PANEL DATA ANALYSIS OF TRADE POLICY EFFECTS ON U.S. TEXTILE INDUSTRIES

by

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Abstract

By applying a gravity model, the study confirms that devalued currencies of Asian exporters of textile products and liberalization of trade policies have significantly contributed to the increased imports of textile products to the U.S. Implications are derived from the abrogation of the WTO's Agreement on Textiles and Clothing (ATC).

Key Words:

textile and apparel industry, trade liberalization, exchange rate policy, multi-fibre arrangement, agreement on textiles and clothing, NAFTA, WTO, gravity model

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Introduction

The convergence of trade liberalization policies, the global financial crisis of 1997, and exchange rate policies stemming from the financial crisis are often blamed for the looming challenges facing the U.S. textile industry complex. On January 1, 2005 the Agreement on Textiles and Clothing (ATC) of the World Trade Organization (WTO) will end, and with it the quota system for international commerce in textiles and clothing that has controlled the imports of textiles and apparel into the U.S, completing a 10-year-long phase-out process. Consequently, from January 1, 2005 the textiles sector would be fully integrated into the WTO's rule of maintaining only tariffs as a market entry requirement. It is expected that trade in textiles and apparels will undergo monumental structural changes, with potential implications for many states in the southeastern U.S. where the industry complex is disproportionately located.

Press reports in North Carolina and other states that have historically depended on the industry complex recount past job losses from previous trade policy changes such as the NAFTA. However, a report by Patterson (2004) contends that the removal of quotas by the WTO will entirely destroy the industry. The reports cite recent trade advantages by East Asian countries, such as China. A coalition of textile associations is also cited as estimating the closure of 1,300 U.S. textile plants that will cause 650,000 more employees to lose their jobs. How did the industry complex get to this impasse?

To answer this question, first it is important to discern, *inter alia*, to what extent policies stemming from recent global trade agreements and exchange rate policies have impacted imports of textile and apparel products into the U.S. Second, what implications can be derived from the economic adjustment effects of these policy changes? We begin with background information on the U.S. industry complex.

Characteristics and Performance of the Textile and Apparel Industry

The U.S. textile and apparel industry is the third largest complex among basic U.S. manufacturing industries. It contributes 0.5% to the U.S. GDP, 3% of total value-added in industrial manufacturing, and about 1 million employees (U.S. Department of Labor). The industry complex is the largest manufacturing employer in eight key states in the Southeast U.S., where they are mainly located in rural areas. However, the key apparel firms tend to be located in metropolitan areas, particularly in New York, Pennsylvania and California (Dickerson, 1999).

Frequently, supporters of trade agreements, such as the WTO and NAFTA, tout the benefits in expanding exports while keeping silent on the impacts of rapid import growth (Zoellick, 2001). Mainly because of the labor-intensive nature of the industry, many developing countries have attempted to use their comparative advantages in relatively abundant and cheaper labor to produce and export textile products as the primary catalyst for their economic growth. Therefore, the U.S. textile and apparel industry complex has experienced steadily increasing trade deficits through the late 1980s and early 1990s. But these deficits have actually escalated rapidly through the 1990s; a period when the NAFTA and WTO came into being (Figure 1). Whereas total exports grew from about $12 billion in 1994 to $15 billion in 2003, imports grew even more from $45 billion to $83 billion during the same time period. Therefore, trade deficits for the industry complex have more than doubled from about $33 billion in 1994 to $68 billion in 2003. Consequently, a *prima facie* case can be made that from 1994 through 2003, growing trade deficits in the textile and apparel industry complex were, at least in part, responsible for eliminating an estimated net total of 586,000 jobs from the U.S. economy.

