IMPACTS OF MULTI-FIBER ARRANGEMENT REMOVAL ON GLOBAL TEXTILE AND COTTON TRADE

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ABSTRACT

Textiles and apparel trade has been governed by the Multi-Fiber Arrangement (MFA) for three decades. Trade restrictions have generated substantial welfare losses and price wedges in exporting and importing countries through trade distortions. Beginning in 1995, textiles and apparel trade underwent fundamental changes. MFA quota will be removed by Jan 2005 according to World Trade Organization's Agreement on Textiles and Clothing (ATC).

This study established an equilibrium displacement model to investigate the impact on textile and cotton sectors of different countries and country-groups of removing the MFA quota. The model specifies the basic linkages of textile and cotton markets in the United States, China and three other country-groups. With different parameter values for U.S. textile supply elasticity, assumptions about foreign cotton exporters' reaction and changes in the U.S. loan deficiency payment, alternative scenarios in the short run and long run are computed to predict changes in domestic and import demand for textiles and apparel, import demand for U.S. cotton, domestic and import price of textiles and apparel, U.S. cotton price and adjusted world cotton price.

Generally, results indicated increased import demand for U.S. cotton, higher textiles/apparel export supply from China, decreased domestic demand for U.S. cotton, and lower U.S. domestic demand for textiles and apparel. However, both textile prices and cotton prices had positive or negative changes depending on different scenarios.

Keywords: Multi-fiber Arrangement, Textile, Apparel, Equilibrium Displacement Model

INTRODUCTION

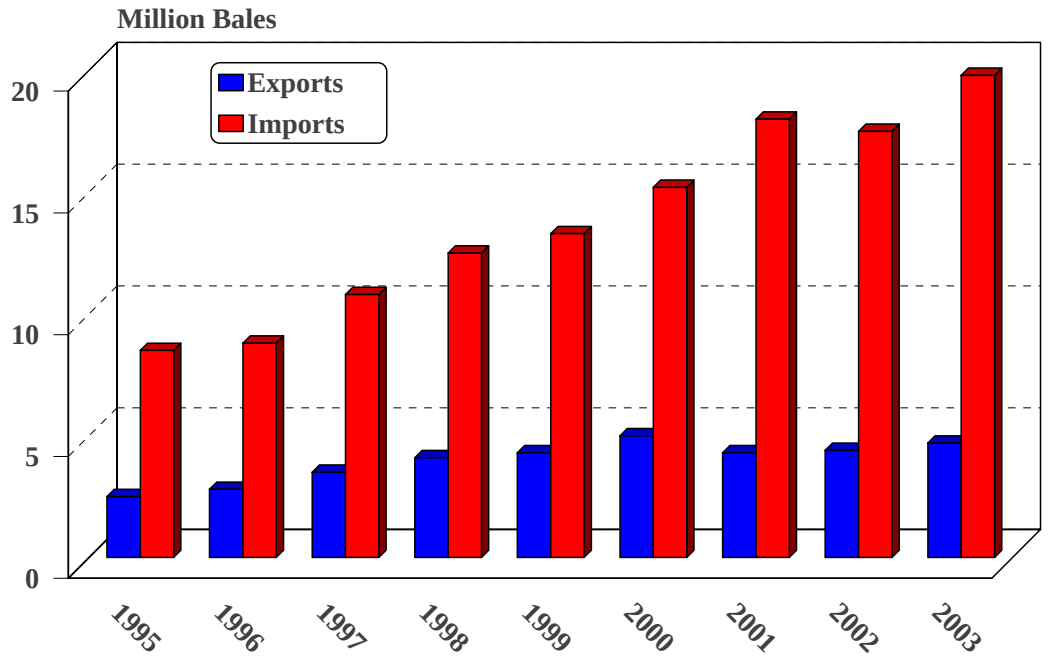
Textiles and apparel have been among the world's most systematically and comprehensively protected sectors (Cline). Up until the end of the Uruguay Round in 1993, textile and apparel quotas were negotiated bilaterally and governed by the rules of the Multi-Fiber Arrangement (MFA). It provided for selective quantitative restrictions on imports of textiles and apparel products. A large portion of international textile and apparel exports from developing countries to industrial countries was thus subject to different quota regimes. The MFA caused an increase in the textile and apparel prices in importing countries, a decrease in the prices in exporting countries and reduction in total consumption.

Since January 1, 1995, international textile and apparel trade has undergone fundamental changes. Instead of an immediate conversion from quotas to tariffs, tariff-rate quotas (TRQs) were adopted. The transitional program of the World Trade Organization's Agreement on Textiles and Clothing (ATC) aimed at removing all quotas by January 2005. With the elimination of the MFA quotas, tariffs will become the primary mechanism for border protection of trade in textiles and apparel (WTO).

The primary objective of this study is to analyze and quantify the impacts of eliminating the MFA quota on textile, apparel and cotton markets. An equilibrium displacement model analyzes how the global restructuring of import demand, export supply, domestic consumption and prices in textile and cotton sectors will be expected to change under freer trade.

This paper follows the format of *American Journal of Agricultural Economics*.

Eliminating the MFA quota will have direct reflections on textile and apparel importers and exporters. In the past decades, the United States remains one of the largest textile and apparel importing countries in the world. U.S. imports. The decade long trend (Figure 1) of import expansion of the U.S. textile industry is expected to continue. The United States mainly imports textile products from developing countries, among which China accounted for approximately 19.62 percent of total U.S. imports of textile and apparel products in 2003. According to the American Manufacturing Trade Action Coalition, this was the largest single contribution of a trading partner to total U.S. textile imports under the MFA.



Source: Economic Research Service, USDA.

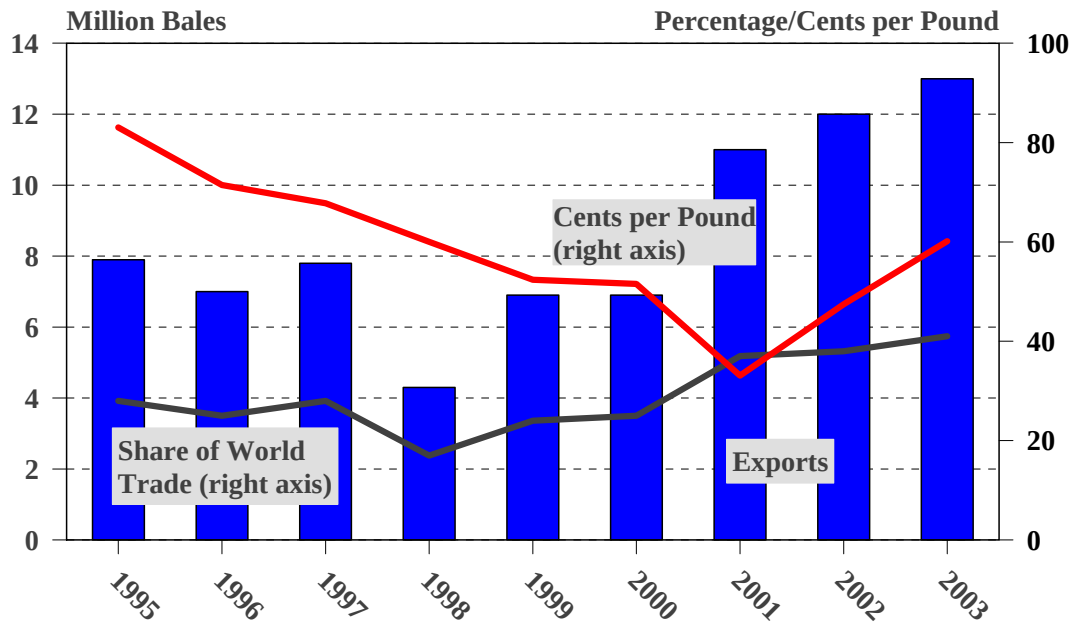
Figure 1. U.S. cotton textile trade

China was widely regarded as the world's most competitive exporter, and the quota equivalent tariffs that China is subject to were typically higher than those for other countries. After the dissolution of the MFA in 1994, and upon joining the WTO in 2001, China's textile and apparel products received quota-free access to the U.S. market which

was preciously withheld due to the lack of the WTO membership, and its textile production expanded rapidly thereof and its position as the dominant supplier of U.S. textiles and apparel is strengthening.

