Non-Tariff Barriers in the U.S.-China Trade War[*]

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Abstract

We use Chinese customs data to show that unofficial non-tariff barriers were responsible for 50% of the overall reduction in Chinese imports from the U.S. during the height of the U.S.-China trade war in 2018 and 2019. We infer non-tariff barriers from the change in imports of U.S. products relative to imports from other countries of the same HS6 product, after controlling for the change in the relative price of U.S. imports to the same product sold by other countries. Non-tariff barriers were imposed on a small number of agricultural products, did not apply to state-owned importers, and were larger for products with a high share of state importers in total imports. Non-tariff barriers were responsible for more than 90% of the welfare cost to Chinese consumers of the U.S.-China trade war. The welfare loss to China from a given reduction in imports from the U.S. from non-tariff barriers is about six times larger than an equivalent import decline due to higher tariffs. Non-tariff barriers are more costly compared to tariffs because they apply to some importers and not others, which results in misallocation, and because non-tariff barriers do not generate revenues.

1 Introduction

In 2018 and 2019, trade between China and the U.S. collapsed as the two countries raised tariffs on products from each other. In January 2020, in an effort to end their deepening trade war, China agreed to purchase more U.S. products in 2020 and 2021, and U.S. exports to China increased by 46% in these two years.[1] The agreement was specific in the amounts and products that China had to buy, but it did not stipulate that China had to lower tariffs on American products, and China did not lower the tariffs imposed in 2018 and 2019.

But how exactly did U.S. exports to China increase by almost 50% in these two years with no reductions in Chinese tariffs? The answer is that higher U.S. exports to China could not have come from lower tariffs but rather from the use of opaque regulatory measures that, this time, favored U.S. exporters. For example, Chinese authorities could have forced some importers to purchase more American goods.

Although much of the focus has been on the tariff hikes in 2018 and 2019, there is some evidence that China used similar opaque mechanisms in these two years, albeit to stifle U.S. exports to China. For example, on April 24, 2018, Chinese authorities announced that new permits were required to sell U.S. pet food in online stores.[2] On May 3, 2018, health officials announced that imports of U.S. apples and lumber were to be inspected for "dangerous pests." And on October 26, 2018, officials of the Agriculture Ministry announced that the formula for pig feed was to change from 20% soybeans to only 12%.[3] Figure 1 (left panel) plots the number of news articles on the use of non-tariff barriers in China and shows the spike in such news reports in late 2018 and early 2019.[4]

The right panel in Figure 1 shows an alternative measure of the use of non-tariff barriers faced by U.S. imports from the Global Trade Trade Alert (GTA) project.[5] The figure shows the share of U.S. products sold in China subject to the non-tariff barriers documented by the Global Trade Alert database. This data shows that the share of U.S. imports subject to non-tariff barriers increased from 10% in 2017 to almost 23% in 2019.

However, it is likely that such measures only capture a small fraction of the non-tariff barriers that were used. In particular, these barriers were designed to be opaque during the U.S.-China trade war, partly to provide plausible deniability to the Chinese authorities, and are thus hard to measure directly. For example, the non-tariff barriers faced by U.S. soybeans in China in 2018 and 2019 do not show up in the Global Trade Alert database, as the regulatory changes on pig feed

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[1]See Bown (2020) for details of the Phase 1 trade deal. U.S. exports to China in 2019 were $123 billion.

[2]See website of the U.S.-China Business Council https://www.uschina.org/industry-update/ecommerce/ecommerce-industry-update-may-17-2018.

[3]Source: The website of the Chinese customs agency, http://guangzhou.customs.gov.cn/urumqi_customs/jyjy123/1716490/1716446/1843299/index.html, and a government report, http://www.gov.cn/xinwen/2018-10/28/content_5335169.htm.

[4]We use the within-site search function of Google to search for the key words "US, China, trade war, non-tariff" in 40 mainstream English language newspapers. The list of newspapers is in Appendix Table A1.

[5]The Global Trade Alert database uses official documents to identify projects subject to non-tariff barriers. Trade Concerns is another such database that compiles concerns raised by WTO members to document these barriers. See Evenett (2014) and Fontagné et al. (2015).

Figure 1: Public Reports on Non-Tariff Barriers on U.S. Exports to China
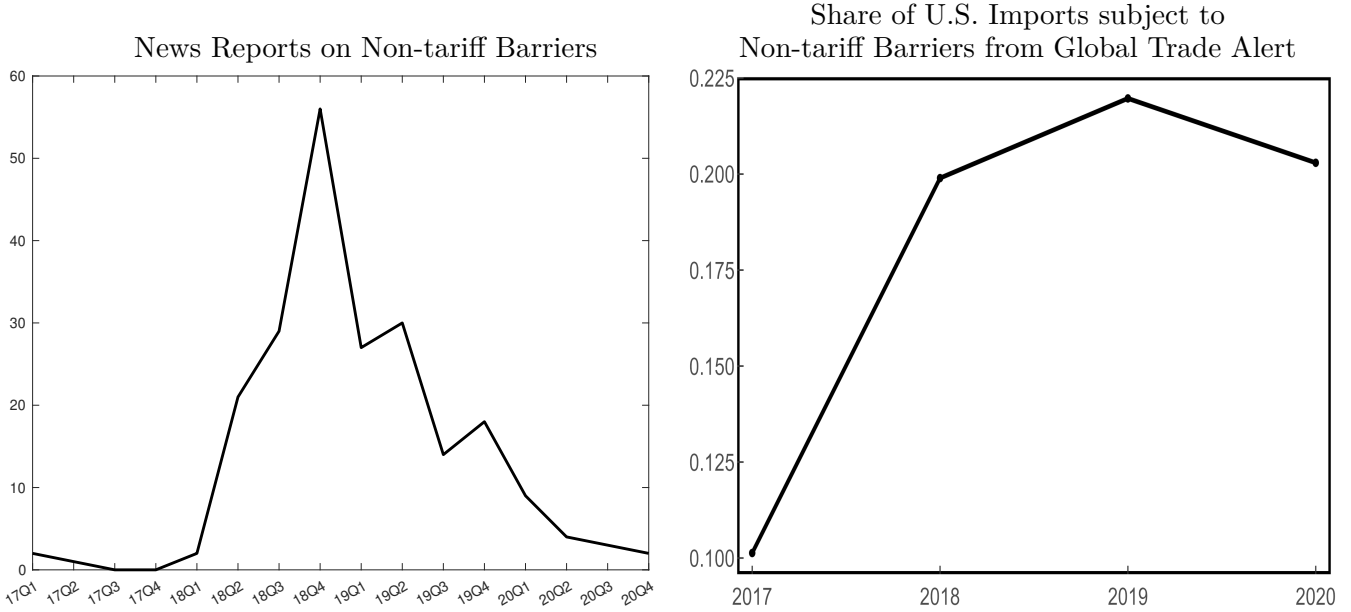
Note: The left panel plots the number of news articles on the use of non-tariff barriers on U.S. exports to China in 40 English newspaper websites in each quarter. The right panel shows U.S. exports to China subject to non-tariff barriers, as measured by the Global Trade Alert dataset on non-tariff barriers, as a share of total U.S. exports to China.

do not explicitly mention soybeans from the U.S. (or imports for that matter). In addition, news reports and lists of industries subject to non-tariff barriers do not quantify the magnitude of such barriers.

We take a different approach. Instead of measuring non-tariff barriers directly, we try to infer such barriers from the change in U.S. exports to China relative to exports from other countries to China in narrowly defined product categories.

We proceed in two steps. First, we estimate import demand and export supply curves for agriculture and manufacturing goods, defined as an HS6 product-country pair, using the increase in tariffs on U.S. imports in 2018 and 2019 relative to imports from other countries as instruments for the demand and supply curves. We estimate the elasticity of substitution across HS6 product-country pairs on the demand side of 3.0 for agricultural products and 2.0 for manufactured products. On the supply side, our estimates suggest that foreign export supply curves are essentially horizontal.

Second, we infer non-tariff barriers on U.S. imports of a given HS6 product as the change in U.S. imports relative to imports from other countries for that product, after using the estimated demand elasticity to control for the effect of tariffs.

We report the four main findings.

First, non-tariff barriers on U.S. imports increased by an average of 56 percentage points (in tariff equivalent units) for agricultural products and by 17 percentage points for manufactured products between 2017 and 2019. For comparison, average tariffs on U.S. products in China increased by 17 and 9 percentage points for agricultural and manufactured products, respectively.

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Second, the use of non-tariff barriers was also much more targeted toward specific products compared to the tariffs. For example, our estimates suggest that the tariff equivalent of non-tariff barriers increased by almost 300 percentage points in 2018 and 2019 for the HS-2 categories "oil-seeds (to which soybeans belong)," "cereals," and "ores, slag and ash." More generally, we find that non-tariff barriers increased by more for agriculture products in which the U.S. has a larger share in Chinese imports of the product.

Third, non-tariff barriers increased primarily for non-state importers of U.S. agricultural products, whereas non-tariff barriers faced by state-owned importers were roughly unchanged. Moreover, the increase in non-tariff barriers facing non-state importers is larger in sectors with a larger share of state importers before the trade war, indicating that the government cares more about state importers.

Fourth, the increase in non-tariff barriers in 2018 and 2019 for agricultural products was partially reversed in 2020, after China agreed to increase purchases of U.S. goods in early 2020. For manufactured products, we see no evidence that the increase in non-tariff barriers in 2018 and 2019 was reversed in 2020.

Finally, we estimate the effect of non-tariff barriers and tariffs on Chinese welfare in a model that accounts for the reallocation of expenditures across source countries for a given HS6 product and across HS6 products, but not between imported and Chinese products. In this framework, higher tariffs on U.S. products lower Chinese welfare via their effect on the dispersion of consumer prices across source countries and products. In contrast, higher non-tariff barriers affect Chinese welfare via their effect on the mean and the dispersion of consumer prices for imported products across source countries and products. This is the well known distinction between tariffs and trade barriers that take the form of non-tariff barriers. The other distinction between tariffs and non-tariff barriers in our context is that non-tariff barriers, perhaps because of their opaque and unofficial nature, do not have to apply uniformly to all importers.

Using this framework, we find that about half of the overall decline in U.S. exports to China between 2017 and 2019 was due to higher tariffs and the other half due to higher non-tariff barriers. However, the vast majority of the welfare loss incurred by China from the trade war was due to non-tariff barriers rather than tariffs. Specifically, we find that China's welfare in 2019 is 38 billion US$ lower compared to 2017 due to the hike in trade barriers in 2018 and 2019, and 93% of the welfare loss was due to higher non-tariff barriers imposed in 2018 and 2019.

Compared to tariffs, there are three features of non-tariff barriers that make them particularly costly. First is the standard revenue loss from non-tariff barriers compared to tariffs. Second, the dispersion across products in non-tariff barriers is larger than that of tariffs faced by U.S. products in China. Third is the differential non-tariff barriers faced by state vs. non-state importers. The first channel contributes to 8.7% of total welfare loss from higher trade barriers in 2018 and 2019, the second channel 70.1%, and the third channel 13.4%, compared to 7.8% resulting from higher tariffs.

Our paper builds on Amiti et al. (2019), Fajgelbaum et al. (2019), Waugh (2019), Flaaen et al. (2020), and Cavallo et al. (2021) who study the effect of the U.S.-China trade war. In particular, we

borrow Fajgelbaum et al. (2019)'s procedure to estimate demand and supply elasticities of American exports to China. We also find, as they do, that export supply curves are essentially elastic so the cost of the trade barriers are entirely borne by consumers. We differ from these papers in that we examine the effect of trade barriers to American exports on Chinese consumers, and we focus on the use of non-tariff barriers in addition to tariffs.[6]

Our paper also contributes to the measurement of non-tariff barriers. Our model-based estimates of such barriers complement the existing measures of such barriers based on explicit policy measures (see, e.g., Fontagné et al. (2015)). Methodologically, our paper is closely related to Kee et al. (2009), which also employs a residual approach to back out non-tariff measures. Our paper differs in that we use a structural model, which allows us to measure the welfare effect of non-tariff barriers.