The 1997-98 global financial crises are also blamed for exacerbating the trade woes facing the industry. Following the crisis the currencies of almost all the major textile and apparel

exporting countries in Asia collapsed, followed by imports of low-priced textile and apparel products from Asia into the U.S. Indeed, U.S. textile imports from Asia grew precipitously from $28.5 billion in 1996 to $40.9 billion in 2001. At its zenith in 2000, textile imports from the major Asian exporters amounted to $34.8 billion. U.S. textile imports from China alone rose from $8.81 billion to $10.24 billion during the period.

Trade in textiles and apparel has historically been governed by quantitative restrictions based on the Multi-Fibre Arrangement (MFA). From the 1970s through 1994 the MFA, although a major exception to the General Agreement on Tariffs and Trade (GATT) rules, governed the bulk of world textile and apparel trade, with textile and clothing quotas being negotiated bilaterally between trading partners. However, the WTO ratification of the 1995 Agreement on Textiles and Clothing provided significant changes in sector liberalization that resulted in dramatic increase in textile and apparel trade. The ATC will phase out the MFA restrictions on January 1, 2005, effectively ending quantitative restrictions that have historically protected the U.S. market.

Regional trade agreements such as the NAFTA have created duty-free and quota-free markets for textile and apparel trade for the United States, Mexico, and Canada. NAFTA has imposed a yarn forward rule that ensures enhanced market access for yarns and fibers produced by NAFTA signatory countries based on the agreement's rules of origin. Whereas the last duties on textile and apparel trade between Canada and the U.S. were eliminated on January 1, 1998 as specified by the Canada-U.S. Free Trade Agreement, all remaining duties between the U.S. and Mexico in textile and apparel trade were eliminated on January 1, 2003.

In a previous quantitative study, Amponsah (2001), and Amponsah and Qin (2000) determined that textile and apparel trade between the U.S. and Mexico, in particular, has

experienced major changes. Since U.S. yarn and fabric production became more automated while apparel production in Mexico was more labor intensive and could be produced at relatively lower cost, it became cheaper for U.S. textile firms to produce yarns and export them to Mexico to cheaply produce apparels. The authors also determined that the factors that influenced U.S. textile exports to Mexico and apparel imports from Mexico included the U.S.-Mexican exchange rates, U.S. foreign direct investment (FDI) in Mexico, and the reduced tariff rates that Mexico levied on U.S. exports as a result of NAFTA.

Model Derivation

To determine the impacts of policies stemming from recent trade agreements, the typical gravity model for aggregate goods is re-specified into a commodity-specific model to analyze trade flows in textile and apparel. Gravity models represent trade between two or more economies as a function of their respective economic masses, the distance between the economies and a variety of other factors. Gravity modeling was originally developed by Tinbergen (1962), but with little in the way of theoretical justification. Recently, it has found empirical application in determining boarder effects in inhibiting trade (McCallum, 1995; Helliwell, 1996 and 1998), and impacts of currency arrangements on bilateral trade (Rose, 2000; Frankel and Rose, 2002; Glick and Rose, 2002). Deardoff (1998) argues that the basic regressors of gravity models – distance and income – are actually implied by a wide variety of theoretical models.

Koo and Karemera (1991) derived the single commodity gravity model following procedures indicated in the trade literature. In Linneman (1966) and Bergstrand (1985, 1989), the gravity model is specified as a reduced form equation from partial equilibrium demand and supply systems. The import demand equation for a specific commodity can be derived by

4

maximizing the constant elasticity of substitution (CES) utility function (U_{ij}) subject to income constraint:

$$U_j = (\sum_{i=1}^{N} X_{ij}^{\theta_j})^{1/\theta_j} \qquad (1)$$

Where:

X_{ij} =   the quantity of the commodity imported from country i

It is assumed that the commodity can be differentiated by country of origin. Therefore, the exponent $\theta_j = (\sigma_j - 1)/\sigma_j$, where σ_j, is the CES among imports. Consumption expenditures are limited by the income constraints (Y_j) of importing country j.

$$Y_j = \sum_{i=1}^{N} \bar{P}_{ij} X_{ij}; \text{ Where } \bar{P}_{ij} = P_{ij} T_{ij} C_{ij}/E_{ij} \qquad (2)$$

P_{ij} =   the unit price of country i's commodity sold in country j's market;
T_{ij} = $1 + t_{ij}$ where t_{ij} is import tariff rates on j's imports;
C_{ij} =   transport cost of shipping commodity to country j; and
E_{ij} =   spot exchange rate of country j's currency in terms of i's currency.