Since demand for cotton is a derived demand, which is dependent upon the associated demand for textiles and apparel, the changes occurring in textile production and textile trade will inevitably affect the production, and trade flows of cotton, one of the most important and basic raw input for the textile and apparel industry.

Currently, U.S. cotton production accounts for roughly 20 percent of world supply (ERS, USDA). During that decade, the United States ranked second in world cotton production, third in world cotton consumption, and third in the size of ending stocks. Although the following decade saw reduction in production and supply, U.S. cotton exports still increased (Figure 2).



Source: PS&D/USDA

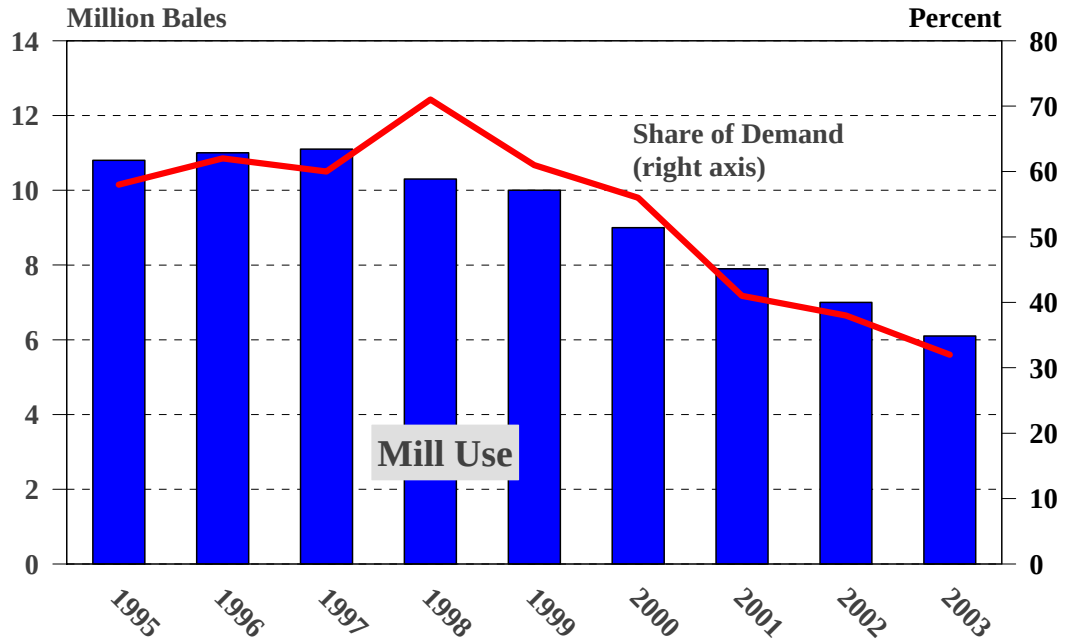
Figure 2. U.S. cotton exports, share of world trade and prices

Noticeable changes were also present in domestic consumption of cotton. In the market period 1986-2001, domestic mill use of cotton was the most significant factor influencing demand for domestically produced cotton. However, trade liberalization, along with the strength of the U.S. dollar, intensified import competition in the textile industry. Consumers of U.S. textiles benefit from consuming cheaper textiles and apparel products from exporters. This adversely affected the U.S. textile industry. While trying to reduce production capacity and cost, U.S. mill use of domestic cotton fell dramatically from 1997 to 2003 (Figure 3). In addition, the import demand for U.S. cotton will increase as a result of expansion in textile industry of textile exporting countries. U.S. cotton producers will evolve from being primary suppliers to the domestic textile industry to being stronger export competitors in international market.

As the third largest importer of U.S. cotton in 2003 (FAS, USDA), China imported 28 percent of total U.S. cotton exports in 2003. It is reasonable to believe this trend will continue following China's recent liberalization in textile trade policy. Currently, China is the world's largest cotton producer and the world's largest cotton consumer (ERS, USDA). Any shifts in production and policy regarding the textile and cotton sectors will have considerable impact on the global cotton market as well as textile/apparel markets.

After the phasing out of the MFA, developing countries will find it easier to access developed countries' textile and apparel markets, assuming that tariffs are not prohibitively high. The cotton and textile sectors of the United States and China are major contributors to each country's respective gross national products. It is expected that policy implications are important and will have significant impact from this

interdependent trend. It is essential that the impacts of textile trade liberalization be investigated, quantified and analyzed.



Source: ERS/USDA, Bureau of Census

Figure 3. U.S. cotton mill use

QUALITATIVE FRAMEWORK

Graphic analysis of partial equilibrium is used to demonstrate how the removal of the MFA will impact the United States, China, and world's textile and cotton markets (Figure 4). The cotton market and textile/apparel market are vertically linked. Cotton's share of textile and apparel products is assumed to be 100 percent for analysis convenience.

By imposing a tariff of TB (import quota tariff equivalent) in the textile and apparel market, a price wedge is created between the United States and Chinese textile/apparel market. U.S. domestic price rises to P_{us} (panel d), while China's domestic price drops to P_{ch} (panel f). This induces less textile and apparel consumption in the

United States. In the short run, the price changes have no effect on the supply of textiles and apparel because the supply is perfectly price inelastic due to rigidity of cotton production. The total trade volume shrinks from Q_{w1} down to Q_{w2} (panel e).

Since textile and apparel prices are positively related to the demand for cotton, the increase in textile and apparel prices in the United States would shift U.S. cotton demand curve up to D'^{us}_{c} while the decrease of textile and apparel prices in China would shift its cotton demand curve down to D'^{ch}_{c}. The new world price of cotton, P'^{c}_{w}, could be higher or lower than the free trade level, P^{c}_{w}, depending on the relative shift magnitude of each country's cotton demand curve, which is determined by the cross elasticity of cotton demand with respect to textile price in the United States and China. The cotton trade volume, however, unambiguously declines from Q_w to Q'_w (panel b). Diagram (b) demonstrates that, under the assumption that the impact of textile and apparel market price change on U.S. cotton market is relatively smaller than that on China's cotton market, cotton price falls to P'^{c}_{w}.

To see how the removal of MFA equivalent import tariff will affect textiles and apparel trade as well as cotton trade, the above analysis can be reversed. Eliminating the MFA quota would cause U.S. textile and apparel price to fall and China's price to rise. There is no change in textiles and apparel supply in both United States and China in the short run. Domestic demand for textiles and apparel expands in the United States but declines in China along the demand curve. Higher trade volume of textile and apparel products is resulted. As textiles and apparel price drops in the United States, demand for cotton declines.

To meet the demands of larger textile and apparel consumption, China will expand its textile and apparel production. This, in turn, stimulates its demand for cotton. It should be noted that the demand for cotton would not shift back to where it was under trade restrictions in the United States and China. This is because that some end users like industrial users who switched to manmade-fiber textiles and apparel products under the trade restrictions would not return to consume as much cotton textile and apparel as before the trade liberalization due to preference change and relative price of manmade fiber and cotton. In the long run, the demand changes in both the United States and China's cotton sector will drive world cotton price up or down. As a result, the world cotton production and trade volume will expand.

