THE IMPACT OF THE REMOVAL OF THE MULTI-FIBER ARRANGEMENT ON TEXTILE AND COTTON TRADE OF THE UNITED STATES AND CHINA

A Thesis

by

YAN XIA

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

December 2004

Major Subject: Agricultural Economics

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C. Parr Rosson (Chair of Committee)	David Bessler (Member)
Julian Gaspar (Member)	A. Gene Nelson (Head of Department)

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ABSTRACT

The Impact of the Removal of the
Multi-Fiber Arrangement on Textile and Cotton Trade of the
United States and China. (December 2004)
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Chair of Advisory Committee: Dr. C. Parr Rosson

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 in trade flows and patterns. The World Trade Organization's Agreement on Textiles and Clothing (ATC) aimed to remove all MFA quotas by January 2005.

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 four other country-groups. With different assumptions about U.S. textile supply elasticity, foreign cotton exporters' reaction and changes in the U.S. farm program payments, alternative scenarios are simulated 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. Uniform distribution was imposed for selected parameters

involved in the model to overcome the deficiency of equilibrium displacement models of assuming certainty of known related parameters.

Results indicate increased import demand for U.S. cotton by China, higher U.S. cotton supply, more textile and apparel supply from China, decreased domestic demand for U.S. cotton, and lower U.S. domestic demand for textiles and apparel. However, prices of both textile and cotton markets experience both positive and negative changes under different scenarios. Holding other assumptions unchanged, when farm program payments increase, U.S. cotton price and adjusted world cotton price declined. When farm program payments are held constant, prices rise. The changes expected in U.S. cotton price are, in absolute value, greater than those of the adjusted world price.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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). The MFA is a legal agreement negotiated and signed by participating countries. It allowed for the restriction on flows of textiles and apparel from an exporting country to an importing country. It also provided for selective quantitative restrictions when imports of textiles and apparel products would cause, or likely cause, serious damage to the textile and apparel industries in the importing country (Shui). A large portion of international textile and apparel exports from developing countries to industrial countries was thus subject to different quota regimes. The MFA was criticized as a departure from the General Agreement on Trade and Tariff (GATT) rules, in particular, the principle of non-discrimination. It also generated substantial welfare losses through trade distortions. The MFA caused an increase in the textile and apparel prices in importing countries, mainly industrial ones and a decrease in the prices in exporting countries, mainly developing ones. It should be noted that the countries imposing the MFA collect the economic rents generated by this import quota system.

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

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supply, domestic consumption and prices in textile and cotton sectors will be expected to change under freer trade.

The rationale of MFA dates back to the 1950s when it was first used to temporarily restrain textile and apparel imports from Japan to the United States(Hufbauer). Together with short-term and long-term treaties governing international trade in cotton textiles, these were the earliest trade barriers instituted against textiles and apparel. Decades later, in 1974, the first official MFA emerged. The MFA I, along with the 1977 Protocol extending the MFA I for an additional four years, was known as MFA II. In 1981, a new five-year protocol was negotiated, and together with MFA II, became known as MFA III. In 1986, the United States and 53 other nations renewed the MFA for an additional five years. The modified agreement incorporated new regulations along with more restrictive quotas. The MFA had evolved into a complex protocol involving all major trading countries and addressing all significant categories of textile and apparel products. At the end of 1994, when the MFA was integrated into the World Trade Organization, it had 39 country members, eight of which were developed countries that were informally designated as importers; the remaining 31 developing countries were considered exporters.

Since January 1, 1995, international textile and apparel trade has undergone fundamental changes. The Uruguay Round Agreement on Agriculture in 1996 initiated several steps toward freer trade (Skully). Instead of an immediate conversion from quotas to tariffs, tariff-rate quotas (TRQs) were adopted. A TRQ is a two-level tariff quota system. A certain level of low tariff is imposed on a specified amount of imports,

referred to as in-quota tariff, and a much higher tariff is charged on imports over the specified level, referred to as the over-quota tariff. Unlike a standard quota, TRQs set no restrictions on import quantities, as long as over-quota tariff is paid. Usually, importers profit from the import unless the over-quota tariff is high enough to prohibit trade.

The transitional program of the World Trade Organization's Agreement on Textiles and Clothing (ATC) aimed at removing all quotas by January 2005(Table 1). With the elimination of the MFA quotas, tariffs will become the primary mechanism for border protection of trade in textiles and apparel (WTO). It is generally accepted that in the long run, the reduction in trade restrictions will economically induce an increase in textile output. This will effectively improve market access for developing countries, and further change the world textile trade flows.

Table 1. Stages for Elimination of Multi-Fiber Arrangement Quotas

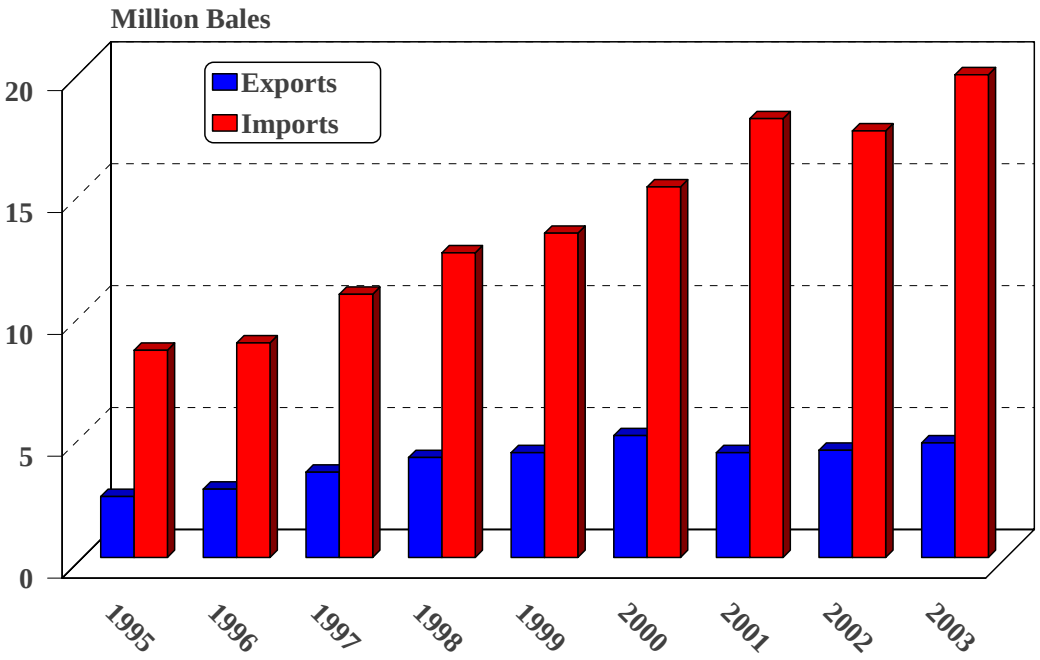
Step	*Percentage of Products to be brought under WTO Control* (including removal of any quotas)
Step 1: 1 Jan 1995 - 31 Dec 1997	6.96% per year
Step 2: 1 Jan 1998 - 31 Dec 2001	8.7% per year
Step 3: 1 Jan 2002 - 31 Dec 2004	11.05% per year
Step 4: 1 Jan 2005	Import quota eliminated

Source: World Trade Organization

Eliminating the MFA quota will have direct reflections on textile and apparel importers and exporters. Among all importers, the United States will be one to increase imports and relinquish a portion of its domestic textile demand.

In the past decades, the United States remains one of the largest textile and apparel importing countries in the world. U.S. imports, together with the EU and Canada account for more than half of the world textile trade (Shui). The decade long trend of import expansion by the U.S. textile industry is expected to continue. Consequently, the U.S. textile trade deficit will be expected to increase, while exports remain near the 2001 level (USDA, ERS).

According to the National Cotton Council of America, U.S. cotton textile imports will surpass 20 million bales in calendar year 2004 (Figure 1). The United States mainly imports textile products from developing countries. 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.



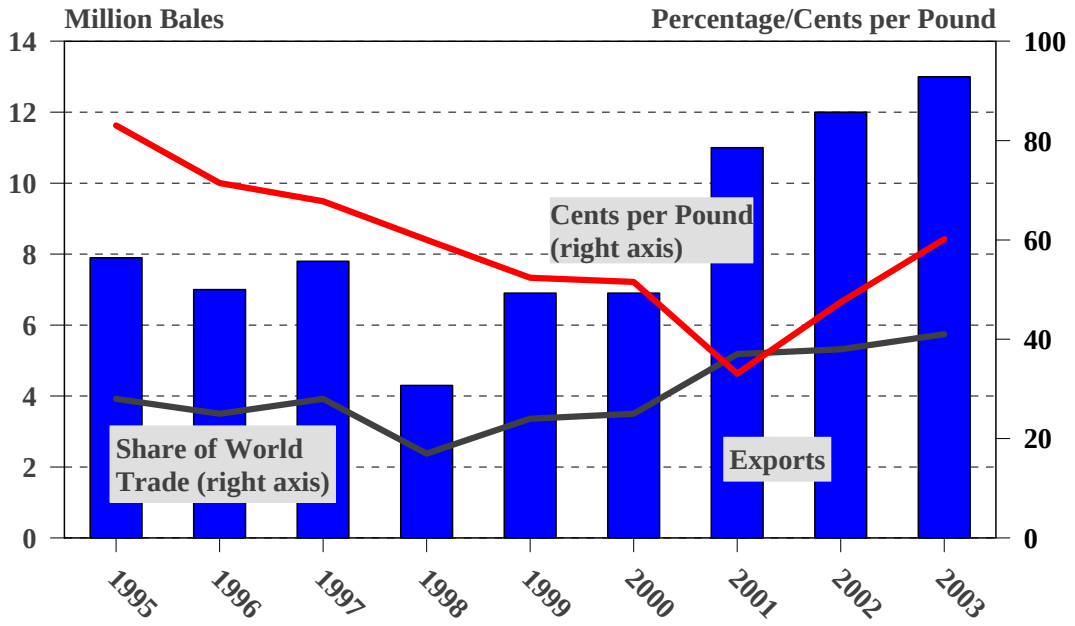
Source: USDA Economic Research Service

Figure 1. U.S. cotton textile trade

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, but still with tariff, and its textile production and trade expanded rapidly. China's position as the dominant supplier of U.S. textile and apparel products is strengthening.

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 materials for the textile and apparel industry. Demand for cotton is a derived demand, which is dependent upon the associated demand for textile and apparel products. As an important input, cotton trade would be altered substantially as an indirect result of trade liberalization.

In the 1990's, the United States was the world's leading cotton exporter, accounting for 25 percent of total world trade. Currently, U.S. production accounts for roughly 20 percent of world supply (USDA, ERS). 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. However, the following decade saw changes in production, supply and demand. In 2002, the U.S. cotton-producing sector experienced an average production loss. In 2003, favorable growing conditions increased cotton yields. During the same period, U.S. total cotton supply (production plus imports) decreased from 26.32 million bales in 2001 to 23.65 million bales in 2003 (USDA, ERS). Yet, U.S. cotton exports increased (Figure 2).

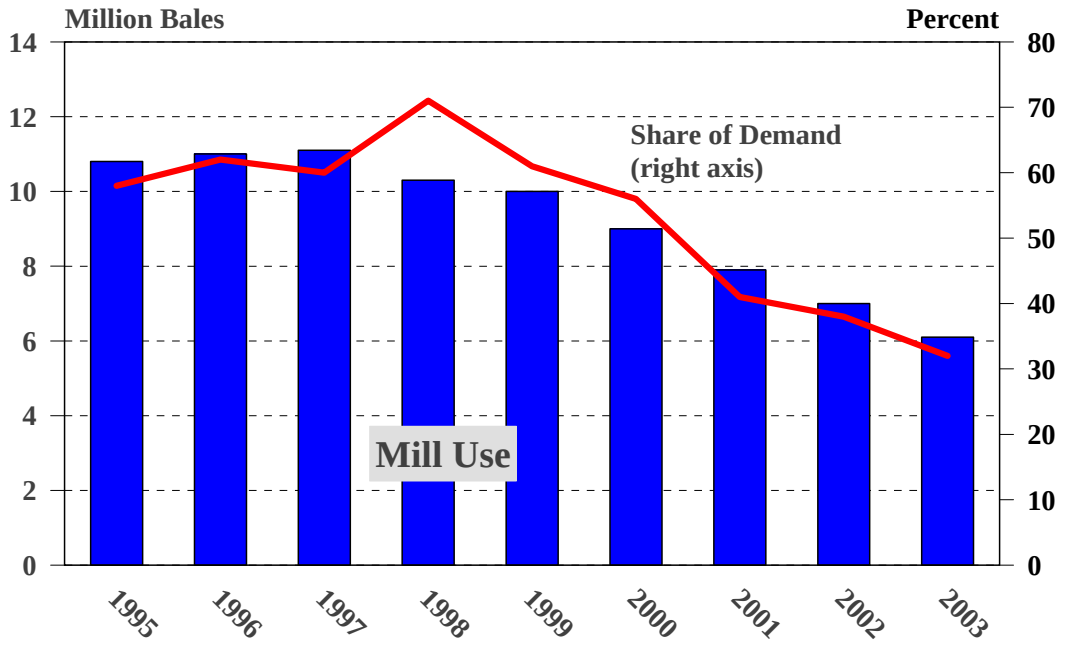


Source: USDA Economic Research Service

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

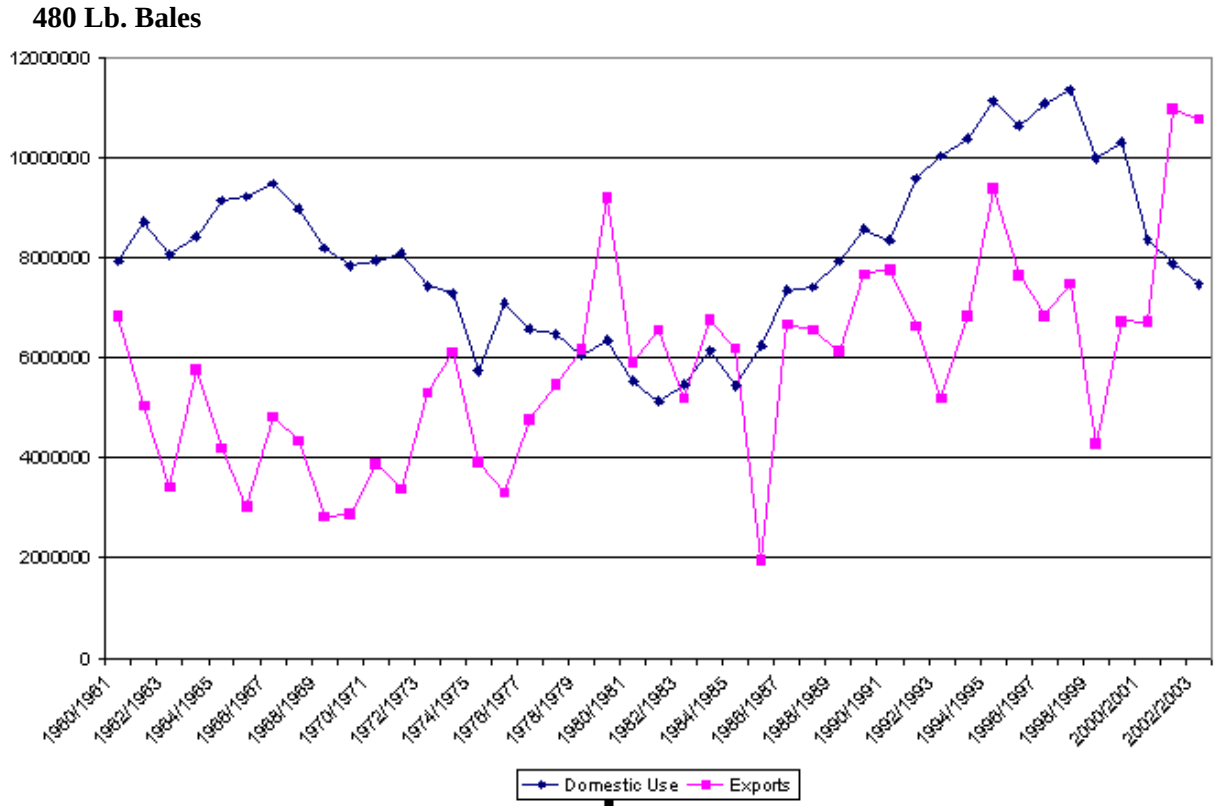
Changes were also seen in domestic use of cotton. The demand for U.S. cotton consists of domestic mill use, exports and ending stocks. In the market period 1986-2001, domestic mill use of cotton was the most significant factor influencing demand for domestically produced cotton. However, trade liberalization, along with the strength of the U.S. dollar, intensified import competition in the textile industry. U.S. textile producers were forced to reduce capacity and production costs, or exit the textile industry. Consequently, mill use of U.S. cotton fell dramatically from 1997 to 2003 (Figure 3). Consumers of U.S. textiles would benefit from trading with international textiles and apparel producers who could supply relatively cheaper textile and apparel products. This adversely affected the U.S. textile industry. After the elimination of the MFA quota, this trend is very likely to continue.

It is predicted that foreign demand for U.S. cotton will increase as a result of expansion in textile industry and there will be a shift within the industry. U.S. cotton producers may evolve from being primary suppliers to the domestic textile industry to being stronger export competitors in international market (Figure 4.). This trend has already been confirmed and substantiated by the fact that U.S. cotton exports accounted for over 40 percent of world cotton trade in 2003 (USDA, 2003).



Source: USDA Economics Research Service

Figure 3. U.S. cotton mill use



Source: Paggi, Center for Agricultural Business, 2004

Figure 4. U.S. cotton use in 480 lb. bales

As the third largest importer of U.S. cotton in 2003, China imported 28 percent of total U.S. cotton exports in 2003. It is reasonable to assume this trend will continue following China's recent liberalization in textile trade policy and China's entry into the World Trade Organization. Currently, China is the world's largest cotton producer, the world's largest cotton consumer and is believed to hold 30 percent of the world's ending cotton stocks (USDA.ERS). Due to the size of China's cotton sector, any shifts in production and policy concerning the textile and cotton sectors will have considerable impact on the global cotton market and global textile and apparel markets.

According to the World Trade Organization's Agreement on Textiles and clothing, import quotas will be completely removed by January 2005. This means that developing countries, like China, will find it easier to access developed countries' textile and apparel markets, assuming that tariffs are not prohibitively high. The cotton and textile sector 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 impact from this interdependent trend. It is essential that the impacts of textile trade liberalization be investigated, quantified and analyzed.

LITERATURE REVIEW

There are many previous studies analyzing the impacts of removing the Multi-Fiber Arrangement on cotton, textile trade and welfare. This review will focus mainly on the latest research results related to the United States and the People's Republic of China.

