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A Tariffying Thought: Imposing Tariffs on US Apparel Imports from China

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Abstract

Using a source-differentiated Almost Ideal Demand System (SDAIDS) model, this paper analyzes US demand for apparel imports and estimates effects of a 15% tariff increase on clothing imports from China. Our welfare analysis estimated a consumer surplus loss of about $348 million per year. Our findings show that China can improve its market position by lowering their prices, or conversely, that tariffs will disproportionally reduce Chinese market share. However, other Asian apparel exporting countries, especially Vietnam and Bangladesh, are strong competitors that could represent a challenge to the current market position of China.

Keywords: AIDS model, apparel/clothing imports, source-differentiated, tariff

Introduction

Over the past two decades, the United States became increasingly dependent on textile and clothing imports to meet consumer demand. Data describing the share of domestically-produced apparel currently sold through US retail channels is limited. One known source is a retail audit conducted by Cotton Incorporated, which estimates the proportion of U.S.-made clothing offered for sale in the United States to be near one percent (Cotton Incorporated, 2019). From 2000 to 2018, the value of US garment imports increased by 46% to US$82.9 billion. Average costs decreased over the same period, and in volume terms (measured in square meter equivalence or SME), the percentage increase in imports was an even greater at 73% (OTEXA, 2019).

The increase in US clothing imports was coincident with strong growth in shipments from China. China's accession to the World Trade Organization (WTO) in 2001 and the elimination of quotas previously allowed under the Agreement on Textiles and Clothing (ATC)[1] in 2005 gave China greater access to the U.S. market (WTO, 2019). From 2000 to 2009, China's share of apparel SME grew from 6% to 41%. Since 2009, China has been the dominant supplier of US clothing imports, consistently maintaining a share of unit volume within a tight range between 41 and 42% through the end of 2018 (OTEXA, 2019).

With this dependence on apparel sourcing from China, the escalation in the US-China trade dispute since 2018 was a significant source of concern among retailers selling clothing in the United States. Most consumer goods were excluded from the rounds of tariff increases that occurred in 2018 and the first half of 2019. However, the United States had been making threats to increase tariffs on everything it imports from China since at least July 2018 (Bown and Kolb, 2019).

Those threats were partially realized with announcements made in August 2019, when the United States indicated that it would hit all goods not covered by previous tariff increases in two phases (List 4a and List 4b). List 4a, which includes product categories where China's share is less than 75%, faced a fifteen-percentage point rise in duty rates beginning on September 1, 2019. List 4b, which covers product categories where China's share is greater than 75%, were scheduled to face a fifteen-percentage point increase in duty rates beginning on December 15, 2019. The tariff additions represented by List 4b were indefinitely postponed as part of the rapprochement that accompanied negotiations towards the signing of the Phase One agreement. With the Phase One deal, the United States agreed to halve the tariff increases it imposed in September, dropping the penalty applied on Chinese apparel on List 4a from 15 to 7.5

percentage points on February 14, 2020 (Bown and Kolb, 2019). With the outbreak of COVID-19, there has been speculation that the United States could eliminate all of the supplemental tariffs imposed on Chinese-made goods since 2018.[2]

Given the importance of China as a source for the US apparel market and the implementation of tariff increases on apparel made in China, there are important questions about what the consequences might be for profitability and sourcing allocation among US apparel retailers, and the impacts on other competing exporters including India, Indonesia, Vietnam, Bangladesh and Mexico. For example, the United States can divert its imports from China to its competitors such as Vietnam and Bangladesh. These reallocations caused by the trade policy changes will further affect domestic prices, supply and demand in those exporting countries. In addition, due to the rapid globalization of the US apparel industry and increased competition among apparel products from different sources, the US apparel market has become increasing complex and fragmented. Thus, it is important to consider source of origin when analyzing the US demand for apparel imports. This knowledge is of importance to US apparel industry participants in understanding this complex consumer market and providing helpful insight to develop effective marketing strategies.

Hence, the primary objective of this study is to analyze US demand for apparel imports and estimates the effects of a 15% tariff increase on clothing imports from China. A source-differentiated Almost Ideal Demand System (AIDS) model was developed using quarterly data differentiated by product type and by country of origin from 2000 through 2018. This approach accounts for importer preferences and allows for interactions across different products coming from specific import sources. The model estimates US apparel import demand and provides own-price, cross-price, and expenditure elasticities. Baseline and alternative tariff scenarios were analyzed using this empirical model to quantify welfare change. Results inform participants in the US apparel supply chain and policymakers regarding the potential effects of tariff increases and expected market responses.

Literature Review

Source-differentiated Almost Ideal Demand System (SDAIDS) models have been broadly applied to estimate import demand relationships, especially for agricultural products (Yang and Koo, 1994; Henneberry and Hwang, 2007; Lee, Kennedy and Hilbun, 2008; Mekonnen, Fonsah and Borgotti, 2011; Lee, Gallardo and Giacinti, 2020). However, the application of an SDAIDS model to US apparel import demand has been limited. There is only one known study that investigated apparel demand in the United States using the AIDS model. Lee and Karpova (2011) analyzed aggregated apparel demand in both the United States and Japan from 1995 to 2004 using an AIDS model. This research assessed the proportions of apparel products manufactured domestically in the United States and Japan relative to imports. The Lee and Karpova (2011) study analyzed apparel as a unitary product, without any differentiation by garment type (e.g., jeans) and country of origin. As a result, its findings relative to the analysis of country-specific tariffs are limited.

Import demand elasticities are an essential element of trade policy analysis. For instance, elasticities can be used to estimate effects on the trade volume, welfare, and customs revenue with the introduction of a given trade barrier. Few studies have examined demand elasticities of US apparel. Fadiga, Misra, and Ramirez (2005) estimated price and expenditure elasticities for nine apparel products (male shirts, male jeans, male shorts, male slacks, female slacks, female shorts, female jeans, skirts, and dresses) in the US apparel market. However, this study focused on the overall US apparel market, not on apparel import demand. In addition, the analysis in the Fadiga, Misra, and Ramirez (2005) study is based on aggregate demand for apparel products without allowing for differentiation by country of origin. The most recent example of research that examined US apparel import demand using price and income elasticities is Chadwick and Dardis (1993). In this analysis, a single-equation import demand model was developed to estimate price and income elasticities for apparel imports from developing and developed countries between 1974 and 1988. These aggregate demand studies implicitly assume that apparel products from different sources are homogeneous with single prices. Ignoring the country of origin may lead to biased elasticity estimates.

