer in 2020, following the EU, Japan,

¹⁶ The increase in beef consumption in China is a function of modeling the scenarios independently. The authors could run them simultaneously, but (as will be shown later) the price wedge for pork is much bigger than for beef—thus the model will basically ignore the removal of the price wedge. Conducting the scenarios independently is likely overestimating the impacts from removing price wedges, but the authors wanted to show how each commodity would be impacted by the removal of its own price wedge.

and Mexico. In 2020, China's total imports of corn more than doubled to 11.2 million metric tons and rose to 28 million metric tons in 2021 (figure 8). This surge in imports was driven in part by tighter corn supplies in China, the rebuilding of China's pig herd, and China's purchase commitments in the Phase One agreement. The share of China's corn imports from the United States rose from 7 percent in 2019 to 70 percent in 2021. The share from Ukraine fell from 86 percent to 29 percent during those years. Russia's invasion of Ukraine could affect the ability of Ukraine to produce and trade their agricultural products.

Figure 8
Volume of China's imports of corn, 2010-20



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

China's corn price wedge fluctuates due to the country's evolving government policy. In efforts to stabilize domestic prices from 2007 to 2016, China implemented a nationwide corn stockpiling program that included direct purchases from farmers at minimum support prices. The price wedge grew when international corn prices dropped to about half the Chinese support price. Chinese feed mills and processors felt a strong incentive to import corn, but a TRQ limited corn imports. Instead, Chinese feed mills imported substitutes like sorghum, barley, and distillers dried grains with no quotas and low tariffs (Gale, 2015).

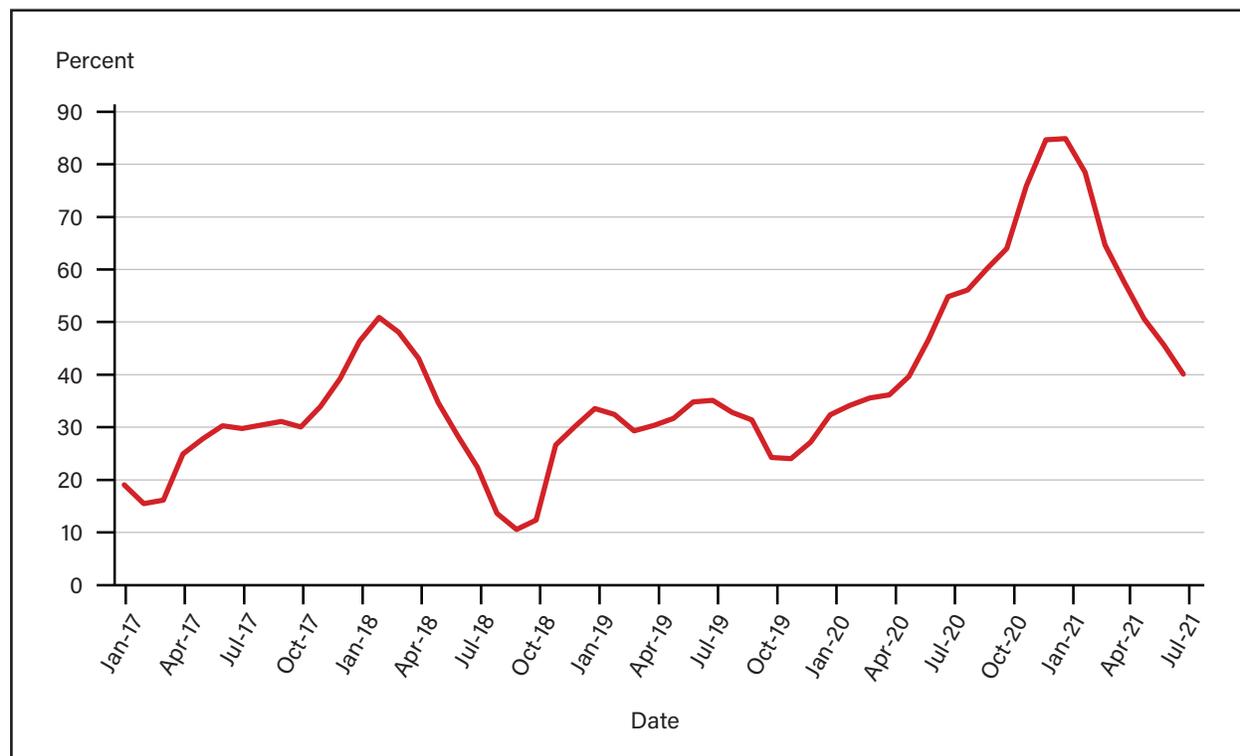
In 2016, China abandoned the support price program, replaced it with a direct payment, introduced a 5-year program to shift land to alternative crops, and began to sell off corn reserves reported to contain a year's worth of production (Wu and Zhang, 2016). Eliminating the support price narrowed the price wedge as domestic prices fell more closely in line with international prices during 2016-19.

China's TRQ for corn allows up to 7.2 million metric tons of imports annually at a tariff of 1 percent. Imports outside the quota are subject to a prohibitive tariff of 65 percent. However, imports never reached the quota despite the difference between Chinese and international prices that would motivate such imports. In 2017, the United States initiated a WTO dispute alleging China administered its TRQs for wheat, corn, and rice in a manner that inhibited the full utilization of the TRQs. In 2019, a WTO panel found that China administered its TRQs in a manner inconsistent with its WTO commitments and recommended remedies for China to bring its measures into compliance. In 2020, the surge in China's corn imports met and

exceeded the quota for the first time, as China reportedly changed the administration of its TRQ to reach compliance, although it is unclear what those changes were.

In 2020, the rapid growth in Chinese corn prices—along with its strengthening currency—increased the corn price wedge from 32 percent in early 2020 to 85 percent in January 2021 (figure 9). However, the wedge narrowed to 40 percent during 2021 as Chinese corn prices began to gradually decline and U.S. prices rose.

Figure 9
China-U.S. corn price wedge



Source: USDA, Economic Research Service using the average price at Guangzhou from China National Grain and Oils Information Center and the unit value of imported corn from Trade Data Monitor (2021).

For the CGE model, we estimated a price wedge of 64 percent for June 2020–May 2021. In the baseline period, China’s imports of corn already exceeded the 7.2 million metric ton quota limit. The simulations assume that the 65-percent over-duty rate is not applied. The impacts estimated by the CGE model that removes the price wedge on corn are presented in table 3. First, for China, the removal of the price wedge leads to a 90.9-percent increase in the country’s aggregate corn imports. Other regions in the model (ROW and the United States) show small changes in imports. The increase in corn imports in China does lead to a decrease in the country’s imports of other agricultural products, but this impact is smaller than it was for beef.

Table 3

CGE results from removing the price wedge on corn (percent change)

	Aggregate imports		Exports to China		Aggregate exports		Production	
	Corn	Other ag	Corn	Other ag	Corn	Other ag	Corn	Other ag
China	90.9	-1.7	-	-	25	3.7	-3.2	0.5
ROW	-1.7	0	80.5	-1.6	38.5	-0.4	12.4	-0.1
United States	2.1	0.1	132.1	-2.7	42.8	-0.9	7.7	-0.2

Note: CGE = computable general equilibrium (model); ROW = Rest of the World; ag = agricultural (imports; exports; production).
Source: USDA, Economic Research Service calculations based on estimated impacts from the economic model.

