Firms, Agricultural Imports, and Tariff-Rate Quotas: An Assessment of China's Wheat, Corn, and Rice Imports Using Firm-Level Data

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This Commissioned Paper was co-authored by a working group in the area of trade economics which responded to a call for Commissioned Papers from the Executive Committee of the IATRC. The members of the group were:

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The International Agricultural Trade Research Consortium (IATRC) is an organization of approximately 220 economists from 28 different countries, interested in research, policy analysis, and current developments in international agricultural trade. It is supported by the United States Department of Agriculture (ERS, FAS, and OCE), Agriculture and Agri-Food Canada, and the participating organizations. Funding for this commissioned paper comes from the USDA Foreign Agricultural Service.

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Executive Summary

During its accession to the World Trade Organization in 2001, China established a system of tariff-rate quotas (TRQs) for wheat, corn, rice, soybean and rapeseed oil, palm oil, sugar, cotton, wool tops and fertilizer. Since 2011, marking the end of its transition period, China's TRQs for wheat, corn and rice have come under increased scrutiny. In December of 2016, the United States launched a formal complaint to the World Trade Organization (WTO) concerning the administration of China's wheat, corn, and rice TRQs. A formal panel was requested in August 2017, with several other major grain trading countries, including Australia, Brazil, Canada, Ecuador, the European Union (EU), Guatemala, India, Indonesia, Japan, Kazakhstan, Korea, Norway, Russian Federation, Chinese Taipei, Singapore, Ukraine and Vietnam, reserving their rights to participate as third party Members.

In addition to private and foreign owned firms, China's economic regime is characterized by a number of state trading enterprises (STEs). These STE firms are key players in the importation of agricultural products, particularly those products governed by TRQs. Using two unique Chinese firm-level/firm-type datasets, this study provides an overview and empirical examination of firm-type dynamics operating in China's cereal grain and other important agricultural import markets. Because China reserves a sizeable share of the tariff-quota for state-trading enterprises, trading activity among state-owned relative to privately held firms is an important feature of this market.

We uncover several important findings concerning China's overall imports of agricultural products and the subset of cereal grains subject to TRQs, more specifically. First, import shares of China's STEs in commodities subject to tariff-quotas are consistently higher than quota-free imported commodities. Second, the larger role of STEs in China's cereal grain imports is significant and negatively correlated with China's overall food security status proxied by its lagged stocks/use ratio. Conversely, above average food security levels in China's cereal grain market leads to an important extensive margin adjustment of private non-SOE import participation. Finally, a defining feature of China's TRQ administration is the reallocation of unused quota in September each year. Using a unique dataset on monthly firm-level/firm-type imports, however, we find no compelling empirical evidence that China's September reallocation of unused quota has had any economic impact on the entry of private non-SOE firms into importing or the intensity with which their imports occur.

Keywords: Tariff-Rate Quotas, TRQs, TRQ Administration, Firm-level data, difference-in-differences, intensive and extensive margins of trade, Non-tariff measures (NTMs).

JEL Codes: F13, Q17, Q18

TABLE OF CONTENTS

LIST OF ACRONYMS AND SHORT FORMS

ACRONYM	FULL NAME
COFCO	China's National Cereals, Oil, and Foodstuffs Corporation
DID	Difference-in-Difference
EU	European Union
GATT	General Agreement on Tariffs and Trade
GM	Genetically Modified
HTS	Harmonized Tariff Schedule
IATP	Institute for Agriculture and Trade Policy
ISGEP	International Study Group on Export and Productivity
MFN	Most Favored Nation
MT	Metric Tons
NDRC	National Development and Reform Commission (of China)
NTB	Non-Tariff Trade Barriers
NTM	Non-Tariff Measures
SOE	State Owned Enterprise
SPS	Sanitary and Phyto-Sanitary
TBT	Technical Barriers to Trade
TFP	Total Factor Productivity
TRQ	Tariff Rate Quota
UN	United Nations
URAA	Uruguay Round Agreement on Agriculture
USDA	United States Department of Agriculture
USITC	United States International Trade Commission
USTR	United States Trade Representative
WTO	World Trade Organization

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

The well-known Chinese idiom "bread comes first" highlights the value Chinese citizens' place on food security. However, China's continuing urbanization, increasing household income, and growing economy, creates an imbalance between agricultural resource availability and its demand for agricultural products (Gale et al. 2015). Chinese per capita water availability is only one-fourth of the global average, and its effective arable land accounts for less than 8% of the world total despite being the world's most populated country with 18% of world population (Huang and Yang, 2017).Thus, while China's ambitious 1996 food security policy stipulated a 95% self-sufficiency rate for wheat, corn, and rice (China State Council, 1996),[1] since 2013 these goals have not been met largely due to China's continued dietary shift from crop-based to animal-based products (Fukase and Martin, 2016).

Since its accession to the World Trade Organization (WTO) in 2001, China has become an important player in global agri-food trade. The value of China's agricultural imports has risen from $10.3 billion in 2002 to $157.7 billion in 2020, representing an average annual growth rate of 19%.[2] China's share of global agriculture imports increased nearly six-fold from 2.1% to 12% over the same period.

While China's agricultural exports increased over four-fold since 2002, totaling $58 billion in 2020, exports are only 37% of imports resulting in China being the largest net importer of food and agricultural products. And while some projected China to become the world's largest importer of corn by 2023 (Hansen and Gale, 2014), it has easily become the world's largest corn importer in 2020 due to stronger feed demand from a rebuilding hog herd and relatively high domestic corn prices. China's leading suppliers of agricultural imports are countries richly endowed with land resources such as the United States, Brazil and Australia. In 2020, 22%, 15% and 6% of China's total agricultural imports were sourced from these three countries, respectively. China's reliance on imports of agriculture and food products is expected to continue with real income (Gross Domestic Product (GDP)) and population growth averaging 5.2% and 2.2%, respectively, from 2021-2032, respectively, according to the International Macroeconomic Projections by the Economic Research Service (ERS).[3] China's 2032 real GDP (2015 dollars) is expected climb to $26.6 trillion surpassing U.S. real GDP of $24.8 trillion.

Despite significant growth in agricultural imports, China's implementation of its commitments to the WTO have posed challenges for global agricultural exporting countries. For example, China maintains a number of trade policy measures on key commodities of interest to exporters including the administration of its tariff-rate quota for wheat, rice and corn, as well as a regulatory regime over trade in genetically-modified (GM) agricultural products, creating uncertainty for exporters of corn, soybeans, rapeseed and cotton. For example, China's customs authorities have previously rejected shipments of U.S. corn found to have contained traces of the GMO corn variety (MIR 162) currently unapproved in the Chinese market (Reuters 2013). In addition, China maintains sanitary and phytosanitary (SPS) measures and technical barriers to

[1] To help achieve this level of self-sufficiency, China implemented a series of domestic policies including price supports which were intended to stabilize and expand domestic production of grains (Gale 2015).
[2] Author's calculations based on UN Comtrade Data available at https://comtrade.un.org/, and Trade Data Monitor (TDM) available at: https://tradedatamonitor.com/

[3] See: https://www.ers.usda.gov/data-products/international-macroeconomic-data-set/

trade (TBT) that broadly regulate the conditions under which products can enter the Chinese market (Grant and Arita 2017; Martin 2001).

Among the list of non-tariff policies on China's agricultural imports, the administration of its tariff-rate quotas (TRQs) for wheat, corn and rice have been one of the most contentious (Gale et al., 2015; USITC, 2011; USTR, 2018a; Zhou and Kang, 2009). TRQs are two-tiered tariffs separated by a quota limit. In-quota imports are permitted up to the specified quota quantity at a low or favorable in-quota tariff rate. Imports in excess of the quota, often referred to as out-of-quota (or over-quota) imports, are permitted in unlimited quantities but face a much higher, often prohibitive tariff rate. China's tariff-quotas for wheat, corn, and rice are 9.6 million metric tons (mmt), 7.2 mmt, and 5.2 mmt, respectively, and have remained at these levels since 2004.

A 1% tariff is applied to all in-quota imports of wheat, corn and rice, whereas out-of-quota imports face a 65% Most Favored Nation (MFN) tariff. Given the significant difference between in- and out-of-quota tariff rates, decisions concerning the administration of the quota, and in particular, who gets the right to import at the favorable in-quota tariff rate, is an important and often political consideration influencing both trade flows and social welfare (de Gorter and Sheldon, 2000; Gervais and Surprenant, 2000, 2003).

In addition to the question of import rights, the administration of China's cereal grain TRQ certificates (i.e. licenses) are further complicated for two reasons:

1) The allocation of China's cereal grain TRQs has explicit reservations for China's state-trading firms. The reservations of China's wheat, corn and rice TRQs for designated state trading firms are: 90% for Wheat; 60% for corn; and 50% for rice.

2) The allocation of China's cereal grain TRQs contains a reallocation mechanism by which unused TRQ certificates are to be redistributed after September 15th each calendar year.

Lead in principle by the U.S., several grain exporting countries including Canada, Australia, and the European Union (EU) have raised concerns about the operation and transparency of China's TRQ administration methods. Formal criticisms have focused on historically low filling rates of the TRQ, transparency issues by which firms apply for quota rights, and the allocation and reallocation of the quota itself (USTR 2018b).

As explained in the first written submission by USTR (2018b), the Allocation Criteria established by China's National Development and Reform Commission (NDRC) neither publicly communicates specific factors which are considered in the application process, nor the weights assigned to them in selecting which firms receive import quota licenses (USTR 2018b). As noted, "China does not provide sufficient information in its TRQ instruments, or otherwise, to enable applicants to easily understand or discern the criteria and principles applied by NDRC in the TRQ allocation and reallocation processes" (pg. 23). While the NDRC publicizes the list of firms who submit TRQ applications, actual recipients of TRQ certificates and quota amounts remain unknown (Gale 2017).

Under the mid-year (September) reallocation mechanism, unused TRQ licenses are required to be returned by September 15 each year. However, uncertainty remains over the TRQ amounts returned, the amount available for reallocation, how the NDRC assigns unused quota to firms on the applicant list, whether unused quota reserved for SOEs is available for reallocation including to non-SOE private firms, and whether the quota volume allocated to individual recipients is

large enough to reflect the logistical realities of international trade. Given their sizeable quota allocation, China's National Cereals, Oils and Foodstuffs Corporation (COFCO) – the largest SOE operating in China - plays an important role in China's importation of cereal grains.

Estimates by the United States Department of Agriculture (USDA) indicate that if China's grain TRQs had been filled in 2015, Chinese imports would be $3.5 billion more. Chen, Villoria and Xia (2020) use price comparisons and estimation of cereal grain import demand and find that Chinese grain imports could have been 1.2 billion dollars or 38% higher in 2017. In their analysis, the U.S. loses significant wheat exports to China valued at $314 million.

On December 15, 2016, the United States launched a formal complaint to the WTO concerning China's administration of their wheat, corn, short- and medium-grain rice, and long-grain rice TRQs (see WTO Dispute Settlement (DS) 517). Consultations between China and the U.S. did not result in a resolution. In August 2017, a formal WTO panel was requested by the U.S. to investigate China' TRQ administration. Seventeen WTO member countries joined this dispute as third-party members.[4] A formal panel was composed on February 12th, 2018, with the panel report adopted on May 28th, 2019.

The panel's findings with respect to the U.S. claims highlighted several inconsistencies concerning China's obligations to the WTO including:

- China's eligibility criteria for TRQ administration
- The TRQ allocation principles
- China's reallocation procedures (i.e., its September reallocation each year)
- The administration of the STE and non-STE portions of the TRQ
- TRQ usage requirements by holders of TRQ certificates for wheat and corn
- More generally, the panel found that China's TRQ administration as a whole is inconsistent with its obligations to administer TRQs on a transparent, predictable, and fair basis, and in a manner that does not inhibit the filling of the quotas

On June 24th, 2019, China informed the dispute settlement body (DSB) that it intended to implement the panel recommendations and rulings in a manner consistent with its WTO obligations by December 31, 2019. This deadline has been subsequently extended multiple times, perhaps due to the COVID-19 pandemic, with the final extension granted to June 29th, 2021. On July 15, 2021, however, the U.S. requested authorization to suspend its concessions pursuant to Article 22.2 of the legal text of the Dispute Settlement Understanding (DSU), to which China objected.[5] Finally, on July 15th, 2021, China requested the establishment of a compliance panel which the DSB established on August 30th, 2021. When this was written, this was the latest information.

[4] Third parties to this consultation are: Australia, Brazil, Canada, Ecuador, the European Union, Guatemala, India, Indonesia, Japan, Kazakhstan, the Republic of Korea, Norway, the Russian Federation, Singapore, Chinese Taipei, Ukraine, and Viet Nam. Detailed information about this dispute can be accessed here: https://www.wto.org/english/tratop_e/dispu_e/cases_e/ds517_e.htm .

[5] The suspension of concessions pursuant to Article 22.2 of the DSU implies the use of temporary measures available to the complaining party if it has been determined that the original DSB recommendations and rulings have not been fully implemented by the respondent party after a reasonable period of time.

1.1 Objectives and Key Trade Policy Questions

Against this backdrop, the purpose of this study is to provide a closer examination of the participation and import activity of China's state and non-state-owned firms within China's agricultural product imports. We focus attention on China's cereal grain commodities impacted by TRQ administration compared to other agricultural commodities not impacted by this type of trade policy. Given China's explicit TRQ reservations for state-trading and non-state trading enterprises (i.e., private- or foreign-owned firms), our analysis makes use of a novel firm-level, firm-type database of China's SOE and non-SOE import transactions over the period 2007-2017. Working at the firm-level, we evaluate and test four key features of China's system of TRQs:

i. The institutional role of China's SOEs in TRQ constrained and related unconstrained markets,
ii. A breakdown of the TRQ fill rates by firm-type, including the ability to track out-of-quota trade transactions,
iii. The role of private non-SOE firms in China's TRQ grain imports, including the extent to which non-SOE firms respond to market signals along the intensive (per-firm imports) and extensive (number of firms participating in importing) margins, and
iv. The role of China's September reallocation mechanism of unused quota and the extent to which this improves the participation and trading of non-SOE private firms.

A unique feature of this study is the matching of importing firm types from Chinese Customs import data with information on China's TRQs governing its wheat, corn and rice imports. To the best of our knowledge, this is the first time a firm-level analysis has been conducted within the context of China's cereal grain TRQ imports.

Specifically, this study addresses several key policy questions:

1) How significant are SOE firms in China's agricultural imports and has their role changed over time, particularly since 2012 marking the end of China's transition period following WTO accession?

2) How have firm- and commodity-specific TRQ fill rates evolved since 2012 marking the end of China's transition period following WTO accession?

3) How significant are SOE firms in China's TRQ grain imports compared to related feed grain and oilseed commodities not subject to TRQs? To what extent has China's grain TRQ policy affected the intensive and extensive margin activity of non-SOE private firms compared to related agricultural commodities not subject to TRQs?

4) To what extent do domestic and international price distortions and prior levels of China's estimated cereal grain reserves impact the participation and trading activity of China's SOE and non-SOE firms?

5) To what extent does China's September TRQ reallocation mechanism of unused quota foster increased market participation and trading of non-SOE firms?

To briefly summarize, first, we provide a detailed overview of China's agricultural trade activity at the firm-type level. Second, we examine the relative significance of SOEs in China's grain imports relative to other agricultural markets which are not subject to TRQs. State trading enterprises factor heavily in the WTO's multilateral negotiations where explicit attempts were made to reform and strengthen the rules governing their activity in Member countries (McCorriston and MacLaren 2010). However, in most cases, deregulation of state trading has involved reducing the role that SOEs play in domestic and international markets rather than removing them outright.[6] Institutional frameworks with an explicit role for state trading can distort the efficient allocation of resources within a country and serve as an additional drag on productivity (Khandewahl, Schott and Wei 2013).