With regard to direct impacts of trade restrictions (tariffs and quotas) on importers, Bergsten (1972) concluded that buyers of imported goods suffer from trade restrictions on apparel and textiles by facing limits on choices stemming from tariffs and quotas. Although it has become accepted that trade restrictions have adverse effects on an importing country's purchasers, no known empirical research has estimated welfare loss that could result from the US imposition of tariffs on apparel imports from China. The purpose of this study is to evaluate the welfare loss to importers/retailers due to the imposition of an import tariff based on import demand elasticities estimated from the SDAIDS model.

Methods

The Almost Ideal Demand System (AIDS) model, proposed by Deaton and Muellbauer (1980), is one of the most popular models used for analyses of import demand. Its popularity is due to several critical properties. First, its flexibility of functional form provides an approximation to any demand system and is compatible with aggregation over retailers. Secondly, the AIDS model in its linear approximate form is relatively easy to estimate. Finally, theoretical restrictions, such as homogeneity and symmetry, can be tested and imposed through linear restrictions on the parameters.

This study is intended to offer a better understanding of US clothing retailers' preferences for clothing from various countries, and a Source-Differentiated Almost Ideal Demand System model (SDAIDS) is used to estimate different types of imported apparel. The SDAIDS model is a modified version of the original AIDS model, which allows for differentiation of import demand by product category and country of origin (Yang and Koo, 1994; Henneberry, and Hwang, 2007; and Mekonnen, Fonsah and Borgotti, 2011). Following Yang and Koo (1994), the SDAIDS model can be expressed as follows:

$$w_{i_h} = \alpha_{i_h} + \sum_j \sum_k \gamma_{i_h j_k} \ln(p_{j_k}) + \beta_{i_h} \ln(E/P^*) \tag{1}$$

where α, β and γ are parameters. The subscripts i and j indicate goods ($i, j = 1, 2, \ldots, n$), and h and k indicate countries of origins or sources. A given good i can be imported from m different origins, while good j may have n origins (where $i \neq j$, $h = 1, \ldots, m$, and $k = 1, \ldots, n$). w_{i_h} denotes the expenditure share of good i imported from source h (product i_h) in the total US apparel imports, p_{j_k} is the price of good j imported from source k (product j_k), E is the total expenditure on all n goods in this demand system, and P^* represents a price index for all imported apparel products from all the origins which is defined as:

$$\ln(P^*) = \alpha_0 + \sum_i \sum_h \alpha_{i_h} \ln(p_{i_h}) + \frac{1}{2} \sum_i \sum_h \sum_j \sum_k \gamma^*_{i_h j_k} \ln(p_{i_h}) \ln(p_{j_k}) \tag{2}$$

The above SDAIDS model in equation (1) is nonlinear due to the nonlinear price index in equation (2). To make the system linear, Deaton and Muellbauer (1980) suggested using the Stone's price index as a linear approximation, which is spedified as:

$$lnP^* = \sum_i \sum_h w_{i_h} \ln(p_{i_h}) \tag{3}$$

However, w_{i_h} employed as an independent variable in the above equation is also used as a dependent variable in equation (1), which may lead to a simultaneity problem. To avoid the problem, the average share of w_{i_h} as suggested by (Haden, 1990) has been used in the Stone's price index.

The large number of coefficients that need to be estimated in the SDAIDS model poses a problem of degrees of freedom, which is common in demand estimation models. Therefore, block substitutability is assumed to reduce the number of parameters to be estimated (Yang and Koo, 1994; Henneberry and Hwang, 2007). As suggested by Yang and Koo (1994), we estimated a restricted SDAIDS model (RSDAIDS) by imposing the assumption of block substitutability:

$$\gamma_{i_h j_k} = \gamma_{i_h j}, \forall k \in j \neq i \tag{4}$$

This assumption implies that the cross-price effects of good i from origin h are the same for all goods j regardless of their origins. In our analysis, this assumption means that importers respond differently to jeans imported from different sources (i.e., China, Mexico, Bangladesh and ROW) while allocating expenditures among different sources for the same good. However, US demand for jeans imported from China exhibits the same cross-price response to coats from China as it does to coats from Vietnam. As we anticipate little price impact across broad product categories, this assumption is justified. By substituting equation (4) into equation (1), the resulting RSDAIDS is specified as:

$$w_{i_h} = \alpha_{i_h} + \sum_k \gamma_{i_{hk}} \ln(p_{i_k}) + \sum_{j \neq i} \gamma_{i_h j} \ln(p_j) + \beta_{i_h} \ln(E/P^*) \tag{5}$$

where $\ln(p_j) = \sum_k w_{jk} \ln(p_{jk})$, which represents the weighted average of the other good j from all its sources, $\gamma_{i_{hk}}$ is a cross-price response parameter of the same good imported from different origins, and $\gamma_{i_h j}$ is the block subsititubility cross-price parameter.

The general demand restrictions of adding-up, homogeneity and symmetry can be imposed by restricting the parameters of the import demand system as follows:

Adding-up: $\sum_i \sum_h \alpha_{i_h} = 1$; $\sum_h \gamma_{i_{hk}} = 0$; $\sum_i \sum_h \gamma_{i_h j} = 0$; $\sum_i \sum_h \beta_{i_h} = 0$ (6)

Homogeneity: $\sum_k \gamma_{i_{hk}} + \sum_{j \neq i} \gamma_{i_h j} = 0$ (7)

Symmetry: $\gamma_{i_{hk}} = \gamma_{i_{kh}}$ (8)

With block substitutability, the symmetry conditions are not applicable among goods but only within group goods. The estimated parameters of the RSDAIDS model can be used to calculate Marshallian measures of price elasticities:

$$\varepsilon_{i_h i_h} = -1 + \gamma_{i_{hh}} / w_{i_h} - \beta_{i_h} \tag{9}$$

$$\varepsilon_{i_h i_k} = \gamma_{i_{hk}} / w_{i_h} - \beta_{i_h} \left(w_{i_k} / w_{i_h} \right) \tag{10}$$

$$\varepsilon_{i_h j} = \gamma_{i_h j} / w_{i_h} - \beta_{i_h} \left(w_j / w_{i_h} \right) \tag{11}$$

Equation (9) represents own-price elasticities; (10) represents cross-price elasticities between the same good from different sources; and (11) represents cross-price elasticities between different goods.

