COMPETITION OR COOPERATION? A STUDY OF THE RELATIONSHIP BETWEEN IMPORT PENETRATION AND THE OPERATION OF THE U.S. TEXTILE AND APPAREL INDUSTRIES FROM 2002 TO 2008

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Professor Kitty Dickerson, Committee Chair

Professor Douglas Miller

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Professor Pamela Norum

To mom and dad

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COMPETITION OR COOPERATION? A STUDY OF THE RELATIONSHIP BETWEEN IMPORT PENETRATION AND THE OPERATION OF THE U.S. TEXTILE AND APPAREL INDUSTRIES FROM 2002 TO 2008

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ABSTRACT

In response to rising imports and globalization, the U.S. textile and apparel industries respectively adopted various restructuring strategies in recent years which fundamentally changed the way the two industries operate and imply their shifting relationship with imports. This study conducted panel data model based on government official trade and industry data ranging from 2002 to 2008 at 4-digit North American Industrial Classification System (NAICS) code level to empirically test the relationship between import penetration and the operation of the U.S. textile and apparel industries.

Results from the random effect model suggests that overall the U.S. textile industry formed a weak cooperative relationship with import penetration level in the U.S. market, while fixed effect model suggests an overall neutral relationship between the U.S. apparel industry and the level of imports in the U.S. market.

Findings of this study are of great value to understand the global nature of today's U.S. textile and apparel industries under substantial structural changes. This study is also with important implications to the appropriate making of U.S. trade and industrial policies affecting the two industries.

CHAPTER 1

INTRODUCTION

Significance of the study

The textile and apparel industry is a thick textbook study far beyond fiber, yarn, fabric and clothing. It is THE industry that triggered the first Industrial Revolution, among those sectors that embraced globalization early and still plays a critical role in the global economy with cross-cutting economic, social and political influences in the 21st century (Dickerson, 1999; Gereffi, 1999; Dicken, 2003).

First, the textile and apparel industry is one of the few sectors that have a true "global presence." Textiles and apparel are produced in nearly all countries around the world, although in extremely diversified conditions. Despite of the advancement of technology and achievement of automation in production, millions of people remain directly employed in the textile and apparel industries today, a good proportion of whom are females living in poor rural areas (Dickerson, 1999; Dicken, 2003). Additionally, in contrast to the large number of "participants in the game" with disparity in competiveness, 80% of the world textile and apparel import market is disproportionally concentrated in the United States, European Union and Japan (Cattaneo, Gereffi & Staritz, 2009; WTO, 2010). This unbalanced market structure causes special problem of production overcapacity and intensive competition for world textile and apparel industries.

Second, the textile and apparel industry matters for both developing and developed countries. For some developing countries, the textile and apparel sector accounts for 60%--90% of their total merchandise exports and provides one of the very few opportunities for local economic development (WTO, 2010). For populous nations such as China, the well-being of its textile and apparel sector even contributes to the social stability which is regarded as a prioritized national security issue (Lu, 2009). For developed countries, textile and apparel sector not only remains as one of the largest job creators (OTEXA, 2010c), but also closely links with people's daily lives. As one typical example, it is estimated that each year textile and apparel imports help U.S. consumers save billions of dollars which greatly improve Americans' living standard than otherwise would be (Griswold, 2009).

Third, because of the social and economic significance, the textile and apparel industry often raises heated political and policy debates. Interestingly enough, despite its global nature, textile and apparel might be the only sector other than agriculture that is so heavily regulated by trade policies (Dickerson, 1999). Almost all critical bilateral, regional and multilateral trade policy debates nowadays are closely related to the textile and apparel industry, no matter for trade remedy measures, free-trade agreement (FTA), WTO Doha Round negotiation (or DDA), labor standards, corporate social responsibility practices, customs border measures, trade adjustment assistance (TAA) program, climate change or carbon tariffs. Moreover, a special quota system was solely placed on world textile and apparel trade and quantitatively restricted normal trade activities for as long as forty years!

Last but not least, changes and innovations are found throughout the history of textile and apparel industry. The traditional industry lifecycle theory generally divides evolution process of the textile complex into several stages, each of which is featured by distinct patterns of production and trade (Toney, 1984; Dickerson, 1999; Kilduff, 2005). The dynamic nature of the textile and apparel industry is driven both by the application of new technologies and the business entrepreneurship which leads to the creation of many new business models that previously did not exist. In recent decades, this has included the emergence of global fragmented production, quick response (QR), agile production, regional production-trade network and various models for global supply chain governance, which altogether significantly shift the way the textile and apparel industry operates in a much more integrated global economy compared to the past (Gereffi,2001; Dicken, 2003).

It is against such background that this study focuses on the restructuring of the U.S. textile and apparel industries in the globalized era from 2002 to 2008, with particular interests in exploring their respective relationships with imports after various restructuring strategies were adopted. Although the textile and apparel industry is specifically discussed, implications and relevance of this study can be extended to a much broader scope and linked with many critical questions facing today's global economy. For both scholars and policymakers, this study presents a unique case study to inspire new thinking on the impacts of global economic integration, the relationship between trade and development, the future of a declining traditional manufacturing sector in a high-wage developed economy, the adjustment of a country's industrial structure and incurred transition costs, the dynamics of the composition and upgrading of the global value chain (GVC), the choice between import substitution and export orientation strategy, as well as the long-time debate over trade protection and liberalization.

Research Background

Since 1960s, the United States has quickly become one of the largest importers of textile and apparel in the world (Dickerson, 1999; Curran, 2008). In 2009, U.S. textile and apparel imports totaled $17.90 billion and $63.10 billion respectively, which were up to nearly four times as much as the import volume in 1990 (WTO, 2008; OTEXA, 2010a). From a global perspective, in 2009 the United States absorbed 8.6% of the world textiles imports as well as 21.8% of the world apparel imports by value, both were second only to the European Union (WTO, 2010).

Concurrent with the quick increase of imports, the U.S. domestic textile and apparel industries suffered from steady reduction of output and great loss of employment, especially for those manufacturing-concentrated functions (Abernathy, Volpe, & Weil, 2006; Datta, Malhotra, & Russel, 2006). As examples, value added of the U.S. textile and apparel industries respectively declined from $23.3 billion and $24.9 billion in 1990 to $21.6 billion and $15.0 billion in 2007 (BEA, 2010a). Although around 1,728,000 employees still worked for the U.S. textile and apparel industries in 1990, this figure significantly shrank to 259,000 by the end of 2009 (Dickerson, 1999, p.265; BLS, 2010a). Understandably, imports were largely blamed for causing the difficult situation of the U.S. textile and apparel industries (NCTO, 2008). More specifically, the rising level of import penetration—the percentage of domestic apparent consumption supplied by imports (Morgan, 1988, p. 13), was often identified as the threatening and disruptive factor to the survival of the U.S. domestic textile and apparel firms (Krueger, 1996; Evans & Harrigan, 2004).

However, one important aspect of the story often overlooked is the dramatic restructuring process that has occurred in the U.S. textile and apparel industries in response to globalization (Dicken, 2003, p. 340). For example, U.S. apparel manufacturers have established solid business relationships with apparel exporting countries, either through cut-and-sew contracts, opening and owning plants, or full package sourcing (Abernathy et al., 2006). The U.S. textile industry has also formed closer ties with clients outside the U.S. border by taking full advantage of the regional trade packs such as the North America Free Trade Agreement (NAFTA) which encouraged countries that have geographic proximity such as Mexico and those in the Caribbean

Basin region to use U.S.-made yarns and fabrics so as to enjoy tariff-free apparel exports to the U.S. market (Dickerson,1999; Gereffi,1999). Therefore, the relationship between import penetration and the operation of the U.S. textile and apparel industries actually suggests a tremendous change in this globalized era characterized by fragmentation in production and new international division of labor (Graziani, 2001; Dicken, 2003). In particular, imports may no longer simply compete with the domestic operation of the U.S. textile and apparel industries, but rather have become one integral component of their whole supply chain.

Capturing the relationship between import penetration and the operation of the U.S. textile and apparel industries in the globalized era can be valuable both to academia and government policy making. For academia, this relationship is critical to the understanding of the global nature of today's textile and apparel industries, particularly as to how the adoption of various restructuring strategies fundamentally transformed the way the industry functions in more developed economies. If a non-competing relationship different from the traditional views is suggested by the findings, it may call for rethinking on the conclusions of many existing trade theories built upon old paradigms when globalization was far less influential in depth and in breadth. On the other hand, for policymakers, such relationship matters to the appropriateness of trade and industrial policies which intend to create a favored environment for the development of the U.S. domestic textiles and apparel industry. In particular, trade restrictions stemmed from the grave concerns about the negative impacts of import penetration and these have dominated U.S. textile and trade policy for decades. History of the world textile and apparel trade is also associated with the creation and implementation of various policy tools with the purpose of trade restriction (Dickerson, 1999). However, if imports no longer pose a threat to the survival of the domestic industry, but rather they two become "partners," then a significant shift in the direction of policy might be needed.

Gaps in the Current Research

Fruitful studies have been conducted on the patterns and shift of the U.S. textile and apparel imports. Popular research topics include the shifting import sources (such as USITC, 2004; Nordas, 2004; Gelb, 2007; Zhang & Hathcote, 2008), the impacts of the elimination of the global quota system on trade flows (such as Nordas , 2004; Mayer, 2004; ITCB, 2008; Harrigan & Barrows, 2009), regional trade patterns under the preferential trade agreements (such as Bonacich, 1994; Chomo, Hall, & USITC, 2002; Bair, 2002; Lu & Jung, 2009) as well as the impacts of various trade policies (such as Joseph, 1983; Fox, Powers & Winston, 2007; USITC, 2009). However, the majority of these studies had focus on exploring and describing the trade patterns only, but seldom connected trade activities with industry performance in the United States.

Some other studies discussed the various restructuring strategies adopted by the U.S. domestic textile and apparel industries and how these strategies significantly shifted the functions and business models of firms (such as Gereffi, 2001; Christoffersen & Datta, 2004; Kilduff, 2005; Datta, Malhotra & Russel, 2006; Parrish, Cassill & Oxenham, 2006a; Parrish, Cassill & Oxenham, 2006b). However, imports in most cases were still treated as an exogenous factor shaping the business environment of the U.S. textile and apparel industries. Few studies have been conducted to systematically evaluate the impacts of offshore production and outsourcing on the overall performance of the U.S. textile and apparel industries, especially at the macro industry level.

A number of studies empirically tested how rising imports affect the performance of the U.S. domestic textile and apparel industries (e.g. Sinnott, 1990; Revenga, 1992; Shippen, 1995; Conway, 2009). Despite of the variation in the choice of estimation methods and model specifications, variables normally used in these studies usually include employment, wage level and price effects. However, given the adoption of restructuring strategies and shift of industry priorities, even the combination of the above factors might still be insufficient to comprehensively reveal the conditions of today's U.S. textile and apparel industries. Moreover, findings of these studies were mostly drawn from the trade and industry data earlier than 2005 when the global quota system was still in place. As the quota system significantly distorted normal trade activities (Dickerson, 1999; Dicken, 2003) and several new trade patterns have already emerged in the post-quota era (Nordas, 2004; Forstater, 2009), new studies on the basis of updated data are needed to objectively evaluate the relationship between imports and the operation of the U.S. textile and apparel industries in the "normal" trade environment.

Research Questions

This paper tries to fulfill the current research gaps by linking the level of import penetration with the operation of the U.S. textile and apparel industries in the globalized era between 2002 to 2008. In specific, two research questions will be studied:

1. By adopting the various industry restructuring strategies, do the U.S. domestic textile and apparel industries respectively incorporate imports into their operations?
2. Is the rising import penetration level still positively associated with the decline of the domestic U.S. textile and apparel industries after various industry restructuring strategies were adopted?

To be noted, the level of import penetration shall not be simply treated as the volume of imports. This is because the level of import penetration is determined jointly by the import volume and the size of the apparent consumption in the importing country (Morgan, 1988, p. 13; Dickerson, 1999, p.298). Thus, compared to the volume of imports, the import penetration level can more accurately reflect the role of imports in fulfilling the market demand in relation to the domestic supply in the importing nation.

Research Objectives

Research objectives of this study include:

1. To capture the status of imports, import penetration and the operation of the U.S. textile and apparel industries in an integrated global economy.
2. To identify the restructuring strategies respectively adopted by the U.S. textile and apparel industries in response to globalization.
3. To explore the role of imports in the operation of the U.S. textile and apparel industries after the adoption of the various restructuring strategies.
4. To empirically evaluate the relationship between the import penetration level with the operation of the U.S. textile and apparel industries in an integrated global economy from 2002-2008.

Definition of Terms in the Study

Import penetration. Import penetration usually is measured by the import penetration ratio (IPR) which equals the percentage of imports within the domestic apparent consumption.

As domestic apparent consumption is measured by the sum of domestic production and volume of imports (Morgan, 1988, p. 13; Dickerson, 1999, p. 298), thus IPR reflects the comparative status of imports in fulfilling the market demand in importing countries in relation to the supply of domestic-made products.

Textile industry. Typically refers to the industry segment that manufactures fibers, yarns and select finished products (Dickerson, 1999, p.19). However, except for otherwise noted, the scope of the textile industry in this study is defined as the activities of textile mills covered by the North American Industry Classification System (NAICS) code 313, which refers to the production of fibers, yarns, threads and fabrics (Census, 2011b). Although NAICS code 314 (textile product mills) by Dickerson's (1999) definition is also part of the textile industry, its outputs are finished textile products heterogeneous in nature with fibers, yarns and fabrics mostly used as intermediaries (Census, 2011b). Thus, to avoid distraction on the research findings, NAICS 314 is excluded from the scope of "textile industry" in this study.

Apparel industry. Typically refers to the industry segment that manufactures garments and accessories. For this study, the scope of the apparel industry is defined as the activities of the apparel manufacturing mills covered by the NAICS code 315, which refers to the manufacturing of apparel and accessories both through cutting and sewing and knitting (Census, 2011b).

CHAPTER 2

LITERATURE REVIEW

Import Competition: Theoretical Views

A good proportion of studies referred to the difficult time faced by the U.S. textile and apparel industries over the past decades as the direct results of the intensive competition from rising imports (Christoffersen & Datta, 2004). The often-mentioned sufferings include declined output, job losses and wage cuts (Hodges & Karpova, 2006; NCTO, 2008; AMTAC, 2008). Classic trade models are helpful in explaining why the U.S. textile and apparel industries appeared to be negatively affected by rising imports, especially those cheap ones produced in the low-wage developing countries.

1. Heckscher-Ohlin Model

According to the Hecksher-Ohlin model (H-O model) built upon the David Ricardo's famous comparative advantage theory, countries usually export product for which it has abundant factors of production and import product for which it has scarce factors (Batra & Casas, 1973). Assuming in a two countries two products and two production factors (2×2×2) scenario, the United States and one lower-income developing country both produce the same machine (M) and apparel (A) with inputs of capital (K) and labor (L) by using the same technology. In both the two countries, the production of machine is comparatively more capital intensive than apparel (i.e. K/L of machine is larger than K/L of apparel). At the same time, due to the different stages of economic development, capital is a relatively abundant factor with labor, a relatively scare factor in the United States, while the situation in the developing country is the opposite. As illustrated in Figure 1, the production frontier of the United States takes a flatter shape than the developing country, because based on the assumption the United States is able to produce more capital-intensive machines compared to apparel. Without trade (i.e. autarky), the United States produces at point C and the developing country produces at point B where the indifference curve is tangent to the production frontiers. Since $P_C > P_B$ [1], the United States has a comparative advantage in producing machines and the developing country is more efficient in producing apparel. With trade, the United States specializes in producing machines and exchanges machines for apparel. The developing country does the opposite. The equilibrium achieves at point E where P_A/P_M equals the same in both countries. The indifference curve II where E reaches is further away from the origin O than the indifference curve I for point C and B, indicating that both the United States and the developing country benefit from this trade pattern on the basis of respective comparative advantage.

Despite the overall welfare gains in both the United States and the developing country, the H-O model also suggested the different sectoral impacts because of trade, especially the "unfavorable" consequences for import-competing industries. Consider the apparel industry in the United States for example. Compared to the autarky situation, international trade first lowered the relative price of apparel in the U.S. market as $P_{C'} < P_C$. Second, the output corresponding to point C' is smaller than the level corresponding to point C, meaning the U.S. apparel production also declined because of trade. These phenomena echo the often-heard complaints made by the U.S. textile industry, claiming that imports suppressed domestic production and product price (NCTO, 2008).

[1] $P=P_A/P_M$, i.e. the comparative price of apparel and machine

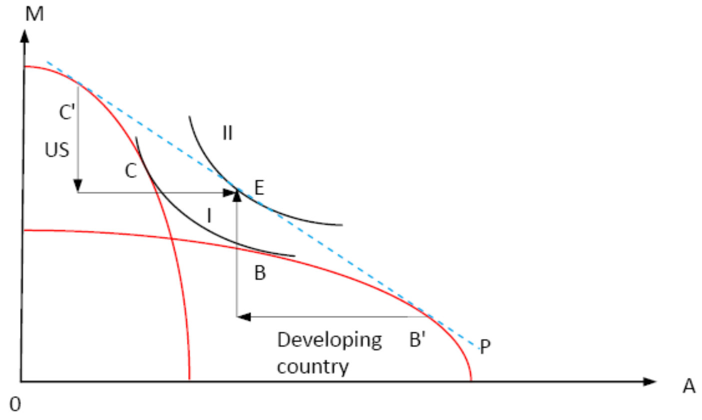

Figure 2-1 Heckscher-Ohlin Trade Model

Source: Salvatore (2004), pp.128

2. Factor-price Equalization theorem (H-O-S model)

Built upon the H-O model, Paul Samuelson developed the factor-price equalization theorem (H-O-S model) which extended the trade impacts analysis from product market to factor market (Samuelson, 1949). According to the H-O-S model, international trade will not only equalize the relative price of trading goods in countries participating in international trade, but also will equalize the factor price in these countries both in relative and absolute terms (Salvatore, 2004). This conclusion suggests that international trade will bring unequal returns to different production factors, depending on their relative intensity in production and endowment to the trading nation (Maneschi, 1998; Baldwin, 2008).

Conclusions of the H-O-S model are helpful to explain the impacts of trade on the wage level in the U.S. textile and apparel industries. Continuing with the case illustrated in Figure 2-1. Suppose both in the United States and the developing country; the production of one unit apparel requires a_1 and b_1 amount of labor and capital input. Similarity, the production of one unit of machine requires input of a_2 and b_2 amount of labor and capital. As technology is assumed without change, thus a_1, a_2, b_1 and b_2 remain constant. Furthermore, as the machine is capital intensive in nature and apparel is comparatively labor intensive, so that $a_1 / b_1 > a_2 / b_2$ (or $a_1 / a_2 > b_1 / b_2$). In addition, w stands for the wage level and r stands for the rent level. Thus, we have:

$$P_A = wa_1 + rb_1 \quad (2.1)$$

$$P_M = wa_2 + rb_2 \quad (2.2)$$

Equation (2.1) and (2.2) express how the prices of apparel and machines in the market are determined on the basis of their cost structure. Rearrange equation 2.1 and 2.2 to express w and r in the functions of other variables, we have:

$$w = \frac{b_2 P_A - b_1 P_M}{a_1 b_2 - a_2 b_1} \quad (2.3)$$

$$r = \frac{a_1 P_M - a_2 P_A}{a_1 b_2 - a_2 b_1} \quad (2.4)$$

Divide equation (2.3) by (2.4) and rearrange, we have:

$$w / r = (b_2 / a_2) \frac{[(P_A / P_M) - (b_1 / b_2)]}{[(a_1 / a_2) - (P_A / P_M)]} \quad (2.5)$$

By definition, the value of w / r and b_2 / a_2 shall always be positive, so that the denominator and the numerator in equation (2.5) shall both either be positive or negative. However, to be consistent with the above assumption that machine manufacturing is relatively more capital intensive than the production of apparel, thus $a_1 / a_2 > P_A / P_M > b_1 / b_2$ is the only valid possibility.

As shown in Figure 2-1, because of trade, P_A / P_M which measures the relative price of machines and apparel in both the United States and the developing country will finally equalize at the equilibrium point E. Based on the equation (2.5), this means that trade will further equalize the relative price of labor and capital measured by w/r in the United States and the developing country. In particular, this is a process of declining wage level in the United States. Moreover, we can derive equation (2.3) and equation (2.4) into:

$$w/P_A = [b_2/(a_1b_2 - a_2b_1)][1-(b_1/b_2)(P_M/P_A)] \quad (2.6)$$

$$r/P_A = [a_2/(a_1b_2 - a_2b_1)][(a_1/a_2)(P_M/P_A)-1] \quad (2.7)$$

Equation (2.6) and (2.7) imply that when the value of P_A/P_M equalizes, so it will be the real wage level and rent level in the two trading nations. In particular, since P_A/P_M decreases in the United States after international trade, the U.S. apparel industry suffered from declined wage levels in absolute term measured by w/P_A.

3. Specific-factor Model

Both the H-O and H-O-S theories assume free mobility of production factors across different industry sectors, a phenomenon which, however, is not always valid in the real world (Minabe, 1974; Goldberg & Klein, 1999). To overcome the shortcoming, the specific factor model developed by Jacob Viner assumes immobility of some factors due to their specificity to a certain sector, at least in the short run. The specific-factor model argues that trade will benefit the immobile factor specific to the nation’s export-oriented industry while negatively affecting the immobile factor specific to the nation’s import-competing industry (Deardorff, 1994; Jacob Viner, 1999; Salvatore, 2004). To illustrate, as shown in Figure 2-2, the horizontal axis represents the total labor supply in the United States which is assumed mobile between the machine industry and the apparel industry. The vertical axis on the left and right respectively measure the wage level for the machine and the apparel industry. The wage level equals the value of the marginal product of labor (VMPL), for which:

$$VMPL_A = P_A \times \frac{\partial F(K,L)}{\partial L} \quad (2.8)$$

$$VMPL_M = P_M \times \frac{\partial F'(K,L)}{\partial L} \quad (2.9)$$

where $MP_A = \frac{\partial F(K,L)}{\partial L}$ and $MP_M = \frac{\partial F'(K,L)}{\partial L}$, respectively measuring the marginal output of machine and apparel given one more unit input of labor. $VMPL_A$ and $VMPL_M$ are downward sloping because of the law of diminishing marginal return (Savatore, 2004).

