AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
http://ageconsearch.umn.edu
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

No endorsement of AgEcon Search or its fundraising activities by the author(s) of the following work or their employer(s) is intended or implied.

Global Trade Analysis Project
https://www.gtap.agecon.purdue.edu/

This paper is from the
GTAP Annual Conference on Global Economic Analysis
https://www.gtap.agecon.purdue.edu/events/conferences/default.asp

The Impact of Chinese Retaliatory Tariffs on U.S. Cotton Industry

Hongyi Yuan
Yangxuan Liu
Jing Liu
Cesar Escalante

Yuan is Master of Agribusiness Candidate, and Yangxuan Liu is Assistant Professor in the Department of Agricultural and Applied Economics, University of Georgia; Jing Liu is Postdoctoral Research Associate in the Department of Agricultural Economics, Purdue University; Escalante is Professor in the Department of Agricultural and Applied Economics, University of Georgia.

Copyright 2020 by Hongyi Yuan, Yangxuan Liu, Jing Liu and Cesar Escalante. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies.

Abstract *This research investigates the impacts of retaliatory tariffs imposed by China on U.S. cotton exports and the U.S. tariffs on Chinese textile products due to the recent escalation of trade dispute between these two largest economies in the world. The cotton industry seems to be severely undermined due to the intimate trade relationship between these two countries over time. This research utilizes the Global Trade Analysis Project (GTAP) model to generate estimates for export values, export volumes and employment situations in terms of cotton and textile sectors in the U.S. and the rest of the world. GTAP model can also predict changes in general economic well-being associated with the implementation of tariffs. To achieve these objectives, we proposed a special version of the GTAP model named GTAP-CTTN by redesigning the levels of regional and sectoral aggregations based on the latest release of standard GTAP database. The GTAP results underscore important potential economic consequences brought by the tariffs. As the U.S. trade policy exhibits inconsistency and even contradiction, it is crucial for decision-makers and farmers to beware of the vulnerability of cotton industry as well as the global cotton supply chain when facing tariffs enforced by trade partners.*
Key Words: Cotton, Textile, Trade, Tariff, GTAP

1. Introduction

Trade plays an essential role in the U.S. agricultural industry as it constitutes 20% of farmers' annual income (USDA-FAS, 2018). The recent U.S.-Sino trade dispute has once again revealed the vulnerability of the American agricultural sector to tariffs imposed by its counterparts. As the export growth was dragged by reduced sales to Asia, the trade surplus for American agriculture decreased to its lowest point since 2007 (USDA-ERS, 2019).

This study provides an early attempt to empirically analyze the implications of tariffs on cotton and cotton-related commodities. Unlike soybean, which receives more spotlight from the latest trade tension, the impacts of tariffs on cotton sector are hardly addressed based on quantitative approaches. Global Trade Analysis Project (GTAP) model serves as an effective tool for scrutinizing trade affairs and its application subjects can be extended to the cotton industry. This paper applies the GTAP model to quantitively analyze the impacts of retaliatory tariffs specifically on global cotton supply chain and industry.

Our analysis proceeds in the following manner. A review of the trade relationship between the United States and China for the agricultural industry from historical point of view is presented first. A brief summary about the dynamic development of bilateral trade dispute follows. Then related literature focusing on potential outcomes of imposed tariffs in terms of cotton and textile products is presented. Subsequently, a special version of GTAP model is introduced as a major quantitative tool to simulate the potential impacts of the established tariffs on economic well-being, export value, export volume, and employment.

2. Literature Review

2.1 U.S.-Sino Trade Relations on Cotton

The United States and China have been close trade partners across a wide variety of industries since the latter initiated the policy of reform and opening-up in the late 1970s. The opening-up policy of China transformed the country from a planned economy to a market economy. According to the U.S. Department of Agriculture Foreign Agricultural Service, in the year of 2012, China surpassed Canada and became the biggest overseas market for U.S. agricultural commodities (Marchant, 2017). Several factors jointly contributed to China's substantial demand for U.S. agricultural commodities: strong income growth arising from the success of its economic reforms, radical urbanization, and a rising middle class. While Rural China relies heavily on labor, a large number of young farmers migrate to the cities in search of better opportunities and higher wages. Farmlands are transformed into residential areas while remaining land resources were scattered into fragments operated by small household units, which results in compromised productivity. The agricultural dilemma in China underscored its incapability to satisfy domestic demands.

The U.S. is one of the major suppliers of agricultural products to China. The largest growth in U.S. agricultural exports to China has been in commodities that are not included in China's self-sufficiency maintaining policy (Marchant, 2017), in contrast to rice. Before the initiation of recent trade conflict that commenced in March 2018, U.S. cotton exports to China had witnessed significant and steady growth overtime given the demand coming from China's expanding textile business (Table 1). On the other hand, the U.S. has become the leading customer for Chinese textiles and clothing imports since the year of 2005 (World Integrated Trade Solution, 2018). The bilateral trade relationship in cotton and cotton-related commodities between China and the U.S. has a profound influence on the global cotton supply chain.

Table 1. China's Cotton Imports by Country of Origin (Tons)

Country	MY14/15	MY15/16	MY16/17	MY17/18	MY18/19*
Australia	272,075	268,389	199,963	282,467	341,826
United States	**153,372**	**191,680**	**501,178**	**558,777**	**119,411**
Uzbekistan	107,675	137,415	68,616	85,020	9,603
India	160,723	120,980	151,826	120,125	123,150
Brazil	134,084	116,075	44,571	82,148	292,176
Burkina Faso	18,588	5,557	4,464	10,501	
Cameroon	8,811	51,233	14,795	3,291	
Mali	2,238	2,862	4,608	502	
Benin	6,582	13,918	26,710	9,501	
Mexico	11,271	14,788	9,635	22,010	
Cote d Ivoire	3,224	8,283	5,575	9,634	
Zimbabwe	12,542	2,345	1,654	3,544	
Others	35,951	28,281	63,287	57,349	
Total	927,136	961,806	1,096,882	1,244,869	1,037,994
Price $/ton	1,840	1,716	1,858	1,950	

* First six-month data of MY18/19;

Source: Global Trade Atlas; USDA-FAS, GAIN Report Number: CH19023. P.16

2.2 The Shifts of U.S. Foreign Policy

This section summarizes the trade contentions between the U.S. and China to explore the possible theory toward explaining the motives behind tariff enaction. President Trump's criticism of China's unfair trade practices dates back to the 2016 Presidential Election. In March 2018, the United States Trade Representative released an investigation report where the current administration expressed concerns about the massive trade deficit with China. The report revealed that American corporations were forced to form joint ventures with local companies and share their technology. It also claims China's theft, or insufficient compensation for the use of their intellectual property and analyzed China's 2025 industrial plan (USTR, 2018). Before the implementation of first-round tariffs, the White House had been urging China to adjust its trade and foreign investment policies in favor of American corporations. China considered the listed allegations untenable for the following reasons: trade deficit reflects the market and consumer preferences instead of government interventions; the U.S. trade deficit to China was overestimated due to the inclusion of transit trade; restrictions on business activities for foreign companies were applied for the purpose of preserving sovereignty. Without seeing substantive progress, the

Trump administration officially announced tariff penalties on Chinese products in early 2018, which led to China's subsequent execution of retaliatory tariffs on U.S. products, including cotton exports.