Third, we address explicitly the role of SOEs in Chinese grain TRQ allocation and quota fill rates focusing on the importing activity of COFCO – China's National Cereals, Oil & Foodstuff Import and Export Company and its subsidiaries. In principle, COFCO is the only SOE eligible for the STE quota share of China's cereal grain TRQs. This, it is important to understand COFCO's unique role in China's grain imports. Because we observe the types of firms participating in China's agricultural imports, we provide a more nuanced assessment of China's cereal grain TRQ fill rates on the SOE and non-SOE portion of the quota compared to previous studies at the country level and evaluate firm-type TRQ fill rates over time.

Fourth, we evaluate the specific importing activity of private non-SOE firms. In particular, we are interested in the participation of non-SOE (SOE) firms along the extensive margin, as well we their per firm imports along the intensive margin. Specifically, we examine these margins of trade during periods in which China's grain reserves (i.e., stocks-to-use ratios) are below or above trend. We conduct similar tests on years in which China's domestic support price for wheat and corn exceed world prices by a factor of 1.5.

Fifth, we examine the impact of China's mid-year quota reallocation (referred herein as the 'September Reallocation") to assess whether this quota redistribution improves the participation of non-SOE firms. In this analysis we adopt a difference-in-differences (DID) approach to quantify whether China's September reallocation of tariff-quota certificates stimulates the intensive or extensive margin participation of non-SOE cereal grain importing firms.

1.2 RESULTS PREVIEW

A brief preview of our findings is described as follows:

1. Domestic private firms account for 60% of China's total agricultural trade, contributing 60%, or $96 billion, of the agricultural trade growth over the 2002-2017 sample period. However, on an imports or exports per firm basis (i.e., the intensive margin), SOEs continue to dominate their non-SOE counterparts increasing from an average of $0.8 million/firm worth of agricultural imports in 2001 to a peak of $16.76 million/firm in 2015.

2. Although the economic activity of China's SOEs is declining, their share of imports in "strategically important" commodities, such as wheat and corn are consistently higher than related cereal grains not subject to TRQs and most other agricultural commodities.

[6] Australia, Indonesia, Japan, and Canada are important examples of this deregulation, among others.

The higher share of SOE imports in TRQ constrained commodities continues well after China's transitional period of WTO accession, which ended in 2011.

3. The role of China's SOE firms is concentrated in years in which estimated cereal grain stock levels fall below median values. Using estimated stocks-to-use ratio of China's cereal grain reserves as an indicator of the country's food security status, we find that the role of SOEs in China's cereal grain imports is negatively correlated with its lagged stocks/use ratio. Put another way, the intensity of SOE imports in TRQ designated cereal grains is a decreasing function of China's strategic grain reserves.

4. Conversely, significantly higher domestic support prices relative to world prices is associated with a relatively small, but significant extensive margin adjustment of non-SOE importing firms. Thus, potential import demand by private non-SOE firms in cereal grains is increasing in the differential between China's domestic support and world market prices. More generally, however, import participation by private non-SOE firms is constrained by the TRQ administration structure, and the explicit TRQ quota shares reserved for state trading enterprises governing China's imports of wheat, corn and rice.

5. Finally, we find little economically compelling or statistically significant evidence that China's annual September reallocation of unused cereal grain TRQ certificates has improved the participation of non-SOE firms or the intensity with which their imports occur. This finding is important because the reallocation mechanism was designed to promote the market orientation of Chinese grain imports (Skully, 2001), particularly during peak harvest and export marketing periods of northern hemispheric countries.

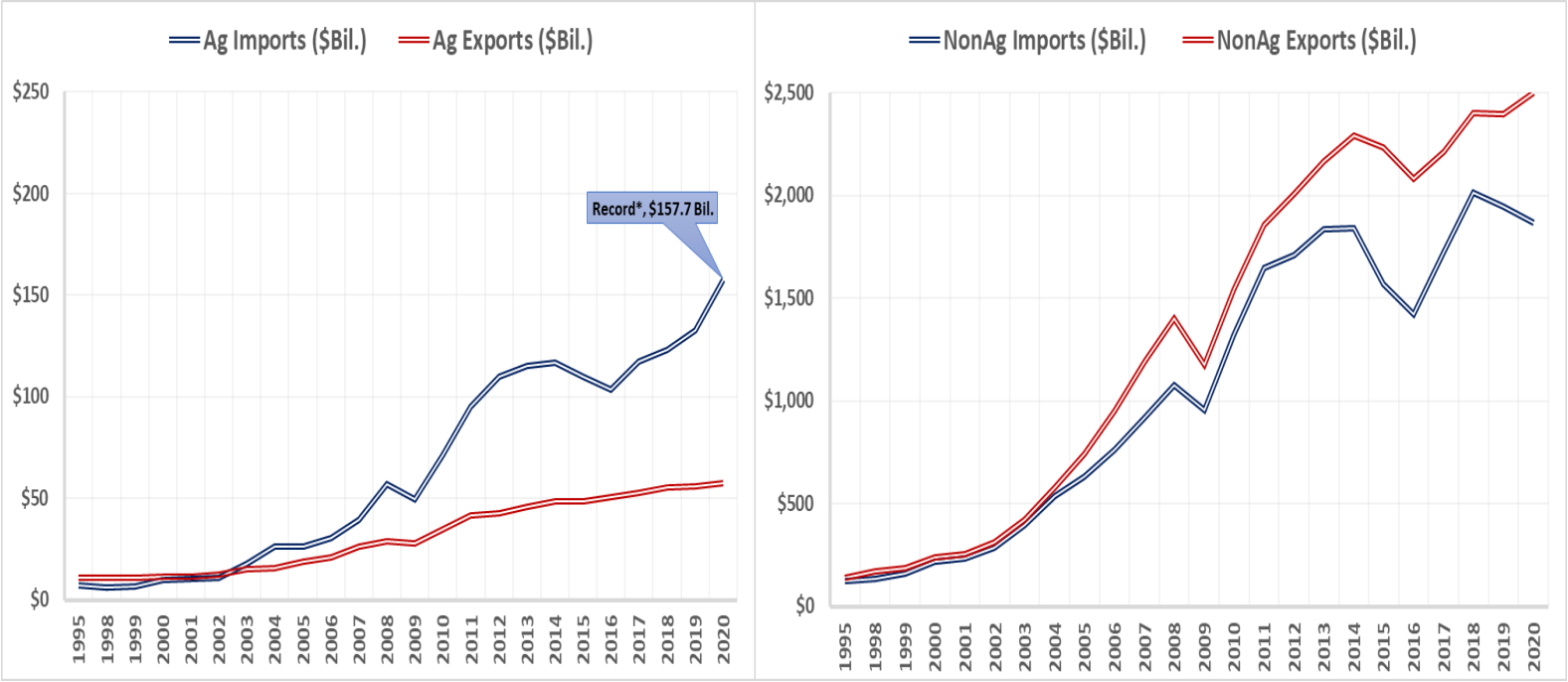
1.3 REPORT STRUCTURE

The remainder of this study is organized as follows. In section two, we review the role of China in the global trade of agricultural products. Section three summarizes China's TRQ policy and provides a literature review on China's TRQ administration methods. Section four introduces the empirical methods used to examine the core research questions of this study. The data used in the analysis are summarized in section five. Section six presents the econometric results, and section seven concludes.

2. ROLE OF CHINA IN GLOBAL TRADE OF AGRICULTURAL PRODUCTS

Since joining the WTO in 2001, China has experienced rapid growth in its agricultural trade, particularly imports. Figure 1 illustrates the growth in value of China's total merchandise and agricultural imports and exports from 1995-2017. To facilitate comparison between the growth of total merchandise imports and exports (left panel) and China's agricultural imports and exports (right panel), both vertical axes are measured on a common scale adjusted by a factor of ten.

Figure 1: China's Agricultural Imports and Exports, 1995-2020



Source: Author's calculations from UN Comtrade Statistics

The growth of China's total merchandise exports is striking, reaching nearly $2.5 trillion worth of exports in 2020. Total merchandise imports, which peaked in 2018 at approximately $2.0 trillion, trail merchandise exports by roughly $500 billion. Thus, China's total merchandise trade balance continues to be in surplus.

China's agricultural imports trailed agricultural exports prior to 2007. However, from 2007-2020 China has become a consistent net importer of agricultural products. Imports averaged $12 billion per year prior to 2007, before surpassing agricultural exports and nearly matching the growth rate of China's total merchandise trade. From 2007-2020, China's agricultural imports have grown at an average annual rate of 12% per year and totaled $158 billion worth of imports in 2020. China's agricultural exports, however, have not kept pace, growing at 7% per year on average. Although China is a leading exporter of many agricultural products such as seafood and vegetables, the country's large human (and livestock) population along with a growing middle class has made China a net agricultural importer of many products since 2007.

Table 1 compares the 2016 sectoral composition of China and U.S. imports and exports with the rest of the world for all two-digit chapters comprising agricultural trade within the Harmonized System (HS) of product codes.[7] The largest U.S. agricultural exporting sectors with trade surpluses are land-based agricultural products including Oilseeds (Chapter 12), with a trade surplus $25.3 billion in 2016, Cereals (Chapter 10), with a trade surplus of $16.7 billion, and Residue and Food Waste (Chapter 23) which includes Distiller Dried Grains and Meat and Edible Offal (Chapter 02) products, with trade surpluses of nearly $7.1 and $6.8 billion, respectively, in 2016. If we add cotton (HS Chapter 52) to the list of sectors with large U.S. trade

[7] We define agriculture as products belonging to the Harmonized System (HS) of product codes falling in chapters 01-24 and cotton in chapter 52. Table 1 includes fish and seafood products given its importance as an export (import) sector in China (U.S.).

surpluses, these five sectors account for over half (53.8%) of total U.S. agricultural exports.[8] Combined, these five sectors are largely responsible for the U.S.'s agricultural trade surplus, which stood at $12.1 billion in 2016 (excluding seafood).

Table 1: China and U.S. 2-Digit Agricultural Commodity Trade, 2016

		U.S. Trade with World ($ Mil.)			China Trade with World ($ Mil.)		
HS	**Description**	**Exports**	**Imports**	**Balance**	**Exports**	**Imports**	**Balance**
01	Live Animals	$784	$2,823	($2,039)	$647	$394	$252
02	Meat & Edible Offal	$14,655	$7,910	$6,746	$902	$10,263	($9,360)
03	Seafood	$4,965	$16,370	($11,405)	$13,705	$6,918	$6,788
04	Dairy	$3,906	$2,510	$1,395	$590	$3,517	($2,927)
05	Products of Animal Origin	$1,014	$992	$21	$1,772	$522	$1,250
06	Plants, Trees, Bulbs, etc.	$427	$2,165	($1,738)	$330	$226	$104
07	Vegetables	$4,690	$10,311	($5,620)	$10,546	$1,864	$8,682
08	Fruits	$14,065	$16,717	($2,652)	$5,485	$5,865	($380)
09	Coffee, Tea, Mate, Spices	$1,220	$7,939	($6,719)	$2,981	$667	$2,314
10	Cereals	$19,000	$2,311	$16,689	$429	$5,661	($5,232)
11	Milling Products	$878	$1,663	($785)	$565	$892	($327)
12	Oilseeds	$27,703	$2,437	$25,266	$2,674	$38,295	($35,622)
13	Gums, resins, veg. saps	$556	$1,334	($778)	$1,258	$214	$1,043
14	Vegetable Materials	$30	$130	($100)	$121	$204	($84)
15	Animal/Veg. Fats & Waxes	$3,195	$6,400	($3,204)	$584	$7,041	($6,457)
16	Prepared Meat/Fish	$2,160	$4,808	($2,648)	$7,942	$183	$7,759
17	Sugars and Confectionary	$1,914	$4,392	($2,477)	$1,707	$1,460	$247
18	Cocoa	$2,033	$5,209	($3,176)	$426	$686	($260)
19	Flour, Starch, Milk Preparations	$4,056	$6,893	($2,837)	$1,579	$4,559	($2,980)
20	Veg./Fruit Preparations	$5,048	$7,936	($2,888)	$7,338	$982	$6,356
21	Misc. Edible Preparations	$8,636	$4,511	$4,125	$3,205	$2,164	$1,041
22	Beverages, Spirits, Vinegar	$7,720	$23,292	($15,573)	$2,203	$4,787	($2,584)
23	Residues and Food Wastes	$9,896	$2,822	$7,074	$2,768	$3,062	($295)
24	Tobacco	$2,298	$2,201	$97	$1,377	$1,728	($350)
52	Cotton	$3,959	$12	$3,947	$15	$1,561	($1,546)
	Total	$140,916	$144,350	$719	$71,148	$103,714	($32,567)
	Total Excluding Seafood	$135,951	$127,980	$12,124	$57,442	$96,797	($39,355)

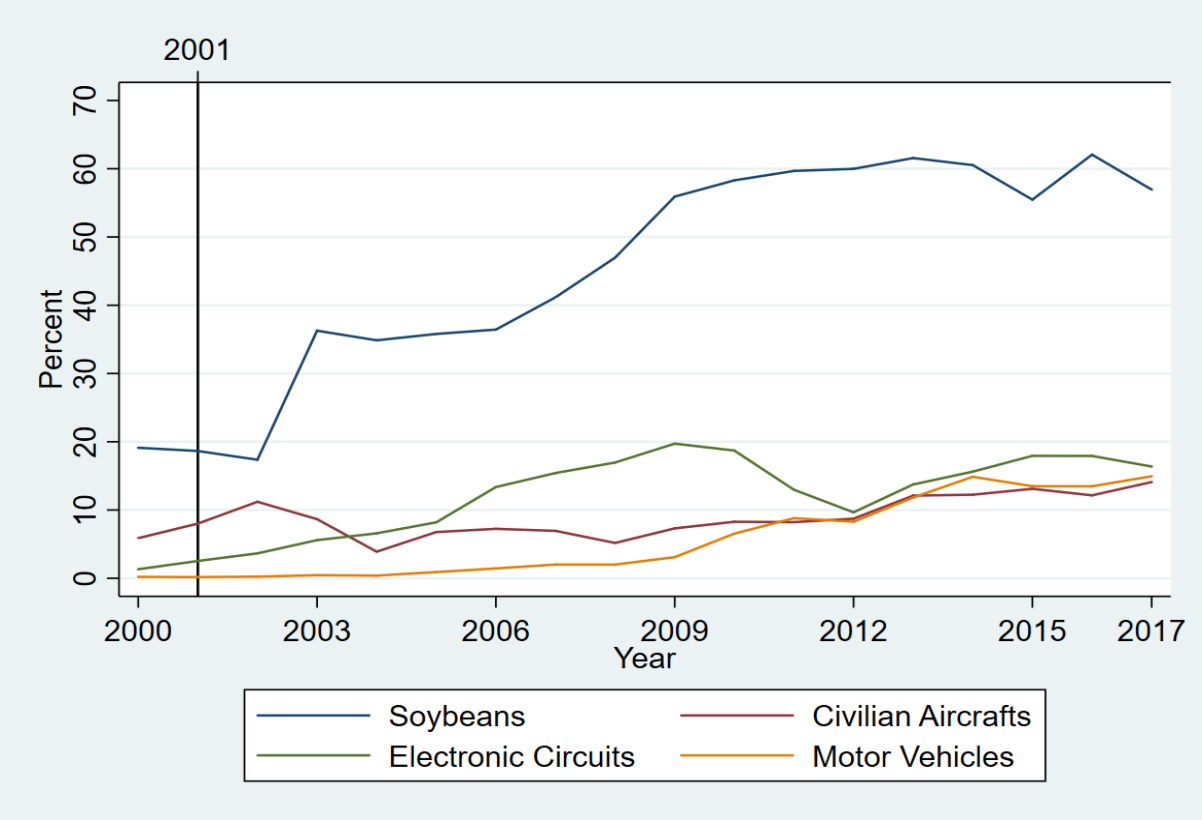
Source: Authors calculations from UN Comtrade database: https://comtrade.un.org/ and Global Trade Atlas: https://www.gtis.com/gta/

Conversely, while Oilseeds, Cereals, Residues and Food Waste, and Meat and Edible Offal sectors are characterized by large trade surpluses in the U.S., they represent some of the largest imports into China. Combined, Oilseeds, Cereals and Meat and Edible Offal sectors account for 56% of China's total agricultural imports and are the largest contributors to China's overall agricultural trade deficit of nearly $40 billion. The contrasting agricultural trade balance

[8] Soybeans (Chapter 12) accounted for 17% (16%) of total U.S. agricultural exports in 2016 (2017).

comparison between the U.S. and China is suggestive of a symbiotic and economically important relationship between the two countries. Indeed, the sectors in which the U.S. experiences large trade surpluses (deficits) tend to be associated with relatively large trade deficits (surpluses) in China.