In Figure 2-2, the no-trade equilibrium is at point E. As shown above, trade will raise P_M because of the specialization of production. Suppose the change equals ΔM, then the line $VMPL_M$ will move up to $VMPL_{M'}$ with new equilibrium at point E'. Trade results in different returns to labor and capital in the production of machine and apparel in the United States. For the export-oriented machine industry, the nominal wage level increased by ΔW, which attracted a total DD' amount of labor shift from apparel industry to machine industry to reach. With fixed amount of capital used, K/L ratio in the machine industry declined but leads to the rise of $\frac{\partial F'(K,L)}{\partial K}$. As $VMPK_M = P_M \times \frac{\partial F'(K,L)}{\partial K}$, return to capital in the machine industry also increases in consequence. For the apparel industry, the nominal wage level also increases by ΔW. As more labor shifted to machine production, K/L increases and results in lower return to capital used in the apparel industry, i.e. $VMPK_A = P_A \times \frac{\partial F'(K,L)}{\partial K}$ declined. Overall, the specific-factor model suggested that the import-competing apparel industry will be negatively affected by trade, reflected by the shrinkage of labor and the lower return of specific-factor.

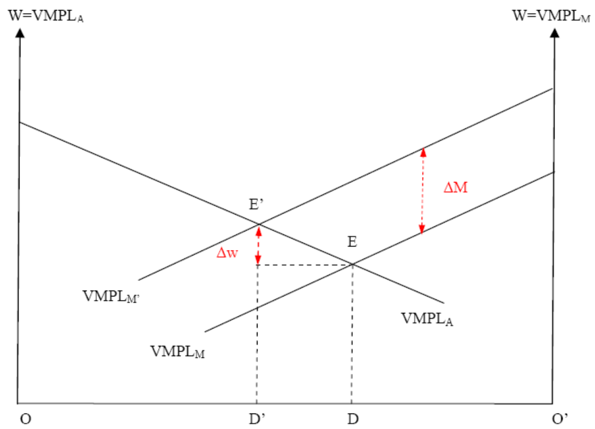

Figure 2-2 Specific Factor Model

Source: Salvatore (2004), p.155

4. Rybczynski Theorem

H-O model, H-O-S model and factor-specific model all assume unchanged factor endowment in a country over time. However, statistics showed that, fixed assets owned by U.S. businesses in all industries totaled $48,499 billion in 2009, an increase of 15% from $30,146 billion in 2000 (BEA, 2010b); during the same period, the total U.S. employment across all sectors slightly declined from 132.48 million to 129.5 million (BLS, 2010a).[1] This phenomenon suggests that factor endowment in a country is dynamic rather than static. The Rybczynski theorem thus was developed, focusing on explaining the impacts of trade on factor returns when different factors in a country change disproportionally (Salvatore, 2004; Krugman, 2008). According to the Rybczynski theorem, holding the price of trading goods constant, the increase of one production factor will result in disproportionally more production of the product intensively using that production factor (Deardorff, 1994; Krugman, 2005).

[1] However, it is important to realize that economy cycle may also affect the endowment of production factors.

Figure 2-3 briefly illustrates the case when the capital availability increases but labor supply remains constant in the United States. The upper graph shows the Edgeworth box diagram, in which the horizontal axis denotes the total supply of labor and the vertical axis represents the total supply of capital. When a point in the Edgeworth box is farther away from O_A horizontally and farther away from O_M vertically, more labor and capital are used in apparel production respectively. Trade equilibrium is at point A which corresponds to the point A on the production frontier I in the lower graph of Figure 2-3.

Since capital supply increases and the supply of labor remains unchanged, the Edgeworth Box expands from the triangular shaped by O_AO_M to $O_AO_{M'}$ and the production frontier shifts from I to II. The new equilibrium is at point B, which has the same K/L ratio as point A in the Edgeworth Box as well as the same $-P_A / P_M$ as point A in the production frontier graph. However, compared to A, at point B the output of apparel declined from A_1 to A_2 and the amount of labor used in apparel production also declined from L_1 to L_2. The reason why the growth of capital in the United States will result in disproportional reduction of labor-intensive apparel production can be further demonstrated as below:

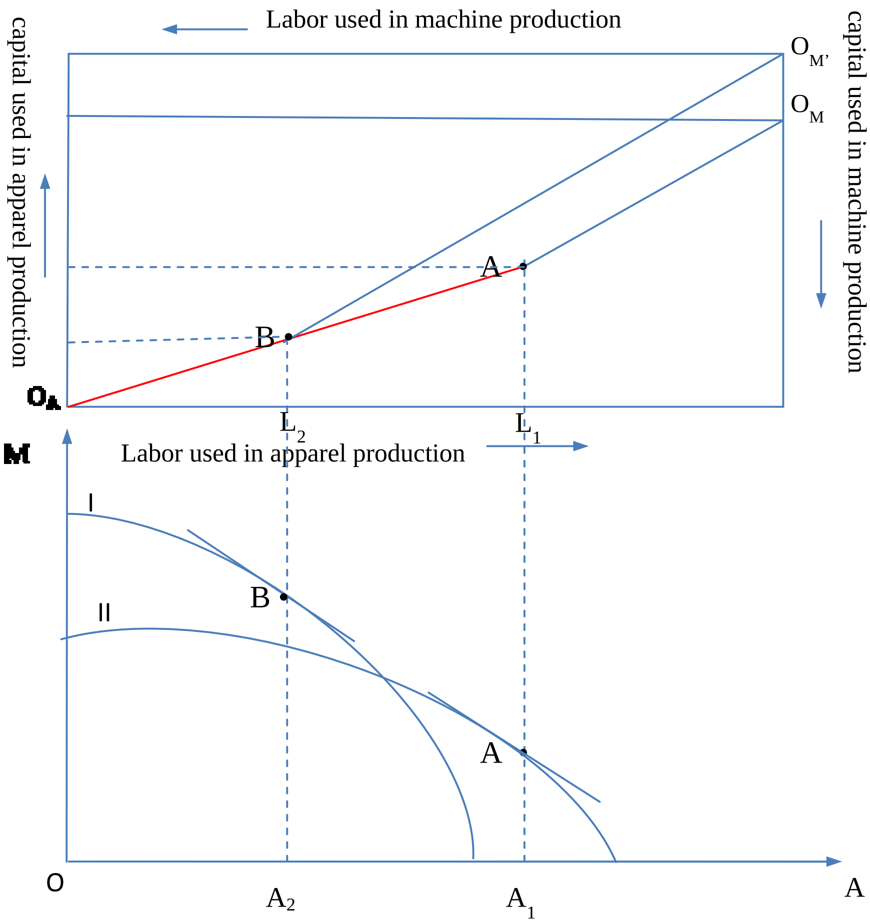

Figure 2-3 Rybczynski Theorem

Source: (Salvatore, 2004, pp.227: Krugman, 2005, pp.253)

Assume within the total K amount of capital in the United States, K_A is used for the production of apparel and K_M for machine. a_1 and a_2 respectively denote the amount of capital used in the production of one unit of apparel and machine. With the output of apparel and machines totaled A and M, we have equation (2.10). As capital grows by ΔK, we have equation (2.11), which can be further derived into equation (2.13). Left side of the equation (2.13) is negative because the growth of apparel output shall be much smaller than the total growth of capital, given the fact that capital is shared using by the apparel and machine production. $\frac{a_2 M}{K}$ is positive in value too, because it means the percentage of capital used in the machine production. Thus, to keep the right side positive in value, $(\Delta A/A)-(\Delta M/M)$ can only be negative, implying the output of apparel grows slower (or even declines) than the output of machines in the case.

$$K = K_A + K_M = a_1 A + a_2 M \quad (2.10)$$

$$\Delta K = a_1 \Delta A + a_2 \Delta M = a_1 A(\Delta A/A) + a_2 M(\Delta M/M) \quad (2.11)$$

$$\frac{\Delta K}{K} = \frac{a_1 A}{K}(\Delta A/A) + \frac{a_2 M}{K}(\Delta M/M) \quad (2.12)$$

$$\because \frac{a_1 A}{K} + \frac{a_2 M}{K} = 1$$

$$\therefore \Delta A/A - \Delta K/K = \Delta A/A - \frac{a_1 A}{K}(\Delta A/A) - \frac{a_2 M}{K}(\Delta M/M) = \frac{a_2 M}{K}(\Delta A/A) - \frac{a_2 M}{K}(\Delta M/M)$$

$$\therefore \Delta A/A - \Delta K/K = \frac{a_2 M}{K}[(\Delta A/A) - (\Delta M/M)] \quad (2.13)$$

5. Hicksian Technical Progress

In contrast to the previous trade theories, Hicksian technical progress theory relaxes the rigid constant technology assumption and explains how technical progress would affect factor returns in international trade. Hicks (1966) categorizes technical progress into three types: neutral, labor-saving and capital-saving, respectively referring to paralleled or disproportional increase of factor productivities. Among these three types of technical progress, labor-saving technical progress is closest to what happened in the U.S. textile and apparel industries given the wide adoption of labor-saving capitalization practices over the past decades (Gupta & Taher, 1984; Hong, 1993; Datta, A & Christoffersen, 2005). According to the Hicksian technical progress theory, labor-saving technical progress will lead to the substitution of labor by capital in production and finally lower the wage level relative to rent (Hicks, 1966; Findlay& Jones, 2000). Such tendency will be even greater in labor-intensive industries such as apparel production (Salvatore, 2004, pp230).

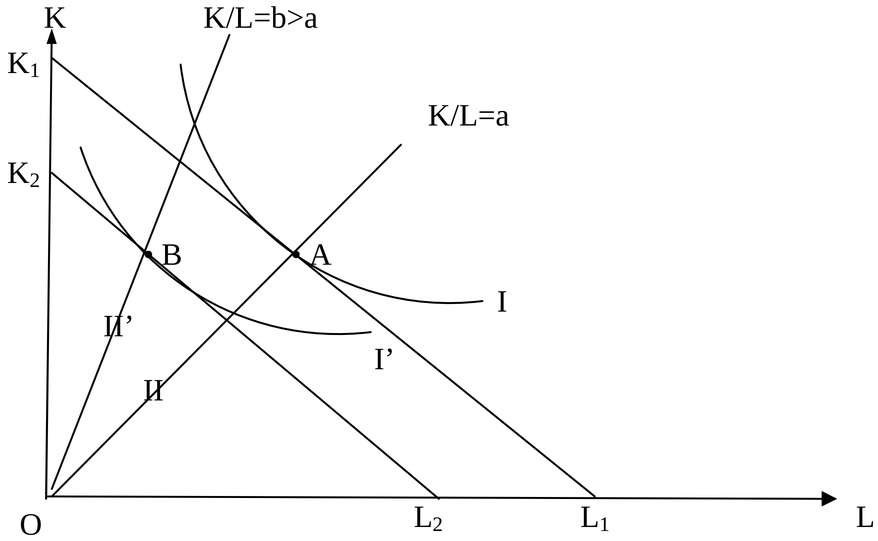

Figure 2-4 Hicksian Labor-saving Technical Progress

Source: Hicks (1966); Salvatore (2004), pp230

Figure 2-4 illustrates the Hicksian technical progress theory in a two-factor two-product model. In Figure 2-4, the horizontal axis and vertical axis respectively denote the labor and capital supply in the United States. The initial equilibrium of apparel production is at point A where isoquant curve I and isocost curve K_1L_1 intersect. Slopes of the isocost curve measures w/r. With the adoption of labor-saving technologies, the same amount of output now requires less production factor. Thus, isoquant curve moves to I' which has the same output level as curve I. The corresponding isocost curve to isoquant I' is K_1L_1. The new equilibrium is at point B where isoquant curve I' and isocost curve K_1L_1 intersect. Due to the labor-saving technical progress, K/L ratio of the expansion path II' which contains point B is higher than the path II which holds point A. This shift implies that less labor will be needed in the production of apparel, if apparel output remains the same.

To conclude, trade theories are helpful in accurately describing and predicting the relationship between rising imports and the operation of the U.S. domestic textile and apparel industries. As summarized in Table 2-1, most of the trade theories suggest that international trade based on the production specialization will exert negative impacts on the competing textile and apparel industries in the importing country, reflected by the reduction of output, employment decline and lower product price and wage level. However, conclusions of these theories are based on the rigid assumptions, including perfect competitive markets, identical domestic-made and imported products as well as no policy interventions. When either of these assumptions no longer holds which may be seen in the real world, the validity of these conclusions might be challenged more or less.

Table 2-1 Impacts of Import Competition from Labor-abundant Developing Countries on the Labor-intensive U.S. Apparel Industry: Summary of Theoretical Views

Theory	Assumptions	Impacts of Import Competition			
		Output	Employment	Product price	Wage
H-O model	*	decline	/	decline of relative price	/
H-O-S model	*	decline	decline	decline of relative price†	decline of relative wage
Specific-factor model	*, labor mobile and capital immobile in the short run	/	decline	decline of relative price	nominal wage increase
Rybczynski Theorem	*, capital grows faster than the supply of labor	decline	decline	/	/
Hicksian technical Progress theory	*, except for constant technical progress	/	decline	/	decline of relative wage

*: all the above theories are based on the 2×2×2 model, assuming the trade happens between the United States (capital abundant) and one developing country (labor abundant) on machine (capital intensive in production) and apparel (labor intensive in production). The products are identical in both countries adopting the identical technology with constant returns to scale.

†: The conclusion is based on equation (2.5), which assumes that machine manufacturing is relatively more capital intensive than the production of apparel, i.e. $a_1 / a_2 > P_A / P_M > b_1 / b_2$.

Import Penetration in the U.S. Textile and Apparel Industries

The United States is the second largest importer of textiles and apparel in the world (WTO, 2010). However, imports of textiles and apparel presented very different pictures over the past decades in the United States. In terms of textile products, patterns of imports vary among different product categories. For example, from 2000 to 2009, total U.S. imports of fiber, yarn and thread (NAICS 3131) declined by 49.4% in quantity and 38.7% in value with unit price of imports went up by 21.2%; imports of fabric (NAICS 3132) increased by 56.2% in quantity, but declined 29.0% in value with unit price down 54.6%; imports of fabric finishing and dying product (NAICS 3133) reduced by 63.9% in quantity, but increased 41.2% in value with unit price surged 291.1%. In comparison, apparel imports of all major categories keep steady growth in the United States from 2000 to 2009. Over that period, the United States imported 144.8% more knitted apparel (NAICS 3151) in value and 17.1% more in quantity as well as 59.4% more woven apparel (NAICS 3152) in value and 4.3% more in quantity. Unit price of knitted apparel and woven apparel imports respectively declined 34.9% and 10.9%. Moreover, during the same period, imports of apparel accessories (NAICS 3139) in the United States increased by 25.1% in quantity and up 22.5% in value, with unit price slightly down 2.0% (USITC, 2010). Detailed U.S. textile and apparel import statistics are presented in Table 2-2(A) and (B).

Table 2-2 (A) U.S. Imports of Textiles and Apparel from 2000 to 2009 (by quantity)

Unit: million kg

NAICS	2000	20001	2002	2003	2004	2005	2006	2007	2008	2009
3131	227.8	203.9	216.4	210.8	239.3	230.5	227.5	174.6	144.9	115.2
3132	192.6	212.1	273.8	288.0	313.1	330.4	317.2	309.0	302.2	300.9
3133	7.6	5.8	4.2	3.9	6.1	5.5	4.6	4.3	3.9	2.7
3151	63.9	64.1	79.3	93.6	124.2	128.6	137.6	147.9	150.3	156.4
3152	3212.6	3267.8	3494.1	3843.7	3988.0	4302.0	4418.4	4452.8	4169.0	3761.4
3159	208.6	212.3	226.5	353.9	279.1	287.5	282.8	289.9	285.9	260.9

Table 2-2 (B) U.S. Imports of Textile and Apparel from 2000 to 2009 (by value)

Unit: million USD

NAICS	2000	20001	2002	2003	2004	2005	2006	2007	2008	2009
3131	805	701	670	699	894	825	820	710	626	494
3132	5714	5150	5531	5402	5676	5765	5634	5760	5371	4055
3133	522	484	577	690	817	863	907	986	947	738
3151	946	919	1027	1085	1313	1362	1457	1519	1568	1509
3152	58417	57922	57687	61626	64870	68516	70916	72768	69813	60947
3159	3564	3587	3600	3788	4350	4596	4637	4675	4799	4366

Data source: USITC (2010)

Table 2-3 (A) Top Five Sources of U.S. Imports for Textiles (by value) Unit: %

Top 5 economies	Market Share	Change of Import Value		
	2009	2000-09	2008	2009
China	35.4	14.9	2.9	-13.7
India	10.7	6.1	2.6	-14.2
EU (27)	10.5	-3.9	-10.5	-30.7
Pakistan	7.5	4.3	-4.8	-11.4
Mexico	7.1	-1.5	-14.4	-8.7
Above 5	71.3	/	/	/

Table 2-3 (B) Top Five Sources of U.S. Imports for Apparel (by value) Unit: %

Top 5 economies	Market Share	Change of Import Value		
	2009	2000-09	2008	2009
China	39.1	13.6	0.2	-1.3
Vietnam	7.4	67.0	19.7	-3.5
Indonesia	5.8	6.6	1.2	-4.7
Mexico	5.0	-9.5	-10.4	-15.8
Bangladesh	5.0	5.1	11.3	-2.1
Above 5	62.2	/	/	/

Data source: WTO (2010)

As illustrated in Table 2-3(A) and (B), the majority of U.S. textile and apparel imports come from low-income or lower-middle income countries (World Bank, 2011) such as China, India, Pakistan and Vietnam where an abundant labor supply at much lower wages than the United States is available (Dickerson, 1999; USITC, 2004). In comparison, in 2009 top U.S. exports to the world include machinery, aircraft, vehicles, chemicals and pharmaceutical products, all of which are relatively more capital intensive in production than textile and apparel

(WTO, 2010). Such trade pattern is consistent with the conclusions of many trade theories, which predict the division of labor and production specialization between the capital-abundant countries like the United States and labor-abundant developing countries.

Moreover, although the U.S. textile industry has for years unswervingly called for restricting the flood of imports dominating the U.S. textile and apparel market (NCTO, 2010), data suggested that the status of import penetration in the U.S. textile and apparel industries could be different from public perception. Import penetration is typically measured by import penetration ratio (IPR) calculated by dividing imports by apparent consumption which equals the sum of import and domestic production (Morgan, 1988, p. 13; OTEXA, 2010b). Based on the formula, IPR reflects the extent to which the market demand is met by imported goods against domestic supply.

Table 2-4 Import Penetration Ratio in the U.S. Textile Industry from 2000 to 2008 Unit: %

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
By Gross output[1]	20.2	20.0	22.0	25.9	21.6	24.1	25.8	25.7	29.1
By Shipment[2]	11.9	12.2	13.0	13.7	15.3	15.0	15.9	17.1	17.9

Source: Census (2010c); U.S. International Trade Commission, USITC (2010); BEA (2010a)

[1] According to BEA (2011a), gross output consists of "sales, or receipts, and other operating income, plus commodity taxes and changes in inventories." The definition is the same for Table 2-5.
[2] According to Census (2011a), shipment refers to "the total value of all products produced and shipped by producers." The definition is the same for Table 2-5.

Table 2-5 Import Penetration Ratio in the U.S. Apparel Industry from 2000 to 2008 Unit: %

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
By Gross output	68.5	71.6	74.6	76.7	77.3	82.3	83.2	84.0	84.3
By Shipment	51.1	53.3	59.7	63.3	68.3	70.3	71.7	76.6	79.5

Source: Census (2010c); U.S. International Trade Commission, USITC (2010); BEA (2010a)

As shown in Table 2-4, by the end of 2008 IPR in the U.S. textile industry (NAICS 313) was still at a modest level of 29.1% measured by gross output and 17.9% measured by shipment, meaning the majority of market demand for fiber, yarn, thread and fabrics in the United States were still supplied by the U.S.-made textiles instead of by imports. In comparison, the IPR in the U.S. apparel industry (NAICS 315), as presented in Table 2-5, was at a much higher level of 84.3% by gross output and 79.5% by shipment.

On the other hand, although IPR in both textile and apparel industries are on the rise over the past 10 years, the growth rate is much lower for the textile industry compared to the apparel industry. From 2000 to 2008, IPR in the U.S. textile industry only gained 8-9 percentage points while imported apparel gained more than 20 percentage points additional market share during the same period.

However, despite the relatively low IPR level for the U.S. textile industry and modest growth of textile imports, it is important to realize that many foreign-made textiles indirectly entered the United States through apparel imports. As shown in Figure 2-1(A) and (B), U.S. apparel imports began to surge in 1993, which instantly resulted in the quick decline of U.S. domestic apparel output. In comparison, output of the U.S. textile industry continued increasing from 1993 to 1998 and the growth trend did not go reverse until 1999. Such consequential phenomena can be explained as the dual impacts of rising apparel imports which first affected the U.S. apparel output and then caused the shrinkage of demand for textile products in the United States. Therefore, both the absolute market size and the relative market share of the U.S. domestic output should be taken into consideration when interpreting the IPR level in the U.S. textile industry.