Identifying critical factors during the decision-making process of great powers across the globe falls in the scholarship of foreign policy. Although determining the motives behind policy makers' decisions to apply tariffs does not serve as a priority for this paper, relevant studies give valuable insights on why such policy would be enacted in the first place, despite the awareness that the other party will take countermeasures and the potential damage might be greater than gains. A possible explanation toward such ambivalence is built upon loss aversion theory, in which Trump Administration perceived itself as being situated in a loss position in the trade status quo, based on the allegations against China displayed in the previous paragraph. The core argument of loss aversion implies that individuals are more risk-averse for gains than risk-acceptant for losses. Berejikian and Early (2013) found that American policy makers are more tough and resolute, and less willing to step back in trade disputes with preventive goals when compared to promotive cases. In other words, American policy makers are prone to make risky decisions like striking tariffs on China to avoid losses.

2.3 Existing tariffs on U.S. Cotton and Chinese Textiles

This section discusses the general timeline of the ongoing U.S.-Sino trade war with greater emphasis on tariffs involving cotton and textiles. On March 8, 2018, President Trump approved the order to impose 25% of tariffs on imported steel and 10% of tariffs on imported aluminum. In March 2018, the first round of 25% retaliatory tariffs on U.S.-exported agricultural products was announced by China, which further escalated the tension between the two nations. Among the $22 billion worth of U.S. agricultural products that were covered by the penalized duties, $14 billion are soybeans (Regmi, 2019), with the rest imposed on agricultural products include pork, fruits, and nuts. Table 2 shows the Chinese tariffs imposed on cotton and cotton-related commodities since the initiation of the trade dispute. Later in July 2018, 25% of tariffs on American cotton exports were activated, along with rest of the agricultural commodities initially excluded from the original penalties such as beef, wheat, sorghum and rice, that, in turn, caused a proliferation of 65% for out-of-quota cotton duty.

Table 2: China Tariffs on Cotton Products

Category	Before Trade Dispute with China	Effective July 6, 2018	Effective August 23, 2018	Effective September 24, 2018	Effective June 1, 2019
Cotton Linters	4%	29%	-	-	29%
Cotton, Not Carded or Combed					
In-Quota	1%	26%	-	-	26%
Out-of-Quota	40%	65%	-	-	65%
Yarn Waste Of Cotton	10%	-	35%	-	35%
Garnetted Stock Of Cotton Waste	10%	-	35%	-	35%
Other Cotton Waste	10%	-	35%		35%
Cotton, Carded or Combed					
In-Quota	1%	26%	-	-	26%
Out-of-Quota	40%	65%	-	-	65%
Cotton-Seed Oil (Excl. Crude) & Fractions Thereof	10%	-	-	15%	20%

Source: USDA-FAS, GAIN Report Number: CH18017; CH18034; CH18047; CH18052; CH18061; CH19030

In the case of American tariffs on Chinese textile exports, a series of adjustments on tariff rates were made with respect to textile, apparel and home textile products overtime (see Table 3). Chinese-exported textile and related products first braced the impacts during the 3rd stage of the game on September 1, 2018, from which a 10% tariff rate was formalized to $39.4 billion products (Tranche 3, Tranche 4A, and Tranche 4B), which constitutes the largest proportion of Chinese textile exports to America. Among the entire $39.4 billion worth of textile products:

1). $3.7 billion worth of goods from Tranche 3 were subject to an increased rate of 25% since September 24, 2018;

2). $31 billion worth of goods from Tranche 4A were subject to an increased rate of 15% since September 1, 2019;

3). The remaining $4.7 billion of textiles from Tranche 4B were also subject to an increased rate of 15% effective December 15, 2019.

In contrast to the consistency of the tariff schedule on U.S. cotton exports, the textile sector experienced significant delay and reduction in tariff rates as two countries made progress in reaching an interim trade agreement on December 13, 2019. Washington decided to halt the 15% tariff rate targeting commodities from Tranche 4B that were

planned to activate on December 15, 2019 as well as cutting the existing 15% tariffs in half with respect to textile products from Tranche 4A. As a result, $31 billion worth of Chinese-exported textiles will comply with an updated 7.5% of tariff rates; 15% of expected tariffs on $4.7 billion worth of textiles would be temporarily frozen until further notice. However, 25% of tariffs on $3.7 billion worth of textile goods in Tranche 3 continues.

China also enforced tariffs targeting American textile and wearing apparel. Both the tariff rates and the value of exports being affected were insignificant compared to punitive tariffs imposed by its trading partner. Approximately $973.5 million worth of American products were under active tariffs between 5%, 10%, 20% and 25% since September 24, 2018. As part of the December trade deal, Additional textile and apparel products totaling $1.36 billion were granted exemption from 5% and 10% of tariffs, respectively (Lu, 2020).

Table 3: The U.S. tariff on Chinese textile and apparel products

Stage	Punitive tariff rate & current status	Products covered (8-digit HS code)	Impact on textiles and apparel
Tranche 1	25% tariff rate, effective July 6, 2018 - present: active	818 tariff lines (US$34bn imports)	No textile and apparel products covered
Tranche 2	25% tariff rate, effective August 23, 2018 - present: active	279 tariff lines (US $16bn imports)	No textile and apparel products covered
Tranche 3	10% tariff rate, effective September 24, 2018; increased to 25% tariff rate, effective May 10, 2019 - present: active	5,773 tariff lines (US $200bn imports)	Around US$3.7bn textile products covered
Tranche 4A	15% tariff rate (was 10%), effective September 1, 2019 - present. The tariff rate will decease to 7.5% after the implementation of the U.S.-China 'Phase One' trade deal: active	3,243 tariff lines (US$112bn imports)	Around US$31bn textile, apparel and home textile products covered
Tranche 4B	15% tariff rate (was 10%), scheduled to take effect on December 15, 2019. Suspended because of the U.S.-China 'Phase One' trade deal	555 tariff lines (US$160bn imports)	Around US$4.7bn textile, apparel and home textile products covered

Source: HS Chapter 50 to 63; trade value in 2018 (data source: USTR, 2019; USITC, 2019).
(Taken from https://www.just-style.com/analysis/us-china-tariff-war-the-textile-and-apparel-hit-list-updated_id136519.aspx)

2.4 The Potential Impacts of Existing Tariffs

This section explores the existing literature that strikes the importance of potential outcomes of tariff implementation on American cotton exports and the global cotton supply chain. The relevant publications can be categorized into three genres: (a) research that expounded on the structure of cotton sector in global scale and forecasted the imminent harm of Chinese retaliatory tariffs on American cotton exports based on historical statistics; (b) research that retrieved the recently released data to analyze the long-run implications of Chinese cotton tariffs; (c) research that focused on the impact of Chinese retaliatory tariffs targeting other American agricultural commodities, with some implications on how tariffs reshaped American cotton sector.