Figure 2: Top U.S. Exports to China as a Share of Total U.S. Exports in Each Product Category



Source: Source: Authors calculations from Global Trade Atlas: https://www.gtis.com/gta/

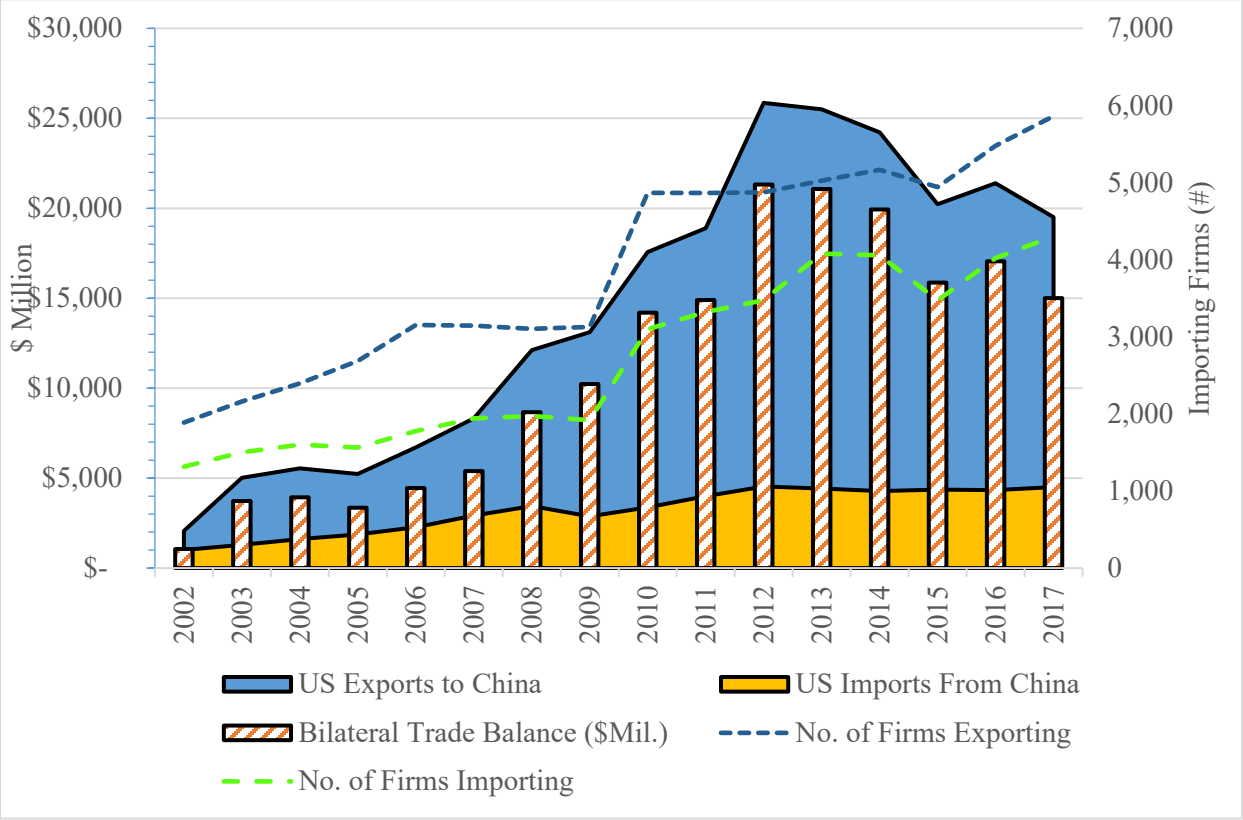
To illustrate the relative importance of China as a destination market for some of the largest products exported by the U.S. (by value), Figure 2 plots the share of U.S. global exports in each product category to China. Top products exported are motor vehicles, civilian aircrafts, electronic circuits, and soybeans. Although U.S. exports of civilian aircrafts was the top category exported to China, valued at over $20 billion in 2017, when viewed as a share of total U.S. exports to all destinations in each product category, the importance of China as an export market for U.S. soybeans exceeds all other product categories in U.S. total merchandise exports.

In many respects, China's food security targets have helped shape U.S. agricultural exports. While Chinese officials set specific food security targets for cereal grain production, fewer acres are devoted to soybean production and China has strategically opened its market to imports of soybeans. China now plants a combined 220 million acres of wheat, corn, and rice, but just 17 million acres of soybeans. China has also made substantial overseas investments in land (Gooch and Gale 2018, Qui et al. 2013). U.S. soybean exports represented 56% of U.S. total agricultural exports to China in 2020 and oilseeds more generally (Chapter 12, Table 1) accounted for 23%

of total U.S. oilseed exports to the world in 2020 by value. Thus, oilseeds in Chapter 12, and in particular soybeans, are the most prominent U.S. agricultural export commodity to China.

While Table 1 provided an overview of HS2-digit agricultural trade balances for the US and China globally, Figure 3 illustrates the *bilateral* agricultural trade balance between the two countries and the number of Chinese firms engaged in importing from and exporting to the U.S. as further evidence of the economic importance of the U.S.-China agricultural trade relationship.[9]

Figure 3: U.S. Agricultural Trade with China and Number of Chinese Firms, 2002-2017



Source: Source: Authors calculations from UN Comtrade database: https://comtrade.un.org/

U.S. agricultural exports to China consistently exceed exports of these products from China to the U.S. Since 2012 and the end of China's transition period of WTO accession, the U.S. agricultural trade balance with China has exceeded $15 billion annually and peaked in 2012 at nearly $22 billion.[10] In 2017, U.S. agricultural exports to China exceeded its agricultural imports from China by $15 billion. Thus, following its accession to the WTO, China has become one of the most important agricultural export markets for U.S. agriculture.

[9] As our Chinese firm level data stop in 2017, we do not illustrate the U.S.-China bilateral trade balance in more recent years (i.e., 2018-2020).

[10] From the U.S. perspective, it should be noted that the bilateral trade balance between the U.S. and China increased to $22.6 billion in 2020.

Also plotted in Figure 3 are the number of Chinese firms engaged in importing from and exporting to the U.S. in agricultural and food product sectors.[11] As illustrated in the figure, the number of Chinese firms in agricultural imports from the U.S. nearly parallels the growth in value of China's agricultural imports from the U.S. Overall, while the number of Chinese firms that export agricultural products to the U.S. is consistently greater than those involved in importing from the U.S., the number of firms engaged in importing and exporting has increased approximately three-fold since China joined the WTO in 2001.

2.1 CHINA'S AGRICULTURAL TRADE BY FIRM TYPE

In December 2004, the Chinese government amended its Foreign Trade Law, and removed the trade approval system[12]. The new system extended trading rights to most domestic enterprises and individuals. Prior to this, trading rights were entitled to foreign enterprises, selected SOEs, and monopolistic intermediary companies. Thus, only a handful of privately held domestic firms had rights to trade globally.

After 2004, China's domestic, privately held firms now play a critical role in the export and sourcing of China's international trade. First, engagement of private firms in China's agricultural trade increased by a factor of 24 over the past 16 years from just 1,202 private firms in 2000 to 28,616 in 2016. Second, the progressive reform of SOEs has reduced the weight of the state sector in China's economy (Fan and Hope 2013). The number of SOEs as a share of the total number of Chinese firms engaged in agricultural trade declined sharply from 43.8% (5,851) in 2000 to just 4.5% (1,622) in 2016. However, as we will see shortly, the decline in the number of SOE firms does not always translate into smaller trade volumes on a per firm basis.

Table 2 presents several indicators summarizing SOE and private domestic Chinese firms' agricultural imports and exports for the years 2002, 2010 and 2016.[13] For each of the importing and exporting columns, Table 2 summarizes seven indicators:

(i) SOE and private firm-type agricultural import and export values,
(ii) The number of SOE and private firms conducting agricultural imports and exports,
(iii) Average import and export value per firm-type,
(iv) Average number of partner countries with which each firm-type conducts imports and exports transactions,
(v) Average number of imported and exported HTS8-digit products per firm-type,
(vi) Average number of per firm product-by-country import and export observations, and
(vii) The total number of annual firm-country-product import and export observations.

Several findings from Table 2 are worth noting. First, China's SOEs play a much more active role in importing agricultural products compared to exporting. Starting in 2002, SOE firms engaged in importing and exporting agricultural products was equal at $2.0 billion. By 2010, SOE imports increased to $13 billion compared to $6 billion of SOE exports. In 2016, China's SOEs imported $20 billion of agricultural products, representing 20% of

[11] As described later, the number of Chinese firms engaged in trade with the U.S. makes use of our firm-level dataset comprising China's agricultural trade transactions.
[12] For further information, see: http://www.npc.gov.cn/wxzl/gongbao/2004-07/23/content_5335694.htm .
[13] Because the summary indicators for foreign invested firms follow closely thos of domestic private firms, foreign invested firms are omitted to ease exposition. The share of firms denoted as "other" types is negligible - 0.17% on average. Thus, we do not include firm-types classified as "other" in the discussion of Table 2.

Table 2. Chinese Agricultural Imports and Exports by Firm-Type

	Panel A: Chinese Agricultural Imports						Panel B: Chinese Agricultural Exports					
	2002		*2010*		*2016*		*2002*		*2010*		*2016*	
	SOEs	**Private**	**SOEs**	**Private**	**SOEs**	**Private**	**SOEs**	**Private**	**SOEs**	**Private**	**SOEs**	**Private**
1. Trade value ($ Bil)	2	1	13	18	20	50	2	1	6	22	5	47
2. Number of Firms (Count)	2,512	1,091	1,210	7,683	1,017	15,468	4,548	2,686	1,486	12,244	956	15,375
3. Average Import Value ($ Mil)	0.9	0.9	10.9	2.3	19.7	3.2	0.5	0.6	4.0	1.8	5.5	3.0
4. Average # of Partner Countries per Firm	3.2	3.0	3.5	2.2	4.7	2.4	3.8	3.1	5.8	3.7	5.8	3.7
5. Average # of Traded Products per Firm	4.8	4.9	4.4	3.1	6.6	3.4	6.0	4.0	4.7	3.4	5.1	3.5
6. Average # of Country-Product Pairs per Firm	2.4	3.8	5.9	3.8	10.9	5.0	3.1	3.6	10.1	6.4	11.8	7.3

Notes: SOEs denotes China's state-owned enterprises and Private denotes domestic private firms. Since foreign invested firms share similar trade patterns with their counterparts in China, "Private," this table does not include summary statistics for this firm type.

China's total agricultural imports (see Table 1) and an average annual growth rate of 16%. This compares to a 6% growth in SOE agricultural exports since 2002.

Second, the 16% and 6% growth of SOE agricultural import and export values, respectively, since 2002, was roughly one-half and 25% of the respective 30% and 26% annual average growth of import and export values for domestic private firms.

Third, the SOE import share in China's total agricultural imports declined from 33% in 2002 to 20% in 2016. For China's agricultural exports, the SOE share declined from 21% in 2002 to 7% of China's exports in 2016.

Fourth, further evidence of the declining (increasing) role of SOEs (private firms) in China's agricultural trade is illustrated by tabulating the number of firms (Table 2). Since 2002, the number of SOE firms engaged in China's agricultural imports decreased from 2,512 to 1,017 in 2016 – a reduction of 64%. In terms of China's agricultural exports, the number of SOE firms decreased from 4,548 in 2002 to just 956 SOE firms in 2016.

Conversely, the number of private firms engaged in China's agricultural imports and exports increased significantly from 1,091 importing and 2,686 exporting firms in 2002 to over 15,000 private firms engaged in importing and exporting agricultural products.

Fifth, it is also instructive to examine the intensive margin of firm-type trade, defined as the average value of imports and exports per firm ($ million) or row one (multiplied by 1000) divided by row 2 in Table 2. While SOE firms have decreased in number, the intensive margin of their imports has increased from $0.9 million per SOE firm in 2002 to nearly $20 million per SOE firm in 2016 ($0.5 million to $5.5 million per firm for China's SOE exports). The intensive margin of private firms increased from $0.9 and $0.6 million in 2002 to $3.2 and $3.2 billion in 2016 for imports and exports, respectively. Although import and export growth along the intensive margin was less for private firms compared to SOEs, much of this smaller growth rate is attributable to the remarkable growth in the number of private firms from 2002-2016, which tends to deflate the value of trade on a per firm basis.

Sixth, the extensive margin of trade examines the number of partner countries and/or products with which the average SOE or private firm conducts trade. Here, we find that the average Chinese private firm imports from or exports to just 2-3 countries. By comparison, the average SOE firm imported from nearly 5 source countries and exported to an average of nearly 6 destination markets. A similar pattern exists in terms of the number of products traded. The average private Chinese firm traded between 3 and 4 HTS8-digit products in 2016, whereas the average SOE traded between 5 and 7 products. If we count products and countries as unique varieties, the numbers remain consistent with the average SOE firm importing from (exporting to) 10.9 (11.8) country-product pairs compared to 5.0 (7.3) country-product pairs for the average private firm.

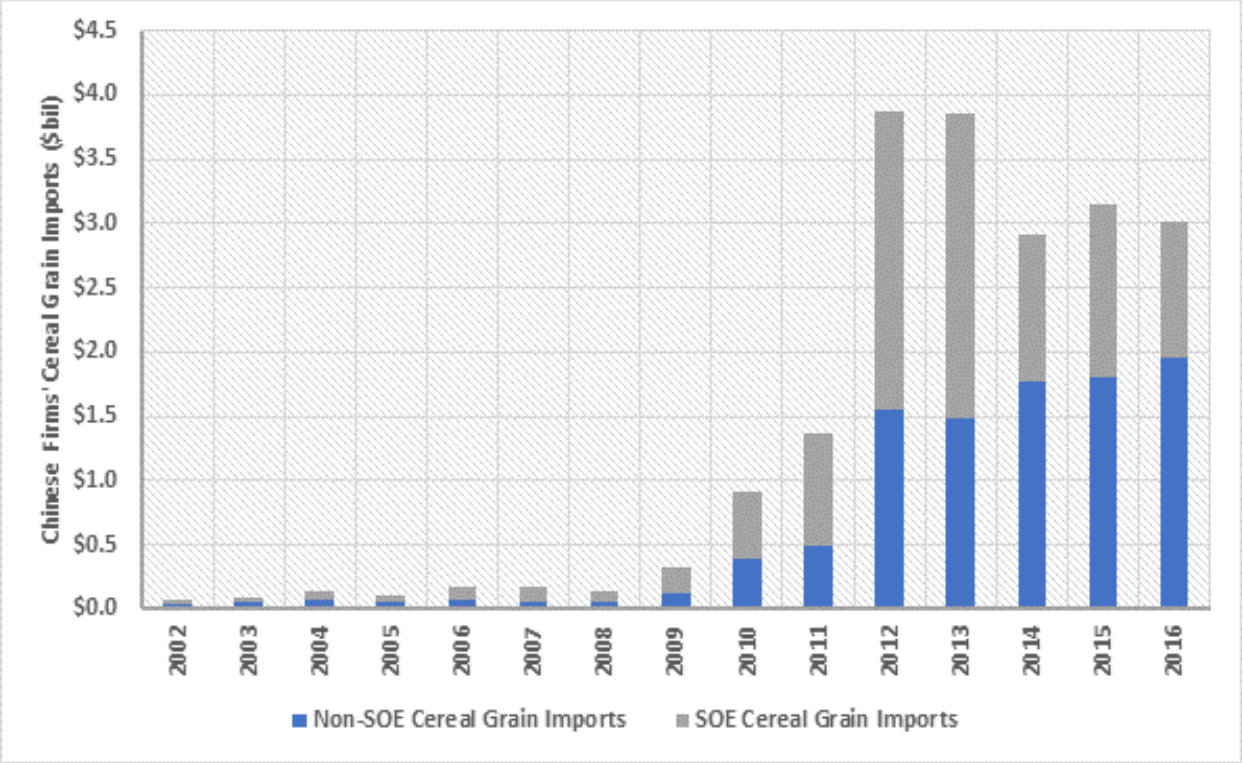
2.2 CHINA'S IMPORTS OF CEREAL GRAINS

While the preceding analysis examined the role of China's SOE and private firms across all agricultural imports and exports, the aggregate summary statistics mask some important underlying trends in specific sectors. For example, key concerns about the administration of China's cereal grains TRQs are constraints on the type and number of Chinese enterprises

permitted to engage in imports. Traditionally TRQ-regulated sectors such as cereals, oils, and cotton are administered by a system of "trading rights" that has historically limited the scope of firms permitted to import agricultural products and access China's internal distribution infrastructure. These trading rights have been primarily allocated to China's SOEs. And, while the role of state traders has evolved since China's WTO accession, SOEs continue to play an important role in the importation of politically sensitive commodities such as wheat, corn, and rice (McCorriston and MacLaren 2010, 2007).