The model estimates that both the ROW and the United States increase their exports of corn to China, basically matching China's aggregate corn imports. The United States shows a larger increase compared with the ROW, as the U.S. diverts product destined for other markets to China. Exports to China of all other agricultural products decrease for the United States. All regions in the model show an increase in aggregate exports, but China is a very small exporter of corn. The ROW shows a 38.5-percent increase in aggregate exports, which is smaller than the change for the United States (42.8 percent). The ROW and the United States show a decrease in aggregate exports of other agricultural products, as the removal of the price wedge leads to more demand for corn in China but a reduction in demand for other products. Finally, table 3 presents changes to production. China is estimated to have a 3.2-percent decrease in production, while the ROW and the United States show increases of 12.4 percent and 7.7 percent, respectively. This is largely a result of the increase in exports—for the ROW and the United States—and the increase in imports for China. There are small changes in production for other agricultural products. For instance, China shows an increase in the production of other agricultural products as resources previously allocated to corn are freed, while the United States shows a decrease in these products as resources are pulled out of other commodities and into corn.

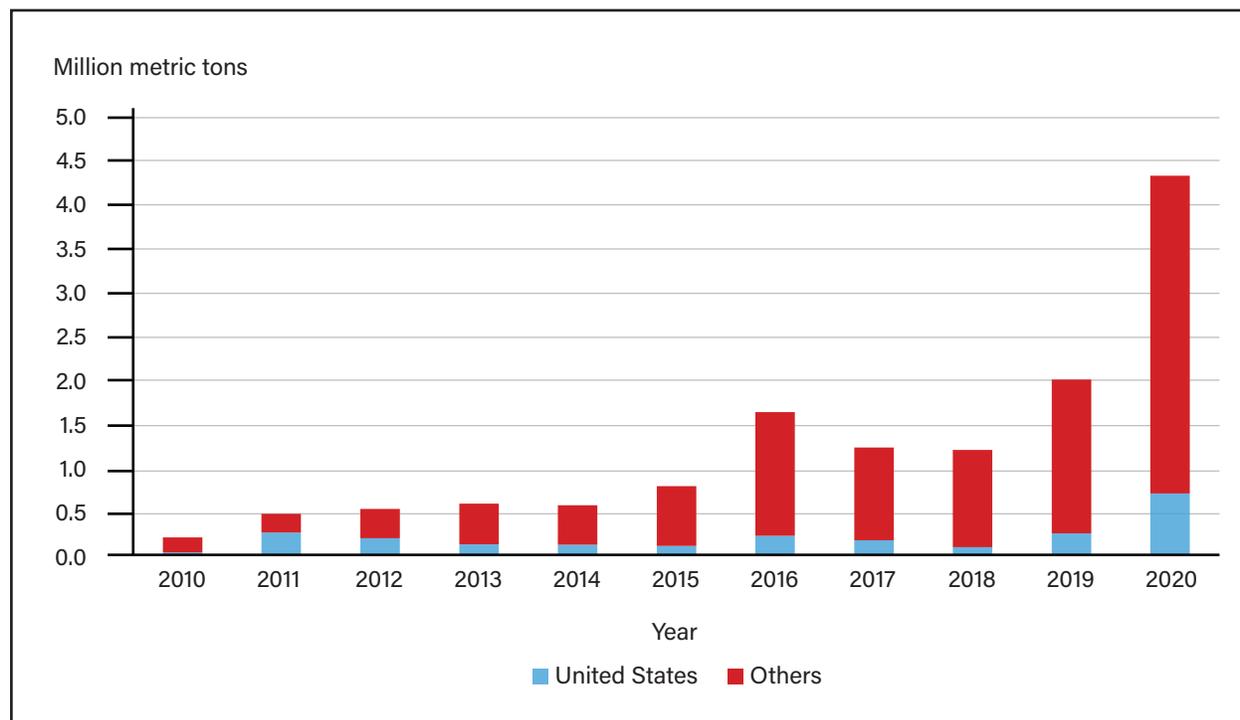
Pork

China's pork production and consumption account for about half of the world's total for both categories. Historically, China's pork was produced by small, backyard swine operations, but China now is home to some of the largest swine-producing operations in the world. According to China's Ministry of Agriculture and Rural Affairs (MARA), above-scale operations increased their share of production from 11 percent to 57 percent between 2000 and 2020. Millions of rural households stopped raising pigs in backyards as nonfarm employment opportunities absorbed rural labor and as recent environmental and biosecurity initiatives—and high feed prices—favored large-scale farms. In particular, farm construction subsidies, credit, and land requisition policies aimed at rebuilding production capacity from the ASF epidemic encouraged larger-scale operations. A dozen swine-producing companies listed on stock exchanges gained an influx of capital for investment through soaring share prices during 2020. Chinese officials claimed that pork output returned to pre-ASF epidemic levels in 2021, but USDA's *Production, Supply, and Distribution* Database estimated that 2021 pork output was still below the pre-ASF output.

Despite being the largest producer of pork, China also became the largest importer because of rising costs and weak productivity growth (Gale, 2017). Imports rose from 200,000 metric tons to 4.3 million metric tons between 2010 and 2020 (figure 10). According to USDA's *Production, Supply, and Distribution* Database, China was the leading importer of pork in all but one year during 2016–21. China's pork imports are supplied by the United States and about a dozen other countries, including Germany, Spain, Brazil, Canada,

the Netherlands, Denmark, Chile, and the UK. In 2020, the EU was the largest source, providing over 40 percent of China’s imports, while the United States was the next-largest source at 16.2 percent.¹⁷

Figure 10
Volume of China’s imports of pork by country, 2010–20



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

While China’s per capita consumption of pork is growing more slowly than consumption of other meats, USDA (2021) projected that total consumption would rise from 55.3 million metric tons in 2018—the year before ASF affected production and consumption—to 60.3 million metric tons in 2030. Consumption of poultry, beef, and aquatic products is growing faster than pork consumption (USDA, FAS, 2018b), but pork still accounts for about 60 percent of China’s meat consumption, and income growth is expected to spur more growth. Demographic change, the rapid growth in foodservice, new retail formats, and e-commerce are changing traditional consumption habits. The Chinese Government is supporting the development of cold chain infrastructure to expand the consumption of chilled and prepacked pork over freshly slaughtered meat to concentrate production and processing in regions separated from densely populated cities (USDA, FAS, 2021c). The growing consumer acceptance of chilled and frozen pork improves the competitiveness of imported pork.

China is expected to remain a large importer of pork. USDA (2021) projected that pork imports would rise to 5.5 million metric tons in 2030, even higher than the amount imported during 2020 when domestic supplies were constricted by the impact of the ASF epidemic. One reason for this could be that China’s

¹⁷ Over time, China’s strict import policies for meat challenged U.S. exports. For example, the EU was preferred to the United States because of the EU’s zero-tolerance policy for ractopamine use—a feed additive that promotes lean muscle growth (USDA, FAS, 2007). More recently, starting in mid-2018, China imposed retaliatory Section 232 and Section 301 tariffs on U.S. agricultural products. Section 232 accounts for an additional 25-percent tariff on certain pork products. In response to the ASF outbreaks and low domestic pork supplies, the imposing of retaliatory tariffs was followed by several tariff exclusion processes that exempted only the retaliatory Section 301 tariffs (USDA, FAS, 2020b). These exemptions were introduced in February 2020. The importers need to apply and get approval, as these exclusions do not apply automatically. However, the Section 232 tariffs levied on pork are still in place (USDA, FAS, 2021b).

policies favored stability rather than additional growth. In September 2021, MARA announced an Interim Implementation Plan to Manage Swine Production Capacity that called for continued consolidation of the industry into larger-scale operations and stabilizing the national sow inventory at around 41 million head until 2025 (USDA, FAS, 2021f). A 5-year plan for livestock and veterinary affairs during 2021–25 set a pork output target of 55 million metric tons, about equal to the pre-ASF volume, and set a self-sufficiency target of 95 percent, implying imports of about 2.7 million metric tons.

In 2018, U.S. pork was assessed both Section 232 and 301 tariffs, a cumulative 50 percent in additional tariffs for six tariff lines. After the Phase One agreement was in place in 2020, Chinese officials reportedly granted exclusions from Section 301 tariffs to some importers, but no exclusions were granted for Section 232 tariffs. China's customs data indicate that the United States was the second-leading supplier of China's pork imports during 2019–20 despite the additional tariffs.