Shortly after the announcement of tariffs targeting Chinese exports proposed by Trump Administration, the logical expectation was that the American cotton industry, as well as the entire agricultural sector would be severely undermined. Some authors articulated the structure of the world cotton production network and drew the conclusion based on previous-year's U.S. cotton export volumes and values by country of destination (Liu, Robinson & Shurley, 2018). The complexity of the cotton supply chain explained why the corresponding tariffs can extend its profound impacts from two competitors of this trade clash to other major cotton-importing and cotton-exporting countries, and ultimately the rest of the world. Key components of this supply chain interact with each other in two dimensions: domestic and international. Firstly, cotton is produced, processed and stockpiled at the farm level. Then merchants approach farmers and purchase cotton in large amounts. Thereafter the cotton is sold and shipped to yarn mills around the world, which marks the beginning of international transactions. Yarn and fabric are refined in textile factories and received by apparel mills to manufacture finished products; the textile-made apparel and mixed fabric clothes are eventually allocated to retail stores and sold to customers (Liu et al., 2019).

By examining the procedures of raw cotton being converted to textile products, it is evident that the American cotton basis, which functions as a segment of the cotton supply chain, depends tremendously on overseas interactions since spinning mills and textile factories are densely spread outside the homeland. Wang, Kinnucan and Duffy (2019) concluded that China remains as the largest consumer and importer of cotton yarn owing to the integration of global textile production combining the rising demand from the downstream industries. Another perspective is to review the adjustments of China's cotton policy in the past ten years. The determining factors of China's cotton trade activity are the volume, timing, and conditionality of quotas (MacDonal, Gale & Hansen, 2015). Several studies recognized a major shift in China's cotton policy in the year 2012 and 2013 that introduced out-of-quota imports with 40% of tariffs in order to reach a price uplift for cotton markets at home. American cotton sector is facing the most direct impact from the existing Chinese quota system plus the additional retributory tariffs (Hopkinson, 2018). The evaluation of the cotton supply chain is beneficial for our design of scenarios to be tested by GTAP model as the scenario of existing Chinese tariffs on American cotton

exports and the scenario of American tariffs on Chinese textile exports are corresponding to the first involvement of foreign transactions and the destination of this chain, respectively.

The assumption about the American cotton sector bracing for negative impacts was further confirmed by a series of statistics released months after the trade conflict broke out. A series of studies employed these latest data in terms of changes in American and global cotton prices, U.S. cotton exports by volumes and China's cotton and yarn imports to determine the immediate effects of increased Chinese protection on American cotton exports as the trade dispute continues. The U.S. share of China's cotton imports is considerably less than that of the previous marketing and three-year average, whereas Brazil and Australia's shares are higher compared to previous years (Muhammad & Smith, 2019). Other than taking advantage of China's expanding textile-processing industry, the U.S. share of China's cotton imports is noticeably being replaced by other cotton-exporting countries in the world a year since the trade war kicked off. It is most likely that such a trend will continue in the following years as alternative sellers would take up more shares of American cotton exports to China. A more detailed approach is by examining how the Chinese tariffs are eroding the economic wellbeing of certain region in the U.S. that is dominant in cotton production. Texas and Georgia are the top two cotton-producing states in the U.S. In Texas, upland cotton production reached 6.86 million (480-pound) bales in 2018 (USDA, 2019); Georgia produced 1.955 million 480-pound bales in the same year (Georgia Cotton Commission, 2019). In Georgia, the size of cotton shipments shrank due to the change of destinations with compromised demands in response to the trade war. The change of shipment size led to higher transaction costs and therefore impaired the local cotton business (Munisamy, Liu, Rabinowitz & Dorfman, 2019). In Texas, there had been growing anxiety about the potentially reduced cotton yields as less than 50% of crop cotton bolls were opening after a drought ramping in September 2019 (Farm Supply, 2019; USDA-NASS, 2019). There have not been adequate studies that investigate the situation of Texas cotton basis under trade tensions. It is predictable that the reduction in cotton yields and the current tariff penalty would jointly affect the cotton basis for Texas in the following year.

A shared characteristic of the current studies about cotton trade crises is the weighty reliance on established data. These studies established the general trend that warned about the prolonged depression of American cotton sector in the future. The question about how to quantify the magnitude or severity of such depression is assessed only to a very limited extent. A partial equilibrium econometric simulation model suggested that the overall U.S. cotton exports would only experience a moderate strike from China's 25% of tariffs on American cotton exports (Liu and Hudson, 2019). According to Liu and Hudson, the proposed model forbids changes in elasticities that are believed to be the result from restructuring supply chain (2019). We argue that additional quantitative models are needed to simulate the effects of tariffs on cotton exports for scholars to consider. Nevertheless, several works discussed above (Liu et al., 2018; Muhammad & Smith, 2019; Liu & Hudson,

2019) made contribution to identifying Vietnam as a merging cotton-importing country particularly after the present trade tension was intensified, apart from other well-known, traditional cotton-importing countries. This accomplishment helped improve the accuracy of our GTAP model as Vietnam was ruled out as an independent region from ROW (Rest of the World) in geographical aggregation.

To discover a suitable quantitative solution to investigate the impacts of tariffs on cotton commodities, the search for relevant literature was expanded to soybean-oriented studies. Because soybeans are the leading American agricultural exports and China is the top customer of American soybeans (USDA-ERS, 2018), scholars in the field of agricultural policy and international trade had been attempting to derive empirical approaches to predict the legacy of Chinese retaliatory tariffs on soybean sector, which provided some trustworthy references for our experimental design. Taheripour and Tyner (2018a) pioneered the application of the GTAP model in analyzing the effect of Chinese tariffs on American agricultural exports. A different set of scenarios were tested after the official imposition of 25% of tariffs on American soybean exports (Taheripour and Tyner, 2018b). The GTAP model designed for the case of soybean tariffs is capable of measuring the potential changes in the bilateral trade balance, production, price and economic welfare. Given the scarcity of empirical research that inspects impacts of tariffs on the cotton basis and the productive use of the GTAP model in soybean sector, we believed that redesigning the levels of regional and sectoral aggregations within the model would make it more appropriate for the study of cotton variety.

3. Computable General Equilibrium Analysis Using the GTAP-CTTN Model

3.1 GTAP-CTTN Model

In order to study the impacts of tariffs on the cotton and textile industries as well as for the rest of the economy, we consider the general equilibrium modeling approach to capture the economy-wide effects of trade policies. The Global Trade Analysis Project (GTAP) model has been widely adopted for this purpose. The standard GTAP model is a multi-regional, multi-sectoral, computable general equilibrium model, under assumption of perfect competition and constant returns to scale (Hertel, 1997). In this model, producers maximize their profits from the production technology with a CES (constant elasticity of substitution) functional form. Consumers maximize their utility by choosing an optimal mix of quantity of commodity goods. Private household preferences follow the non-homothetic CDE (Constant Distance Elasticity) functional form. Bilateral trade is handled under the Armington assumption. A global banking sector intermediates between global savings and consumption. After the original GTAP model was published in 1997 (Hertel, 1997), the standard GTAP model has been regularly updated over the course of twenty years. The latest version of the model is well documented in a recent paper by Corong et al. (2017).