Figure 4 decomposes the growth of China's imports of cereal grains by SOE and non-SOE firms. Cereal grains are defined as those commodities in Chapter 10 of the Harmonized System (HS) of product codes and encompass TRQ commodities wheat, corn and rice as well as other non-TRQ grains such as sorghum, oats, barley, mixed grains, and millet. Recall, SOE firms were responsible for 20% of China's aggregate agricultural imports in 2016. For cereal grains, however, SOEs play a much more significant role. For example, with the exception of 2008 (58%) and 2010 (58%) between 2007-2014 SOE firms imported nearly two-thirds (63%) of China's cereal grains, on average.

Figure 4: SOE and Non-SOE Cereal Grain Imports into China, 2002-2016



Note: cereal grain imports include grains in Chapter 10 of the Harmonized System of product codes

In 2012 and 2013, which coincided with a significant drought impacting the 2012 U.S. and North American corn and soybean crop (Rippey 2015), China's SOE firms imported $2.3 billion per year compared to $1.5 billion of cereal grain imports by non-SOE firms. From 2014-2016, however, this trend has reversed with non-SOE firms importing nearly 60% of China's cereal grain imports valued at $1.84 billion compared to $1.2 billion among SOE firms.

Drilling down to the product line, Table 3 presents a summary of the firm-level data for these grains for each of three years: 2007, 2010 and 2017. To facilitate comparison with TRQ unconstrained commodities, SOE and non-SOE imports of soybeans and canola (rapeseed), are also included.

Several firm-type observations within select TRQ constrained cereal imports are worth noting.

1) First, the number of firms conducting imports into China for wheat and corn are noticeably smaller compared to rice and soybeans. In 2017, there were 96 and 122 firms (SOE, foreign invested and private) importing wheat and corn into China compared to 456 and 240 firms importing rice and soybeans, respectively.

2) Since 2007, the number of firms importing wheat and corn has increased significantly, from just six Chinese firms (2 SOE firms) importing wheat and 36 firms (8 SOEs) importing corn from the world market, to 96 (19 SOEs) and 122 (13 SOEs) wheat and corn importing firms, respectively, representing a 16- and 3.5-fold increase. By comparison, the number of firms importing soybeans increased less than 2-fold since 2007 from 127 to 240 firms (38 SOEs).

3) More significant differences are observed along the intensive margin of average imports per firm (Avg Imports/Firm). In 2017, the overall intensive margins for wheat, corn, and rice were 45.8, 23.8, and 8.8 (1000mt) compared to 413.9 and 107.7 (1000mt) for soybean and canola. It is also interesting to note that only two SOE firms conduct imports of canola compared to 19, 13, 60 and 38 for wheat, corn, rice and soybeans.

3. POLICY BACKGROUND

In this section we briefly review the historical context of TRQs, and their operation and administration in China. We then summarize the concerns raised by the U.S. against China's TRQ administrative methods and China's response to these concerns. Finally, we provide a brief literature review of the impact of TRQs on agricultural trade.

3.1 THE WTO AND TRQ ADMINISTRATION

The 1994 Uruguay Round Agreement on Agriculture (URAA) permitted a system of tariff-rate quotas (TRQs) to replace NTMs in cases where the tariff equivalent of the original NTM was going to be prohibitive (GATT, 1994). Box 1 presents an introduction to the economics of tariff rate quotas. The URAA introduced three mechanisms to ensure exporting Members were offered a minimum market access commitment for certain commodities previously impacted by quantitative constraints in destination markets.[14]

[14] As noted by Abbott (2002), TRQs were a compromise between countries, such as the US and the Cairns Group (with the exception of Canada), that insisted on tariffication of all non-tariff barriers (NTBs) to trade without exception and other countries, such as the European Community and Japan, that were reluctant to open their domestic markets for certain agricultural commodities.

Table 3: Select Chinese Commodity Imports by Firm Type, 2007, 2013, 2017

	2007				2013				2017			
	Import Value (1000 mt)	# Firms	Avg Imp/Firm (1000 mt)	Avg. # Exporting Countries	Import Value (1000 mt)	# Firms	Avg Imp/Firm (1000 mt)	Avg. # Exporting Countries	Import Value (1000 mt)	# Firms	Avg Imp/Firm (1000 mt)	Avg. # Exporting Countries
						Wheat						
Overall	81	6	13.5	1.3	5,495	49	112.1	1.8	4,397	96	45.8	1.4
SOE	63	2	31.3	1.5	4,397	12	366.4	1.6	2,618	19	137.8	1.5
Foreign	17	3	5.8	1.3	301	16	18.8	2.0	510	22	23.2	1.6
Private	1	1	1.0	1.0	797	21	38.0	1.7	1,268	55	23.1	1.2
						Corn						
Overall	34	36	1.0	1.6	3,438	95	36.2	1.3	2,907	122	23.8	1.3
SOE	3	8	0.3	2.7	2,503	21	119.2	1.3	1,228	13	94.5	1.4
Foreign	0	5	0.1	1.0	101	14	7.2	1.1	548	8	68.5	1.0
Private	31	23	1.4	1.4	834	60	13.9	1.3	1,131	101	11.2	1.3
						Rice						
Overall	469	98	4.8	1.1	2,278	190	12.0	1.7	3,992	456	8.8	1.5
SOE	194	36	5.4	1.2	454	50	9.1	1.9	550	60	9.2	1.6
Foreign	2	10	0.2	1.2	474	10	47.4	1.5	705	32	22.0	1.6
Private	273	52	5.2	1.0	1,349	130	10.4	1.6	2,736	364	7.5	1.4
						Soybeans						
Overall	31,755	127	250.0	2.1	67,110	190	353.2	2.1	99,342	240	413.9	1.8
SOE	5,439	28	194.3	1.7	12,269	34	360.8	2.0	17,791	38	468.2	2.0
Foreign	20,366	44	462.9	2.4	27,046	60	450.8	2.5	41,085	52	790.1	2.6
Private	5,950	55	108.2	2.0	27,795	96	289.5	2.0	40,466	150	269.8	1.5

First, countries were required to convert their non-tariff trade barriers (NTBs) to tariff equivalents, a process called tariffication. Second, tariffs arising out of this process were bound at maximum levels equivalent to protection levels that existed in the base period (1986-1988), and most bound rates were reduced during the URAA implementation period.[15] Finally, importers were required to permit a minimum quota of 3% (later increasing to 5%), of the greater of either domestic consumption or import levels in the base period.

43 WTO members have notified 1,425 tariff quotas to the WTO. Globally, fruits and vegetables have the largest number of notified TRQs (370 tariff quotas; 25.9% of total), followed by meat products (258; 18.1%) and cereals (226; 15.9%) (WTO, 2002). Of particular significance is the fact that while GATT Article XIII governs TRQ administration, it included no specific provisions regarding how tariff-quotas should be distributed. This ambiguity left countries considerable discretion over the administration of their TRQs. Seven methods for administering TRQs have been adopted by WTO Members. These are summarized in Table 4.

In addition, some Members have implemented further conditions such as domestic purchase requirements, limits on the maximum share or quantity of quota allowed to be held by a single firm, submission of export certificates, or limiting eligibility to firms who have historical experience and/or capacity to import the product (WTO, 2000).[16] While various TRQ administrative methods are valid as long as they do not inhibit market access nor result in discrimination between WTO members, in practice, this is frequently not the case (Skully, 2001). Quota administration methods can have significant impacts on trade patterns and TRQ fill rates.

[15] The implementation period was 6 years (1995-2000) for developed countries and 10 years (1995-2004) for developing countries.
[16] See: G/AG/NG/S/8.

Box 1. The Economics of Tariff-Rate Quota Administration

TRQs are a two-tiered tariff. In a given period, a lower in-quota tariff is applied to the first units which are imported until the quota amount, Q^{TRQ}. A higher tariff is applied to any units which are imported in excess of this quota. Figure 5 below presents a simplified depiction of how tariff-rate quotas affect export supply (S). This depiction assumes that the international market is competitive and the importing country applying the tariffs is "small" and thus does not import sufficient volumes so as to affect international prices. Here, world prices are denoted by W, and P describes the domestic prices in the importing country. The in- and out-of-quota tariff rates are denoted by t and T respectively, where $T > t$. The domestic market would clear under free trade, and under a simple tariff, with imports of quantities Q^F and Q^t, respectfully.

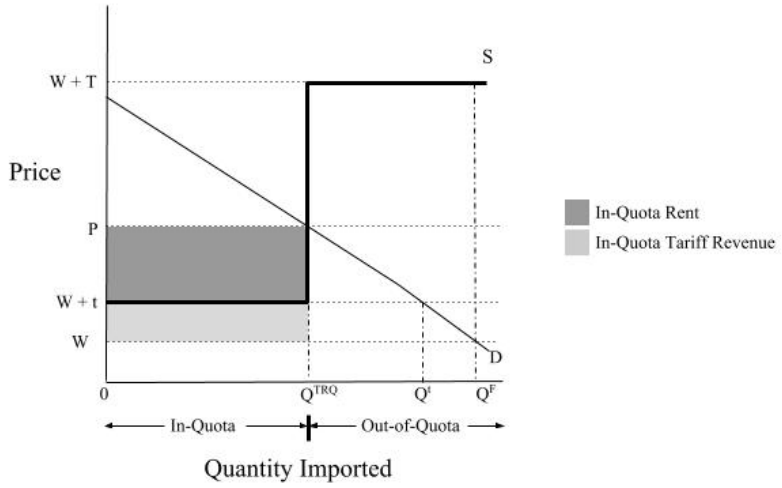


Figure 5. TRQ Regime when the imported quantity is equal to the quota

The effect of a tariff quota on trade depends on the demand for imports of that product. As depicted in Figure 5, the demand for imports is equal to the quota (the minimum access commitments). When import demand is less than the quota, the TRQ is not binding for quantities imported between 0 and Q^{TRQ}. These imports are subject the in-quota tariff t. The quota is filled and becomes binding once import volumes reach Q^{TRQ}. Quantities imported greater than Q^{TRQ} are considered out-of-quota. Out-of-quota imports can occur in unlimited amounts but are subject to the higher tariff T. These and additional special cases of TRQ market outcomes are presented in Abbott (2002).

A key question concerning the operation of TRQs is: who gets the right to import products at the often favorable in-quota tariff rate (t). When the quota is binding, the difference between the domestic price P and the actual purchase price ($W+t$) can offer a significant opportunity for profit. This quota rent is depicted as the dark shaded area in Figure 5. Because numerous companies will typically apply and compete for the opportunity to import products in-quota, a variety of TRQ administration methods have been developed to allocate (ration) quota volumes. These TRQ administration methods are summarized in Table 4. The economic efficiency of TRQs depends critically on the effectiveness of the quota administration method, and in many cases can result in a transfer of quota rents between exporters and importers, or to the government, depending on who retains the quota rights.

Table 4: Methods of TRQ Administration

TRQ Administration Method	Description
Applied Tariff	A quota is not enforced. Unlimited imports are allowed at or below the in-quota tariff rate.
License on Demand	Licenses are required to import a product at the in-quota tariff rate. The method by which licenses are allocated may differ by the demand for importing licenses relative to the quota availability. If the demand for licenses is less than the quota, import quotas are likely to be allocated on a first come, first served basis. If demand exceeds the available quota, the requested import volume may be proportionately reduced across applicants.
First-come, first-served	Importers are permitted entry at the in-quota tariff rates until the tariff quota is filled. All subsequent imports are subject to the over-quota tariff rate.
Historical	Licenses are issued, based largely on past importing experience of the product in question. For example, allocation of the tariff quota in proportion to a firm's share of imports during a base period.
Auction	Licenses issued, largely on the basis of an auctioning or competitive bid process.
State trader producer group	Tariff quota allocated largely or entirely to a state trading entity which imports (or directly controls imports by intermediaries) of the product.
Mixed	Administration methods involving a combination of the methods described above with no single method being dominant.
Other	Administration methods which do not clearly fall within any of the above categories.

Notes: Adopted from WTO, 2000[17] and Skully, 2001. The order that TRQ Administration methods appear in this Table reflect the relative prevalence of their use according to results presented in Skully, 2001.

3.2 CHINA'S ACCESSION TO THE WTO AND TRQ ADMINISTRATION

As part of its WTO accession, China committed to allowing market access through TRQs on ten commodities: corn, wheat, short- and medium- grain rice, long grain rice, sugar, cotton, wool and wool tops, and soybean, rapeseed, and palm oil. In 2006, China eliminated TRQs for soybean, rapeseed (i.e., canola), and palm oil. Thus, China effectively has seven agricultural commodities whose imports are subject to TRQs.

In 2003, the Chinese government published its Provisional Measures for the Administration of Import Tariff Quotas of Agricultural Products ("2003 Provisional Measures") and designated the National Development and Reform Commission of China (NDRC) as the authority responsible for the administration of its cereal grain TRQs.[18] Since this time, quota levels are set annually in accordance with Chinese law and its WTO commitments.

China's TRQ commitments for wheat, corn, and rice (in aggregate) are presented in Table 5. Quotas levels for wheat, corn and rice have remained unchanged since 2004 after China fully phased-in its TRQ commitments following WTO accession.

[17] For referencing: G/AG/NG/S/8.

[18] The release of China's Provisional Measures for Administration of Import Tariff Quotas is available at: http://www.mofcom.gov.cn/article/b/f/200310/20031000135653.shtml

Table 5: China's Tariff-Rate Quota Commitments

Grain	Tariff Item Number	TRQ Features		Allocation	
		In-Quota Tariff Rate [a]	Quota Volume (MT)	SOE	Private Sector [b]
Corn	10051000 10059000	1%	7,200,000	60%	40%
	11022000 11031300	9%			
	11042300	10%			
Rice, Short- and Medium Grain	10061010x 10061090x 10062000x 10063000x 10064000x	1%	2,660,000mt	50%	50%
	11023000x 11031400x	9%			
Rice, Long Grain	10061010y 10061090y	1%	1,662,500mt	50%	50%
Wheat	10011000 10019010 10019090	1%	9,636,000 mt	90%	10%
	11010000	6%			
	11031100	9%			
	11032100	10%			

Notes:
The TRQ features and allocation reflect the final figures after full implementation of the TRQ.
[a] The out-of-quota MFN tariff rate is equal 65%.
[b] Private Sector includes China's domestic firms and foreign invested firms.