Our paper also builds on Khandelwal et al. (2013)'s important paper that examines the effect of *export* quotas allocated to Chinese state owned firms. Our paper examines the effect of non-tariff barriers facing non-state vs. state-owned *importers*. And as in Khandelwal et al. (2013), our point is that the efficiency costs of non-tariff barriers can be large if such barriers apply to some firms and not to others.

Finally, Ma et al. (2021) and Liu (2020) also use Chinese customs data to show that Chinese imports dropped significantly in products where China increased tariffs on these products. Using high-frequency night lights data and measures of the trade exposure of fine grid locations, Chor and Li (2021) find that a one-percentage-point increase in exposure to the U.S. tariffs led to a 0.6% reduction in night-time luminosity. Chang et al. (2020) quantify the welfare cost of higher tariffs on Chinese welfare. Our focus is on non-tariff barriers, which we argue was the main instrument used by China in the trade war.

The paper proceeds as follows. First, we discuss the data and present preliminary facts that are suggestive of the presence of non-tariff barriers. We then propose a theoretical framework to measure the effect of non-tariff barriers (as well as tariffs). The next section then uses the theoretical framework to impute the change in non-tariff barriers between 2017 and 2020. We then use the estimates of non-tariff barriers and quantify their effect (as well as the effect of tariffs) on welfare. We provide several external validity checks in the next section. The last section concludes.

2 Data and Facts

We use the administrative data from China's customs agency from 2015 to July 2020.[7] The data is at the transaction level, with information on the importer's ownership and location, source country, quantity, *cif* price, and the HS6 code of the imported product. Individual importers are not identifiable. We can only distinguish imports of state- and non-state-owned importers. To

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[6]Flaaen and Pierce (2019), Amiti et al. (2020), Handley et al. (2020), and Goswami (2020) investigate the effect of the trade war on the supply side of the U.S. economy.

[7]The data can be accessed on-site at the Tsinghua Data Center. See http://www.tcdc.sem.tsinghua.edu.cn/ for instructions on accessing the data.

make the observations in 2020 comparable to the earlier ones, we only use the monthly data from January to July in each year and aggregate the monthly data over these seven months in each year.

The tariff data is constructed in two steps. First, we get the MFN tariff data from the World Trade Organization. Then we add the tariff raised in the trade war against the U.S., starting on 04/02/2018 and ending on 12/26/2020.[8] We calculate the annual average tariff as the weighted average over the year of the tariff at each date of the year.[9] We then merge the tariff data with the customs data using HS 2012 system.[10]

Our final dataset has the annual total quantities of each HS6 product (946 in total) by source country and by state-owned and non-stated-owned importers from 2015 to 2020, and the average tariff rate and imputed *cif* price (the ratio of import value to quantity) of each HS6 product-source country in the year.

Table 1 shows the weighted average level of Chinese tariffs on U.S. goods and the U.S. share of Chinese imports from 2015 to 2020.[11] During the period of the trade war from 2017 to 2019, tariffs on U.S. products increased and the share of U.S. imports fell, with a larger effect on agricultural products compared to manufactured products.[12] In 2020, during the first year of phase 1 of the trade agreement signed in January 2020, the average U.S. share of Chinese agricultural imports increased from an 13.7% to 17.2%, without any reduction in Chinese tariffs on imports of these products from the U.S. Table 1 also shows that there was no increase in the U.S. share of Chinese imports in manufacturing in 2020, and no change in tariffs on U.S. manufacturing goods.

The fact that the U.S. share of agricultural imports in China increased in 2020, despite no decrease in tariffs, suggests that non-tariff mechanisms were used to increase purchases of U.S. agricultural products in 2020. We now probe for evidence that non-tariff mechanisms were also used during the trade war in 2017-2019. Figure 2 plots the residuals of the U.S. from a regression of the change in log import quantities for each source country and HS6 product pair on the change in tariffs, with fixed effects for each HS6 product interacted with year. The left panel shows the distribution of residual import growth between 2015-2017 and 2017-2019 for agriculture; the right panel shows the same for manufactured products.

The figure shows that the distribution of residual growth of import quantities from the U.S. shifted to the left between 2017 and 2019. Moreover, the dispersion of the residual import growth of the products from the U.S. also widens considerably; the variance of the growth rate of the agricultural (manufacturing) goods increased from 0.27 (0.50) between 2015-2017 to 0.58 (1.21)

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[8]We compile the list of Chinese tariffs on U.S. products from the official documents released by the Customs Tariff Commission of the State Council between 2018 and 2020. The specific documents with the official announcement of tariffs are 2018 Document No. 5 to 8, 10, and 13; 2019 Document No. 1 to 8; 2020 Document No. 1, 3, 4, 8, and 10.

[9]For example, the tariff on U.S. beans was increased by 25% on 07/06/2018 and stayed at the same level until 2020. We impute the average tariff on U.S. beans as $25\% \times \frac{179}{365}$ in 2018 and 25% in 2019 and 2020.

[10]We use the concordance between HS 2012, HS 2017, and SITC 4 from https://unstats.un.org/unsd/trade/classifications/correspondence-tables.asp.

[11]Unless otherwise indicated, we use the expenditure share of the HS6 product in 2017 as the weight.

[12]There was essentially no change in Chinese tariffs on the other countries over the same period. 60% of HS6 products imported from a non-U.S. source country (weighted by the 2017 import share of the product-country pair) did not experience any tariff change; the equivalent number for U.S. products is 17%.

Table 1: U.S. Tariffs and Import Share

	2015	2017	2019	2020
Agriculture				
Average Tariff rate	7.6%	7.5%	24.5%	26.0%
Average U.S. import share	20.7%	21.7%	13.7%	17.2%
Manufacturing				
Average Tariff rate	5.2%	5.6%	14.6%	14.8%
Average U.S. import share	10.5%	9.5%	8.4%	7.4%

Notes: Table shows the weighted average tariff rate of each HS6 product and imports from the U.S. as a share of total Chinese imports of the product for agricultural (top panel) and manufacturing products (bottom panel). Weights are the share of imports on the HS6 product in total imports in 2017.

Figure 2: Distribution of import growth residuals (controlling for tariff change) for U.S. products

Δ log Residual Import Quantities (controlling for tariff change) from the U.S.
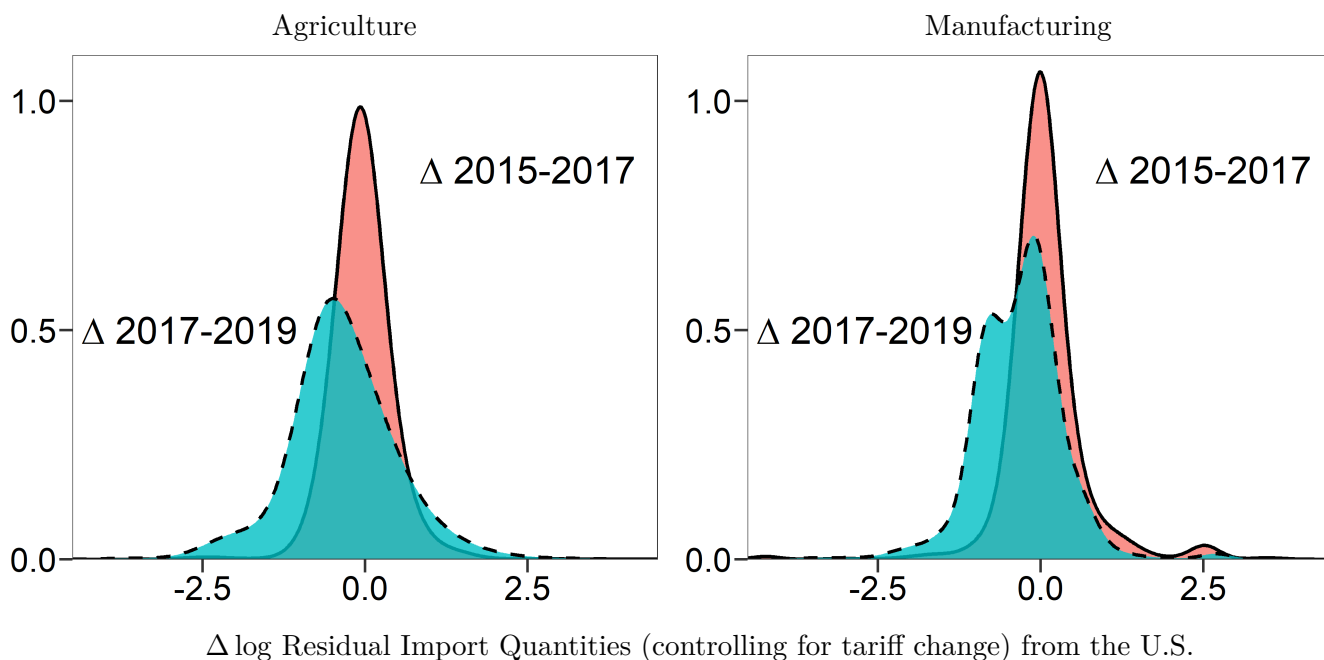
Notes: Observation is HS6 product. The left panel plots the distribution of growth rate between 2015-2017 and 2017-2019 of import quantities of U.S. agricultural goods after controlling for the changes in the tariff rate. The right panel plots the distribution of the growth rate between 2015-2017 and 2017-2019 of import quantities of U.S. manufacturing goods after controlling for the changes in the tariff rate.

between 2017-2019.

The dispersion in Figure 2 reflects differences in residual import growth across HS6 products. Table 2 probes for evidence of heterogeneity across state vs. non-state importers in the decline of U.S. imports. The table shows the weighted average of the share of state-owned firms in total

imports, separately for U.S. products and for products from the rest of the world. The top panel shows the state share of agricultural imports, and the bottom panel for manufacturing imports. The share of state-owners in agricultural imports from the U.S. roughly doubled in 2019 before falling to the "normal" share of about 20%. As for imports of manufactured products from the U.S., the state share declines gradually over this period. The table also shows that the share of state-owners in imports from the rest of the world (non-U.S.) did not change over this period.

Table 2: Share of Imports by State-Owned Firms

	2015	2017	2019	2020
Agriculture				
U.S.	24.0%	19.3%	39.8%	19.8%
Rest of World	21.5%	19.8%	21.4%	21.3%
Manufacturing				
U.S.	20.4%	16.2%	11.5%	10.5%
Rest of World	13.1%	13.7%	15.0%	15.4%

Notes: Table shows the weighted average of the share of state-owned firms in total imports in each HS6 product for agricultural products (top panel) and manufactured products (bottom panel) from the U.S. and the rest of the world (excluding the U.S.).

3   Welfare Effect of a Trade War

In this section, we lay out a simple model to illustrate how tariffs and non-tariff barriers affect welfare.