However, the United States imports textile and apparel from developing countries other than China, such as South Asia and ASEAN countries. Phasing out the MFA would intensify the competition between these textile-exporters and China. Given the high substitutability of textile and apparel products among developing countries, the increase in China's textile and apparel exports will be less than the amount under the assumption that China is the sole exporter of textile and apparel products. Yet China will remain the dominant exporter[1] in the world textile market. Like other competitors of China's textile industry, China will source their increased demand for cotton from both domestic production and global trade to satisfy its expanding textile sector.

[1] According to the simulation results of The Impact of China and Taiwan Joining the WTO on U.S and World Agricultural Trade (Wang,), China's entry into WTO will more than double its share in world textile market from an already large base of 13.5 percent to nearly 30 percent and cut the market expansion of ASEAN and South Asia countries by more than half.

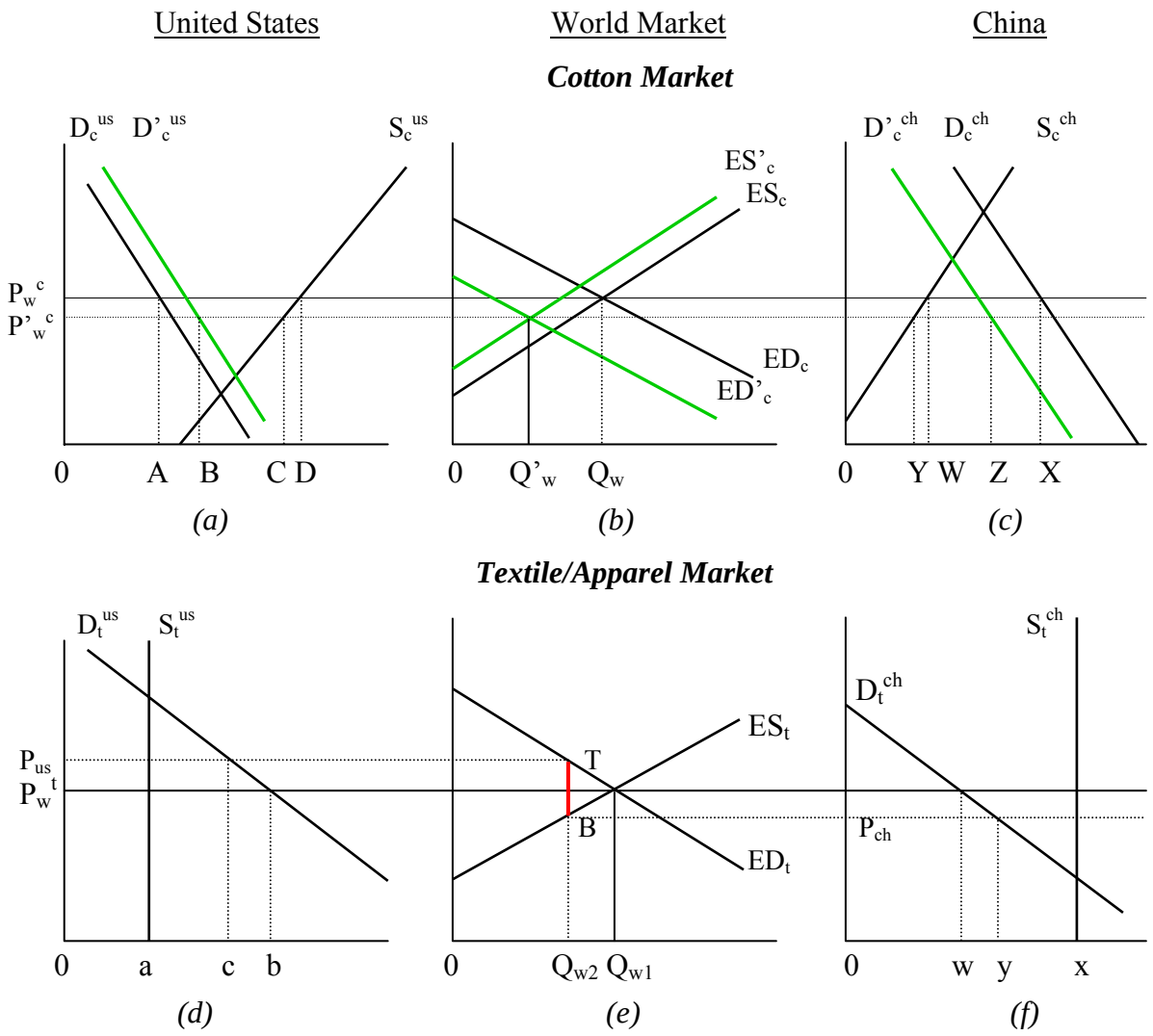


Figure 4. Impact of imposing MFA quota and import tariff on textile & apparel and cotton market[2]

[2] P_w^c - the world price level under free trade; $P'_w{}^c$ – world price level under quota and tariff; D_c^{us} and $D'_c{}^{us}$ – domestic demand for cotton in the United States before and after quota and tariff were imposed, respectively; S_c^{us} – domestic supply of cotton in the Untied states, ES_c and ES'_c – excess supply of cotton before and after the quota and tariff were imposed, respectively; ED_c and ED'_c – excess demand for cotton before and after the quota and tariff were imposed, respectively; Q_w and Q'_w – cotton trade volume under free trade and quota and tariff regime; D_c^{ch} and $D'_c{}^{ch}$ - domestic demand for cotton in China before and after the quota and tariff were imposed, respectively; S_c^{ch} - domestic supply of cotton in China; P_{us} – import price of textile and apparel in the United States under quota and tariff regime; P_w^t – world price of textile and apparel under free trade; D_t^{us} and S_t^{us} – domestic demand and supply of textile and apparel in the United States; TB – sum of tariff equivalent quota and tariff rates; ES_t and ED_t – excess supply and excess demand for textile and apparel, respectively; P_{ch} – export price in China under quota and tariff regime; Q_{w1} and Q_{w2} – textile and apparel trade under free trade and quota and tariff regime; D_t^{ch} and S_t^{ch} - domestic demand and supply of textile and apparel in China.

As cost efficient developing countries become more competitive in textile and apparel production, import demand from these countries for U.S. cotton will increase while the U.S. domestic demand for cotton, formerly dominated by U.S. mill use, will decrease. This trend has occurred since 1997 (Paggi). The U. S. cotton industry is evolving from a supplier to the domestic textile industry to one dependent on cotton exports driven by textile trade liberalization.

METHODOLOGY

To quantify the impact of removing the MFA on the U.S. and China's cotton industry, an economic model was specified to capture the basic linkages of the cotton and textile/apparel sectors. An equilibrium displacement model was then developed to quantify the impact

Theoretical Considerations

Textile production, consumption and trade are modeled based on modern economic consumer and producer theory. Homothetic preference, competitive markets, and nonjointness[3] of production are assumed. By solving the utility maximization problem of a representative consumer, the aggregate market demand for textile and apparel products can be derived. Furthermore, if domestic and import textile goods are not perfectly substitutable, the following demand function can be defined:

$$T_i = Ti\ (PT, PT^*, PX, Y)$$

[3] A multiouput industry's supply and demand possesses the same properties as a single output industry. According to Hall (1972), the necessary and sufficient condition for nonjointness technology is that the total cost of producing all outputs is the sum of the cost of producing each output separately, which is,

$$C\ (Y, W) = C^1\ (Y^1, W) + \ldots\ldots\ldots + C^n\ (Y^n, W)$$

where C(Y, W) is the total cost function, C^i is the cost function producing output i, Yi is the ith output, and W is the vector of inputs price. If the technology displays constant returns to scale, the total cost function can be further specified as

$$C\ (Y,W) = Y^1\ b^1\ (W) + \ldots\ldots\ldots + Y^n\ b^n\ (W)$$

$T_i^* = T_i^* (PT, PT^*, PX, Y)$

where T_i is the U.S. domestic demand for textile product i, T_i^* is the U.S. import demand for textile product i. PT, PT* and PX are price vectors of domestic textile products, imported textile products and other goods, respectively, and Y is per capita income.