An important feature of China's TRQ administration is the specific delineation of TRQ quota for state-trading and non-state-trading enterprises. Throughout this report we use the term SOE to refer to all state-owned enterprises conducting imports into China. However, for wheat, corn, and rice imports under TRQs, China's National Cereals, Oil, & Foodstuff Import and Export Company (COFCO), is the only SOE designated as the office state-trading authority for the SOE allocation. Non-state traders refer to any type of enterprise, other than China's SOEs, including privately held domestic and foreign invested firms with trading rights.

To import within quota, state and non-state traders must apply annually for TRQ certificates which specify the quantity of grain they are permitted to import at the in-quota tariff rate. China has adopted a mixed approach to allocate import quota licenses among non-state traders; this approach considers "historical records, processing capacity, production, imports, sales, or experience and the capability of providing services on the international market" (2018 Allocation Notice). In addition, the announcement specifies that if the total quota applied exceeds the total amount of quota available, priority will be given to firms that have a history of imports. Not surprisingly, and as will be discussed later, applications for quota importing rights far exceed the quota availability (see also Gale 2021). The 2003 Provisional Measures further stipulates that

both the quota license and the imported grain must be used by the TRQ certificate holder,[19] and imported wheat and corn must be processed and used in the TRQ certificate holder's own plant, whereas imported rice must be transacted in the name of the TRQ recipient. In addition, if a TRQ certificate holder does not import sufficient volumes to fill their entire TRQ allocation for two consecutive years, the NDRC will penalize the firm with a corresponding deduction in quota for the following year.

3.2.1 China's TRQ Import License Application Process

The application and allocation process occur annually between September and November for quota import licenses for the following year. One month prior to the application period (mid-September), the NDRC issues an Allocation Notice announcing the quota volume amounts for each type of grain for the non-state trading portion of the quota. Requirements for TRQ allocation eligibility, and factors which will be considered in allocating quota amounts across eligible applicants are also descried in this Allocation Notice and may vary over time. By way of example, the 2018 Allocation Notice identified both basic firm criteria (largely related to firm registration and inspections), and commodity-specific requirements.[20] Firms who wish to apply for non-state trading quota, must submit applications to one of the 37 provincial and municipal entities which are authorized by the NDRC[21] between October 15 and October 30 each year. After the application period closes, the NDRC publishes a compiled list of non-state trading TRQ applicants for 14 days (December 1-14) to allow for public notice and comment. This notice includes detailed firm characteristics data that are submitted by each applicant. By January 1 of each year, an Import Tariff-Rate Quota Certificate for Agricultural Products is issued to each recipient of TRQ allocation. However, data on China's actual allocations of the TRQ remain unknown.

3.2.2 September Reallocation of Unused Quota

Another interesting feature of China's cereal grain TRQs is the September reallocation of unused quota. If a TRQ certificate holder is unable to sign or complete import contracts for their entire TRQ allocation by the end of the year, the 2003 Provisional Measures requires that the unused portion of the quota be returned before September 15th each year. Because SOEs are the largest TRQ certificate holder, they are most affected by this requirement, and it has been claimed that this provision was designed to incentivize SOEs to behave more like commercial enterprises (Lohmar and Skully, 2003). Firms who fail to return their unused allocation, face a corresponding reduction in their quota allocation in the following year. Firms who comply with the application criteria may apply for a portion of the returned quota volume, although to the best of our knowledge, China does not publish the amount of unused quota available for reallocation.

[19] While the quota allocation is supposed to be used by certificate holders, there is evidence that this is not always adhered to. By way of example, videos can be found of interviews with China's top private feed processing company (New Hope) stating that that they have had to purchase TRQs from other certificate holders.

[20] Specifically, applicants must register with the Administration of Industry and Commerce and pass an annual review of the enterprise by the Administration of Industry and Commerce and the inspection and quarantine authorities. It is worth noting that the registration process can be quite onerous, and effectively excludes some market participants (Nigh, 2013). Further, commodity-specific requirements may also disqualify some firms with lower production capabilities and credit ratings.

[21] For the full list of entities authorized entities, readers can consult the following weblink: http://www.mofcom.gov.cn/article/b/e/200310/20031000136571.shtml (Chinese version).

An application, which is separate from the standard quota application (described above), is required by firms who wish to apply for a portion of this returned quota volume. In early August each year, NDRC releases a Reallocation Notice which details criteria for application. In the past, these criteria have been the same as those for the standard quota allocation at the beginning of the calendar year. Applications for reallocated quota must be submitted between September 1 and September 15 each year. TRQs certificates are allocated according to the order in which applications are submitted to local offices. When quota applications for reallocated quota exceeds the returned (i.e., unused) quota volume, the 2017 Reallocation Notice indicates that reallocated quota is carried out in accordance with applicants' actual production and input capabilities (including historical production and processing, actual import performance, and the status of operations) and other relevant commercial standards. By October 1st of each year, reallocated TRQ Certificates are issued to successful applicants.

3.3 WTO DISPUTES RELATED TO CHINA'S TRQ ADMINISTRATION

At the time of its accession, China was considered a developing country by the WTO[22] and, as such, was granted ten years to implement its WTO commitments. Since its transition period ended in 2011, a number of countries have expressed concern about China's TRQ administration procedures for wheat, grain, and rice. The low rate at which China has filled its cereal grain TRQs (below 65% each year prior to 2020-2021), has been subject to a number of critiques by major grain exporting countries. While market forces may have been one cause of China's inability to fill their quotas in the past (Zhou and Kang, 2009), the large gap between China's high domestic prices and lower world prices for these grains suggest that quotas may not be efficiently allocated (Beckman, Gale and Lee 2021)

3.3.1 U.S. Complaint to the WTO Concerning China's Administration of Cereal TRQs

In 2016, the Office of United States Trade Representative (USTR) requested the WTO to establish a dispute settlement panel to investigate China's TRQs and highlighted several issues associated with the transparency of China's TRQ administration. Table 6 reviews some of the major concerns presented by the USTR (USTR, 2018b).

First, the application criteria and procedures for allocating quotas to prospective Chinese importers have been unclear. While the Allocations Notices indicate that "historical records, processing capacity, production, imports, sales, or experience, and the capability of providing services on the international market" are used to determine TRQ allocations, they fail to identify the weight of each factor in the allocation process. Second, information about those non-state firms which have submitted tariff applications has been available online since 2015. However, information regarding which applicants were successful in obtaining TRQ certificates, their allocation amount, or the aggregate amount of TRQs allocated to all TRQ certificate holders has not been made public.

Third, China has delayed making required tariff quota administration notifications to the WTO's Committee on Agriculture. The most recent notification dates back to 2003 (15 years ago). China has attributed this delay to the fact that there has been no change in tariff quota administration policy since 2003 (Nigh, 2013).

[22] WTO members decide for themselves whether they are developed or developing countries. Although the World Bank considers China as an upper middle-income country, by the WTO definition it is still classified as a developing country.

Fourth, while the 2003 Provisional Measures stipulate that the minimum total quota amount for each recipient should be determined according to the commercially viable shipping volumes for each kind of agricultural product, Lohmar and Skully (2003) point out that, in reality, many allocations may be too small to be commercially viable. A potential importer holding a quota for a few thousand metric tons would have to pool the quota with other shipments to fill a cargo ship. This practice adds transaction costs and may discourage imports. Prohibitions against exchanging or selling quota rights further limit import alternatives to companies. As a consequence, Chinas TRQ administration may inhibit the quotas from being filled (USTR, 2018b).

In response to questions from the WTO Committee on Agriculture, China indicated that it did not intend to review its methods for allocating quotas, and suggested that the low level of imports relative to the size of the tariff quota was due to high levels of domestic production coupled with higher international prices (Nigh, 2013).

3.3.1 China's Response to U.S. Complaints

In its First Written Submission, China claimed that U.S. concerns against its TRQ administrative measures are misguided and unfounded. Table 5 also provides select responses from China. While the Chinese government does provide convincing responses to some of the U.S. concerns, several key concerns were left unanswered. For example, China fails to show the specific criteria regarding its TRQ allocation mechanism. The opaqueness of China's TRQ administrative method creates uncertainty for foreign grain exporters. Moreover, the high portion of state trading quota impedes China's non-SOE firms to take full advantage of the international cereal markets.

3.4 LITERATURE REIVEW

As China's TRQ policy divides corn, wheat and rice quotas between firm-types (SOE and non-SOEs), a more nuanced evaluation of the impact of this policy requires the use of firm-level information. Studies examining TRQ administration methods, and advances in utilizing firm-level data in international trade analysis are reviewed below.

3.4.1 TRQ Administration

Li and Carter (2009) demonstrate that reducing in-quota tariffs will significantly improve market access and raise TRQ fill rates. Grant et al. (2009) evaluate the impacts of several scenarios for liberalizing U.S. specialty cheese imports and find that the impacts of liberalization varies significantly depending on the reform approach undertaken.

Among common TRQ administration approaches, auctioning import licenses has been suggested as the most non-discriminatory administration method (Skully, 2001). However, Gervais and Surprenant (2003, 2000) argue that under the conditions of imperfect competition, historical

Table 6: Summary of Concerns Expressed by the U.S. over China's TRQ Administration and China's Response

Concern Number	Concerns Expressed by the U.S.	China's Response
1	*Basic Criteria not easily understood.* • Good financial condition, integrity, no violations, social responsibilities, etc., are not well defined by China. [23]	*U.S. did not show Basic Criteria causes negative impacts on TRQ applicants.* [24]
2	*Allocation principles not easy to discern/understand.*[25]*:* 1) How does NDRC evaluate "actual production/operating capacities." 2) Context of "other relevant commercial standards." 3) No apparent opportunity to specify an allocation under the state trading or non-state trading portion.[26]	*China's Response* 1) Historical production, processing, import performance, and operations"[27] 2) Use of residual categories "other relevant commercial criteria" is common practice among WTO Members[28]. 3) COFCO is the only state trading enterprise (STE) authorized to import and is allocated the full STE portion of each TRQ.[29]
3	*No information regarding which entities received quota and in what amounts.*[30]	*Recipient allocations are confidential business information*[31]
4	*No information regarding what quantities, if any, are returned for reallocation*.[32]	*"Change" that must be notified changes to scheduled quotas – not "any change" to the specific quantities allocated from those quotas.*

[23] FIRST WRITTEN SUBMISSION OF THE UNITED STATES OF AMERICA, para.77-84&119-125&159&180-188&233-238.
[24] FIRST WRITTEN SUBMISSION OF THE PEOPLE'S REPUBLIC OF CHINA, para.30-43.
[25] See FIRST WRITTEN SUBMISSION OF THE UNITED STATES OF AMERICA, para.85-96&126-134&154-158&239-244.
[26] Applicants do not know, apparently until they receive their TRQ certificate, whether they may import directly or must import through a state trading enterprise, which carries additional conditions of importation.
[27] See FIRST WRITTEN SUBMISSION OF THE PEOPLE'S REPUBLIC OF CHINA, para.47-51.
[28] See FIRST WRITTEN SUBMISSION OF THE PEOPLE'S REPUBLIC OF CHINA, para.52-55.For example, consider the United States' sugar TRQ regulations. Title 15 of the United States Code of Federal Regulations, section 2011.07(a) (Issuance of certificates to foreign countries) provides: "The Secretary may issue certificates of quota eligibility to foreign countries for any quota period in such amounts and at such times as he or she determines are appropriate to enable the foreign country to fill its quota allocation for such quota period in a reasonable manner, taking into account traditional shipping patterns, harvesting period, U.S. import requirements, *and other relevant factors*."
[29] See FIRST WRITTEN SUBMISSION OF THE PEOPLE'S REPUBLIC OF CHINA, para.94-99&101-102.
[30] See FIRST WRITTEN SUBMISSION OF THE UNITED STATES OF AMERICA, para.97-101&108-112&140-144&207-213&261-266.
[31] See FIRST WRITTEN SUBMISSION OF THE PEOPLE'S REPUBLIC OF CHINA, para.61-69.
[32] See FIRST WRITTEN SUBMISSION OF THE UNITED STATES OF AMERICA, para.102-107&135-139&272-282.

5	*Penalties for non-use impose significant burdens on TRQ Certificate holders and discourage applicants from applying for the full amounts desired for import.*[33]	*Penalties encourage full TRQ utilization.*[34]
6	*Local authorities do not provide guidance on requirements associated with the Basic Criteria. Therefore, each local authorized agency may interpret and apply these requirements differently.*[35]	*The role of the authorized agencies is simply to check the applications for completeness and forward applications to NDRC for review.*[36]
7	*NDRC fails to provide any explanations regarding how does the agency vet the comments and make decisions on the final allocations to applicants*.[37]	*Applicants are informed of any comments of public that are submitted in relation to their data and are provided with the opportunity to rebut or refute those comments. NDRC also engages in an independent evaluation of any comments received, based on information collected by the authorized agencies*.[38]
8	*China's TRQ administration requires the "Self-Use" of the imported grains limiting flexibility and the ability of importers to react to commercial considerations*.[39]	*This is not a restriction on the use of the imported grains under the quota – it is a restriction on transferring or selling the quota itself.* [40]
9	*The fact that COFCO does not need to return unused quota to the NDRC for reallocation impedes the full use of TRQs*.[41]	*Not Answered*

allocation offers a better administrative method if social welfare is considered. Particularly relevant to the current study, in their detailed overview of the role of COFCO and its subsidiaries, McCorriston and MacLaren (2010) find distortionary impacts of state trading in Chinese wheat imports. Additionally, using a theoretical model followed by simulations focused on Canada's poultry sector, Pouliot and Larue (2012) find initially counter-intuitive results that increased imports through tariff rate quotas, may stimulate domestic price increases. It is worth noting, however, that Abbott and Morse (2000) and Abbott (2002) argue that rather than

[33] See FIRST WRITTEN SUBMISSION OF THE UNITED STATES OF AMERICA, para.214-222.
[34] See FIRST WRITTEN SUBMISSION OF THE PEOPLE'S REPUBLIC OF CHINA, para.123&126&129-131.
[35] See FIRST WRITTEN SUBMISSION OF THE UNITED STATES OF AMERICA, para.245-249.
[36] See FIRST WRITTEN SUBMISSION OF THE PEOPLE'S REPUBLIC OF CHINA, para.40.
[37] See FIRST WRITTEN SUBMISSION OF THE UNITED STATES OF AMERICA, para.160&250-254.
[38] See FIRST WRITTEN SUBMISSION OF THE PEOPLE'S REPUBLIC OF CHINA, para.113-117.
[39] See FIRST WRITTEN SUBMISSION OF THE UNITED STATES OF AMERICA, para.302-308.
[40] See FIRST WRITTEN SUBMISSION OF THE PEOPLE'S REPUBLIC OF CHINA, para.123&126&129-131.
[41] See SECOND WRITTEN SUBMISSION OF THE UNITED STATES OF AMERICA, para.158-161.

improving TRQ administrative methods, lowering MFN tariffs is a better way to promote market access.

The extent to which China's TRQ fill rates are an indication of inefficient TRQ administration also deserves additional consideration. A more transparent process of TRQ administration is not a sufficient condition guaranteeing higher levels of market access (Bureau and Tangermann, 2000; Cunha and Santos, 1996). There may, for example, either be insufficient supply or low demand leading to unfilled quotas. Further, a fill rate of 100% (or more) does not necessarily imply efficiency (Boughner et al., 2000). As shown by Bureau and Tangermann (2000), although the European Union (EU) maintains a relatively more transparent TRQ administration system compared to other countries, the system does not encourage agricultural imports, nor does it improve economic efficiency. Cunha and Santos (1996) further point out that low TRQ fill-rates may also be the result of monopolies who "waste" received TRQ allocations intentionally for the purpose of preventing potential entrants to the market. This does not appear to be the case in South Korea and Japan, however, where although TRQ administration remains a concern, SOEs had higher quota fill rates than non-state traders (Choi and Sumner, 2000). In the case of China, Zhou and Kang (2009) report that the primary cause for the low utilization of Chinese grain TRQs was due to sufficient domestic supply. However, this argument depends on both the quality and quantity of China's strategic reserve policy.