Utility of a representative consumer from imports is given by:

$$\text{Utility} = \left(\sum_i C_i^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \tag{1}$$

where i is an HS6 product, σ is the elasticity of substitution between HS6 products, and C_i is aggregate consumption of product i defined as:

$$C_i = \left(\sum_f C_{if}^{\frac{\epsilon-1}{\epsilon}} \right)^{\frac{\epsilon}{\epsilon-1}} \tag{2}$$

where f is a country selling in the Chinese market, ϵ is the elasticity of substitution between imports of a given product across source countries, and C_{if} denotes consumption of product i using imports from country f defined as:

$$C_{if} = \left(\sum_j \left(b_{if}^j C_{if}^j \right)^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}} \tag{3}$$

where j indexes a local firm that converts imports of product i from country f to C_{if}^{j}, η is the elasticity of substitution between local firms that use the same imports, and b_{if}^{j} is a time-invariant preference parameter. We implicitly assume that trade barriers on a given country affect the allocation of expenditures across the foreign countries that sell to China, but have no effect on the allocations between foreign and domestic products.[13]

The *shadow* price of product i from country f faced by firm j is:

$$\text{Shadow Price}_{if}^{j} = \left(1 + \phi_{if}^{j}\right)\left(1 + \tau_{if}\right) p_{if} \tag{4}$$

where τ_{if} is the ad-valorem tariff, ϕ_{if}^{j} is the tariff-equivalent of the non-tariff barriers, and p_{if} is the *cif* price given by:

$$p_{if} = \tilde{p}_{if} \left(\sum_{j} C_{if}^{j}\right)^{\frac{1}{\gamma}} \tag{5}$$

where $\tilde{p}_{if}$ is the vertical intercept of the foreign supply curve and γ is the supply elasticity. We assume that all firms pay the same tariff rate τ_{if} but non-tariff barriers can be applied differently across importing firms so ϕ_{if}^{f} is also indexed by firm j.

Finally, we assume that tariff revenues are rebated to the consumer. This assumption, combined with the demand functions implied by equations 1-3 and the shadow price in equation 4, yields the following expression for indirect utility V:

$$V = \left(\sum_{i}\left[\sum_{f}\left(\sum_{j}\left[b_{if}^{j}\frac{(1+\bar{\tau})}{(1+\phi_{if}^{j})(1+\tau_{if})\,p_{if}}\right]^{\eta-1}\right)^{\frac{\epsilon-1}{\eta-1}}\right]^{\frac{\sigma-1}{\epsilon-1}}\right)^{\frac{1}{\sigma-1}} \tag{6}$$

where p_{if} is given by equation 5, $\bar{\tau}$ is the weighted average of τ_{if} across products and countries.[14]

Trade policy then affects welfare via three channels. First, tariffs affect welfare through the *dispersion* of τ_{if} across source country f, with an elasticity that depends on ϵ, and via the dispersion of the average tariff rate across HS6 products, with an elasticity that depends on σ. Changes in tariffs that only affect $\bar{\tau}$ and that do not change the dispersion of tariff rates have no effect on welfare.

Second, non-tariff barriers that affect all firms equally affects welfare through the dispersion *and* the mean of ϕ. The welfare effect of non-tariff barriers differs from tariffs only because the tariff revenues are rebated to the consumer, whereas the lost revenues from the non-tariff barriers are not. This is the well-known distinction between tariffs and non-tariff barriers.

Third, a feature of non-tariff barriers, at least as practiced by China during the trade war with the U.S., is that these barriers were not publicly disclosed. This "secrecy" may imply that these barriers were not uniformly implemented. To the extent non-tariff barriers applied with more force

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[13]We relax this assumption in Section 5.1.

[14]$1 + \bar{\tau} \equiv \left(\sum_{i}\frac{F_i}{F}\left(\sum_{f}b_{if}^{j}(1+\tau_{if})^{1-\varepsilon}\right)^{\frac{\sigma-1}{\varepsilon-1}}\right)^{\frac{1}{1-\sigma}}$, where F_i is the number of countries that sell product i in China and F is the sum of F_i across all products i. Equation 6 also normalizes aggregate nominal expenditures to 1.

to some firms compared to other firms, their welfare effect will also depend on the dispersion of ϕ across *firms* and the elasticity η.

4   Estimates of Model Parameters and Non-Tariff Barriers

The model is summarized by three forcing variables (τ_{if}, ϕ_{if}^n, and ϕ_{if}^s) and four parameters (ϵ, η, σ, and γ). The three forcing variables vary by country-HS6 product. We assume that the four parameters vary by agriculture and manufacturing but otherwise are the same for all HS6 products.

4.1   Inferring Non-Tariff Barriers from Trade Data

In this section, we show how, conditional on estimates of the model parameters ϵ, η, and σ, we estimate the change in non-tariff barriers ϕ from data on trade. We proceed in three steps.

We first back out the ratio of non-tariff barriers of non-state vs. state importers. We use the change in the import quantities of a *product-country* pair by non-state vs. state importers:

$$\Delta \log \left(\frac{C_{if}^s}{C_{if}^n} \right) = - \eta \, \Delta \log \left(\frac{1 + \phi_{if}^s}{1 + \phi_{if}^n} \right) \tag{7}$$

Conditional on an estimate of η, equation 7 yields the ratio of non-tariff barriers of non-state vs. state importers for each product-country pair.

Next we infer the ratio of non-tariff barriers of a given country relative to another country. We use the change in imports of a *product-firm* pair from a given country f relative to another country g:

$$\Delta \log \left(\frac{C_{if}^j}{C_{ig}^j} \right) = \left(1 - \frac{\eta}{\epsilon} \right) \Delta \log \left(\frac{C_{if}}{C_{ig}} \right) - \eta \, \Delta \log \left(\frac{p_{if}}{p_{ig}} \cdot \frac{1 + \tau_{if}}{1 + \tau_{ig}} \right) - \eta \, \Delta \log \left(\frac{1 + \phi_{if}^j}{1 + \phi_{ig}^j} \right) \tag{8}$$

The first term is the ratio of aggregate consumption of product i from country f relative to country g; the second term is change in the ratio of the *cif* price and tariffs of the product from country f relative to country g. The third term is the ratio of non-tariff barriers of the product-firm of country f relative to country g. The contribution of the first two terms can be measured empirically (conditional on a value of η and ϵ), so the ratio of non-tariff barriers of country f relative to country g of a given product-firm pair can inferred from the residual from equation 8.

Third, we infer the ratio of non-tariff barriers of a product relative to another product. We use the change in import quantities of a *firm-country* pair of a given product i relative to another product h:

$$\begin{aligned}
\Delta \log \left(\frac{C_{if}^j}{C_{hf}^j} \right) = {} & \left(\frac{\eta}{\epsilon} - \frac{\eta}{\sigma} \right) \Delta \log \left(\frac{C_i}{C_h} \right) + \left(1 - \frac{\eta}{\epsilon} \right) \Delta \log \left(\frac{C_{if}}{C_{hf}} \right) - \eta \, \Delta \log \left(\frac{p_{if}}{p_{hf}} \frac{1 + \tau_{if}}{1 + \tau_{hf}} \right) \\
& - \eta \, \Delta \log \left(\frac{1 + \phi_{if}^j}{1 + \phi_{hf}^j} \right)
\end{aligned} \tag{9}$$

Here, assuming we know η, ϵ, and σ, we can measure the first three terms on the right hand side of equation 9. The last term, which is the change in non-tariff barriers of product i relative to product h of a given firm-country pair, can be measured as the residual from equation 9.

Finally, we normalize the average change in non-tariff barriers facing all importers on all goods from all countries except the U.S. to zero.[15] This normalization, along with the residuals from equations 7-9, yields the change in the non-tariff barriers for each product i, country f, and firm-type j.

4.2 Model Parameters

We need estimates of ϵ, η, σ, and γ to implement equations 7-9. We start with the supply elasticity γ and the elasticity of demand for imports of the same product between source countries ϵ. After substituting equations 4 and 5 into the CES demand implied by the preferences in equation 3, the change in import demand and *cif* price of product i from country f are given by:

$$\Delta \log C_{if} = -\frac{\epsilon\,\gamma}{\epsilon+\gamma}\Big[\Delta \log\big(1+\tau_{if}\big) + \Delta \log\big(1+\bar{\phi}_{if}\big) + \Delta \log\widetilde{p}_{if}\Big] + FEs \tag{10}$$

$$\Delta \log p_{if} = -\frac{\epsilon}{\epsilon+\gamma}\Big[\Delta \log\big(1+\tau_{if}\big) + \Delta \log\big(1+\bar{\phi}_{if}\big)\Big] + \frac{\gamma}{\epsilon+\gamma}\Delta \log\widetilde{p}_{if} + FEs \tag{11}$$

where C_{if} is total import quantities of product i from country f, $\bar{\phi}_{if}$ is a weighted average of the non-tariff barriers on the corresponding imports, and FEs includes year, product and source country fixed effects.[16] Under the assumption that the change in tariffs is orthogonal to the change in non-tariff barriers and supply shifts, we can use the variation in the change in import quantities and tariffs across source countries of a given product to estimate the demand and supply elasticities.[17] Specifically, a regression of Δ log import quantity on Δ log tariff with product-country fixed effects yields a coefficient of $-\frac{\epsilon\gamma}{\epsilon+\gamma}$ on the change in tariffs. A similar regression of Δ log *cif* price on Δ log tariff yields a coefficient of $-\frac{\epsilon}{\epsilon+\gamma}$.

The first two rows in the top panel in Table 3 show the estimates from the regressions at the product-country level of the change in import quantities (equation 10) and the change in the *cif* price (equation 11) on the change in tariffs. In the estimates shown in the first column, we pool annual data from 2015 to 2019 for all agricultural products from all countries, and show the coefficient on the change in tariffs in equation 10 (row 1) and equation 11 (row 2). The second column does the same for the sample of manufactured products from 2015 to 2019.

The first row in Table 3 shows that, as expected, import quantities from a given source country fall when the tariff rate on imports from the country increases. The elasticity of import quantities with respect to tariffs is -3.0 for agriculture and about -2.0 for manufacturing. The second row shows that the *cif* import price change is uncorrelated with the tariff change, suggesting that the incidence of higher Chinese tariffs are entirely borne by the Chinese.

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[15]We will also show that our results are robust to different normalizations.

[16]$1 + \overline{\phi}_{if} \equiv M_{if}^{-1}\big(\sum_j b_{if}^j(1+\phi_{if}^j)^{1-\eta}\big)^{\frac{1}{1-\eta}}$, where M_{if} is the number of importers of each product-country pair.

[17]We examine this assumption later.

Table 3: Elasticity of Import Quantities and Price to Tariffs

	Agriculture	Manufacturing
Elasticity with respect to tariff		
Import Quantity	-3.002	-1.968
	(0.233)	(0.140)
cif Import Prices	-0.125	0.178
	(0.086)	(0.097)
Aggregate Import Quantity	-1.426	-1.393
	(0.580)	(0.618)
Demand and supply elasticities		
Demand across source country ϵ	3.00	1.97
Supply γ	$\approx \infty$	$\approx \infty$
Demand across products σ	1.43	1.39

Notes: Top panel shows coefficient from regressions of Δ log import quantities (first row) or Δ log *cif* price (second row) of each HS6 product-country on Δ log $(1 +$ tariff rate$)$ on annual observations of agricultural products (column 1) or manufacturing products (column 2) from 2015 to 2019 (see equations 10 and 11). The third row shows the coefficient from regressions of Δ log aggregate import quantities at the HS6 product level on change in the log of the aggregate tariff rate of each HS6 product (see equation 12). All regressions include product, country, and year fixed effects. Bottom panel shows demand elasticity of substitution across source countries ϵ, supply elasticity γ, and demand elasticity of substitution across HS6 products σ implied by the coefficient estimates in the top panel.

The bottom panel in Table 3 shows the elasticity of demand ϵ across countries and supply γ implied by the elasticity of import quantities and prices to tariffs. The elasticity of substitution for agricultural products is 3.00 and 1.97 for manufactured products. The implied supply elasticity is infinite for both agricultural and manufactured products.