Finally, expenditure elasticity is specified as follows:

$$\eta_{i_h} = 1 + \beta_{i_h} / w_{i_h} \tag{12}$$

Data

Quarterly import values (US$) and quantities of apparel imports by product and country of origin from 2000 (quarter I) to 2018 (quarter IV) were collected from the US Office of Textiles and Apparel (OTEXA). Through simple division, unit prices and import shares by country of origin were derived. Unit prices, which exclude transport costs, are treated as proxies for the total price for importing garments. Import prices were adjusted for inflation with a base year of 2010, using the consumer price index published by USDA/ERS (2019). Data were adjusted for seasonality using the Census X – 12 method developed by the US Census Bureau.

During the period from 2000 to 2018, the top apparel categories imported by the United States were knit shirts, woven shirts, jeans, bottoms (non-jean pants and shorts), and coats. Each of the apparel categories is an aggregation for all subcategories coming from selected import sources.[3] More specifically, each of these apparel categories is an aggregation of products defined by either Harmonized System (HS) codes (for jeans) or the Multi-Fiber Agreement (MFA) product definitions available from the OTEXA website (all non-jean categories). For example, the knit shirt category includes men's and boys' cotton-dominant knit shirts (MFA code 338), women's and girls' cotton-dominant knit shirts (MFA code 339), men's and boys' MMF-dominant (man-made-fiber-dominant) knit shirts (MFA code 638) and women's and girls' MMF-dominant knit shirts (MFA code 639). Collectively, these five apparel products accounted for 67% of total US apparel import value in 2018.

The United States imports apparel from virtually every country in the world. To save degrees of freedom, countries supplying at least 10% of total US imports of the selected product were considered as individual sources of supply. All other sources were aggregated together as the rest of the world (ROW). Summary statistics of import market shares by value for each apparel category considered are presented in Table 1.

TABLE 1
Summary Statistics for Expenditure Shares of US Apparel Imports, 2000 – 2018

Variables	Mean	Std. Dev.	Minimum	Maximum
Knit Shirts	0.3644	0.0159	0.3260	0.3851
China	0.0576	0.0353	0.0003	0.1012
Vietnam	0.0340	0.0203	0.0003	0.0631
India	0.0152	0.0034	0.0061	0.0193
ROW	0.2577	0.0425	0.2114	0.3246
Woven Shirts	0.1183	0.0081	0.1027	0.1476
China	0.0274	0.0128	0.0066	0.0439
Bangladesh	0.0123	0.0022	0.0084	0.0171
India	0.0140	0.0018	0.0098	0.0178
Vietnam	0.0072	0.0048	0.0003	0.0161
Indonesia	0.0125	0.0014	0.0092	0.0153
ROW	0.0449	0.0220	0.0240	0.0995
Jeans	0.0796	0.0098	0.0640	0.0988
China	0.0130	0.0092	0.0001	0.0312
Mexico	0.0277	0.0119	0.0142	0.0501
Bangladesh	0.0054	0.0034	0.0000	0.0114
ROW	0.0336	0.0089	0.0224	0.0535
Bottoms	0.3295	0.0151	0.3052	0.3617
China	0.0573	0.0323	0.0006	0.0965
Vietnam	0.0346	0.0206	0.0003	0.1078
Mexico	0.0496	0.0253	0.0241	0.1071
Bangladesh	0.0286	0.0141	0.0014	0.0476
ROW	0.1594	0.0411	0.1192	0.2433
Coats	0.1082	0.0100	0.0859	0.1258
China	0.0438	0.0188	0.0118	0.0680
Vietnam	0.0149	0.0076	0.0000	0.0275
ROW	0.0496	0.0167	0.0323	0.0909

Source: U.S. Department of Commerce, Office of Textile and Apparel (OTEXA)

Estimation Procedure

Before the model can be estimated, testing for stationarity and cointegration of the data is required. Nonstationarity in the variables and the presence of cointegration among the equations can jeopardize the consistency of parameters to be estimated. A modified Augmented Dickey Fuller (ADF) unit root testing procedure, the DF-GLS test, was used to determine nonstationarity among individual time series. The DF-GLS test was selected because it offers significantly improved power compared to the basic ADF test when an unknown mean or trend is present (Elliott, Rothenberg and Stock, 1996).

Results from DF-GLS testing are presented in Table 2. The DF-GLS test results generally failed to reject the null hypothesis that the series are non-stationary at the 5% significance level. Exceptions were for import expenditure shares for bottoms imported from Vietnam and Bangladesh and logged prices of bottoms imported from Vietnam.

TABLE 2

Unit Root Test Results for US apparel Import Expenditure Shares and Prices

	Expenditure Shares		Prices	
	Test Statistic	5% Critical Value	Test Statistic	5% Critical Value
Knit Shirts				
China	-1.53 (10)	-2.76	-2.09 (4)	-3.01
Vietnam	-2.19 (1)	-3.10	-2.24 (10)	-2.76
India	-1.57 (11)	-2.72	-2.31 (1)	-3.10
ROW	-1.49 (9)	-2.81	-1.08 (1)	-3.10
Woven Shirts				
China	-1.33 (9)	-2.81	-1.75 (1)	-3.10
Bangladesh	-1.59 (6)	-2.93	-1.36 (1)	-3.10
India	-1.92 (1)	-3.10	-1.95 (1)	-3.10
Vietnam	-1.68 (6)	-2.93	-1.94 (8)	-2.85
Indonesia	-2.24 (7)	-2.89	-0.93 (7)	-2.89
ROW	-1.13 (6)	-2.93	-1.53 (6)	-2.93
Jeans				
China	-1.56 (1)	-3.10	-2.25 (7)	-2.89
Mexico	-2.30 (7)	-2.89	-2.06 (1)	-3.10
Bangladesh	-1.57 (11)	-2.72	-2.75 (10)	-2.76
ROW	-1.83 (11)	-2.72	-1.72 (3)	-3.05
Bottoms				
China	-1.18 (4)	-3.01	-1.28 (11)	-2.72
Vietnam	-2.84 (11)	-2.72	-4.18 (10)	-2.76
Mexico	-1.33 (7)	-2.89	-2.34 (1)	-3.10
Bangladesh	-3.01 (11)	-2.72	-1.80 (5)	-2.97
ROW	-1.07 (6)	-2.93	-2.48 (2)	-3.08
Coats				
China	-1.91 (9)	-2.72	-1.60 (1)	-3.10
Vietnam	-2.17 (6)	-2.93	-1.25 (7)	-2.89
ROW	-0.61 (1)	-3.10	-1.60 (9)	-2.81

Note: The DF-GLS unit root test were used on levels of import expenditure shares and logged values of prices. Lag lengths are in parenthesis, which are determined by the Ng-Perron sequential t-test procedure. Critical values reported in this table is from Elliott, Rothenberg and Stock (1996).