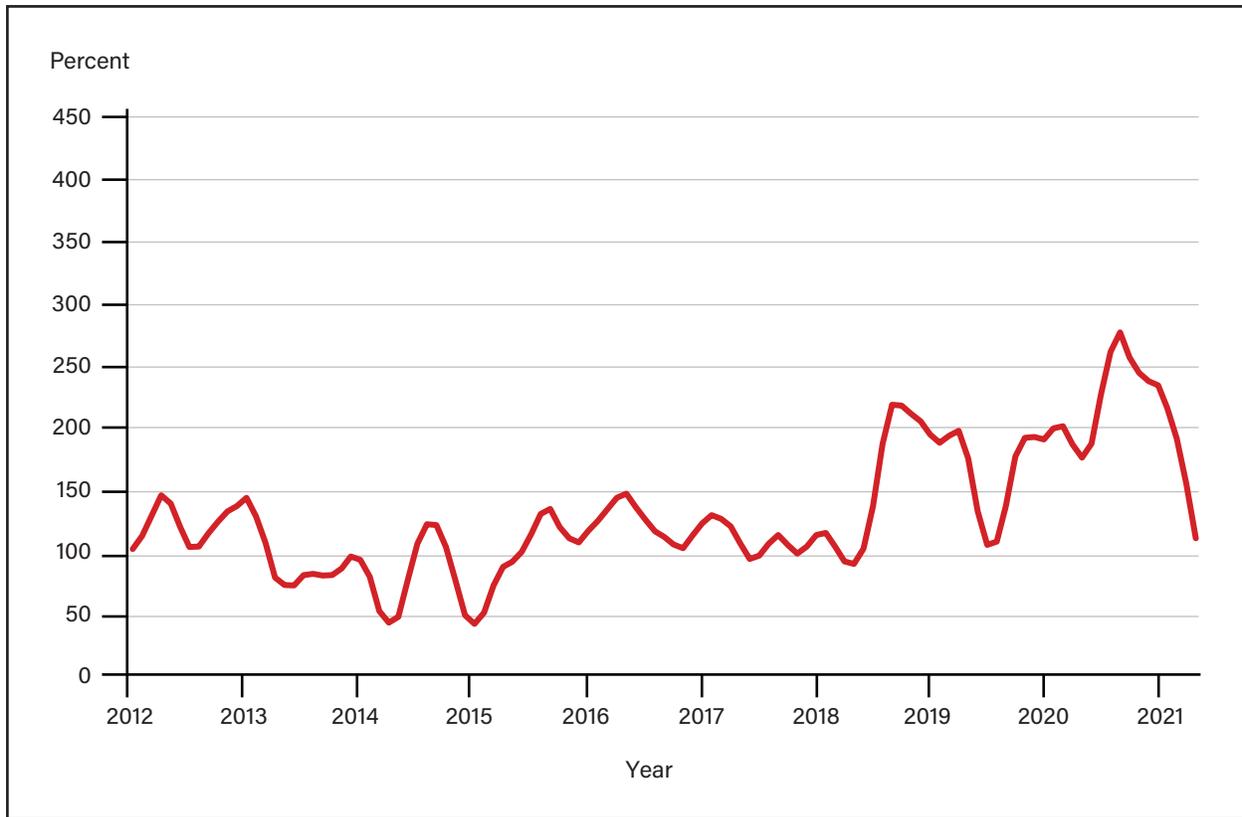
The Phase One trade deal addressed a longstanding pork trade concern by calling for China to conduct a scientific risk assessment of tolerances for maximum residue levels for the feed additive ractopamine in pork. China has rejected imported pork containing any traces of ractopamine since the substance was banned in the country.¹⁸ This meant that pork exported to China must be produced in segregated facilities where no ractopamine or other beta agonist was used. Another concern is China's practice of banning all imports of pork and other meats due to disease outbreaks in isolated regions. China banned U.S. pork for an extended period during the 2009 H1N1 influenza epidemic, and it also banned German pork in 2020 due to several cases of ASF in wild boars in that country.

Figure 11 depicts the price wedge between China's pork prices and U.S. prices. The price wedge fluctuated around a mean of about 100 percent, indicating that Chinese pork prices were consistently about double the price of imported pork. However, the price wedge rose to more than 200 percent in 2018. The increase in the wedge coincided with the ASF epidemic that caused Chinese pork prices to more than double during 2019–20. Pork imports surged to more than 4 million metric tons during 2020, but China's pork production decreased 10 million metric tons that year from its pre-ASF level, indicating that imports filled only part of China's supply shortfall. For the CGE model, we estimated a price wedge of 213 percent for June 2020–May 2021.¹⁹

¹⁸ The European Union—the leading supplier of China's pork imports—also has a zero tolerance for ractopamine.

¹⁹ The abrupt rise in the unit value in 2018–19 may reflect tariffs on U.S. pork. The authors observed that unit values of imported U.S. pork dipped sharply below those of pork from other pork-supplying countries during mid-2018, several months before the first African Swine Fever cases in China and a year before Chinese pork prices rose to their peak levels. This suggests the possibility that importers in China may have demanded a price discount from U.S. suppliers to offset the cost of the additional tariffs. The difference in unit values diminished in mid-2019 and 2020. Using prices from Canada or the European Union, a price wedge of 194 percent or 145 percent, respectively, was estimated.

Figure 11
China-U.S. pork price wedge, percentage change, 2012-21



Source: USDA, Economic Research Service using the average wholesale price of swine carcasses from the China Ministry of Agriculture and Rural Affairs, the unit value of imported frozen pork from Trade Data Monitor (2021), and the pork cutout value using data from USDA, Agricultural Marketing Service.

The impacts estimated by the CGE model due to the removal of the price wedge on pork are presented in table 4. First, for China, the removal of the price wedge leads to a 402-percent increase in the country’s aggregate pork imports. This increase is almost double the price wedge. This large response is because pork is directly purchased by consumers, so it is a higher value product. Other regions/countries in the model (the ROW and the United States) show a decrease in their pork imports, as all product on the global market is essentially imported by China. As with beef, there is a large decrease in China’s imports of other agricultural products—as the model indicates that consumers switch from other protein sources to pork. The model estimates that China has a 51.6-percent decrease in beef imports and a 13.5-percent decrease in chicken imports.

Table 4

CGE results from removing the price wedge on pork (percent change)

	Aggregate imports		Exports to China		Aggregate exports		Production	
	Pork	Other ag	Pork	Other ag	Pork	Other ag	Pork	Other ag
China	402	-13.3	-	-	683.7	15.6	-77.9	-0.8
ROW	-1.4	0.2	395.6	-13.3	281.8	-2	92.4	0.5
United States	-2.7	0.3	440.1	-14.6	171.5	-3.7	53.2	0.7

Note: CGE = computable general equilibrium (model); ROW = Rest of the world; ag = agricultural (imports, exports, production).
Source: USDA, Economic Research Service calculations based on estimated impacts from the economic model.