We now turn to the elasticity of substitution between products σ. Note that the estimates of γ in Table 3 based on the variation in import quantities and prices across source countries are "large." When γ is sufficiently large, the change in the CES aggregate of imports of product i is given by:

$$\Delta \log C_i = - \sigma \left[\Delta \log \left(1 + \bar{\tau}_i\right) + \Delta \log \left(1 + \bar{\phi}_i\right) + \Delta \log \bar{p}_i \right] + FEs \tag{12}$$

where $\bar{\tau}_i$, $\bar{\phi}_i$, and $\bar{p}_i$ denote the weighted average of the tariff rate, non-tariff barriers, and the intercept of the foreign supply curve $\tilde{p}_{if}$ of product i, and FEs include year and product fixed effects.[18] The estimated coefficient from equation 12, shown in the third row in the top panel in Table 3, are negative.[19] The bottom panel (third row) shows that the implied elasticity of substitution between HS6 products is $\sigma = 1.43$ for agriculture and $\sigma = 1.39$ for manufacturing.

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[18]$\bar{p}_i \equiv \frac{\sum_f Y_{if} p_{if}}{\sum_f Y_{if}}$ and $\bar{\tau}_i \equiv \frac{\sum_f \tau_{if} Y_{if} p_{if}}{\sum_f Y_{if} p_{if}}$.

[19]We use data on imports and the estimates of ϵ and η in Table 3 to calculate the CES aggregate of imports of

The last parameter is the elasticity across firm types η. We set η equal to the estimated ϵ as the benchmark case. Note that the imposed values for η are close to 2.8 implied by Khandelwal et al. (2013), who measure the change in the market shares and prices paid by state vs. non-state exporters in response to the elimination of export quotas allocated to state owned firms in the early 1990s.[20] An alternative is Brandt et al. (2017)'s estimates of industry-specific markups using the Chinese firm-level data. Their estimates of the markup vary between 0.2 and 0.4, implying a range of 3.5 and 6 for η. [21]

4.3 Non-Tariff Barriers on U.S. goods

With estimates of ϵ, η, γ, and σ, we can now estimate the change in non-tariff barriers on U.S. goods from equations 7-9.

Table 4 shows the *average* change in non-tariff barriers faced by American goods in China. The first two columns show the data moments that go into this calculation. Column 1 shows the weighted average of the change in import quantities from the U.S. relative to the sum of import quantities from other countries of the same HS6 product. Column 2 shows the change between 2017-19 and 2019-2020 in the log import price of U.S. goods (inclusive of the tariff) of an HS6 product relative to the weighted average of the import price of the same HS6 product of other countries selling to China.

Columns 3-5 in Table 4 then show the average change in the tariff equivalent of non-tariff barriers on U.S. imports inferred from this data. The first row shows that non-tariff barriers were essentially unchanged between 2015 and 2017 (prior to the trade war). The second row shows that non-tariff barriers on agricultural products on non-state importers increased by 0.83 log points and by only 0.2 log points for state importers between 2017-2019.

The third row shows the change in non-tariff barriers calculated over the entire 2017-2020 period (trade war plus the first year of the Phase 1 agreement). This includes the trade war in 2018 and 2019 and the first year of the Phase 1 agreement in 2020. It shows that average non-tariff barriers over the entire 2017-2020 period increased by 0.20 log points compared to an increase of 0.72 log points during the years of the trade war between 2017 and 2019. In addition, the reversal in non-tariff barriers is also entirely due to changes in barriers on purchases of U.S. agricultural products by non-state importers. There was no big change on non-tariff barriers facing state importers.

The bottom panel in Table 4 shows that the decline in U.S. manufacturing imports between

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a product C_i on the left-hand side of equation 12. We calibrate the preference parameters b_{if}^j by assuming that non-tariff barriers are zero in 2017.

[20]In Khandelwal et al. (2013)'s data (Table 3), the change in the market share is -0.14 and 0.10 for state and non-state exporters, respectively, and the initial market shares of state and non-state firms are 0.26 and 0.17, respectively (these last two numbers are reported in the working paper version). The weighted price change for state and non-state exporters are -0.11 and -0.10, respectively, and the initial level of prices are 0.26 and and 0.17 for state and non-state exporters, respectively (Tables 4 and 5). The price changes are -0.11/0.26 and -0.10/0.17 for each type of exporter. The tariff equivalent of the license fee is $\phi = 0.14$. These numbers imply that $\eta = 2.8$.

[21]In the next section, we show the robustness of our estimates of NTBs to $\eta = 6$, which is the upper bound of the estimates in the literature.

Table 4: <u>Mean</u> Δ Non-Tariff Barriers on U.S. Imports

	Δ Import Quantities	Δ *cif* price + tariff	Δ Non-Tariff Barriers			
			Non-State	State	Avg.	Avg.|GTA
Agriculture						
Pre Trade War (2015-17)	-0.156	-0.051	0.150	0.263	0.170	0.195
Trade War (2017-19)	-2.146	0.111	0.829	0.212	0.719	0.719
Trade War and Phase 1 (2017-2020)	-0.756	0.109	0.217	0.125	0.201	0.188
Manufacturing						
Pre Trade War (2015-17)	0.054	-0.007	-0.038	-0.007	-0.033	-0.041
Trade War (2017-19)	-0.436	0.122	0.042	0.475	0.107	0.105
Trade War and Phase 1 (2017-2020)	-0.689	0.177	0.121	0.793	0.221	0.219

Notes: Table shows the mean across HS6 products in agriculture (top panel) and manufacturing (bottom panel). Column 1 shows the change in log U.S. import quantities relative to import quantities from all other countries; Column 2 shows the change in the log *cif* price of U.S. imports inclusive of tariffs relative to other importers; Columns 3 and 4 show the weighted average change in non-tariff barriers on non-state and state importers estimated from the change in import quantities after removing the effect of the change in import prices, given the estimates of $\epsilon\,\eta$, γ, and σ in Table 3, using equations 7-9. Column 5 shows the weighted average of Δ non-tariff barriers of non-state and state importers of U.S. products. Column 6 shows the weighted average of Δ non-tariff barriers after controlling for non-tariff measures in the Global Trade Alert database. See Section 6 for details.

2017 and 2019 was smaller than in agriculture. The main reason is that the increase in average non-tariff barriers is smaller in manufacturing compared to agriculture: the tariff equivalent of non-tariff barriers in manufacturing was essentially unchanged between 2017 and 2019, while the increase in agriculture was 0.72.

Table 5 reports the *standard deviation* of change in non-tariff barriers $\Delta \log(1 + \phi_{if}^{j})$. For comparison, column 1 shows the standard deviation of $\Delta \log(1 + \tau_{i,US})$ across products. The second column reports the standard deviation of change in non-tariff barriers, and the third column shows the same conditional on ownership. The dispersion in the change in non-tariff barriers during the trade war is substantially larger than that of tariffs.

Appendix Table A2 provides more granular detail on the sectors (at the two digit level) most affected by non-tariff barriers. The hike in non-tariff barriers between 2017 and 2019 were focused on a small number of products. For example, non-tariff barriers on "oil seeds" and "cereals" rose by 1.2 and 1.4 log points. The increase in the tariff rate for the same products is much lower, at 0.15 and 0.25 log points.

Table 5 also shows that the dispersion in the change in non-tariff barriers over the entire 2017-2020 period fell compared to the 2017-2019 period. This says that the decline in *average* non-tariff barriers documented in Table 4 comes from the reversal in the non-tariff barriers put in place in 2018 and 2019. A regression at the HS6 product level of the change in non-tariff barriers on U.S. products between 2019 and 2020 on the change in non-tariff barriers between 2017 and 2019 of the

Table 5: <u>Standard Deviation Δ Tariff and Δ Non-Tariff Barriers on U.S. Imports</u>

| | | Δ Non-Tariff Barriers | | |
	Δ Tariff	Uncond.	| Ownership	| GTA
Agriculture				
Pre Trade War (2015-17)	0	0.360	0.377	0.333
Trade War (2017-19)	0.071	0.815	0.796	0.817
Trade War and Phase 1 (2017-2020)	0.084	0.532	0.533	0.530
Manufacturing				
Pre Trade War (2015-17)	0	0.564	0.577	0.564
Trade War (2017-19)	0.084	0.567	0.546	0.566
Trade War and Phase 1 (2017-2020)	0.089	0.777	0.746	0.777

Notes: Column 1 shows weighted standard deviation of change in tariffs, $\Delta \log(1 + \tau_{i,US})$, across products. Column 2 shows weighted standard deviation of change in non-tariff barriers, $\Delta \log(1 + \phi_{i,US}^{j})$, across products and importer type (state and non-state). Last two columns report weighted standard deviation of the residual from regression of $\Delta \log(1 + \phi_{i,US}^{j})$ on ownership (state or non-state) or non-tariff barriers measured by the Global Trade Alert database.

same HS6 yields a precisely estimated coefficient of -0.817 (s.e: 0.04). The coefficient is not -1 so the reversion in 2020 of the hike in non-tariff barriers between 2017 and 2019 was incomplete.

How much of the non-tariff barriers we infer from trade data is captured by direct measures of non-tariff barriers? To answer this question, we regress our estimate of changes in non-tariff barriers on the direct measures complied by the Global Trade Alert (GTA) project. The GTA classifies non-tariff barriers into "red," "amber," and "green." We measure non-tariff barriers in the GTA as the sum of "red" and "amber" notices on a product minus the number of "green" notices. This regression shows that our imputed non-tariff barriers are correlated with direct measures of non-tariff barriers for agriculture but not for manufacturing.[22] But the direct measures from the GTA do not capture most of the non-tariff barriers that we impute from the trade data. Specifically, the residuals from the regression on our measure of non-tariff barriers on the GTA's measures, shown in the last columns in Tables 4 and 5, show that the mean and standard deviation of the residual change in the non-tariff barrier is virtually unchanged.

4.4   Alternative Model Parameters

An identifying assumption behind our estimates of the demand elasticities is that the changes in tariffs across products and countries are orthogonal to changes in non-tariff barriers and supply shifts in the source country. In this subsection, we address the possible bias in our estimates of non-tariff barriers from this assumption.

First, we cannot directly test this assumption, but we can use the pre-existing growth rate of

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[22]A regression of $\Delta \log(1 + \phi_i, US)$ on Δ non-tariff barriers from the GTA yields a coefficient on 0.089 (s.e.: 0.018) for agriculture ($R^2 = 0.017$) and -0.004 (s.e.: 0.002) for manufacturing ($R^2 = 0.000$).

import quantities of the HS6 product from the U.S. as a proxy for trends in productivity growth. Appendix Figure A1 shows the scatter-plot between the growth rate of import quantities of an HS6 product from the U.S. between 2015-2017 (on the y-axis) and the change in tariffs between 2017-2019 (on the x-axis). The correlation is almost zero (correlation coefficient -0.05).

Second, we can also impute non-tariff barriers using alternative estimates of the demand elasticity that do not rely on the variation in tariffs. Columns 2-4 in Table 6 show non-tariff barriers calculated using the demand elasticities in Broda and Weinstein (2006). The table shows that the non-tariff barriers inferred from Broda and Weinstein (2006)'s estimates of the demand elasticities are similar to the baseline estimates in Table 4. Specifically, Table 6 indicates that non-tariff barriers increased between 2017 and 2019 by more than tariffs, and largely affected non-state importers instead of state importers. In addition, the estimates based on Broda and Weinstein (2006)'s demand elasticities also show that non-tariff barriers declined in 2020 and the decline is primarily among non-state importers.

Table 6: Avg Δ Non-Tariff Barriers on U.S. *Agricultural* Imports with Alternative Parameters

| | Broda-Weinstein Elasticities | | | Elas. Subst. Firms $\eta = 6$ | | |
	Non-State	State	Average	Non-State	State	Average
Pre Trade War (2015-17)	0.141	0.254	0.161	0.149	0.244	0.166
Trade War (2017-19)	0.754	0.134	0.644	0.592	0.323	0.547
Trade War and Phase 1 (2017-2020)	0.182	0.091	0.166	0.206	0.153	0.196

Notes: Table shows the mean of $\Delta \log(1 + \phi)$ for HS6 agricultural products from the U.S. inferred using estimates of ϵ in Broda and Weinstein (2006) (columns 1-3) and with $\eta = 6$ (columns 4-6) using equations 7-9.