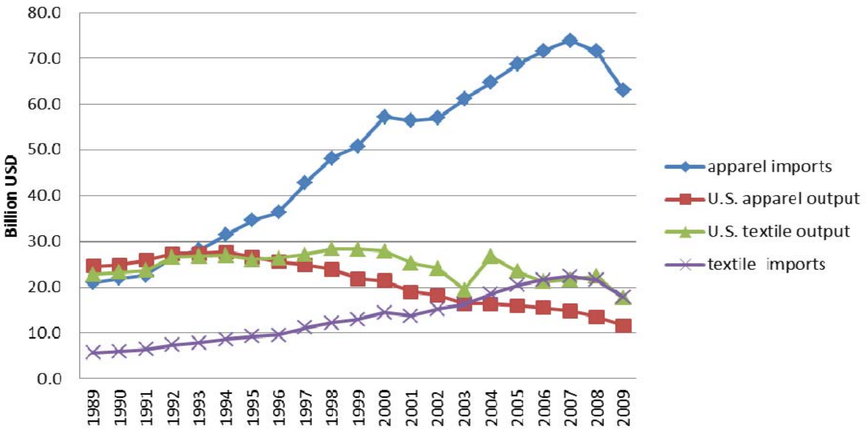

Figure 2-1 (A) U.S. Textile and Apparel Output and Imports (by value)

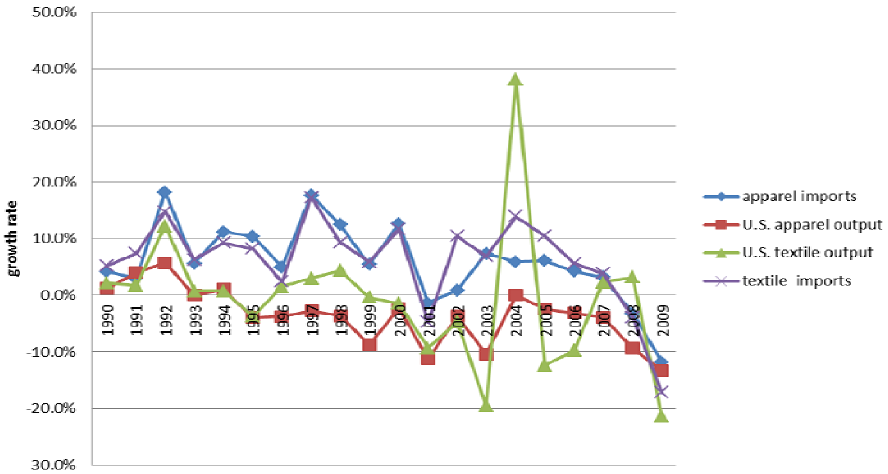

Figure 2-1 (B) Growth Rate of U.S. Textile and Apparel Output and Imports (by value)

Data source: OTEXA (2010a); BEA (2010a)

Additionally to be noted, the IPRs in Table 2-4 and 2.5 were calculated based on the value of the products. As the United States-made products are usually higher-priced than the imports, IPR could be higher if calculated based on quantity (Dickerson, 1999, pp289; AAFA, 2008).

The Heterogeneity of Textile and Apparel Industries

Although textile and apparel are often treated as a single industry, actually the two are diverse and heterogeneous with distinct characteristics (Dicken, 2003, p. 318; Bruce, Daly & Towers, 2004).

First, the two industries are of different factor-intensity in production. In general, textile manufacturing, which usually involves yarn spinning (NAICS 3131), fabric forming (NAICS 3132) and fabric finishing (NAICS 3133) is comparatively more capital and technology intensive. In comparison, apparel manufacturing, mainly composed of knitting (NAICS 3151), cutting and sewing (NAICS 3152) as well as the making of various apparel accessories (NAICS 3159), requires much larger input of labor and is technically difficult to automate (Dickerson, 1999; Nordas, 2004).

Second, textile products and apparel products are different in usage and demand. Output of textiles, no matter the fiber, yarns or fabrics are normally used as intermediaries for apparel manufacturing, while apparel is an end-use product directly sold to consumers (Dickerson, 1999). Related, because of the intermediary-usage nature, textiles are typically standardized products suitable for mass production by taking advantage of economies of scale (Dickerson, 1999; Dicken, 2003). In contrast, with increasingly higher consumer demands for more unique-looking, personalized and fashion-oriented clothing and accessories, apparel production has become more agile and flexible, fulfilling orders in smaller quantity and more varieties (Gereffi, 2002; Nordas, 2004).

The heterogeneity of the textile and apparel industries provides one major explanation for their different import penetration status in the United States. Because of the abundance in capital factors, the United States enjoys more comparative advantage in relatively capital-intensive textile production in relation to imports from labor-abundant developing countries. Similarly, import penetration ratio is higher in the U.S. apparel industry because of the more labor-intensive nature of apparel production which more favors developing countries. The capital-intensity nature of textile production also stems from the fact that mechanization is more appropriate for standardized mass production and less efficient for products of great varieties and in small quantity.

The heterogeneity of textile and apparel production further affect the path of structural change and selection of restructuring strategies by the two industries, which are detailed in the following sections.

The U.S. Textile and Apparel Industries in Structural Change

Concurrent with the rise of imports, the U.S. textile and apparel industries have undergone tremendous structural changes in the past few decades in terms of their appearances and the way they operate. At the same time, similar as the status of import penetration, the U.S. textile industry and apparel industry share common trends but have individual patterns as well.

First, the size of both industries has substantially shrunk, making smaller contributions to the overall U.S. economy; however, apparel production suffered from a more dramatic decline than textile production in the United States. According to the U.S. Bureau of Economic Analysis

(BEA), in 2008 the gross domestic product of the U.S. textile industry[1] reached $57.8 billion, down 32.1% from $85.1 billion in 2000. Over the same time, the gross domestic product of the U.S. apparel industry totaled $34.2 billion, a steeper drop of 49.2% compared to $67.3 billion in 2000. In 2008, only 0.35% of the U.S. GDP came from the textile and apparel industries, dropping more than half from 0.83% in 2000 (BEA, 2010a).

Second, both industries saw significant decline in employment. Statistics released by the Bureau of Labor Statistics (BLS) showed that, in 2009 around 125,000 and 170,000 employees on average worked for the U.S. textile and apparel industries, down respectively 66.9% and 65% compared to the number of employees in 2000 (BLS, 2010a). Additionally, although textile and apparel industries are often regarded as one of the leading job generators due to their relative labor-intensive nature in relation to others, only 1.03% and 1.04% employment in the U.S. manufacturing sector came from the textile and apparel industries in 2009 (BLS, 2010a).

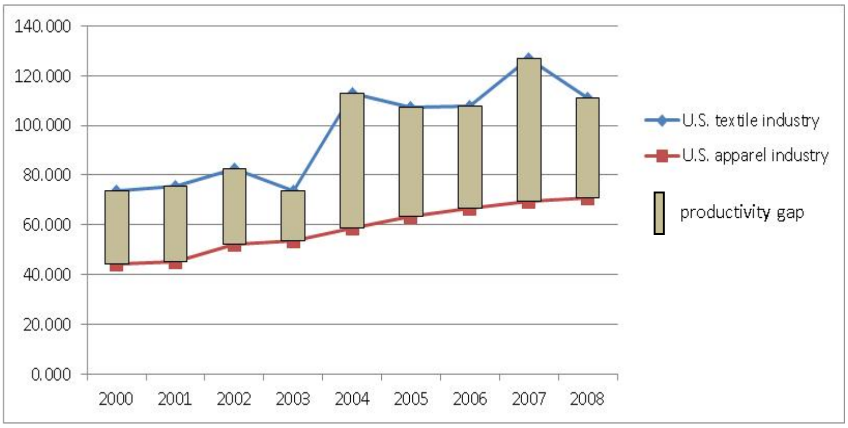

Figure 2-2 Productivity of the U.S. Textile and Apparel Industries (by output value per worker)

Data source: BLS (2010b)

[1] This figure covers both NAICS 313 (textile mills) and NAICS 314 (textile product mills)

Third, both the U.S. textile and apparel industries were moving toward more value-added production; however, the productivity gap of the two was also widening. Despite the decline of employment, annual output (by value, nominal) per worker in the U.S. textile and apparel industries rose from $73,520 and $44,060 in 2000 to $110,890 and $70,940 in 2009, a jump of almost 50% (BLS, 2010b) as illustrated in Figure 2-2, suggesting improved efficiency in operation. However, as to the productivity index measured by output (by value, nominal) per hour, the U.S. textile industry increased from 86 in 2000 to 124 in 2008 (year 2000=100), while the U.S. apparel industry dropped from 116 to 55 over the same period (BLS, 2010b), suggesting great productivity growth in the textile industry but significant decline for the apparel.

Fourth, the U.S. textile and apparel industries further widened their gaps as to their capital intensity measured by the capital-labor ratio. As indicated in Table 2-6, the U.S. textile industry more than doubled its capital-labor ratio from 2002 to 2008. Although the ratio for the U.S. apparel industry also increased, its gap with the ratio of the textile industry expanded from 4.11 times to 5.11 times over that period (Census, 2010c), once again reflecting the heterogeneous nature of the two sectors.

Table 2-6 Capital-Labor Ratio Index of the U.S. Textile and apparel industries

(year 2000=100)

Item/year	2002	2003	2004	2005	2006	2007	2008
Textile industry	100	83	78	84	95	113	119
Apparel industry	100	103	93	117	104	106	95
Textile/Apparel*	4.11	3.30	3.44	2.95	3.74	4.40	5.11

Data Source: Census (2010c)

*Note: calculated by dividing the capital-labor ratio of the textile industry by the ratio of the apparel industry

Furthermore, industry structure in terms of the size of firms (as defined by number of employees) also changed substantially; although the U.S. textile industry and the apparel industry moved in different directions. As shown in Table 2-7 (A) and (B), number of firms of all sizes experienced significant decline both in the U.S. textile industry and the apparel industry from 1998 to 2008. This change is compatible with the contraction of production volume and size of employment in the two industries. However, according to Figure 2-3 (A) and (B), firms in large size (with number of employees exceeding 100) still account for 13% of the total number of firms in the U.S. textile industry by the end of 2008. In comparison, large-size firms dramatically shrank in share from 12% in 1998 to only 5.3% by the end of 2008 in the U.S. apparel industry, while apparel firms with total employees less than four rose from 34% to 44% during the same period. Given the relative capital-intensive nature of textile manufacturing and labor-intensive apparel production, the above figures indicate that the U.S. textile mills remain larger in size and the U.S. apparel firms have become smaller.

Table 2-7 (A) Number of Firms in the U.S. Textile Industry by Firm Size Unit: Number

Year/size	0-4	5--9	10--19	20--99	100 or over
1998	1362	611	499	782	597
2008	964	389	296	496	334

Table 2-7 (B) Number of Firms in the U.S. Apparel Industry by Firm Size Unit: Number

Year/size	0-4	5--9	10--19	20--99	100 or over
1998	5917	2521	2719	4166	2103
2008	3147	1392	1145	1187	324

Source: Census (2010b)

Note: firm size is measured by the number of employees in the firm

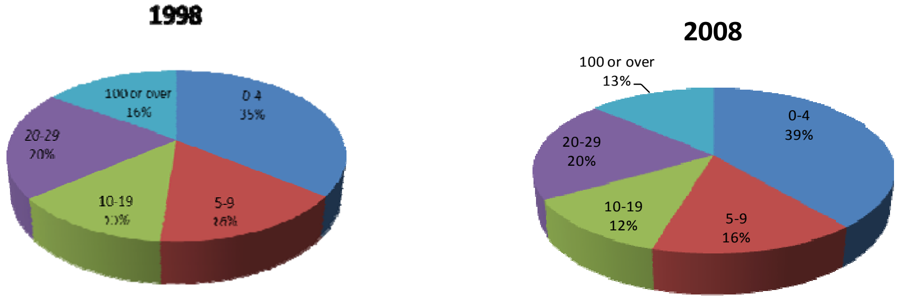

Figure 2-3 (A) Structure of the U.S. Textile Industry by Firm Size

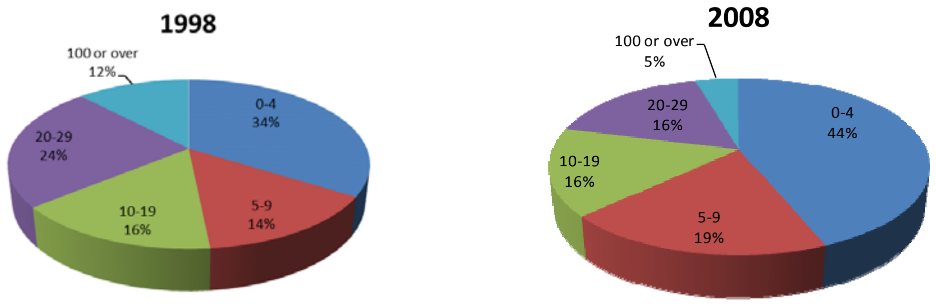

Figure 2-3 (B) Structure of the U.S. Apparel Industry by Firm Size

Data source: Census (2010b)

To summarize, the U.S. textile and apparel industries have undergone substantial changes from 2002 to 2008 in terms of their overall shrinkage in employment, decline of production, improvement of productivity, number of firms as well as shifting in industry structure. These new patterns are the direct results of various restructuring strategies adopted by the two industries, which not only led to a brand new look of the U.S. textile and apparel industries different from previous times, but also fundamentally changed in the way the two industries operate in a globalized world economy. Therefore, to fully understand and interpret the above changes, it is important to examine in greater detail the various restructuring strategies adopted by the U.S. textile and apparel industries.

Restructuring Strategies Adopted by the U.S. Textile Industry

As the United States is abundant with capital and technology endowments and given the capital intensive characteristic of the textile production, in response to the challenges of increasing competition from imports, the U.S. textile industry adopted various measures to streamline the manufacturing process, minimize the production costs and improve the productivity (Dickerson, 1999, p. 273; Dicken, 2003, p. 272). Several specific restructuring strategies were commonly practiced by the U.S. textile mills:

First, the U.S. textile industry capitalized production by investing in new machines, equipment, and technology (Toyne, Arpan, Barnett, Ricks, & Shimp, 1984; Dickerson, 1999, p. 273; Christoffersen et al., 2004). The rising capital-labor ratio in the U.S. textile industry as indicated in Table 2-6 is the direct result of capitalization efforts. Capitalization and investment in technology also led to the higher productivity and lower cost of textile production (Levinsohn & Petropoulos, 2001). Datta & Christoffersen (2005) suggested that labor saving technical progress helped the U.S. textile industry improve its productivity by 2.1% and reduced production cost by 2.4% annually from 1953 to 2001. Figure 2-4 further shows, from 2002 to

2008, within the value added of the U.S. textile industry, investment on machinery accounted for an increasing share, indicating the continued capitalization trend of the U.S. textile industry in recent years.

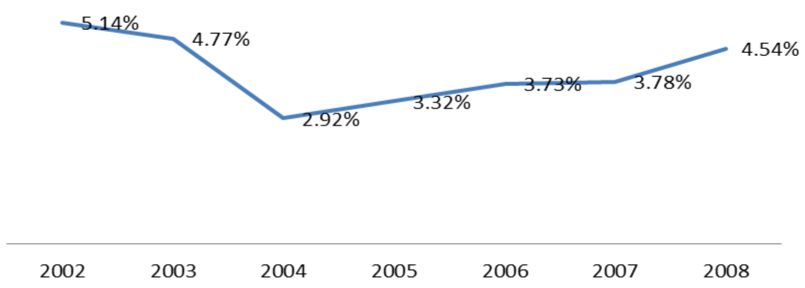

Figure 2-4 Ratio of New Machines Investment to the Value Added of the U.S. Textile Industry

Data source: BEA (2010b)

Second, the U.S. textile industry enlarged production capacity through mergers and acquisitions (M&A). The main purposes of the M&A strategy were to take advantage of economies of scale and achieve lower production cost (Dickerson, 1999, p. 275; Mock, 2002; Dicken, 2003, p. 340). The adoption of the M&A strategy may explain why large firms (with employees exceeding 100) remain in good proportion in the U.S. textile industry despite the overall decline of the total number of firms (Christoffersen et al., 2004). Empirical studies further suggested that plants that survived in the U.S. textile industry emerged with stronger competitiveness while those that exited were comparatively less productive (Levinsohn & Petropoulos, 2001; Chi, Kilduff, Vidyaranya & Dyer, 2009).

Third, the U.S. textile mills improved supply chain management. Supply chain (or commodity chain) is defined as the network of organizations that are involved through the upstream and downstream linkages in the different processes and activities that produce value in the form of products and services delivered to the ultimate customers (Teng & Jaramillo, 2006). The supply chain in the textile complex is highly buyer-driven, which means downstream sectors usually play pivotal roles affecting the production activity in the upstream sector (Gereffi, 1999). As customers' demands for apparel products are turning more volatile, shorter-life-cycle and unpredictable, textile production is expected to be more "sensitive" toward the quick market changes (Dickerson, 1999, p. 277; Christopher, Lowson & Peck, 2004). Two main categories of strategies have been widely adopted in the U.S. textile industry: one category is lean supply with the goal of shortening the delivery time and the other one is agile supply which intends to deliver the products more "efficiently" by making the high volatility products available to the customers (Dickerson, 1999, pp281; Bruce et al., 2004; Oh & Kim, 2007). Specific supply chain management strategies commonly applied by the U.S. textile industry include quick response (QR), automatic replenishment, just-in-time (JIT) systems, point of sale information, and mass customization (Dickerson, 1999, p. 278-279; Teng et al., 2006; Hyunjoo Oh & Eunjung Kim, 2007).

Fourth, the U.S. textile industry actively engaged in the building of regional production networks with countries that are geographically close to the United States. This strategy received strong support from U.S. trade policymakers which purposefully added special provisions encouraging the use of United States-made yarns or fabrics in the preferential trade agreements reached with trading partners (Gereffi, Spener & Bair, 2002; Hyunjoo Oh et al., 2006; Hodge et al., 2006; Kunz & Garner, 2007). As shown in Table 2-8(A) and 2.8(B), by the end of 2009, the United States had reached eleven such free-trade agreements and four preferential trade agreements with developing countries mostly located in North and South America. For example, under the North America Free Trade Agreement (NAFTA), Dominican Republic-Central America Free Trade Agreement (DR-CAFTA), United States-Jordan Free Trade Agreement, Andean Trade Preference Program and Sub-Saharan Africa Preference Program, trading partners such as Mexico and those in the Caribbean Basin region can benefit from preferential tariff treatment for their apparel exports to the United States as long as these apparel products use U.S.-made textiles (Gelb, 2003; USITC, 2001). Statistics from the Office of Textile and Apparel (OTEXA) indicated that from 2000 to 2009, more than 50% of U.S. textile mill exports went to partners under the NAFTA, CBI and DR-CAFTA. In March 2010, the Obama Administration further launched the National Export Initiative (NEI) program with the goal of doubling the U.S. exports within the next five years. Under the NEI program, OTEXA pledged to provide various support including trade promotion, trade agreement, research grant and various market access services to help U.S. textile products expand and more easily enter foreign markets (OTEXA, 2010c; Morrissey, 2010).

Table 2-8 (A) U.S. Free Trade Agreements Related to Textile and Apparel Products

Free Trade Agreement (FTA)	FTA Members	Status
U.S. - Israel Free Trade Agreement	Israel	Effective since 1985
North American Free Trade Agreement	Mexico, Canada	Effective since 1994
U.S. - Jordan Free Trade Agreement	Jordan	Effective since 2001
U.S. - Australia Free Trade Agreement	Australia	Effective since 2005
U.S. - Chile Free Trade Agreement	Chile	Effective since 2004
U.S. - Singapore Free Trade Agreement	Singapore	Effective since 2004
U.S. - Dominican Republic-Central America Free Trade Agreement	El Salvadore, Honduras, Nicaragua, Guatemala, Dominican, Costa Rica	Effective since 2006*
U.S. - Bahrain Free Trade Agreement	Bahrain	Effective since 2006
U.S. - Morocco Free Trade Agreement	Morocco	Effective since 2006
U.S.-Oman Free Trade Agreement	Oman	Effective since 2009
U.S. - Peru Trade Promotion Agreement	Peru	Effective since 2009

Source: summarized based on OTEXA (2010a)

*The Agreement entered into force between the United States and El Salvador on March 1, 2006, Honduras on April 1, 2006, Nicaragua on April 1, 2006, Guatemala on July 1, 2006, the Dominican Republic on March 1, 2007 and Costa Rica on January 1, 2009.

Table 2-8 (B) U.S. Preferential Trade Agreements Related to Textile and Apparel Products

Agreement	Members	Status
African Growth and Opportunity Act (AGOA)	Botswana, Lesotho, Namibia, South Africa, Burkina Faso, Madagascar, Niger, Swaziland, Ethiopia, Malawi, Nigeria, Tanzania, Ghana Mali, Senegal, Tanzania, Kenya, Mozambique, Sierra Leone and Zambia	Effective since 2000 until 2015 by the AGOA Acceleration Act of 2004
Caribbean Basin Trade Partnership Act (CBTPA)	Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, British Virgin Islands, Dominica, Grenada, Guyana, Haiti, Jamaica, Montserrat, Netherlands Antilles, Panama, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Trinidad and Tobago	Effective since 2000 until 2020
Andean Trade Promotion and Drug Eradication Act (ATPDEA)	Bolivia, Colombia, Ecuador and Peru	Effective since 2002
Trade Preference Program for Haitian Textiles and Apparel	Haiti	Effective since 2006

Source: Summarized based on OTEXA (2010b)

On the other hand, with the shrinkage of domestic demand, overseas markets are of growing importance to the future of the U.S. textile industry. Table 2-9 shows that from 2002 to 2008, the export dependency rate measured by dividing the total value of export by domestic output (Smith, 1998, p. 199), keep constant rising for all textile product groups. In particular, for certain types of textile products such as fiber, yarns and threads (NAICS 3131), more than 65.9% of the sales had already been achieved overseas in 2008. Moreover, in 2008, over 70% of the U.S. textile exports were achieved under the established free-trade agreement or preferential trade programs, illustrating the important roles of trade policy in promoting the U.S. textile exports (OTEXA, 2010c). This figure even reached 86% for yarn exports (OTEXA, 2010a). Additionally, Table 2-10 shows that for most U.S. FTA/PTA partners in the Western Hemisphere, the United States was their largest source of textile imports in 2008, which further indicated the special role of the United States as the leading textiles provider to the softgoods production network in the region.