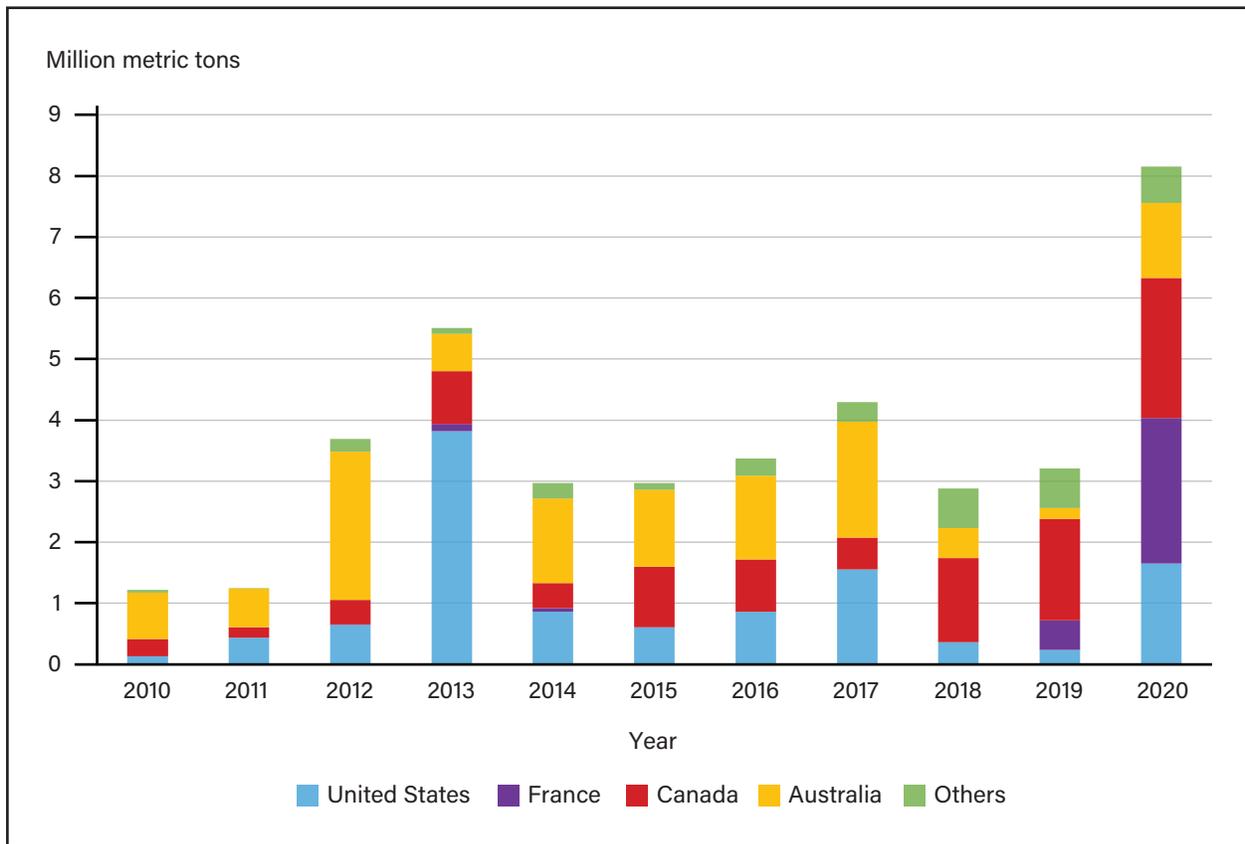
The model estimates that both the ROW and the United States increase their exports of pork to China, basically matching China's aggregate imports. The United States shows a larger increase compared to the ROW. This is because the United States shifts pork exports from other markets to China more than the ROW. Exports to China of all other agricultural products decrease, mainly due to the switch in consumption (e.g., U.S. beef exports to China decrease by 49 percent). All regions in the model show an increase in aggregate exports. China is a very small exporter (essentially only exporting to Hong Kong), so the large percentage increase causes a negligible impact on the world market. The ROW shows an increase in aggregate exports of 281.8 percent, which is larger than the change for the United States (171.5 percent). Finally, table 4 presents changes to production. China is estimated to have a decrease in production (77.9 percent), while the ROW and the United States show increases of 92.4 percent and 53.2 percent, respectively. This is largely due to the increase in exports for the ROW and United States and to the increase in imports for China. Given these large changes, we present a sensitivity analysis on these price wedge estimates later in the paper.

Wheat

China is the world's largest consumer of wheat, but a large volume of domestic production nearly satisfies this consumption. In fact, China is the second-largest wheat producer in the world, behind only the EU (USDA, FAS, 2021e). Policies help to shield China's wheat producers from international competition, reducing imports and keeping prices high to encourage production. As is the case with corn, China has a TRQ for wheat imports in which a 1-percent tariff is applied to the first 9.64 million metric tons imported into China, and a 65 percent tariff is applied to any imports beyond 9.64 million metric tons. However, 90 percent of this wheat import quota is reserved for imports by one state trading enterprise (STE) (Gale, 2021a). The WTO dispute over China's grain TRQ management revealed that the STE share was unavailable to other companies, which could only apply for the 10 percent of the quota designated as non-STE.

China is traditionally a medium-size importer of wheat, importing less than 2 percent of the global total. In 2020, the country became one of the top five importers, as imports surged to over 8 million metric tons, more than double the volume imported in most previous years. Figure 12 indicates that China's wheat came from four main countries—Australia, Canada, France, and the United States. Until 2012, Australia was the main source, but in 2020, it was France (29 percent), followed by Canada (28 percent) and the United States (20 percent).

Figure 12
Volume of China's imports of wheat by country, 2010–20

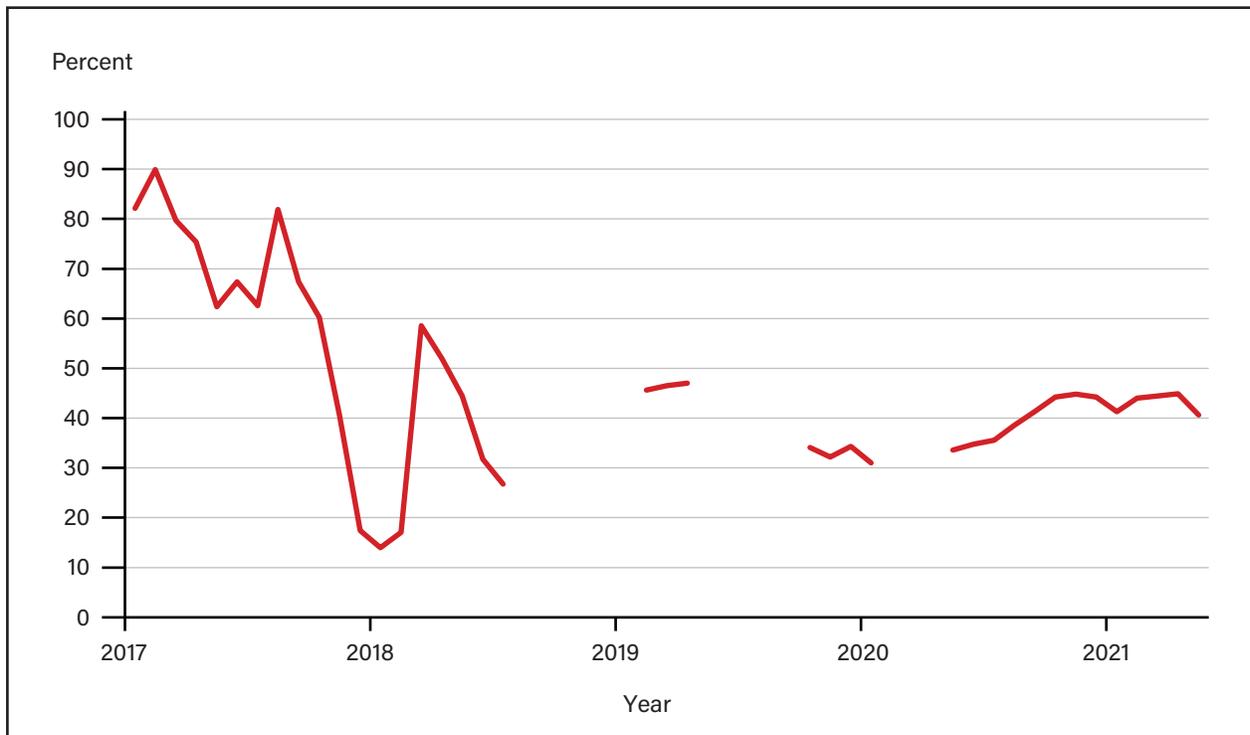


Source: USDA, Economic Research Service using data from Trade Data Monitor (2021).