3.4.2 Firm Level Analysis

Recent advances in the international economics literature that emphasize the role of firm-level productivity differences have shed new light on the dynamics of international trade (Bernard et al., 1995, 2009; Eaton and Kortum, 2002; Manova and Zhang, 2012). The Melitz (2003) and Chaney (2008) models of heterogeneous firms under monopolistic competition have proven extremely useful for analyzing the behavior of individual firms in an international context. To briefly summarize findings stemming from these studies, when trade barriers fall or transportation costs decline, high-productivity exporting firms survive and grow, while lower-productivity, non-exporting, firms become more likely to fail. In this setting, the growth of high-productivity firms and the exit of low-productivity firms results in the reallocation of economic resources which, in turn, leads to improvements in an economy's aggregate productivity and non-traditional sources of welfare gains from trade.

A growing body of empirical work has emerged that examines the micro foundations of firm-level productivity differences, and export and import performance. These studies make use of micro datasets that capture firm-level transactions and offer insights into the important role that firms play in not only in determining a country's trade growth and import and export patterns, but also in identifying characteristics of firms that successfully engage in trade. Studies by ISGEP (2008), Bernard et al. (2009), Manova and Zhang (2012), Fontagné et al. (2015), and Arkolakis et al. (2015), use firm-level data to examine various issues in the U.S., Germany, China, France, and Brazil, respectively. These studies demonstrate that firms that engage in international trade differ substantially from those who serve only domestic markets. Among the now well-established stylized facts are: trading firms (exporters & importers) are larger, have higher total factor productivity (TFP), pay higher wages (even within narrowly defined sectors), and are more skill- and capital-intensive than comparable non-trading firms.

Despite gaining significant traction in the international economics literature, firm-level analyses within agricultural economics are comparatively rare and, as emphasized by Gopinath et al.,

(2007) and Prehn and Brümmer (2012) are needed. While the trading behavior of manufacturing firms can be directly applied to food manufacturing firms and industries, trade of agri-food products is often unique due to policy complexity and the higher level of import protection for agricultural products (Gopinath et al., 2007). Additionally, bulk commodity trade that can be stored, the presence of intermediary firms, and climatic conditions of trading partners play a more important role in shaping commodity trade flows than is the case for manufactured products (Ahn et al., 2011; Greenaway and Kneller, 2007; Prehn and Brümmer, 2012).

4. EMPIRICAL METHODS

This section consists of three parts. In the first subsection, we develop the empirical model based on the heterogeneous firms literature to examine differences in SOE import shares and non-SOE intensive and extensive margins between TRQ constrained and unconstrained products. Particularly, we are interested in the two policy questions: (1) How significant is the role of SOEs in China's TRQ grain imports compared to similar agricultural commodities not subject to TRQs? And (2) What is the impact of China's cereal grain TRQ policy on the intensive and extensive margins of non-SOE private firms as compared to agricultural commodities not subject to TRQs? In the second subsection, we focus attention on China's mid-year grain quota reallocation (referred herein as the "September Reallocation"). Here, we employ a difference-in-difference approach to investigate the extent to which China's September TRQ reallocation mechanism and the end of its WTO transition period improved market participation of non-SOE firms. Finally, we examine the responsiveness of Chinese firms to market signals when importing cereals grains subject to TRQs.

4.1 THE ROLE OF SOE IN CHINA'S TRQ GRAIN IMPORTS

Our assessment of the potential market inefficiency of China's grain TRQs is based on a framework of heterogeneous firms (Melitz 2003, Chaney 2008) with asymmetric productivities. While trade barriers themselves can distort the efficient productivity of firms and the distribution of resources such as capital, land and labor across industries, inefficient institutional frameworks can also serve as an additional drag on productivity vis á vis the administration, application process, and distribution of TRQs. Khandelwal, Schott and Wei (2013) used the export share of SOEs in Chinese textiles as an indicator of inefficiency to test whether Chinese textile quotas were misallocated over the 2003-2006 sample period. Exploiting quota-bound and quota-free Chinese firm-level trade flows, they find that non-SOE shares in China's quota-bound textile exports were significantly lower than the non-SOE share in quota-free sectors. However, after the historic removal of textile quotas under the Multi-Fiber Arrangement (MFA) in 2005, private sector entrants emerged and gained market share at the expense of relatively unproductive incumbent SOEs. While our analysis does not contain a significant policy event such as the removal of China's grain TRQs, here, we examine non-SOE import shares in Chinese cereal grains to quantify whether non-SOE shares for wheat, corn, and rice are systematically lower than other agricultural commodities not subject to TRQs.

Further, as McCorriston and MacLaren (2010) contend, the degree to which SOEs participate in sensitive sectors such as China's imports of cereal grains depends on the government policy bias toward agriculture and the competitiveness of the domestic procurement market. Thus, we attempt to control for this potential 'bias' in the SOE role in grain commodities by controlling for

estimated stock levels of China's strategic reserve policy. The stocks-to-use ratio, or what we will call China's food security indicator is a one period lag of China's stocks-to-use ratio of commodity *h* in a given year *t.* We might expect China's SOE participation and importing intensity to increase when food security levels are below median historical values.

The set of market related covariates affecting SOE and non-SOE firm-level imports depend importantly on underlying supply and demand conditions in China and global markets (see for example Abbott, Hurt and Tyner 2011). These factors include domestic use and absorption rates, world prices, and China's domestic support price. They also include source country characteristics such as production and fob prices, shipping costs as well as trade cost factors that are specific to China but constant across firms and origin countries including the in- and out-of-quota tariffs, the quota amount and non-tariff regulations. Our first empirical model to examine differences in non-SOE import shares between TRQ constrained and unconstrained products conditional on these factors is as follows,

$$(1) \quad y_{okt} = \alpha_{ot} + \alpha_{kt} + \sum_{k} \gamma_k D_k + \beta_1 stocks/use_{kt} + \varepsilon_{okt}$$

where *o*, *k*, and *t* represent origin (i.e., source) country, commodity, and year, respectively, y_{okt} is China's SOE import share of commodity *k* from origin country *o* in a given year *t*, α_{ot} and α_{kt} are country-time and commodity-year specific effects, respectively, to control for time-varying country specific and commodity-year unobserved effects such as exporter production capacity, exporter fob prices, shipping costs, country specific trade costs, and commodity specific world price movements over years, in- and out-of-quota tariff rates and the TRQ quota levels. The variable D_k and associated coefficient γ_k is an indicator function equal to one if commodity *k* is affected by China's TRQ policy (i.e, $k \in wheat, corn, rice$). Finally, $stocks/use_{kt-1}$, is a lagged food security indicator for commodity *k* in year *t-1*, representing the one period lag estimate of China's cereal grain reserves relative to domestic use.[42] While this variable would normally be absorbed by the commodity-year specific effects (α_{kt}), as a robustness check we drop the α_{kt} effects and include the $stocks/use_{kt}$ variable to understand the role of SOEs during periods of decreased reserves.

In addition to the SOE share in equation (1) we also estimate alternative specifications to shed light on the intensive and extensive margins of China's non-SOE firms. More specifically, we replace the dependent variable y_{okt} in equation (1) with $Non\text{-}SOE\text{-}EM_{okt}$ denoting the number of non-SOE firms importing product *k* from origin *o* in year *t* as a measure of the extensive margin (*EM*) of private firm participation in importing TRQ commodities and $Non\text{-}SOE\text{-}IM_{okt}$ denoting per firm imports of product *k* from origin *o* in year *t (intensive margin (IM))*. Again, our benchmark in these regressions is the set of commodities not subject to TRQs.

4.2 SEPTEMBER REALLOCATION IMPACT

In this specification, we adopt a difference-in-difference (DID) framework to estimate the casual effects of China's September reallocation on the SOE import share and non-SOE's intensive and extensive margins. The specification of the DID approach is as follows,

[42] Note, because we could only retrieve stocks-to-use estimates for a select number of China's cereal grains (wheat, corn, rice, oats, barley, millet, grain sorghum) regressions that include this variable are estimated on the subset of agricultural commodities in chapter 10 of the harmonized system.

$$(2) \qquad y_{kt} = \beta_0 + \beta_1 1\{t > Event\} + \beta_2 1\{h \in quota\} + \beta_3 1\{t > Event\} * \{k \in TRQ\} + \epsilon_{kt}$$

where *k* and *t* denote commodity and time, respectively. The dependent variables are: (1) SOE import share; (2) the number of non-SOEs importers (*extensive margin*); and (3) the average import quantity per non-SOE firm (*intensive margin*). $1\{t = Event\}$, $1\{k \in quota\}$, and $1\{t = Event\} * \{k \in quota\}$ are indicator functions that equal to one if the month is post-September, the commodity is subject to a TRQ, or both, respectively. We refer to the estimated coefficient β_3 as the DID estimate, which captures the average difference between y_{kt} in-quota bound imports before and after the policy event relative to the difference among quota-free imports.

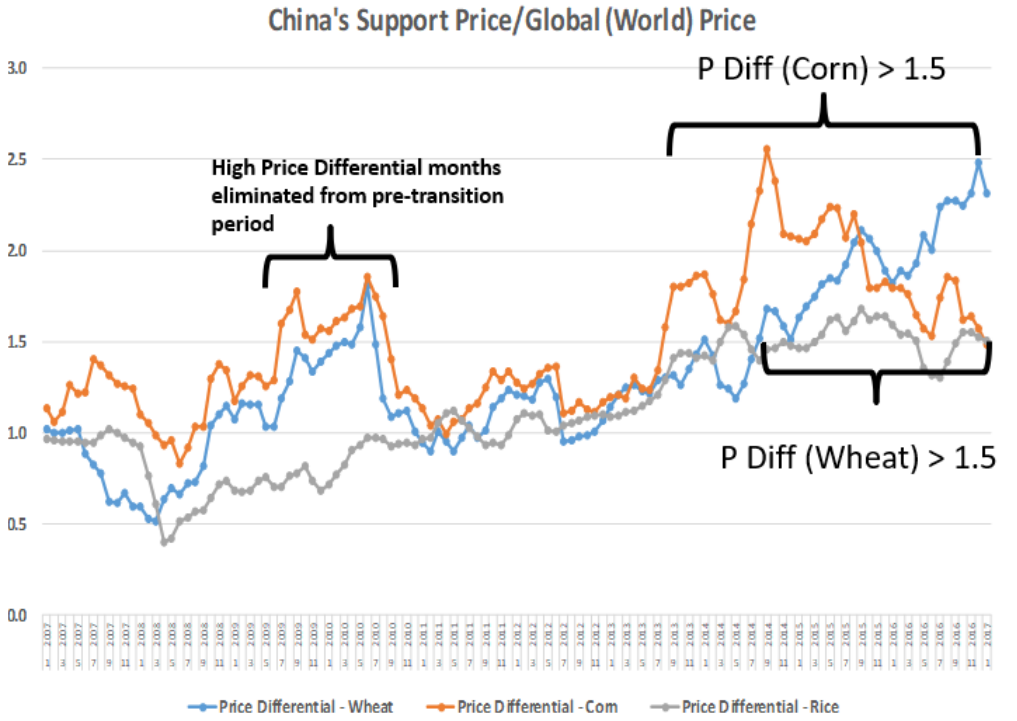
4.3 IMPORTERS' RESPONSE TO MARKET SIGNALS

A major concern among cereal grain exporting countries is that China's cereal grain imports are less responsive to market price signals, which has resulted in low Chinese TRQ fill-rates. Figure 5 presents the price differential between Chinese domestic and global markets for wheat, corn, and rice. Although there are a few outliers in the early years of the sample period, overall, China's domestic prices are much higher than the world market prices. For example, domestic prices of wheat and corn were over two times as much as those of world markets in recent years. Under high price differentials, firms should find it profitable to participate in importing cereal grains from the world market. Thus, we expect that the price differential is positively related with the number of non-SOEs participating in global markets and their import volumes.

The most straightforward approach to test this hypothesis is adding an interaction term between the TRQ dummy and the price differential variable to the model. Unfortunately, due to the lack of non-TRQ commodities' price data, such practice would simply drop all the non-TRQ commodity observations in the estimation process, and thus no DID estimation results could be produced. As an alternative, we (1) group the full sample period into low- and high-price differential periods based on the average price differentials for each commodity over the sample period; (2) generate a new sample by restricting the pre-event period to be the low-price differential period and the post-event period to be the high price differential period; (3) run DID estimation using the new sample, and (4) compare the new DID estimate with the specification using the full sample.

To explain, the new DID estimate confounds the impact of policy events with the impact of price differentials on TRQ commodities, whereas the old DID estimate purely reports the policy effects. However, The difference between the two DID estimates, thus shed new lights on the responsiveness of non-SOEs to grain price signals. Non-SOE TRQ importers are less sensitive to market signals relative to their counterparts importing non-TRQ commodities when the difference between the two DID estimations is negative. Otherwise, we postulate that non-SOE TRQ commodity importers are more responsive to the price wedge. Since the parallel trends assumption is important to ensure internal validity of DID models, we undertake several robustness checks on the results to ensure stability of estimates.

Figure 5: Price Differential between Chinese Domestic and World Markets



5. DATA

An important innovation offered by this study is our ability to disentangle China's cereal grain and other agricultural imports by firm type. Two unique firm-level datasets are used to assess the role of SOE and non-SOE firms in China's agricultural and TRQ imports. While these datasets both come from the General Administration of Customs of China, they have some important differences – in particular, concerning their level of aggregation, and the time period they cover. Below, we briefly describe each database in turn.

5.1 ANNUAL DATA AT HTS 8-DIGIT LEVEL

The first dataset encompasses the universe of Chinese firm-level annual bilateral imports of agricultural products of the Harmonized Tariff Schedule (HTS), Chapters 01-24 at the HTS 8-digit level over the 2000-2016 period (henceforth the Annual Database). At the HTS 8-digit level, we observe the Chinese importing firm, the value of shipments denoted in U.S. dollars, (current value), the quantity traded(kg), the ownership structure of the importing firm, and the exporting (i.e., source) country.

In this database, each importing firm is assigned one of eight possible ownership types. In order to facilitate our analysis, we follow Ahn et al. (2011) and group importing Chinese firms into three general categories: state owned enterprises (SOEs), privately held firms (privately held domestic firms, collectively-owned firms, self-employed industrialist), and foreign invested firms (fully foreign-owned affiliates, foreign joint ventures).

To confirm the accuracy of this dataset, for each of the commodities of interest, we aggregate firm-level imports at the HS-4 level to the country-level and compare these figures to the United

Nations (UN) Comtrade data for China's reported agricultural imports over the 2000-2016 time period. The average import differences between the aggregated firm-level data and the UN Comtrade figures over the 2000-2016 period are $6.3 million, $19.7 million, and $9.7 million for wheat, rice, and corn, respectively. These figures represent 0.72%, 2.6%, and 0.68% differences from the average reported Chinese import statistics for wheat, corn, and rice, respectively. Additionally, because not all trade modes are included in China's official country level statistics, the aggregated firm-level data in general are larger than the figures documented by the UN Comtrade.