Given the focal interest of this paper, we created a special version of the GTAP model, dubbed GTAP-CTTN based on the latest release of the GTAP database, i.e. the GTAP version 10. The GTAP 10 database covers 141 countries, which represent 98% of the world's GDP and 92% of the world's population. A total of 57 sectors are included in GTAP 10 - agricultural and food (20), natural resource (6), manufacturing (19), and service sectors (12). These are aggregated into six sectors in GTAP-CTTN: plant-based fibers (cott), textiles and wearing apparel (tex), crops (crop), livestock and processed food (food), manufacturing (mnfc), and services (serv)[1]. We retain China, the U.S., Vietnam, and Brazil as individual countries while the other countries are aggregated into four regions, namely South and the rest of Southeastern Asia (S.SE.ASIA), the rest of Latin America (LAM), Europe, and the rest of the World (ROW)[2]. The baseline of the model represents the economy of 2014.

3.2 Experimental Design

Given the complexity of global cotton supply chain, we not only intend to investigate the joint effect of both Chinese tariffs targeting American cotton exports and American tariffs targeting Chinese textile exports, but also seek to decompose the impacts of individual tariff on the cotton and textile sectors for each category of the regions aggregated in GTAP-CTTN with respect to economic well-being (measured by GDP), export value and employment situation. The results are generated from three cases via GTAP-CTTN simulations:

- Case 1: China imposes a 25% tariff rate on U.S. cotton exports.
- Case 2: U.S. imposes a 15% of tariff rate on Chinese textiles.
- Case 3: A combination of China's 25% cotton tariffs and America's 15% textile tariffs.

Case 1 serves as a review of the previous trade situation that lasted over a year before the U.S. implementation of 15% tariffs targeting Chinese textiles. Case 2 is proposed for the impact evaluation of textile tariffs only. Case 3 represents the joint effect of both cotton and textile penalties, which is also the current trade standoff between U.S. and China. The highlight of GTAP-CTTN model is its capacity of detecting the cross-sectoral effect of each tariff. For instance, we are able to not only articulate the effects of Chinese cotton tariff on cotton sectors but also determine whether cotton tariff alters textile sectors for all regions aggregated in GTAP-CTTN in terms of export value and employment. This feature also applies to textile tariffs.

---

[1] See Table 13 attached in appendix for detailed sectoral aggregation of the GTAP-CTTN derived from the standard GTAP database.

[2] See Table 14 attached in appendix for detailed regional aggregation of the GTAP-CTTN derived from the standard GTAP database.

4. Result Analysis

4.1 Economic Well-being

We evaluate changes in economic well-beings of major players in the global cotton market as a direct result of each case (Table 4). China's economic well-being decreases by $143 million, which is 78% more than the entire world's welfare losses and 66% more than America's welfare gains under Case 1; The decline in economics welfare worsens under Case 2 whereby China's economic well-being drops by more than $1.1 billions. The additive influence of cotton and textile tariffs eventually account for $1.25 billions of loss in China's economic welfare, which reflects the adverse effects of its retaliatory tariff targeting American cotton commodities and the effectiveness of American tariffs on Chinese textile.

The U.S. records the highest welfare gains in Case 1, which is nearly 35 times higher than S.SE.ASIA., the region with the second highest gains under the same case. Although the policy targeting Chinese textile exports in Case 2 seems to work, it causes far more economic losses to America itself with approximately $3.9 billion. For both Cases 2 and 3, the decrease in American economic well-being is three times larger than the decrease in China's economic wellbeing as well as 45 times larger than its own economic gains in Case 1. S.SE.ASIA shares similar scenario with the U.S. on a microscale. The economic well-being declines by $100 million and $97.5 million for Case 2 and Case 3, respectively, in contrast to the slight increase in Case 1.

Vietnam becomes the biggest beneficiary as the welfare gains from Case 2 strongly suggested its potential to replace China as the main supplier of textile products to the U.S. since the activation of textile tariffs. It is also the only country that observed subsequent increase of $11 million in economic welfare from individual tariff application in Case 2 to the two tariffs combined in Case 3.

Brazil ranks 2nd among regions that benefit from the trade tension, followed by the rest of the Latin America (LAM). While 25% of tariffs on American cotton revealed no considerable impact for both regions, the economic gains of Brazil and LAM remained at constant level for Cases 2 and 3, with Brazil earning around $149 million and LAM earning close to $57.6 million.

A twenty-five percent cotton tariff brings down Europe's economic welfare by $26 millions, which makes the region a major loser based on this index, following China. However, omitting the cotton tariffs and implementing a separate 15% of tariffs on Chinese textile contributed a substantial increase of $64 millions to Europe's economic well-being. The joint effects of both duties not only compensated for the loss from cotton tariff enforcement but also created a $40 million gains.

ROW shows a moderate decrease of $ 1.5 millions in economic welfare under Case 1, it manages to rise by $33.8 millions under Case 2 and remains relatively constant under joint effects of the two tariffs.

Overall, it seems that negative effects of tariff imposition are re-channeled back to their original executors. China's additional 25% tariffs on American cotton exports eventually leads to a loss of its own economic well-being, not mentioning its attendant positive gain to its American rival. On the other hand, despite the fact that a 15% American tariff on Chinese textile intensifies the loss of China's economic well-being, it causes more damage to America itself. As two schedules of tariffs jointly affect global cotton market, neither of the two protagonists in this trade dispute will get rewarded by their own trade policies. Secondly, the magnitude of changes in economic well-being caused by 15% of textile tariffs is significantly larger than that caused by 25% of cotton tariffs for all regions, whereas mild changes in economic well-being are shown for all regions between the case of 15% textile tariff case and the case of two tariffs combined. The Global economic welfare is reduced in all cases. In spite of the welfare growth in Vietnam, Brazil, LAM, Europe and ROW, the welfare decrease for United States and China are too dramatic to be offset, thus translating to an overall decline in global economic welfare by $4.57 billion and $4.63 billion for Cases 2 and 3, respectively.

Table 4. Changes in economic well-being by region and by case (million USD)

Region	Case 1: 25% of Chinese tariff on American cotton exports	Case 2: 15% of American tariff on Chinese textile exports	Case 3: Combination of 25% cotton and 15% textile tariffs
China	-143.0	-1108.0	-1250.0
USA	86.0	-3908.0	-3824.0
Vietnam	1.0	247.0	258.0
S.SE.ASIA	2.5	-100.0	-97.5
Brazil	0.0	148.9	148.8
LAM	0.5	57.3	57.8
Europe	-26.0	64.0	40.0
ROW	-1.5	33.8	32.3
Totoal	-80.5	-4565.1	-4634.7

4.2 Export value

Tables 5 and 6 below indicates changes in cotton and textile export values in each region under the 3 cases. These will be separately discussed in the following sections.

4.2.1 Changes in cotton export values

Global cotton export value shows a 0.74% decline under the influence of a 25% tariff targeting American cotton exports. Without the cotton duty, the presence of a 15% textile tariff only increases global cotton export by 0.2%. When both tariffs are imposed, global cotton export is reduced by 0.51%. The total change of export values in the cotton sector on a global scale is determined by the U.S., Vietnam, China and S.SE.ASIA.

The value of the U.S. cotton exports decreases dramatically by 13.72% as a direct outcome of the 25% Chinese cotton tariffs. Its own textile-importing duty slightly increases cotton export by 0.31%. Eventually the joint effect of two tariffs brings about a 13.07% of decrease in total export value.