In 1990, Shui conducted a study, "Impact on the US cotton industry of removing the Multi-Fiber Arrangement," in which he focused on the welfare effects on the U.S. cotton industry of removing the MFA and textile import tariffs by developing a multi-market equilibrium displacement model.

Shui began with a brief review of the latest major works on welfare analyses of textile trade liberalization, methodologies utilized in analyzing trade policy and estimation of cotton demand and supply. The critical position of cotton in the textile industry and the basic linkages among textile trade, US and world cotton sectors were explored. The major assumptions are constant returns to scale and nonjointness[1] of production technology.

The trading countries were classified into four groups: the United States and other OECD countries, twenty-two developing country as textile exporters, other cotton exporting countries and other cotton importers without textile exports. The United States imports textiles largely from developing countries and exports cotton. The other OECD

[1] Nonjointness of production processes means that the multiouput industry's supply and demand can possess the same properties as a single output industry. 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, Hall (1973).

countries import both textiles and cotton. Textile trade occurs between the US and OECD countries as well.

To capture a country's behavior related to trade flows, consumption and production, an equation system was defined for textile end-uses and apparel, cotton, world textile export price, trade restrictions and equilibrium conditions. In order to investigate the response of domestic and international textile and cotton markets to exogenous shocks, the comparative static method was used and the equilibrium displacement structure was constructed. Given all the information about the parameter values involved, the effect on U.S. cotton industry of removal of the MFA was quantified.

The procedures used to obtain the values of different parameters involved in quantifying the simulation results of the effects on the US cotton industry of removal the MFA were discussed. Computation was done for some parameter estimates, while sensitivity analysis was performed for other assumed parameter values. Estimated parameters include demand elasticities of textile end-uses and apparel, input demand elasticity, cost and output share and supply elasticities of cotton.

Three policy scenarios were simulated: removing quotas only; removing tariffs and quotas completely; and tightening MFA quotas. Two different policy regimes were analyzed: adjustments under free market and under the U.S. farm program. Generally, total or partial liberalization in textile trade would induce small changes for the total demand for U.S. cotton, but significant increase in the demand for U.S. cotton exports. The U.S. cotton producer became more dependent on export markets. The simulation

also predicted changes in domestic textile outputs and prices, and on textile trade flows and prices. It suggested a decline in the domestic textile end uses and apparel and an increase in textile imports by the United States.

To evaluate the producer welfare changes, the change in the cotton industry total revenue and the change in producer surplus were calculated. The net effect depends largely on how foreign cotton exporters respond to U.S. trade policy adjustment. If foreign cotton exporters did not take any actions, increasing cotton supply, textile trade liberalization would induce a decline in farm program costs and leave U.S. cotton producer revenue and surplus unchanged. If the response of foreign cotton exporters was taken into account, farm program cost would increase.

Shui did not investigate the possible impact on developing countries, especially China, one of the most important bilateral trading partners with the United States. China has a large share of the U.S. textile market and imports considerable U.S. cotton each year. The growth of China's textile industry is becoming a critical element shaping world cotton and textile trade. As it moves toward a market economy, China's comparative advantage in production of labor-intensive goods, like textiles and apparel is strengthening. It is necessary to focus on China for further analysis as a crucial part in global textile and cotton market. Shui's parameters need to be updated since the market structure has been changing continually. It is necessary that a more current analysis be developed and applied to the decision-making process.

Cheng and Babcock addressed this issue in the article "China's Cotton Policy and the Impact of China's WTO Accession and Bt (Bacillus thuringiensis) Cotton Adoption

on the Chinese and US Cotton Sectors" (2003). The four chronological stages of China's cotton sector policy were examined. From 1949 – 1954, production and marketing of cotton were free and private traders were allowed to operate in the cotton market. To stimulate cotton production, the Supply and Marketing Cooperatives system (SMC) initiated an advance payment program and total cotton production, increased about three times compared to 1949.

As demand for cotton from the rapidly developing textile industry outweighed the cotton production, the Chinese government adopted Unified Planned Cotton Procurement from 1954 to 1985. All free markets were closed starting in 1954 and the entire marketing system, procurement, processing, storage, transportation, and the cotton allocation to textile industries were solely controlled by SMC. All farmers were assigned compulsory quotas for delivering cotton at administered low prices. This program weakened the cotton growers' incentive and the cotton production declined. However, after the Household Responsibility System was launched in 1978, together with the rise in cotton procurement price and fertilizer subsidy, cotton production increased to 6.26 mmt (million metric tons) in 1984.

In order to promote agricultural market efficiency, Chinese government changed the cotton marketing system to the Contract Purchasing Arrangement in 1985. Farmers could sell surplus cotton in the free market after they completed their contracted delivery quota.

Starting in 1991, the Chinese government switched its policy to a more market oriented system under which domestic cotton prices reflected market conditions to some

extent. Although a reference price was still set by the central government, it was no longer binding. Large and medium-size state-owned textile enterprises were allowed to purchase cotton directly from private growers including grower associations and local branches of SMC.

China has imposed significant barriers in cotton trade, among which were state trading, import licensing, tariffs, a value-added tax (VAT), and export subsidies. As part of its agreement to join the World Trade Organization, China agreed to the reduction of both within-quota tariff, out-of-quota tariff and elimination of cotton export subsidies (Table 2).

To analyze China's cotton sector, Cheng and Babcock developed a comprehensive demand and supply framework of nine production regions, consisting of cotton area equations, yield equations, production equations, total cotton consumption equation, ending stock equation, export equation, import identity, price transmission equation between cotton producer price to reference price. The estimated parameters from these equations, linked to Food and Agricultural Policy Research Institute (FAPRI) modeling system were used to simulate various scenarios of the combination of China's WTO accession and Bt (Bacillus thuringiensis) cotton adoption. China, as the results suggested, would increase its cotton imports during the 2002 – 2011 projection period. With the adoption of Bt cotton alone, its cotton imports would expect to increase and production cost will decline substantially. Although the United States would see a slight loss from China's Bt cotton adoption, the gain from China's WTO accession would exceed the loss, therefore resulting in a net gain for the United States.

Table 2. China's Policy Changes for Cotton Trade

	'02	'03	'04	'05	'06	'07	'08	'09	'10
Baseline tariff (%)	3	3	3	3	3	3	3	3	3
In-quota tariff (%)	1	1	1	1	1	1	1	1	1
Out-quota tariff (%)	76	67	58	49	40	40	40	40	40
Quota level (tmt)	740	780	820	860	890	890	890	890	890

Source: Cheng and Babcock.

This study focused mainly on China's cotton industry. It did not model the linkages between the cotton sector and textile and apparel industry nor did it incorporate the behavior of other cotton and textile importers and exporters in the rest of the world, both of which could have a considerable impact on textile and cotton trade patterns.

A study "Cotton Exports and Interaction with Textile Trade" (2001) conducted by Hudson and Ethridge examined the implications of the competitiveness of the U.S. cotton industry in the world market. Enhancing US cotton price competitiveness in order to obtain a larger world market share of cotton exports is a crucial part of U.S. farm policy. It does so by paying cotton exporters and domestic cotton users the difference between the U.S. and world adjusted price of cotton, which is also known as "Step 2". The competitiveness provision has improved U.S. cotton exports. However, some long-run unanticipated effects on the program emerged since 1985 on the rest of the cotton industry, which could offset and be a detriment to U.S. cotton.

The United States is a large cotton producer and has experienced an increase in cotton exports overtime. However, due to the fact that cotton processing occurs independently in different parts of the world, the United States maintained

competitiveness only in those stages where capital could be easily substituted for labor, such as spinning and weaving. Other labor-intensive processes, like cutting, sewing and assembly shifted from developed countries to developing countries. The growth of U.S. cotton textile and apparel imports outstripped exports making the United States a net importer of cotton (both cotton fiber and fiber equivalent of textile products). The United States also has a large textile industry that is a consistent consumer of U.S. cotton fiber. However, as the significant changes took place in world textile trade, Asian newly industrialized economies (NIEs) who managed to produce textile products with one-half the cost of the United States, became the primary competitor of U.S. textiles sector. These developments threatened the competitiveness of the U.S. cotton complex.

A preliminary empirical model was developed to assess the net trade balance ratio (cotton exports to imports). The variables included are ratio of the US average manufacturing wage to that in Asian NIEs, Cotlook-A Index[2] world offer price for cotton, the domestic mill use of cotton, the trade-weighted exchange rate index, the real per capita GDP. Two dummy variables, the dissolution of former USSR (1 for 1992 and after) and the existence of US competitiveness provisions (Step 2), mainly export subsidies (1 for 1985 and after) are included.

Results worth noticing include: (1) the U.S. net trade balance improves as world cotton prices increase relative to the U.S. price; (2) there is an inverse and statistically significant relationship between the competitiveness provisions (Step 2) and the net trade

[2] The A-Index is compiled by Cotton Outlook, a private UK cotton consultancy, and is intended to be representative of the price level on the international raw cotton market. It is the simple average of the lowest five quotations from a selection of the principal upland cottons traded internationally.

balance; (3) the wage rate differential had no significant impact on the net trade balance in cotton, but the value of exports and imports changed. The net trade balance is 1.25 percent lower on average when Step 2 was implemented compared to the prior period.

The elasticities are critical for evaluating the response of endogenous variables to the changes of exogenous variables. The latest available estimates of elasticities dated back to 1982. As important changes were occurring in the international textile and cotton market due to the implementation of various policies, Isengildina, Hudson and Herndon conducted a study in 2000 of the foreign demand elasticity for US cotton and their potential changes over time integrating the dynamic nature of world cotton market.

The study was divided into three periods: 1972 – 1984, 1985 – 1991, and 1992 – 1996. Based on the trade group membership, countries were divided into 6 regions, European Union (EU) 15 member countries plus Norway and Switzerland, North America Free Trade Area (NAFTA) member countries, Association of Southeast Asian Nations (ASEAN) member countries, China, other Asian cotton importers, and other cotton importing countries.

By using the Armington framework, the import demand function was specified in the form of market share of imports from one country into another. A trend variable was included as a part of intercept term to reflect the changes in the world economy. An assumption of the total demand elasticity of cotton was made, which was computed as the weighted average of the regional import demand elasticities weighted by their average share of total US exports. An upper bound of 0 (perfectly elastic), a lower bound of –1 (perfectly inelastic), and an empirical estimate of –0.24 were tested (Table 3).

As the total elasticity of demand changed from 0 to –1, the demand elasticities of NAFTA countries almost tripled. This suggested that the import demand for US cotton is sensitive to the total elasticity of demand for all cotton in the NAFTA region. Other countries, however, seemed not very sensitive to these changes, indicating that US cotton acts as a substitute for other cotton sources. The EU region became more price-sensitive to US cotton imports as its import demand elasticity increased from 1992 – 1996. The dramatic increase in the import demand elasticity for ASEAN countries over time suggested that they became more price-responsive as well. Estimates for NAFTA countries were stable and remained inelastic through time due to their geographic proximity to the United States, which makes them consistent customers for U.S. cotton.

China demonstrated a sharp decrease in its import demand elasticity for US cotton, which indicated that China had become more responsive to the world price by integrating into a market economy and implementing trade liberalization policies. It is reasonable to expect the continuation of this trend in the future. Other Asian countries displayed stable and slightly higher demand elasticity for US cotton imports, which was an indicator of higher price competition in this region. The total elasticity of export demand for US cotton increased from –2.13 to –2.41, indicating that U.S. cotton would face more substitutes on the global market. The cotton market had become more competitive over the past two decades due to trade liberalization. The U.S. farm program costs using Step 2 would increase substantially as cotton demand elasticities become larger over time.

Table 3. Calculation of U.S. Export Demand Elasticities

	Elasticity		
Region	$\eta = 0$	$\eta = -.24$	$\eta = -1$
EU[a]	-3.900	-3.933	-4.035
ASEAN[b]	-3.258	-3.341	-3.605
NAFTA[c]	-0.450	-0.651	-1.287
CHINA	-16.232	-16.312	-16.567
OTASIA[d]	-2.158	-2.264	-2.599
OTHER	-2.280	-2.305	-2.384
TOTAL	-3.84	-3.93	-4.21
TOTAL w/o CHINA	-2.20	-2.28	-2.54

a Australia, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and United Kingdom.
b Indonesia, Malaysia, Philippines, Singapore, Thailand
c The NAFTA region was comprised of Canada and Mexico
d Taiwan, Hong Kong, Japan, and South Korea.

Source: Hudson and Ethridge

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 5).

The cotton market and textile and apparel markets are vertically linked. Cotton's share of textile and apparel products is assumed to be 100 percent. The rest of the world will be left out due to the dimensional limitation of the diagrammatic analysis.

By imposing a tariff of TB (tariff equivalent import quotas plus tariff rate) in the textile and apparel market, a price wedge is created between the United States and Chinese textile and apparel markets[3]. Compared with the free-trade price level, P_w^t, U.S. domestic price rises up 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, but higher consumption in China. In the short run, the price changes have no effect on the supply of textile and apparel products because the supply is perfectly price inelastic due to rigidity in cotton production. Overall, the world market experiences a decline in both excess demand for, and excess supply of textile and apparel products. The total trade volume therefore shrinks from Q_{w1} down to Q_{w2} (panel e).

Given that the textile and apparel prices are positively related to the demand for cotton, the increase of textile and apparel price in the United States would push the U.S. cotton demand curve up to $D'_c{}^{us}$ while the decrease of textile and apparel price in China

[3] If only quota is imposed, the excess demand curve in panel (e) will be downward sloping and kinked somewhere between Q_{w2} and Q_{w1}.

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 magnitude of shift of each countries' cotton demand curve. This shift 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, would unambiguously decline 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, world cotton excess and supply and excess demand curves move to ES'_c and ED'_c (panel b), and 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, but keeping the tariff, would cause U.S. textile and apparel price to fall below P_{us}, and China's price to rise above P_{ch} without overlapping the free trade price level, P^{t}_w. There is no change in 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. Higher excess demand and excess supply, and thus higher trade volume of textile and apparel products follow (between Q_{w2} and Q_{w1} in panel e). As textiles and apparel price drops in the United States, demand for cotton declines, shifting the demand curve down towards D^{us}_c.

To meet the demands of larger world textile and apparel market, China will expand its textile and apparel sector. This will, in turn, stimulate its demand for cotton, thus shifting the demand curve up towards D^{ch}_c. It should be noted that the demand for

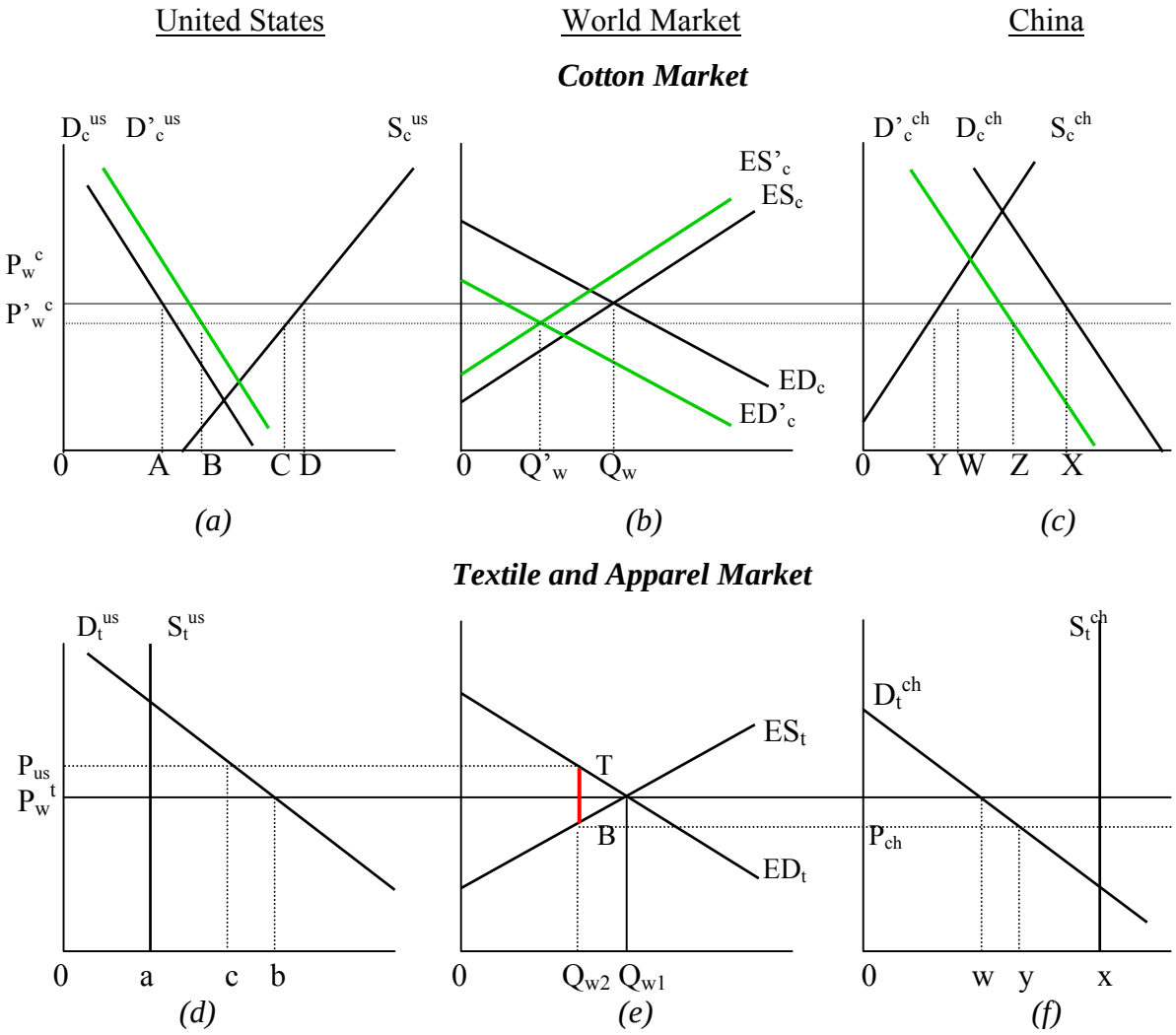


Figure 5. Impact of imposing MFA quota and import tariff on textile & apparel and cotton market[4]

[4] 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.

cotton would not shift back to D_c^{us} and D_c^{ch} in the United States and China, respectively. This is because first, only part of the trade barrier, the import quota, is removed. The import tariff still remains; second, some end users like industrial users who switched to manmade-fiber textiles and apparel products under the trade restrictions would not return to cotton textile and apparel even with looser import restrictions due to preferences changes. In the long run, the demand changes in both the United States and China's cotton market will drive world cotton price up or down somewhere between P_w^c and $P'_w{}^c$, closer to P_w^c. As a result, the world cotton production and trade volume will expand [5], closer to Q_w.