5.2 MONTHLY IMPORT DATABASE, HS CHAPTER 10

The second dataset consists of Chinese firms' total monthly cereal (HS chapter 10) imports over the 2007-2017 period (henceforth Monthly Database). The Annual and Monthly datasets offer complementary insights as the former provides broader commodity coverage (all agricultural products) and an important source-country dimension over a longer sample period (2000-2016). The latter Monthly dataset allows us to examine the extent to which private firms enter TRQ markets within a calendar year and their associated per-firm imports along the extensive and intensive margins after China's September TRQ quota reallocation. The Monthly Database, however, does not, report the source country of imports and is limited to cereal products in Chapter 10 of the Harmonized System (HS). Importantly, the Monthly data is at the HTS10-digit level and allows us to observe in-quota versus over-quota imports of Chinese wheat, corn, and rice.

5.3 ADDITIONAL VARIABLES

Several additional variables related to China's cereal imports are incorporated in the econometric estimation. Soybeans are included in some aspects of this analysis to offer comparison of a commodity which is important to China, but which is not subject to TRQs. Three groups of prices are used in this study: (i) global monthly price (not seasonally adjusted) of wheat, corn, rice, and soybeans from IndexMundi;[43] (ii) China's domestic monthly prices for listed commodities from the China Grain Reserve Corporation;[44] and (iii) the Chinese firm-level monthly unit value import prices.

In addition, levels and projections of Chinese cereal stockholding are needed. This information is particularly difficult to obtain as the Chinese government forbids the publication of stocks data because they consider this information to be a state secret due to food security implications (IATP, 2012). Thus, we rely on the USDA's Foreign Agricultural Service's estimates of China's stocks-to-use. The mean (median) stock-to-use ratios are 50% (46%), 36% (31%), and 38% (34%) for wheat, corn, and rice over the sample period.

6. RESULTS AND DISCUSSION

The results are organized in four subsections. In the first subsection, we present the evolution of China's SOE and non-SOE TRQ fill rates from 2012 to 2016 (the Post-Transition) and within a

[43]Index Mundi is a data portal that gathers statistics from multiple reliable sources. https://www.indexmundi.com/about.html (access date: June 20, 2018).

[44] The website, http://english.cngrain.com/, is sponsored by China Grain Reserve Corporation (access date: June 25, 2018). Chinese domestic prices for sorghum were not available from this source or able to be found through other data sources.

given year. Subsection two presents results of the SOE import share regressions (equation 1) for wheat, corn, and rice as compared to other agricultural commodities not subject to TRQs. The third subsection examines the non-SOE's intensive and extensive margins between quota-bound and quota-free commodities to investigate per firm imports along the intensive margin and the number of private firms operating in TRQ markets (extensive margin) compared to non-TRQ constrained markets. In this section, we also illustrate how market signals affect non-SOEs import decision; we use China's food security indicator and the price differential between the domestic and global cereal market. In the last subsection, we present the DID results that examine the extent to which China's September TRQ reallocation affects both SOE import shares and non-SOE firms' participation along the intensive and extensive margin.

6.1 TRQ FILL RATES

In the first subsection, we examine the role of SOEs in China's TRQ grain imports. In particular, we are interested in the annual fill rates for wheat, corn, and rice and their monthly cumulative fill rates by firm type. While most of the countries that joined the dispute are major wheat and corn exporters, only four of the world's top ten rice exporters raised concerns against China's TRQ administration for cereal (Table 7). Additionally, since the U.S. is not a major rice exporter, we mainly focus on the evolution of China's SOE and non-SOE TRQ fill rates for wheat and corn in this subsection. Results suggest that (1) non-SOEs' import demands for wheat and corn continue to be strong; (2) China has strong demand for U.S. wheat, whereas, U.S. corn is losing market share in China; and (3) non-SOEs' import patterns appear to be more season-related than those of SOE.

Table 7: Top Cereal Grain Exporters

Wheat		**Corn**		**Rice**	
Top 10	*Export (1,000 mt)*	*Top 10*	*Export (1,000 mt)*	*Top 10*	*Export (1,000 mt)*
European Union	32,500	United States	41,912	**Thailand**	10,000
Russia	23,000	Brazil	28,000	India	8,600
Canada	22,000	**Argentina**	17,000	Vietnam	7,000
United States	21,092	Ukraine	15,500	**Pakistan**	4,600
Canada	22,000	Russia	3,800	United States	3,175
Australia	17,000	**Paraguay**	2,300	**Burma**	1,800
Ukraine	15,500	**Serbia**	1,700	**Uruguay**	950
Argentina	7,000	European Union	1,500	**Cambodia**	900
Kazakhstan	6,500	Canada	1,000	Brazil	830
Turkey	4,700	**Mexico**	1,000	**Guyana**	536

Notes: Countries in bold did not join the dispute as third-party Members against China's TRQ administration.

Table 8 illustrates SOE and non-SOE's in-quota imports and their corresponding TRQ fill rates over the 2012 – 2017 sample period. Imports of corn and wheat present different patterns. First, SOE import volumes of corn decreased by over 90% from 3.934 mmt in 2012 to 0.361 mmt in 2017, and Chinese total in-quota imports for corn dropped 47% from 5.259 mmt in 2012 to 2.81

mmt in 2017. Conversely, non-SOE corn imports increased 85% from 1.325 mmt in 2012 to 2.449 mmt in 2017. Second, these trends are also reflected in the fill rates of corn imports. The fill rate on the SOE portion of the corn TRQ plummeted from 91% in 2012 to 8% in 2017, whereas, non-SOE fill rate (on the non-SOE portion) rose from 46% in 2012 to 85% in 2017. In particularly, non-SOE fill rate for corn reached 128% in 2015.

Unlike corn, China's in-quota imports for wheat remained steady over the sample period. On average, China imported 3.58 mmt of wheat each year, of which COFCO and its subsidiaries imported 2.51 mmt. While SOEs accounted for over 70% (2.51/ 3.58) of Chinese wheat imports, the average fill rate of the SOE portion was only 29%. On the contrary, non-SOE fill rates continued at over 90%, and non-SOE fill rates in 2012, 2013, and 2014 were above 100%. These high fill rates of non-SOE portions for both wheat and corn indicate strong import demand for wheat and corn imports into China.

Table 8: SOE and non-SOE's In-Quota Imports and Fill Rates

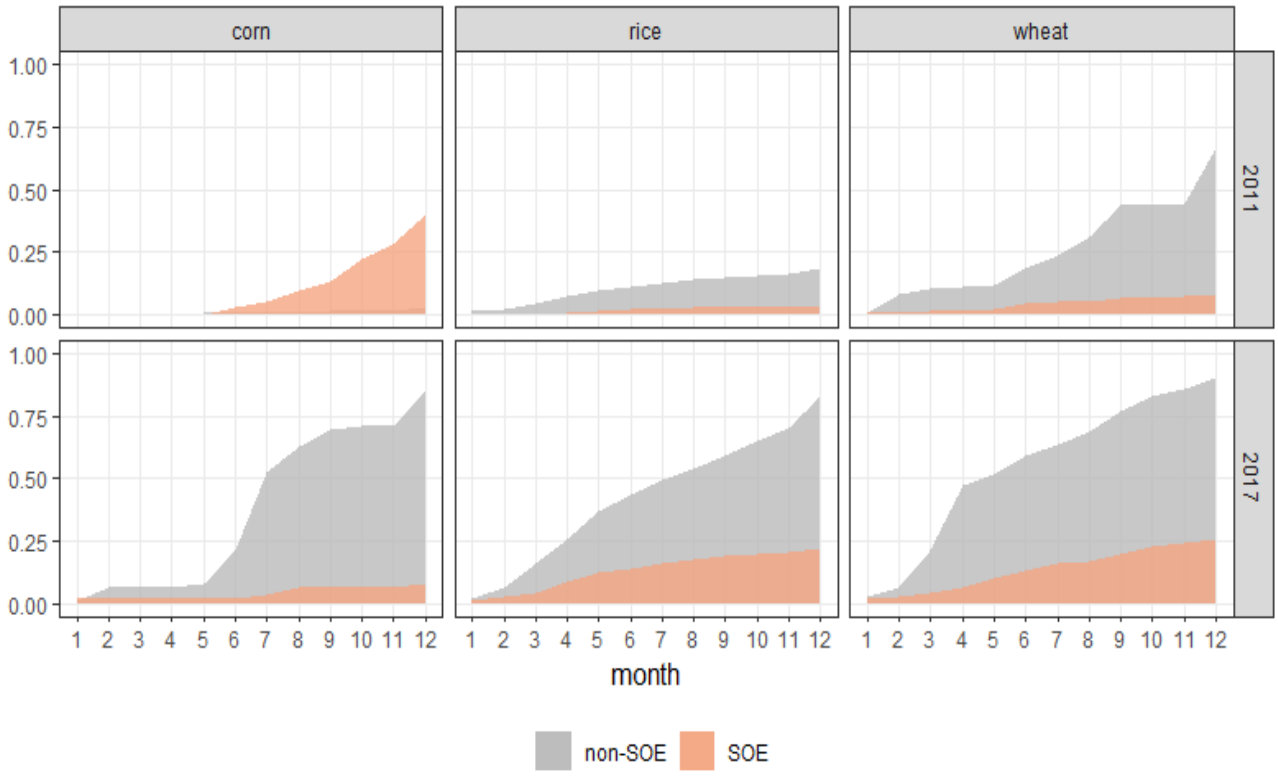
Year	COFCO SOE In-quota Imports (mmt)	Non-COFCO In-quota Imports (mmt)	Fill RATE (COFCO Portion)	Fill RATE (non-COFCO Portion)	Share of In-Quota COFCO Imports Sourced from US	Share of In-Quota Non-COFCO Imports Sourced from US	US Share of Global Exports
CORN	(1)	(2)	(3)	(4)	(7)	(8)	(9)
2012	3.934	1.325	0.91	0.46	0.95	0.90	0.26
2013	2.054	1.319	0.48	0.46	0.90	0.86	0.20
2014	0.184	2.390	0.04	0.83	0.06	0.39	0.28
2015	1.210	3.679	0.28	1.28	0.16	0.09	0.31
2016	0.773	2.476	0.18	0.86	0.07	0.07	0.37
2017	0.361	2.449	0.08	0.85	0.02	0.35	0.50
Avg. 2012-2017	2.511	1.070	0.29	1.11		0	0.267
WHEAT							
2012	2.667	1.096	0.31	1.14	0.07	0.44	0.16
2013	4.204	1.262	0.48	1.31	0.78	0.50	0.21
2014	1.540	1.373	0.18	1.43	0.31	0.24	0.14
2015	2.152	0.860	0.25	0.89	0.14	0.35	0.12
2016	2.251	0.958	0.26	0.99	0.16	0.45	0.13
2017	2.249	0.869	0.26	0.90	0.24	0.53	0.17

Notes: SOE Definition: COFCO and its subsidiaries; Commodity TRQ definition - only from Chapter 10 (excludes Chapter 11 - Flour (small China imports)).
Source: UN Comtrade and FAS Global Agricultural Trade System (GATS).

In terms of U.S. grain exports to China, the corn industry suffered significantly. The share of China's total SOE and non-SOE corn imports from the U.S. dropped from 95% and 90% in 2012 to 2% and 35% in 2017, respectively, compared to a 50% share of U.S. exports to the world. Conversely, China's demand for U.S. wheat by non-SOE firms remained strong. Specifically, 53% of non-SOE wheat imports were sourced from the U.S. in 2017, while U.S. wheat exports accounted for just 17% of global wheat exports.

Figure 6 presents monthly additions to the SOE and non-SOE fill rates for corn, rice and wheat in 2011 and 2017. SOE and non-SOE firms illustrate different patterns in China's cereal grain imports subject to TRQs. While non-SOEs cumulative fill rate increased over time, we observe substantial seasonality in this trend. In particular, non-SOEs import a significant amount of wheat in March and corn in June. On the other hand, imports conducted by COFCO and its subsidiaries appear to be smoother throughout the year. Additionally, in 2011, the corn fill rate on the state-trading portion is much higher than that of non-state trading portion. Thus, it appears that the import behavior of COFCO and its subsidiaries may be influenced by other factors.

Figure 6: Monthly SOE and Non-SOE Contributions to the Overall TRQ Fill Rate: A Comparison between 2011 and 2017



6.2 THE ROLE OF SOES IN CHINA'S TRQ GRAIN IMPORTS

Table 9 presents the results from estimation of equation (1) using China's firm-level annual data at the HS8-digit level to examine the share of SOE imports for each of the examined TRQ commodities. Columns (1)-(6) report results considering the full and alternative subsamples of the data. Columns (7)-(9) include a grain stocks/use ratio as an indicator of China's lagged food security levels. Column 1 considers the case where the share of wheat, corn, and rice imports by SOEs is contrasted with that of all other agricultural commodities. Using the full sample comprising most agricultural commodities, Column 1 shows that, on average, SOE import shares for wheat are 10.9% higher than those of SOE imports of agricultural commodities not subject to TRQs. SOE imports of corn and rice are also higher with rates of 5.74% and 2.7%, respectively. Column (2) considers the SOE import share for 2012-2016. During this more recent time period, the higher rate of wheat and corn SOE imports relative to other commodities not subject to TRQs are even more notable (18.7% and 7.6%, respectively). This suggests that the role of SOEs in

China's wheat and corn imports has increased in more recent years despite flat or declining fill rates. Results from both Column (1) and Column (2) reveal that rice imported by SOEs was not found to be significantly different than that of SOE imports of other commodities.

Although China sources TRQ commodities from over 30 countries, Column (3) (Table 9) considers the role of SOEs for the top five wheat and corn exporting countries (U.S., Canada, Australia, Brazil, and Ukraine). The table shows that the share of SOEs in China's wheat imports from the top five exporting countries is 22 percentage points higher than the average non-TRQ product sector and 20 percentage points higher in the case of corn imports. The mean SOE share in the top five exporting countries' non-TRQ commodity exports is 13%. Thus, the results in column (3) imply that for wheat and corn, the SOE share is responsible for approximately one-third (35% and 33%, respectively) of China's corn and wheat imports from these countries.

Table 9: SOE Import Results, TRQ and Non-TRQ Commodities

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Chapters 1-24 excluding 1,5,6,17,24			**Chapters 10-12**			**Chapter 10**		
	All	2012-2016	Top 5 exporters	All	2012-2017	Top 5 exporters	All	Low Stocks/Use years	2012-2016
WHEAT	10.91***	18.74***	22.66***	8.48***	15.92***	22.63***	25.15***	57.85***	65.35***
	(1.85)	(2.54)	(4.60)	(2.09)	(2.81)	(5.12)	(8.08)	(21.79)	(14.46)
CORN	5.74***	7.56***	19.99***	4.45***	6.69***	20.94***	17.82***	38.67**	41.03***
	(1.43)	(2.01)	(4.10)	(1.62)	(2.24)	(4.57)	(6.78)	(15.65)	(11.76)
RICE	2.7	-0.01	8.56	1.91	0.1	7.91	28.30***	49.24***	38.35***
	(2.03)	(2.70)	(6.17)	(2.31)	(2.99)	(6.87)	(5.82)	(13.90)	(9.94)
$stock/use_{k(t-1)}$	----	----	----	----	----	----	0.19	-0.56	-0.54*
	----	----	----	----	----	----	(0.15)	(0.59)	(0.29)
Observations	43,861	18,186	2,045	6,148	2,524	409	614	403	294
R-squared	0.097	0.093	0.175	0.153	0.144	0.267	0.315	0.345	0.445

Notes: dep. var. is the SOE share of imports from origin country o, commodity k and year t. Cluster robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 In column (8), we define years with food security level lower than the median level over the sample period as low food security years. Low food security years for wheat are: 2004, 2005, 2006, 2007, 2008, 2009, 2012; Low food security years for corn are: 2005, 2006, 2007, 2008, 2010, 2011, 2012; Low food security years for rice are: 2005, 2006, 2007, 2008, 2009, 2010, 2011.

The following Columns (4-6) examine imports relative to other grain and oilseeds products that are not subject to TRQs as the benchmark (HS chapters 10-12). With the exception of column (6), where the SOE share results in the top five exporting countries are consistent with column (3) on the full sample, the results suggest that the role of SOEs is 8 to 16 percentage points higher in wheat and 4 to 7 percentage points higher in corn compared to other non-TRQ grain and oilseed products.