Vietnam appears to be the biggest winner. The 25% Chinese cotton tariff on American cotton boosts its export value by 10.80%, which is also the highest rate across the globe. Although 15% textile tariff alone brings down its export value by 3.06%, it still exhibits an increased rate higher than any other region when the two tariffs are combined.

S.SE.ASIA shares a similar trend with Vietnam. Case 1 contributes a 4.28% increase in its cotton export value while Case 2 accounts for 0.73% of decrease. It realizes a 3.44% rise in cotton export value under a combined 25% Chinese cotton tariffs and 15% American textile tariffs.

Brazil, Europe and LAM exhibit register increases in cotton export values ranging between 2.34~3.19% under Case 1 and 2.83~3.28% under Case 3, respectively. The implementation of a 15% tariff on Chinese textile initiated by U.S. government does not have significant impact on any of the three regions in the cotton sector.

China's cotton export value is expected to have a limited decrease of 0.8% as a result of its own policy. Such number is considered insignificant as China's cotton exports remain low when compared to its total amount of cotton use (Nguema, 2019). It is noteworthy that a 15% tariff affecting Chinese textile exports will provide a 3.46% increase for China's cotton export value, in contrast to Vietnam's 3.06% loss in the same sector. The overall impact from two tariffs combined results in China's cotton values rising by 2.65%.

By examining cotton export values, it is obvious that American cotton business braces the worst impacts from China's 25% retaliatory tariffs in terms of export value. The increase in Vietnam's cotton export value under Cases 1 and 3 might be the rerouting effects, as Vietnam serves as an intermediated market between U.S. and China in terms of cotton trade. The subsequent countermeasure against Chinese textile established by the U.S. government improves China's cotton exports and unintentionally decreases Vietnam's cotton export values. Yet Vietnam benefits the most from China's trade policy alone as well as under a combined tariff regime

Table 5. Changes in cotton export values by region and by case (%)

Region	Case 1: 25% of Chinese tariff on American cotton exports	Case 2: 15% of American tariff on Chinese textile exports	Case 3: Combination of 25% cotton and 15% textile tariffs
China	-0.80	3.46	2.65
USA	-13.72	0.31	-13.07
Vietnam	10.80	-3.06	7.46
S.SE.ASIA	4.28	-0.73	3.44
Brazil	2.34	0.98	3.28
LAM	2.50	0.39	2.83
Europe	3.19	-0.05	3.09
ROW	3.67	0.57	4.18
Totoal	-0.74	0.20	-0.51

4.2.2 Changes in textile export values

The summary in Table 6 indicates that global textile exports exhibit mild decreases in Cases 2 and 3. The analysis of this subsection will put emphasis on Cases 2 and 3 as all regions show minimal changes of no higher than 0.1% in textile export value under Case 1.

China's textile export value drops considerably by 8.17% as a direct outcome of the 15% American tariffs pointing at its commodities. The decrease in textile exports is eventually intensified as the two tariffs are combined (8.22%).

America's tariff imposition has conservative side effects, which are responsible for a 1.34% decrease in its own textile exports. Given the degree of loss from China's textile exports in the same case, the efficacy of this policy is justified.

LAM achieves the highest increase in textile exports with 16% in average for Cases 2 and 3. Vietnam also sees a substantial 8.57% increase in textile exports following LAM. S.SE.ASIA and Brazil show parallel favorable tendencies of prosperity in textile exports with growth ranging between 4.2%~4.8% across Case 2 and Case 3.

European textile exports are not greatly affected by all cases, similar to its cotton exports. ROW shows a moderate average increase of 3.15% for Cases 2 and 3.

Table 6. Changes in textile export values by region and by case (%)

Region	Case 1: 25% of Chinese tariff on American cotton exports	Case 2: 15% of American tariff on Chinese textile exports	Case 3: Combination of 25% cotton and 15% textile tariffs
China	-0.06	-8.17	-8.22
USA	0.10	-1.34	-1.25
Vietnam	0.01	8.57	8.57
S.SE.ASIA	-0.01	4.79	4.78
Brazil	0.01	4.20	4.21
LAM	0.06	15.96	16.01
Europe	0.04	0.66	0.70
ROW	0.05	3.13	3.18
Totoal	0.00	-0.98	-0.98

In general, we draw upon a series of findings from the two subsections above:

It is evident that the 15% of American tariff on Chinese textile exports has a cross-sectional effect on many regions' cotton exports. For example, the cotton export value in China increases by 3.46% and Vietnam's cotton export value decreases by 3.06%. Brazil, S.SE.ASIA. and LAM also have various degrees of changes in cotton export values resulting from the American textile tariffs. Meanwhile the Chinese tariff targeting American cotton exports with a higher rate does not show a significant sign of cross-

sectional effect on textile exports in any region. Although we are unable to articulate the mechanism behind such phenomenon based on knowledge at hand, it is safe to assume that this cross-sectional effect of textile tariffs on cotton exports is correlated to the structure of the global cotton supply chain.

Both China's cotton tariff and America's textile tariff cause dramatic decrease in their trade counterpart's corresponding commodity exports, as well as a recession in the total export values of the corresponding commodities across the globe. For the two protagonists of this trade dispute, there may be mild repercussions on their own commodity exports. It seems to be a rational decision to impose tariffs targeting rival's corresponding commodity exports as the damage to the rival will be much higher than the side effect.

Vietnam stands out as the biggest winner of this bilateral trade dispute between the U.S. and China. Both its cotton exports and textile exports show impressive overall increases. Brazil and S.SE.ASIA also improve their cotton and textile exports while LAM is booming in textile exports.

4.3 Export volume

This section analyzes the impacts of three tariff cases on the export volumes of the cotton and textile sectors in each region as well as the entire world. The trend of changes in export volume is highly analogous to that in the export value for both cotton and textile sectors. The 15% American tariff on Chinese textile exports has a cross-sectional effect on many regions' cotton export volume. In comparison, the 25% Chinese tariff on American cotton exports does not influence textile exports.

4.3.1 Changes in cotton export volume

Table 7 lists changes in cotton export volume under the different cases. U.S.A., Vietnam, China and S.SE.ASIA are the main regions affected by cotton and textile tariffs:

A sharp decline is observed in the U.S. cotton export volume under China's 25% tariff targeting its cotton basis. Its own 15% textile-importing tariff produce minimal impacts. The combination of both cotton and textile tariffs accounts for a 12.42% decline in its cotton export volume. The results are consistent with those for cotton export values from the previous section.

Vietnam exhibits the strongest growth in cotton export volume under Case 1 and Case 3. It also produces the greatest reduction in cotton exports due to 15% American textile tariff. Nevertheless, the growth rate under the existence of Chinese cotton tariff in Case 1 is much higher than any other region, keeping Vietnam as the leading cotton-exporting nation when those two tariffs are combined. S.SE.ASIA shares a similar pattern with lower rates of increase under Cases 1 and 3 and lower rate of decline in comparison to Vietnam under Case 2.

Brazil, Europe and LAM show increases in cotton export volume ranging between 2.26%~3.09% under Case 1 and 2.68%~3.18% under Case 3. The presence of 15% tariff on Chinese textile exports imposed by the U.S. does not lead to a significant effect on any of the three regions in terms of cotton export volume.