With statistical evidence suggesting the presence of unit roots within several time series, cointegration relationships among variables for each import share equation were investigated using the Engle-Granger (1987) approach referred to as the Augmented Engle-Granger (AEG) test. The AEG method is based on assessing whether residuals have a unit root from a single-equation regression involving the variables that are potentially cointegrated. The results of AEG testing are presented in Table 3. As shown in the table, the ADF test statistics are all smaller (in absolute value) than their corresponding 5% significance level critical values. Therefore, in all cases, the null hypothesis of no cointegration cannot be rejected at the 5% significance level. These diagnostic tests justify the use of the first-differenced version of an RSDAIDS model for estimation. The final estimation equation can be expressed as:

$$\Delta w_{i_h} = \sum_{k} \gamma_{i_{hk}} \Delta \ln\left(p_{i_k}\right) + \sum_{j \neq i} \gamma_{i_h j} \Delta \ln\left(p_j\right) + \beta_{i_h}\left(\Delta lnE - \Delta lnP^{*}\right) \tag{13}$$

where Δ denotes the difference operator. A dummy variable for the period of 2000 – 2004 was included in the model as an intercept shifter to capture the strong growth of China during that period since its accession to the WTO.

The RSDAIDS model described above was estimated using the seemingly unrelated regression (SUR) with correction for the first-order serial correlation in Statistical Analysis System (SAS) software, version 9.4. The restrictions of symmetry, adding-up, and homogeneity were imposed. The model includes 22 import expenditure share equations. They include estimates for knit shirts from China, Vietnam, India, and the ROW; woven shirts from China, Bangladesh, India, Vietnam, Indonesia, and the ROW; jeans from China, Mexico, Bangladesh, and the ROW; bottoms from China, Vietnam, Mexico, Bangladesh, and the ROW; and coats from China, Vietnam, and the ROW. Since the sum of all expenditure shares in the model is equal to unity, the residuals of the variance-covariance matrix are singular. This is one of the central properties of the AIDS model. Correspondingly, the last equation (coats from ROW) was dropped from the estimation to avoid singularity problems. The parameter estimates of the dropped equation can be recovered using the adding-up restriction. However, a different equation was dropped in this study, and the model was re-estimated to determine the parameters and standard errors of the dropped equation. According to Henneberry and Hwang (2007), estimated parameters are similar and produce similar elasticities regardless of which equation is dropped.

Estimation Results

Elasticities Estimates

The expenditure elasticities, uncompensated (Marshallian) own-price and cross-price elasticities are calculated for periods of 2000 – 2004 and 2005 – 2018, respectively.[4] The expenditure elasticity estimates (Table 4) summarize the relationships between the overall change in import expenditure on selected apparel categories and the relative import shares of each of those categories. With the exception of bottoms from ROW, all expenditure elasticities are positive and statistically significant at the 5% level, ranging from 0.37 for coats from the ROW to 3.62 for bottoms from Vietnam.

TABLE 4

Estimated Expenditure Elasticities of US Import Demand for Apparel, 2005 – 2018

Countries	Expenditure Elasticities
Knit Shirts	
China	2.20***
	(0.25)
Vietnam	1.54***
	(0.21)
India	0.64*
	(0.33)
ROW	0.48***
	(0.09)
Woven Shirts	
China	1.56***
	(0.20)
Bangladesh	0.84***
	(0.25)
India	1.64***
	(0.22)
Vietnam	1.22***
	(0.18)
Indonesia	0.93***
	(0.17)
ROW	0.43**
	(0.18)

Jeans	
China	2.50***
	(0.34)
Mexico	0.69***
	(0.23)
Bangladesh	1.13***
	(0.30)
ROW	0.54**
	(0.19)
Bottoms	
China	2.44***
	(0.27)
Vietnam	3.62***
	(0.94)
Mexico	0.52*
	(0.26)
Bangladesh	0.77***
	(0.23)
ROW	-0.13
	(0.30)
Coats	
China	1.49***
	(0.22)
Vietnam	0.77***
	(0.22)
ROW	0.37*
	(0.22)

Note: *, **, *** denote significant at one, five and ten percent levels, respectively. Standard errors are in parentheses. ROW refers to the rest of the world.

Concerning the woven shirts market, expenditure elasticities of woven shirts from China, India and Vietnam show elastic expenditure elasticities (1.56, 1.64 and 1.22, respectively), suggesting that when total expenditure on apparel imports rise in the United States, a higher proportion of those expenditures will go to woven shirts from China, India and Vietnam. On the other hand, woven shirts from Indonesia, Bangladesh and ROW show inelastic expenditure elasticities (0.93, 0.84 and 0.43, respectively). This result may be interpreted that woven shirts produced in China, India and Vietnam are perceived by U.S. retailers as of higher quality compared to those produced in other countries. Over time, this could lead to a longer-term increase in market shares of woven shirts from China, India, and Vietnam, with relative prices held constant.

Among the imported products of bottoms, those from Vietnam show the highest expenditure elasticity (3.62) compared to bottoms from other sources. This implies that bottoms imported from Vietnam are particularly favoured over bottom imports from other sources when import expenditure on apparel grows in the United States.

Specifically, the import share of bottoms from Vietnam should increase by 3.62% when US apparel import expenditure increases by 1%. Additionally, the share for bottoms imported from China is more expenditure elastic (2.44) compared with the demand for bottoms from Bangladesh (0.77) and Mexico (0.52). These expenditure elasticities show that the market for imported bottoms tends to be concentrated on major exporting countries like China and Vietnam.