Table 2-9 Export Dependency Rate of the U.S. Textile Industry Unit: %

NAICS	2002	2003	2004	2005	2006	2007	2008
NAICS 3131	55.2	53.8	64.3	63.7	65.9	62.4	65.9
NAICS 3132	3.1	3.7	4.1	4.8	6.1	7.6	9.9
NAICS 3133	6.9	8.8	8.1	8.4	10.6	12.1	13.5

Data source: Census (2010d); USITC (2010)

Table 2-10 Share of Textile Imports from the United States for Western Hemisphere Countries in 2008

Importers	Mexico	Nicaragua	El Salvador	Dominican	Costa Rica	Honduras
Share of U.S. textiles[1]	81.7%	92.4%	82.8%	74.8%	65.8%	94.0%

(Continue)

Importers	Chile	Peru	Guatemala	Columbia	Chile	Canada
Share of U.S. textiles*	40.2%	86.1%	81.2%	50.1%	40.2%	63.1%

Data source: UnComtrade (2011)

Restructuring Strategies Adopted by the U.S. Apparel Industry

Compared with the U.S. textile industry, the U.S. apparel industry had a more difficult time facing the flood of imports coming from the low-wage developing countries. High domestic production cost, especially labor, is regarded as one of the greatest disadvantages for the U.S. apparel industry to compete on price (Gereffi et al., 2002; Hodges et al., 2006). As Table 2-11 shows, labor cost in world leading apparel manufacturing and exporting countries was only a small portion of the cost in the United States. On the other hand, contrary to the case in the textile industry, the nature of apparel manufacturing makes it quite difficult to incorporate automation. Thus, despite the financial capability of investing in the state-of-art high technology and machines, the United States-made apparel is still far more expensive than imports from developing countries (Nordas, 2004). Studies conducted by Ramcharran (2001) indicated a low-level and declining elasticity of factor substitution in the U.S. apparel industry since 1993,

[1] Textiles refer to Category 26 under the SITC Rev.2 (Standard International Trade Classification, second version) system.

suggesting that capital and labor became less substitutable in apparel production. This result to certain extent reflects the difficulty of achieving further technology breakthrough in apparel manufacturing and may also suggest the U.S. apparel industry is different from what it was.

Table 2-11 Labor Cost in the Apparel Industry of Leading Exporters as the Ratio to the Cost in the United States in 2007

Country	China	Vietnam	Bangladesh	Indonesia	India	Mexico
Ratio	3%/5%*	3%	2%	4%	4%	14%

Source: Werner International Management Consultants (2008)

* 3% refers to the cost in inland China; 5% refers to the cost in China coastal areas.

Over time as retailers bought increasing quantities of low cost imports, the fierce competition caused the U.S. apparel industry to abandon most of the domestic production capacity in favor of outsourcing and offshore sub-contracting. The U.S. apparel industry turned out to be quite globalized as the result of this restructuring strategy (Gereffi, 1999; Kilduff, 2005). Furthermore, with the traditional manufacturing function diminished, apparel firms in the United States also greatly shifted their roles in the business as well as their relationship with their partners overseas. (Bonacich, 1994; Gereffi et al., 2002). Two types of apparel firms emerged quickly in the industry: one is "marketers", which is only engaged in design and marketing activities and characterized as manufacturers without factories (Gereffi et al., 2002). The typical firms include Liz Claiborne, Donna Karan, Ralph Lauren and Nike. The other type of apparel firms is "branded manufacturers" which still deal with activities ranging from design, cutting, assembly, laundry to marketing. However, the key role of "branded manufacturers" is to organize and manage the whole production process rather than simply manufacture by themselves (Gereffi, 1999; Gereffi et al., 2002; Mortimore, 2003). The typical firms under this category include Levi Strauss, VF Corporation, Kellwood, etc. (Bair, 2002; Gereffi et al., 2002; Cattaneo, 2010). For both “marketers” and “branded manufacturers,” their operations are based on the close contracting networks with overseas companies, especially the manufacturers in the developing countries. These transformed U.S. apparel firms did not regard imports as competitors. Quite the opposite, a large portion of U.S. apparel imports actually were arranged by “marketers” and “branded manufacturers.”

Ironically, the emerging competitors for U.S. apparel firms turned out to be U.S. retailers. Although retailers used to be the customers of apparel firms, they are ambitious in establishing their own sourcing network so as to shorten the lead time and further reduce the sourcing cost (Gereffi et al., 2002). In addition, some large scale U.S. apparel firms, including branded manufacturers are also extending their business realm into the retailing sector by means of forward integration (Kilduff, 2005; Gereffi & Frederick, 2010). The phenomenon of “scrambled softgoods chain” within which some traditional steps in the supply-chain are skipped is turning more popular in the U.S. apparel industry (Dickerson, 1999).

On the other hand, although imported apparel through sourcing networks has played a dominant role in supplying the U.S. apparel market, the U.S. apparel industry still maintains certain local production bases, such as in New York and Los Angeles (Bailey-Todd, Eckman, & Tremblay, 2008). Compared with imports which target the mass market and achieve profits on high volumes, this locally produced apparel, in most cases, serve a U.S. niche market. They cater to particular needs from the customers on quality and flexibility and compete mostly on non-price factors, such as design and service (Parrish et al., 2004; Parrish et al., 2006a; Parrish et al., 2006b).

Summary

This chapter reviewed various trade theories explaining the impacts of import competition on the pattern of production specialization, changes of product price as well as factor returns in the importing country. As summarized in Table 2-1, these trade theories provide a useful framework for further empirical studies to systematically evaluate the relationship between rising import penetration and the operation of the U.S. textile and apparel industries.

This chapter also reviewed the heterogeneity of the textile industry and the apparel industry reflected by the different factor intensity in production and the nature of product usage. Such heterogeneity is closely related to their different status of import penetration, patterns of structural change, and selection of restructuring strategies in response to foreign competition.

CHAPTER 3

RESEARCH CONCEPTUAL MODEL

Import Competition and the U.S. Textile and Apparel Industries: Relevant Empirical Studies

A number of studies have been conducted to evaluate the impact of import competition on the operation of the U.S. textile and apparel industries.

Regression analysis conducted by Sinnott (1990) based on the 25 four-digit Standard Industrial Classification (SIC) codes covering the U.S. textile and apparel industries from the Census of Manufactures in 1982 showed that the value of imports was negatively associated with the market concentration in the United States, reflected by the lower value of Herfindahl-Hirshman Index (HHI). This finding suggested that textile and apparel imports intensified the competition in the U.S. market. However, by simulating only one-year data of 25 heterogeneous SIC industries together, the validity of the finding could be challenged and limited. Also, the study mistreated the volume of import the same as "import penetration," thus failed to actually reflect what might happen to the U.S. domestic industry if imports take up more share in the market.

With the purpose of exploring the causes of employment and wage level in the U.S. textile and apparel industries, Shippen (1995) conducted ordinary least square (OLS) regression based on the 1977—1991 statistics and found that import price was negatively associated with the wage level in the U.S. textile industry (estimated coefficient -0.038) and in the U.S. apparel industry (estimated coefficient -0.053). Shippen (1995) also suggested that import price was positively related with the level of employment, implying that the declining import price will lead to the job losses of the U.S. textile and apparel industries.

Cusum and Cusum squares tests conducted by Yang (1998) based on the statistical data from 1949-1993 suggested that rising imports intensified the competition in the combined U.S. textile and apparel market which saw significant decline in employment and the decline of apparel output. However, Yang (1998) also suggested that imports may contribute to the structural shift in the factor demand relationship in the industry. The study found that both the price elasticity of labor and the elasticity of elasticity of substitution between labor and capital in the U.S. textile and apparel industry turned from negative (between 1949—1979) to positive (between 1980—1993). The results suggested that the U.S. textile and apparel industry was interested in using capital replace labor in production.

Lord & McIntyre (2003) studied the relationship between import competition and the financial leverage of the U.S. textile and apparel industries from 1974 to 1987. Panel data model based on the financial information of 25 U.S. textile firms and 20 apparel firms found that import penetration ratio (calculated based on 3-digit Standardized Industrial Classification, SIC Code) was positively associated with the ratio of total debt to total asset (financial leverage) of the U.S. textile firms (estimated coefficient 1.7299) and negatively associated with the leverage of the apparel firms (estimated coefficient -0.9951), both of which were statistically significant.

Bahmani-Oskooee & Chakrabarti (2003) applied cointegration analysis based on the quarterly data from 1977 to 1992 to evaluate the impacts of import competition on the wage and employment of twelve 2-digit U.S. domestic manufacturing sectors. Findings of the study showed that when employment was measured by the average person hours per week, import price was significantly positive with the employment level in the U.S. textile (estimated coefficient 0.34) and apparel (estimated coefficient 0.05) industry; however, when employment was measured by the number of workers, the correlation was insignificant. On the other hand, the study indicated significant positive correlation between import price and the wage level in the U.S. textile industry (estimated coefficient 0.36) while the significant negative relationship for the apparel industry (estimated coefficient -0.06).

Regression analysis conducted by Christoffersen & Datta (2004) based on the 1962-1994 time series data found that although rising imports intensified competition and pushed forward the structural reform of the U.S. domestic industry, when holding technological progress and capitalization constant, the ceteris paribus effect of imports on the total factor productivity (TFP) of the U.S. textile industry was statistically insignificant. This finding implied that import competition is part of rather than the whole reason for the structural change of the domestic industries.

Conway (2009) used the Annual Survey of Manufactures (ASM) and the Census of Manufactures (CM) data from 1989 to 2004 to simulate the impacts of price-based import competition on the plant closure, employment level, product price and technical progress of the U.S. textile industry. The study attributed plant closure and price drop of textile products in the United States to the joint effect of technical progress and waning market demand instead of import competition. However, this study suggested rising imports due to trade liberalization to be responsible for the downsizing of employment and loss of market share of the U.S. textile industry.

To sum up, empirical studies conducted so far greatly contributed to the understanding of the impacts of import competition on the operation of the U.S. domestic textile and apparel industries. However, despite efforts, there are still several research gaps.

1. Most of the studies used volume of imports or import price as the measurement of import competition. However, economic theories suggest that demand for imports were jointly

determined by import behaviors and macro-economic conditions in the importing country (Krugman, 2005; Leamer & Stern, 2008). Therefore, the concurrent rise of imports and the decline of production, wage level and employment of the domestic industry in the importing country do not necessarily imply that imports are primarily responsible for such industrial injury (Kelly, 1988). In comparison, import penetration is a more appropriate proxy measuring import competition as it directly reflects the result of market share competition between imports and domestic made-products under the same exogenous market environment.

2. Trade theories in chapter two have suggested that impacts of import competition on the operation of domestic industries are reflected in four dimensions, including output, employment, wage level and price of product. At the same time, according to the Hicksian technical progress theory, productivity growth through technical progress is also related to the wage and employment level of domestic industries. Although these factors were selectively included in many previous studies, few studies ever take all of these dimensions into consideration and comprehensively evaluate the impacts of import competition.
3. The majority of the studies were conducted based on the data before 2005 when the global quota system for textile and apparel were still in place which significantly distorted the normal trade patterns. Because of the existence of trade barriers, industries were not operating under normal market conditions.

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Research Conceptual Models and Hypotheses

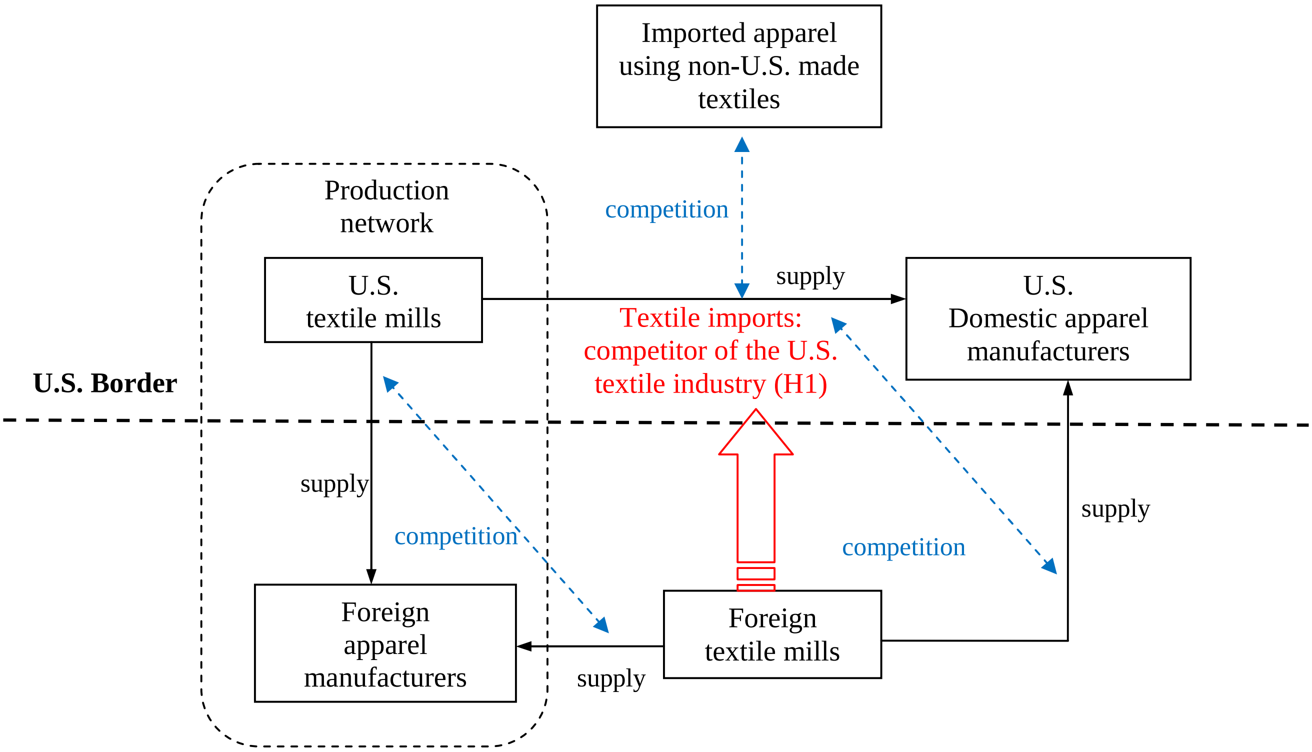


Figure 3-1 Conceptual Model of the Relationship Between Import Penetration and the Operation of the U.S. Textile Industry

Figure 3-1 is the research conceptual model illustrating the theoretically-suggested relationship between import penetration and the operation of the U.S. textile industry in the globalized era. As discussed in the previous chapter, despite the various categories, restructuring strategies adopted by the U.S. textile industry in general focused on building a stronger domestically-based production capability rather than offshoring production outside the United States (Dicken, 2003; Kilduff, 2005). After restructuring, the U.S. domestic-made textiles still largely compete with imports, because both of them target U.S. domestic apparel manufacturers as key customers.[1] The rising level of imports reflected by a higher import penetration ratio may still exert negative impacts on the operation of the U.S. textile industry, as it means the U.S.-made textile products account for less market share. Therefore, this study proposes the following hypothesis:

Hypothesis 1: After restructuring, the U.S. domestic textile industry still directly competes with imports. Therefore, a higher import penetration ratio shall be positively associated with the decline of the U.S. textile industry and vice versa.

Two other things need to be noted in Figure 3-1. First, the U.S. domestic textile industry is suggested not only directly competing with textile imports, but also competes with imported apparel which uses non-U.S. made textile products, although in an indirect way. As Figure 2-1 shows, with the quick rise of apparel imports since the 1990s, output of the U.S. apparel industry first started to decline and then followed up by the U.S. textile industry. This pattern suggested that a good proportion of prior U.S. domestic demand for textiles disappeared because of the shrinkage of U.S. domestic apparel production capacity as the result of rising apparel imports. Second, U.S. textile industry also competes with foreign-made textiles in third-country markets such as Mexico and Central-South American countries (Gereffi, 2002). The rising export dependency ratio shown in Table 2-9 demonstrates the importance of overseas sales to the survival of the U.S. textile industry.

[1]This study only focuses on textiles to be used for apparel manufacturing. However, in general, the U.S. textile production also supplies products for the interior furnishings and industrial textile markets (Dickerson, 1999).

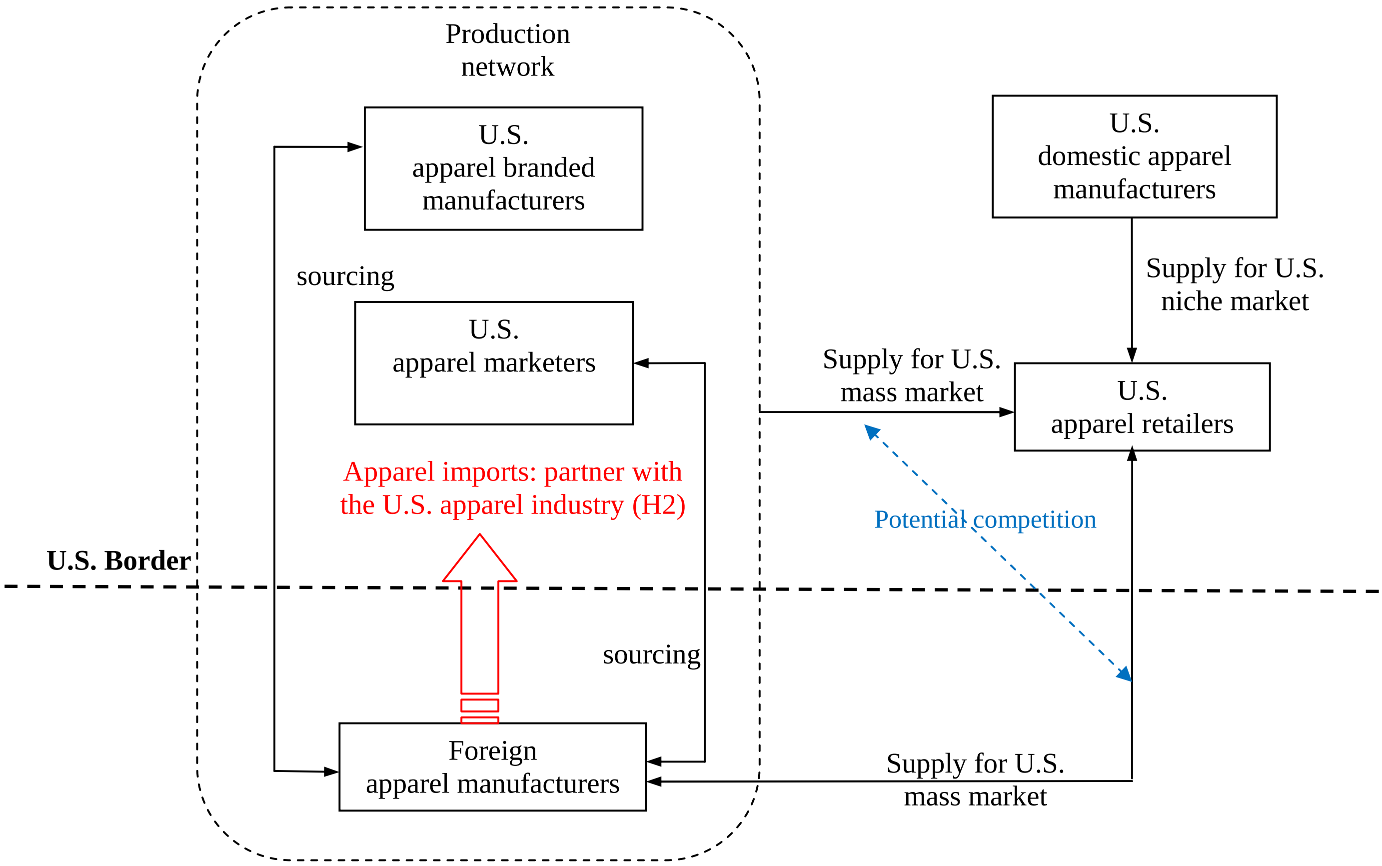


Figure 3-2 Conceptual model of the Relationship between Import Penetration and the Operation of the U.S. Apparel Industry

Figure 3-2 is the conceptual model illustrating the theoretically-suggested relationship between import penetration and the operation of the U.S. apparel industry in the globalized era. As discussed in the previous chapter, the U.S. apparel industry has largely achieved global operations in the globalized era with traditional manufacturing-oriented functions largely replaced by offshore production and outsourcing (Kilduff, 2005). Under the new business model, on the one hand, a good proportion of imports were brought into the U.S. market by the U.S. apparel firms themselves, such as "marketers" and "branded manufacturers" whose commercial success were heavily dependent on the efficient cooperation with contracted apparel manufacturers overseas. On the other hand, as the transformed U.S. apparel industry treats imported apparel as an integral part of the supply chain instead of competitors, the rising import level reflected by a higher import penetration ratio will no longer imply the U.S. apparel industry lost in competing with imports. Although certain apparel domestic manufacturing capacity remained in the United States, in most cases they fulfill the needs of the niche market and are supplementary to the imports which basically serve the mass consumer markets (Gereffi, 2001). As the nature of the game has changed from zero-sum competition into win-win cooperation, operation of the restructured U.S. apparel industry shall not be negatively affected by the rising imports at worst. Therefore, the study proposes the following hypothesis:

Hypothesis 2: After restructuring, the U.S. domestic apparel industry no longer competes with imports. Therefore, a higher import penetration ratio at least shall not be positively associated with the decline of the U.S. apparel industry and vice versa.

Summary

This chapter first reviewed previous studies which empirically evaluated the relationship between imports and the operation of domestic industries in importing countries. Non-consensus views were reached in terms of the impacts of imports on domestic industries' employment, wage level, production and productivity growth. Conceptual models and hypotheses were then proposed. Based on the nature of adopted restructuring strategies, it is suggested that in the globalized era, imported textiles still largely compete with U.S. domestic textile industries. However, for U.S. apparel industry, as it has incorporated imports into its major functions, the relationship between imports is suggested as a partnership.

CHAPTER 4

METHODOLOGY

Empirical Model Structure

The empirical model serves the purpose of directly linking import penetration ratio with the operation of the U.S. textile and apparel industries. Based on demand-supply theories, Figure 4-1 briefly describes the relationship among market demand, domestic supply and import supply of textile and apparel in the United States. The figure also illustrates how import-penetration ratio might change under various scenarios when imports directly compete with the U.S. domestic output. Understanding these scenarios can help us identify specific variables that both reflect operation of the U.S. textile and apparel industries and that can be affected by the import penetration ratio.