China will face 4% and 3.01% increases under Cases 2 and 3, respectively. Its own policy of implementing 25% tariff on American cotton exports results in less than 1% of moderate decrease in cotton export volume.

Table 7. Changes in cotton export volume by region and by case

Region	Case 1: 25% of Chinese tariff on American cotton exports	Case 2: 15% of American tariff on Chinese textile exports	Case 3: Combination of 25% cotton and 15% textile tariffs
China	-0.97	4.00	3.01
USA	-12.92	0.16	-12.42
Vietnam	10.51	-3.57	6.64
S.SE.ASIA	4.15	-1.08	2.95
Brazil	2.26	0.96	3.18
LAM	2.52	0.21	2.68
Europe	3.09	-0.05	2.99
ROW	3.64	0.56	4.14
Total	-0.59	0.09	-0.47

4.3.2 Changes in textile export volume

Table 8 lists the changes in textile export volume under various tariff schedules. Global textile export volume remains at constant level in all cases. The 25% cotton tariff initiated by China does not produce noticeable effects on any specific region's textile exports. The results from Case 2 simulation are nearly identical to those of Case 3:

A sharp reduction (8.02%) is obtained for China's textile export volume as a direct outcome of 15% American tariffs on its textile exports. America maintains a relatively stable volume in textile exports when compared to China's recession in the same sector under Cases 2 and 3, highlighting the effectiveness of 15% textile tariffs on the latter. Only China and USA show decreases in cotton export volumes. LAM illustrates the sharpest increase in textile export volume in Cases 2 and 3, following Vietnam, S.SE.ASIA, Brazil and Europe.

Table 8. Changes in textile export volume by region and by case

Region	Case 1: 25% of Chinese tariff on American cotton exports	Case 2: 15% of American tariff on Chinese textile exports	Case 3: Combination of 25% cotton and 15% textile tariffs
China	-0.08	-8.02	-8.09
USA	0.11	-1.63	-1.53
Vietnam	0.00	8.51	8.50
S.SE.ASIA	-0.02	4.72	4.70
Brazil	0.01	4.21	4.22
LAM	0.06	15.89	15.94
Europe	0.04	0.67	0.70
ROW	0.05	3.14	3.18
Total	0.00	-0.93	-0.95

4.4 Price changes

4.4.1 Changes in cotton price

The changes in cotton prices are presented in Table 9. Case 2 (15% American tariff on Chinese textile exports) reveals little effect on the cotton sector for all regions within the GTAP-CTTN model. The results of the single 25% Chinese cotton tariff are similar to those from the combined tariff case. China exhibited the largest increase in cotton price ranging from 3.24% to 3.38% in Cases 2 and 3. The USA records a mild decrease in cotton price from 0.91% to 0.74% in the face of 25% Chinese cotton tariff and the combination of the two tariffs. The remaining regions indicated subtle changes in domestic cotton prices under Cases 1 and 3.

Table 9. Changes in cotton price by region and by case (%)

Region	Case 1: 25% of Chinese tariff on American cotton exports	Case 2: 15% of American tariff on Chinese textile exports	Case 3: Combination of 25% cotton and 15% textile tariffs
China	3.24	0.14	3.38
USA	-0.91	0.15	-0.74
Vietnam	-0.21	0.12	-0.08
S.SE.ASIA	0.09	0.31	0.40
Brazil	0.08	0.02	0.09
LAM	-0.37	0.15	-0.21
Europe	0.07	0.01	0.08
ROW	-0.04	0.03	-0.01

4.4.2 Changes in textile price

In terms of the changes in textile price, the summary in Table 10 indicates that the magnitude of effects of all three scenarios on domestic textile prices are much smaller than that on cotton prices for all regions. All regions excluding China and USA experienced almost constant textile prices that fluctuated only by less than 0.1% for all the three cases. The USA exhibits a moderate increase in textile price with 0.77% for Cases 2 and 3. China shows a mild 0.15% decrease in average for Cases 2 and 3.

Table 10. Changes in textile price by region and by case

Region	Case 1: 25% of Chinese tariff on American cotton exports	Case 2: 15% of American tariff on Chinese textile exports	Case 3: Combination of 25% cotton and 15% textile tariffs
China	0.02	-0.16	-0.14
USA	0.00	0.77	0.77
Vietnam	0.01	-0.07	-0.06
S.SE.ASIA	0.01	0.03	0.04
Brazil	0.01	-0.02	-0.02
LAM	0.00	0.04	0.05
Europe	0.01	-0.02	-0.02
ROW	0.00	-0.02	-0.02

4.5 Employment

The final economic indicator that may be affected by the agricultural implications of the U.S.-Sino trade dispute is employment. This section will present the resulting employment situations for workers involved in cotton sector and textile sector under all tariff scenarios.

4.5.1 Employment changes in cotton sector

Based on the results in Table 11, employment in the American cotton industry substantially decreases by 8.02% as a consequence of the 25% Chinese tariff on cotton exports. With respect to America's retaliatory duty on Chinese textile exports, it manages to worsen China's employment condition in cotton sector by 2.88% while slightly improving its own employment situation. The consolidation of the two tariffs would, in turn, result in a 6.86% decline in employment in the American cotton sector.

China's own policy produces a 1.44% of job increase in its domestic cotton sector; however, the inclusion of 15% American tariff on Chinese textile exports disrupts China's cotton industry and eventually results in a 1.48% decrease in employment.

Vietnam experiences the most beneficial employment effect, with a high rate of job increases in all cases. The employment growth in Vietnam's cotton sector is also the highest around the world under all three cases. The cumulative benefits from two separate tariffs stimulate 6.68% more jobs for the country's cotton basis. Other regions show modest job increases in their own cotton sectors in Cases 2 and 3, ranging between 0.28%~ 1.98%.

Table 11. Changes of employment in cotton sector by region and by case (%)

Region	Case 1: 25% of Chinese tariff on American cotton exports	Case 2: 15% of American tariff on Chinese textile exports	Case 3: Combination of 25% cotton and 15% textile tariffs
China	1.44	-2.88	-1.48
USA	-8.02	0.95	-6.86
Vietnam	3.44	3.36	6.68
S.SE.ASIA	0.59	1.41	1.98
Brazil	0.95	0.44	1.38
LAM	-0.15	1.29	1.14
Europe	0.81	0.01	0.81
ROW	0.55	0.28	0.82

4.5.2 Employment changes in textile sector

The summary in Table 12 indicates that the employment situation for the textile sector in all regions remains unchanged under China's 25% cotton tariffs. In the case of the 15% textile tariff, some notable job changes are expected in some textile sectors.

American trade policy succeeds in increasing its domestic jobs in the cotton industry by an average of 4.2% while cutting down 3.28% of employment in China's cotton textile sector for Cases 3 and 4. Vietnam registers the strongest growth (7.72% on average for Cases 3 and 4) in employment in the cotton sector. LAM produces the second highest increase in jobs with an average of 4.15% in cotton sector for Cases 2 and 3. Other regions show small job increases in their cotton sectors under Cases 3 and 4, ranging between 0.1% and 1.9%.