More than 900 Chinese companies applied for non-STE TRQs, but from 2001 to 2019, China's wheat TRQ was never filled. In 2019, in response to the WTO investigation dispute brought by the United States, China revised its guidelines so that any company could apply for STE and non-STE quotas. These revised guidelines went into effect in 2020 (Gale, 2021a). Even with a low 1-percent in-quota tariff rate, there is a large price wedge between China's domestic wheat prices and exporter prices, which suggests that China could import significantly more wheat (figure 13).²⁰

²⁰ The authors note that the price wedge does not control for quality differentials. The United States typically sends higher protein hard wheats that are subsequently blended with lower quality wheats to make flour. Thus, by ignoring the quality differentials, the price wedge tends to understate the level of distortions.

Figure 13
China-U.S. wheat price wedge percentage change, 2017-21



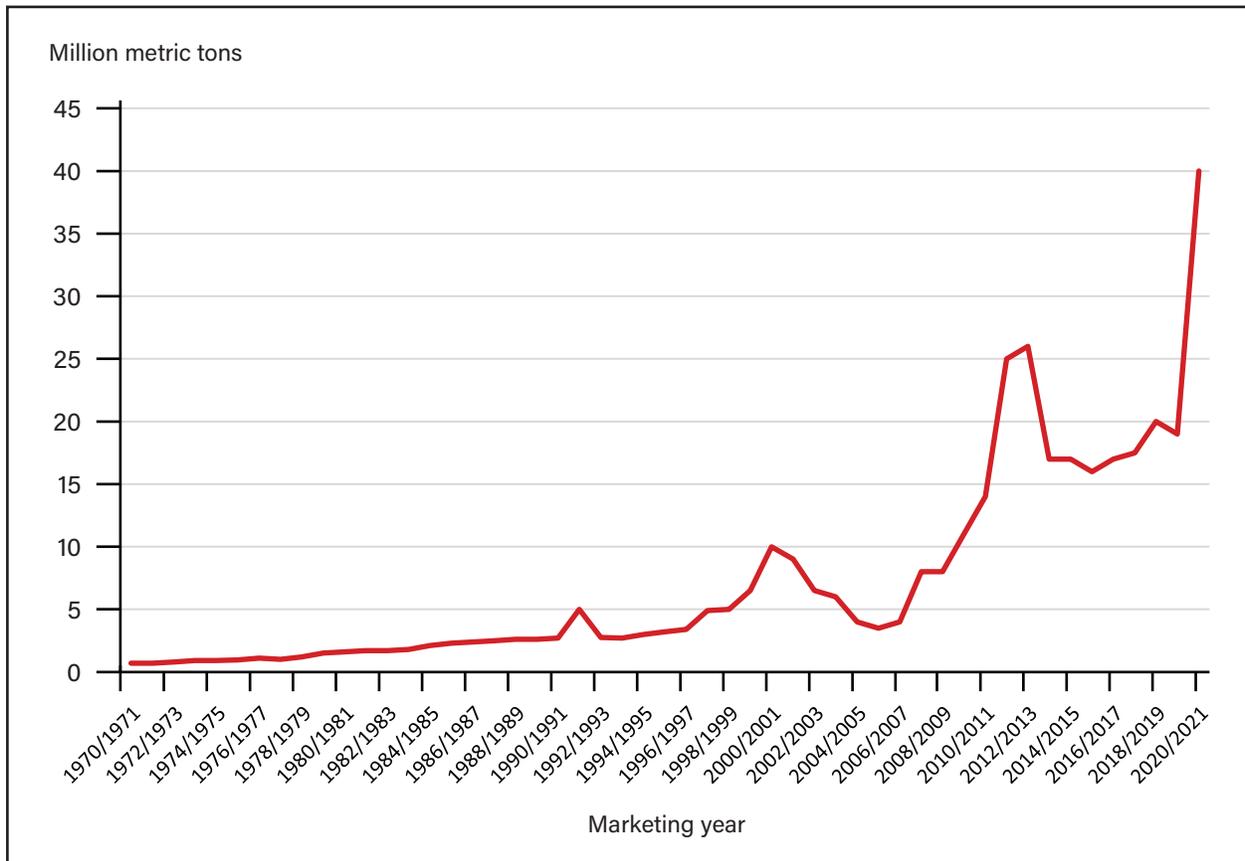
Note: Data are missing for months when no U.S. wheat was imported.

Source: USDA, Economic Research Service using the average price at Guangzhou from China National Grain and Oils Information Center and the unit value of imported wheat from Trade Data Monitor (2021).

Historically, China’s primary source of wheat demand has been the flour milling industry. However, in 2020, USDA’s Foreign Agricultural Service (FAS) estimated that China’s demand for wheat used as livestock feed more than doubled from the previous year (figure 14). Feed use may have played a role in doubling wheat imports from 2019 to 2020 (figure 10) (Gale, 2021a), as did China’s commitments in the Phase One trade deal and stockpiling for potential supply chain disruptions caused by COVID-19. FAS forecast a decline in China’s wheat imports to 8 million metric tons for marketing year 2021/22 (USDA, FAS, 2021b; USDA, FAS, 2021e).

Figure 14

Volume of China's domestic wheat feed consumption by marketing year



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

For the CGE model, we estimated a price wedge of 42 percent for June 2020–May 2021. The impacts estimated by the CGE model due to the removal of the price wedge on wheat are presented in table 5. First, for China, the removal of the price wedge leads to a 248.9-percent increase in the country’s aggregate wheat imports (similar to corn, we assumed that the over-quota rate is not binding). This response—the change in imports relative to the price wedge—is the largest across all four commodities and indicates that the demand for wheat in China is not being filled (i.e., wheat has the largest excess demand of all the commodities). Like the other three commodities, the increase in wheat imports in China is accompanied by a decrease in imports of other agricultural products.

Table 5

CGE results from removing the price wedge on wheat (percent change)

	Aggregate imports		Exports to China		Aggregate exports		Production	
	Wheat	Other ag	Wheat	Other ag	Wheat	Other ag	Wheat	Other ag
China	248.9	-0.6	-	-	33.5	1.3	-5.5	0.2
ROW	-1.5	0	254.6	-0.6	9.3	-0.1	4.2	0
United States	2.9	0	234.5	-0.8	12.2	-0.4	9.8	-0.1

Note: CGE = Computable General Equilibrium (model); ROW = Rest of the world; ag = agricultural (imports, exports, production).
Source: USDA, Economic Research Service calculations based on estimated impacts from the economic model.