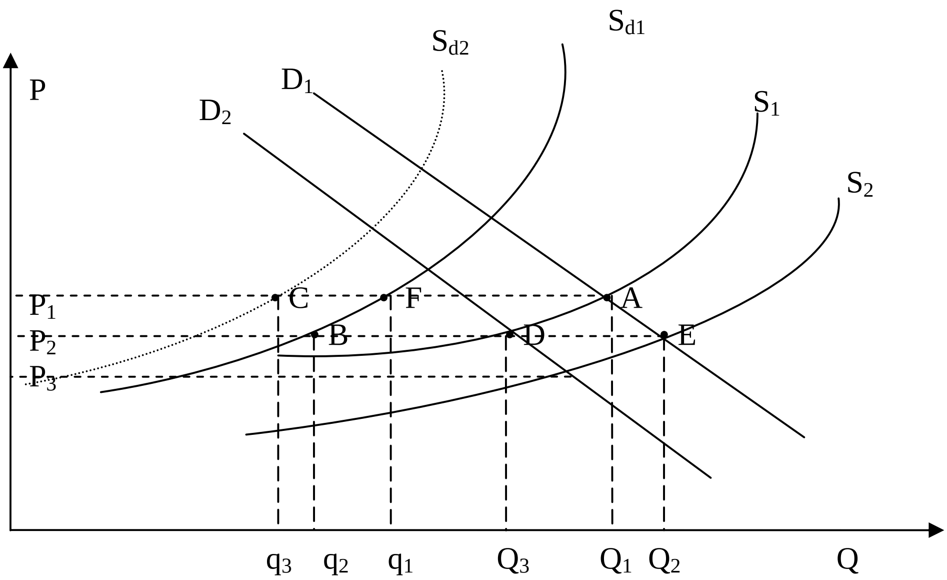


Figure 4-1 Demand and Supply of Textile and Apparel in the U.S. Market

Assume imports and U.S. domestic-made textile and apparel are identical and perfectly substitutable with each other. Aggregate market demand for textile and apparel in the United States are fulfilled by the sum of domestic supply (i.e. output of the U.S. domestic industry) and import supply. Supply of imports is assumed as unlimited, which is accorded with the overproduction condition of today's global textile and apparel industries (Dickerson, 1999). In Figure 4-1, the horizontal axis represents the quantity of products and the vertical axis measures market price. At the initial market equilibrium point A where market demand curve D_1 and total supply curve S_1 intersects, market price is at P_1. At this price level, the U.S. domestic industry is willing to provide textile and apparel in total amount of q_1 at point F based on its supply curve S_{d1}. Quantity of import supply equals the difference of total demand Q_1 and U.S. domestic supply q_1, i.e. $M = Q_1 - q_1$. At point A, import penetration ratio can be calculated as:

$$IPR_A = (Q_1 - q_1) / Q_1$$

According to Figure 4-1, the following three scenarios will result in changes of IPR:

First, supply curve S shifts due to increase of import supply. As example, suppose market supply curve moves from S_1 to S_2 due to the increase of import supply in amount of ΔM . The new market equilibrium is reached at point E and market price declines from P_1 to P_2. At P_2, the U.S. domestic textile and apparel industries are only willing to provide product in total quantity of q_2, which is Δq less than q_1, although the total market supply increased to Q_2. At point B, import penetration ratio is higher than at point A, because:

$$IPR_B = (Q_2 - q_2) / Q_2 = (Q_1 - q_1 + \Delta M)/(Q_1 - \Delta q) > IPR_A \text{ , where } \Delta M, \Delta q > 0$$

Second, supply curve of the U.S. textile and apparel industries shifts due to the changes of their wage level, labor supply or productivity. For example, suppose supply curve of the U.S. textile and apparel industries shift from Sd_1 to Sd_2. If market price remains at P_1, supply of the

U.S. domestic industry will total in quantity q_3, which is $\Delta q'$ amount less than q_1. As the supply of imports equals the residual demand and supply of imports is assumed unlimited, market equilibrium can remain at point A if supply of imports increases by $\Delta q'$. IPR at point C will be higher than at point A because:

$$IPR_C = (Q_1 - q_3)/Q_1 = (Q_1 - q_1 + \Delta q')/(Q_1 - \Delta q') > IPR_A \text{, where } \Delta q' > 0$$

Third, U.S. domestic demand curve shifts as result of changes of U.S. aggregate demand. For example, the economic slowdown causes the U.S. total demand for textile and apparel shrinks from D_1 to D_2. The total demand in the market is Q_3,which is ΔQ smaller than Q_1. The new market equilibrium will be at point D whose corresponding equilibrium market price is at P_2. The declined market price will reduce the U.S. domestic supply by Δq, i.e. from q1 to q2. As the decline of numerator is smaller than the denominator, therefore import penetration will increase as result:

$$IPR_D = (Q_3 - q_2)/Q_3 = [(Q_1 - \Delta Q) - (q_1 - \Delta q)]/(Q_1 - \Delta Q)$$
$$= [(Q_1 - q_1 - \Delta Q + \Delta q)]/(Q_1 - \Delta Q) > IPR_A$$

To summarize, Figure 4-1 suggested that import penetration ratio is closely related to the changes of import supply, domestic supply and the overall market demand in the U.S. market. Factors reflecting the operation of the U.S. textile and apparel industries such as wage level, labor input, productivity and aggregate demand are suggested having direct impacts on the import penetration ratio in the U.S. market as long as U.S. domestic output directly competes with imports.

To empirically reflect and measure such relationship, this study develops a revised model based on the work of Grossman (1982) and Greenaway, Hine &Wright (1999).

First, assume for a 4-digit NAICS industry i in period t, Q_{it}^{s} represents the domestic supply of U.S. textile and apparel industries, Q_{it}^{d} represents the total demand in the United States. Import supply M_{it} is defined as the difference of U.S. domestic demand and domestic supply (Francois & Reinert, 1997):

$$M_{it} = Q_{it}^{d} - Q_{it}^{s} \quad (4.1)$$

Based on the common definition, such as Morgan (1988), import penetration ratio (IPR_{it})is calculated as the share of imports within the total U.S. demand:

$$IPR_{it} = \frac{M_{it}}{Q_{it}^{d}} = \frac{Q_{it}^{d} - Q_{it}^{s}}{Q_{it}^{d}} = 1 - \frac{Q_{it}^{s}}{Q_{it}^{d}} \quad (4.2)$$

Second, to describe the behavior of U.S. domestic supply of textile and apparel, assuming Cobb-Douglas production function is:

$$Q_{it}^{s} = A_{it}^{\lambda} K_{it}^{\alpha} \cdot L_{it}^{\beta} \quad (4.3)$$

where A_{it}^{λ} denotes total factor productivity which changes over time; K and L respectively represents capital and labor input with output elasticity at α and β.

To maximize profit, marginal revenue product of labor (MPL) of industry i in period t shall equal its wage (W_{it}) level and marginal revenue product of capital (MPK) shall equal rent (C_{it}).Therefore:

$$MPL_{it} = ML_{it} \cdot P_{it} = \frac{\partial Q_{it}^{s}}{\partial L_{it}} \cdot P_{it} = \beta A_{it}^{\lambda} \cdot K_{it}^{\alpha} \cdot L_{it}^{\beta-1} \cdot P_{it} = \frac{\beta Q_{it}^{s}}{L_{it}} \cdot P_{it} = W_{it} \quad (4.4)$$

$$MPK_{it} = MK_{it} \cdot P_{it} = \frac{\partial Q_{it}^{s}}{\partial K_{it}} \cdot P_{it} = \alpha A_{it}^{\lambda} \cdot K_{it}^{\alpha-1} \cdot L_{it}^{\beta} \cdot P_{it} = \frac{\alpha Q_{it}^{s}}{K_{it}} \cdot P_{it} = C_{it} \quad (4.5)$$

As most concerns for the impacts of import competition are concentrated on the labor side, K is expressed as a function of parameter L, W and C, so that Q_{it}^{s} will be directly dependent on employment and wage level. By solving equations (4.4) and (4.5) simultaneously, we get:

$$K_{it} = \frac{P_{it}\alpha Q_{it}^{s}}{C_{it}} = \frac{P_{it}\alpha L_{it}W_{it}}{P_{it}\beta C_{it}} = \frac{\alpha L_{it}W_{it}}{\beta C_{it}} \quad (4.6)$$

Equation (4.7) further expresses the profit-maximizing output of the U.S. textile and apparel industries, which is derived by putting equation (4.6) into equation (4.3):

$$Q_{it}^{s} = A_{it}^{\lambda} \cdot (\frac{\alpha L_{it}W_{it}}{\beta C_{it}})^{\alpha} \cdot L_{it}^{\beta} = A_{it}^{\lambda} \cdot (\frac{\alpha L_{it}}{\beta} \cdot \frac{W_{it}}{C_{it}})^{\alpha} \cdot L_{it}^{\beta} \quad (4.7)$$

Third, in term of the behavior of U.S. total domestic demand for industry i in period t, assume:

$$Q_{it}^{d} = B \cdot P_{it}^{b_1} \cdot Y_{t}^{b_2} \quad (4.8)$$

where P_{it} denotes the market price of industry i in period t; Y_t is the real national income of the United States. b_1 measures the price elasticity of demand in a ceteris paribus condition, i.e. the percentage change of demand for industry i given one percentage change of market price when other factors hold constant; b_2 measures impact of aggregate income elasticity for industry i, i.e. the percentage change of the U.S. demand for industry i given one percentage change of U.S. national income. B is constant.

Finally, replacing Q_{it}^{s} and Q_{it}^{d} in equation (4.2) with equation (4.7) and (4.8), we have:

$$1 - IPR_{it} = \frac{Q_{it}^{s}}{Q_{it}^{d}} = \frac{A_{it}^{\lambda} \cdot (\frac{\alpha L_{it}}{\beta} \cdot \frac{W_{it}}{C_{it}})^{\alpha} \cdot L_{it}^{\beta}}{B \cdot P_{it}^{b_1} \cdot Y_{t}^{b_2}} \quad (4.9)$$

Take logarithm of both sides of equation (4.9), we can have:

$$Ln(1-IPR_{it}) = [\alpha \ln(\alpha) - \alpha \ln(\beta) - Ln(B)] + \lambda LnA_{it} + (\alpha+\beta)Ln(L_{it}) + \alpha Ln(\frac{W_{it}}{C_{it}}) - b_1 LnP_{it} - b_2 LnY_t$$

$$Ln(1-IPR_{it}) = \phi_0 + \phi_1 Ln(A_{it}) + \phi_2 Ln(L_{it}) + \phi_3 Ln(W_{it}) + \phi_4 Ln(P_{it}) + \phi_5 Ln(Y_t) \quad (4.10)$$

where $\phi_0 = \alpha \ln(\alpha) - \alpha \ln(\beta) - Ln(B) - Ln(C)$; $\phi_1 = \lambda$; $\phi_2 = \alpha + \beta$; $\phi_3 = \alpha$; $\phi_4 = -b_1$; $\phi_5 = -b_2$;

Equation (4.10) links the import penetration with the operation of the U.S. textile and apparel industries, although in an indirect way. On the left side of the equation, $1-IPR_{it}$ measures the share of U.S. domestic-made textile and apparel products in fulfilling the market demands in the United States. On the right side are variables reflecting the operation status of the U.S. textile and apparel industries. In particular, we are interested in the value of the following parameters:

ϕ_1 (elasticity of supply associated with productivity): which measures the impact of productivity change of the U.S. domestic textiles and apparel industries on its market share in relation to imports in the U.S. market, i.e. the market share changes of the U.S. domestic textile or apparel industry, given one percentage change of its productivity when other factors are held constant. As productivity is positively associated with the supply of U.S.-made textile and apparel, when imports directly compete with U.S. product, productivity growth will result in the right outward shift of curve S_{d1} in Figure 4-1. Therefore, we expect:

For the U.S. textile industry, $H_0 : \phi_1 > 0$; $H_1 : \phi_1 \leq 0$ (Hypothesis 1A)

For the U.S. apparel industry, $H_0 : \phi_1 \leq 0$; $H_1 : \phi_1 > 0$ (Hypothesis 2A)

ϕ_2 (elasticity of labor input): which measures the impacts of labor input (employment) of the U.S. textile and apparel industries on their market share in the United States in relation to imports, i.e. the market share changes of the U.S. domestic textile and apparel industries, given one percentage change of its labor input (employment) when other factors are held constant.

Similar as the case of productivity growth, when imports directly compete with U.S. products, the increase of labor supply will result in supply curve of the U.S. textile and apparel industries shifting right outward and domestic supply increasing market shares. Therefore, we expect:

For the U.S. textile industry, $H_0: \phi_2 > 0$; $H_1: \phi_2 \leq 0$ (Hypothesis 1B)

For the U.S. apparel industry, $H_0: \phi_2 \leq 0$; $H_1: \phi_2 > 0$ (Hypothesis 2B)

ϕ_3 (elasticity of wage level): which measures the impact of relative wage level of the U.S. textile and apparel industries on its market share in the United States in relation to imports, i.e. the market share changes of the U.S. domestic textile and apparel industries, given one percentage change of its relative wage level when other factors are held constant. When productivity is held constant, the rising wage level should be the result of rising product price as $MPL = ML \cdot P = W$. If imports directly compete with U.S. products, in this occasion, supply curve of the U.S. domestic textile and apparel industries will shift backward from S_{d1} to S_{d2} as shown in Figure 4-1. Therefore, we expect:

For the U.S. textile industry, $H_0: \phi_3 < 0$; $H_1: \phi_3 \leq 0$ (Hypothesis 1C)

For the U.S. apparel industry, $H_0: \phi_3 \geq 0$; $H_1: \phi_3 < 0$ (Hypothesis 2C)

ϕ_4 (elasticity of price elasticity): which measures the impact of market price on the market share of U.S. domestic made textile and apparel products, i.e. the market share change of the U.S. domestic made textile and apparel, given one percentage change of the market price when other factors are held constant. Figure 4-1 shows, when imports directly compete with U.S. products and both demand curve (D) and supply curve (S) are held constant, rising market price will encourage U.S. domestic textile and apparel industries increase supply and leave less demand for imports to fulfill. To be noted, if imports also increase because of the rise of market price, the supply curve S_1will shift right outward and post downward pressure on market price. Therefore, we expect:

For the U.S. textile industry, $H_0:\phi_4 > 0$; $H_1:\phi_4 \leq 0$ (Hypothesis 1D)

For the U.S. apparel industry, $H_0:\phi_4 \leq 0$; $H_1:\phi_4 > 0$ (Hypothesis 2D)

ϕ_5 (elasticity of demand/income elasticity): which measures the impact of aggregate demand of the United States (aggregate income) on the share of its domestic-made textile and apparel products in the market, i.e. the market share change of the U.S. domestic made textile and apparel, given one percentage change of the U.S. domestic aggregate demand (income). As showed in Figure 4-1, enlarged domestic demand will raise the market price and result in more domestic supply. Therefore, when imports directly compete with U.S. products, we expect:

For the U.S. textile industry, $H_0:\phi_5 > 0$; $H_1:\phi_5 \leq 0$ (Hypothesis 1E)

For the U.S. apparel industry, $H_0:\phi_5 \leq 0$; $H_1:\phi_5 > 0$ (Hypothesis 2E)

Data Source

Data used in this study came from various U.S. government agencies, which are the best sources available for official national-level aggregated industry and trade statistics. Except for otherwise noted, all data were collected at the 4-digit NAICS code level[1], so as to make industry performances and trade activities compatible with each other. More specifically:

For import penetration ratio (variable IPR), volumes of import for each 4-digit NAICS code sectors were measured in dollar terms and collected from the United States International Trade Commission (USITC) Interactive Tariff and Trade DataWeb. Domestic supply of each 4-digit

[1] Separate data for each specific 4-digit NAICS-code sector.

NAICS code U.S. textile and apparel industries was measured by the total value of shipments collected from the United States Census Bureau Annual Survey of Manufactures (ASM). In particular, by the Census's definition, value of shipment means the total value of all products shipped by the producers (Census, 2011a) [1]. Therefore, this index is more appropriate than production output to reflect the U.S. domestic supply of textiles and apparel in the market.

Employment level (variable L) of each 4-digit NAICS code U.S. textile and apparel industries was measured by the total number of employee provided by the United States Census Bureau Annual Survey of Manufacturers. Wage level (variable W) was measured by the average hourly earnings of all employees collected by the United States Bureau of Labor Statistics (BLS). By the definition of BLS, this average wage level cover all occupations in one industry, including both manufacturing and non-manufacturing functions (BLS, 2010c).

Productivity (variable A) of each 4-digit NAICS code U.S. textile and apparel industries was measured by the productivity index (year 2002=100) provided by the Bureau of Labor Statistics (BLS). According to BLS's definition, labor productivity is the "ratio of output of goods and services to the labor hours devoted to the production of that output." (BLS, 2010b).

Producer price index (PPI) of each 4-digit NAICS code U.S. textile and apparel industries provided by the BLS was used as the proxy for market price (variable P). According to the definition of BLS, PPI measures the average change over time in the selling prices received by domestic producers for their output (BLS, 2010d).

Last but not least, aggregate demand (income) in the United States was measured by Gross Domestic Product (GDP), which was provided by the United States Bureau of Economic Analysis (BEA, 2010a).

[1] As admitted by the Census, value of shipments was self-reported by firms (Census, 2011c). However, for the concerns of competition, firms may not always be honest. Unfortunately, this factor is out of control of this study.

Data used in this study range from 2002 to 2008. Year 2002 was the first time when statistics collected based on NAICS was available. Prior to that, industry activities in the United States were collected based on the Standard Industrial Classification (SIC) system, whose industry classification method was different and incompatible with NAICS. On the other hand, the latest statistics based on NAICS is updated until 2008.

Model Estimation and Statistical Test

$$Ln(1-IPR_{it}) = \phi_0 + \phi_1 Ln(A_{it}) + \phi_2 Ln(L_{it}) + \phi_3 Ln(W_{it}) + \phi_4 Ln(P_{it}) + \phi_5 Ln(Y_t) + \phi_6 Quota + \phi_7 t + c_i + \mu_{it} \tag{4.11}$$

Equation (4.11) is the empirical model of equation (4.10) which links the import penetration with the operation of the U.S. textile and apparel industries, although in an indirect way. All variables included in equation (4.10) remain the same meaning in equation (4.11). Two additional variables are included in equation (4.11):

One is the dummy variable $Quota$, which is used to capture the potential impacts of the elimination of the quota system on the import penetration level. Since 1960s, a series of quantitatively-restrictive measures in the name of “quota system” were imposed on the U.S. textile and apparel imports to prevent their flood into the U.S. market (Dickerson, 1999). It was until January 1, 2005 that the 40-year quota system was finally eliminated through a ten-year process according to the Agreement on Textiles and Clothing (ATC) under the World Trade Organization (WTO) (Dickerson, 1999; Nordas, 2004). As variable $Quota = 0$ for year 2002-2004 and $Quota = 1$ for year 2005-008, parameter ϕ_6 can reveal whether IPR has any structural changes in the post-quota era due to the significant changes of the” rules of game.”

Another variable is t, which is used to capture the potential time trend existed in the data. Without controlling the time trend may result in spurious regression problem (Wooldridge, 2002), especially when time-series data are not stationary.

Besides, c_i refers to the possible unobserved sectoral effect and μ_{it} denotes error terms. Because of the interconnection between textile industry and apparel industry, simply simulating the equation (4.11) individually for each 4-digit NAICS code is likely to result in biased estimation of parameters due to the correlation among μ_{it} for different textile and apparel subsectors (Wooldridge, 2002).

To achieve unbiased and consistent estimation, the panel data modeling technique is adopted in this study, which is specifically developed to tackle a dataset involving both cross-sectional and time-series data. Compared to the traditional cross-sectional regression, a panel data model has several advantages. First, panel data model can help solve the potential problem of cross-sectional heteroskedasticity in the dataset. Second, a panel data model can reveal the potential dynamics in the dataset which is unable to be detected by the cross-sectional regression. Third, as panel data consists of time series of T length on n parallel units, the total number of observations will be larger (Wooldridge, 2002).

Moreover, the generalized least square (GLS) method instead of pooled ordinary least square (POLS), is used in this study to ensure consistent and efficient estimation of the parameters. GLS has the advantages of tolerating certain extent of correlation among independent variables (Wooldridge, 2002; Wooldridge, 2006). This is particularly useful in this study given the linkage among productivity, wage level and employment size in equation (4.11). GLS will be conducted in the following steps:

First, Breusch and Pagan Lagrangian Multiplier (BP) test will be conducted to detect the presence of unobserved sectoral effects c_i. The hypothesis for BP test is as follows:

$H_0 : \sigma_c^2 = 0$, with no unobserved effects; and $H_1 : \sigma_c^2 \neq 0$, with unobserved effects

where σ_c^2 stands for the off-diagonal elements in residual $\hat{\Omega}$ derived from POLS estimation as shown in (4.3)

$$\hat{\Omega} = \begin{pmatrix} \sigma_c^2 + \sigma_u^2 & \sigma_c^2 & \cdots & \sigma_c^2 \\ \sigma_c^2 & \sigma_c^2 + \sigma_u^2 & \cdots & \vdots \\ \cdots & & \ddots & \sigma_c^2 \\ \sigma_c^2 & & & \sigma_c^2 + \sigma_u^2 \end{pmatrix} \quad (4.12)$$

BP statistics asymptotically follows the chi-squared distribution with one degree of freedom as shown in (4.13) (Lloyd, Morrissey & Osei, 2001):

$$BP = \frac{NT}{2(T-1)} \left[\frac{\sum_i \left(\sum_t \hat{\mu}_{it} \right)}{\sum_i \sum_t \hat{\mu}_{it}^2} - 1 \right]^2 \overset{a}{\sim} \chi_1^2 \quad (4.13)$$

,where $\hat{\mu}_{it}$ stands for the residual from the POLS estimations.

At the 95% confidence level, if *P-value* of the BP statistics is smaller than 0.05, null hypothesis is rejected, indicating the presence of unobserved effect; otherwise, the null hypothesis will be accepted, indicating no presence of unobserved effect. In the later case, the study will safely adopt the seemingly unrelated regression (SUR) technique to simulate the model (4.11).

Second, if presence of unobserved effect is suggested by the BP test, Hausman test will be further conducted to determine whether fixed effect (FE) model or random effect (RE) model is more appropriate for the dataset. The fundamental difference between FE model and RE model relies on their different assumptions about the correlation between unobserved sectoral effect c_i with other independent variables. For FE model, it assumes c_i is correlated with all independent variables in the model (4.11), while RE assumes the opposite.