The expenditure elasticities of selected apparel categories indicate that regardless of the distance between the United States and Asian apparel exporting countries, apparel products from Asian countries have certain attributes (like lower price) that appeals to US retailers over products from Mexico, a country with a geographic proximity advantage. In particular, except for imported bottoms, China shows the highest expenditure elasticity in all cases of selected apparel categories, suggesting that the more the total expenditure on the imported apparel products, the more likely the majority of the increase would be imported from China. This is consistent with the fact that China has captured a large proportion of the US apparel market over the study period.

Consistent with economic theory, all own-price elasticities (highlighted in bold) are negative and statistically significant at the 5% level (Table 5). Bottoms imported from Vietnam have the most price-elastic demand (-1.32) among all the countries exporting this commodity to the United States, indicating that bottoms from Vietnam are the most sensitive to own price changes. In contrast, import demand for woven shirts from Vietnam is the most price-inelastic (-0.71). The wide disparity of own-price effects on Vietnam imports are, of course, a function of the product. However, these results suggest woven shirts are viewed by buyers as more of a "necessity" than bottoms. This may indicate that woven shirts have fewer substitutes in quality and/or that supply chains to US buyers are more fixed than with bottoms. More importantly for this analysis, we also found that all apparel products imported from China are sensitive with respect to own price changes (own-price elastic), except for jeans, suggesting that it is possible for China to improve its market position by lowering their prices, or conversely, that tariff will disproportionally reduce Chinese market share.

According to Yang and Koo (1994), a country is regarded as having strong export potential in an import market if the quantity demanded for its product is insensitive to price changes (own-price inelastic) but increases with import expenditure (expenditure elastic). In the woven shirts market, Vietnam is found to satisfy this criterion with an elastic expenditure elasticity of 1.22 and inelastic own-price elasticity of -0.71. Additionally, China and Bangladesh are also found to have relatively strong market positions in the jeans import market. That is to say, removal or reduction of trade restrictions to those exporting countries or increases in US total apparel import expenditure would stimulate woven shirts exports to the United States from Vietnam, and jeans exports from China and Bangladesh.

A majority of cross-price elasticities (Table 5) are positive, indicating a substitute relationships among products originating from different sources. For example, in the market for knit shirts, the ROW/China cross-price elasticity is 0.04, suggesting a weak substitutability relationship between them. Net substitutability are prevalent among woven shirts from different sources. More specifically, woven shirts from Vietnam and ROW are shown to be substitutes for woven shirts from China. However, different from the woven shirt market, the results show complementary relationships in Chinese jeans and bottoms markets. These unexpected complementary relationship might be due to that US apparel supply chains are more fixed. Buyers in the United States are unlikely to respond fully to changes in prices in the short run. Inventory adjustments or institutional factors could be reasons for lagged response.

The right side of Table 5 shows cross-price elasticities among different categories, which reveals economic relationships of each of the clothing categories by country of origin with other categories. The negative (positive) cross-price elasticity implies that when the price of the given product from the given source increases, the quantity demanded of a different category decreases (increases), which in turn implies that the categories are complement (substitute). For example, the cross-price elasticities show that there is a high degree of substitutability between woven shirts and knit shirts from China (13.70), while jeans and bottoms show strong complementary relationships with knit shirts from China (-8.78 and -3.27, respectively).

Welfare Analysis

With the United States imposing a 15% import tariff on Chinese apparel imports, US retailers could be expected to suffer welfare loss. The RSDAIDS model established above is then used to run the baseline and tariff scenarios. The baseline scenario assumes no US supplemental import tariff on apparel imports from China, while the alternative tariff scenario assumes a 15% tariff imposed on all US imports apparel from China (i.e., does not differentiate between Lists 4a and 4b and considers both being applied).

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TABLE 5

Estimated Marshallian Price Elasticities of US Import Demand for Apparel, 2005 – 2018

	Demand of Imports from									
Prices of Imports from	Countries						Other Blocks			
Knit Shirts	China	Vietnam	Indonesia	ROW			Woven Shirts	Jeans	Bottoms	Coats
China	**-1.04*****	-0.11	-0.05*	-0.29***			13.70***	-8.78*	-3.27***	-2.36
	(0.06)	*(0.03)*	*(0.03)*	*(0.07)*			*(4.26)*	*(4.89)*	*(0.90)*	*(2.69)*
Vietnam	-0.15**	**-1.11*** **	0.02	-0.06			-7.32*	6.92	0.74	-0.58
	(0.05)	*(0.06)*	*(0.05)*	*(0.08)*			*(3.83)*	*(4.57)*	*(0.96)*	*(2.24)*
Indonesia	-0.08	0.10	**-0.91*****	0.04			14.57**	-17.83**	3.39**	0.08
	(0.12)	*(0.13)*	*(0.14)*	*(0.17)*			*(6.37)*	*(7.31)*	*(1.44)*	*(3.54)*
ROW	0.04**	0.03**	0.01	**-0.90*****			-0.18	0.24	1.03***	-0.75
	(0.02)	*(0.01)*	*(0.01)*	*(0.03)*			*(1.34)*	*(1.54)*	*(0.27)*	*(0.92)*
Woven Shirts	China	Bangladesh	India	Vietnam	Indonesia	ROW	Knit Shirts	Jeans	Bottoms	Coats
China	**-1.15*****	0.07	0.07	0.09***	0.05	0.20***	-3.13**	7.13***	-4.35***	-0.54
	(0.07)	*(0.05)*	*(0.04)*	*(0.03)*	*(0.03)*	*(0.07)*	*(1.29)*	*(2.39)*	*(0.74)*	*(2.10)*
Bangladesh	0.22*	**-0.96*****	-0.05	0.23**	0.11	-0.32*	5.25**	-7.13**	1.20	0.56
	(0.12)	*(0.18)*	*(0.17)*	*(0.12)*	*(0.11)*	*(0.18)*	*(2.08)*	*(3.21)*	*(1.05)*	*(2.71)*
India	0.16	-0.06	**-1.21*****	0.10	0.06	-0.17	2.29	5.64*	-0.53	-7.96***
	(0.11)	*(0.17)*	*(0.17)*	*(0.12)*	*(0.11)*	*(0.16)*	*(1.78)*	*(2.91)*	*(0.90)*	*(2.45)*
Vietnam	0.35***	0.33*	0.16	**-0.71*****	0.25	0.03	2.69**	-3.44	0.88	-1.76
	(0.11)	*(0.17)*	*(0.18)*	*(0.20)*	*(0.20)*	*(0.14)*	*(1.35)*	*(2.44)*	*(0.78)*	*(1.97)*
Indonesia	0.14*	0.10	0.08	0.18	**-0.86*****	-0.06	5.15***	-0.16	1.33*	-6.83***
	(0.08)	*(0.11)*	*(0.12)*	*(0.14)*	*(0.13)*	*(0.10)*	*(1.36)*	*(2.23)*	*(0.72)*	*(1.84)*
ROW	0.25***	-0.12*	-0.05	0.01	-0.02	**-1.22*****	-0.50	1.65	4.16***	-4.60**
	(0.07)	*(0.07)*	*(0.07)*	*(0.04)*	*(0.04)*	*(0.14)*	*(1.31)*	*(2.24)*	*(0.70)*	*(1.93)*
Jeans	China	Mexico	Bangladesh	ROW			Knit Shirts	Woven Shirts	Bottoms	Coats
China	**-0.95*****	-0.07	-0.09*	-0.09*			-2.45	7.44**	-5.67***	-0.63
	(0.15)	*(0.13)*	*(0.09)*	*(0.10)*			*(2.43)*	*(3.70)*	*(1.39)*	*(3.71)*
Mexico	-0.02	**-1.08*****	-0.04	0.06			3.08*	-4.72*	-3.87***	5.89**
	(0.10)	*(0.10)*	*(0.06)*	*(0.07)*			*(1.79)*	*(2.52)*	*(0.91)*	*(2.48)*