Given that the market is competitive, by Shepard's lemma, output supply and input demand were characterized as

$P = AC (W)$

$X = X (W, Y)$

where AC is average cost function, P is output price vector, and X is input vector.

Under free trade, comparative advantage determines trade flows and trade patterns. However, under the MFA, the trade flows of textile and apparel products are subject to import quota restrictions. The excess demand curve is thus kinked at the quota limit Q_w (Figure 5). Equilibrium in this market occurs at $P^S \bullet (1+T)$, where P^S is the price received by exporters, P^M is the price paid by importers, and T is the ad valorem tariff equivalent quota when the quota is binding.

U.S. Farm program

U.S. cotton production has long been supported by a U.S. farm program. The Farm Security and Rural Investment Act of 2002 was signed into law on May 13, 2002, and will last until 2007 (ERS, USDA). One of the major purposes of the U.S. farm program is to maintain price competitiveness for domestically produced cotton on the international market. The 2002 farm bill provides support for cotton through three programs: direct payments, marketing loans, and a counter-cyclical payment.

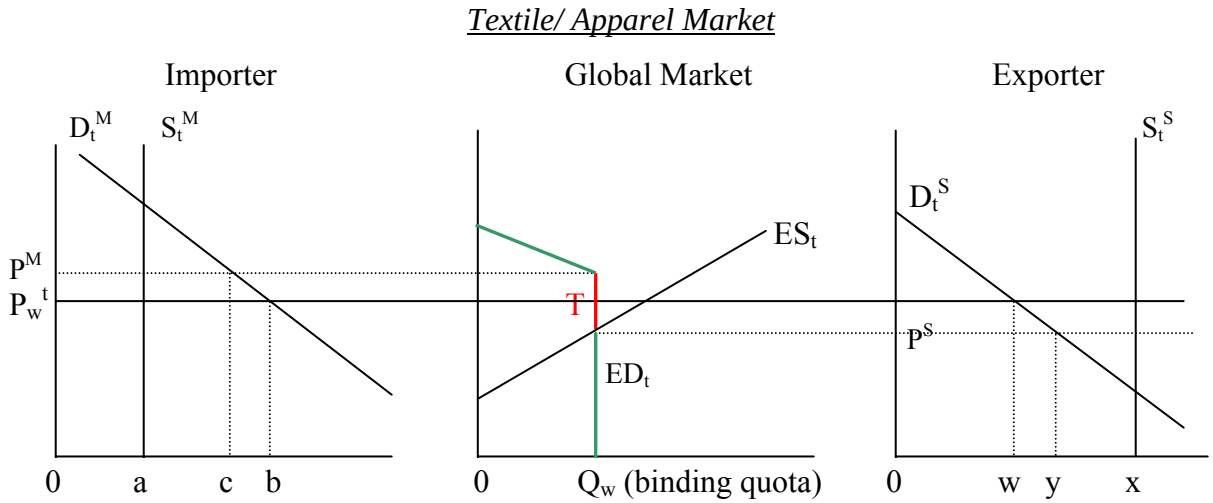


Figure 5. Quotas on textile and apparel market[4]

The direct payment (DP) rate is fixed and not affected by current production or market prices. Eligible growers receive annual direct payments based on the payment rate.

The marketing loan program allows producers to receive a loan at a specific loan rate per unit of production. It provides a loan deficiency payment or marketing loan gain to producers when market prices are low. The nonrecourse marketing loan also reduces the revenue risk associated with price variability (ERS, USDA).

The Counter-cyclical payment (CCP) is a new program. The 2002 farm bill established a target price. When the higher of the loan rate or the commodity price (season average price) plus the direct payment rate is lower than the target price, a CCP is made at a rate equal to the difference,

CCP rate = Target price – (DP rate + max {loan rate, commodity price})

[4] P^M – import price of textile and apparel in importing country with quota restriction; P_w^t – world textile and apparel price under free trade; D_t^M and S_t^M – domestic demand and supply of textile and apparel in importing country; T- quota equivalent tariff; ED_t and ES_t – excess demand and supply of textile and apparel, respectively; Q_w – binding quota level, also the trade volume under quota restriction; P^S – export price of textile and apparel in exporting country; D_t^S and S_t^S – domestic demand and supply of textile and apparel in exporting country.

The farm bill has important policy implications for U.S. cotton production. Although direct payments and counter-cyclical payments may influence the production decisions of the cotton growers, marketing loan have the greatest effect on production decisions because it is directly coupled to producers' current production. Therefore, LDP is an important exogenous consideration for U.S. cotton supply. This study focuses on simulating the policy implication of reduction of Loan Deficiency Payment in the short run and long run.

Analytical Model

Based on considerations noted above, an economic model was set up to reflect the linkage of textile and cotton markets. The world's textile and cotton trading nations are divided into five groups: the United States, which is a textile importer and a cotton exporter; EU-15 member states, which imports both textiles and cotton; China, which exports textile/apparel products and imports cotton; AO[5], which exports textiles and imports cotton; other cotton exporters, k. The model is specified as below:

I. Textile & Apparel

Consumption

(1) $DT_i = DT_i (PT_i, PT_i^D)$

(2) $DA_i = DA_i (PA_i, PA_i^D)$

(3) $DTM_i = DTM_i (PT_i, PT_i^D)$

(4) $DAM_i = DAM_i (PA_i, PA_i^D)$

Production

(5) $PT_i = AC^T{}_i (PC, PO)$

(6) $PA_i = AC^A{}_i (PC, PO)$

(7) $PT_j^S = AC^T{}_j (PC, PO)$

(8) $PA_j^S = AC^A{}_j (PC, PO)$

[5] Bangladesh, India, Indonesia, Korea, Malaysia, Pakistan, Philippines, Singapore, Sri Lanka, Taiwan, Thailand.

II. Cotton

Demand

(9) $DC_i = DC_i\ (TS_i, AS_i, PC, PO)$

(10) $DO_i = DO_i\ (TS_i, AS_i, PC, PO)$

(11) $DC_j = DC_j\ (TMS_j, AMS_j, PC, PO)$

(12) $DO_j = DO_j\ (TMS_j, AMS_j, PC, PO)$

Supply

(13) $SC = SC\ (PC, LDP)$

(14) $SO_k = SO_k\ (PO, \alpha)$

III. World Textile Export Price Determination

(15) $PT^S = \sum(STM_j / STM)\ PT_j^S$

(15) $PA^S = \sum(SAM_j / SAM)\ PA_j^S$

IV. Trade Restrictions and Equilibrium Conditions

(17) $PT_j^D = PT^S\ (1+T)$

(18) $PA_j^D = PA^S\ (1+A)$

(19) $STS_i = DT_i$

(20) $SA_i = DA_i$

(21) $SM_j = DTM_i$

(22) $\sum SAM_j = \sum DAM_i$

(23) $SC = \sum DC_i + \sum DC_j$

(24) $SO_k = \sum DO_i + \sum DO_j$

where subscript i refers to the United States and EU-15 states, j stands for China and AO countries.