The null hypothesis and alternative hypothesis for Hausman test are:

$$H_0 : E[c_i \mid Ln(A_{it}), Ln(L_{it}), Ln(W_{it}), Ln(P_{it}), Ln(Y_t)] = 0\,;$$

$$H_1 : E[c_i \mid Ln(A_{it}), Ln(L_{it}), Ln(W_{it}), Ln(P_{it}), Ln(Y_t)] \neq 0$$

The form of the Hausman statistics is expressed in (4.12)

$$H = (\hat{\phi}_w - \hat{\phi}_{FGLS})'[A\hat{v}ar(\hat{\phi}_w) - A\hat{v}ar(\hat{\phi}_{FGLS})]^{-1}(\hat{\phi}_w - \hat{\phi}_{FGLS})\ (4.13).$$

In equation (4.13), $\hat{\phi}_w$ denotes the within estimator based on fixed effect model, $\hat{\phi}_{FGLS}$ denotes the feasible GLS estimator of random effect model. $A\hat{v}ar(\hat{\phi}_w)$ denotes the asymptotic variance of $\hat{\phi}_w$ and $A\hat{v}ar(\hat{\phi}_{FGLS})$ denotes asymptotic variance of $\hat{\phi}_{FGLS}$. More specifically:

$$\hat{\phi}_w = (X'M_D X)^{-1} X'M_D y \quad (4.14)$$

where $M_D y = M_D X\phi + M_D\varepsilon$

$$\hat{\phi}_{FGLS} = (\sum_{i=1}^{N} X_i'\hat{\Omega}^{-1}X_i)^{-1}(\sum_{i=1}^{N} X_i'\hat{\Omega}^{-1}y_i)\ (4.15)$$

$$A\hat{v}ar(\hat{\phi}_w) = \left[\frac{\sum_i \sum_t (y_{it} - a_i - x_{it}\hat{\phi}_w)}{NT - N - K}\right][X'P_D X]^{-1} \quad (4.16)$$

Where $P_D = D(D'D)^{-1}D'$, $y = Da + x\phi + \varepsilon$

$$A\hat{v}ar(\hat{\phi}_{FGLS}) = \sigma_u^2[E(\breve{X}_i'\breve{X}_i)]^{-1}/g = \sigma_u^2[E[(x_{it} - \lambda\overline{x}_i)'(x_{it} - \lambda\overline{x}_i)]^{-1}/i \quad (4.17)$$

where $\lambda = 1 - \sqrt{\dfrac{1}{1 + T(\hat{\sigma}_c^2/\hat{\sigma}_u^2)}}$

Hausman test follows χ^2_M distribution, where the degree of freedom (df) M equals the number of element β which is 6 in this study. At the 95% significant level, if the *P-value* corresponding to H is smaller than 0.05, then we reject H_0 and choose FE model; if *P-value* corresponding to H is larger than 0.05, then we failed to reject H_0 and choose RE model.

Third, either choosing RE model or FE model, F-statistics will be conducted to test the overall statistical significance of model (4.11). For F-test,

$$H_0 : \phi_1 = \phi_2 = \phi_3 = \phi_4 = \phi_5 = 0$$

$$H_1 : \text{at least one of the } \phi_1, \phi_2, \phi_3, \phi_4, \phi_5 \neq 0$$

$$F = \left[\left(\sum_{i=1}^{N} \tilde{u}_i' \hat{\Omega}^{-1} \tilde{u}_i - \sum_{i=1}^{N} \hat{u}_i' \hat{\Omega}^{-1} \hat{u}_i \right) / \left(\sum_{i=1}^{N} \hat{u}_i' \hat{\Omega}^{-1} \hat{u}_i \right) \right] \sim \chi^2_{K-1} \quad (4.18)$$

. where $\tilde{u}$ denotes the residuals from constrained FGLS (i.e. following the null hypothesis).

At the 95% confidence level, if *P-value* corresponding to F statistics is smaller than 0.05, then we reject H_0, meaning all independent variables are statistically insignificant to the explanations of dependent variables. If *P-value* corresponding to H is larger than 0.05, then we failed to reject H_0.

Finally, t-test will be conducted to evaluate the significance of each independent variable.

$$H_0 : \phi_i = 0\,;\ H_1 : \phi_i \neq 0, \text{ where i=0…5}$$

$$\sqrt{N}(\hat{\phi}_{FEGLS} - \phi) \sim Normal(0, \sigma_u^2 \left[E(\ddot{X}_i' \ddot{X}_i) \right]^{-1}) \quad (4.19)$$

$$\sqrt{N}(\hat{\phi}_{REGLS} - \phi) \sim Normal(0, \sigma_u^2 \left[E(\breve{X}_i' \breve{X}_i) \right]^{-1}) \quad (4.20)$$

At the 95% confidence level, if $t \leq T_{0.25}$ or $t \geq T_{0.75}$, we rejected H_0, which suggests the statistical significance of ϕ_i; otherwise, we accept H_1 which means the effect represented by ϕ_i is insignificant.

Summary

This chapter develops an empirical model which links the import penetration with the operation of the U.S. textile and apparel industries. Based on the demand-supply functions, a number of factors, including the productivity, employment, wage level of the U.S. domestic industry, price of products in the U.S. market and the aggregate market demand are suggested having significant influences on the import penetration ratio of the U.S. textile and apparel markets. Data sources for model estimation and procedure of model estimation are also introduced in the chapter.

CHAPTER 5

RESULTS AND DISCUSSIONS

Results of Model Estimation

First, the Breusch and Pagan Lagrangian Multiplier (BP) test was conducted to see whether unobserved sectoral effect c_i was present. For the BP test, the null hypothesis (H_0) assumes no existence of unobserved sectoral effect, i.e. $H_0 : \sigma_c^2 = 0$ and $H_1 : \sigma_c^2 \neq 0$. Results of the BP best simulated by STATA 10.0 were shown in Table 5-1. As *P-value* for Chi-square is less than 0.05, therefore we reject the null hypothesis at 95% confidence level, i.e. unobserved sectoral effect c_i was suggested present in the empirical model (4.11).

Table 5-1 Results o Breusch and Pagan Lagrangian Multiplier Test

Chi-squares	*P-value*
58.00	0.00*

* denotes p<0.05.

Second, the Hausman test was conducted to see whether the unobserved sectoral effect c_i was correlated with other independent variables in equation (4.11). The result will provide necessary guidance on the selection between the fixed effect model (FE) and the random effect model (RE). The null hypothesis (H_0) assumes c_i has no correlation with productivity, employment, wage, market price and GDP. Results of the Hausman test simulated by STATA

10.0 are shown in Table 5-2 (A) and (B), respectively for the U.S. textile industry and the apparel industry.

For the U.S. textile industry, the *P-value*=0.08>0.05, therefore at 95% confidence level, therefore we fail to reject the null hypothesis. When unobserved sectoral effect c_i is suggested uncorrelated with other independent variables, both fixed effect model (FE) and random effect model (RE) can generate consistent estimation. However, as RE estimation usually is more efficient than FE (Wooldridge, 2002), therefore RE is chosen for studying the U.S. textile industry.

For the U.S. apparel industry, the *P-value*=0.01<0.05, therefore at 95% confidence level, we reject the null hypothesis. Because of the suggested correlation between unobserved effect and other independent variables, fixed effect model (FE) is chosen for studying the relationship between the U.S. apparel industry and import penetration level.

Table 5-2 (A) Result of the Hausman Test for the U.S. Textile Industry

Chi-squares	*P-value*
5.0	0.08

Note: cover NAICS 3131, 3132 and 3133
*denotes p<0.05.

Table 5-2 (B) Result of the Hausman Test for the U.S. Apparel Industry

Chi-squares	*P-value*
10.57	0.00*

Note: cover NAICS 3151, 3152 and 3159
*denotes p<0.05.

Third, RE and FE model were run by STATA 10.0 and the estimation results were shown in Table 5-3 (A) and (B).

Table 5-3 (A) Results of Random Effect Model on the U.S. Textile Industry

$Ln(1-IPR_{it})$	Productivity $Ln(A_{it})$	Employment $Ln(L_{it})$	Wage $Ln(W_{it})$	Market price $Ln(P_{it})$	GDP $Ln(Y_t)$	Quota *quota*	Time *t*
Textile	-0.018	-0.179**	0.17	0.50	-0.23	0.08	-2.52
industry	(0.06)	(0.04)	(0.54)	(0.45)	(1.09)	(3.75)	(7.31)
Constant: 6.01(135.02)*							
P-value for F-test of overall significance: 0.00**							

* denotes *p*<0.05, **denotes *p*<0.01.

Table 5-3 (B) Results of Fixed Effect Model on the U.S. Apparel Industry

$Ln(1-IPR_{it})$	Productivity $Ln(A_{it})$	Employment $Ln(L_{it})$	Wage $Ln(W_{it})$	Market price $Ln(P_{it})$	GDP $Ln(Y_t)$	Quota *quota*	Time *t*
Apparel	0.04	-0.02	-0.15	-0.50*	-0.12	-2.15	0.19
industry	(0.04)	(0.02)	(0.52)	(0.22)	(0.57)	(1.92)	(3.33)
Constant: 82.03 (66.5)							
P-value for F-test of overall significance: 0.00**							

* denotes *p*<0.05, **denotes *p*<0.01.

In both Table 5-3 (A) and (B), *P-value* of the F-statistics were smaller than 0.01 at the 95% confidence level. This suggests that overall the dependent variable $1-IPR_{it}$ which measures the share of U.S. domestic-made textile and apparel in the U.S. market, has strong correlation with independent variables describing the operation of the U.S. textile and apparel industries, namely productivity, employment, wage level, market price and GDP.

Relationship Between Imports and the U.S. Textile Industry: Empirical Results

Table 5-4 Relationship of Import Penetration and the U.S. Textile Industry: Empirical Results

Productivity	Employment	Wage	Market price	GDP	Quota elimination
Neutral	Cooperation	Neutral	Neutral	Neutral	Neutral

Table 5-4 transforms the estimation results in Table 5-3 (A) into category format that directly shows the relationship between import penetration and the operation of the U.S. textile industry. In general, if the estimated parameter is statistically significant at 95% confidence level, the result is categorized as "Cooperation" or "Competition" against the hypothesized value of parameters and their associated meanings. If the estimated parameter is statistically insignificant at 95% confidence level, i.e. we failed to reject the null hypothesis that $H_0 : \phi_g = 0$,where g stands for specific independent variables in equation (4.11), then the result is categorized as "Neutral." For a "Neutral" relationship, it means no evidence suggested that import penetration of the U.S. textile industry is directly affected by the changes of one particular independent variable.

Interesting enough, the hypothesized "competing" relationship between imports and the U.S. domestic textile output was not supported by the empirical results in Table 5-3 (A) and Table 5-4 at all. In most cases, import penetration level seems independent with the operation of the U.S. textile industry. Changes of the productivity and wage level of the U.S. textile industry were both suggested having no statistically significant impacts on the changes of the import penetration level. Neither did the market price nor aggregate U.S. demand show significant relationship with the import penetration level. The only exception occurs to the case of employment. Table 5-3 (A) shows that when other factors hold constant, a 1% change of the employment level in the U.S. textile industry will result in 0.5% change of its share in the U.S. market in opposite direction. This implies that expansion of the workforce in the U.S. textile industry will not help the U.S. textile industry gain more market share in the domestic market, but rather will result in more imports. Moreover, estimated parameter for the dummy variable *quota* is not statistically significant, suggesting that impacts of the quota elimination did not lead to the structural changes of the import penetration level in the U.S. textile industry.

Despite the inconsistency with hypotheses, the non-competing and even cooperative relationship between import penetration and the operation of the U.S. textile industry suggested by the empirical tests may still be explained by the following factors.

First, contrary to the public perception about the flood of imports and their negative impacts, the U.S. textile industry actually still maintains a fairly strong presence in the U.S. market. As shown in Table 5-5, for 4-digit NAICS textile sectors, the import penetration ratio (IPR) was still at a modest level and only had slight increase from 2002 to 2008. In particular, for yarn, fiber and thread mills sector (NAICS 3131) and finishing and coating mills sector (NAICS 3133), imports only accounted for a very small fraction of the total shipment value of the U.S. domestic textile industry in 2008. [1] Although figures in Table 5-5 could go upward, should IPR were calculated based on quantity, overall the U.S. textile industry appeared to be fairly stable at present. This phenomenon is also compatible with theories describing the development stages of textile complex such as Toyne (1984) and Kilduff (2005). It is argued that although textile and apparel industry in industrialized countries such as the United States has entered the stage of "significant decline," the industry won't completely disappear. Instead, despite contraction of the

[1] It is equally important to realize that the figure in Table 5-5 only reflects the direct market share competition between imported textiles and the U.S. domestic output. As mentioned earlier, many imported textiles indirectly entered into the U.S. market through imported apparel, which not only replaces U.S. domestic-made apparel products, but also cause shrinkage of the overall market demand for textiles in the United States. However, such market demand shrinkage caused by indirectly imported textiles was not reflected in Table 5-5.

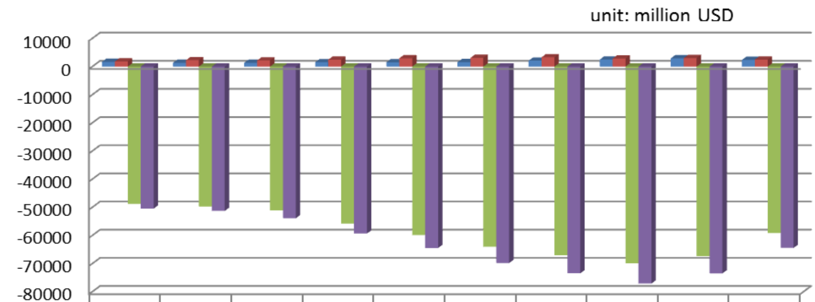
overall industry size, textile and apparel industry in these industrialized countries may still survive and continue existing by focusing on high-end capital and technology intensive textile products and achieving highly automated manufacturing (Kilduff, 2005; Chi, 2010).

Table 5-5 Import Penetration of the 4-digit U.S. Textile Sectors (by value) Unit:%

Item/year	2002	2003	2004	2005	2006	2007	2008
Fiber, yarn and thread (NAICS 3131)	5.78	6.00	8.02	7.37	7.83	6.99	6.69
Fabric (NAICS 3132)	22.60	21.89	21.16	22.21	22.87	25.57	26.25
Fabric finishing and coating (NAICS 3133)	4.86	6.08	6.77	7.41	8.82	10.05	11.70

Data source: USITC (2010), Census (2010)

Second, with shrinkage of U.S. domestic demand, operation of the U.S. textile industry relied more heavily on its performance in overseas markets. As shown in Table 2-9, export dependency rate of the U.S. textile industry continued to increase from 2002 to 2008, meaning the industry is turning more export oriented and growing proportion of industry output is finally shipped outside the U.S. border because of the disappearance of market demand domestically. This is particularly the case for fiber, yarn and thread mills sector (NAICS 3131), for which sales in the domestic U.S. market only accounted for 34.1% of its total output in 2008. Figure 5-1 further shows that since 2000, the United States maintains a stable trade surplus for yarn and fabrics, although the size of the surplus only accounted for a small fraction of the total trade deficit the two industries suffered. Overall, the export-orientation nature of the U.S. textile industry may explain the phenomenon why import penetration ratio could still rise when the U.S. domestic fiber, yarn and thread mills improve their productivity, enlarge employment and raise wage level. When the U.S. textile industry no longer specifically targets the domestic market, it seems reasonable that neither the rising market price nor the expanded aggregate demand (income) in the United States result in more industry supply.

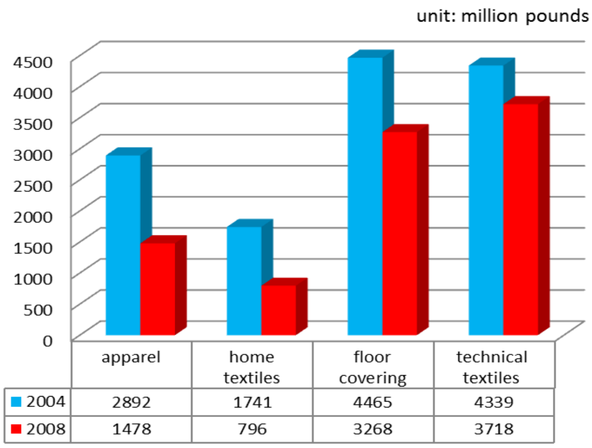


	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
yarn	1665	1342	1347	1540	1509	1557	2098	2480	2938	2372
fabric	1808	2256	2171	2422	2950	3091	3286	2843	3026	2467
apparel	-48818	-49705	-51096	-55761	-59877	-63975	-67030	-69902	-67385	-59159
total	-50470	-51277	-53895	-59319	-64443	-69800	-73442	-77101	-73451	-64418

Figure 5-1 Trade Balance of the U.S. Textile and Apparel Industries

Data source: OTEXA (2010a); OTEXA (2011)

Third, although the U.S. textile industry still largely focuses on domestic production after the adoption of various restructuring strategies, the industry may still have undergone substantial structural changes reflected on the nature of its output. While apparel used to be the single largest end user of textile products, Figure 5-2 (A) and (B) shows that, only 14% of the total U.S. fiber output was used for apparel production by the end of 2008, reduced from 18% in 2004. In comparison, technical textiles which was widely used in military, healthcare/medical, constructing, engineering and agriculture industries (Dickerson, 1999; Chi, 2010), have accounted for a lion’s share of total fiber usage in the United States. Around 41% U.S. fiber output was used for producing various technical textiles in 2008, increased substantially from 34% in 2004. It is likely that although imported textiles and the U.S. domestic textile output were counted under the same 4-digit NAICS code, they were heterogeneous in nature with different end-use purposes. From Table 5-6, it is further interesting to note that the current U.S. yarn and fabric imports were concentrated in two major categories: (1) raw materials commonly used for producing technical textiles as well as carpeting and home textiles; and (2) semi-finished fabrics that can be further processed for apparel manufacturing or dying and finishing. Such complimentary product structure between the U.S. textiles output and imported textiles provide another explanation as to why the relationship between import penetration and the operation of the U.S. textile industry is suggested no longer competing in nature but rather has become cooperative.



	apparel	home textiles	floor covering	technical textiles
2004	2892	1741	4465	4339
2008	1478	796	3268	3718

Figure 5-2 (A) U.S. Fiber Production by End Use [1]

[1] Data in Figure 5-2 refers to the different end use of fibers produced by the U.S. textile mills rather than the total fiber consumed in the U.S. market.

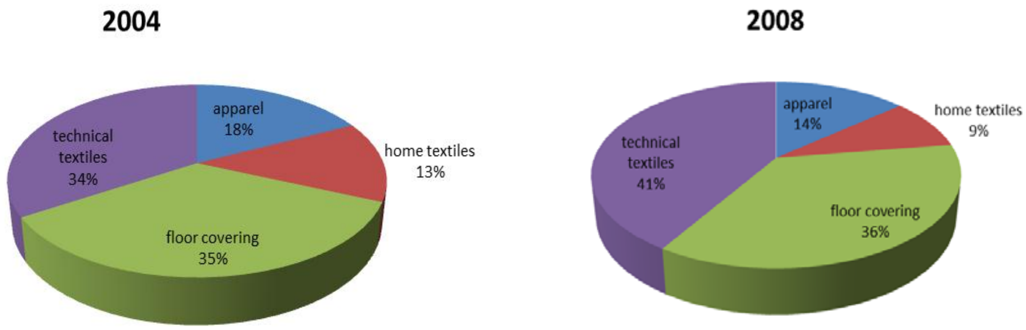


Figure 5-2 (B) U.S. Fiber Consumption by End Use

Data source: Fiber Organon (2009)

Table 5-6 Major Categories of U.S. Yarn and Fabric Imports (by value)

Yarn		Fabric	
Category (TC code)*	Percentage	Category (TC code)	Percentage
Non-textured filament (606)	33.48%	Non-woven fabric(223)	39.29%
Textured filament yarn (600)	19.29%	Special purpose fabric(229)	26.53%
Specialty yarn(201)	12.85%	Knit fabric(222)	15.79%
Others	34.37%	Others	18.40%

Data source: OTEXA (2010a)

Note*: TC code is a specific textile and apparel categorization system used by OTEXA; Figures in the table refer to the share of each specific product category in the total U.S. yarn and fabric imports (by value).

Relationship Between Imports and the U.S. Apparel Industry: Empirical Results

Hypothesis 2 argues that the relationship between imports and the U.S. domestic apparel industry should largely be cooperative in nature due to the fact the U.S. apparel industry has largely outsourced its manufacturing functions to factories in lower-cost developing countries and many apparel imports actually were brought into the United States by apparel firms themselves. This proposition is consistent with Table 5-6, which shows import penetration ratio of the U.S. apparel industry at the four-digit NAICS code level not only is much higher than the case in the textile industry, but also increased at a much faster pace. By the end of 2008, imports had fulfilled over 87% of the U.S. market demand for cut and sew apparel (NAICS 3152) and over 82% for apparel accessories (NAICS 3159). This figure could be even larger, should import penetration ratio were calculated in quantity.

Table 5-6 Import Penetration of the 4-digit U.S. Apparel Sectors (by value) Unit:%

Item/year	2002	2003	2004	2005	2006	2007	2008
Knitted apparel (NAICS 3151)	17.83	19.51	20.70	25.21	27.68	37.62	41.81
Cut and sew apparel (NAICS 3152)	70.30	70.36	67.78	77.69	79.13	84.63	87.60
Apparel accessories (NAICS 3159)	58.62	60.83	61.04	70.17	74.38	80.25	82.92

Data source: USITC (2010), Census (2010)

Table 5-7 transforms the estimation results in Table 5-3 (B) into category format that directly shows the relationship between import penetration and the operation of the U.S. apparel industry. The categorization method is the same as used for Table 5-4 which describes the U.S. textile industry. Hypothesis 2 was partially supported by the empirical results shown in Table 5-3 (A) and Table 5-7. Overall, operation of the U.S. apparel industry and imports were suggested "immune" to each other. Variables describing operation of the U.S. apparel industry were mostly found having no statistically significant impacts on the relative market position of imports in relation to U.S. domestic output. This means a rising import penetration in the U.S. market financially was not associated with negative development of the U.S. domestic apparel industry.