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 among these textile-exporters, which all have comparative advantages in production of labor-intensive products. In addition to the high substitutability of textile and apparel products among developing countries, the increase in China's textile and apparel exports to the United States will be less than the amount under the assumption that China is the sole exporter of textile and apparel products into the U.S. market. Yet China will remain the dominant exporter[6] in the world textile market. The competitors of China's textile industry will increase their demand for cotton, both domestically and globally. China's textile and apparel industry is expected

[5] This conclusion is based on normal weather condition and an assumption of continuation of current policy.

[6] According to the simulation results of The Impact of China and Taiwan Joining the WTO on U.S and World Agricultural Trade (Zhi), 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.

to grow rapidly as a result of relaxed trade barriers and relatively low labor costs. However, it is not very likely that China's domestic cotton production can keep pace to the cotton demand from its expanding textile industry. Given this situation, China will be expected to source cotton in the international market and increase its domestic cotton production at the same time.

As developing countries become more cost competitive, the U.S. domestic demand for cotton, formerly dominated by U.S. mill use, will decrease, while import demand for U.S. cotton will increase due to the expansion of textile output in developing countries. This trend has occurred since 1997 (Paggi). It is reasonable to believe that the U. S. cotton industry is evolving from a supplier to the domestic textile industry to one dependent on cotton exports, which is driven by textile trade liberalization. The changes investigated above will be quantified in this study.

METHODOLOGY

To quantify the impact of removing the MFA on the U.S. and China's cotton industry, an empirical model was specified to capture the basic linkages of the cotton industry and textile markets, both domestic and global. An equilibrium displacement model was developed to fit this study based on Shui's study in 1990 and described below.

Theoretical Considerations

Textile production, consumption and trade are modeled based on modern consumer and producer theory. Homothetic preference, competitive markets, and nonjointness of production are assumed. So, if an individual's preference can be expressed by a well-behaved utility function, twice differentiable and nonincreasing in price, 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:

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

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

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.

An additional assumption, nonjointness of production, was made so that a multiouput industry's supply and demand possesses the same properties as a single

output industry. According to Hall (1973), 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

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

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.

Comparative advantage states that a country will specialize in the production of a commodity that has the lowest opportunity cost. Under free trade, comparative advantage determines trade flows and trade patterns. Trading countries mutually gain, and individual consumers diversify their consumption set thereof. 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 6). 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

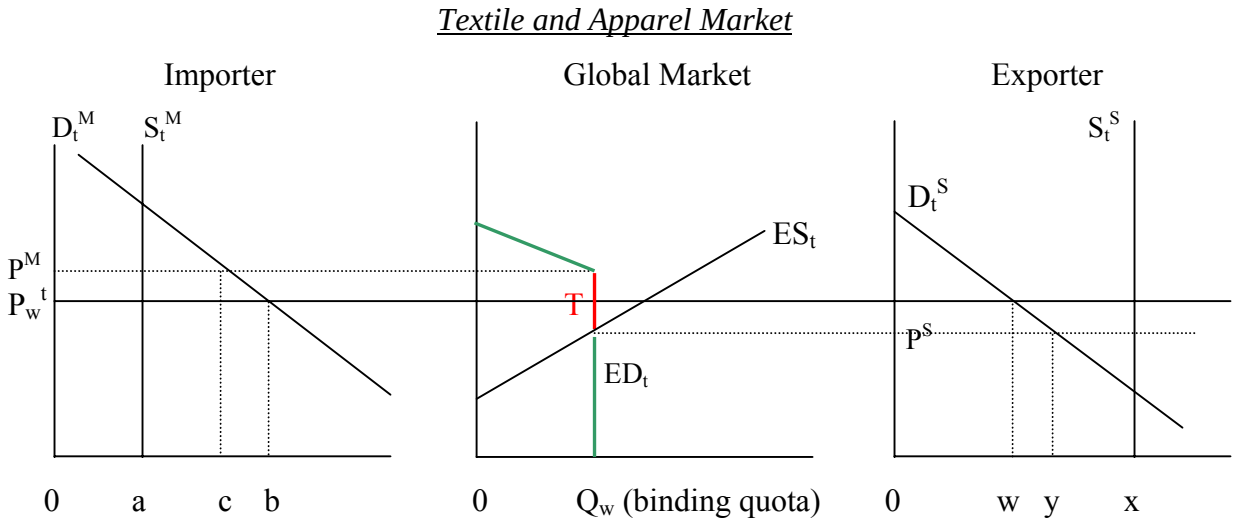


Figure 6. Quotas on textile and apparel market[7]

[7] 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.

quota when the quota is binding. Given that textile trade is also restricted by import tariff, if only the MFA quota is removed, T will reduce to the applied tariff rate.

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 (Westcott, 2002). The purposes of the U.S. farm program are mainly to protect U.S. farm income, allow markets to manage cotton supply level, and 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.

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, given as,

DP = (DP rate) * (DP yield) * (Base acres * 0.85)

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.

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})

(the term in the parentheses is referred to as effective price in the 2002 farm bill)

CCP = CCP rate * CCP yield * (Base acres * 0.85)

The farm bill has important policy implications for U.S. cotton production. Counter-cyclical payments may influence the production decisions of the growers because their linkage to market price may reduce revenue variability and risk. Although less direct impacts are expected from direct payments since they are decoupled from current production, they will influence production through wealth and investment effects (USDA, ERS). The marketing loan may have the greatest effect on production decisions because it is directly coupled to producers' current production. Therefore, the 2002 farm bill was an important exogenous consideration in the model.

Analytical Model

Based on considerations noted above, a modified equilibrium displacement model is developed to reflect the textile and cotton markets. The world's textile and cotton trading nations are divided into six groups: the United States, which is a textile importer and a cotton exporter; CE[8], which imports both textiles and cotton; China, which exports textile products and imports cotton; AO[9], which exports textiles and imports cotton; other cotton exporters, k; and h, other cotton importers without textile exports(Table 4). Additional assumptions are that textile products and cotton are internationally mobile, but other inputs, such as labor and capital are not; only cotton

[8] EU-15, Switzerland, Canada and Japan.
[9] Bangladesh, India, Indonesia, Korea, Malaysia, Pakistan, Philippines, Singapore, Sri Lanka, Taiwan, Thailand, and Vietnam.

and cotton textile products are considered in this study for simplicity and to avoid double counting. The model is specified as:

I. Textile & Apparel

Consumption

(1) $TD_{US} = TD_{US} (PT_{US}, PT_{US}^{D})$

(2) $TD_{CE} = TD_{CE} (PT_{CE}, PT_{CE}^{D})$

(3) $AD_{US} = AD_{US} (PA_{US}, PA_{US}^{D})$

(4) $AD_{CE} = AD_{CE} (PA_{CE}, PA_{CE}^{D})$

(5) $TMD_{US} = TMD_{US} (PT_{US}, PT_{US}^{D})$

(6) $TMD_{CE} = TMD_{CE} (PT_{CE}, PT_{CE}^{D})$

(7) $AMD_{US} = AMD_{US} (PA_{US}, PA_{US}^{D})$

(8) $AMD_{CE} = AMD_{CE} (PA_{CE}, PA_{CE}^{D})$

Production

(9) $PT_{US} = AC^{T}_{US} (PC, PO)$

(10) $PT_{CE} = AC^{T}_{CE} (PC, PO)$

(11) $PA_{US} = AC^{A}_{US} (PC, PO)$

(12) $PA_{CE} = AC^{A}_{CE} (PC, PO)$

(13) $PT_{CH}^{S} = AC^{T}_{CH} (PC, PO)$

(14) $PT_{AO}^{S} = AC^{T}_{AO} (PC, PO)$

(15) $PA_{CH}^{S} = AC^{A}_{CH} (PC, PO)$

(16) $PA_{AO}^{S} = AC^{A}_{AO} (PC, PO)$

II. Cotton

Demand

(17) $CD_{US} = CD_{US} (TS_{US}, AS_{US}, PC, PO)$

(18) $OD_{US} = OD_{US} (TS_{US}, AS_{US}, PC, PO)$

(19) $CD_{CE} = CD_{CE} (TS_{CE}, AS_{CE}, PC, PO)$

(20) $OD_{CE} = OD_{CE} (TS_{CE}, AS_{CE}, PC, PO)$

(21) $CD_{CH} = CD_{CH} (TMS_{CH}, AMS_{CH,} PC, PO)$

(22) $OD_{CH} = OD_{CH} (TMS_{CH}, AMS_{CH,} PC, PO)$

(23) $CD_{AO} = CD_{AO} (TMS_{AO}, AMS_{AO}, PC, PO)$

(24) $OD_{AO} = OD_{AO} (TMS_{AO}, AMS_{AO}, PC, PO)$

(25) $CD_h = CD_h (PC, PO)$

(26) $OD_h = OD_h (PC, PO)$

Supply

(27) $CS = CS (PC, TP^{10})$

(28) $OS_k = OS_k (PO, \alpha)$

III. World Textile Export Price Determination

(29) $PT^S = (TMS_{CH} / TMS)\, PT_{CH}^S + (TMS_{AO} / TMS)\, PT_{AO}^S$

(30) $PA^S = (AMS_{CH} / AMS)\, PA_{CH}^S + (AMS_{AO} / AMS)\, PA_{AO}^S$

IV. Trade Restrictions and Equilibrium Conditions

(31) $PT_{US}^D = PT^S (1+T)$

(32) $PT_{CE}^D = PT^S (1+T)$

[10] Total Payment = Direct Payment + Counter Cyclical Payment.

(33) $PA_{US}^{D} = PA^{S}(1+A)$

(34) $PA_{CE}^{D} = PA^{S}(1+A)$

(35) $TS_{US} = TD_{US}$

(36) $TS_{CE} = TD_{CE}$

(37) $AS_{US} = AD_{US}$

(38) $AS_{CE} = AD_{CE}$

(39) $TMS_{CH} + TMS_{AO} = TMD_{US}$

(40) $TMS_{CH} + TMS_{AO} = TMD_{CE}$

(41) $AMS_{CH} + AMS_{AO} = AMD_{US}$

(42) $AMS_{CH} + AMS_{AO} = AMD_{CE}$

(43) $CS = CD_{US} + CD_{CE} + CD_{CH} + CD_{AO} + CD_{h}$

(44) $OS = OD_{US} + OD_{CE} + OD_{CH} + OD_{AO} + OD_{h}$

Table 4. Variables and Their Definitions in the Model

Variable	Definition
TD_{US}	demand for domestic textiles in the United States
TD_{CE}	demand for domestic textile in CE countries
AD_{US}	demand for domestic apparel in the United States
AD_{CE}	demand for domestic apparel in CE countries
TMD_{US}	demand for textile imports in the United States
TMD_{CE}	demand for textiles imports in CE countries
AMD_{US}	demand for apparel imports in the United States
AMD_{CE}	demand for apparel imports in CE countries
PT_{US}	domestic textiles price in the United States
PT_{US}^{D}	textile import price in the United States
PT_{CE}	domestic textiles price in CE countries

Table 4. Continued

Variable	Definition
PT_{CE}^{D}	textiles import price in CE countries
PA_{US}	domestic apparel price in the United States
PA_{US}^{D}	apparel import price in the United States
PA_{CE}	domestic apparel price in CE countries
PA_{CE}^{D}	apparel import price in CE countries
PC	U.S. cotton price (upland cotton spot price)
PO	foreign cotton price (adjusted world price)
PT^{S}_{CH}	export supply price of textiles from China
PT^{S}_{AO}	export supply price of textiles from AO countries
PA^{S}_{CH}	export supply price of apparel from China
PA^{S}_{AO}	export supply price of textiles from AO countries
CD_{US}	derived demand for U.S. cotton in the United States
OD_{US}	demand for foreign cotton in the United States
CD_{CE}	import demand for U.S. cotton in CE countries
OD_{CE}	import demand for foreign cotton in CE countries
CD_{CH}	import demand for U.S. cotton in China
OD_{CH}	import demand for foreign cotton in China
CD_{AO}	import demand for US cotton in AO countries
OD_{AO}	import demand for foreign cotton in AO countries
CD_{h}	import demand for US cotton in country h
OD_{h}	import demand for foreign cotton in country h
TS_{US}	domestic supply of textiles in the United States
AS_{US}	domestic supply of apparel in the United States
TS_{CE}	domestic supply of textiles in CE countries
AS_{CE}	domestic supply of apparel in CE countries
TMS_{CH}	textile export supply from China
AMS_{CH}	apparel export supply from China

Table 4. Continued

Variable	Definition
TMS_{AO}	textile export supply from China
AMS_{AO}	apparel export supply from China
CS	U.S. cotton supply
OS_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
TP	total payment rate under US farm program
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 (dX/X = EX) and elasticities (for derivation of equations, refer to Appendix. B), which is known as the equilibrium displacement model (EDM):

I. Textile & Apparel

Consumption

(1) $ETD_{US} = \eta_{US}\, EPT_{US} + \eta'_{US}\, EPT^D_{US}$

(2) $ETD_{CE} = \eta_{CE}\, EPT_{CE} + \eta'_{CE}\, EPT^D_{CE}$

(3) $EAD_{US} = \eta^*_{US}\, EPA_{US} + \eta^{*\prime}_{US}\, EPA^D_{US}$

(4) $EAD_{CE} = \eta^*_{CE}\, EPA_{CE} + \eta^{*\prime}_{CE}\, EPA^D_{CE}$

(5) $ETMD_{US} = \eta_{USI}\, EPT_{US} + \eta'_{USI}\, EPT^{D}_{US}$

(6) $ETMD_{CE} = \eta_{CEI}\, EPT_{CE} + \eta'_{CEI}\, EPT^{D}_{CE}$

(7) $EAMD_{US} = \eta^{*}_{USI}\, EPA_{US} + \eta^{*'}_{USI}\, EPA^{D}_{US}$

(8) $EAMD_{CE} = \eta^{*}_{CEI}\, EPA_{CE} + \eta^{*'}_{CEI}\, EPA^{D}_{CE}$

Production

(9) $EPT_{US} = \delta_{US}\, EPC + \delta'_{US}\, EPO$

(10) $EPT_{CE} = \delta_{CE}\, EPC + \delta'_{CE}\, EPO$

(11) $EPA_{US} = \delta^{*}_{US}\, EPC + \delta^{*'}_{US}\, EPO$

(12) $EPA_{CE} = \delta^{*}_{CE}\, EPC + \delta^{*'}_{CE}\, EPO$

(13) $EPT^{S}_{CH} = \delta_{CH}\, EPC + \delta'_{CH}\, EPO$

(14) $EPT^{S}_{AO} = \delta_{AO}\, EPC + \delta'_{AO}\, EPO$

(15) $EPA^{S}_{CH} = \delta^{*}_{CH}\, EPC + \delta^{*'}_{CH}\, EPO$

(16) $EPA^{S}_{AO} = \delta^{*}_{AO}\, EPC + \delta^{*'}_{AO}\, EPO$

II. Cotton

Demand

(17) $ECD_{US} = \mu_{US}\, ETS_{US} + \mu^{*}_{US}\, EAS_{US} + \gamma_{US}\, EPC + \gamma_{USI} EPO$

(18) $EOD_{US} = \mu'_{US}\, ETS_{US} + \mu^{*'}_{US}\, EAS_{US} + \gamma'_{US}\, EPC + \gamma'_{USI}\, EPO$

(19) $ECD_{CE} = \mu_{CE}\, ETS_{CE} + \mu^{*}_{CE}\, EAS_{CE} + \gamma_{CE}\, EPC + \gamma_{CEI} EPO$

(20) $EOD_{CE} = \mu'_{CE}\, ETS_{CE} + \mu^{*'}_{CE}\, EAS_{CE} + \gamma'_{CE}\, EPC + \gamma'_{CEI}\, EPO$

(21) $ECD_{CH} = \mu_{CH}\, ETMS_{CH} + \mu^{*}_{CH}\, EAMS_{CH} + \gamma_{CH}\, EPC + \gamma_{CHI}\, EPO$

(22) $EOD_{CH} = \mu'_{CH}\, ETMS_{CH} + \mu^{*'}_{CH}\, EAMS_{CH} + \gamma'_{CH}\, EPC + \gamma'_{CHI} EPO$

(23) $ECD_{AO} = \mu_{AO}\ ETMS_{AO} + \mu^*_{AO}\ EAMS_{AO} + \gamma_{AO}\ EPC + \gamma_{AOI} EPO$

(24) $EOD_{AO} = \mu'_{AO}\ ETMS_{AO} + \mu^{*\prime}_{AO}\ EAMS_{AO} + \gamma'_{AO}\ EPC + \gamma'_{AOI} EPO$

(25) $ECD_h = \gamma_h\ EPC + \gamma_{hI}\ EPO$

(26) $EOD_h = \gamma'_h\ EPC + \gamma'_{hI}\ EPO$

Supply

(27) $ECS = \epsilon_{US}\ EPC$

(28) $EOSk = \epsilon_k\ EPO + d\beta$

III. World Textile Export Price Determination

(29) $EPT^S = \alpha_{CH}\ EPT^S_{CH} + \alpha_{AO}\ EPT^S_{AO}$

(30) $EPA^S = \alpha^*_{CH}\ EPA^S_{CH} + \alpha^*_{AO}\ EPA^S_{AO}$

IV. Trade Restrictions and Equilibrium Conditions

(31) $EPT^D_{US} = EPT^S + T/(1+T)\ ET_{US}$

(32) $EPT^D_{CE} = EPT^S + T/(1+T)\ ET_{CE}$

(33) $EPA^D_{US} = EPA^S + A/(1+A)\ EA_{US}$

(34) $EPA^D_{CE} = EPA^S + A/(1+A)\ EA_{CE}$

(35) $ETS_{US} = ETD_{US}$

(36) $ETS_{CE} = ETD_{CE}$

(37) $EAS_{US} = EAD_{US}$

(38) $EAS_{CE} = EAD_{CE}$

(39) $\beta_{CH}\ ETMS_{CH} + \beta_{AO}\ ETMS_{AO} = ETMD_{US}$

(40) $\beta'_{CH}\ ETMS_{CH} + \beta'_{AO}\ ETMS_{AO} = ETMD_{CE}$

(41) $\beta^*_{CH}\ EAMS_{CH} + \beta^*_{AO}\ EAMS_{AO} = EAMD_{US}$

(42) $\beta^{*'}_{CH}\, EAMS_{CH} + \beta^{*'}_{AO}\, EAMS_{AO} = EAMD_{CE}$

(43) $ECS = \pi_{US}\, ECD_{US} + \pi_{CE}\, ECD_{CE} + \pi_{CH}\, ECD_{CH} + \pi_{AO}\, ECD_{AO} + \pi_{h}\, ECD_{h}$

(44) $EOS_{k} = \pi'_{US}\, EOD_{US} + \pi'_{CE}\, EOD_{CE} + \pi'_{CH}\, EOD_{CH} + \pi'_{AO}\, EOD_{AO} + \pi'_{h}\, EOD_{h}$

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 percentage changes of the endogenous variables in matrix X can be quantified.