Table 2. Variables and Their Definitions in the Model

Variable	Definition
DT_i	demand for domestic textiles in country i
DA_{US}	demand for domestic apparel in country i
DTM_{US}	demand for textile imports in country i
DAM_{US}	demand for apparel imports in country i
PT_i	domestic textiles price in country i
PT_i^D	textile import price in country i
PA_i	domestic apparel price in country i
PA_i^D	apparel import price in country i

Table 2. Continued

Variable	Definition
PC	U.S. cotton price (upland cotton spot price)
PO	foreign cotton price (adjusted world price)
PT^S_j	export supply price of textiles from country j
PA^S_j	export supply price of apparel from country j
DC_i	derived demand for U.S. cotton in country i
DO_i	demand for foreign cotton in country i
DC_j	import demand for U.S. cotton in country j
DO_j	import demand for foreign cotton in country j
DC_h	import demand for US cotton in country h
DO_h	import demand for foreign cotton in country h
ST_i	domestic supply of textiles in country i
SA_i	domestic supply of apparel in country i
STM_j	textile export supply from country j
SAM_j	apparel export supply from country j
SC	U.S. cotton supply
SO_k	cotton export supply from country k
PT^S	world textile export supply price
PA^S	world apparel export supply price
T, A	the total ad valorem equivalent tariff of the quota when the quota is binding
LDP	loan deficiency payment
α	cotton export supply shifter

Equilibrium Displacement Model

To investigate the impacts on cotton sectors of exogenous textile trade policy shocks in different country groups, the total differential of each equation in the model was taken and was expressed in the form of relative changes[6] ($dX/X = EX$) and elasticities which is known as the equilibrium displacement model (EDM):

I. Textile & Apparel

Consumption

(1) $EDT_i = \eta_i \, EPT_i + \eta'_i \, EPT^D_i$

(2) $EDA_i = \eta^*_i \, EPA_i + \eta^{*\prime}_i \, EPA^D_i$

(3) $EDTM_i = \eta_{iI} \, EPT_i + \eta'_{iI} \, EPT^D_i$

[6] Derivation of equations is available upon request.

(4) $EDAM_i = \eta^*_{iI}\, EPA_i + \eta^{*\prime}_{iI}\, EPA^D_i$

Production

(5) $EPT_i = \delta_i\, EPC + \delta'_i\, EPO$

(6) $EPA_i = \delta^*_i\, EPC + \delta^{*\prime}_i\, EPO$

(7) $EPT^S_j = \delta_j\, EPC + \delta'_j\, EPO$

(8) $EPA^S_j = \delta^*_j\, EPC + \delta^{*\prime}_j\, EPO$

II. Cotton

Demand

(9) $EDC_i = \mu_i\, EST_i + \mu^*_i\, ESA_i + \gamma_i\, EPC + \gamma_{iI} EPO$

(10) $EDO_i = \mu'_i\, EST_i + \mu^{*\prime}_i\, ESA_i + \gamma'_i\, EPC + \gamma'_{iI}\, EPO$

(11) $EDC_j = \mu_j\, ESTM_j + \mu^*_j\, ESAM_j + \gamma_j\, EPC + \gamma_{jI}\, EPO$

(12) $EDO_j = \mu'_j\, ESTM_j + \mu^{*\prime}_j\, ESAM_j + \gamma'_j\, EPC + \gamma'_{jI} EPO$

Supply

(13) $ESC = \epsilon_{US}\, EPC + d\, ELDP$

(14) $ESO_k = \epsilon_k\, EPO + d\beta$

III. World Textile Export Price Determination

(15) $EPT^S = \alpha_j \sum EPT^S_j$

(16) $EPA^S = \alpha^*_j \sum EPA^S_j$

IV. Trade Restrictions and Equilibrium Conditions

(17) $EPT^D_i = EPT^S + T/(1+T)\, ET_i$

(18) $EPA^D_i = EPA^S + A/(1+A)\, EA_i$

(19) $EST_i = EDT_i$

(20) $ESA_i = EDA_i$

(21) $\beta \sum ESTM_j = \sum DETM_i$

(22) $\beta^*_j \sum ESAM_j = \sum EDAM_i$

(23) $ESC = \pi_i \sum EDC_i + \pi_j \sum EDC_j$

(24) $ESO_k = \pi' i \sum EDO_i + \pi'_j \sum EDO_j$

where η is the price elasticity of demand for domestic textile products, η^* is the price elasticity of demand for imported textile products, δ is the cost share, μ is the output

share, γ is the price elasticity of input demand, ϵ is the supply elasticity, β is the textile and apparel import market share in terms of value, π is the market share of demand for U.S. cotton, and π' is the market share of demand for foreign cotton.

The equation system can be expressed in matrix form, A* X = B, where A is a nonsingular matrix of all parameters, X is the matrix of all endogenous variables, and B is the matrix of exogenous shocks. By inverting matrix A and taking the product of A^{-1} and matrix B, the endogenous variables in matrix X were solved.

Parameter Values Specification

1. Textile and apparel demand elasticities

The latest available results on U.S. price elasticity of demand for both domestic and imported textile and apparel products with respect to price can be found in "The Future of World Trade in Textiles and Apparel" by William R. Cline in 1990. No other systematic estimates for textile and apparel demand elasticities were found. Therefore, the demand elasticities estimated by Cline are applied in this study. There are no estimates available for EU countries as a group. However, studies showed that they have many similar characteristics in textile and apparel consumption, production and trade (Cline, 1990). It is reasonable to assume the same demand elasticities for EU countries as those of the United States.

2. Cost share and output share

In this study, cost share and output share for the United States and China were computed by the author. Those for EU countries were sourced from Shui's study in 1990 and other Asian countries were assumed to possess the same values as those of China. The cost share was calculated based on data on four-year averages (1999-2002).

3. Input demand elasticities

The input demand elasticities for all the five study groups were estimated by the author using OLS regression analysis (available upon request).

4. Cotton supply elasticities

The latest study conducted by Westcott and Meyer titled "U.S. Cotton Supply Response Under the 2002 Farm Act" suggested that the short run upland cotton supply elasticity for the United States is 0.466. This value is incorporated to solve endogenous variables. Other values, including long run supply elasticity for the United States, short run and long run supply elasticities for other cotton exporters are obtained from Shui's study.

5. Tariff equivalent of MFA quota

According to Shui, the average quota rates of the United States are 22.87 percent for textiles, and 28.3 for apparel; those of EU countries are 21.4 percent for textiles, and 27.31 for apparel. When the quota is removed, the tariff rate for textiles and apparel will be decreasing by 100 percent weighted by their own fraction.