We can also check whether the non-tariff barriers we estimate from the Broda and Weinstein (2006) demand elasticities are orthogonal to the change in tariffs. Appendix Figure A2 shows the scatter-plot of the change in non-tariff barriers for a given HS6 product from the U.S. using Broda-Weinstein estimates of ϵ (on the y-axis) vs. the change in tariffs for the same product from the U.S. (on the x-axis). There is essentially zero correlation between these two variables (correlation coefficient 0.02).

Finally, the last 3 columns in Table 6 show the mean change in non-tariff barriers assuming that the elasticity of substitution across state and non-state firms η is 6. The estimated changes in non-tariff barriers are similar with this alternative value for η.

4.5 "Non-Tariff Barriers" in Other Periods

It is possible that what we infer as an increase in non-tariff barriers in 2018 and 2019, and a partial reversal of the hike in non-tariff barriers in 2020 may be something else. We cannot entirely rule out this possibility, but in this section we check whether we see similar patterns in other periods.

Specifically, we use the same procedure (and the same model parameters) to back out changes in "non-tariff barriers" on U.S. exports to China over successive two-year periods between 2005-2015. We assume 2007 is the benchmark year and use the same Chinese customs data.

The bars in Figure 3 show the average change in non-tariff barriers over successive two-year periods for state (red bars) and non-state (blue bars) importers between 2005 and 2015.[23] For comparison, the figure replicates the average change in non-tariff barriers between 2017 and 2019. It is clear that the increase in non-tariff barriers we infer for non-state importers during the trade war in 2018 and 2019 is an outlier; in all previous periods, the change in "non-tariff barriers" facing non-state importers is essentially zero.

Figure 3: Δ "Non-tariff Barriers" on Exports of U.S. Agricultural Goods to China, 2005-2015
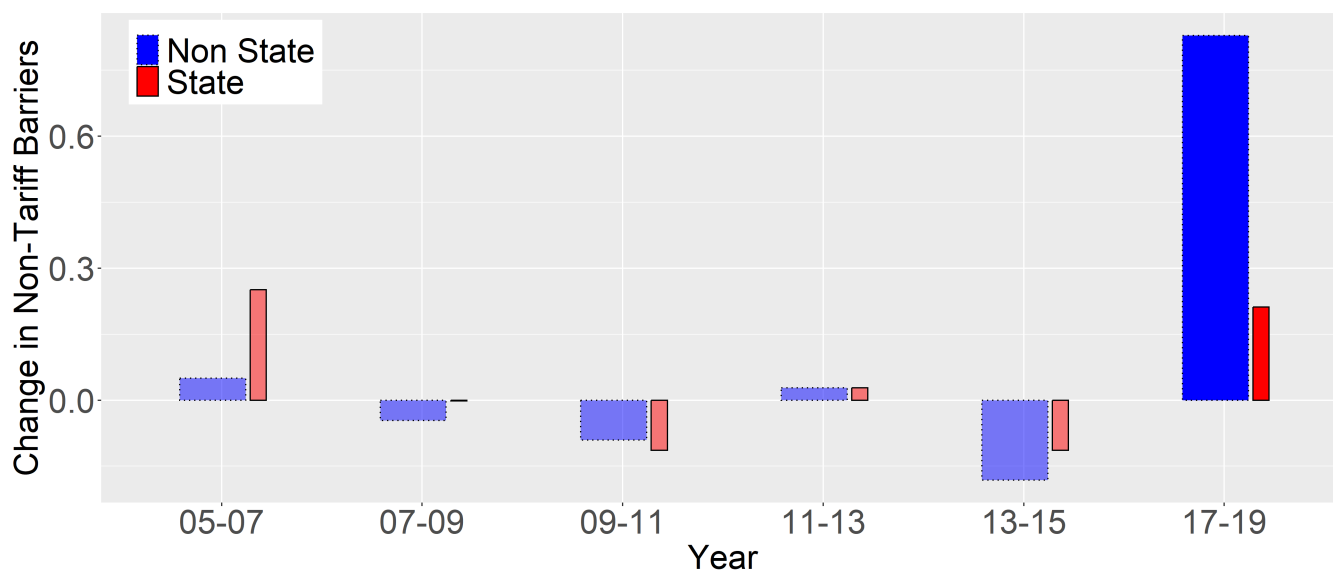
Notes: The height of each bar is the change in non-tariff barrier facing non-state (blue) or state (red) importers in the period. The width of the bar represents the share of imports from the U.S. by non-state (blue) and state firms (red). The benchmark year is 2007 for non-tariff barriers in 2005-15.

We can also explore whether the reversion of non-tariff barriers in the first year of the Phase 1 agreement was due to a policy change or due to statistical mean reversion. Remember that a regression of the change in non-tariff barriers in 2020 on the change in non-tariff barriers between 2017 and 2019 yields a coefficient of -0.817. A similar regression over successive two-year periods prior to 2015 yields a coefficient of -0.141 (s.e. 0.031). So there is some statistical mean reversion in non-tariff barriers, but the much larger mean reversion in 2020 is likely due to policies enacted during Phase 1 of the trade agreement.

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[23]The width of the bars denotes the share of imports from the U.S. by non-state and state firms.

4.6 Non-Tariff Barriers on Imports of Other Countries

Our estimates of non-tariff barriers are relative to the weighted average of non-tariff barriers faced by all countries except the U.S. It is possible that what we measure as an increase in non-tariff barriers for American products may be driven by the normalization. For example, it could be the case that non-tariff barriers *decreased* for another country selling in the Chinese market.

We cannot rule this out but we can assess its plausibility by trying alternative normalizations. The four largest exporters of agricultural products to China (in addition to the U.S.) are Brazil, Canada, Thailand, and Australia. Likewise, the four largest exporters of manufacturing products to China (in addition to the U.S.) are South Korea, Japan, Taiwan, and Germany. We now assume that the average change in non-tariff barriers faced by all exporters of agricultural goods to China, except for the five largest exporters of agricultural goods, is zero. Likewise, we assume that the average change in non-tariff barriers of exporters of manufacturing products to China, except for the five largest exporters of manufacturing products, is zero.

Table 7 shows the estimated non-tariff barriers under this alternative normalization. We highlight two findings. First, there is no evidence that non-tariff barriers fell for the largest exporters to China. Second, the average increases in non-tariff barriers for American agricultural and manufactured products are essentially the same as those using our baseline normalization in Table 4.

Table 7: Δ non-tariff barriers for China's Main Trading Partners, 2017-2019

Agriculture		Manufacturing	
U.S.	0.759	South Korea	0.181
Brazil	0.149	Japan	0.144
Canada	0.057	Taiwan	0.054
Thailand	0.246	U.S.	0.148
Australia	0.040	Germany	0.111

Note: Table shows the weighted average of change between 2017 and 2019 in non-tariff barriers, $\Delta \log(1 + \phi)$, under the assumption that the weighted average of the change in non-tariff barriers of agricultural products (column 1) or manufacturing products (column 2) of all the countries exporting to China (except the countries in the table) is equal to zero.

4.7 Explaining Variation in Tariff and Non-Tariff Barriers

It is clear that a central objective of the Chinese authorities was to lower imports from the U.S. However, why did the authorities choose to lower imports by more for some products, and why did it choose to hike non-tariff barriers compared to tariffs for some products but not for others? In this section we provide suggestive evidence that the variation across products in the use of tariffs vs.

non-tariff barriers can be partially explained as an outcome of a government facing three objectives, which are to "punish" the U.S. by blocking imports from the U.S., deny that they are attempting to punish the U.S. and to protect profits of state-owned firms.

First, if the goal is to lower imports from the U.S., there is no reason to favor non-tariff measures relative to tariffs. On the contrary, tariffs raise revenues while non-tariff measures do not. However, the advantage of non-tariff measures is that they are opaque and allow the Chinese authorities to deny that they are attempting to block U.S. exports.

Second, remember that tariffs apply equally to all firms whereas non-tariff barriers can apply to some firms and not to others. Further, recall our evidence that non-tariff barriers primarily applied to non-state firms but not to state firms. All else equal, the government wants to lower imports from the U.S. by raising barriers (both tariffs and non-tariff barriers) on U.S. imports. However, since the government also cares about the profits of state-owned firms, it will raise tariffs by less for products imported from the U.S. in which state-owned firms have a larger market share. At the same time, since non-tariff barriers do not apply to state owners but benefit the government by lowering imports from the U.S., the hike in non-tariff barriers facing non-state importers will tend to be *larger* for U.S. products where the state share is larger.

Table 8: Regressions of Δ Tariffs and Non-Tariff Barriers on U.S. Imports on State Share

	Δ Tariff		Δ Non-Tariff Barriers	
State Share of HS6 Product from U.S.	−0.153 (0.034)	−0.172 (0.033)	1.419 (0.286)	1.314 (0.287)
Share of U.S. in Total Imports of HS6 Product		0.078 (0.020)		0.426 (0.170)
R^2	0.055	0.095	0.066	0.082

Notes: Table shows coefficients from regression at the HS6 product level of the change in tariffs $\Delta \log (1 + \tau)$ (columns 1 and 2) or non-tariff barriers faced by non-state importers $\Delta \log (1 + \phi)$ (columns 3 and 4) on an HS6 product imported from the U.S. on the share of state-owners in total imports of the HS6 product from the U.S. in 2017 (row 1) and the share of the U.S. in total imports of the HS6 product from all countries in the same year (row 2). Number of observations = 354.

Table 8 provides support for this prediction. Each observation is weighted by the value of 2017 U.S. imports. The first column shows the regression of the change in tariffs on a U.S. HS6 product on the share of state owners in total imports from the U.S. of each HS6 product prior to the trade war. The regression shows that tariffs on a U.S. product increase by less when state owners have a larger share of the imported product. This supports the logic that the government is less likely to raise tariffs when the tariffs will have a larger adverse effect on the profits of state owners. The third column shows the regression of the change in non-tariff barriers faced by *non-state* importers of the U.S. HS6 product on the state share of total imports of the U.S. product. Here the coefficient

is positive, suggesting that the government hikes up non-tariff barriers facing non-state firms by more in sectors where it has a larger stake.

Columns 2 and 4 in Table 8 introduce controls for the share of U.S. imports in total imports of the HS6 product. The evidence here suggests that the Chinese government indeed increased trade barriers by more for products where the U.S. has a larger share. However, it is still the case that even accounting for the importance of U.S. goods in the HS6 product, tariffs increase by less, and non-tariff barriers facing non-state owners increase by more in HS6 products where state owners have a larger share of imports from the U.S.

We end by noting that a recent paper by Benguria and Saffie (2021) finds that variation across products in U.S. exports to China is correlated with the presence of state owners. Their finding is related to our evidence in Table 8 that changes in trade barriers are related to the state share, although our point is that the state share has a different effect on tariffs vs. non-tariff barriers.

5 Welfare Cost of U.S.-China Trade War

We now estimate the welfare cost to China of the trade barriers imposed during the course of the U.S.-China trade war from 2017 to 2020. Specifically, welfare in our model is given by equation 6, where the U.S.-China trade conflict affects welfare through the dispersion of tariffs across countries and HS6 products and the mean and the dispersion of non-tariff barriers across countries, state vs. non-state importer, and across HS6 product.

Table 9 shows the resulting estimates of the welfare loss from higher tariffs and non-tariff barriers. We start with the forcing variables in 2017 and change only the trade barriers to those prevailing in 2019 and 2020. The table then shows the changes in imports from the U.S. and Chinese welfare in this counterfactual. The top panel shows the results of this exercise for agricultural HS6 products. The first row shows the effects only of higher Chinese tariffs on U.S. agricultural products in 2019 and 2020, both relative to 2017. The first two columns show that higher tariffs result in lower imports of U.S. agricultural products by 9.19 billion in 2019 and 8.21 billion in 2020 (all units are nominal US$). The next two columns show that higher tariffs on U.S. products lower Chinese welfare by 1.34 billion in 2019 and 2.21 billion in 2020 (relative to the 2017 baseline).