Parameter Values and Probability Distribution Specification

The accuracy of parameters involved in the model has a direct impact on the simulation results. In an EDM, the parameters are treated as fixed constants, therefore, once the value for all parameter are chosen, the value of endogenous variables can be determined. Assuming that the parameters are known with certainty is a drawback of EDM because with this practice, the values might be biased in order to generate desired results. A common practice to overcome this deficiency is to conduct a series of

sensitivity analysis on the simulation results by adopting alternative values of some parameters.

As suggested by Davis and Espinoza[11], this study extends the common practice of imposing certain probability distributions for selected parameters in the model instead of adopting only one value for them to generate stochastic estimates for endogenous variables. All the parameter values are listed in Table 4, Table 5, Table 6 and Table 7.

1.Textile and apparel demand elasticities

The latest 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 CE countries as a group. However, studies showed that they have many similar characteristics in textile and apparel consumption, production and trade (Cline, 1990). Therefore, it is reasonable to assume the same elasticities as those of the United States for CE countries.

2. Cost share and output share

Cost share and output share in this study are sourced from Shui's study. Shui calculated the cost share based on the four-digit SIC code industries' cost data on five-year average(1982-1987). No probability distributions are assumed for these parameters.

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[11] *A Unified Approach to Sensitivity Analysis in Equilibrium Displacement Model.* Amer. J. Agr. Econ. 80 (November 1998).

3. Input demand elasticities

The input demand elasticities for all the six study groups were estimated by the author using OLS regression analysis, which can be found in the Appendix C of this study. When more than two values were estimated in the regression results, the smallest one was assumed to be the lower limit while the largest one was the upper limit of the uniform distribution for the estimated parameter. No probability distribution was assumed for those parameters that were estimated with only one value in the regression.

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 rather than 0.36 used in Shui's study. This value is incorporated in the simulation 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 taken from Shui's study. No probability distribution is assumed for these four parameters.

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 CE countries are 21.4 percent for textiles, and 27.31 for apparel. These tariff equivalent quota rates was used in this study. When the quota is removed, the tariff rate for textiles and apparel will be decreasing by 100 percent weighted by their own fraction (Appendix B).

6. Uniform Distribution

Due to the limitation of parameter estimates, test for probability distribution cannot be performed for selected parameters involving in the equilibrium displacement model. For those parameters that only one value was found or estimated, the single value was used in the simulation. For those that more than one value was obtained or estimated, a maximum and a minimum level was chosen to form a uniform distribution. This means that the probabilities that every number is randomly drawn between the lower and upper level are the same.

Table 5. Elasticities and Shares: Definition, Value, and Probability Distribution

Item	Value/Prob. Distribution	Source
Textile demand elasticity		
• Price elasticity of demand		
Domestic textile	$\eta_{US} = -0.60$	Cline
	$\eta_{CE} = -0.60$	Cline
Domestic apparel	$\eta^*_{US} = -1.40$	Cline
	$\eta^*_{CE} = -1.40$	Cline
Imported textile	$\eta'_{USI} = -1.30$	Cline
	$\eta'_{CEI} = -1.30$	Cline
Imported apparel	$\eta_{USI} = -1.60$	Cline
	$\eta^{*\prime}_{CEI} = -1.60$	Cline
• Cross price elasticity of demand for domestic goods with respect to import price		
Textile	$\eta'_{US} = 0.205$	Cline
	$\eta'_{CE} = 0.205$	Cline

Table 5. Continued

Item	Value/Prob. Distribution	Source
Apparel	$\eta^* = 1.18$	Cline
	$\eta^{*'}_{CE}$ 1.18	Cline
• Cross price elasticity of demand for imported goods with respect to domestic price		
Textile	$\eta_{USI} = 1.90$	Cline
	$\eta_{CEI} = 1.90$	Cline
Apparel	$\eta^*_{USI} = 1.10$	Cline
	$\eta^*_{CEI} = 1.10$	Cline
Cost share		
U.S.		
• Cotton/Textile	$\delta_{US} = 0.0951$	Shui, 1990
• Cotton/Apparel	$\delta^*_{US} = 0.2312$	Shui, 1990
CE		
• U.S. cotton/Textile	$\delta_{CE} = 0.0338$	Shui, 1990
• Other cotton/Textile	$\delta'_{CE} = 0.0667$	Shui, 1990
• U.S. cotton/Apparel	$\delta^*_{CE} = 0.0838$	Shui, 1990
• Other cotton/Apparel	$\delta^{*'}_{CE} = 0.1733$	Shui, 1990
China		
• U.S. cotton/Textile	$\delta_{CH} = 0.0593$	Shui, 1990
• Other cotton/Textile	$\delta'_{CH} = 0.0561$	Shui, 1990
• U.S. cotton/Apparel	$\delta^*_{CH} = 0.041$	Shui, 1990
• Other cotton/Apparel	$\delta^{*'}_{CH} = 0.0512$	Shui, 1990
AO		
• U.S. cotton/Textile	$\delta_{AO} = 0.0593$	Shui, 1990
• Other cotton/Textile	$\delta'_{AO} = 0.0883$	Derived from Shui

Table 5. Continued

Item	Value/Prob. Distribution	Source
• U.S. cotton/Apparel	$\delta^*_{AO} = 0.041$	Shui, 1990
• Other cotton/Apparel	$\delta^{*\prime}_{AO} = 0.0577$	Shui, 1990
Output share		
U.S.		
• Cotton/Textile	$\mu_{US} = 0.5021$	Shui, 1990
• Cotton/Apparel	$\mu^*_{US} = 0.4979$	Shui, 1990
CE		
• U.S. cotton/Textile	$\mu_{CE} = 0.449$	Shui, 1990
• Other cotton/Textile	$\mu^*_{CE} = 0.551$	Shui, 1990
• U.S. cotton/Apparel	$\mu'_{CE} = 0.449$	assumption
• Other cotton/Apparel	$\mu^{*\prime}_{CE} = 0.551$	assumption
China and AO		
• U.S. cotton/Textile	$\mu_{CH}, \mu_{AO} = 0.1394$	Shui, 1990
• Other cotton/Textile	$\mu^*_{CH}, \mu^*_{AO} = 0.1629$	Shui, 1990
• U.S. cotton/Apparel	$\mu'_{CH}, \mu'_{AO} = 0.1394$	assumption
• Other cotton/Apparel	$\mu^{*\prime}_{CH}, \mu^{*\prime}_{AO} = 0.1629$	assumption
Input demand elasticity		
U.S.		
• Cotton	$\gamma_{US} \sim$ uniform (-0.67, -0.267)	Shui, 1990
• Other cotton	$\gamma'_{USI} = -0.666$	author's estimation
CE		
• U.S. cotton	$\gamma_{CE} = -1.806$	author's estimation
• Other cotton	$\gamma'_{CEI} \sim$ uniform (-1.072, -0.456)	author's estimation

Table 5. Continued

Item	Value/Prob. Distribution	Source
CH		
• U.S. cotton	γ_{CH} ~ uniform(-3.712, -1.615)	author's estimation
• Other cotton	γ'_{CHI} = -3.451	Shui, 1990
AO		
• U.S. cotton	γ_{AO} ~ uniform (-2.518, -2.424)	author's estimation
• Other cotton	γ'_{AOI} ~ uniform (-1.737, -1.326)	author's estimation
h		
• U.S. cotton	γ_{h}~ uniform (-1.694, -0.97)	author & Duffy, 1990
• Other cotton	γ'_{hI} ~ uniform(-0.959, -0.846)	author & Duffy, 1990
Cross price elasticity of U.S. cotton with respect to other cotton		
• U.S.	γ_{USI} = 0.255	author's estimation
• CE	γ_{CEI} = 2.769	author's estimation
• China	γ_{CHI} ~ uniform (3.502, 6.597)	author's estimation
• AO	γ_{AOI} ~ uniform (2.771, 3.207)	author's estimation
• h	γ_{hI} ~ uniform(0.685,1.499)	author & Duffy, 1990
Cross price elasticity of other cotton with respect to U.S. cotton		
• U.S.	γ'_{US} = 2.578	author's estimation
• CE	γ'_{CE} ~ uniform (0.734, 0.941)	author's estimation
• China	γ'_{CH} = 4.46	Shui, 1990
• AO	γ'_{AO} ~ uniform (0.99, 1.20)	author's estimation
• h	γ'_{h} ~ uniform(0.758, 0.796)	author & Duffy, 1990
Cotton supply elasticity		
Short-run		
• U.S.	ϵ_{US} = 0.466	Westcott and Meyer, 2003

Table 5. Continued

Item	Value/Prob. Distribution	Source
• 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 6. Textile & Apparel Export Market Share of China & AO Countries to the U.S. & CE Countries

	Exporters	United States	CE*
Textile	China	$\beta_{CH} = 0.1479$	$\beta'_{CH} = 0.0745$
	AO*	$\beta_{AO} = 0.3197$	$\beta'_{AO} = 0.1345$
Apparel	China	$\beta^*_{CH} = 0.2262$	$\beta^{*'}_{CH} = 0.2596$
	AO	$\beta^*_{AO} = 0.3362$	$\beta^{*'}_{AO} = 0.1585$

* Bangladesh, India, Indonesia, Korea, Malaysia, Pakistan, Philippines, Singapore, Sri Lanka, Taiwan, Thailand, and Vietnam.

* EU-15, Switzerland, Canada and Japan

Source: Computed from various issues of International Trade Statistics on www.wto.org

Table 7. Cotton Import Market Share

Groups	U.S. cotton	Foreign cotton
U.S. consumption	$\pi_{US} = 0.3526$	$\pi'_{US} = 0.0035$
CE imports	$\pi_{CE} = 0.042$	$\pi'_{CE} = 0.2239$
China imports	$\pi_{CH} = 0.1692$	$\pi'_{CH} = 0.1321$
AO imports	$\pi_{AO} = 0.164$	$\pi'_{AO} = 0.4194$
h* imports	$\pi_h = 0.2722$	$\pi'_h = 0.225$

* other cotton importing countries without textile and apparel exports.

Source: Computed from World Cotton Database, National Cotton Council, www.cotton.org

Solving the equilibrium displacement equation system by substituting values and probability distribution for each parameter, the results in stochastic estimates for all the endogenous variables. Simetar draws one number each time randomly from the uniform distribution and substitutes it into the equation system to solve for the endogenous variables. Simulation was repeated 500 times with 500 difference randomly drawn numbers. Instead of reporting only one value, a Probability Density Function (PDF) graph is presented for each variable. The PDF shows intervals of different endogenous variables with certain confidence level, which is easy to be interpreted. By changing the confidence level, people can get different intervals resulted for solved endogenous variables.

SCENARIOS AND SIMULATION RESULTS

Four scenarios of the equilibrium displacement model derived in the previous section were simulated using Simetar, an Excel add-on program. Since the farm bill has important policy implications for U.S. cotton production, two potential cases were investigated in this study: 1) textile trade liberalization with a change in farm program payment rate and 2) holding the current policy constant. For each case, two scenarios were simulated, a short run model and a long run model. Since the solved endogenous variables were stochastic, an interval was given for those with significant minimum and maximum differences, all with a confidence interval of 90 percent; a mean value was presented for those with small minimum and maximum differences.

Scenario one, in the short run model, the MFA quota was removed, the total payment rate was estimated to increase by 8.4 percent, and cotton supply from other countries was assumed to increase by 5 percent.

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 CE countries were 21.4 percent for textiles and 27.31 for apparel (Shui, 1990).

To estimate the changes of the total payment rate under the farm program, the U.S. domestic cotton price (PC) was forecasted since it was the only changing element in the Counter Cyclical Payment (CCP) rate. Once the projection for PC was complete, the changes in the CCP rate could be determined. Time series analysis was then applied

to forecast PC from 2005 to 2010. By comparing the average value of PC from 2005-2007 with the average from 2001-2004, the changes in the total payment rate in the short run were calculated. It was forecasted to be an 8.4 percent increase. The direct payment (DP) rate was not included in calculating the change since the DP was decoupled from cotton producers' current production decisions.

The supply elasticity of cotton used in this scenario was 0.466 for the United States and 0.38 for other cotton suppliers (Shui, 1990).

Other cotton exporters were assumed to increase their export supply by 5 percent in the short run in response to the textile trade liberalization policy changes. This conservative assumption was based on the fact that foreign cotton exports increased from 17.9 million bales in 2001 to 19.3 million bales in 2004, about an 8 percent increase. In the long run, it was assumed that 10 percent of extra export supply originates from other cotton exporters.

The results suggest that there was a significant increase in import demand for textile and apparel products in the United States and CE countries after the removal of the MFA quota. For the United States, it was predicted that the import demand for textiles increased by 49.93 percent (Table 8). A corresponding import demand increase in apparel was estimated to be 33.94 percent. For the CE countries, the import demand for textile and apparel products increased by 22.4 percent and 33.46 percent, respectively.

An increase in import demand would induce a decrease in the demand for domestic textile and apparel products. According to the results, the decrease for the

Table 8. Scenario (1): Removal of the MFA Quotas, 8.4 Percent Increase in Payment Rate and 5 Percent Increase in Cotton Supply from Other Countries in the Short Run

Endogenous Variables	Percentage Change*
U.S. Import demand for textiles	49.93
U.S. Import demand for apparel	33.94
U.S. Domestic demand and supply for textiles	-11.91
U.S. Domestic demand and supply for apparel	(-24.96, -22.71)
CE Import demand for textiles	22.4
CE Import demand for apparel	33.46
CE Domestic demand and supply for textiles	-3.42
CE Domestic demand and supply for apparel	(-24.82, -22.74)
U.S. Import price of textiles	-18.76
U.S. Import price of apparel	-22.18
U.S. domestic price of textiles	13.45
U.S. domestic price of apparel	(-2.55, -0.82)
CE Import price of textiles	-17.78
CE Import price of apparel	-21.57
CE domestic price of textiles	-0.37
CE domestic price of apparel	(-2.02, -0.41)
Textile export supply from China	(87.7, 126)
Apparel export supply from China	114
Textile export supply from AO	(98.69, 113)
Apparel export supply from AO	24.09
U.S. cotton supply	(3.25, 6.74)
U.S. cotton price (PC)	(-11.04, -3.56)
Adjusted world cotton price (PO)	(-6.26, 0.64)
U.S. demand for domestic cotton	(-17.2, -14.06)
CE demand for U.S. cotton	-10.93
China's demand for U.S. cotton	(15.4, 46.18)
AO demand for U.S. cotton	(24.64, 27.61)

* Values in parenthesis reflect a range for a 90 percent confidence interval. Others are average.

United States was 11.91 percent for textiles, and between 24.96 percent and 22.71 percent for apparel. CE countries experienced a 3.46 percent decrease in demand for domestic textile and a decrease between 24.82 and 22.74 in demand for domestic apparel products.

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 between -17.2 percent to –14.06 percent was expected. At the same time, the demand for U.S. cotton by CE countries was forecasted to decline by 10.93 percent. Due to geographic proximities and historical trading practices, Canada may import more cotton from the United States. Likewise, European countries might source more cotton within the EU. Similarly, Japan would find it cost efficient to import cotton from other Asian countries instead of turning to the United States. Despite the elimination of MFA, and the effective removal of other trade barriers, business traditions will continue to impact trade.

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 87.7 to 126 percent relative to restricted trade. Likewise, the predicted increase in apparel export supply from China was 114 percent higher after the elimination of the quota. For the AO countries, a positive change in both textile and apparel export supply occurred as well. The textile export supply was 98.69 percent to 113 percent higher and the apparel export supply increased by 24.09 percent.

The increase in export supply of textile and apparel products stimulated the demand for both U.S. cotton and foreign cotton in textiles and apparel exporting countries, which were China and AO countries in the model. As was revealed, there was an increase in Chinese demand for U.S. cotton, between 15.4 percent and 46.18 percent; the same demand from AO countries was projected to be between 24.64 percent and 27.61 percent. In response to this increase in demand, it was expected that cotton supply from the United States would be responsive. A contributing factor associated with an increase in cotton supply from the United States was the interrelationship between the farm payment rate and United States cotton price. With this taken into consideration, the cotton supply from the United States would be expected to increase between 3.25 percent and 6.74 percent.

Although, as was shown in the simulation output, the potential increase in textiles and apparel export supply from both China and AO countries were significant, more than double the export volume before the removal of the MFA quota. These results should be viewed with caution because of the possibility of significant administrative impediments and potential policy changes in China. The estimated percentage change in China was greater than that in AO countries, indicating that China would likely become the leader among all developing textile and apparel exporters worldwide.

A decline in the import price of both textile and apparel products in the United States was predicted to take place, which corresponded with the results of the qualitative analysis as a result of the quota elimination. There would be a significant decline in import prices, 18.76 percent and 22.18 percent for textiles and apparel, respectively.

Due to vertical linkages to the textile and apparel markets, the price for cotton experienced a decline as well. The decline in U.S. cotton price (PC) was between 11.04 percent and 3.56 percent; the decline in adjusted world price (PO) was predicted to be between 6.26 percent and 0.64 percent. The reason that the interval associated with PO was smaller than that associated with PC is because the A-Index takes the average of lowest five cotton price quotations as a proxy for adjusted world price for cotton. This tends to reduce the fluctuations in cotton prices.

Scenario 2 presented the changes in the long run. The MFA quota was removed; the total payment rate was estimated to increase by 8 percent and cotton supply from other countries was predicted to increase by 10 percent.

Based on a time series forecast, the changes of the total payment rate in the long run, the period from 2008 to 2010, would be 8 percent, slightly less than that predicted for the short run, which distinguished the short run and long run simulation scenarios.

The short run and long run simulation results differed also because in the long run, cotton supply is more elastic than in the short run. Short run supply elasticity incorporated in the simulation was 2.36 for the United States and assumed the same for other cotton suppliers (Shui, 1990). In the long run, a significant difference was expected to be seen in the following endogenous variables, mainly variables concerning cotton market: U.S. cotton price, adjusted world price for cotton, domestic demand for U.S. cotton, CE's demand for U.S. cotton, China's demand for U.S. cotton, AO's demand for U.S. cotton and cotton supply from the United States (Table 9). Other variables, mainly

concerning textiles and apparel market did not experience noticeable changes, compared with the same variables in the short run.

The decline in U.S. demand for domestic cotton in the long run was greater than that in the short run, which reflected the trend in the growth of textiles and apparel imports into the United States and contractions of domestic textile sector. This decrease was estimated to be 17.99 percent. The demand for U.S. cotton in CE countries declined further, 14.32 percent, which was 31.02 percent more than the average level in the short run. This confirms the importance of geographic proximity for the cotton source.

China's demand for U.S. cotton increased between 33.2 percent and 38.3 percent in the long run, a little less than that in the short run. A less increase was predicted in AO countries' demand for U.S. cotton, 20.67 percent, which was 19.66 percent less than the average level in the short run. This indicated that, in the long run, China kept taking market share of U.S. cotton imports from AO countries.