Table 3. Elasticities and Shares: Definition, Value and Source

Item	Value	Source
Textile demand elasticity		
• Price elasticity of demand		
Domestic textile	$\eta_i = -0.60$	Cline
Domestic apparel	$\eta^*_i = -1.40$	Cline
Imported textile	$\eta'_{iI} = -1.30$	Cline
Imported apparel	$\eta^{*\prime}_{iI} = -1.60$	Cline
• Cross price elasticity of demand for domestic goods with respect to import price		
Textile	$\eta'_i = 0.205$	Cline
Apparel	$\eta^{*\prime}_i = 1.18$	Cline
• Cross price elasticity of demand for imported goods with respect to domestic price		
Textile	$\eta_{iI} = 1.90$	Cline
Apparel	$\eta^*_{iI} = 1.10$	Cline

Table 3. Continued

Item	Value	Source
Cost share		
U.S.		
• Cotton/Textile	$\delta_{US} = 0.0827$	author
• Cotton/Apparel	$\delta^*_{US} = 0.085$	author
EU		
• U.S. cotton/Textile	$\delta_{EU} = 0.0338$	Shui, 1990
• Other cotton/Textile	$\delta'_{EU} = 0.0667$	Shui, 1990
• U.S. cotton/Apparel	$\delta^*_{EU} = 0.0838$	Shui, 1990
• Other cotton/Apparel	$\delta^{*'}_{EU} = 0.1733$	Shui, 1990
China		
• U.S. cotton/Textile	$\delta_{CH} = 0.0161$	author
• Other cotton/Textile	$\delta'_{CH} = 0.0143$	author
• U.S. cotton/Apparel	$\delta^*_{CH} = 0.0634$	author
• Other cotton/Apparel	$\delta^{*'}_{CH} = 0.0565$	author
AO		
• U.S. cotton/Textile	$\delta_{AO} = 0.0593$	Shui, 1990
• Other cotton/Textile	$\delta'_{AO} = 0.0808$	Derived from Shui
• U.S. cotton/Apparel	$\delta^*_{AO} = 0.1753$	Derived from Shui
• Other cotton/Apparel	$\delta^{*'}_{AO} = 0.1793$	Derived from Shui
Output share		
U.S.		
• Cotton/Textile	$\mu_{US} = 0.2758$	author
• Cotton/Apparel	$\mu^*_{US} = 0.468$	author
EU		
• U.S. cotton/Textile	$\mu_{EU} = 0.449$	Shui, 1990
• Other cotton/Textile	$\mu^*_{EU} = 0.551$	Shui, 1990
• U.S. cotton/Apparel	$\mu'_{EU} = 0.449$	assumption
• Other cotton/Apparel	$\mu^{*'}_{EU} = 0.551$	assumption
China and AO		
• U.S. cotton/Textile	$\mu_{CH}, \mu_{AO} = 0.0945$	author
• Other cotton/Textile	$\mu^*_{CH}, \mu^*_{AO} = 0.0842$	author
• U.S. cotton/Apparel	$\mu'_{CH}, \mu'_{AO} = 0.1594$	author
• Other cotton/Apparel	$\mu^{*'}_{CH}, \mu^{*'}_{AO} = 0.138$	author
Input demand elasticity		
U.S.		
• Cotton	$\gamma_{US} = -0.67$	Shui, 1990
• Other cotton	$\gamma'_{USI} = -0.666$	author
EU		
• U.S. cotton	$\gamma_{EU} = -1.806$	author
• Other cotton	$\gamma'_{EUI} = 1.072$	author

Table 3. Continued

Item	Value	Source
CH		
• U.S. cotton	$\gamma_{CH} = 3.712$	author
• Other cotton	$\gamma'_{CHI} = -3.451$	Shui, 1990
AO		
• U.S. cotton	$\gamma_{AO} = 2.518$	author
• Other cotton	$\gamma'_{AOI} = 1.737$	author
h		
• U.S. cotton	$\gamma_{h} = 1.694$	author
• Other cotton	$\gamma'_{hI} = -0.959$	author
Cross price elasticity of U.S. cotton with respect to other cotton		
• U.S.	$\gamma_{USI} = 0.255$	author
• EU	$\gamma_{EUI} = 2.769$	author
• China	$\gamma_{CHI} = 3.502$	author
• AO	$\gamma_{AOI} = 2.771$	author
• h	$\gamma_{hI} = 0.685$	author
Cross price elasticity of other cotton with respect to U.S. cotton		
• U.S.	$\gamma'_{US} = 2.578$	author
• EU	$\gamma'_{EU} = 0.734$	author
• China	$\gamma'_{CH} = 4.46$	Shui, 1990
• AO	$\gamma'_{AO} = 0.99$	author
• h	$\gamma'_{h} = 0.758$	author
Cotton supply elasticity		
Short-run		
• U.S.	$\epsilon_{US} = 0.466$	Westcott and Meyer, 2003
• Other cotton exporters	$\epsilon_{k} = 0.38$	Shui, 1990
Long-run		
• U.S.	$\epsilon_{US} = 2.36$	Shui, 1990
• Other cotton exporters	$\epsilon_{k} = 2.36$	Shui, 1990

Table 4. Textile & Apparel Export Market Share of China & AO countries to the U.S. & EU countries

	Exporters	United States	EU
Textile	China	$\beta_{CH} = 0.3694$	$\beta'_{CH} = 0.3064$
	AO	$\beta_{AO} = 0.6306$	$\beta'_{AO} = 0.6936$
Apparel	China	$\beta^*_{CH} = 0.2884$	$\beta^{*'}_{CH} = 0.4094$
	AO	$\beta^*_{AO} = 0.7116$	$\beta^{*'}_{AO} = 0.5906$

Source: Computed from various issues of International Trade Statistics

Table 5. Cotton Import Market Share

Groups	U.S. cotton	Foreign cotton
U.S. consumption	$\pi_{US} = 0.3526$	$\pi'_{US} = 0.0035$
EU imports	$\pi_{EU} = 0.042$	$\pi'_{EU} = 0.2239$
China imports	$\pi_{CH} = 0.1692$	$\pi'_{CH} = 0.1321$
AO imports	$\pi_{AO} = 0.164$	$\pi'_{AO} = 0.4194$

Source: Computed from World Cotton Database, National Cotton Council

SCENARIOS AND RESULTS

Four scenarios of the equilibrium displacement model derived in the previous section were computed by using Excel. Since the loan deficiency payment has important policy implications for U.S. cotton production, two potential cases were investigated in this study: 1) textile trade liberalization with a decrease in the LDP rate and 2) holding the current policy unchanged. For each case, two scenarios were simulated, a short run model and a long run model.

The removal of the MFA quota resulted in a proportional decline in the import prices of textiles and apparel, which was a 100 percent reduction in the quota equivalent tariff weighted by its own fraction T/(1+T) and A/(1+A). The average quota rates of the United States were 22.87 percent for textiles and 28.3 for apparel. Those of EU countries were 21.4 percent for textiles and 27.31 for apparel (Shui, 1990).

Scenario one, in the short run, the MFA quota was removed, the total payment decreased by 3 percent, and cotton supply from other countries was assumed to be unchanged in response to the textile trade liberalization policy changes.

The results suggested that there was a significant increase in import demand for textile and apparel products in the United States and EU countries after the removal of the MFA quota equivalent tariff. For the United States, it was predicted that the import

demand for textiles increased by 23.98 percent (Table 6). A corresponding import demand increase in apparel was estimated to be 35.21 percent. For the EU countries, the import demand for textile and apparel products increased by 22.95 percent and 34.40 percent, respectively.

An increase in import demand would induce a decrease in the demand for domestic textile and apparel products assuming no sharp fluctuations of the total demand for textile and apparel products. According to the results, the decrease for the United States was 3.75 percent for textiles, and 25.90 for apparel. EU countries experienced a 3.62 percent decrease in demand for domestic textiles and a decrease of 25.39 in demand for domestic apparel.

The decrease in domestic demand for textiles and apparel, in turn, had a negative impact on the U.S. domestic demand for cotton. A drop in demand for domestic cotton of 12.01 percent was expected.