The second row adds the effect of changes in non-tariff barriers, $\Delta \log(1 + \phi_{i,US}^{j})$. Chinese welfare in 2019 is 11.7 billion US$ lower compared to 2017. The welfare loss in 2019 from non-tariff barriers is an order of magnitude larger than that due to higher tariffs.

The welfare loss from the non-tariff barriers is driven by the dispersion and the mean of the change in non-tariff barriers. To separate the effect of differential non-tariff barriers via the mean and the dispersion of consumer prices, we construct a hypothetical uniform non-tariff barrier change $\Delta \log(1+\phi)$ across both product i and importer j. We calibrate $\Delta \log(1+\phi)$ to match the change in the total import value of U.S. agriculture goods over the period and calculate the resulting welfare loss.[24] The number, shown in the third row, is 5 billion.

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[24]The calibrated $\Delta \log(1 + \phi)$ is 0.24 for 2017-19.

Table 9: Effect of U.S.-China Trade War on Imports from U.S. and Chinese Welfare (billion US$)

| | Δ U.S. Import Value | | Δ Welfare | |
	2019	2020	2019	2020
Agriculture				
Tariffs Only	-9.19	-8.21	-1.34	-2.21
Tariffs + Non-Tariff Barriers	-20.4	-12.75	-11.69	-8.90
Tariffs + Uniform Non-Tariff Barriers	-20.4	-12.75	-4.96	-3.86
Tariffs + HS6-Specific Non-Tariff Barriers	-20.4	-12.75	-7.18	-8.45
Manufacturing				
Tariffs Only	-10.7	-10.06	-1.41	-2.07
Tariffs + Non-Tariff Barriers	-17.74	-17.03	-26.06	-43.2
Tariffs + Uniform Non-Tariff Barriers	-17.74	-17.03	-2.47	-3.57
Tariffs + HS6-Specific Non-Tariff Barriers	-17.74	-17.03	-22.43	-39.78

Notes: Table shows the effect of changes in tariffs only (row 1), changes in all trade barriers (tariffs and the estimated non-tariff barriers) (row 2), changes in tariffs and the uniform non-tariff trade barrier across HS6 and importers, calibrated to match the total change in U.S. import value (row 3), and changes in tariffs and the HS6-specific non-tariff barriers (but same for state and non-state importers) calibrated to match the change in U.S. import value of the product (row 4) on imports of U.S. products and Chinese welfare (in billions of US$) in 2019 relative to 2017 (columns 1 and 3) and 2020 relative to 2017 (columns 2 and 4).

The dispersion in non-tariff barriers is across products and state vs. non-state importers. The fourth row tries to isolate the effect of dispersion in non-tariff barriers across state and non-state importers. Here we calibrate the corresponding hypothetical change in the HS6-specific non-tariff barrier $\Delta \log(1+\phi_i)$, which does not distinguish between state and non-state importers. $\Delta \log(1+\phi_i)$ for each i is calibrated to match the change in the import value for each U.S. product i. The corresponding welfare loss is 7.2 billion. This is higher than the welfare loss of 5 billion from a hypothetical uniform non-tariff barrier (the third row) but substantially lower than the 11.7 billion loss from the actual change in non-tariff barriers that favor state importers (the second row).

The partial reversal of the non-tariff barriers in 2020 increases Chinese welfare but does not entirely undo the effect of higher non-tariff barriers imposed in 2018 and 2019. Chinese welfare in 2020 from consumption of imported agricultural products is still 8.9 billion lower compared to 2017 (the second row in the last column). As shown in Table 4, the reversal is mainly driven by reducing non-tariff barriers on non-state importers. This can also be seen by comparing the second and fourth rows. The welfare loss caused by changes in non-discriminatory non-tariff barriers is almost identical to the actual changes.

The bottom panel in Table 9 shows the results of the same exercise for trade barriers on manufacturing exports from the U.S. Remember that trade barriers, both in the form of tariffs and also

in the form of non-tariff barriers, increased by less for U.S. manufactured products compared to agricultural products.[25] However, the effects of trade barriers on imports and welfare are larger than in agriculture because U.S. manufacturing exports to China are much larger than agricultural exports: in 2017 the U.S. manufacturing exports to China totaled 100 billion US$ and U.S. agricultural exports totaled 31.9 billion US$. The total welfare loss from higher trade barriers in 2019 was 26.1 billion US$, and the bulk of the welfare loss (95%) comes from the use of non-tariff barriers as opposed to tariffs. In addition, in contrast to what we see for agricultural products, there is no evidence of a reversal in the welfare loss in 2020 in the first year of the purchase agreement. The welfare loss in 2020 from higher trade barriers was larger than in 2019.

Adding up the effects of trade barriers for agricultural and manufacturing goods, our estimates suggest that Chinese welfare fell by 38 billion US$ in 2019 compared to 2017 due to the higher trade barriers imposed by China in 2018 and 2019. The bulk – about 93% – of this welfare cost was due to the use of non-tariff barriers instead of higher tariffs. In sum, non-tariff barriers account for about half of the reduction in imports of U.S. products but almost all of the loss in welfare suffered by the Chinese due to the trade war. Some of the higher non-tariff barriers facing U.S. agricultural exports were removed in 2020, but not for U.S. manufactured products that account for the most U.S. exports to China. As a consequence, China's welfare loss in 2020 is still 52.1 billion US$ lower compared to 2017.

Figure 4 uses the variation across HS6 products to illustrate that the use of non-tariff barriers as an instrument to lower imports from the U.S. was much more costly compared to tariffs. In this figure, we ask the following question: how much did the increase in tariffs and non-tariff barriers between 2017 and 2019 on each HS6 product sold by the U.S. lower U.S. imports and Chinese welfare? The figure plots the change in Chinese welfare (on the y-axis) against the change in imports from the U.S (on the x-axis) due to the change in tariffs and imputed non-tariff barriers on each HS6 product, separately for agricultural products (left panel) and manufacturing products (right panel). The observations in the red circle denote the effect of a change in non-tariff barriers on welfare and imports from the U.S., and the observations in the blue triangle denote the same for the change in tariffs.

Figure 4 shows clearly that for every dollar reduction in imports from the U.S., non-tariff barriers are much more costly to Chinese consumers. The elasticity of welfare change to the change in imports due to non-tariff barriers is about five times larger than the elasticity of welfare with respect to imports due to tariff hikes. Of course, this is to be expected: compared to tariffs, non-tariff barriers are more costly because there are no tariff revenues from non-tariff barriers and because of the misallocation of imports when non-tariff barriers apply to some firms and not to others. Therefore, to the extent that the goal of the Chinese government was to retaliate against U.S. tariffs on Chinese products by cutting imports from U.S., using non-tariff barriers is a much more costly policy instrument than using tariffs.

Compared to tariffs, there are three features of non-tariff barriers that made them costly: the

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[25]See Table 1 for the increase in tariffs and Table 4 for the increase in non-tariff barriers.

Figure 4: Elasticity of Chinese Welfare to U.S. Import Value: Tariffs vs. Non-Tariff Barriers
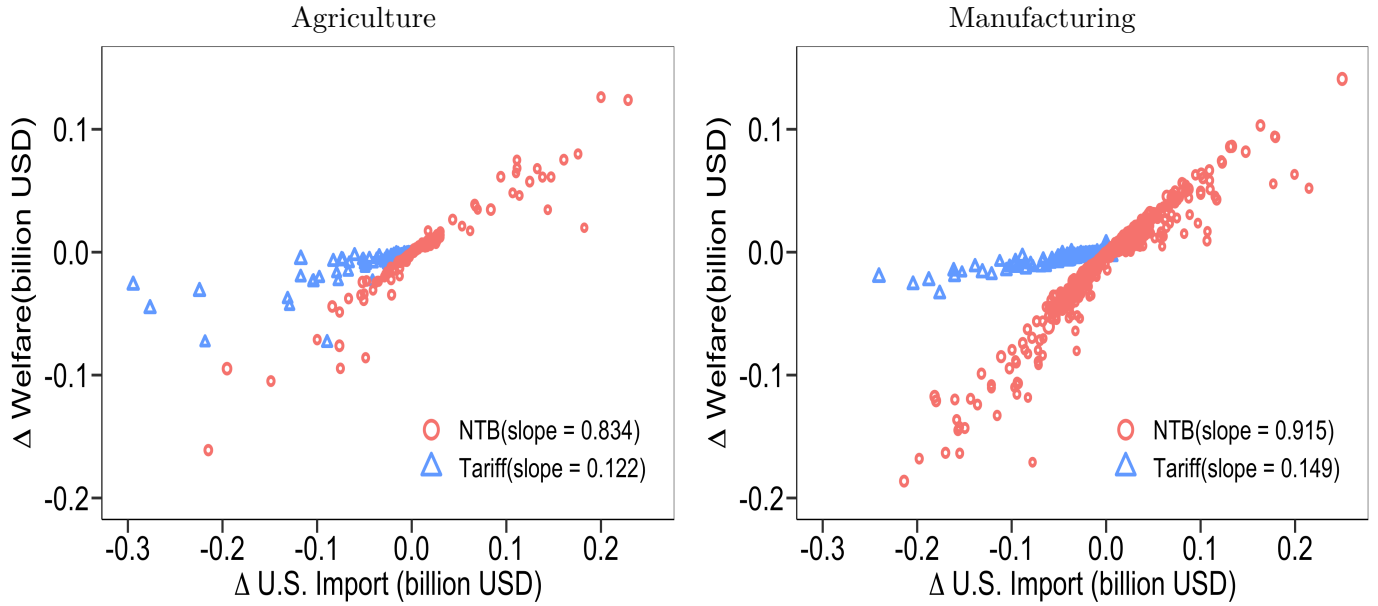
Notes: Each observation is an HS6 product. Figure plots change in Chinese welfare against change in U.S. imports caused by the actual change in tariffs (dots) and non-tariff barriers (triangles) in 2018-19 for each HS6 product.

revenue loss from non-tariff barriers compared to tariffs; the dispersion across products in non-tariff barriers and the differential non-tariff barriers faced by state vs. non-state importers. We now decompose the total welfare loss of 20.59 (69.26) billion US$ for the agriculture (manufacturing) sector combining 2019 and 2020 into the above three channels.

The difference between the third and first rows of the upper (lower) panel of Table 9 tells us the welfare loss in the agriculture (manufacturing) sector due to the revenue loss of non-tariff barriers, totaling 5.27 (2.56) billion US$ combing 2019 and 2020. The revenue channel, therefore, accounts for 8.7% of the total welfare loss. The difference between the fourth and third rows shows the welfare loss due to the dispersion across products in non-tariff barriers, totaling 6.81 (56.17) billion US$ for agricultural (manufactured) products and accounting for 70.1% of the total welfare loss. Finally, the difference between the second and fourth rows shows the welfare loss due to the differential non-tariff barriers faced by state vs. non-state importers, totaling 4.96 (7.05) billion US$ for agricultural (manufactured) products and accounting for 13.4% of the total welfare loss.