Columns (7) through (9) add one period lag stocks/use ratio as an indicator of China's food security with respect to grain products in Chapter 10. The results are illuminating along several dimensions. First, the increased predictive power of the model is evidenced by the larger R^2 values, particularly in column (9), which considers more recent years (2012-2016). Second, column (8) considers only the subset of years with below-median lagged stocks/use ratios[45] and column (9) focuses exclusively on the post-transition period. In both regressions, the coefficient on the lagged food security indicator is negative, although it is only significant in the 2012-2016 period (column (9)) (Table 9). This suggests a negative correlation between SOE imports and

[45] We define years with food security levels lower than the median level over the sample period as low food security years. Low food security years for wheat are: 2004, 2005, 2006, 2007, 2008, 2009, 2012; Low food security years for corn are: 2005, 2006, 2007, 2008, 2010, 2011, 2012; Low food security years for rice are: 2005, 2006, 2007, 2008, 2009, 2010, 2011.

lagged stocks/use ratios. As China's grain reserves fall by 10%, for example, the SOE share of grain imports increases by 5.4%. Third, columns (8) and (9) depict significantly higher SOE shares in all three commodities compared to the full sample (columns (1)-(3)) or the subset of grains and oilseeds (columns (4)-(6)). In particular, when we compare the estimation results in column (5) to column (8), whose sample period only covers the years that food security indicators are lower than the median, the coefficients for wheat, corn, and rice increased over threefold for wheat and fivefold for corn. Moreover, the coefficient on rice becomes larger and statistically significant.

6.2 NON-SOE INTENSIVE AND EXTENSIVE MARGINS

Table 10 employs equation (1) and China's firm-level annual data at the HS8-digit level to compare non-SOEs' intensive and extensive margins (number firms per source country-commodity-year and source country-commodity-year imports per firm, respectively) between quota-bound and quota-free commodities. To ease the number of regression results reported, the estimation scenarios in Table 10 follow those of Table 9 but omit estimations on the subset of the top five exporting countries (U.S., Canada, Australia, Brazil, and Ukraine). Column (1) shows that cereal commodity imports subject to TRQs in China reduce firm participation by over four firms in corn and three firms in wheat. While the intensive margin results for wheat are generally insignificant, they are significant in the case of corn and rice, both economically and statistically. The results in column (1) (Table 10) suggest that per firm non-SOE corn imports are $-0.72 million lower than the average per firm non-SOE imports of non-TRQ commodities. This intensive margin reduction further increases (in absolute value) to $-0.78 million in column (2), which focuses exclusively on subset of the more recent years (2012-2016). If we focus on only the subset of TRQ and non-TRQ commodities in cereal grains and oilseeds (Chapters 10-12, Columns (3) and (4), Table 10) the results are again consistently negative for corn and the wheat extensive margin coefficient becomes statistically significant (-2.59 and -2.67 fewer firms).

The remaining columns (5-7) in Table 10 add lagged stocks/use ratio. It is important to note that these values are compared to other non-TRQ grain imports only within Chapter 10 and thus do not include soybeans or other oilseeds included in Chapter 12. Consistent with the previous results using the SOE share equation (1), the magnitude of the extensive and intensive margin results increases (in absolute value) and are particularly pronounced in low food security years (i.e., when stocks/use fall below median values). For example, the results in columns (7) suggest a considerable "compression" effect on (mostly) private non-SOE firms with reductions of nearly 17 firms in TRQ wheat imports, 11 firms in TRQ corn imports, and 15 firms in China's TRQ rice imports. Moreover, of the surviving non-SOEs, per firm imports see a considerable contraction in import values with per firm non-SOE wheat imports falling by $3.38 million, per firm non-SOE corn imports falling by $3.31 million, and per firm non-SOE rice imports falling by $4.12 million, on average.

These results lend support to the concerns raised by the Office of United States Trade Representative (USTR, 2018b) in the first written submission to the WTO – individual Chinese TRQ certificate allocations for wheat, corn, and rice may be too small to be commercially viable for private non-SOE firms. However, column (6) shows that the difference in intensive margins between quota-bound and quota-free commodities became insignificant after China's WTO transition period ended in 2011. This finding implies that, after China's WTO transition period, while the number of non-SOEs importing cereals is still less than those importing quota-free

Table 10: Non-SOE Intensive and Extensive Margin Results, TRQ and Non-TRQ Commodities

	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
	Chapters 1-24 excluding 1,5,6,17,24				**Chapters 10-12**				**Chapter 10**					
	All		2012-2016		All		2012-2016		All		2012-2016		Low Stocks/Use Year	
	EM	*IM*	*EM*	*IM*	*EM*	*IM*	*EM*	*IM*	*EM*	*IM*	*EM*	*IM*	*EM*	*IM*
WHEAT	-3.04**	-0.11	-1.81	-0.12	-2.59***	-0.1	-2.67**	-0.15	-5.63**	-1.19*	-19.88***	-0.06	-16.70***	-3.38*
	(1.53)	(0.20)	(3.22)	(0.34)	(0.59)	(0.50)	(1.14)	(0.86)	(2.24)	(0.70)	(4.70)	(1.46)	(3.68)	(1.93)
CORN	-4.36***	-0.72***	-3.54	-0.78***	-4.20***	-0.65*	-4.43***	-0.73	-1.48	-2.08***	-11.39***	-1.5	-11.39***	-3.31**
	(1.19)	(0.15)	(2.55)	(0.27)	(0.46)	(0.38)	(0.91)	(0.67)	(1.88)	(0.58)	(3.82)	(1.21)	(2.65)	(1.32)
RICE	-0.26	-0.66***	3.31	-0.68*	-0.83	-0.3	2.17*	-0.29	-5.70***	-2.49***	-14.58***	-1.33	-12.16***	-4.12***
	(1.68)	(0.22)	(3.42)	(0.36)	(0.65)	(0.55)	(1.22)	(0.89)	(1.62)	(0.50)	(3.23)	(1.04)	(2.35)	(1.17)
$STOCKS/USE_{k,(t-1)}$									0.12***	-0.02	0.44***	-0.04	0.37***	-0.02
									(0.04)	(0.01)	(0.09)	(0.03)	(0.10)	(0.05)
Observations	43,861	41,117	36,394	17,417	12,312	5,592	5,070	2,390	1,252	502	602	260	830	332
R2	0.091	0.041	0.09	0.042	0.137	0.111	0.16	0.116	0.266	0.326	0.633	0.365	0.282	0.327

Notes: EM dep. var. denotes the number of firms. IM dep. var. denotes per firm imports. Cluster robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

commodities, non-SOEs seem to be receiving more TRQ allocations than they used to. Finally, another important finding from Table 10 is that the number of non-SOE importers (extensive margin) participating in TRQ imports rises with higher values of the lagged food security indicator (columns 5-7). This seems to suggest that non-SOE firm participation in China's TRQ imports is an increasing (decreasing) function of more (less) cereal grain reserves.

Table 11 presents the DID results (equation (2)) for the end of the transition period and price differential impacts on non-SOEs' intensive and extensive margins using Chinese firms' monthly import data. Panel A reports the results on the full sample period (2007-2017), while Panel B focuses on the comparison between pre-transition low price differential period and post-transition high price differential period.[46] The results in both Panels are consistent. The DID results (interaction term between variables "TRQ" and "Post-Tran") show that non-SOEs' participation in global cereal markets increased by 8-9 firms in corn and 5-6 firms in wheat at the expenses of a decrease of firms' intensive margins. To put the figures into context, there were 74 and 37 Chinese non-SOE firms importing corn and wheat in 2013, respectively. In other words, the number of non-SOEs importing wheat and corn after the WTO transition period increased by over 10%. However, the rise in the number of non-SOEs is at the cost of average import volumes per firm. The average wheat and corn imports of non-SOEs declined 5-8.6 thousand metric tons (1000 mt) and 1.2-2.5 (1000 mt), respectively, after the transition period.

We can further compare the DID estimates between Panels A and B. The results show that non-SOE wheat importers are less sensitive to market signals relative to their non-TRQ commodity counterparts, whereas corn importers are more responsive to price differentials. This is because the difference of DID estimates for wheat (corn) between Panel B and A is negative (positive), which indicates the impact of price differential on the number of non-SOE wheat (corn) importers is lower (higher) than that on the number of non-SOEs importing non-TRQ commodities.

[46] We use Figure 5 to distinguish the low and high price differential periods before and after China's WTO transition period. For the analysis of Panel B in Table 11, we removed high price differential periods during the transition period and low price differential periods after the transition period from our sample.

Table 2: Non-SOE DID Results - End of Transition Period & Price Differentials

DID Estimation on the End of Transition Period (Chapter 10 Only)										
	Panel A: Full Sample Period						Panel B: High vs. Low Price Support Years Before and After the Transition Period			
	TRQ		Wheat		Corn		Corn		Wheat	
VARIABLES	EM	IM	EM	IM	EM	IM	EM	IM	EM	IM
Post-Tran	6.090***	6.120***	6.090***	6.120***	6.090***	6.120***	7.300***	7.385***	8.632***	8.855***
	(1.650)	(0.686)	(0.641)	(0.778)	(0.725)	(0.770)	(0.854)	(0.915)	(0.730)	(0.905)
TRQ	10.627***	-0.938	0.393	1.900	7.877***	-2.199*	7.421***	-2.086	0.393	1.900
	(1.905)	(0.748)	(1.109)	(1.303)	(1.255)	(1.198)	(1.479)	(1.419)	(1.095)	(1.326)
*TRQ*Post-Tran*	24.160***	-3.646***	5.943***	-5.111***	7.643***	-1.231	8.908***	-2.549	4.884***	-8.621***
	(2.694)	(1.041)	(1.569)	(1.772)	(1.775)	(1.688)	(2.092)	(1.996)	(1.788)	(2.059)
Observations	960	807	720	567	720	577	576	458	576	451
R-squared	0.343	0.130	0.200	0.100	0.306	0.130	0.324	0.158	0.273	0.180

Notes: EM dep. var. denotes the number of Chinese importing firms. IM dep. var. denotes imports per firm. Cluster robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

6.3 SEPTEMBER REALLOCATION IMPACT

In this final subsection, we use Chinese firms' monthly cereal imports over the 2007-2017 period and a DID framework (equation (2)) to examine the September reallocation effect. Table 12 presents the DID estimation results on SOEs import share (Panel A) and non-SOEs' extensive (Panel B) and intensive margins (Panel C). In each panel, we report two sets of estimation results. The first column of each panel (columns 1, 3, 5) presents the estimation results using the whole sample period (2007-2017), whereas the second column (columns 2, 4, 6) focuses on China's post transition period (2012-2017). Results in each panel are consistent. We find virtually no evidence of a statistically significant or economically plausible post-September increase in the SOE share, and perhaps more importantly, in the extensive (post 2012 sample) or intensive margins of non-SOE imports. Although not reported in Table 12, if we exclude rice from our analysis, the results remain consistent. In Table 12, the only instance where we find a marginally significant result on the DID estimate is in column (3) (full sample non-SOE extensive margin). Thus, if the purpose of China's September reallocation is to redistribute unused quota to benefit hundreds of non-SOE TRQ applicants that did not receive TRQ quota certificates at the start of the calendar year, or to bolster quota available to firms who did not receive their full initial request, we find very little evidence that this is occurring. In China's post-transition period (2012-2017), which coincides with the period in which USTR challenged China's TRQ administration for wheat, corn, and rice (USTR 2018), we find no compelling empirical evidence in Table 12 that favors the entry of non-SOE firms nor the intensity of their per firm imports after the September reallocation.

Table 3: DID Results - September Reallocation

	Panel A: SOE Share		Panel B: Non-SOE Extensive Margin		Panel C: Non-SOE Intensive Margin	
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	All	2012-2017	All	2012-2017	All	2012-2017
Post-Sep.	0.03	1.16	-0.38	-0.67	-0.07	-0.00
	(2.69)	(3.70)	(2.41)	(3.76)	(0.88)	(1.35)
TRQ quota	28.61***	24.83***	-18.34***	-28.96***	-3.65***	-5.12***
	(2.03)	(2.84)	(1.82)	(2.89)	(0.67)	(1.03)
DID	-5.58	-5.67	6.86*	8.99	-0.59	-1.16
	(4.08)	(5.67)	(3.66)	(5.75)	(1.34)	(2.05)
Observations	893	503	893	503	888	501
R-squared	0.214	0.155	0.157	0.243	0.047	0.070

Notes: Cluster robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 All refers to the full sample period from 2007 to 2017. For the low

7. CONCLUSIONS

The trade statistics are well known – China has become the world's largest agricultural importing country. The management of certain commodities in China's agricultural imports, however, has been criticized since China's accession to the WTO in 2001. In particular, the administration of China's cereal grain TRQs has sparked a number of specific trade concerns among major cereal

grain exporters. Yet detailed knowledge of key factors influencing Chinese grain TRQ allocations, and to what extent Chinese TRQ policies promote China's grain imports among state- and non-state-owned firms, remain unexplored.

This article employed two unique Chinese trade transaction datasets at firm-level to shed new light on the role of SOE and non-SOE firm imports of cereal grain commodities subject to TRQs. Several important findings emerge from our analyses. First, SOE import shares of quota-bound commodities are significantly higher than those of quota-free commodities. In particular, when we restrict our sample to cereal grain imports in Chapter 10, we observe significantly higher SOE shares in all three quota-bound commodities compared to the full sample. Second, we find that the larger role of SOEs in China's grain imports are negatively correlated with the lagged stocks/use ratio as an indicator of China's food security status in cereal grains. As China's grain reserves as a percentage of use fall by 10 percentage points, the SOE share of grain imports increases by 5.4 percentage points. Third, higher food security levels in China's cereal grains lead to an extensive margin adjustment of non-SOE import participation as opposed to other market forces. Finally, we find very little evidence that China's September reallocation of unused TRQ quota has any economic impact on non-SOE entry into importing or the intensity with which their imports occur.

The first three findings suggest that China's TRQ administration and its TRQ policy, which stipulates significant market share for state-owned firms, may act as an important barrier to the sourcing of imports of non-SOE firms from the global market, particularly when it is profitable to do so. As documented by Bernard, Jensen and Schott (2009) and Manova and Zhang (2012), non-SOEs tend to have higher productivity compared to SOEs, and policies that distort the efficient allocation of TRQs may prevent productivity gains in specific sectors such as cereal grains that are highly demanded inputs in food processing and livestock feed.

We used the SOE import share as a potential misallocation indicator. However, it is important to note that Chinese government authorities may not wish to allocate the quota to maximize productive efficiency among the heterogeneous mix of SOE and non-SOE firms. Rather, Chinese governments may choose to allocate the quota evenly across provinces so as to not appear to be favoring one municipality with large feed and processing firms over other municipalities that have a larger proportion of smaller firms. However, given the relatively low quota fill rates coupled with significant demand for TRQ certificates by non-SOEs (over 2000 applicants for cereal TRQ certificates each year from 2015-2017), our results suggest that there is perhaps a better distributional allocation of TRQ quota and a more efficient September reallocation that would allow for greater participation of non-SOE firms and potentially higher fill rates that align with market demand. Taken together, our results suggest that, counter to China's WTO commitments, non-market forces may be unduly affecting the administration of this program.

As of this writing, the WTO dispute over China's TRQ Administration (DS517) remains in compliance proceedings, with the U.S. requesting the WTO to suspend concessions against China in retaliation for China's failure to comply with the 2019 ruling that its rice, wheat and corn TRQ allocation is not consistent with its WTO commitments. While the U.S. and China continue to spar over TRQs, this report provided a comprehensive overview of China's TRQ administration and empirical evidence on the impact of TRQs on China's firm-level imports.

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