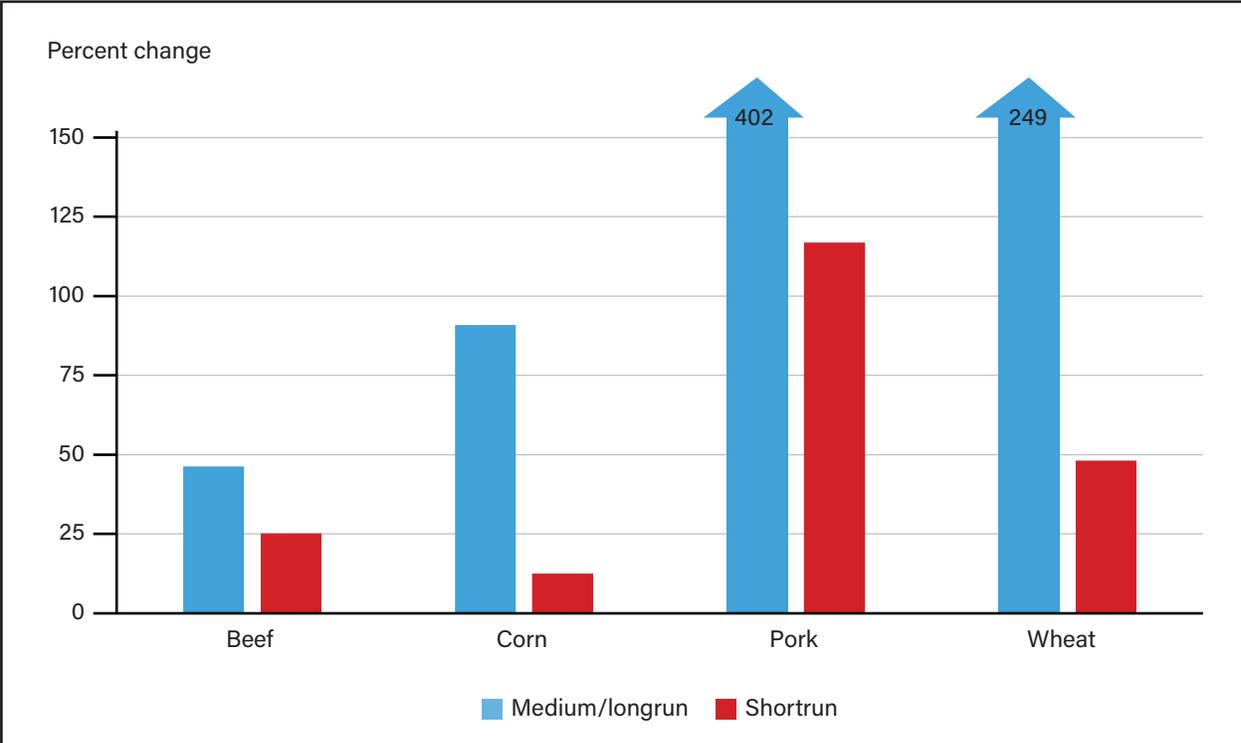
The model estimates that both the ROW and the United States will increase their exports of wheat to China, basically matching China's aggregate imports. The ROW shows a larger increase compared with the United States, as the ROW shifts wheat exports from other markets to China more than the United States does. Exports to China of all other agricultural products are estimated to decrease, similar to the results for the other commodities. All regions in the model show an increase in aggregate exports. Because China is a very small exporter, the large increase is deceiving. The ROW shows an increase in aggregate exports of 9.3 percent, which is smaller than the change for the United States (12.2 percent). Finally, table 5 presents changes to production. China is estimated to have a production decrease (-5.5 percent),²¹ while the ROW and the United States have increases of 4.2 percent and 9.8 percent, respectively. This is largely a result of the increase in exports for the ROW and the United States and for the increase in imports for China.

²¹ In this and the other scenarios where production decreases for a given commodity, resources are generally shifted to other agricultural activities. In this instance, there is a quarter-percent increase in rice and corn production, for example. But, in general, the loss in production from the decrease (in this instance, wheat) generally outweighs the increase in production of the other agricultural activities since resources are assumed to be in their most efficient usage before the price wedge is removed.

Effects of Removing China's Price Wedges: Shortrun Impacts

An additional scenario considers the supply response of beef, corn, pork, and wheat producers to the removal of the price wedges in a shorter term where producers are limited in their ability to move productive resources around quickly. The previous scenarios considered a longer time horizon where producers could move land, labor, and capital out of sectors and into others. In other words, previously, the large changes in China's demand for the products where the price wedge was being moved would lead to resources moving out of all other sectors and into the sector with the price wedge—leading to large production increases. This supply response could be overstated, especially given that we were removing one price wedge at a time. To consider a limited supply response, we reduced the ability for these resources to move across sectors. This could be thought of as a shortrun response, where producers do not have the ability to respond to price changes as quickly. Figure 15 presents these changes, comparing the shortrun with the medium/longrun results. For most of the commodities, the increase in imports is reduced by half. The decrease is more than triple for corn and wheat because these commodities use land, which is limited, as a resource, while beef and pork use only labor and capital in the model. As a result, corn and wheat are more limited in their production. For pork, the change is 116.9 percent compared with 402 percent, but there is still a large increase in imports due to the size of the price wedge and the demand for pork in China.

Figure 15
Estimated change in China's imports from removing the price wedge for different time horizons (percent changes)



Note: The shortrun scenario refers to somewhat limited production and trade responses as resource mobility is limited, the medium/longrun scenario allows agricultural producers to shift land, labor, and capital.
 Source: USDA, Economic Research Service calculations based on estimated impacts from the economic model.

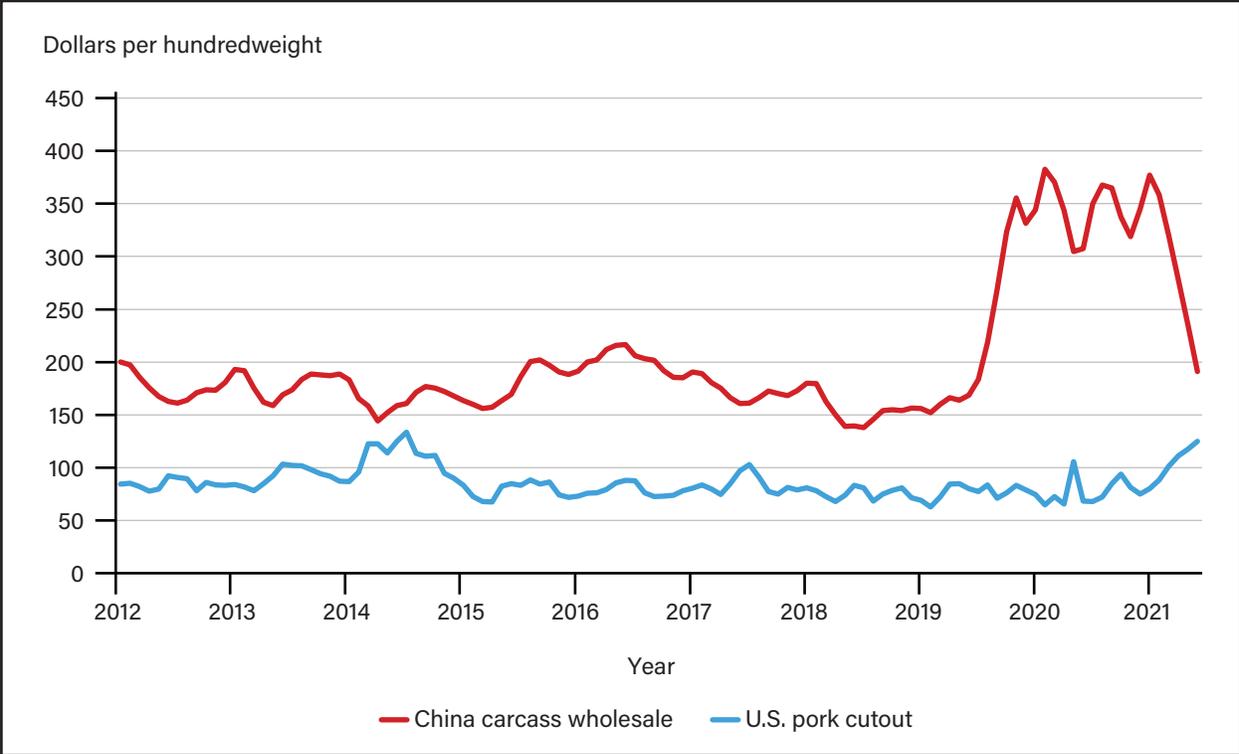
Recent Pork Prices

China’s pork price wedge was consistently wide in recent years, but it was unusually large during the base year of 2020. We conducted sensitivity analysis to determine whether the unusual conditions in China’s pork market that year affected the analysis.