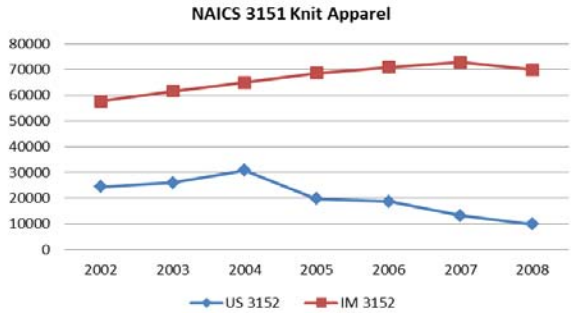
Moreover, empirical results suggest that holding other variables constant, 1% change of the U.S. market price would result in 0.5% decline of the market share of the domestic output in the same direction. This means imports will continue increasing when output of the U.S. domestic-made apparel move toward higher-end of the market. On the other hand, similar as the case in the U.S. textile industry, no evidence shows that elimination of the quota system had resulted in structural change of the overall level of U.S. apparel imports. [1]

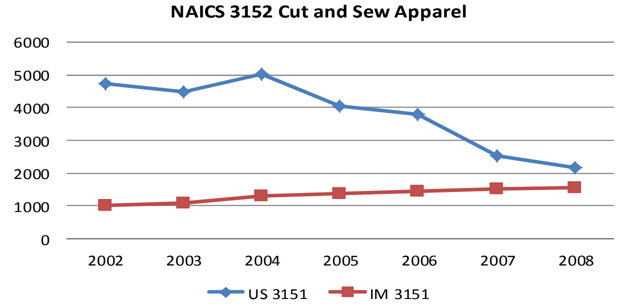
Table 5-7 Relationship of Import Penetration and the U.S. Apparel Industry: Empirical Results

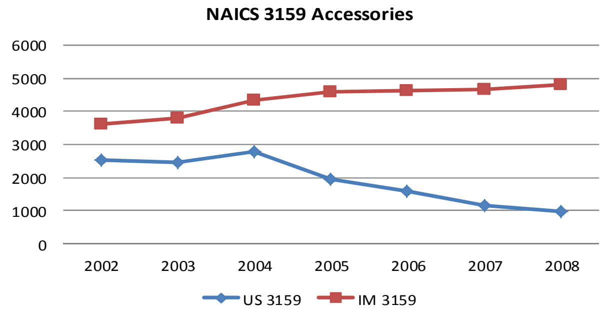
Productivity	Employment	Wage	Market price	GDP	Quota elimination
Neutral	Neutral	Neutral	Cooperation	Neutral	Neutral

More detailed scrutiny of the data would find that while the U.S. apparel imports remained a stable development from 2002 to 2008, the U.S. domestic apparel industry experienced significant shrinkage over the same period. As shown in Figure 5-3, the U.S. apparel imports for all the three 4-digit NAICS code sectors increased at a moderate rate from 2002 to 2008. In contrast, the U.S. domestic apparel output in these three sectors slumped sharply. Figure 5-4 further illustrates that, productivity of the U.S. apparel industry which was measured by the output per hour, also suffered from a deep decline from 2002 to 2008. Significant change occurred in the labor side as well. Although wage level of the U.S. apparel industry only had slight increase, size of employment indicated a steep downward trend as demonstrated in Figure 5-5.

[1] The “insignificant” results may due to two major reasons. First, quota elimination may exert more significant impacts on the country structure of import sources rather than the overall import volume which is more closely related to the macro economic conditions (Nordas, 2004). Second, the largest textile and apparel exporter to the United States—China, was still subject to quota restriction for many of its most competitive products until the end of 2008.







Unit: Million USD

Note: the prefix “US” refers to the U.S. domestic shipment value and the prefix “IM” refers to value of imports

Data source: USITC (2010); Census (2010)

Figure 5-3 Comparison of U.S. the Apparel Output and Imports from 2002 to 2008

(Index: 2002=100)

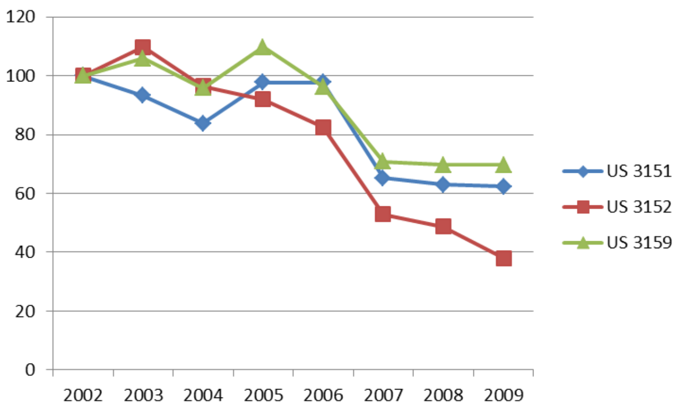
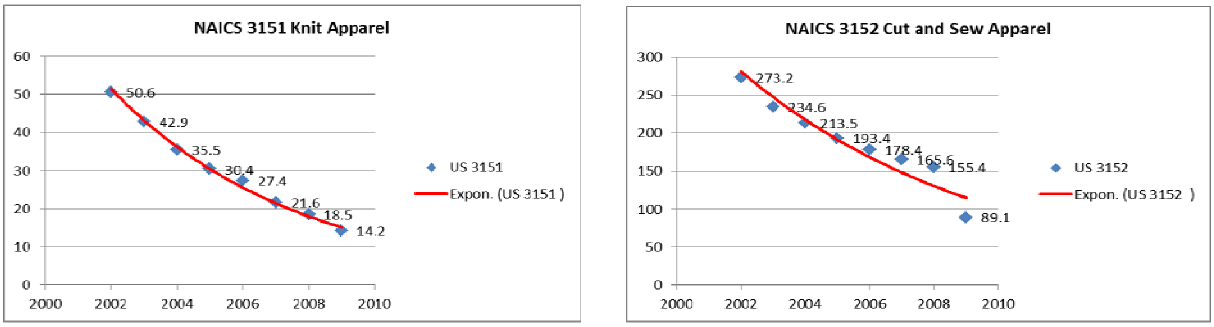
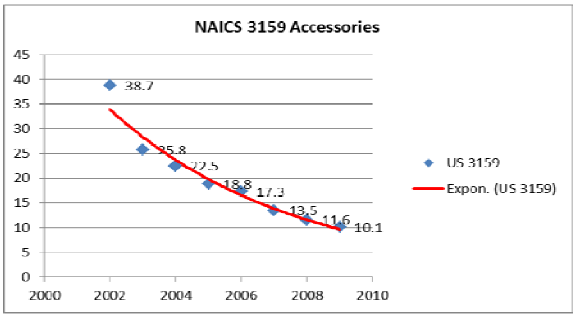


Figure 5-4 Productivity of the U.S. Apparel Industry from 2002 to 2008

Data source: BLS (2010)





Unit: Thousand

Note: curves in the graph are time trend lines simulated by Excel

Data source: BLS (2010)

Figure 5-5 Employment of the U.S. Apparel Industry from 2002 to 2008

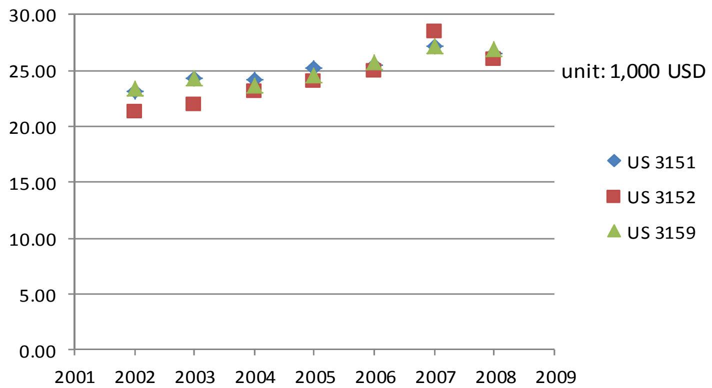


Figure 5-6 Wage Level of the U.S. Apparel Industry from 2002 to 2008

The statistically insignificant results and suggested "independent" development between imports and the operation of the U.S. apparel industry at 4-digit NAICS code level can be further explained from the following three aspects:

Table 5-8 Correlation Coefficient between PPI and Price of Apparel Imports from 2002 to 2008

		PPI 3151	PPI 3152	PPI 3159	IM 3151	IM 3152	IM 3159
PPI 3151	Pearson Correlation	1					
	P-value (2-tailed)						
PPI 3152	Pearson Correlation	-.043	1				
	P-value (2-tailed)	(.926)					
PPI 3159	Pearson Correlation	.035	.968**	1			
	P-value (2-tailed)	(.941)	(.000)				
IM 3151	Pearson Correlation	.681	-.607	-.564	1		
	P-value (2-tailed)	(.092)	(.149)	(.187)			
IM 3152	Pearson Correlation	.555	.601	.594	.137	1	
	P-value (2-tailed)	(.196)	(.153)	(.160)	(.770)		
IM 3159	Pearson Correlation	-.370	.445	.468	-.324	.419	1
	P-value (2-tailed)	(.414)	(.317)	(.289)	(.478)	(.349)	

Note: ** Correlation coefficient is significant at the 0.01 level (2-tailed); Prefix "IM" refers to apparel imports; prefix "PPI" refer to the Producer Price Index of the U.S. apparel output.

First, the results maybe due to the fact that the U.S. domestic apparel output and imported apparel target different segments of the U.S. market. As proposed in Figure 3-2, while imports largely fulfill the demand from mass market, the U.S. domestic-made apparel has narrowed their focus to niche markets in the United States whose preferences give more weight to added values, services or speed of product delivery that cannot be easily fulfilled by imports (Parrish et al, 2006a; Parrish et al., 2006b). Some niche markets are created by U.S. legislation, such as the Berry Amendment[1]. When target markets had little in overlap, it is not too surprising to see that operation of the U.S. apparel industry had minimum impacts on the ebb and flow of imports. Moreover, should the U.S. domestic-made apparel and imports target the same market, Producer

[1] Under the Berry Amendment, clothing, fabrics, fibers, yarns or other made-up textiles procured by the U.S. Department of Defense (DoD) need to be 100% made in the United States (DPAQ, 2011).

Price Index (PPI) of the U.S. domestic apparel shipments and price of imported apparel would be highly correlated with each other. In a free-market economy such as the United States, market price is one of the most important deciding factors guiding product supply and demand. However, results of the correlation analysis in Table 5-8 fail to indicate the close relationship between PPI and price of imported apparel. Additionally, the correlation coefficient of none of the three 4-digit NAICS apparel sectors was statistically significant at 95% confidence level.

Second, insignificance of the empirical results could also attribute to the fact that multiple parties in the U.S. softgoods industry are involved in importing apparel. In particular, as demonstrated in Figure 3-2, the U.S. apparel retailers (defined by NAICS 448) now frequently source products directly from overseas factories or vendors rather than solely relying on the supply from U.S. apparel firms (Gereffi, 1999). It has become a common practice for apparel retailers in the United States, especially those in large scale, to set up their respective departments solely responsible for global sourcing management.

Retailers' active involvement in apparel imports were largely driven by their growing interests in raising the share of private-label products in their total sales, aimed at building more customer loyalty based on exclusive product supplies and obtaining greater profit margin by eliminating apparel firms (Dickerson, 1999; UNIDO, 2009). However, under the NAICS system, apparel retailers (NAICS 448) and apparel firms (NAICS 315) were classified separately, which means their industry activities such as output, productivity and employment were independently collected and released. Unfortunately retailers' participation in international trade currently is not traced and reported by official statistical sources. Should apparel imports sourced by retailers have reached certain sizable scale but cannot be separated from total import volumes, it unavoidably weakens the sensitivity of data in reflecting the actual linkage between imports and the operation of the U.S. apparel industry (NAICS 315).

Third, the diversity of apparel products may further complicate the empirical estimation of the relationship between imports and the operation of the U.S. domestic firms. In contrast with the highly standardized textiles products such as fiber, yarn and fabric, apparel products are more heterogeneous in nature due to consumers' seeking of uniqueness. As illustrated in Figure 5-7, apparel imports from different sources have demonstrated a wide range of average price measured by dollars per square meters (SME). For example, imports from European Union countries were at a much higher price level than those coming from Caribbean Basin regions (CBI), implying apparel imports from these two regions were likely to target very different segments of the market. Some studies already argue that origin of imports matters for their impact on an importing country's domestic industries (Bernard, Jensen, & Schott, 2006). Similarly, the proposed cooperation between imports and the operation of the U.S. apparel industry could be more remarkable if empirical tests were narrowed down to a smaller group of apparel firms and imports from certain geographic regions.

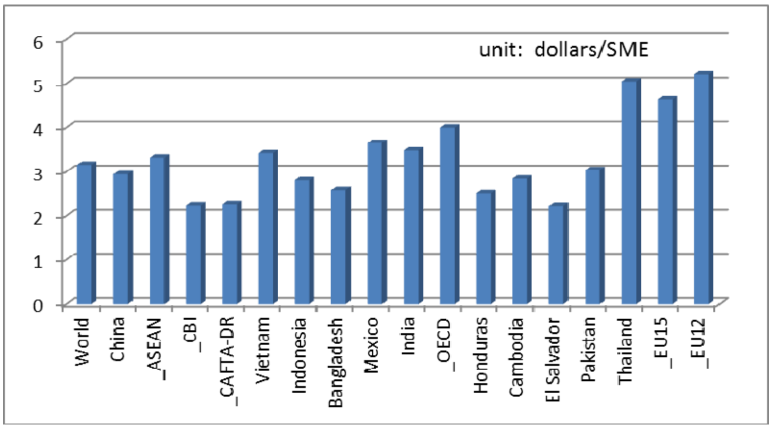


Figure 5-7 Unit Price of U.S. Apparel Imports from Major Sources in 2008

Data source: OTEXA (2010a)

Summary

This chapter presents and discusses results of empirical tests estimated by RE and FE panel model based on equation (4.11). Overall, Hypothesis 1 which proposes a competing relationship between imported textiles and the U.S. domestic textile output was not supported. Instead, a cooperative relationship of the two is suggested for aspects including productivity, wage level, and employment, with different combinations of statistical significance for specific four-digit NAICS code sectors. The empirical results also suggest that operation of the U.S. apparel industry and imports somehow were independent with each other. This partially supports Hypothesis 2 which proposes a non-competing relationship between imported apparel and the U.S. domestic apparel industry.

CHAPTER 6

CONCLUSIONS

Research Findings

This study conducted panel data model based on trade and industry data ranging from 2002 to 2008 at 4-digit NAICS code level to empirically test the relationship between import penetration and the operation of the U.S. textile and apparel industries. Two major findings of the study include:

First, the random effect model suggests that overall the U.S. textile industry formed a weak cooperative relationship with imports in the U.S. market. Specifically, employment size of the U.S. textile industry was found negatively associated with its market share in relation to imports in the U.S. market. However, no evidence showed that productivity and wage level of the U.S. domestic textile industry as well as the aggregate demand in the United States had statistically significant impacts on the import penetration level in the U.S. textile market. Neither was the elimination of the quota system in 2005 suggested having statistically significant impact on the overall import penetration level in the U.S. textile market.

Second, the fixed effect model suggests that U.S. apparel industry overall formed a neutral relationship with imports in the U.S. market. No evidence showed that productivity, employment and wage level of the U.S. domestic apparel industry as well as the aggregate demand in the United States had statistically significant impacts on the import penetration level in the U.S. apparel market. However, market price was found negatively associated with the share of U.S. domestic-made apparel in the U.S. market. Similar as the case in the U.S. textile industry, impacts of the quota elimination on the import penetration level in the U.S. apparel market was suggested not statistically significant.

Implications of the Findings

Findings of this study have several important implications both regarding the evolution of the U.S. textile and apparel industries and many broader issues critical to the global economy and its governance in the 21st century.

First, results of this study present a somewhat more encouraging picture of the current status of the U.S. textile and apparel industries than many previous studies suggested. Although pessimistic and stereotyped public images of a dying U.S. textile and apparel industry are to an extent still popular (Mock, 2002; NCTO, 2008), this study argues that the two industries overall have stabilized as a result of their sweeping restructuring. In particular, indexes often used to measure the size of an industry such as employment and output may not be solely appropriate for evaluating an industry which is undergoing significant structural changes. Instead, a more comprehensive and objective assessment of the conditions of the U.S. textile and apparel industries should take aspects such as product structure, productivity growth, demand for job occupations at different skill levels and export dependency rate into consideration. Overall, it is important to keep in mind that both the U.S. textile and apparel industries today are but a shadow of what they were even a decade ago. However, the two industries have survived through strategic transformation and are expected to continue development in the future. This provides some useful experiences for many other U.S. manufacturing sectors facing the similar difficulties of rising import and contraction of domestically-based production such as steel and automobile.

Second, findings of this study raise questions on the necessity of being nervous about rising imports, especially in the context of an integrated global economy in which global fragmented production and trade networks predominate. Although the benefits of division of labor and specified production based on each country's comparative advantage was already proposed and convincingly demonstrated by David Ricardo hundreds of years ago, unfortunately mercantilism philosophy never fades away and is still deeply rooted in the general public's perception about trade, even in the 21st century (Griswold, 2009).

Actually, the validity of arguments stressing the adverse impacts of rising imports largely depends on the assumption that imports and output of importer's domestic industry necessarily constitute a "zero-sum" game. However, this assumption is questionable when international trade in an integrated global economy today is no longer arm's-length transaction in nature (Cattaneo et al., 2010). Findings of this study also pose challenges to the "zero-sum" game assumption. In most cases, import penetration level was found either positively associated with the development of the U.S. textile and apparel industries or the two were suggested having no statistically significant relationship at all. This implies that not only has the U.S. apparel industry extensively incorporated imports into its global-based operation, but also the U.S. textile industry may benefit from imports and offshore production, although the detailed mechanism needs further exploration.

Furthermore, findings of this research call for shifting the orientation of the U.S. textile and apparel trade policy from focusing on import restriction to export promotion. To a large extent, curbing the growth of imports dominates the history of the U.S. textile and apparel trade policy over the past 40 years. From tariff barriers, voluntary export restraints (VER), the quota system, anti-dumping, countervailing duties to China-specific textile safeguard measures, a variety of policy tools were "creatively" invented to either quantitatively limit entry of imports or make them less price-attractive in the U.S. market (Dickerson, 1999; Lu et al., 2009). Such single-focused policy orientation nevertheless is the result of influential and persistent political lobbies from the U.S. domestic textile and apparel industries seeking protection from the government (Dickerson, 1999; NCTO, 2008). But on the other hand, it reflects policymakers' strong suspicion, skepticism and deep anxiety about rising imports and their presumed negative impacts on the health of the U.S. domestic industries. However, evidence provided in this study shows that with the adoption of various restructuring strategies, maintaining today's U.S. textile and apparel industries largely depend on the free flow of goods and services across the borders. Even if imports were restricted, those lost jobs—mostly low-skill types, would not simply go back to the United States as wished (Griswold, 2009). Instead, with the rising export dependency rate, it is the time that policymakers should more wisely spend precious policy resources to strengthen the competiveness of U.S. textiles and apparel products in the global marketplace which is with growing importance to the industries' future prosperity (OTEXA, 2010c).

Limitations of the Study

Despite of the interesting and meaningful results of the findings, several changes can be made to further improve the quality of the study.

First, it could be better if longer time-series data were used. Because of the limitation of data availability, the empirical test of this study was only able to capture performance of the U.S. textile and apparel industry and matchable import activities ranging from 2002 to 2008. Although this length of time meets the basic needs of running the RE panel data model, a longer time-series data will help improve the overall reliability of the estimation results by increasing the number of data points and degree of freedom for the model. However, cautions should also be given to the possible new “noises” brought in with data cross longer time span. For example, if data prior than 2002 were used in the model, how to deal with the China’s WTO accession effect as well as the correspondence of NAICS with other industry classification system previously used (such as SIC) should be carefully considered. Even within the years used in the study, this was a very significant transition period because the industry faced the final phase-out of quota in 2005, with the exception of certain remaining quota on Chinese products until the end of 2008 (Dickerson, 1999; Nordas, 2004; Lu et al., 2009). Additionally, dynamic panel data model could be needed to capture the possible time-variant structural changes of the U.S. textile and apparel industries when longer timespan data were used.

Second, it could be better if empirical test can be conducted at even more disaggregated data level. From results of this study, it seems like analysis at the 4-digit NAICS code level may not be sufficient enough to fully reveal the actual interactions between imports and the operation of the U.S. textile and apparel industries. The heterogeneity of different sub-sectors within the textile and apparel industries might also cause the insignificance of the estimation results. Therefore, more insightful conclusions could be drawn in the future if conduct analysis at the 5 or 6-digit NAICS code level.

Third, the study could be improved if the interactions between the textile industry and the apparel industry can be taken into consideration. In this study, the relationship between imports and the operation of the U.S. textile and apparel industries were evaluated based on products within the same NAICS-code sector. However, given the nature of textile and apparel manufacturing, in reality both the U.S. textile mills and apparel firms could use imported input made outside the U.S. border. Results of the empirical test also imply that the U.S. textile mills may use imported intermediate inputs. A more comprehensive and objective evaluation of the relationship between imports and the U.S. domestic textile and apparel industry should take such cross-sector connections into consideration.

Fourth, the study can be further improved if the relationship between rising imports and the structural changes of the U.S. textile and apparel industries can be evaluated. Instead of just choosing variables traditionally used to measure the size of the industry, variables such as product structure, structure of occupations and capital/labor ratio which can better reflect the structural changes of the U.S. textile and apparel industries could be added to the model.

Last but not least, structure of the empirical model can be further improved. In specific, another way to tackle the potential endogeneity problem among the independent variables is by using the instrumental variable version of the RE or FE estimator. On the other hand, future research should also take the potential existence of stochastic trends in the dataset into consideration. With the presence of stochastic trends, the dataset will be non-stationary and may lead to biased estimation even when time trend variable t is included in the model. As one solution, the Dickey-Fuller test or related tools can be conducted in the future to detect the potential existence of stochastic trends.

Look into the Future

Restructuring of the U.S. textile and apparel industries did not stop by the end of 2008. On the contrary, a new round of restructuring just unfolded because of the most recent world financial crisis.