In the long run, both the U.S. cotton price and adjusted world price of cotton saw a smaller drop than in the short run. The decrease in U.S. cotton price was 2.13 percent and for adjusted world price, the decrease was negligible, only 1.04 percent.

Although a higher demand for U.S. cotton would result due to the expansion of China's export supply of textiles and apparel, in the long run, the U.S. cotton supply increased less in the short run, between 2.6 percent to 3.4 percent. This might be because in the long run, contributing effects of the decrease in U.S. cotton prices was amplified by the long run cotton supply elasticity, thus offsetting the production stimulating provisions of U.S. farm program payments.

Table 9. **Scenario (2): Removal of the MFA Quotas, 8 Percent Increase in Payment Rate and 10 percent Increase in Cotton Supply from Other Countries in the Long Run**

Endogenous Variables	Percentage Change*
U.S. Import demand for textiles	50.49
U.S. Import demand for apparel	34.82
U.S. Domestic demand and supply for textiles	-12.11
U.S. Domestic demand and supply for apparel	-25.39
CE Import demand for textiles	22.72
CE Import demand for apparel	33.99
CE Domestic demand and supply for textiles	-3.54
CE Domestic demand and supply for apparel	-24.86
U.S. Import price of textiles	-18.66
U.S. Import price of apparel	-22.1
U.S. domestic price of textiles	13.81
U.S. domestic price of apparel	-0.49
CE Import price of textiles	-17.68
CE Import price of apparel	-21.49
CE domestic price of textiles	-0.14
CE domestic price of apparel	-0.36
Textile export supply from China	120
Apparel export supply from China	115
Textile export supply from AO	102
Apparel export supply from AO	26.20
U.S. cotton supply	(2.6, 3.4)
U.S. cotton price (PC)	-2.13
Adjusted world cotton price (PO)	-1.04
U.S. demand for domestic cotton	-17.99
CE demand for U.S. cotton	-14.32
China's demand for U.S. cotton	(33.2, 38.3)
AO demand for U.S. cotton	20.67

* Values in parenthesis reflect a range for a 90 percent confidence interval. Others are average.

Under scenario 3, in the short run, the MFA quota was removed, cotton supply from other countries was assumed to increase by 5 percent, and the farm program payment rate was held constant.

Simulation results suggested that there were only small differences in changes in domestic demand for textile and apparel products in the United States, import demand for textile and apparel, and import price of textile and apparel in both the United States and CE countries compared to the results under which farm program payments changed (Table 10). This is because the changes in these variables are driven mainly by changes in textile trade policy, largely offsetting U.S. policies affecting cotton supply.

The import demand for textiles in the United State more than doubled, which was between 53.49 percent and 56.74 percent. Likewise, an increase was also seen in the import demand for apparel in the United States, which was between 36.74 percent and 42.24 percent. These increases were all larger than those expected when farm program payment rate increased. For CE countries, similar conclusion was drawn. The import demand for textiles increased between 23.92 percent and 26.94 percent, and the import demand for apparel increased, between 36.09 percent and 42.27 percent.

As a result of higher import demand for textiles and apparel, domestic demand for these products dropped even further. It was noticed that the domestic demand for textiles declined by 13.53 percent and 4.36 percent in the United States and CE countries, respectively. However, the decrease in apparel sector was comparatively more dramatic, which was between 35.38 percent and 29.79 percent for the United States, and

Table 10. Scenario (3): Removal of the MFA Quotas, 5 Percent Increase in Cotton Supply from Other Countries in the Short Run and Constant Payment Rate

Endogenous Variables	Percentage Change*
U.S. Import demand for textiles	(53.49, 56.74)
U.S. Import demand for apparel	(36.74, 42.24)
U.S. Domestic demand and supply for textiles	-13.53
U.S. Domestic demand and supply for apparel	(-35.38, -27.97)
CE Import demand for textiles	(23.92, 26.94)
CE Import demand for apparel	(36.09, 41.27)
CE Domestic demand and supply for textiles	-4.36
CE Domestic demand and supply for apparel	(-34.69, -27.67)
U.S. Import price of textiles	-18.09
U.S. Import price of apparel	-21.78
U.S. domestic price of textiles	(15.59, 17.84)
U.S. domestic price of apparel	(1.49, 7.17)
CE Import price of textiles	-17.11
CE Import price of apparel	-21.17
CE domestic price of textiles	(0.7, 2.83)
CE domestic price of apparel	(1.79, 7.22)
Textile export supply from China	(115, 247)
Apparel export supply from China	(122, 139)
Textile export supply from AO	(62.94, 114)
Apparel export supply from AO	(26.6, 31.79)
U.S. cotton supply	(3, 14.46)
U.S. cotton price (PC)	(6.45, 31.03)
Adjusted world cotton price (PO)	(7.17, 26.22)
U.S. demand for domestic cotton	(-31.97, -21.47)
CE demand for U.S. cotton	(-9.50, -3.56)
China's demand for U.S. cotton	(43.05, 152)
AO demand for U.S. cotton	(15.59, 26.56)

* Values in parenthesis reflect a range for a 90 percent confidence interval. Others are average.

between 34.69 percent and 27.67 percent for CE countries, respectively, which was greater than that in Scenario One.

The import demand share for U.S. cotton was redistributed between China and AO countries. China increased demand for U.S. cotton between 43.05 percent and 152 percent. The increase in the demand for U.S. cotton in AO countries was offset somewhat by the greater demand from China, resulting in a smaller increase, which was between 15.59 percent and 26.56 percent compared to Scenario One.

The sharp increase in demand for U.S. cotton drove up both the U.S. cotton price (PC) and adjusted world cotton price (PO). PC rose between 6.45 percent and 31.03 percent, and the increase in PO was between 7.17 percent and 26.22 percent.

The redistribution was also occurring in the textile and apparel export markets among China and AO countries. In the textile market, China would gain larger market share with larger increase in export supply, which would be 115 to 247 percent, compared to before the quota elimination. AO countries, however, experienced a smaller increase, between 62.94 percent and 114 percent. In the apparel market, the increase in China's export supply was not large enough to offset the increase in apparel exports by AO countries below the level of Scenario One. The increase in China's export supply of apparel was between 122 percent and 139 percent and AO's export supply increased between 26.6 percent and 31.79 percent.

Holding the farm program payment rate constant, the change in U.S. cotton supply was determined by the percentage change of PC weighted by the cotton supply

elasticity, which was between 3percent and 14.46 percent, which was a wider range than under scenario one.

Under scenario 4, in the long run, the MFA quota was removed, cotton supply from other countries was assumed to increase by 10 percent, and again, the farm program payment rate remained unchanged.

Noticeable results were seen for the changes in the U.S. cotton prices (PC), adjusted world cotton price (PO), U.S. demand for domestic cotton, CE's demand for U.S. cotton, China's demand for U.S. cotton, export supply of textiles and apparel from China and AO countries, and cotton supply from the United States. For the changes of other variables, refer to table 11.

Compared to the short run, the PC and PO tended to remain steady in the long run. According to the results, only a 0.426 percent increase occurred in PC, which was smaller than the level in Scenario Three. For PO, there was a negligible decline of only 0.076 percent.

With a significant decrease in U.S. demand for domestic cotton in the short run, there was less reduction in the long run, which was predicted to be 19.39 percent. However, a further decline in demand for U.S. cotton from CE countries was expected. The decrease was estimated to be 16.56 percent, nearly 127 percent more than the average change in the short run, which was also the largest change among all four scenarios.

China's demand for U.S. cotton saw a smaller increase in the long run, which was predicted to be 34.69 percent, almost half of the average level of the change in the

Table 11. Scenario (4): Removal of the MFA Quotas, 10 Percent Increase in Cotton Supply from Other Countries in the Long Run and Constant Payment Rate

Endogenous Variables	Percentage Change*
U.S. Import demand for textiles	50.86
U.S. Import demand for apparel	35.39
U.S. Domestic demand and supply for textiles	-12.24
U.S. Domestic demand and supply for apparel	-26.16
CE Import demand for textiles	22.93
CE Import demand for apparel	34.33
CE Domestic demand and supply for textiles	-3.62
CE Domestic demand and supply for apparel	-25.33
U.S. Import price of textiles	-18.61
U.S. Import price of apparel	-22.05
U.S. domestic price of textiles	14.04
U.S. domestic price of apparel	0.098
CE Import price of textiles	-17.63
CE Import price of apparel	-21.44
CE domestic price of textiles	-0.0093
CE domestic price of apparel	0.022
Textile export supply from China	125
Apparel export supply from China	115
Textile export supply from AO	101
Apparel export supply from AO	27.59
U.S. cotton supply	1
U.S. cotton price (PC)	0.426
Adjusted world cotton price (PO)	-0.076
U.S. demand for domestic cotton	-19.39
CE demand for U.S. cotton	-16.56
China's demand for U.S. cotton	34.69
AO demand for U.S. cotton	17.34

* Values in parenthesis reflect a range for a 90 percent confidence interval. Others are average.

short run. This, in turn, had an effect on textile and apparel export supply from China, which exhibited a smaller increase. For textile export supply, there was a 125 percent increase and 115 percent increase for apparel export supply, which were all less than the level under Scenario Three. However, compared to the short run, the increase in textile and apparel export supply from AO countries stayed stable since the increase of demand for U.S. cotton from this group remained steady in the long run. AO would export 101 percent more textiles and 27.59 percent more apparel.

The U.S. cotton supply experienced a smaller increase in the long run as well. The increase was 1 percent, which was also the smallest change among the four scenarios.

CONCLUSIONS

This study simulated changes in textile/apparel trade and cotton trade after the removal of the Multi-Fiber Arrangement. An equilibrium displacement model (EDM) was developed based on Shui's study. The EDM equation system was solved by incorporating a probability distribution for selected parameters affecting the cotton market under four different scenarios. Six groups of countries were classified according to their international trade status in textiles, apparel and cotton. These groups were the United States, CE countries (the textile importers and cotton exporters), China, AO countries (the textile exporters and cotton importers), other cotton exporters, and other cotton importers without textiles and apparel exports. The first four groups were the focal points of this study.

The simulation results were consistent with the impacts examined by the qualitative framework on the basis of modern international trade theory.

U.S. and CE countries' domestic demand for textiles and apparel tends to decrease after MFA quota elimination. The largest decline occurred in the third scenario under a free market adjustment without any change in U.S. farm program payments. The reduction in domestic demand for apparel was predicted to be larger than that in domestic demand for textiles.

Following the removal of the MFA quota, consumers in both the United States and CE countries benefited from a lower price of imported textile and apparel products. Lower prices stimulated quantity imported in the United States and CE countries, which suggested that the international market would gradually become a larger supplier of

textiles and apparel to these two country groups. The increase seen in the United States was larger than that in CE 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. This will offset the increase in import demand occurring in Canada and Japan. There was no explicit difference in import demand increases in the United States and CE countries among the 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 CE countries. A more significant increase was predicted to occur in China. However, the results concerning China should be interpreted with caution because of the potential administrative impediments and the extent of its policy transparency.

As U.S. domestic demand for textiles and apparel declined, demand for domestic cotton was also driven down. China and AO countries' increased their demand for U.S. cotton to meet the needs in textile production in order to support the expansion of the textile industries.

MFA quota elimination, coupled with increased farm program payments, had a negative impact on U.S. cotton prices (PC) and adjusted world cotton price (PO). The decrease in PC was more than that in PO in both short run and long run as was shown in Scenarios 1 and 2. The programs enhanced the competitiveness of U.S. cotton in the global market.

Differences occurred in scenario three when the farm program payments were held constant in the simulation. In the short run, a sharp increase in demand for cotton from China and AO countries raised both PC and PO. In the long run, however, PC and PO would remain fairly stable.

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. More cotton exports moved to foreign textile and apparel suppliers, such as China and other Asian developing countries.

Market access for textile and apparel exporters into the developed countries such as the United States and the European Union improved. The competition among the developing textile and apparel exporters strengthened to secure and gain a larger market share of the developed importers. China would very likely become the leading exporter after the elimination of the MFA quota and take up a considerable part of the market share from other Asian textile and apparel exporting countries.

While U.S. farm programs have direct effects on the cotton market, they also have implicit impacts on textile and apparel markets. In the short run, textile and apparel exports from China, with higher farm program payments incorporated in simulation, were less than when holding the farm program payment constant. This appears to protect the U.S. textile industry to some degree. However, in the long run, no significant difference was found.

Models reflecting specific linkages of textile and cotton markets are limited. Different assumptions for alternative scenarios, different classification of country-

groups, newer estimates of associated parameters and the inclusion of probability distribution for selected parameters in this study limit valid comparison of results to Shui's study in 1990. Similar scenarios in Shui's study, compared to the scenarios simulated in this study (Scenario 2 and Scenario 4), generated most results that were consistent in the direction of change, but different in magnitude. The differences, however, were within reasonable ranges.

Under Scenario 2, the adjusted world cotton price was estimated to decrease by 1.04 percent, while Shui found a 1.22 percent increase for the same variable. In this study, the U.S. domestic price of textiles was predicted to increase by 13.81 percent, however, Shui's study suggested a 0.07 decline.

Under Scenario 4, PC increased by 0.426 percent and PO decreased by 0.076 percent, while Shui found a 0.29 percent decrease and a 3.11 increased in PC and PO, respectively. The U.S. domestic price of textiles and apparel were predicted to increase by 14.04 percent and 0.098 percent. In Shui's study, however, these two variables experienced a decline of 0.01 percent and 0.35 percent, respectively. As to the CE's domestic price of textiles and apparel, the results suggested a 0.0093 percent decrease and 0.022 percent increase, respectively. Shui concluded a 0.21 increase and a 0.97 decrease for the same variables.

A major contributing factor for these differences might be the new estimates of selected parameters involved in this study. This likely has occurred due to major structural changes in China, the United States, and/or the world market for textiles and apparel and cotton.

LIMITATIONS AND SUGGESTIONS FOR FURTHER STUDY

Uniform distribution was applied for selected parameters in this study to form a probability distribution to solve each endogenous variable. The underlying probability distribution for the parameters, however, may differ. Due to the lack of estimates for associated parameters, no further specification for the probability distribution could be tested. In addition, probability distribution was not assigned to parameters in the textile and apparel market since only one value was found for those and further estimation would require substantial additional data and econometric analysis due to the complexity and commodity variety in textile and apparel sector. In future study, subjective probabilities could be considered imposing on associated parameters.

Also, some parameter estimates used in the simulation, mainly the cost share and output share, were selected from previous studies with different underlying theoretical assumptions. Therefore, it is desirable to verify the predictive powers before using them in the model to perform more accurate policy simulations.

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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APPENDIX A

SIMULATION RESULTS OF SELECTED VARIABLES IN PROBABILITY DENSITY FUNCTION (PDF) FORM

Scenario 1: Short run, MFA quota is removed, the total farm program payment rate increases by 8.4 percent, and the cotton supply from other countries increases by 5 percent.