Volatility due to swine disease epidemics and the lags between production decisions and output contributed to persistent cycles in China’s pork prices and imports (Gale et al., 2012). Low pork prices in one year often prompt farmers to slaughter sows, resulting in reduced production capacity that causes prices to soar the following year. Conversely, high prices prompt an expansion of sows, which leads to falling prices (USDA, FAS, 2021c). The ASF impacts on China’s swine herd resulted in the most prominent cycle that had ever occurred, with pork prices increasing by 109 percent in 2019 and another 55 percent in 2020 (USDA, FAS, 2021c). A rapid expansion of sow numbers in 2020 led to a 50-percent decline in hog and pork prices during 2021, returning to their pre-ASF level by the middle of the year (figure 16). By the third quarter of 2021, the Chinese Ministry of Agriculture was encouraging farms to reduce production capacity to boost prices back to profitable levels.

The price wedge between Chinese and world pork prices was unusually wide during 2020. The price wedge’s narrowing during 2021 was accelerated by the rapid decline in Chinese prices, as well as rising U.S. pork prices. Throughout certain points of the summer, the price wedge between U.S. and Chinese pork, when accounting for transportation and tariffs, was likely nonpositive, suggesting U.S. pork was likely to be noncompetitive. Continual fluctuations make it difficult to measure the price wedge.

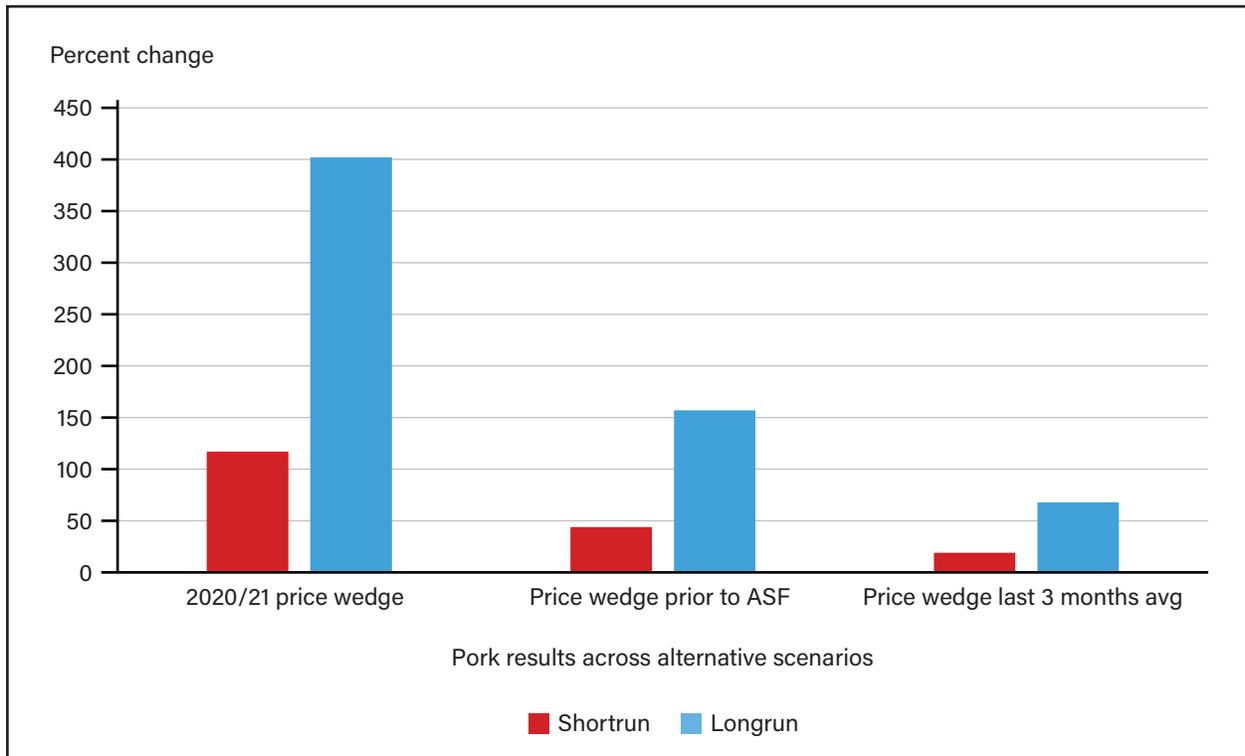
Figure 16
China and U.S. pork prices, 2018-21



Source: USDA, Economic Research Service calculations using the average wholesale price of swine carcasses from the China Ministry of Agriculture and Rural Affairs; USDA, Agricultural Marketing Service (2021); and Federal Reserve Bank of St. Louis (2021).

We conducted sensitivity analyses using price wedges from two different time periods. The first scenario uses the price wedge for the period before ASF (before 2018), when the price wedge was approximately 100 percent. The second scenario considers the price wedge during the summer of 2021, when it was approximately 50 percent. Figure 17 summarizes these results, along with the original pork simulations. The price wedge prior to ASF is estimated to lead to an increase in China’s pork imports of 157 percent—but only a 44-percent increase if resources are immobile. The 50-percent price wedge of the 2021 summer months would lead to even smaller imports, 68 percent in the medium/longrun and 19 percent in the shortrun.

Figure 17
Pork results across alternative scenarios



Note: ASF refers to the African Swine Fever epidemic in China during 2018–19.

Source: USDA, Economic Research Service calculations based on estimated impacts from the economic model.

Conclusions

Although China is the world's largest agricultural importer, dismantling trade barriers could result in even more growth in China's agricultural imports, which could benefit exporters as well as Chinese consumers and processors of agricultural raw materials. The analysis in this report shows that domestic prices in China for several imported commodities far exceed international prices, indicating that imports of these commodities are below their potential. It is estimated that China's domestic prices are 42 to 200 percent higher than the price for U.S. imports for a set of major commodities.

Analysis with an economic model estimated that wheat imports could rise nearly 250 percent and corn imports over 90 percent if these price wedges were eliminated for those commodities. Increases of this magnitude would exceed the TRQs for wheat and corn by significant margins. The Phase One agreement called for China to ensure that no measures impeded in-quota imports for grains. Imports of corn exceeded the quota, while wheat imports approached their quota in 2020, although China did not reveal what specific changes were made in the administration of TRQs. These increases occurred during the 2020/21 base marketing-year period that we considered, yet price wedges were still large for corn and wheat.

The Phase One agreement eliminated several restrictions on U.S. beef and pork imports, and it ended a 4-year ban on U.S. poultry, but China's potential for importing meat may be much larger. We found very large price wedges for both pork and beef, and the wedges were even larger due to a severe pork shortage in China caused by African Swine Fever. These wedges yielded estimates that would lead to extremely large import volumes. The pork wedge fluctuated around a mean of about 100 percent before it soared to over 200 percent during the study's 2020/21 base period. These wedges yielded estimates that would lead to extremely large import volumes. The model estimated a 400-percent increase in pork imports would occur to close the gap between Chinese and international pork prices. China's pork prices were unusually high during the base period but plummeted in 2021 after a rapid rebound in China's pork output, growing demand, consumers' receptivity to chilled and frozen meat, and improvements in cold chain infrastructure favored growth in China's meat imports (USDA, FAS, 2021d).

China's pork imports had already surged to a record of more than 4 million metric tons in 2020 to partially fill China's shortage. Beef imports also hit a record that year. China's pork market is large—it accounts for about half of the world's consumption. Exporting countries would thus need to invest significantly to build enough capacity for supplying such large volumes to China. Expansions of pork and beef export capacity in the United States and other exporting countries to serve the Chinese market are not viable without certainty about large, sustained sales to China. In contrast, reports from China indicate that construction of dozens of large pork projects in the country were subsidized—largely by local governments—to substantially expand capacity in China during 2020–21 (USDA, FAS, 2021a).