5.1 Substitution between Domestic and Imported Products

We have so far assumed that the cost of the U.S.-China trade war comes from the misallocation of expenditures between imported products. We now allow for the misallocation between imported and domestic products. That is, suppose that one of the source countries in the utility function in equation 1 is China. There are two empirical difficulties associated with including the effect on domestic products. First, there is no data on Chinese production at the HS6 product level. The best

that we can do is that the National Bureau of Statistics of China reports the quantity of domestic production of 23 agriculture products, which we match to HS-4 categories.[26] Second, we do not have price data for domestic products, which prevents us from estimating the domestic supply elasticity.[27] We thus bound the effect of the U.S.-China trade war by considering two extremes, which are that the domestic supply elasticity is zero on one extreme and a perfectly elastic supply curve at the other extreme.[28]

Table 10: Effect of U.S.-China Trade War with Domestic Production (Agriculture Only)

| | Δ U.S. Import Value | | Δ Welfare | |
	2019	2020	2019	2020
Domestic supply elasticity $\gamma = 0$				
Tariffs Only	-10.46	- 9.83	-7.23	-7.04
Tariffs + Non-Tariff Barriers	-20.28	-13.04	-19.58	-14.84
Tariffs + Uniform Non-Tariff Barriers	-20.28	-13.04	-14.74	-9.45
Tariffs + HS6-Specific Non-Tariff Barriers	-20.28	-13.04	-16.47	-14.46
Domestic supply elasticity $\gamma = \infty$				
Tariffs Only	-10.66	-10.23	-1.43	-1.88
Tariffs + Non-Tariff Barriers	-20.58	-13.97	-10.39	-8.02
Tariffs + Uniform Non-Tariff Barriers	-20.58	-13.97	-4.44	-2.88
Tariffs + HS6-Specific Non-Tariff Barriers	-20.58	-13.97	-6.09	-7.53

Notes: Table shows the effect of changes in trade costs in the model where utility depends on domestic and imported products. The top panel assumes the domestic supply elasticity is zero. The bottom panel assumes domestic supply elasticity is ∞. See notes for Table 9 for additional details.

Table 10 reports the effect of the U.S.-China trade war, where we include the effect on domestic Chinese products assuming the elasticity of substitution between a Chinese product and a product made by another country is ϵ (as reported in Table 3). The top panel assumes that the supply elasticity of domestic products is zero. The reduction of imports from U.S. in 2019 by non-tariff barriers is 12.4% less than in the benchmark model (see Table 9), while the welfare loss is slightly larger. The reason is because there are two opposite forces at play. On the one hand, adding domestic production lowers the importance of U.S. products in utility. On the other hand, the

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[26]Appendix Table A3 shows the concordance between the 23 products and HS-4 categories.

[27]The estimate of non-tariff barriers on U.S. products in Table 4 only requires an estimate of the elasticity of substitution across products, and does not depend on the supply elasticity.

[28]We note that domestic production growth is not correlated with the change in tariff or non-tariff barriers (the correlation of domestic production growth with the change in tariff and non-tariff barriers between 2017-2019 is 0.17 and -0.03, respectively). There is also little dispersion in the growth rate of domestic production of the 23 agricultural products. These two facts suggest that the domestic supply elasticity is closer to zero than to infinity.

increase in trade barriers on U.S. products leads to higher prices for domestic products, which amplifies the welfare loss from barriers on U.S. imports. The bottom panel in Table 10 assumes the elasticity of domestic supply is very elastic.[29] Here, the large supply elasticity dampens the welfare loss of higher non-tariff barriers on U.S. imports by 13.4%. However, even under the unrealistic assumption that the elasticity of Chinese supply to the local market is almost perfectly elastic, the welfare losses caused by non-tariff barriers remain much larger than those by tariffs.

6 External Validity

In this section, we try to provide external validation of our measures. Of course such evidence can only be suggestive because the non-tariff barriers we attempt to measure were designed to be opaque.

First, it is possible that what we infer as non-tariff barriers on a U.S. product reflects changes in the quality of the particular U.S. product. To determine whether this is likely, we calculate U.S. exports to the rest of the world (excluding China) as a share of exports of the rest of the world to the rest of the world.[30] If what we infer as non-tariff barriers on U.S. products in China reflects quality or price changes of the U.S. product, we should also see this in a decline of U.S. exports to non-Chinese markets. Appendix Figure A3 shows the scatterplot of the change between 2017 and 2019 in exports of a U.S. product to the rest of the world (excluding China) as a share of exports of the rest of the world to the rest of the world (on the y-axis) vs. the change in non-tariff barriers in the Chinese market of the same product sold by the U.S. (on the x-axis). There is no evidence that U.S. exports to the rest of the world (excluding China) fall by more for HS6 products whereas U.S. exports of the same product fall significantly in the Chinese market. U.S. products where we infer a large increase in Chinese non-tariff barriers only see a decline in the Chinese market between 2017 and 2019, and nowhere else in the world.

We can also apply our procedure to infer non-tariff barriers in other contexts where non-tariff barriers are more transparent and can be measured directly. Here we use the measures of non-tariff barriers facing Mexican imports from countries other than Canada and the U.S. in Conconi et al. (2018) due to the "rules of origin" under the North American Free Trade Agreement (NAFTA). Specifically, Conconi et al. (2018) calculates non-tariff barriers on the imports of an intermediate good from non-NAFTA countries as follows. First, they construct an indicator variable equal to one if the import is subject to rules of origin under NAFTA. Then they measure the non-tariff barrier on the import as the sum of the indicator variable across all the final products that use the specific intermediate good.

We can then compare Conconi et al. (2018)'s direct measure of non-tariff barriers in Mexico with an estimate of non-tariff barriers computed from Mexican data following the same procedure we used to infer non-tariff barriers facing U.S. imports in China. That is, we infer non-tariff barriers

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[29]We assume the elasticity of domestic supply is the same as the estimated elasticity of supply of foreign countries ($\gamma = \infty$).

[30]We calculate this number at the HS6 product level from the UN's Comtrade data.

on imports of an HS6 product from non-NAFTA countries in Mexico as the residual of the import share of non-NAFTA countries relative to NAFTA countries.[31] A regression of our estimate of non-tariff barriers on Mexican imports from non-NAFTA countries on Conconi et al. (2018)'s preferred measure of non-tariff barriers on imports from non-NAFTA countries of the same HS6 product yields a statistically significant coefficient of 0.057.[32]

Finally, we remind the reader of the evidence presented earlier that the increase in non-tariff barriers between 2017 and 2019 primarily applied to non-state importers and was substantially larger for HS6 products where the state share of importers was high. In addition, the increase in non-tariff barriers was partially reversed after 2019, after the Chinese government agreed to purchase agreements to stop the trade war. Although not impossible, it is difficult to believe that forces other than the Chinese government's use of unofficial mechanisms in the trade war could account for these patterns.

7   Conclusion

We estimate the use of non-tariff barriers by China in its trade battle with the U.S. in 2018 and 2019 and in the first year of the purchase agreement in 2020. We do this by first estimating the elasticities of demand for U.S. products in China relative to products made by other countries, as well as the elasticity of supply. These estimates indicate that the supply curve is almost horizontal, which suggests that the entire incidence of higher Chinese trade barriers are entirely borne by Chinese consumers.

We then use the estimates of the demand elasticities to back out the changes in non-tariff barriers as the residual of changes in imports of U.S. products relative to imports from other countries of the same HS6 product, after controlling for the effect of tariffs. These estimates suggest that non-tariff barriers for U.S. agricultural exports increased significantly in 2018 and 2019, by a tariff-equivalent of 60 percent. The increase in non-tariff barriers for U.S. manufacturing exports is smaller. And in 2020, some of the increase in non-tariff barriers on U.S. agricultural exports was reversed.

We use a simple model to estimate the effect of trade barriers, including tariffs and non-tariff barriers, on Chinese welfare. We find that trade barriers imposed in 2018 and 2019 lowered Chinese welfare in 2019 by 40 billion US\$, with 93% of the welfare loss coming from the use of non-tariff barriers. This is a large welfare loss out of the 132 billion US\$ of U.S. agricultural and manufacturing exports to China in 2017.

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[31]We use Broda and Weinstein (2006)'s estimates of the elasticity of substitution ϵ at the HS6 product-level.

[32]Conconi et al. (2018)'s preferred measure of non-tariff barriers is the variable "RoO^3" in their paper. See Appendix Table A4 for the regression. Conconi et al. (2018) argues that the incentive of a final goods producer to comply with the rules of origin also depends on the extent to which the product is exported to a NAFTA country and the gap between the MFN and NAFTA tariff. Therefore, their two alternative measures of non-tariff barriers on imports from non-NAFTa countries are the interaction of "RoO^3" and exports to NAFTA countries and the gap between the MFN tariff rate and the NAFTA tariff rate. Appendix Table A4 shows that regressions of our estimate of non-tariff barriers on Conconi et al. (2018)'s two alternative measures of non-tariff barriers also yield positive (and statistically significant) coefficients.

Finally, the use of regulatory tools as a trade barrier is not unique to the U.S.-China trade dispute. For example, after Canadian authorities arrested Meng Wangzhou, the CFO of Huawei, Chinese authorities retaliated on Canadian exports not with higher tariffs, but with similar opaque regulatory procedures. Canadian canola oil was accused of being infected with pests. Imports of Canadian pork and soybeans were subject to long paperwork delays. A similar dynamic took place for Australian exports to China. After Australia passed a national security law and blocked Chinese companies from its 5G mobile networks, Australian exports of barley were hit with anti-dumping duties, import licenses on Australian beef, lobster, and copper were revoked, and directives were issued to stop buying Australian cotton and coal. It would be useful to extend the analysis we undertake in this paper to these, and other, cases.

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Online Appendix
(Not for publication)

Figure A1: Δ U.S. Exports to China 2015-2017 vs. Δ tariff on U.S. Exports 2017-2019

Δ tariff on U.S. exports to China, 2017-2019
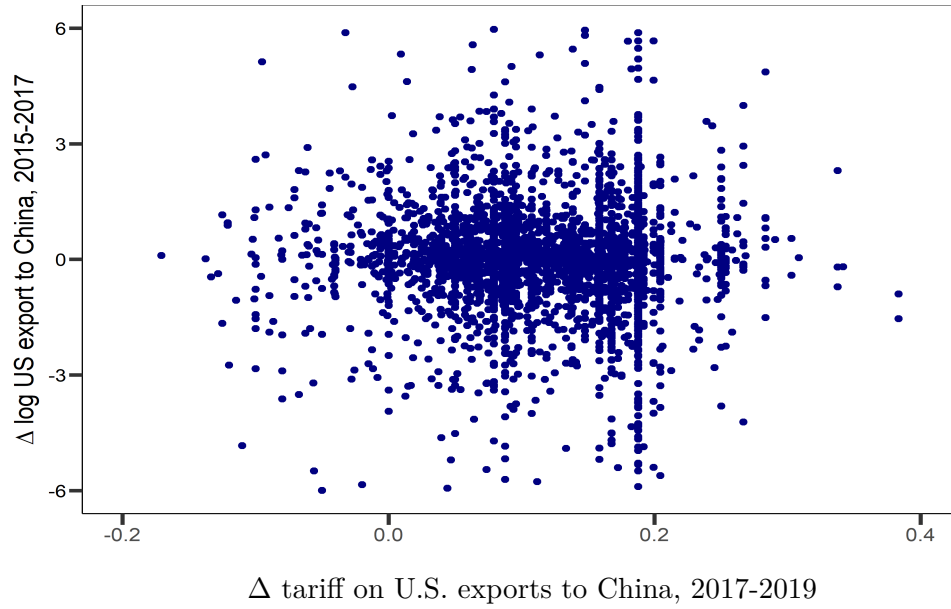
Notes: Observation is HS6 product. Scatter-plot of change in log U.S. exports to China (relative to exports of other countries to China) between 2015 and 2017 (y-axis) against change in tariff rate, $\Delta \log(1 + \tau)$, on U.S. exports to China between 2017 and 2019.