Bangladesh	-0.18	-0.12	-0.88***	0.14		8.92***	-0.36	-2.65*	-5.98*
	(0.21)	*(0.20)*	*(0.26)*	*(0.27)*		*(2.46)*	*(3.33)*	*(1.49)*	*(3.35)*
ROW	-0.01	0.04	0.03	-0.97***		3.46**	-8.41***	3.80***	1.51
	(0.05)	*(0.05)*	*(0.06)*	*(0.07)*		*(1.53)*	*(2.09)*	*(0.91)*	*(2.08)*
Bottoms	China	Vietnam	Mexico	Bangladesh	ROW	Knit Shirts	Woven Shirts	Jeans	Coats
China	-1.11***	-0.15**	-0.16***	-0.05	-0.27***	-7.40***	29.18***	-20.46***	-2.08
	(0.05)	*(0.06)*	*(0.06)*	*(0.05)*	*(0.07)*	*(1.38)*	*(4.31)*	*(4.31)*	*(2.90)*
Vietnam	-0.39***	-1.32***	-0.32**	-0.05	-0.33**	-0.49	-95.65***	117.48***	-22.62**
	(0.13)	*(0.12)*	*(0.12)*	*(0.09)*	*(0.15)*	*(7.30)*	*(15.23)*	*(15.48)*	*(10.34)*
Mexico	-0.19*	-0.21*	-1.21***	0.09	0.22**	0.02	2.93	-4.41	2.26
	(0.11)	*(0.12)*	*(0.11)*	*(0.09)*	*(0.09)*	*(1.93)*	*(4.56)*	*(4.57)*	*(2.95)*
Bangladesh	0.01	0.05	0.08	-0.95**	-0.11	9.94***	7.67*	-14.90***	-2.40
	(0.09)	*(0.08)*	*(0.09)*	*(0.08)*	*(0.09)*	*(1.65)*	*(4.01)*	*(4.20)*	*(2.56)*
ROW	0.05	0.05*	0.08***	0.00	-0.85***	2.68	12.60**	-18.57***	4.08
	(0.03)	*(0.03)*	*(0.02)*	*(0.02)*	*(0.06)*	*(1.93)*	*(4.56)*	*(4.63)*	*(3.25)*
Coats	China	Vietnam	ROW			Knit Shirts	Woven Shirts	Jeans	Bottoms
China	-1.04***	0.02	-0.02			4.32**	-7.62	3.39	-0.53
	(0.10)	*(0.03)*	*(0.04)*			*(1.87)*	*(4.90)*	*(5.59)*	*(1.12)*
Vietnam	0.09	-0.86***	0.08			1.92	-12.15**	11.79**	-1.64
	(0.10)	*(0.12)*	*(0.12)*			*(1.94)*	*(5.07)*	*(5.78)*	*(1.17)*
ROW	0.04	0.04	-0.95***			2.92	-8.91*	6.89	-0.41
	(0.06)	*(0.06)*	*(0.06)*			*(1.87)*	*(4.85)*	*(5.54)*	*(1.14)*

Note: *, **, *** denote significant at one, five and ten percent levels, respectively. Standard errors are in parentheses. ROW refers to the rest of the world.

After solving for baseline and tariff scenarios, results are then compared to determine the impacts of this tariff on prices and import quantities. The welfare change was measured in terms of changes in retailer surplus.[5] As shown in Table 6, US consumption of Chinese apparel decreases substantially due to higher market prices. The largest aggregate losses are in the bottoms category (US$119.87 million), followed by coats (US$114.5 million), knit shirts ($61.74 million) and woven shirts ($55.69 million). This is consistent with our findings involving own-price elasticities, which indicated that Chinese apparel exporters should keep their prices low to maintain an advantage in the US apparel market. China can be expected to lose market share and revenue as prices increase with tariffs. Interestingly, the results also show that retailers will experience welfare gain in the jeans category ($3.82 million). This finding is consistent with our earlier results that China has a strong market position in jean exports.

Overall, US retailers are projected to suffer a net welfare loss of about $348 million per year from the 15% tariffs on Chinese apparel imports. Considering that the 2018 US expenditure on apparel imports at US$55,768 million, the imposed import tariff results in a total welfare decrease by 0.6%. Thus, while the tariffs result in substantial financial effects on individual apparel importers, the single country import tariff results in only a proportionally small welfare loss compared with overall import value.