References

- Andriamananjara, S., M. Ferrantino, and M. Tsiagas. 2003. *Alternative Approaches in Estimating the Economic Effects of Non-Tariff Measures: Results from Newly Quantified Measures*, U.S. International Trade Commission, Office of Economics Working Paper 12-C.
- Arita, S., J. Beckman, and L. Mitchell. 2017. “Reducing Transatlantic Barriers on U.S.-EU Agri-Food Trade: What Are the Possible Gains?” *Food Policy* 68:233–47.
- BBC. 2021. “China Bans British Beef Again Over Mad Cow Disease,” October 11.
- Beckman, J. 2021. *Reforming Market Access in Agricultural Trade: Tariff Removal and the Trade Facilitation Agreement*, Economic Research Report 280, U.S. Department of Agriculture, Economic Research Service.
- Beckman, J. and S. Arita. 2017. “Modeling the Interplay Between Sanitary and Phytosanitary Measures and Tariff-rate Quotas Under Partial Trade Liberalization,” *American Journal of Agricultural Economics* 99:1078–95.
- Beckman, J. and A. Countryman. 2021. “The Importance of Agriculture in the Economy: Impacts From COVID-19,” *American Journal of Agricultural Economics* 103(5):1595–1611.
- Beckman, J., F. Gale, and T. Lee. 2021. *Agricultural Market Access Under Tariff Rate Quotas*, Economic Research Report 279, U.S. Department of Agriculture, Economic Research Service.
- Berden, K., J. Francois, M. Thelle, and M. Tamminen. 2009. *Non-Tariff Measures in EU-US Trade and Investment—An Economic Analysis*, ECORYS.
- Board of Governors of the Federal Reserve System (U.S.), Federal Reserve Bank of St. Louis. 2021. *China/U.S. Foreign Exchange Rate*.
- Bureau, J., A. Disdier, C. Emlinger, and J. Foure. 2014. *Risks and Opportunities for the EU Agri-Food Sector in a Possible EU-US Trade Agreement*, European Parliament.
- Calvin, L. and B. Krissoff. 1998. “Technical Barriers to Trade: A Case Study of Phytosanitary Barriers and U.S.-Japanese Apple Trade,” *Journal of Agricultural and Resource Economics* 23(2):351–66.
- China Ministry of Agriculture. 2021. *推进肉牛肉羊生产发展五年行动方案 (Five-Year Action Plan to Advance Beef and Mutton Production)*, *Nong Mu Fa* (2021) No. 10.
- China Ministry of Agriculture. Various years. *畜产品和饲料集贸市场价格情况 (Livestock Product and Feed Market Price Situation)*, Weekly reports posted on websites.
- China National Grain and Oils Information Center. Various years. Unpublished daily grain price reports, accessed through Reuters database.
- Fouré, J., A. Bénassy-Quéré, and L. Fontagné. 2016. “Modelling the World Economy at the 2050 Horizon,” *The Economics of Transition* 21(4):617–54.
- Gale, F., M. Jewison, and J. Hansen. 2014. *Prospect’s for China’s Corn Yield Growth and Imports*, FDS-14D-01, U.S. Department of Agriculture, Economic Research Service.

- Gale, F., J. Hansen, and M. Jewison. 2015. *China's Growing Demand for Agricultural Imports*, EIB-136, U.S. Department of Agriculture, Economic Research Service.
- Gale, F., D. Marti, and D. Hu. 2012. *China's Volatile Pork Industry*, LDPM-21101, U.S. Department of Agriculture, Economic Research Service.
- Gale, F. 2015. *Development of China's Feed Industry and Demand for Imported Commodities*, FDS-15K-01, U.S. Department of Agriculture, Economic Research Service.
- Gale, F. 2017. *China's Pork Imports Rise Along With Production Costs*, LDPM-271-01, U.S. Department of Agriculture, Economic Research Service.
- Gale, F. 2021a. *Potential Wheat Demand in China: Applicants for Import Quota*, ERR-295, U.S. Department of Agriculture, Economic Research Service.
- Gale, F. 2021b. *China's Refusals of Food Imports*, ERR-286. U.S. Department of Agriculture, Economic Research Service.
- Li, Y. and J. Beghin. 2012. "A Meta-Analysis of Estimates of the Impact of Technical Barriers to Trade," *Journal of Policy Modeling* 34(3):497–511.
- Miljkovic, D. 1999. "The Law of One Price in International Trade: A Critical Review," *Review of Agricultural Economics* 21(1):126–39.
- Orden, D., C. Xie, B. Chen, L. Brink, and C. Zulauf. 2019. *WTO Dispute Panel Report on China's Administration of Tariff Rate Quotas (TRQs) for Certain Agricultural Products*, *farmdoc daily* (9):84.
- Patton, D. and N. Figueiredo. 2021. "Chinese Beef Buyers Expect Brazil Trade To Resume Soon Despite Mad Cow Cases," *Reuters*, September 6.
- Patton, D. and T. Polansek. 2021. "China Gorges on American Grain-Fed Beef Amid Shrinking Supplies from Down Under," *Reuters* September 30.
- Santeramo, F.G. and E. Lamonaca. 2019. "The Effects of Non-Tariff Measures on Agri-Food Trade: A Review and Meta-Analysis of Empirical Evidence," *Journal of Agricultural Economics* 70(3):595–617.
- Trade Data Monitor. 2021. *Global Import and Export Data*.
- U.S. Department of Agriculture. 2021. *USDA Agricultural Projections to 2030*, OCE-2021-1.
- U.S. Department of Agriculture and Office of the U.S. Trade Representative. 2020. *Interim Report on the Economic and Trade Agreement Between the United States of America and the People's Republic of China*, October 23.
- U.S. Department of Agriculture, Agricultural Marketing Service. 2021. *Beef Exports to the People's Republic of China, Import/Export Certificates*.
- U.S. Department of Agriculture, Foreign Agricultural Service. 1999. *China Peoples Republic of Dairy Livestock and Poultry Livestock Annual*, Report Number: CH9037.
- U.S. Department of Agriculture, Foreign Agricultural Service. 2007. *China Peoples Republic of Livestock and Products Semi-annual*, Report Number: CH7014.

- U.S. Department of Agriculture, Foreign Agricultural Service. 2017a. China Livestock and Products Annual, Report Number: CH17053.
- U.S. Department of Agriculture, Foreign Agricultural Service. 2017b. Marketing Lessons Learned From U.S. Beef Promotion Events in Beijing, Report Number: GAIN0023.
- U.S. Department of Agriculture, Foreign Agricultural Service. 2018. China Livestock and Products Annual, Report Number: CH18049.
- U.S. Department of Agriculture, Foreign Agricultural Service. 2020a. China Livestock and Products Annual, Report Number: CH2019-0205.
- U.S. Department of Agriculture, Foreign Agricultural Service. 2020b. Update to the Export Process for U.S. Beef and Beef Products, Report Number: CH2020-0038.
- U.S. Department of Agriculture, Foreign Agricultural Service. 2021a. China 2021 No 1 Document Underscores Seed Genetics Stable Grain and Pork Supplies for Food Security, Report Number: CH2021-0041.
- U.S. Department of Agriculture, Foreign Agricultural Service. 2021b. China Grain and Feed Update, Report Number: CH2021-0075.
- U.S. Department of Agriculture, Foreign Agricultural Service. 2021c. China Livestock and Products Annual, Report Number: CH2021-0101.
- U.S. Department of Agriculture, Foreign Agricultural Service. 2021d. China Livestock and Products Semi-Annual, Report Number: CH2021-0027.
- U.S. Department of Agriculture, Foreign Agricultural Service. 2021e. Production, Supply and Distribution.
- U.S. Department of Agriculture, Foreign Agricultural Service. 2021f. MARA Plan Aims to Manage Swine Sector and Scale, Report number: CH2021-0121.
- U.S. Trade Representative. 2022. 2021 Report to Congress on China's WTO Compliance, February.
- Wu, Q. and W. Zhang. 2016. Of Maize and Markets: China's New Corn Policy, CARD Agricultural Policy Review Fall 7-9.