Figure A2: Δ non-tariff barriers vs. Δ tariff on U.S. exports to China, 2017-2019

Δ tariff on U.S. exports to China, 2017-2019
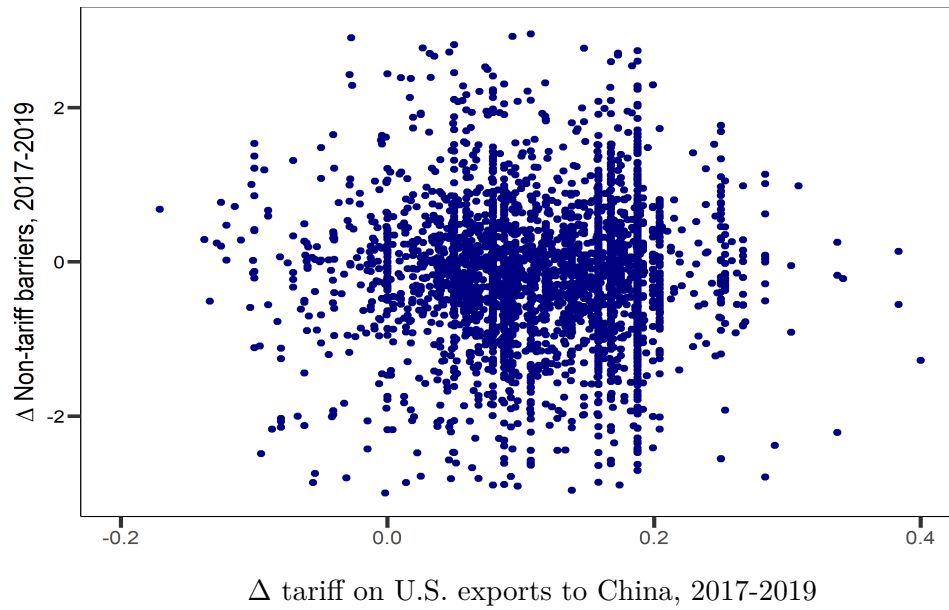
Notes: Observation is HS6 product. Scatter-plot of change in non-tariff barriers on U.S. exports to China, $\Delta \log(1+\phi)$, calculated from the Broda and Weinstein (2006) demand elasticities (y-axis) against change in tariff rate, $\Delta \log(1+\tau)$, on U.S. exports to China, both calculated between 2017 and 2019.

Figure A3: Δ U.S. exports to rest of world (except China) vs. Δ Non-tariff barriers, 2017-2019

Δ Non-tariff barriers on U.S. exports to China, 2017-2019
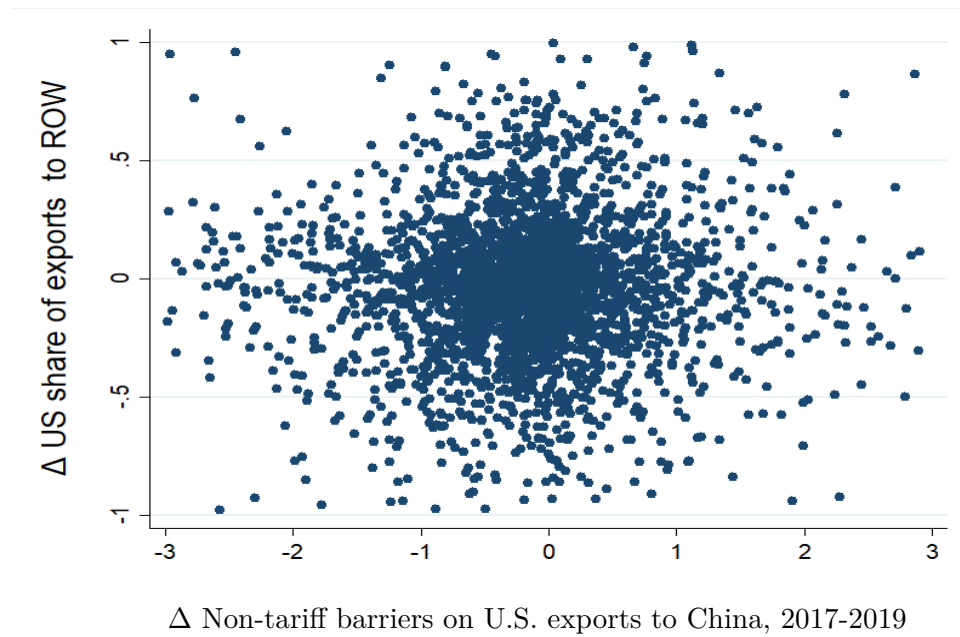
Notes: Observation is HS6 product. Scatter-plot of change in log U.S. exports to the rest of the world as a share of exports of the rest of the world to the rest of the world (y-axis) against change in non-tariff barriers, $\Delta \log(1 + \phi)$, on U.S. exports to China, both calculated between 2017 and 2019. The rest of the world excludes China. Trade of rest of the world calculated from Comtrade database.

Table A1: Number of News Articles on Non-Tariff Barriers and Trade War 2017-2020

Website	# Non-Tariff Articles	# Trade War Articles
abcnews.go.com	2	132
apnews.com	0	159
bbc.com	13	218
bloomberg.com	5	217
cnbc.com	10	214
cnn.com	6	215
dailymail.co.uk	1	213
economist.com	1	238
express.co.uk	0	227
finance.yahoo.com	4	216
forbes.com	5	229
fortune.com	0	231
foxnews.com	2	45
ft.com	5	194
independent.co.uk	0	138
latimes.com	4	229
mirror.co.uk	0	18
msnbc.com	0	19
nbcnews.com	1	222
newsweek.com	1	212
nikkei.com	6	215
npr.org	0	219
nytimes.com	8	237
politico.com	12	238
reuters.com	11	220
scmp.com	97	231
slate.com	0	24
standard.co.uk	0	6
telegraph.co.uk	1	65
theatlantic.com	0	120
theguardian.com	8	228
thehill.com	2	120
theintercept.com	0	19
thestreet.com	2	90
thetimes.co.uk	2	94
time.com	2	172
usnews.com	0	91
vox.com	2	188
washingtonpost.com	3	237
wsj.com	2	229
Total	218	6629

Table A2: Δ Non-Tariff Barriers and Tariffs on U.S. Products by HS2 Product, 2017-2019

	U.S. Share of Imports	Δ Tariff	Δ Non-Tariff Barriers
Agriculture			
Oil seeds, oleaginous fruits, etc.	8.75%	0.145	1.192
Pulp of wood, recovered paper etc.	2.37%	0.176	0.292
Wood and articles of wood	1.66%	0.149	0.141
Cereals	0.95%	0.25	1.413
Cotton	0.74%	0.25	-0.302
Meat and edible meat offal	0.57%	0.533	0.149
Fish and crustaceans, etc.	0.55%	0.282	-0.095
Raw hides and skins and leather	0.53%	0.03	0.682
Rubber and articles thereof	0.38%	0.119	0.364
Fruit and nuts, etc.	0.37%	0.428	-0.402
Food industries, residues and wastes thereof	0.29%	0.139	0.679
Dairy produce, birds' eggs, etc.	0.24%	0.201	0.361
Miscellaneous edible preparations	0.22%	0.063	-0.490
Preparations of vegetables, etc.	0.16%	0.115	0.101
Beverages, spirits and vinegar	0.07%	0.283	-0.135
Preparations of cereals, etc.	0.06%	0.156	-0.384
Sugars and sugar confectionery	0.04%	0.1	-0.205
Animal or vegetable fats, oils, etc.	0.03%	0.166	-0.252
Vegetables and certain roots and tubers	0.03%	0.199	0.220
Wool, fine or coarse animal hair	0.01%	0.188	-0.070
Manufacturing			
Electrical machinery and parts, etc.	1.49%	0.063	-0.084
Nuclear reactors and machinery, etc.	1.40%	0.07	0.027
Vehicles and parts and accessories thereof	1.36%	0.002	0.482
Aircraft, space craft and parts thereof	1.02%	0.001	0.322
Optical instruments, etc.	1.00%	0.073	-0.102
Plastics and articles thereof	0.61%	0.098	0.057
Pharmaceutical products	0.31%	0.007	0.037
Organic chemicals	0.29%	0.101	0.344
Chemical products n.e.c.	0.27%	0.03	-0.089
Copper and articles thereof	0.13%	0.233	-0.014
Iron or steel articles	0.10%	0.137	-0.018
Aluminium and articles thereof	0.10%	0.371	-0.172
Inorganic chemicals, etc.	0.08%	0.099	0.461
Glass and glassware	0.07%	0.093	-0.131
Essential oils and resinoids, etc.	0.07%	0.182	-0.566
Natural, cultured pearls, etc.	0.04%	0.134	-0.022
Salt, sulphur, earths, etc.	0.03%	0.13	-0.035
Iron and steel	0.03%	0.13	0.026
Ores, slag and ash	0.02%	0.097	1.418
Cotton	0.01%	0.187	1.220

Notes: Table shows U.S. exports of each HS-2 product as a share of total U.S. exports to China in 2017 (column 1) and weighted average of $\Delta \log(1 + \tau)$ (column 2) and $\Delta \log(1 + \phi)$ (column 3) across HS6 products for each HS-2 category (weights are expenditure share of a HS6 product in the HS2 sector).

Table A3: Concordance Between Domestic Products and 4-digit HS Code

Domestic Product	HS-4 Code	Domestic Product	HS-4 Code
Beef	0201	Refined Edible	1507
	0202	Vegetable Oil	1508
Pork	0203		1509
Mutton	0204		1510
Seafood	0301		1511
	0302		1512
	0303		1513
	0304		1514
	0305		1515
	0306	Refined Sugar	1701
	0307		1702
	0308	Beer	2203
	0309	Tobacco	2401
Milk	0402	Silkworm Cocoons	5001
	0403		5002
	0404		5003
	0405		5004
	0406		5005
Poultry Eggs	0407		5006
	0408		5007
Honey	0409	Wool	5101
Tubers	0701		5105
	0714		5106
	1105		5107
Fruits	0803		5109
	0804		5111
	0805		5112
	0806	Cotton	5201
	0807		5202
	0808		5203
	0809		5204
	0810		5205
Tea	0902		5206
Cereals	1002		5207
	1003		5208
	1004		5209
	1007		5210
	1008		5211
	1102		5212
	1103	Fiber Crops	5301
	1104		5302
Beans	1201		5303
Oil-bearing Crops	1203		5305
	1204		5306
	1206		5307
	1207		5308
	1208		5309
Sugarcane	1212		5310
			5311

Table A4: Regression of our Estimate of Non-tariff Barriers on Imports from Non-NAFTA Countries in Mexico on Direct Measures of Non-tariff Barriers from Conconi et al. (2018)

	Dependent Variable: Non-tariff Barriers on non-NAFTA countries in Mexico		
#Rules of Origin	0.057 (0.023)	0.027 (0.025)	0.047 (0.027)
Exports to NAFTA		0.097 (.025)	
#Rules of Origin × Exports to NAFTA		0.037 (0.015)	
Tariff MFN - NAFTA			-0.162 (0.088)
#Rules of Origin × Tariff MFN - NAFTA			0.088 (0.054)

Notes: Unit of observation is an HS6 product (N=1,613). The dependent variable is our estimate of non-tariff barriers on Mexican imports from non-NAFTA countries, calculated following the same procedure used to estimate non-tariff barriers on U.S. exports to China, where we use the HS6 product-level estimates of ϵ in Broda and Weinstein (2006). Independent variables from Conconi et al. (2018), where "#Rules of Origin" is the number of final goods with rules of origin requirements on the given intermediate inputs at HS6 level ("RoO^3" in Footnote 31), "Exports to NAFTA" is the log of Mexican exports to Canada and the U.S., and "Tariff MFN - NAFTA" is the difference between the MFN tariff and the NAFTA tariff. We use demeaned "Exports to NAFTA" and "Tariff MFN - NAFTA" interacted with "#Rules of Origin."