TABLE 6

Consumer Surplus Changes of 15% US Import Tariff on Chinese Apparel Imports (million U.S. dollars)

China	Price ($)	% change	Demand (thousands)	% change	CS changes	Total CS changes
Knit Shirts	4.59	15.00%	100,138.91	-7.86%	-61.74	
Woven Shirts	20.67	15.00%	18,525.71	-18.54%	-55.69	
Jeans	21.05	15.00%	2,140.49	9.89%	3.82	
Bottoms	11.42	15.00%	75,361.39	-10.49%	-119.87	
Coats	62.18	15.00%	13,037.11	-13.41%	-114.50	-347.98

Conclusion

This study estimates the impacts of prices and expenditures on the US import demand of source-differentiated apparel products, using a first-differenced version of the restricted source-differentiated Almost Ideal Demand System model. The results of this study are intended to explore how US retailers may react to price increases resulting from tariff increases on apparel imports from China.

Throughout the study period (2000 – 2018), China was the dominant supplier of apparel to the United States. All the statistically significant expenditure elasticities in our study were positive, implying that for the product categories examined (knit shirts, woven shirts, bottoms, jeans, and coats), the quantity demanded of will increase as import expenditures increase (with all other factors held constant). Importantly, China shows the highest expenditure elasticity in all apparel categories except for bottoms, suggesting that the more the total expenditure on the imported apparel products, the more likely the majority of the increase would be imported from China.

Own-price elasticities of all apparel products from each of the major countries that export to the United States were negative and statistically significant. Except for jeans, it was found that all apparel products imported from China were sensitive with respect to own price changes (own-price elastic). This result, combined with expenditure elasticities, suggests that it is possible for China to improve its market position and continually take over market shares from other competing export countries by lowering prices. However, other Asian apparel exporting countries, especially Vietnam and Bangladesh, are strong competitors that could represent a challenge to the current market position of China.

Our welfare analysis indicates that the impact of a US import tariff can be substantial. Under the scenario of a 15% tariff imposed on apparel imports from China, US sourcing costs increase. United States retailers are expected to pay more, causing an estimated loss of $348 million per year. While this is not a trivial amount of money, it represents a decrease of only 0.6% of 2018 US expenditure on apparel imports.

This study is one of the first to analyze the US apparel import demand using disaggregated apparel products (knit shirts, woven shirts, jeans, bottoms and coats), with each category being differentiated by their respective supply countries. Most previous studies in this area have analyzed clothing as an aggregated product, and this can limit their empirical implications. The source-differentiated apparel import demand elasticities obtained here may be used in the analysis of the economic impacts of various policies and marketing strategies on the US apparel market. The general and partial equilibrium models, which are used in evaluating the welfare impacts of these policies, rely on accurate measures of price and expenditure demand elasticities. The scope of this study focused on direct welfare changes for importers due to price increases on apparel. This is only one part of the overall set of impacts associated with the imposition of tariffs on Chinese apparel exports to the United States. Producers' welfare change was not taken into consideration. Despite the limitation, it is believed that this study still makes meaningful contribution to the ongoing debate concerning the impacts of the US – China trade war.

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Endnotes

[1] A 10-year transitional trade arrangement allowing for selective application of tariffs and quotas, which replaced the more restrictive Multi-fiber Arrangement (MFA) in 1995 (WTO).

[2] The timeline of tariff developments related to US apparel imports was up-to-date at the time of writing in April 2020, but may have evolves since then.

[3] OTEXA reports imports in terms of Multi-Fiber Arrangement (MFA) categories. OTEXA publishes MFA categories as aggregations of harmonized system codes with 10 digit-level of precision.

[4] The expenditure, own-price and cross-price elasticities for the period of 2000 – 2004 are not the focus of this current study, which are reported in Appendix Table 1 and 2.

[5] Importers of apparel are US clothing retailers. While these are consumers in that they are purchasers, it is important to consider that they are one step away from end-users (i.e., households buying clothing to wear). There is a markup between importers and households, which may have a change in consumer surplus. However, it is beyond the scope of this analysis.

APPENDIX TABLE 1
Estimated Expenditure Elasticities of US Import Demand for Apparel, 2000 – 2004

Countries	2000 – 2004
Knit Shirts	
China	9.60***
	(1.81)
Vietnam	3.79***
	(1.08)
India	0.40
	(0.54)
ROW	0.61***
	(0.07)
Woven Shirts	
China	3.21***
	(0.77)
Bangladesh	0.80**
	(0.31)
India	1.59***
	(0.21)
Vietnam	2.04**
	(0.87)
Indonesia	1.59***
	(0.21)
ROW	0.76***
	(0.08)
Jeans	
China	17.43***
	(3.78)
Mexico	0.85***
	(0.11)
Bangladesh	2.20
	(2.74)
ROW	0.61***
	(0.16)
Bottoms	
China	8.15***
	(1.34)
Vietnam	4.25***
	(1.17)
Mexico	0.80***
	(0.11)
Bangladesh	0.15
	(0.87)
ROW	0.24
	(0.20)
Coats	

China	2.89***
	(0.87)
Vietnam	0.19
	(0.83)
ROW	0.67***
	(0.12)

Note: *, **, *** denote significant at one, five and ten percent levels, respectively. Standard errors are in parentheses. ROW refers to the rest of the world.

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APPENDIX TABLE 2

Estimated Marshallian Price Elasticities of US Import Demand for Apparel, 2000 – 2004