Table 12. Changes of employment in textile sector by region and by case (%)

Region	Case 1: 25% of Chinese tariff on American cotton exports	Case 2: 15% of American tariff on Chinese textile exports	Case 3: Combination of 25% cotton and 15% textile tariffs
China	-0.04	-3.26	-3.30
USA	0.03	4.19	4.22
Vietnam	0.00	7.72	7.17
S.SE.ASIA	-0.01	1.92	1.92
Brazil	0.00	0.06	0.06
LAM	0.03	4.12	4.14
Europe	0.03	0.33	0.36
ROW	0.03	0.90	0.93

5. Conclusion

USA and China are facing remarkable recessions from the perspectives of economic well-being, export value and employment in both cotton and textile sectors given the trade status quo that neither side intends to reduce the existing tariff rates. A continuation of trade tension will deplete agricultural resources and social welfare in both nations. While the global cotton and textile markets show a downturn trend in economic well-being and export value under the trade war, Vietnam becomes the biggest winner in all aspects: the economic well-being increases $258 million, growth rates for cotton exports and textile exports are higher than 7% and more than 6.5% of jobs are created when China's cotton-importing tariff couples with America's textile-importing tariff.

This study also sheds light on the cross-sectoral effect of 15% of American-initiated textile-importing tariff on the cotton sector's export values, export volumes and employment in a number of regions. Particularly, the cross-sectoral characteristic of American tariffs on Chinese textiles has noticeable but opposite effects between China's cotton sector and Vietnam's cotton industry in terms of export values and employment changes. Apart from concentrating on the struggle of domestic cotton and textile sectors for U.S. and China, future researches could aim at identifying the role of Vietnam in the global cotton supply chain and the reasons behind its economic gains from this trade war.

The U.S. foreign policy has exhibited its uncertainty since the early stage of Sino-U.S. trade dispute, the Trump Administration's strategy for the past two years is to impose maximum pressure on China to force the latter to make concessions. In January 2020, the two nations signed a partial trade deal. One of the major adjustments from the potential trade agreement is that the existing rate of American tariff on Chinese textile exports will be cut in half from 15% to 7.5%; China will freeze the scheduled 5% and 10% tariffs targeting additional $ 1.36 billion worth of American textile exports that were originally scheduled to take effect on December 15, 2019. It would be worthwhile to further investigate whether a possible reduction of American textile tariff is likely to alleviate China's cotton basis and textile basis as well as other regions' relevant industries. Potential damages of 5% and 10% tariffs on American textile exports that were previously planned by China also deserve more attention, considering the possibility that the decrease in China's textile-importing tariff may not be fulfilled in the end, despite the signing of phase-one trade deal.

References

Berejikian, J. D., & Early, B. R. (2013). Loss aversion and foreign policy resolve. *Political Psychology, 34*(5), 649-671.

Corong, E. L., Hertel, T. W., McDougall, R., Tsigas, M. E., & van der Mensbrugghe, D. (2017). The standard GTAP model, version 7. *Journal of Global Economic Analysis, 2*(1), 1-119.

Georgia Cotton Commision. (2019). *GA Cotton Stats.* Available online: http://www.georgiacottoncommission.org/index.cfm?show=10&mid=5

Hertel, T. W. (1997). *Global trade analysis: modeling and applications*: Cambridge university press.

Hopkinson, J. (2018). Profiles and Effects of Retaliatory Tariffs on US Agricultural Exports. *Report R45448. Congressional Research Service*.

Liu, B., & Hudson, D. (2019). A Preliminary Analysis of the Effects of China's Cotton Tariff on the Chinese and US Cotton Markets. *Estey Journal of International Law and Trade Policy, 20*(1753-2019-2986), 15-27.

Liu, Y., Robinson, J. R., & Shurley, W. D. (2018). China's potential cotton tariffs and US cotton exports: Lessons from history. *Choices, 33*(2), 1-6.

Lu, S. (2020). US-China tariff war - The textile and apparel hit-list updated. *Just-style.* Available online: https://www.just-style.com/analysis/us-china-tariff-war-the-textile-and-apparel-hit-list-updated_id136519.aspx

MacDonald, S., Gale, F., & Hansen, J. (2015). Cotton policy in China.

Marchant, M.A. (2017). "Theme Overview: U.S. Commodity Markets Will Respond to Changes in China's Ag Policies." *Choices. Quarter 2.* Available online: http://www.choicesmagazine.org/choices-magazine/theme-articles/us-commodity-markets-respond-to-changes-in-chinas-ag-policies/theme-overview-us-commodity-markets-respond-to-changes-in-chinas-ag-policies

Munisamy, G., Liu, Y., Rabinowitz, A., & Dorfman, J. (2015). The Costs to Agriculture from Recent Trade. Disputes: A Georgia Perspective. *UGA Cooperative Extension.* Available online: https://site.extension.uga.edu/aaecext/files/2019/06/2019_Munisamy-Liu-Rabinowitz-Dorfman.pdf

Farm Supply. (2019). Trade Remains the Focus as Tariffs Take Toll on Agriculture.

Nguema, A. (2019). China: Cotton and Products Annual. *GAIN Report CH19023. USDA Foreign Agricultural Service.* Available online: https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfilename?filename=Cotton%20and%20Products%20Annual_Beijing_China%20-%20Peoples%20Republic%20of_4-11-2019.pdf

Regmi, A. (2019). Retaliatory Tariffs and U.S. Agriculture. *Report R45903. Congressional Research Service.* Available online: https://fas.org/sgp/crs/misc/R45903.pdf

USDA-ERS. (2018). Top 10 U.S. agricultural export markets for wheat, corn, soybeans, and cotton, by volume. Available online: https://ers.usda.gov/data-products/foreign-agricultural-trade-of-the-united-states-fatus/us-agricultural-trade-data-update/#Top%2010%20U.S.%20agricultural%20export%20markets

%20for%20wheat,%20corn,%20soybeans,%20and%20cotton,%20by%20volume

USDA-ERS. (2019). Agricultural Trade. Available online: https://ers.usda.gov/data-products/ag-and-food-statistics-charting-the-essentials/agricultural-trade/

USDA-FAS. (2018). Percentage of U.S. Agricultural Products Exported. Available from https://www.fas.usda.gov/data/percentage-us-agricultural-products-exported

USDA-NASS. (2019). Crop Progress report. Retrieved from https://www.nass.usda.gov/Charts_and_Maps/Crop_Progress_&_Condition/2019/TX_2019.pdf

USTR. (2018). Report on China's Acts, Policies, and Practices Related to Technology Transfer, Intellectual Property, and Innovation. Available online: https://ustr.gov/sites/default/files/Section%20301%20FINAL.PDF

Taheripour, F., & Tyner, W. E. (2018a). *Impacts of Possible Chinese Protection on US Soybeans*. (No. 1237-2019-303)

Taheripour, F., & Tyner, W. E. (2018b). Impacts of possible Chinese 25% tariff on US soybeans and other agricultural commodities. *Choices, 33*(2), 1-7.

Wang, P., Kinnucan, H. W., & Duffy, P. A. (2019). The effects of rising labour costs on global supply chains: the case of China's cotton yarn industry. *Applied Economics, 51*(33), 3608-3623.