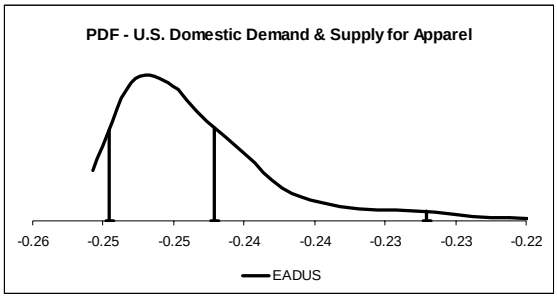

Figure A-1. PDF of US domestic demand & supply for apparel

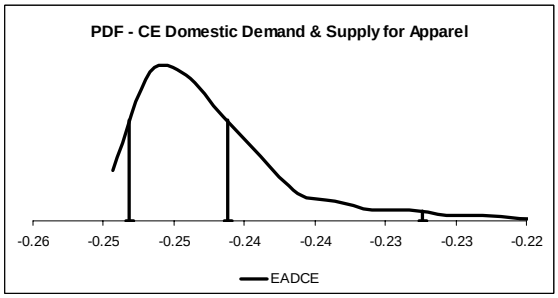

Figure A-2. PDF of CE domestic demand & supply for apparel

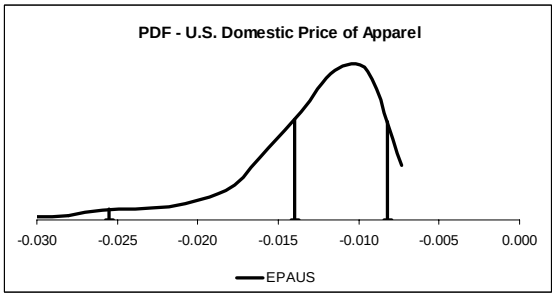

Figure A-3. PDF of US domestic price of apparel

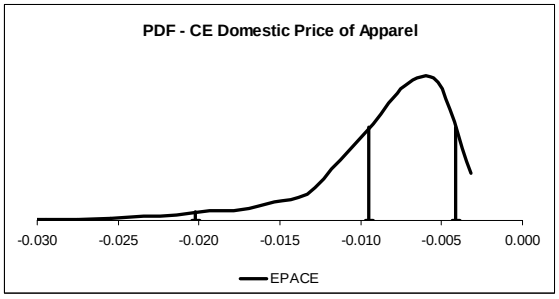

Figure A-4. PDF of CE domestic price of apparel

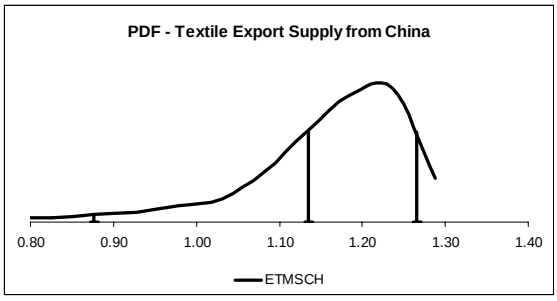

Figure A-5. PDF of textile export supply from China

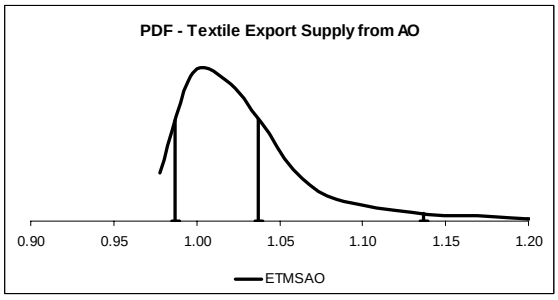

Figure A-6. PDF of textile export supply from AO

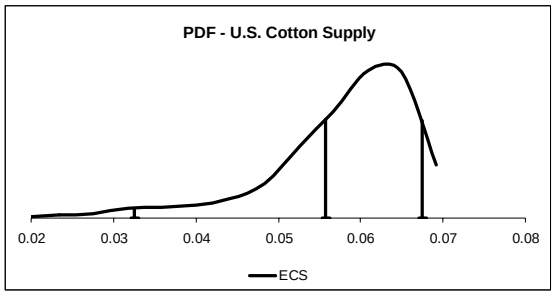

Figure A-7. PDF of US cotton supply

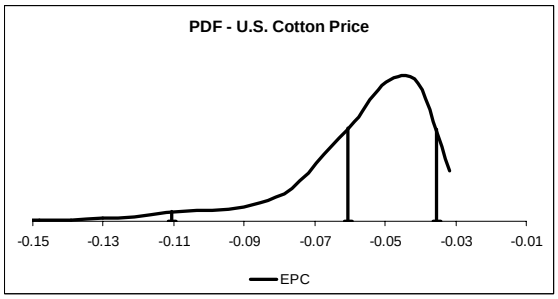

Figure A-8. PDF of US cotton price

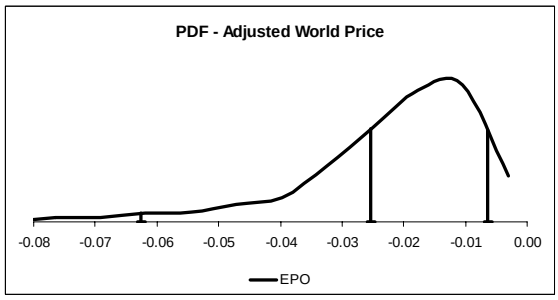

Figure A-9. PDF of adjusted world price

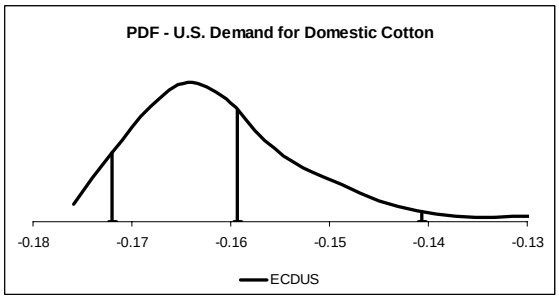

Figure A-10. PDF of US demand for domestic cotton

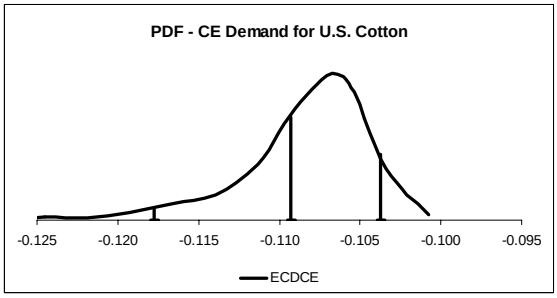

Figure A-11. PDF of CE demand for US cotton

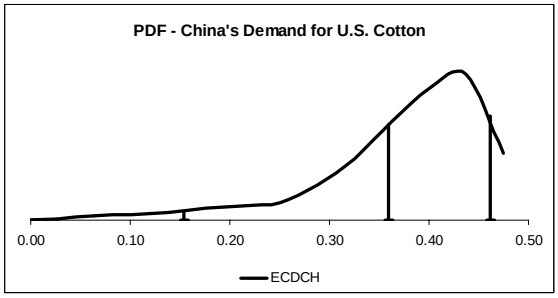

Figure A-12. PDF of CE demand for US cotton

Scenario 2: Long run, MFA quota is removed, the total farm program payment rate increases by 8 percent, and the cotton supply from other countries increases by 10 percent.

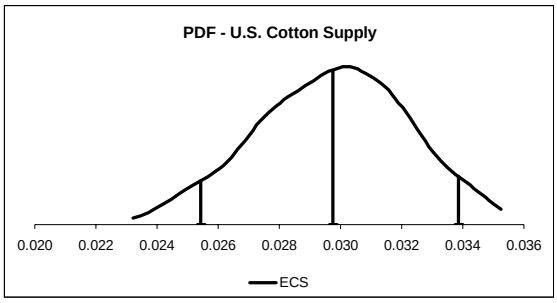

Figure A-13. PDF of US cotton supply

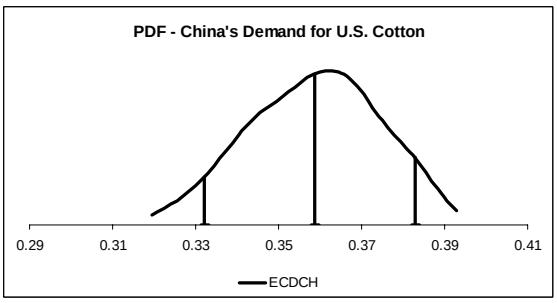

Figure A-14. PDF of China's demand for US cotton

Scenario 3: Short run, MFA quota is removed, total farm program payment rate remains constant, cotton supply from other countries increases by 5 percent.

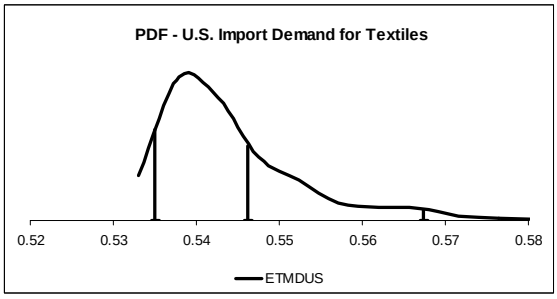

Figure A-15. PDF of US import demand for textiles

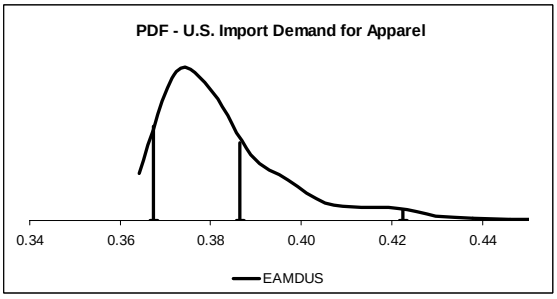

Figure A-16. PDF of US import demand for apparel

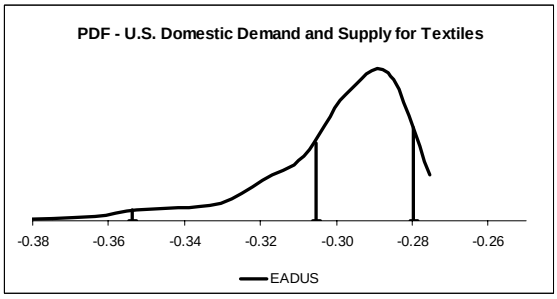

Figure A-17. PDF of US domestic demand & supply for textiles

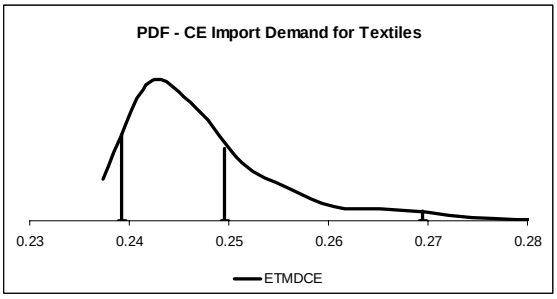

Figure A-18. PDF of CE import demand for textiles

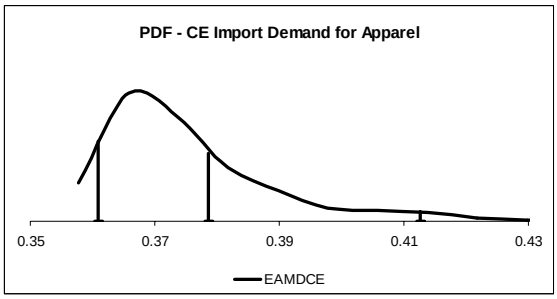

Figure A-19. PDF of CE import demand for apparel

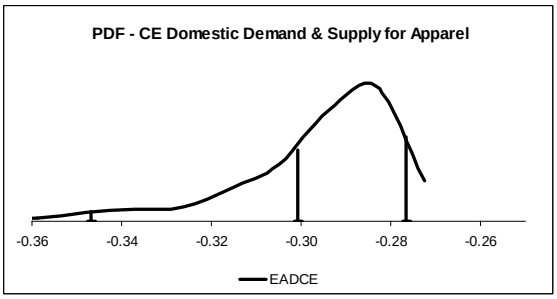

Figure A-20. PDF of CE domestic demand & supply for apparel

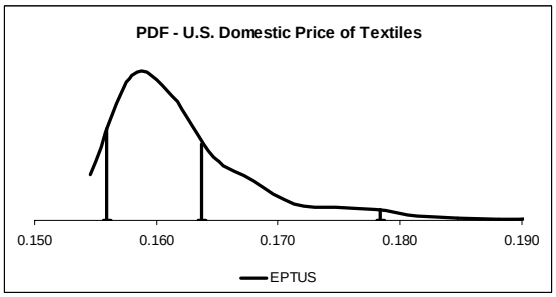

Figure A-21. PDF of US domestic price of textiles

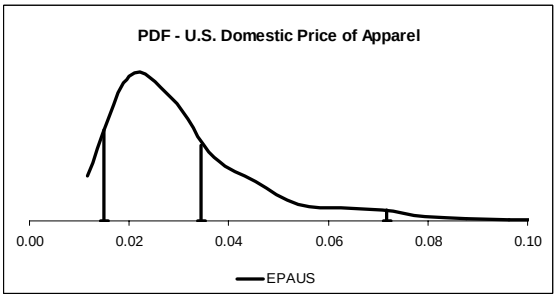

Figure A-22. PDF of US domestic price of apparel

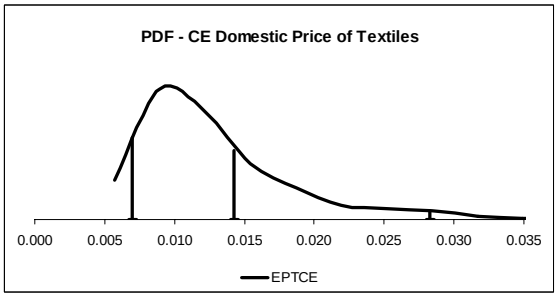

Figure A-23. PDF of CE domestic price of textiles

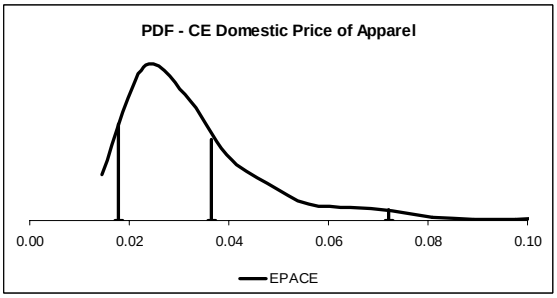

Figure A-24. PDF of CE domestic price of apparel

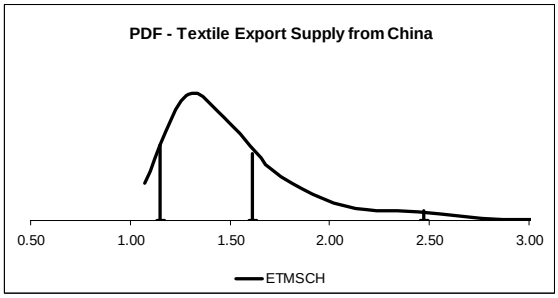

Figure A-25. PDF of textile export supply from China

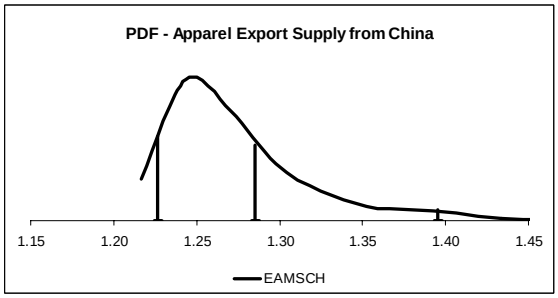

Figure A-26. PDF of apparel export supply from China

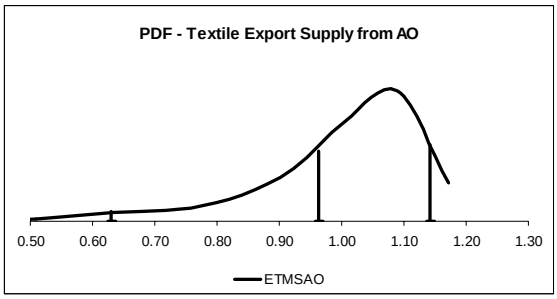

Figure A-27. PDF of textile export supply from AO

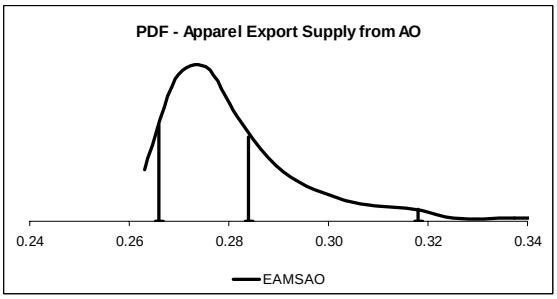

Figure A-28. PDF of apparel export supply from AO

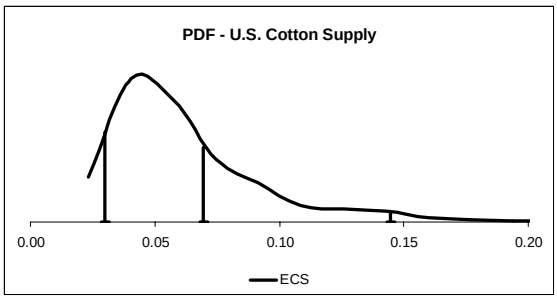

Figure A-29. PDF of US cotton supply

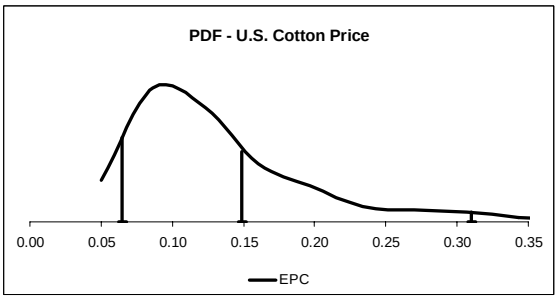

Figure A-30. PDF of US cotton price

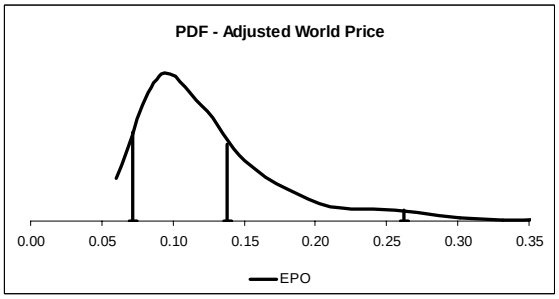

Figure A-31. PDF of adjusted world price

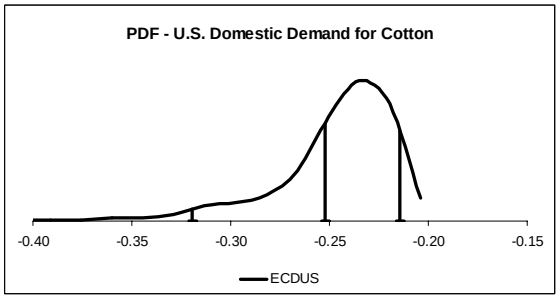

Figure A-32. PDF of US domestic demand for cotton

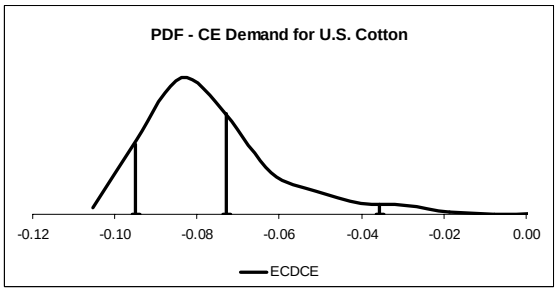

Figure A-33. PDF of CE demand for US cotton

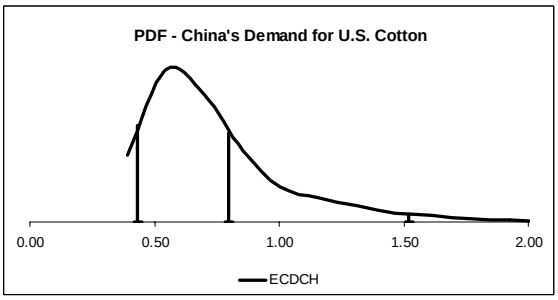

Figure A-44. PDF of China's demand for US cotton

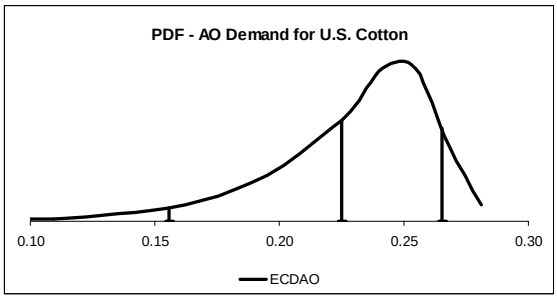

Figure A-35. PDF of AO demand for US cotton

There are no PDF diagrams presented for endogenous variables under scenario 4 since the different between the maximum and the minimum percentage change simulated is extremely small in the rang of 3 percent. Therefore, only average value was provided, which can be found in Table 11 in the Scenario and Simulation Results section in the paper.

APPENDIX B

DERIVATION OF SELECTED EQUATIONS IN THE EQUILIBRIUM DISPLACEMENT MODEL

The domestic demand for textiles and apparel in the United States, equation (1) in the EDM, is given as:

$$TD_{US} = TD_{US}\,(PT_{US}, PT_{US}^{D})$$

Total differentiating equation (1), it gives

$$d\,TD_{US} = [\partial\,TD_{US}(\cdot) / \partial\,PT_{US}] * d\,PT_{US} + [\,\partial\,TD_{US}(\cdot) / \partial\,PT_{US}^{D}\,] *\ d\,PT_{US}^{D}$$

Multiplying right hand side by (PT_{US} / PT_{US}) to the first half and ($PT_{US}^{D} / PT_{US}^{D}$) and second half of (2), and dividing both sides by $TD_{US.}$ It gives

$$d\,TD_{US} / TD_{US} = [\partial\,TD_{US}(\cdot) / \partial\,PT_{US}] * [PT_{US} / TD_{US}(\cdot)] * [d\,PT_{US} / PT_{US}] +$$
$$[\partial\,TD_{US}(\cdot) / \partial\,PT_{US}^{D}] * [PT_{US}^{D} / TD_{US}(\cdot)] * [\,d\,PT_{US}^{D} / PT_{US}^{D}]$$

The term $[\partial\,TD_{US}(\cdot) / \partial\,PT_{US}] * [PT_{US} / TD_{US}(\cdot)]$ is the own price elasticity of demand for domestic textiles and $[\partial\,TD_{US}(\cdot) / \partial\,PT_{US}^{D}] * [PT_{US}^{D} / TD_{US}(\cdot)]$ is the cross price elasticity of demand for domestic textiles with respect to the import textiles. Express the own price elasticity as η_{US} and the cross price elasticity as $\eta'_{US.}$ We get

$$d\,TD_{US} / TD_{US} = \eta_{US} * (d\,PT_{US} / PT_{US}) + \eta'_{US} * (d\,PT_{US}^{D} / PT_{US}^{D})$$

Let $(d\,TD_{US} / TD_{US})$ be ETD_{US}, $(d\,PT_{US} / PT_{US})$ be EPT_{US}, and $(d\,PT_{US}^{D} / PT_{US}^{D})$ be EPT_{US}^{D}, we get

$$ETD_{US} = \eta_{US}\,EPT_{US} + \eta'_{US}\,EPT^{D}_{US}$$

The derivation for equation (9), domestic supply of textiles in the United States is given as following.