	Demand of Imports from									
Prices of Imports from	Countries						Other Blocks			
Knit Shirts	China	Vietnam	Indonesia	ROW			Woven Shirts	Jeans	Bottoms	Coats
China	**-0.74***	-0.51**	-0.27	-2.74***			98.14***	-63.03*	-23.71***	-16.74
	(0.41)	*(0.22)*	*(0.19)*	*(0.64)*			*(30.57)*	*(35.03)*	*(6.45)*	*(19.28)*
Vietnam	-0.58**	**-1.45*****	0.14	0.11			-37.91*	35.77	3.74	-2.97
	(0.27)	*(0.29)*	(0.25)	*(0.30)*			*(19.84)*	*(23.64)*	*(4.96)*	*(11.56)*
Indonesia	0	0.15	**-0.85*****	0.11			24.08**	-29.46**	5.63**	0.12
		(0.21)	*(0.23)*	*(0.30)*			*(10.53)*	*(12.08)*	*(2.39)*	*(5.84)*
ROW	0.00	0.01	0.00	**-0.89*****			-0.13	0.18	0.79***	-0.57
	(0.01)	*(0.01)*	*(0.01)*	*(0.02)*			*(1.02)*	*(1.17)*	*(0.21)*	*(0.70)*
Woven Shirts	China	Bangladesh	India	Vietnam	Indonesia	ROW	Knit Shirts	Jeans	Bottoms	Coats
China	**-1.53*****	0.30	0.25	0.37***	0.19	0.69**	-12.31**	28.17***	-17.25***	-2.10
	(0.27)	*(0.19)*	*(0.17)*	*(0.12)*	*(0.13)*	*(0.27)*	*(5.10)*	*(9.46)*	*(2.92)*	*(8.30)*
Bangladesh	0.27*	**-0.96*****	-0.07	0.28*	0.13	-0.38*	6.48**	-8.81**	1.49	0.69
	(0.15)	*(0.22)*	*(0.22)*	*(0.15)*	*(0.14)*	*(0.23)*	*(2.56)*	*(3.96)*	*(1.30)*	*(3.34)*
India	0.16	-0.06	**-1.19*****	0.10	0.06	-0.18	2.11	5.13*	-0.49	-7.25***
	(0.10)	*(0.15)*	*(0.16)*	*(0.11)*	*(0.10)*	*(0.15)*	*(1.63)*	*(2.65)*	*(0.82)*	*(2.23)*
Vietnam	1.66***	1.54*	0.77	**0.39**	1.20	0.08	12.76**	-16.26	4.14	-8.32
	(0.53)	*(0.80)*	*(0.83)*	*(0.96)*	*(0.93)*	*(0.67)*	*(6.37)*	*(11.53)*	*(3.70)*	*(9.31)*
Indonesia	0.17*	0.12	0.09	0.21	**-0.83*****	-0.07	6.08***	-0.18	1.57*	-8.07***
	(0.10)	*(0.13)*	*(0.14)*	*(0.16)*	*(0.16)*	*(0.12)*	*(1.60)*	*(2.63)*	*(0.85)*	*(2.17)*
ROW	0.10***	-0.05*	-0.02	0.00	-0.01	**-1.08*****	-0.22	0.70	1.75***	-1.93**
	(0.03)	*(0.03)*	*(0.03)*	*(0.02)*	*(0.02)*	*(0.06)*	*(0.55)*	*(0.94)*	*(0.29)*	*(0.81)*
Jeans	China	Mexico	Bangladesh	ROW			Knit Shirts	Woven Shirts	Bottoms	Coats
China	**-0.18**	-1.11	-0.83	-1.05			-26.43	81.46**	-62.67***	-6.57
	(1.60)	*(1.40)*	*(0.94)*	*(1.10)*			*(26.62)*	*(40.62)*	*(15.22)*	*(40.64)*
Mexico	-0.01	**-1.03*****	-0.02	0.03			1.46*	-2.25*	-1.84***	2.80**
	(0.05)	*(0.05)*	*(0.03)*	*(0.04)*			*(0.85)*	*(1.20)*	*(0.43)*	*(1.18)*

Bangladesh	-1.66	-1.13	**0.14**	1.23		81.65***	-3.34	-24.33*	-54.72*
	(1.90)	*(1.80)*	*(2.37)*	*(2.43)*		*(22.55)*	*(30.48)*	*(13.63)*	*(30.67)*
ROW	-0.02	0.05	0.03	**-0.97*** **		2.91**	-7.11***	3.23***	1.27
	(0.04)	*(0.04)*	*(0.05)*	*(0.06)*		*(1.29)*	*(1.77)*	*(0.77)*	*(1.76)*
Bottoms	China	Vietnam	Mexico	Bangladesh	ROW	Knit Shirts	Woven Shirts	Jeans	Coats
China	**-1.11*** **	-0.72**	-1.19***	-0.07	-1.81***	-36.44***	144.51***	-101.35***	-10.18
	(0.22)	*(0.27)*	*(0.30)*	*(0.22)*	*(0.39)*	*(6.82)*	*(21.36)*	*(21.35)*	*(14.34)*
Vietnam	-0.30**	**-1.37*** **	-0.56***	0.02	-0.64**	-0.52	-118.99***	146.10***	-28.08**
	(0.13)	*(0.15)*	*(0.17)*	*(0.10)*	*(0.26)*	*(9.07)*	*(18.94)*	*(19.25)*	*(12.86)*
Mexico	-0.09**	-0.09*	**-1.08*** **	0.03	0.10**	0.00	1.20	-1.80	0.92
	(0.05)	*(0.05)*	*(0.05)*	*(0.04)*	*(0.04)*	*(0.79)*	*(1.86)*	*(1.86)*	*(1.20)*
Bangladesh	0.00	0.18	0.34	**-0.84** **	-0.36	37.32***	28.82*	-55.96***	-9.02
	(0.34)	*(0.31)*	*(0.35)*	*(0.31)*	*(0.36)*	*(6.18)*	*(15.05)*	*(15.78)*	*(9.63)*
ROW	-0.01	0.03	0.09***	-0.02	**-0.84*** **	1.78	8.45**	-12.44***	2.72
	(0.58)	*(0.02)*	*(0.02)*	*(0.01)*	*(0.05)*	*(1.29)*	*(3.06)*	*(3.10)*	*(2.18)*
Coats	China	Vietnam	ROW			Knit Shirts	Woven Shirts	Jeans	Bottoms
China	**-1.08*** **	0.09	-0.14			16.77**	-29.53	13.11	-2.11
	(0.36)	*(0.13)*	*(0.17)*			*(7.22)*	*(18.97)*	*(21.66)*	*(4.35)*
Vietnam	0.28	**-0.52**	0.31			6.85	-43.49**	42.23**	-5.85
	(0.37)	*(0.44)*	*(0.44)*			*(6.93)*	*(18.14)*	*(20.71)*	*(4.18)*
ROW	0.01	0.02	**-0.96*** **			1.55	-4.77*	3.69	-0.21
	(0.03)	*(0.03)*	*(0.03)*			*(1.00)*	*(2.60)*	*(2.97)*	*(0.61)*

Note: *, **, *** denote significant at one, five and ten percent levels, respectively. Standard errors are in parentheses. ROW refers to the rest of the world.