The effects of trade liberalization were also reflected in textile and apparel trade, primarily among developing countries. As the MFA quota was removed, textile exports from China were predicted to increase by 34.36 percent relative to restricted trade. Likewise, the predicted increase in apparel export supply from China was 30.44 percent higher after the elimination of the quota. For the AO countries, both textile and apparel export supply increased and the increases were 17.90 percent and 37.15 percent, respectively.

Due to vertical linkages to the textile and apparel markets, the U.S. cotton price experienced a decline of 1.38 percent. However, the adjusted world price (PO) was predicted to increase slightly by 0.86 percent.

Table 6. Scenario 1: Removal of the MFA Quota Equivalent Tariff Only in the Short Run

Endogenous Variables	Percentage Change*
U.S. Import demand for textiles	23.98
U.S. Import demand for apparel	35.21
U.S. Domestic demand of textiles	-3.75
U.S. Domestic demand of apparel	-25.90
U.S. Import price of textiles	-18.62
U.S. Import price of apparel	-22.09
U.S. domestic price of textiles	-0.114
U.S. domestic price of apparel	-0.118
EU Import demand for textiles	22.95
EU Import demand for apparel	34.40
EU Domestic demand of textiles	-3.62
EU Domestic demand of apparel	-25.39
EU Import price of textiles	-17.64
EU Import price of apparel	-21.48
EU domestic price of textiles	-0.164
EU domestic price of apparel	-0.415
Textile export supply from China	34.36
Apparel export supply from China	30.44
Textile export supply from AO	17.90
Apparel export supply from AO	37.15
U.S. cotton supply	-0.69
U.S. cotton price (PC)	-1.38
Adjusted world cotton price (PO)	0.86
U.S. demand for domestic cotton	-12.01
China's demand for U.S. cotton	13.57
China's demand for foreign cotton	4.78
AO demand for U.S. cotton	10.37
AO demand for foreign cotton	8.6

The increase in export supply of textile and apparel products stimulated the demand for both U.S. cotton and foreign cotton from China and AO. Since the decline of U.S. cotton price and the rise of world adjusted cotton price made U.S. cotton relatively cheaper than foreign cotton. China and AO's demand for U.S. cotton increased more than their demand for foreign cotton. As was revealed, there was an increase of 13.57 percent in Chinese demand for U.S. cotton; the same demand from AO countries was projected to

be 10.37 percent. The increases in Chinese and AO demand for foreign cotton were 4.78 percent and 8.67 percent, respectively.

As was specified in the model, the change in U.S. cotton supply depends on the product of U.S. cotton price change and short run cotton supply elasticity. Given the decrease in U.S. cotton price, cotton supply from the United States dropped slightly by 0.69 percent.

A decline in the import price of both textile and apparel products in the United States was predicted to occur, which corresponded with the results of the qualitative analysis as a result of the quota elimination. The decreases were 18.62 percent and 22.09 percent for textiles and apparel, respectively.

Scenario two presented the changes in the short run with the removal of MFA quota and LDP rate decreased by 3 percent. Again cotton supply from other countries was held unchanged.

Variables related to textile and apparel did not see much difference than scenario one since loan deficiency payment provides competitive provisions for cotton industry. The decline in U.S. demand for domestic cotton when part of the LDP support was removed was greater than that in scenario one. This decrease was estimated to be 13.51 percent (Table 7).

Both the U.S. cotton price and adjusted world price of cotton increased in this scenario. The increase in U.S. cotton price was 1.46 percent and 2.67 percent for world cotton adjusted price. China's cotton imports increased by 9.58 percent and 11.73 percent from U.S. and foreign countries, respectively. AO's imports for U.S. cotton and foreign cotton increased by 8.16 percent and 8.17 percent, respectively.

Table 7. Scenario 2: Removal of the MFA Quota Equivalent Tariff 3 Percent Decrease in LDP in the Short Run

Endogenous Variables	Percentage Change*
U.S. Import demand for textiles	24.30
U.S. Import demand for apparel	35.09
U.S. Domestic demand of textiles	-3.87
U.S. Domestic demand of apparel	-25.95
U.S. Import price of textiles	-18.51
U.S. Import price of apparel	-21.85
U.S. domestic price of textiles	0.121
U.S. domestic price of apparel	0.124
EU Import demand for textiles	23.23
EU Import demand for apparel	34.62
EU Domestic demand of textiles	-3.73
EU Domestic demand of apparel	-25.88
EU Import price of textiles	-17.53
EU Import price of apparel	-21.24
EU domestic price of textiles	0.228
EU domestic price of apparel	0.586
Textile export supply from China	35.02
Apparel export supply from China	32.33
Textile export supply from AO	18.02
Apparel export supply from AO	36.21
U.S. cotton supply	-2.27
U.S. cotton price (PC)	1.46
Adjusted world cotton price (PO)	2.67
U.S. demand for domestic cotton	-13.51
China's demand for U.S. cotton	9.58
China's demand for foreign cotton	11.73
AO demand for U.S. cotton	8.16
AO demand for foreign cotton	8.17

Although the U.S. cotton price rises, its effect was shrunk by the short run cotton supply elasticity and offset by the decrease of loan deficiency payment rate, therefore the cotton supply from the United States declined by 2.27 percent.

Because the competitive provisions provided by the LDP was supposed to affect cotton market not textile and apparel industry, comparing results in this scenario and scenario one, no noticeable difference was observed for most endogenous variables in textile and apparel market except for U.S. and EU's domestic price of textiles and

apparel. U.S. domestic price of textile and apparel increased by 0.121 and 0124 percent, respectively. The same variables for EU increased by 0.228 and 0.586 percent. An explanation was that the increase in both U.S. cotton price and world adjusted cotton price put an upward pressure on the input cost of textile and apparel industry in the United States and EU countries, therefore driving the domestic textiles and apparel price up. Refer to table 8 and table 9 for further comparisons of other variables.

Scenario three gave the results in the long run with the MFA quota removed, cotton supply from other countries increased by 5 percent, and LDP rate held unchanged.

A significant redistribution of China and AO's share of textile and apparel export market was observed. In the long run, China took large share of textile exports from AO countries, increasing by 60.04 percent, 74.74 percent higher than the result in the short run when foreign cotton supply was held unchanged (Table 8). AO's textile exports increased only 9.04 percent. Comparatively, AO saw a significant increase in its apparel exports. This increase was 40.91 percent, 10.12 percent greater than the result with no change in foreign cotton supply. China's apparel export supply only increased by 23.46 percent, 22.93 percent less than the result in scenario two. Over the long run, China will become the primary textile supplier. AO and China will together be the dominators in apparel export markets among all Asian countries.

The import demand for textiles and apparel in the United State were slightly greater in the long run than the results obtained with no foreign cotton supply change. Import demand for textile and apparel increased by 24.80 percent and 36.25 percent, respectively.