Total differentiating the equation $PT_{US} = AC^{T}_{US}(PC, PO)$, it gives

$$d\,PT_{US} = [\partial AC^{T}_{US}(\cdot) / \partial\, PC] * d\,PC + [\,\partial\, AC^{T}_{US}(\cdot) / \partial\, PO\,] * d\,PO$$

Further

$$d\,PT_{US} / PT_{US} = [\partial AC^{T}_{US}(\cdot) / \partial\, PC] * [PC / AC^{T}_{US}(\cdot)] * [d\,PC / PC] +$$
$$[\partial AC^{T}_{US}(\cdot) / \partial\, PO] * [PO / AC^{T}_{US}(\cdot)] * [d\,PO / PO]$$

The term $[\partial AC^{T}_{US}(\cdot) / \partial\, PC] * [PC / AC^{T}_{US}(\cdot)]$ is the cost share of U.S. cotton and $[\partial AC^{T}_{US}(\cdot) / \partial\, PO] * [PO / AC^{T}_{US}(\cdot)]$ is the coast share of foreign cotton. If no foreign cotton is used, the second term becomes zero. If no foreign cotton is used, the second term should be zero. Express the first and second term as δ_{US} and $\delta'_{US,}$ respectively, it gives

$$d\,PT_{US} / PT_{US} = \delta_{US} * (d\,PC / PC) + \delta'_{US} * (d\,PO / PO)$$

which can be expressed as

$$EPT_{US} = \delta_{US}\,EPC + \delta'_{US}\,EPO$$

The derivation for equation (17), $CD_{US} = CD_{US}(TS_{US}, AS_{US}, PC, PO)$, the domestic demand for U.S. cotton is shown as the following.

$$d\,CD_{US} / CD_{US} = [\partial\, CD_{US}(\cdot) / \partial\, TS_{US}] * [TS_{US} / CD_{US}(\cdot)] * [d\,TS_{US} / TS_{US}] +$$
$$[\partial\, CD_{US}(\cdot) / \partial\, AS_{US}] * [AS_{US} / CD_{US}(\cdot)] * [d\,AS_{US} / TS_{US}] +$$
$$[\partial\, CD_{US}(\cdot) / \partial\, PC] * [PC / CD_{US}(\cdot)] * [d\,PC / PC] +$$
$$[\partial\, CD_{US}(\cdot) / \partial\, PO] * [PO / CD_{US}(\cdot)] * [d\,PO / PO]$$

The first and second terms, $[\partial CD_{US}(\cdot)/ \partial TS_{US}] * [TS_{US} / CD_{US}(\cdot)]$ and $[\partial CD_{US}(\cdot)/ \partial AS_{US}] * [AS_{US} / CD_{US}(\cdot)]$ are the output shares. The third term $[\partial CD_{US}(\cdot)/ \partial PC] * [PC / CD_{US}(\cdot)]$ is own price elasticity of demand for U.S. cotton and the fourth term $[\partial CD_{US}(\cdot)/ \partial PO] * [PO / CD_{US}(\cdot)]$ is cross price elasticity of demand for U.S. cotton with respect to foreign cotton. This is expressed as

$$ECD_{US} = \mu_{US} ETS_{US} + \mu^*_{US} EAS_{US} + \gamma_{US} EPC + \gamma_{USI} EPO$$

For equation (31), one of the trade restrictions, the derivation is given as the following.

$$d PT_{US}^{D} / PT_{US}^{D} = d PT^{S} / PT^{S} + [T / (1+T)] * (d T / T)$$

which can also be expressed as

$$EPT^{D}_{US} = EPT^{S} + T/(1+T) ET_{US}$$

When the trade restriction, the MFA quota, is removed, T will reduce by 100 percent weighted by its own fraction.

Similarly, all other equations can be derived and the equilibrium displacement structure is established.

APPENDIX C

ESTIMATION OF SELECTED PARAMETERS USED IN THE EQUILIBRIUM DISPLACEMENT MODEL

The parameters estimated by the author are the price elasticity of demand for U.S. cotton and price elasticity of demand for foreign cotton by using OLS (Ordinary Least Squares) analysis. All the data used for the analysis covers the period of 1989-2003 and was collected from U.S. National Cotton Council.

(1) Own price elasticity and cross price elasticity of demand for U.S. cotton in CE countries.

The imports of U.S. cotton in CE countries are specified as

$$IM^{US}_{CE} = IM^{US}_{CE} (PC, PO, DC)$$

where IM is imports of U.S. cotton, PC is the price of U.S. cotton, PO is the price of foreign cotton, and DC is domestic consumption in CE countries. Take natural logarithm (ln) of both sides of the above equation, it gives

$$\ln (IM^{US}_{CE}) = \alpha_0 + \alpha_1 \ln (PC) + \alpha_2 \ln (PO) + \alpha_3 \ln (DC) + \epsilon$$

where α_1 is the own price elasticity of demand for U.S. cotton and α_2 is the cross price elasticity of demand for U.S. cotton for CE countries (Table C-1). No probability distribution was formed due to lack of further parameter estimates.

Table C-1. Price Elasticity of Demand for Imports of U.S. cotton in CE

OLS Regression Statistics for Imports, 7/28/04 3:50:38 PM					
F-test	12.483	Prob(F)	0.001	Unrestricted Model	
$MSE^{1/2}$	0.250	CV Regr	1.977	F-test	12.483
R^2	0.773	Durbin-Watson	2.253	R^2	0.773
$RBar^2$	0.711	Rho	-0.213	$RBar^2$	0.711
Akaike Information Cı	-2.679	Goldfeld-Quandt	0.377	Akaike Information Cı	-2.679
Schwarz Information	-2.538			Schwarz Information	-2.538
95%	Intercept	PC	PO	Dom. Cons.	
Beta	-7.292	-1.806	2.769	**1.416**	
S.E.	6.003	0.960	1.080	0.416	
t-test	-1.215	-1.880	2.563	3.403	
Prob(t)	0.252	0.090	0.028	0.007	
Elasticity at Mean		0.071	-0.088	1.593	
Variance Inflation Factor		12.356	12.651	1.331	
Partial Correlation		-0.493	0.611	0.716	
Semipartial Correlation		-0.270103306	0.36823	0.488895053	
Restriction					
S.D. Resids	0.21447	MAPE	1.38281		
Actual Imports	Predicted	Residuals			
13.395	13.243	0.152			
13.433	13.225	0.207			
13.205	13.111	0.095			
12.937	12.719	0.217			
12.687	12.659	0.028			
12.778	12.984	-0.206			
12.926	13.020	-0.094			
12.706	12.736	-0.030			
12.505	12.927	-0.423			
12.638	12.320	0.318			
11.831	12.210	-0.379			
12.257	12.280	-0.023			
12.141	12.292	-0.151			
12.249	12.221	0.029			
12.301	12.042	0.259			

(2) Own price elasticity and cross price elasticity of demand for U.S. cotton in AO countries.

Two estimation equations were specified in order to get the minimum and maximum level to form a uniform distribution.

$$IM^{US}_{AO} = IM^{US}_{AO}(PC, PO, CP, Dummy)$$

$$IM^{US}_{AO} = IM^{US}_{AO}(PC, PO, DC, Dummy)$$

where CP is the cotton production in AO countries, IM, PC, PO, and DC are the same as defined in (1). A dummy variable was included for a noticeable low imports volume in 1999. Take natural logarithm (ln) of both sides of the above two equations, it gives

(1) $\ln (IM^{US}_{AO}) = \beta_0 + \beta_1 \ln (PC) + \beta_2 \ln (PO) + \beta_3 \ln (CP) + Dummy + \epsilon$

(2) $\ln (IM^{US}_{AO}) = \beta'_0 + \beta'_1 \ln (PC) + \beta'_2 \ln (PO) + \beta'_3 \ln (DC) + Dummy + \epsilon$

where β_1 and β'_1 are the upper and lower level to form a uniform distribution for the own price elasticity; β_2 and β'_2 are the lower and upper level to form a uniform distribution for the cross price elasticity (Table C-2 and C-3).

Table C-2. Price Elasticity of Demand for Imports of U.S. Cotton in AO (1)

OLS Regression Statistics for Imports, 7/28/04 4:54:43 PM					
F-test	10.236	Prob(F)	0.002	Unrestricted Model	
MSE$^{1/2}$	0.192	CV Regr	1.344	F-test	10.236
R^2	0.804	Durbin-Watson	1.536	R^2	0.804
RBar^2	0.725	Rho	0.156	RBar^2	0.725
Akaike Information Cı	-3.176	Goldfeld-Quandt	#VALUE!	Akaike Information Cı	-3.176
Schwarz Information	-2.988			Schwarz Information	-2.988
95%	Intercept	Dummy	PC	PO	Cotton Prod.
Beta	-3.418	**-0.882**	**-2.424**	**2.771**	1.158
S.E.	8.970	0.230	0.797	0.909	0.588
t-test	-0.381	-3.834	-3.041	3.048	1.970
Prob(t)	0.712	0.004	0.014	0.014	0.080
Elasticity at Mean		-0.004	0.084	-0.078	1.238
Variance Inflation Factor		1.346	14.538	15.300	1.098
Partial Correlation		-0.771	-0.693	0.694	0.529
Semipartial Correlation		-0.537114455	-0.4261	0.427040347	0.2760635
Restriction					
S.D. Resids	0.15647	MAPE	0.86491		
Actual Imports	Predictec	Residuals			
14.334	14.454	-0.120			
14.417	14.385	0.032			
14.323	14.404	-0.082			
14.291	14.151	0.140			
13.938	13.968	-0.030			
14.506	14.267	0.239			
14.673	14.484	0.189			
14.228	14.359	-0.131			
14.164	14.489	-0.326			
14.051	14.030	0.021			
13.272	13.272	0.000			
13.919	14.125	-0.206			
14.503	14.539	-0.036			
14.540	14.475	0.065			
14.728	14.483	0.245			

Table C-3. Price Elasticity of Demand for Imports of U.S. Cotton in AO (2)

OLS Regression Statistics for Imports, 10/9/04 1:58:20 PM					
F-test	9.794	Prob(F)	0.002	Unrestricted Model	
$MSE^{1/2}$	0.195	CV Regr	1.368	F-test	9.794
R^2	0.797	Durbin-Watson	1.890	R^2	0.797
$RBar^2$	0.715	Rho	-0.019	$RBar^2$	0.715
Akaike Information Cr	-3.141	Goldfeld-Quandt	#VALUE!	Akaike Information Cr	-3.141
Schwarz Information	-2.952			Schwarz Information	-2.952
95%	Intercept	Dummy	PC	PO	Dom. Cons.
Beta	1.014	**-0.769**	**-2.518**	**3.207**	0.856
S.E.	7.182	0.228	0.818	0.969	0.464
t-test	0.141	-3.378	-3.077	3.310	1.844
Prob(t)	0.891	0.008	0.013	0.009	0.098
Elasticity at Mean		-0.004	0.088	-0.091	0.936
Variance Inflation Factor		1.273	14.780	16.781	1.456
Partial Correlation		-0.730	-0.697	0.723	0.504
Semipartial Correlation		-0.481657036	-0.43886	0.471953459	0.2629604
Restriction					
S.D. Resids	0.159264	MAPE	0.82872		
Actual Imports	Predicted I	Residuals			
14.334	14.388	-0.055			
14.417	14.447	-0.030			
14.323	14.296	0.027			
14.291	14.077	0.214			
13.938	14.025	-0.087			
14.506	14.365	0.140			
14.673	14.472	0.201			
14.228	14.319	-0.091			
14.164	14.530	-0.366			
14.051	14.021	0.031			
13.272	13.272	0.000			
13.919	14.174	-0.255			
14.503	14.454	0.049			
14.540	14.546	-0.006			
14.728	14.501	0.227			

(3) Own price elasticity and cross price elasticity of demand for U.S. cotton in China. Two specifications were estimated in order to get the minimum and maximum level in the uniform distribution.

$$IM^{US}_{CH} = IM^{US}_{CH} (PC, PO, PCG, Dummy)$$

$$IM^{US}_{CH} = IM^{US}_{CH} (Lag(PC), PO, Lag(CP), Dummy)$$

where PCG is Per Capita GDP of China, Lag(CP) is one period lag of cotton production, and PC and PO are defined the same as before. A dummy variable was included for the noticeable low imports in 1993. Take natural logarithm (ln) of both sides of the above two equations, it gives

(1) $\ln (IM^{US}_{CH}) = \gamma_0 + \gamma_1 \ln (PC) + \gamma_2 \ln (PO) + \gamma_3 \ln (PCG) + Dummy + \epsilon$

(2) $\ln (IM^{US}_{CH}) = \gamma'_0 + \gamma'_1 \ln (Lag(PC)) + \gamma'_2 \ln (PO) + \gamma'_3 \ln(Lag(CP)) + Dummy + \epsilon$

where γ_1 and γ'_1 are the lower and upper level to form a uniform distribution for the own price elasticity; γ_2 and γ'_2 are the upper and lower level to form a uniform distribution for cross price elasticity (Table C-4 and C-5)

Table C-4. Price Elasticity of Demand for Imports of U.S. Cotton in China (1)

OLS Regression Statistics for Imports, 7/28/04 2:59:59 PM					
F-test	12.931	Prob(F)	0.001	Unrestricted Model	
$MSE^{1/2}$	0.446	CV Regr	3.636	F-test	12.931
R^2	0.838	Durbin-Watson	1.285	R^2	0.838
$RBar^2$	0.773	Rho	0.280	$RBar^2$	0.773
Akaike Information Cr	-1.487	Goldfeld-Quandt	#VALUE!	Akaike Information Cr	-1.487
Schwarz Information	-1.298			Schwarz Information	-1.298
95%	Intercept	Dummy	PC	PO	PCG
Beta	**8.586**	**-1.930**	-3.712	**6.597**	0.724
S.E.	2.302	0.505	1.793	2.123	0.376
t-test	3.730	-3.821	-2.070	3.108	1.923
Prob(t)	0.005	0.004	0.068	0.013	0.087
Elasticity at Mean		-0.010	0.150	-0.217	0.378
Variance Inflation Factor		1.197	13.582	15.408	1.571
Partial Correlation		-0.770	-0.548	0.701	0.520
Semipartial Correlation		-0.48642147	-0.263483	0.395545324	0.24479
Restriction					
S.D. Resids	0.36414	MAPE	2.5109602		
Actual Imports	Predicted	Residuals			
12.358	12.742	-0.384			
12.370	12.788	-0.418			
12.583	12.400	0.183			
12.213	11.605	0.608			
9.763	9.763	0.000			
13.111	12.683	0.429			
13.248	13.305	-0.057			
13.009	12.776	0.233			
12.902	13.151	-0.250			
12.004	12.054	-0.050			
11.048	11.644	-0.595			
11.790	12.047	-0.257			
11.800	12.114	-0.314			
12.421	12.154	0.267			
13.376	12.770	0.607			

Table C-5. **Price Elasticity of Demand for Imports of U.S. Cotton in China (2)**

OLS Regression Statistics for Imports, 10/8/04 3:32:16 PM					
F-test	22.465	Prob(F)	0.000	Unrestricted Model	
$MSE^{1/2}$	0.352	CV Regr	2.872	F-test	22.465
R^2	0.909	Durbin-Watson	1.574	R^2	0.909
$RBar^2$	0.868	Rho	0.156	$RBar^2$	0.868
Akaike Information Cı	-1.957	Goldfeld-Quandt	#VALUE!	Akaike Information Cı	-1.957
Schwarz Information	-1.775			Schwarz Information	-1.775
95%	Intercept	Dummy	Lag PC	PO	Lag CP
Beta	-25.766	**-2.438**	**-1.615**	**3.502**	2.537
S.E.	14.084	0.372	0.467	0.586	0.924
t-test	-1.830	-6.551	-3.462	5.972	2.745
Prob(t)	0.105	0.000	0.009	0.000	0.025
Elasticity at Mean		-0.013	0.065	-0.115	3.168
Variance Inflation Factor		1.036	1.462	1.835	1.302
Partial Correlation		-0.909	-0.756	0.894	0.675
Semipartial Correlation		-0.658849393	-0.34817	0.600591068	0.276071
Restriction					
S.D. Resids	0.28244	MAPE	1.94542		
Actual Imports	Predicted	Residuals			
12.358	#N/A	#N/A			
12.370	12.726	-0.356			
12.583	12.725	-0.142			
12.213	12.365	-0.152			
9.763	9.763	0.000			
13.111	12.806	0.305			
13.248	13.440	-0.192			
13.009	12.593	0.416			
12.902	12.514	0.388			
12.004	12.240	-0.236			
11.048	11.533	-0.485			
11.790	11.900	-0.111			
11.800	11.378	0.422			
12.421	12.315	0.106			
13.376	13.338	0.038			

(4) Own price elasticity and cross price elasticity of demand for U.S. cotton country h, the cotton importer without textiles and apparel exports.

The imports of U.S. cotton in CE countries are specified as

$$IM^{US}_{h} = IM^{US}_{h} (PC, PO, DC, Pop)$$

where IM is imports of U.S. cotton, PC, PO, and DC are the same as defined before, Pop stands for population. Take natural logarithm (ln) of both sides of the above equation, it gives

$$\ln (IM^{US}_{h}) = \eta_0 + \eta_1 \ln (PC) + \eta_2 \ln (PO) + \eta_3 \ln (DC) + \eta_4 \ln (Pop) + \epsilon$$

where η_1 is the own price elasticity of demand for U.S. cotton and η_2 is the cross price elasticity of demand for U.S. cotton. To from a uniform distribution for own price elasticity, the upper level was taken from Shui's study, -0.97 and estimated η_1 is the lower level of cross price elasticity. To form a uniform distribution for cross price elasticity, the lower level used is the value in Shui's study, 0.685 and the estimated η_2 is the upper level (Table C-6 and C-7).