With the outbreak of the subprime mortgage crisis in 2008, the U.S. economy quickly suffered from its most serious recession since the 1930s. Thanks to the swift response to the crisis by leading world economies in a joint effort, the financial crisis finally came to an end in late 2010 (Wolf, 2011). However, post-crisis economic recovery means anything but simply returning to the past. Instead, structural adjustment involved in the post-crisis recovery has taken the U.S. economy into a brand new era with fundamental changes in the way it operates (Richard, 2010). In particular, two important features of the post-crisis recovery have far reaching impacts on the future landscape of the U.S. textile and apparel industries:

First, the world will have a two-speed economic recovery. It is predicted that developed economies, such as the United States and many Western European countries, will remain low-rate economic growth and high-level unemployment for an extended period of time (Richard, 2010). In comparison, emerging economies such as the BRIC countries (namely Brazil, Russia, India and China; South Africa was officially admitted as a BRIC nation on December 24, 2010) not only have performed remarkably well in the post-crisis recovery, but also have demonstrated their huge market potentials underpinned by the local rising middle class. According to Figure 6-1, the Asia-Pacific region, covering China, India and many quickly rising economic powers, is predicted to grow into the world largest apparel consumption market by year 2014. For the buyer-driven textile and apparel industries (Gereffi, 1999), such contrasting market outlook generates incentives for a new round of “going global,” featured by market expansion into emerging economies rather than simply treating them as low-cost sourcing destinations.

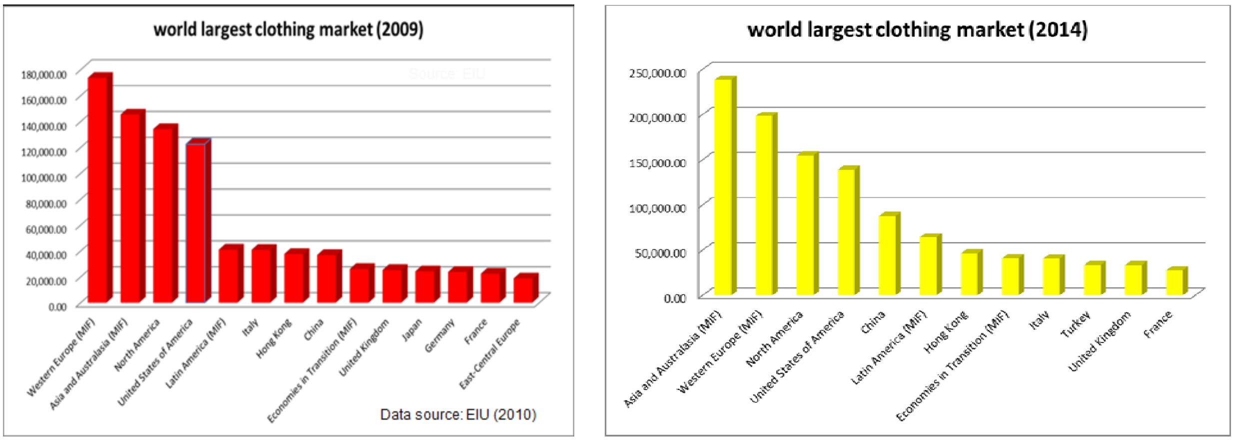


Figure 6-1 World Largest Clothing Market in 2009 and 2014

Data source: Economist Intelligence Unit (EIU), 2010

Second, the post-crisis recovery will be characterized by "green movement." To large extent, the post-crisis recovery is driven by the advancement and application of green technologies and the rising demand for building a low-carbon economy (Reichard, 2011). For the U.S. textile and apparel industries, this "green movement" on the one hand may create a brand new "green market" supported by consumers' rising awareness about environment and sustainability. On the other hand, adoption of green technologies in the production process and implementation of stricter environmental-standard regulations may provide the U.S. textile and apparel industries a unique opportunity to reshape their global competitiveness under "new rules of the game."

The sweeping macro-economic environment shift in the post-crisis era poses challenges as well as opportunities very different from the rising imports in the past to the U.S. textile and apparel industries. In response, future restructuring of the U.S. textile and apparel industries is expected to place more emphasis on new market expansion and business model innovation, which may further complicate the relationship between import penetration and the operation of the U.S. domestic textile and apparel industries. Specifically, three potential movements are interesting to watch:

1. Intensified competition between U.S. apparel firms and U.S. apparel retailers due to their increasingly blurred business boundaries.

In particular, in the post-crisis era, not only the U.S. apparel retailers (NAICS 448) are expected to continue their private-label expansion strategy by taking a more active participation in direct sourcing. Also, the U.S. apparel firms (NAICS 315) have shown growing ambitions to enter retail business with the purposes of directly reaching consumers and maximizing their brand equity (Gereffi & Frederick, 2010). It is particularly interesting to note that the traditional "branded manufacturers" are further transforming into "marketers" as a result of the upgrading of the global apparel value chain. For example, VF Corporation, a leading U.S. apparel firm used to focus on supplying U.S. retailers, have very recently defined "expanding direct-to-consumers business" as one of their six key growth drivers (VF, 2011).

Influences of the business innovation of the U.S. apparel firms and retailers are far beyond the U.S. border, but rather exert far-reaching ripple effects on the composition, governance and upgrading path of the whole global apparel value chain. For example, developing countries, like China, have been eager for years to move up in the apparel value chain and undertake more value-added functions such as ODM (original design manufacturing) or OBM (original brand manufacturing) (Cattaneo et al., 2010). However, when retailers began to play active roles in direct sourcing like apparel firms and retailers' competitive edge happen to be product development and branding, whether developing countries are still in need to "upgrade" and engage in ODM or OBM functions could be a question. The future roles of upper-tier traditional newly industrialized countries/regions (NICs) such as Hong Kong, South Korea, Singapore and Taiwan in the new global apparel value chain are also interesting to watch.

2. Expansion in overseas markets

Because of the stagnant growth potential in the U.S. domestic market, for the first time in history, the U.S. textile and the apparel industries began to shift from their inward-looking strategy to attaching importance to sales opportunities in overseas markets. Besides the traditional means of export, Figure 6-2 shows that the U.S. textile and apparel industries as well as the apparel retailers have quickened their global expansion through foreign direct investment (FDI) since 2007 (BEA, 2010a). Even when the world economy was still deeply trapped in recession from 2008 to 2009, FDI made by the U.S. apparel retailers still achieved 16.7% annual growth.

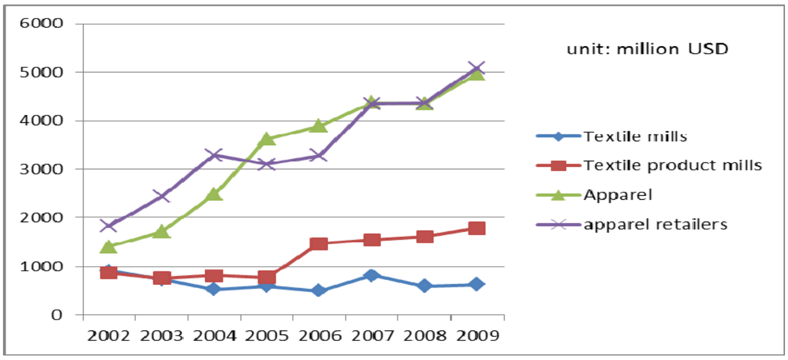


Figure 6-2 Foreign Direct Investment Made by the U.S. Softgoods Industry

Data source: U.S. BEA (2010b)

Adoption of the export-orientation strategy also imposes huge influences on the future outlook of the U.S. textile and apparel industries and raises a number of new questions. For example, where is the export market for U.S.-made textiles and clothing? Are existing free-trade agreements effective in promoting U.S. textile products in the global market as expected? Do

U.S. apparel retailers need to adopt new sourcing strategies in support of their sales in foreign markets? Will cross-border horizontal mergers and acquisitions or integrations increase? Moreover, if exports become a new feature of the U.S. textile and apparel industries, will traditional theories describing the evolution stages of the textile and apparel industries need to be rewritten or revised?

3. Igniting the "green revolution."

The adoption of various green technologies in the U.S. textile and apparel industries not only can generate positive environmental impacts, but also have huge implications on the shaping of new industry structures and "rules of the game." It is far from certain that developing countries can maintain competitiveness when "green textile and apparel" manufacturing are more dependent on technology advancement, capital abundance and capabilities for compliance with stricter environmental standards rather than low labor cost. Composition and operation of the global value chain for "green products" are further complicated by the strong financial support provided by governments in developed countries with the purpose of boosting their domestic "green sector." It is deeply worried that the huge amount of "green subsidies" launched by developed countries may constitute new trade barriers and cause similar severe trade and production distortions as did in the agriculture sector (James, 2009). At the legislation side, both at the national and multilateral level, new rules regulating the emission of carbon and other pollutants are under negotiation and review. The potential passage and enforcement of climate change legislations including the controversial carbon tariff mechanism may add additional uncertainty to the future landscape of the U.S. textile and apparel industries and trade patterns.

In summary, Figure 6-3 describes the prospect for the future relationship between the U.S. textile and apparel industries and imports by taking the post-crisis restructuring into consideration. Compared to Figure 3-1 and Figure 3-2, three distinct changes in Figure 6-3 are worth noticing: First, the U.S. textile and apparel industries are expected to have more frequent and complicated interaction with their counterparts in foreign countries. As a consequence, the relationship between imports and the operation of the U.S. textile and apparel industries will be even more difficult to be simply described as competition or cooperation in nature. Second, due to the innovation of business functions, new players in the global softgoods value chain might emerge in the future. In particular, a new type of business consortium combining the current functions of retailers and apparel firms are likely to predominate. Third, the U.S. textile and apparel industries will have an even more global-based operation, both for production and marketing. In particular, when some countries undertake dual roles both as a sourcing destination and an overseas sales market, we may see new supply chain management models and strategies adopted by the U.S. textile and apparel industries.

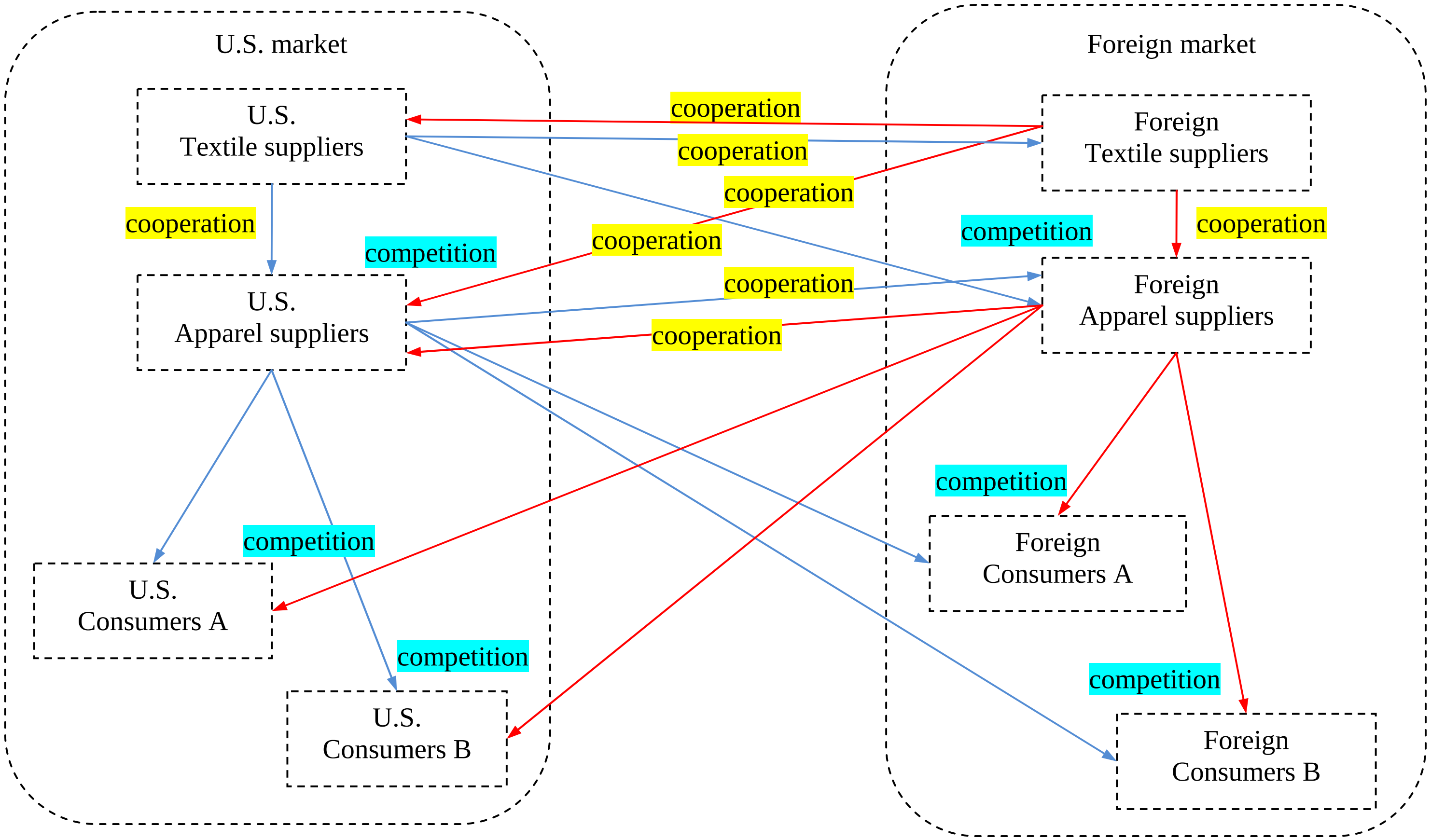


Figure 6-3 Prospect for the Future Relationship between U.S. Textile and Apparel Industries and Imports[1]

[1] In the above figure, if two players constitute supply-demand relationship (such as the U.S. textile suppliers with the U.S. apparel suppliers), then they are assumed forming business partnership. However, if two players target the same potential customers (such as the foreign textile suppliers and the U.S. textile suppliers both can provide textile inputs to the U.S. apparel suppliers), then they are assumed competing with each other for that specific shared market.

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APPENDIX: STATA CODE AND RESULTS

```
. encode industry, generate (industry1)

. xtset industry1 year, yearly
       panel variable:  industry1 (strongly balanced)
        time variable:  year, 2002 to 2008
                delta:  1 year


. xttest0

Breusch and Pagan Lagrangian multiplier test for random effects

        dipr1[industry1,t] = Xb + u[industry1] + e[industry1,t]

        Estimated results:
                         |       Var     sd = sqrt(Var)
                ---------+-----------------------------
                   dipr1 |      150.5       12.26784
                       e |   3.657779       1.912532
                       u |    170.056       13.04055

        Test:   Var(u) = 0
                             chi2(1) =    58.00
                         Prob > chi2 =     0.0000


. xtreg dipr1 productivity employment wage price gdp quota t, re

Random-effects GLS regression                   Number of obs      =        21
Group variable: industry1                       Number of groups   =         3

R-sq:  within  = 0.5344                         Obs per group: min =         7
       between = 0.9853                                        avg =       7.0
       overall = 0.8422                                        max =         7

Random effects u_i ~ Gaussian                   Wald chi2(7)       =     69.39
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
       dipr1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
productivity |  -.0181175     .06281    -0.29   0.773    -.1412229    .1049879
  employment |  -.1797671    .039115    -4.60   0.000     -.256431   -.1031032
        wage |    .172138    .540024     0.32   0.750    -.8862896    1.230566
       price |   .5023925   .4543678     1.11   0.269    -.3881521    1.392937
         gdp |  -.2307872   1.095456    -0.21   0.833    -2.377842    1.916268
       quota |   .0818189   3.753863     0.02   0.983    -7.275617    7.439255
           t |  -2.523507   7.318847    -0.34   0.730    -16.86818    11.82117
       _cons |   6.014355   135.0274     0.04   0.964    -258.6346    270.6633
-------------+----------------------------------------------------------------
     sigma_u |          0
     sigma_e |  2.6065597
         rho |          0   (fraction of variance due to u_i)
------------------------------------------------------------------------------

. estimates store rehat
```

```
. xtreg dipr1 productivity employment wage price gdp quota t, fe

Fixed-effects (within) regression               Number of obs      =        21
Group variable: industry1                       Number of groups   =         3

R-sq:  within  = 0.6930                         Obs per group: min =         7
       between = 0.5046                                        avg =       7.0
       overall = 0.5535                                        max =         7

                                                F(7,11)            =      3.55
corr(u_i, Xb)  = -0.2827                        Prob > F           =    0.0302

------------------------------------------------------------------------------
       dipr1 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
productivity |   .0934699   .0788291     1.19   0.261    -.0800318    .2669717
  employment |  -.0859614   .1178659    -0.73   0.481    -.3453824    .1734596
        wage |  -1.012916    .704053    -1.44   0.178    -2.562527    .5366938
       price |   .5090885   .4377973     1.16   0.270    -.4544968    1.472674
         gdp |  -.4630796    .942532    -0.49   0.633    -2.537579    1.611419
       quota |   .9958288   3.290401     0.30   0.768    -6.246294    8.237952
           t |   .3211241   6.567945     0.05   0.962    -14.13483    14.77707
       _cons |   39.31886   115.9424     0.34   0.741    -215.8686    294.5063
-------------+----------------------------------------------------------------
     sigma_u |  4.5702398
     sigma_e |  2.6065597
         rho |  .75455752   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(2, 11) =     3.44              Prob > F = 0.0691

. estimates store fehat

. hausman fehat rehat, constant sigmamore

Note: the rank of the differenced variance matrix (2) does not equal the number of
        coefficients being tested (8); be sure this is what you expect, or there may be
        problems computing the test.  Examine the output of your estimators for anythi
        unexpected and possibly consider scaling your variables so that the coefficien
        are on a similar scale.

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     fehat        rehat         Difference          S.E.
-------------+----------------------------------------------------------------
productivity |    .0934699    -.0181175        .1115875        .0678406
  employment |   -.0859614    -.1797671        .0938057        .1325861
        wage |   -1.012916      .172138       -1.185055        .6246605
       price |    .5090885     .5023925         .006696        .2391415
         gdp |   -.4630796    -.2307872       -.2322924        .1480911
       quota |    .9958288     .0818189        .9140099        .8948621
           t |    .3211241    -2.523507        2.844631        2.402299
       _cons |    39.31886     6.014355        33.30451        16.06379
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(2) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        5.00
                Prob>chi2 =      0.0820
                (V_b-V_B is not positive definite)
```

```
. xtreg dipr1 productivity employment wage price gdp quota t, re

Random-effects GLS regression                   Number of obs      =        21
Group variable: industry1                       Number of groups   =         3

R-sq:  within  = 0.6787                         Obs per group: min =         7
       between = 0.9910                                        avg =       7.0
       overall = 0.8903                                        max =         7

Random effects u_i ~ Gaussian                   Wald chi2(7)       =    105.52
corr(u_i, X)       = 0 (assumed)                 Prob > chi2        =    0.0000

------------------------------------------------------------------------------
       dipr1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
productivity |   .0852952   .0824671     1.03   0.301    -.0763373    .2469277
  employment |  -.0128967   .0113078    -1.14   0.254    -.0350596    .0092661
        wage |  -.3176523   1.041028    -0.31   0.760     -2.35803    1.722725
       price |   .8604709   .1386762     6.20   0.000     .5886705    1.132271
         gdp |   .8826292   1.052085     0.84   0.402     -1.17942    2.944678
       quota |  -3.300525   3.819493    -0.86   0.388    -10.78659    4.185544
           t |  -6.148253   6.034568    -1.02   0.308    -17.97579    5.679282
       _cons |  -159.6522   103.4368    -1.54   0.123    -362.3846    43.08018
-------------+----------------------------------------------------------------
     sigma_u |          0
     sigma_e |  1.1969098
         rho |          0   (fraction of variance due to u_i)
------------------------------------------------------------------------------

. estimates store rehat


. xtreg dipr1 productivity employment wage price gdp quota t, fe

Fixed-effects (within) regression               Number of obs      =        21
Group variable: industry1                       Number of groups   =         3

R-sq:  within  = 0.9296                         Obs per group: min =         7
       between = 0.2684                                        avg =       7.0
       overall = 0.0265                                        max =         7

                                                F(7,11)            =     20.77
corr(u_i, Xb)  = -0.4422                        Prob > F           =    0.0000

------------------------------------------------------------------------------
       dipr1 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
productivity |   .0435173   .0410029     1.06   0.311    -.0467295    .1337642
  employment |  -.0235933   .0225876    -1.04   0.319    -.0733082    .0261217
        wage |  -.1594703   .5222263    -0.31   0.766    -1.308883    .9899421
       price |    -.50469   .2281615    -2.21   0.049     -1.00687    -.00251
         gdp |  -.1265974   .5731337    -0.22   0.829    -1.388056    1.134861
       quota |  -2.154812   1.926127    -1.12   0.287    -6.394189    2.084564
           t |   .1936172   3.337465     0.06   0.955    -7.152094    7.539328
       _cons |   82.03893    66.5037     1.23   0.243    -64.33472    228.4126
-------------+----------------------------------------------------------------
     sigma_u |  8.0723433
     sigma_e |  1.1969098
         rho |  .97848808   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(2, 11) =    23.98             Prob > F = 0.0001

. estimates store fehat
```

```
. hausman fehat rehat, constant sigmamore

Note: the rank of the differenced variance matrix (2) does not equal the number of
        coefficients being tested (8); be sure this is what you expect, or there may be
        problems computing the test.  Examine the output of your estimators for anythi
        unexpected and possibly consider scaling your variables so that the coefficien
        are on a similar scale.

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     fehat        rehat         Difference          S.E.
-------------+----------------------------------------------------------------
productivity |    .0435173     .0852952       -.0417779        .0286982
  employment |   -.0235933    -.0128967       -.0106966        .0467534
        wage |   -.1594703    -.3176523         .158182        .3912091
       price |     -.50469     .8604709       -1.365161        .4656715
         gdp |   -.1265974     .8826292       -1.009227        .6186926
       quota |   -2.154812    -3.300525        1.145713        1.495367
           t |    .1936172    -6.148253         6.34187        3.754699
       _cons |    82.03893    -159.6522        241.6911        96.73636
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(2) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       10.57
                Prob>chi2 =      0.0051
                (V_b-V_B is not positive definite)
```

VITA

Sheng Lu was born in 1982 in Shanghai, China. From 2000 to 2004, Sheng studied at Donghua University (the former China Textile University) majored in International Economics and Trade with a Bachelor of Science degree in Economics. Since 2004, Sheng studied Industrial Economics (focusing on the textile and apparel industries) at Donghua University under the advisement of Professor Qingliang Gu and Professor Ting Li. Sheng received his Master of Science degree in Economics in 2007.

In August 2007, Sheng was admitted to the doctoral program in Department of Textile and Apparel Management at University of Missouri-Columbia. Under the advisement of Dr. Kitty Dickerson, Sheng's key research areas include textile and apparel industry in the global economy, international trade and trade policy.