Table 8. Scenario 3: Removal of the MFA Quota Equivalent Tariff and 5 Percent Increase in Foreign Cotton Supply in the Long Run

Endogenous Variables	Percentage Change*
U.S. Import demand for textiles	24.80
U.S. Import demand for apparel	36.25
U.S. Domestic demand of textiles	-3.76
U.S. Domestic demand of apparel	-26.02
U.S. Import price of textiles	-18.66
U.S. Import price of apparel	-22.17
U.S. domestic price of textiles	-0.09
U.S. domestic price of apparel	-0.102
EU Import demand for textiles	22.80
EU Import demand for apparel	34.23
EU Domestic demand of textiles	-3.57
EU Domestic demand of apparel	-25.10
EU Import price of textiles	-17.68
EU Import price of apparel	-21.56
EU domestic price of textiles	-0.096
EU domestic price of apparel	-0.245
Textile export supply from China	60.04
Apparel export supply from China	23.46
Textile export supply from AO	9.04
Apparel export supply from AO	40.91
U.S. cotton supply	-2.84
U.S. cotton price (PC)	-1.21
Adjusted world cotton price (PO)	-0.83
U.S. demand for domestic cotton	-12.62
China's demand for U.S. cotton	8.73
China's demand for foreign cotton	15.79
AO demand for U.S. cotton	4.76
AO demand for foreign cotton	10.53

When foreign cotton supply increased by 5 percent, China and AO countries sourced their cotton more from countries other than the United States. In the long run, China's demand for U.S. cotton increased by 8.73 percent, 35.67 percent less than that in the short run with no change in foreign cotton supply and its demand for foreign cotton increased by 15.79 percent, more than 3 times of the percentage increase in the short run. AO countries experienced the same too in the long run. AO's demand for U.S. cotton and foreign cotton increased by 4.76 percent and 10.53 percent, respectively.

The increase in total cotton supply push down both the U.S. cotton price (PC) and adjusted world cotton price (PO). As was shown, PC decreased by 1.21 percent and PO decreased by 0.83 percent. Given the increase in the foreign cotton supply and decrease of foreign cotton price, U.S. cotton supply decreased by 2.84 percent.

Scenario four presented the changes in the long run with MFA quota removal, cotton supply from other countries increased by 5 percent, and the LDP rate decreased by 3 percent.

U.S. cotton price and adjusted world cotton price decreased less than then LDP rate was held unchanged. Results suggested that U.S. cotton price decreased by 0.3 percent (Table 9). Compared to the result in the previous scenario, it was 75.21 percent less. The adjusted world cotton price decreased by 0.55 percent. This was 33.73 percent less than the percentage change in the scenario three.

China sourced its cotton more from foreign cotton supply. Its import demand for foreign cotton increased by 19.14 percent in the long run, 21.22 percent greater than the result in scenario three. Its cotton imports from the United States increased only by 6.46 percent which is the smallest change in all four scenarios. The same pattern was present for AO countries. AO's imports from the United States increased only 3.22 percent, however, its imports from foreign cotton suppliers increased by 10.85 percent.

U.S. cotton supply was determined by the exogenous decrease in LDP rate and product of long run cotton supply elasticity and percentage change in U.S. cotton price. The 0.3 percent drop in U.S. cotton price was amplified by the long run supply elasticity. Together with the 3 percent drop in LDP, U.S. cotton supply decreased by 3.72 percent.

Table 9. Scenario 4: Removal of the MFA Quota Equivalent Tariff, 3 Percent Decrease in LDP, and 5 Percent Increase in Foreign Cotton Supply in the Long Run

Endogenous Variables	Percentage Change*
U.S. Import demand for textiles	24.92
U.S. Import demand for apparel	36.23
U.S. Domestic demand of textiles	-3.80
U.S. Domestic demand of apparel	-26.05
U.S. Import price of textiles	-18.63
U.S. Import price of apparel	-22.11
U.S. domestic price of textiles	-0.025
U.S. domestic price of apparel	-0.026
EU Import demand for textiles	22.86
EU Import demand for apparel	34.26
EU Domestic demand of textiles	-3.59
EU Domestic demand of apparel	-25.20
EU Import price of textiles	-17.65
EU Import price of apparel	-21.50
EU domestic price of textiles	-0.047
EU domestic price of apparel	-0.12
Textile export supply from China	61.04
Apparel export supply from China	23.76
Textile export supply from AO	8.75
Apparel export supply from AO	40.77
U.S. cotton supply	-3.72
U.S. cotton price (PC)	-0.30
Adjusted world cotton price (PO)	-0.55
U.S. demand for domestic cotton	-13.18
China's demand for U.S. cotton	6.46
China's demand for foreign cotton	19.14
AO demand for U.S. cotton	3.22
AO demand for foreign cotton	10.85

China's textile and apparel export supply was slightly greater than those in scenario three. However, the same variables for AO countries increased less than those results in scenario three.

CONCLUSIONS

This study estimated changes in textile/apparel trade and cotton trade after the removal of the Multi-Fiber Arrangement. An equilibrium displacement model (EDM)

was developed and solved by incorporating self estimated parameters under four different scenarios. Five groups of countries were classified according to their international trade status in textiles, apparel and cotton. These groups were the United States, EU, China, AO countries, and foreign cotton exporters. The first four groups were the focuses of this study. The results were consistent with the impacts examined by the qualitative framework on the basis of modern international trade theory.

U.S. and EU countries' domestic demand for textiles and apparel tends to decrease after MFA quota elimination in both the short run and long run under different exogenous assumptions.

Following the removal of the MFA quota, consumers in both the United States and EU benefited from a lower price of imported textile and apparel products. Lower prices stimulated quantity imported in the United States and EU countries, which suggested that the international market would gradually become a larger textiles and apparel supplier to these two groups. The increase seen in the United States was larger than that in EU countries because the trend in EU member countries to trade within EU is expected to strengthen due to reduced border protection and lower transportation costs. There was no explicit difference in import demand increases in the United States and EU countries in all four scenarios, which indicated that U.S. competitiveness supported by the U.S. farm program for cotton would not induce a noticeable impact on textile and apparel trade.

As major textile and apparel exporters, China and AO countries will expand their textiles and apparel output to meet the increasing import demand from the United States

and EU countries. Correspondingly, China and AO increased their demand for both U.S. cotton and foreign cotton to meet the need of textile industries expansion.

The noticeable impact of MFA quota elimination when coupled with decrease in LDP was on U.S. cotton prices and adjusted world cotton price. In the short run, when LDP decreases, U.S. cotton price was rising instead of decreasing with LDP held constant. In the long run, the increase of the foreign cotton supply offset the up pressure from the LDP decrease. Therefore U.S. cotton price decreased, but dramatically less than when no change in LDP. The LDP did enhance the competitiveness of U.S. cotton in the global market.

After trade liberalization, the U.S. cotton industry evolved from being a major cotton supplier to its own domestic textile industry to a larger cotton exporter. This was verified by more cotton exports to foreign textile and apparel suppliers, such as China and other Asian developing countries.

Market access for textile and apparel exporters into the United States and the European Union improved. The competition among the developing textile and apparel exporters strengthened in order to secure and gain larger market share of the developed importers. China would become the leading textile exporter after the elimination of the MFA quota and take up a considerable part of the market share from other Asian textile exporting countries. However, AO countries would be exporting more apparel than China and both dominate apparel exporting market.

While U.S. farm programs have direct effects on the cotton market, no significant impact was found on textile and apparel market according to the results.

While import price for textile and apparel products decreased significantly, the domestic price of textiles and apparel might increase due to the non perfect substitution of domestic and import textiles and apparel. In scenario two when the MFA quota was eliminated and LDP decreased by 3 percent, U.S. and EU domestic textile and apparel prices increased slightly since the cotton input price went up.

LIMITATIONS AND SUGGESTIONS FOR FURTHER STUDY

No estimation was conducted for parameters in the textile and apparel market since further estimation would require substantial additional data and econometric analysis due to the complexity and commodity variety in textile and apparel sector.

The equilibrium displacement model only compares two static equilibria, before and after the removal of the MFA quota. Therefore, no prediction about adjustment between the two-policy equilibrium could be provided.

Finally, Ordinary Least Squares was applied to estimate some parameter values in the model. OLS may not capture all of the causal relationships in the world cotton market. More thorough econometric analysis is needed to update parameter values and improve the accuracy of these parameters and predictive power of this study.

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