Table C-6. Price Elasticity of Demand for Imports of U.S. Cotton in Country h

OLS Regression Statistics for Imports, 8/6/04 2:53:25 PM					
F-test	128.274	Prob(F)	0.000	Unrestricted Model	
$MSE^{1/2}$	0.091	CV Regr	0.716	F-test	128.274
R^2	0.981	Durbin-Watson	2.181	R^2	0.981
$RBar^2$	0.973	Rho	-0.206	$RBar^2$	0.973
Akaike Information Cr	-4.664	Goldfeld-Quandt	0.525	Akaike Information Cr	-4.664
Schwarz Information	-4.476			Schwarz Information	-4.476
95%	Intercept	Dom. Cons.	PC	PO	Population
Beta	**-101.179**	**2.791**	**-1.694**	**1.499**	**3.535**
S.E.	11.636	0.818	0.421	0.497	0.221
t-test	-8.695	3.413	-4.025	3.016	15.979
Prob(t)	0.000	0.008	0.003	0.015	0.000
Elasticity at Mean		3.182	0.066	-0.048	5.749
Variance Inflation Factor		1.580	17.952	20.245	1.610
Partial Correlation		0.734	-0.786	0.690	0.981
Semipartial Correlation		0.149241124	-0.17598	0.131875822	0.69866
Restriction					
S.D. Resids	0.07436	MAPE	0.4774		
Actual Imports	Predicted	Residuals			
11.691	11.822	-0.131			
11.834	11.788	0.045			
11.871	11.719	0.152			
12.540	12.675	-0.135			
12.643	12.688	-0.045			
12.638	12.621	0.017			
12.598	12.635	-0.036			
12.778	12.811	-0.032			
13.163	13.111	0.053			
12.877	12.897	-0.020			
13.204	13.168	0.035			
13.143	13.044	0.098			
13.243	13.252	-0.009			
13.469	13.423	0.046			
13.213	13.252	-0.039			

(5) Own price elasticity and cross price elasticity of demand for foreign cotton in CE countries.

Two specifications were estimated in order to get the minimum and maximum in the uniform distribution.

$$IM^{F}_{CE} = IM^{F}_{CE}(\text{Lag(PC)}, \text{PO}, \text{Lag(CP)})$$

$$IM^{F}_{CE} = IM^{F}_{CE}(\text{PC}, \text{PO}, \text{DC})$$

where PC is U.S. cotton price, PO is adjusted world cotton price, CP is cotton production and DC is domestic consumption of cotton in CE countries. Take natural logarithm (ln) of both sides of the above equations, it gives

(1) $\ln (IM^{F}_{CE}) = \lambda_0 + \lambda_1 \ln (Lag(PC)) + \lambda_2 \ln (PO) + \lambda_3 \ln (Lag (CP)) + \epsilon$

(2) $\ln (IM^{F}_{CE}) = \lambda'_0 + \lambda'_1 \ln (PC) + \lambda'_2 \ln (PO) + \lambda'_3 \ln (DC) + \epsilon$

where λ_1 and λ'_1 are the lower and upper level to form a uniform distribution for the cross price elasticity of demand for foreign cotton with respect to U.S. cotton; λ_2 and λ'_2 are the upper and lower level to form a uniform distribution for own price elasticity of demand for foreign cotton (Table C-7 and C-8).

Table C-7. Price Elasticity of Demand for Imports of Foreign Cotton in CE (1)

OLS Regression Statistics for Imports, 10/8/04 10:11:36 PM					
F-test	7.845	Prob(F)	0.005	Unrestricted Model	
$MSE^{1/2}$	0.131	CV Regr	0.948	F-test	7.845
R^2	0.702	Durbin-Watson	1.784	R^2	0.702
$RBar^2$	0.612	Rho	-0.095	$RBar^2$	0.612
Akaike Information Cr	-3.966	Goldfeld-Quandt	1.363	Akaike Information Cr	-3.966
Schwarz Information	-3.829			Schwarz Information	-3.829
95%	Intercept	Lag CP	Lag PC	PO	
Beta	**20.662**	-0.482	**0.734**	-0.456	
S.E.	2.520	0.187	0.180	0.263	
t-test	8.200	-2.584	4.070	-1.733	
Prob(t)	0.000	0.029	0.003	0.117	
Elasticity at Mean		-0.478	-0.026	0.013	
Variance Inflation Factor		1.918	1.568	2.649	
Partial Correlation		-0.633	0.790	-0.481	
Semipartial Correlation		-0.446263983	0.70283	-0.299305169	
Restriction					
S.D. Resids	0.11111	MAPE	0.60383		
Actual Imports	Predicted	Residuals			
13.930	#N/A	#N/A			
13.872	13.983	-0.110			
14.073	14.026	0.048			
14.074	14.087	-0.013			
14.108	13.961	0.148			
14.001	13.841	0.160			
13.921	13.907	0.014			
13.978	14.091	-0.113			
13.912	13.908	0.004			
13.851	13.848	0.003			
13.856	13.897	-0.040			
13.824	13.624	0.200			
13.697	13.783	-0.086			
13.566	13.558	0.008			
13.338	13.559	-0.221			

Table C-8. Price Elasticity of Demand for Imports of Foreign Cotton in CE (2)

OLS Regression Statistics for Imports, 7/29/04 1:41:48 PM					
F-test	52.796	Prob(F)	0.000	Unrestricted Model	
$MSE^{1/2}$	0.059	CV Regr	0.423	F-test	52.796
R^2	0.935	Durbin-Watson	1.131	R^2	0.935
$RBar^2$	0.917	Rho	0.368	$RBar^2$	0.917
Akaike Information Cr	-5.580	Goldfeld-Quandt	2.012	Akaike Information Cr	-5.580
Schwarz Information	-5.439			Schwarz Information	-5.439
95%	Intercept	PC	PO	Dom. Cons.	
Beta	-0.903	**0.941**	**-1.072**	**1.039**	
S.E.	1.407	0.225	0.253	0.098	
t-test	-0.642	4.181	-4.231	10.649	
Prob(t)	0.536	0.002	0.002	0.000	
Elasticity at Mean		-0.034	0.031	1.068	
Variance Inflation Factor		12.356	12.651	1.331	
Partial Correlation		0.783	-0.787	0.955	
Semipartial Correlation		0.321252711	-0.32511	0.818231989	
Restriction					
S.D. Resids	0.050277	MAPE	0.302827		
Actual Imports	Predicted	Residuals			
13.930	13.996	-0.066			
13.872	13.970	-0.098			
14.073	14.067	0.007			
14.074	14.071	0.004			
14.108	14.079	0.029			
14.001	13.960	0.041			
13.921	13.904	0.017			
13.978	13.902	0.076			
13.912	13.836	0.075			
13.851	13.902	-0.051			
13.856	13.897	-0.041			
13.824	13.832	-0.008			
13.697	13.648	0.049			
13.566	13.550	0.016			
13.338	13.389	-0.051			

(6) Own price elasticity and cross price elasticity of demand for foreign cotton in AO countries.

Two specifications were estimated in order to get the minimum and maximum in the uniform distribution.

$$IM^{F}_{AO} = IM^{F}_{AO}(PC, PO, Lag\ (CP/\ DC))$$

$$IM^{F}_{AO} = IM^{F}_{AO}(PC, PO, DC)$$

where PC, PO, CP and DC are defined the same as before. Take natural logarithm (ln) of both sides of the above equations, it gives

(1) $\ln (IM^{F}_{AO}) = \mu_0 + \mu_1 \ln (PC) + \mu_2 \ln (PO) + \mu_3 \ln (\text{Lag}(CP/DC)) + \epsilon$

(2) $\ln (IM^{F}_{AO}) = \mu'_0 + \mu'_1 \ln (PC) + \mu'_2 \ln (PO) + \mu'_3 \ln (DC) + \epsilon$

where μ_1 and μ'_1 are the upper and lower level used to form a uniform distribution for cross price elasticity of demand for foreign cotton; μ_2 and μ'_2 are the lower and upper level used to form a uniform distribution for own price elasticity of demand for foreign cotton in AO countries (Table C-9 and C-10).

Table C-9. Price Elasticity of Demand for Imports of Foreign Cotton in AO (1)

OLS Regression Statistics for Imports, 10/9/04 1:37:35 PM					
F-test	7.644	Prob(F)	0.006	Unrestricted Model	
$MSE^{1/2}$	0.126	CV Regr	0.892	F-test	7.644
R^2	0.696	Durbin-Watson	1.102	R^2	0.696
$RBar^2$	0.605	Rho	0.423	$RBar^2$	0.605
Akaike Information Cr	-4.049	Goldfeld-Quandt	0.210	Akaike Information Cr	-4.049
Schwarz Information	-3.912			Schwarz Information	-3.912
95%	Intercept	Lag CP/DC	PC	PO	
Beta	**13.770**	-0.852	1.200	**-1.737**	
S.E.	0.119	0.354	0.527	0.585	
t-test	116.045	-2.404	2.280	-2.968	
Prob(t)	0.000	0.040	0.049	0.016	
Elasticity at Mean		0.020	-0.042	0.050	
Variance Inflation Factor		1.158	14.610	14.272	
Partial Correlation		-0.605	0.585	-0.684	
Semipartial Correlation		-0.418976548	0.39728	-0.517114503	
Restriction					
S.D. Resids	0.10658	MAPE	0.66272		
Actual Imports	Predicted	Residuals			
13.780	#N/A	#N/A			
13.933	13.844	0.089			
13.990	14.037	-0.047			
14.003	14.123	-0.120			
14.040	14.258	-0.218			
13.953	14.138	-0.185			
14.122	14.028	0.094			
14.131	14.042	0.089			
13.932	13.973	-0.041			
14.406	14.312	0.094			
14.449	14.397	0.051			
14.416	14.313	0.103			
14.375	14.329	0.046			
14.345	14.255	0.090			
14.295	14.340	-0.045			

Table C-10. **Price Elasticity of Demand for Imports of Foreign Cotton in AO (2)**

OLS Regression Statistics for Imports, 7/29/04 2:19:28 PM					
F-test	25.587	Prob(F)	0.000	Unrestricted Model	
MSE$^{1/2}$	0.087	CV Regr	0.616	F-test	25.587
R^2	0.875	Durbin-Watson	1.601	R^2	0.875
RBar^2	0.840	Rho	0.189	RBar^2	0.840
Akaike Information Cr	-4.791	Goldfeld-Quandt	1.232	Akaike Information Cr	-4.791
Schwarz Information	-4.649			Schwarz Information	-4.649
95%	Intercept	PC	PO	Dom. Cons.	
Beta	-2.628	**0.990**	**-1.326**	**1.074**	
S.E.	3.207	0.339	0.393	0.207	
t-test	-0.819	2.925	-3.376	5.177	
Prob(t)	0.432	0.015	0.007	0.000	
Elasticity at Mean		-0.035	0.038	1.183	
Variance Inflation Factor		12.691	13.819	1.455	
Partial Correlation		0.661	-0.713	0.842	
Semipartial Correlation		0.312203002	-0.36037	0.552626383	
Restriction					
S.D. Resids	0.07461	MAPE	0.46614		
Actual Imports	Predicted	Residuals			
13.780	13.748	0.033			
13.933	13.824	0.109			
13.990	13.941	0.049			
14.003	14.106	-0.103			
14.040	14.139	-0.099			
13.953	14.016	-0.063			
14.122	14.068	0.054			
14.131	14.187	-0.056			
13.932	14.070	-0.138			
14.406	14.303	0.104			
14.449	14.399	0.050			
14.416	14.388	0.028			
14.375	14.316	0.060			
14.345	14.337	0.008			
14.295	14.330	-0.034			

(7) Own price elasticity and cross price elasticity of demand for foreign cotton in country

h, the cotton importer without textiles and apparel exports.

The imports of foreign cotton in country h is specified as

$$IM^F_h = IM^F_h (PC, PO, Pop)$$

where PC, PO and Pop are the same as defined before. Take natural logarithm (ln) of both sides of the above equation, it gives

$$\ln (IM^{F}_{h}) = \xi_0 + \xi_1 \ln (PC) + \xi_2 \ln (PO) + \xi_3 \ln (Pop) + \epsilon,$$

where ξ_1 is the cross price elasticity of demand for foreign cotton and ξ_2 is the own price elasticity of demand for foreign cotton. To form a uniform distribution for cross price elasticity, the lower level was taken from Shui's study, 0.796 and estimated ξ_1 is the lower level of cross price elasticity. To form a uniform distribution for own price elasticity, the upper level used is the value in Shui's study, -0.959 and the estimated ξ_2 is the upper level (Table C-11).

Table C-11. Price Elasticity of Demand for Imports of Foreign Cotton in Country h

OLS Regression Statistics for Imports, 10/9/04 2:11:21 PM					
F-test	14.185	Prob(F)	0.000	Unrestricted Model	
$MSE^{1/2}$	0.155	CV Regr	1.099	F-test	14.185
R^2	0.795	Durbin-Watson	1.513	R^2	0.795
$RBar^2$	0.739	Rho	0.214	$RBar^2$	0.739
Akaike Information Cr	-3.640	Goldfeld-Quandt	1.449	Akaike Information Cr	-3.640
Schwarz Information	-3.499			Schwarz Information	-3.499
95%	Intercept	PC	PO	Population	
Beta	**56.761**	0.758	-0.846	**-2.060**	
S.E.	7.529	0.644	0.759	0.365	
t-test	7.539	1.177	-1.113	-5.643	
Prob(t)	0.000	0.267	0.292	0.000	
Elasticity at Mean		-0.027	0.024	-3.026	
Variance Inflation Factor		14.540	16.353	1.516	
Partial Correlation		0.334	-0.318	-0.862	
Semipartial Correlation		0.160772206	-0.15215	-0.771067255	
Restriction					
S.D. Resids	0.13263	MAPE	0.76098		
Actual Imports	Predicted	Residuals			
14.654	14.586	0.068			
14.521	14.561	-0.040			
14.365	14.571	-0.206			
14.309	14.144	0.165			
14.413	14.112	0.301			
14.148	14.028	0.120			
13.992	14.014	-0.022			
14.066	14.019	0.047			
14.013	13.922	0.090			
13.852	14.032	-0.180			
14.008	13.994	0.014			
13.830	13.952	-0.123			
13.770	13.825	-0.054			
13.739	13.780	-0.042			
13.670	13.810	-0.140			

(8) Forecast the U.S. cotton price using time series analysis.

Twenty-nine data observation used covered from the period of 1975–2003 (collected from the U.S. National Cotton Council). One difference and two lags, after performing Dicker Fuller test and Auto correlation test, were used in the time series analysis for projection. The U.S. cotton price was projected for seven years, from 2004-2010. The results and figure of historical and predicted prices are listed below (Table C-12).

Table C-12. Forecast Results for U.S. Cotton Price

AR Series Analysis Results for 2 Lags & 1 Difference, 8/19/04 11:51:22 AM						
	Constant	PCL1	PCL2			
PC	-0.001	-0.140	-0.318			
S.E. of Coefficients						
PC	0.023	0.198	0.200			
Restriction Matrix						
PC	1	1	1			
Differences	1					
Characteristics	Dickey-Fuller	Aug. Dickey-Fuller	Schwarz	S.D. Residuals	MAPE	AIC
PC	-5.710	-4.720	-1.864	0.10868906	15.78	-4.21
Forecast	Impulse Response	Auto-Correlation	t-Statistic (AutoCorr.)	Partial AutoCorrelation	t-Statistic (Part.AutoCorr.)	Period
0.549	1.000	-0.127689125	-0.6756673	-0.127689125	-0.67566734	1
0.513	-0.139	-0.258833012	-1.3478164	-0.279697862	-1.480021971	2
0.538	-0.298	-0.103006687	-0.5046425	-0.199633038	-1.056358743	3
0.545	0.085	0.140661477	0.6829346	0.013495138	0.07140956	4
0.535	0.083	-0.030278733	-0.144619	-0.092755312	-0.490814974	5
0.533	-0.039	-0.194944136	-0.9304086	-0.222851307	-1.179218276	6
0.536	-0.021	0.088547716	0.4101218	-0.00205512	-0.010874671	7
PC Pred	PC Resid	PC Resid/Pred	Observation			
0.511	0.105	0.206	4			
0.660	0.055	0.083	5			
0.672	0.158	0.235	6			
0.781	-0.177	-0.226	7			
0.599	0.032	0.054	8			
0.698	0.033	0.048	9			
0.708	-0.103	-0.145	10			
0.590	0.010	0.017	11			
0.640	-0.108	-0.169	12			
0.542	0.089	0.165	13			
0.638	-0.062	-0.096	14			
0.552	0.146	0.265	15			
0.697	0.051	0.073	16			
0.702	-0.135	-0.192	17			
0.575	-0.034	-0.059	18			
0.601	0.060	0.100	19			

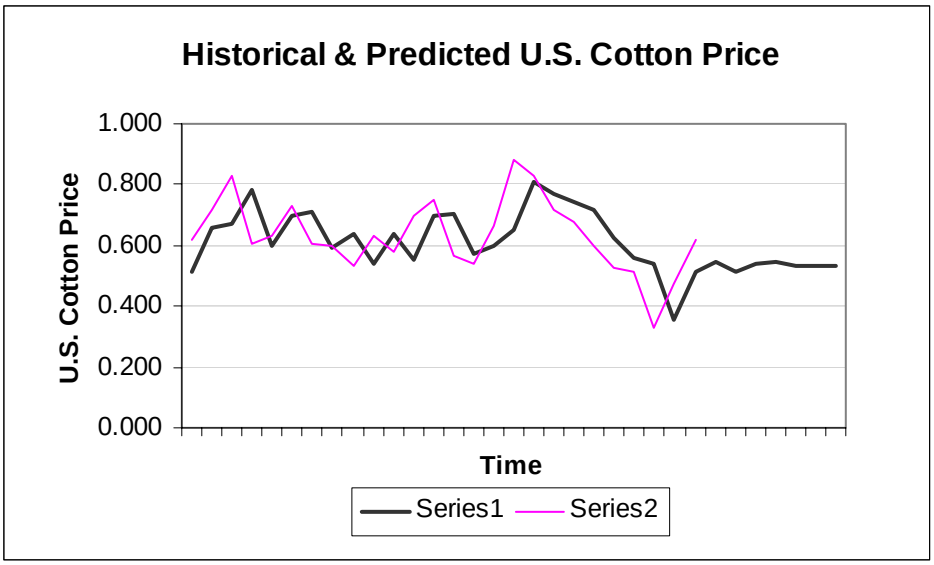

Figure C-1. Historical & predicted U.S. cotton price

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Experience and Relevant Skills

- *Research Experiences*
  -- Develop the equilibrium displacement model for the Impact of Removing the Multi-Fiber Arrangement on Textile and Cotton Trade of the United States and P.R.China.
  -- Assist in the project of The Potential Impact of Country-of-Origin Labeling in Texas by collecting data from various resources and processing data for further analysis.
  -- Updating the data for Mexican cotton industry and reporting on the industry status.
- *Econometric Capability*
  -- Ability to model international economic issues, estimate different elasticities associated with it, and develop econometric analysis. Proficiency in interpreting and presenting econometric results with Excel, PowerPoint and Harvard Graphics.
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