World Integrated Trade Solution. (2018). China Textile and Clothing Exports by Country. Available online https://wits.worldbank.org/CountryProfile/en/Country/CHN/Year/LTST/TradeFlow/Export/Partner/by-country/Product/50-63_TextCloth

Appendix

Table 13. Sectoral aggregation for GTAP-CTTN based on GTAP 10 database

agg.sec.name	gtap.sec.code	gtap.sec.name
crop	pdr	paddy rice
crop	wht	wheat
crop	gro	cereal grains nec
crop	v_f	vegetables, fruit, nuts
crop	osd	oil seeds
crop	c_b	sugar cane, sugar beet
cott	pfb	plant-based fibers
crop	ocr	crops nec
food	ctl	bovine cattle, sheep and goats, horses
food	oap	animal products nec
food	rmk	raw milk
food	wol	wool, silk-worm cocoons
mnfc	frs	forestry
mnfc	fsh	fishing
mnfc	coa	coal
mnfc	oil	oil
mnfc	gas	gas
mnfc	omn	minerals nec
food	cmt	bovine cattle, sheep and goat meat products
food	omt	meat products
food	vol	vegetable oils and fats
food	mil	dairy products
food	pcr	processed rice
food	sgr	sugar
food	ofd	food products nec
food	b_t	beverages and tobacco products
tex	tex	textiles
tex	wap	wearing apparel

mnfc	lea	leather products
mnfc	lum	wood products
mnfc	ppp	paper products, publishing
mnfc	p_c	petroleum, coal products
mnfc	crp	chemical, rubber, plastic products
mnfc	nmm	mineral products nec
mnfc	i_s	ferrous metals
mnfc	nfm	metals nec
mnfc	fmp	metal products
mnfc	mvh	motor vehicles and parts
mnfc	otn	transport equipment nec
mnfc	ele	electronic equipment
mnfc	ome	machinery and equipment nec
mnfc	omf	manufactures nec
serv	ely	electricity
serv	gdt	gas manufacture, distribution
serv	wtr	water
serv	cns	construction
serv	trd	trade
serv	otp	transport nec
serv	wtp	water transport
serv	atp	air transport
serv	cmn	communication
serv	ofi	financial services nec
serv	isr	insurance
serv	obs	business services nec
serv	ros	recreational and other services
serv	osg	public admin. and defence, education, health
serv	dwe	ownership of dwellings

Table 14. Regional aggregation for GTAP-CTTN based on GTAP 10 database

agg.reg.name	gtap.reg.code	gtap.reg.name
ROW	aus	Australia
ROW	nzl	New Zealand
ROW	xoc	Rest of Oceania
China	chn	China
ROW	hkg	Hong Kong, China
ROW	jpn	Japan
ROW	kor	Korea
ROW	mng	Mongolia
ROW	twn	Taiwan, China
ROW	xea	Rest of East Asia
ROW	brn	Brunei Darussalam
ROW	khm	Cambodia
S.SE.ASIA	idn	Indonesia
S.SE.ASIA	lao	Lao People's Democratic Republic
S.SE.ASIA	mys	Malaysia
S.SE.ASIA	phl	Philippines
S.SE.ASIA	sgp	Singapore
S.SE.ASIA	tha	Thailand
S.SE.ASIA	vnm	Vietnam
S.SE.ASIA	xse	Rest of South east Asia
S.SE.ASIA	bgd	Bangladesh
S.SE.ASIA	ind	India
S.SE.ASIA	npl	Nepal
S.SE.ASIA	pak	Pakistan
S.SE.ASIA	lka	Sri Lanka
S.SE.ASIA	xsa	Rest of South Asia
ROW	can	Canada
USA	usa	United States of America
LAM	mex	Mexico
ROW	xna	Rest of North America
LAM	arg	Argentina

LAM	bol	Bolivia
Brazil	bra	Brazil
LAM	chl	Chile
LAM	col	Colombia
LAM	ecu	Ecuador
LAM	pry	Paraguay
LAM	per	Peru
LAM	ury	Uruguay
LAM	ven	Venezuela
LAM	xsm	Rest of South America
LAM	cri	Costa Rica
LAM	gtm	Guatemala
LAM	hnd	Honduras
LAM	nic	Nicaragua
LAM	pan	Panama
LAM	slv	El Salvador
LAM	xca	Rest of Central America
LAM	dom	Dominican Republic
LAM	jam	Caribbean
LAM	pri	Puerto Rico
LAM	tto	Trinidad and Tobago
LAM	xcb	Caribbean
Europe	aut	Austria
Europe	bel	Belgium
Europe	bgr	Cyprus
Europe	hrv	Czech Republic
Europe	cyp	Denmark
Europe	cze	Estonia
Europe	dnk	Finland
Europe	est	France
Europe	fin	Germany
Europe	fra	Greece
Europe	deu	Hungary
Europe	grc	Ireland
Europe	hun	Italy

Europe	irl	Latvia
Europe	ita	Lithuania
Europe	lva	Luxembourg
Europe	ltu	Malta
Europe	lux	Netherlands
Europe	mlt	Poland
Europe	nld	Portugal
Europe	pol	Slovakia
Europe	prt	Slovenia
Europe	rou	Spain
Europe	svk	Sweden
Europe	svn	United Kingdom
Europe	esp	Switzerland
Europe	swe	Norway
Europe	gbr	Rest of EFTA
Europe	che	Albania
Europe	nor	Bulgaria
Europe	xef	Belarus
Europe	alb	Croatia
Europe	blr	Romania
Europe	rus	Russian Federation
Europe	ukr	Ukraine
Europe	xee	Rest of Eastern Europe
Europe	xer	Rest of Europe
Europe	kaz	Kazakhstan
Europe	kgz	Kyrgyzstan
Europe	tjk	Tajikistan
Europe	xsu	Rest of Former Soviet Union
Europe	arm	Armenia
Europe	aze	Azerbaijan
Europe	geo	Georgia
ROW	bhr	Baharain
ROW	irn	Iran Islamic Republic of
ROW	isr	Israel
ROW	jor	Jordan

ROW	kwt	Kuwait
ROW	omn	Oman
ROW	qat	Qatar
ROW	sau	Saudi Arabia
ROW	tur	Turkey
ROW	are	United Arab Emirates
ROW	xws	Rest of Western Asia
ROW	egy	Egypt
ROW	mar	Morocco
ROW	tun	Tunisia
ROW	xnf	Rest of North Africa
ROW	ben	Benin
ROW	bfa	Burkina Faso
ROW	cmr	Cameroon
ROW	civ	Cote d'Ivoire
ROW	gha	Ghana
ROW	gin	Guinea
ROW	nga	Nigeria
ROW	sen	Senegal
ROW	tgo	Togo
ROW	xwf	Rest of Western Africa
ROW	xcf	Central Africa
ROW	xac	South Central Africa
ROW	eth	Ethiopia
ROW	ken	Kenya
ROW	mdg	Madagascar
ROW	mwi	Malawi
ROW	mus	Mauritius
ROW	moz	Mozambique
ROW	rwa	Rwanda
ROW	tza	Tanzania
ROW	uga	Uganda
ROW	zmb	Zambia
ROW	zwe	Zimbabwe
ROW	xec	Rest of Eastern Africa

ROW	bwa	Botswana
ROW	nam	Namibia
ROW	zaf	South Africa
ROW	xsc	Rest of South African Customs
ROW	xtw	Rest of the World