By using the Lagrangian function to maximize utility (equation 1) subject to income constraint (equation 2), the procedure generates the desired import demand as follows:

$$X_{ij}^{d} = Y_j P_{ij}^{-\sigma j} T_{ij}^{-\sigma j} C_{ij}^{-\sigma j} E_{ij}^{-\sigma j} (\sum_{i=1}^{N} \bar{P}_{ij}^{1-\sigma_j})^{-1} \qquad (3)$$

X^{d}_{ij} = the quantity of i's commodity sold in country j; and all variables are as previously defined.

The supply equation is also derived from the firm's profit maximization procedure in exporting countries. The total profit function of the producing firms is given as follows:

$$\Pi_i = \sum_{j=1}^{N} P_{ij} X_{ij} - W_i R_i \qquad (4)$$

Where:
P_{ij} =   the export price of i's commodity paid by importing country j;
X_{ij} =   the amount of i's commodity imported by country j;

W_i =   country i's currency value of a unit of R_i;

R_i =   the single resource input used in the production of the commodity in country i.

The resource in the country is allocated according to the constant elasticity of transformation (CET) during the production process and is defined as:

$$R_i = [(\sum_{i=1}^{N} X_{ij}^{\delta_i})^{1/\delta_i}]^{1/\delta_i} \qquad (5)$$

Where $\delta_i = (1 + \gamma_i) \gamma_i$ and γ_i is the CET among exporters.

Furthermore, we assume that income is a limiting factor in producing textile and apparel in the exporting countries. Therefore, $Y_i = W_i R_i$, where Y_i is the allocated income. Substituting equation 5 into equation 4 and maximizing the resulting profit function yields the desired export supply equation as follows:

$$X_{ij}^{s} = Y_i P_{ij}^{\gamma_i} (\sum_{i=1}^{N} P_{ij}^{1+\gamma_i})^{-1} \qquad (6)$$

General equilibrium conditions require demand to equal supply. Therefore:

$$X_{ij}^{d} = X_{ij}^{s} = X_{ij} \qquad (7)$$

X_{ij} is the equilibrium or actual quantity of the commodity traded from country i to country j. By equating equation 3 to equation 6, the commodity specific gravity equation is derived as follows:

$$X_{ij} = Y_i^{\frac{\gamma_j}{\sigma_j + \gamma_i}} Y_j^{\frac{\sigma_j}{\sigma_j + \gamma_i}} T_{ij}^{-\frac{\gamma_i \sigma_j}{\sigma_j + \gamma_i}} C_{ij}^{-\frac{\gamma_i \sigma_j}{\sigma_j + \gamma_i}} E_{ij}^{\frac{\gamma_i \sigma_j}{\sigma_j + \gamma_i}} (\sum_{i}^{N} P_{ij}^{1+\gamma_i})^{-\frac{\sigma_j}{\sigma_j + \gamma_i}} (\sum_{j}^{N} \bar{P}_{ij}^{1-\sigma_j})^{-\frac{\gamma_i}{\sigma_j + \gamma_i}} \qquad (8)$$

In a departure from the formal theoretical foundations for the traditional gravity model (see Anderson, 1979 and Bergstrand, 1985 and 1989) the commodity-specific gravity model (see Koo and Karemera, 1991) is modified in a panel framework to incorporate three variable components. They are: (1) economic factors affecting trade flows in the origin country; (2)

economic factors affecting trade flows in the destination country; and (3) natural or artificial factors enhancing or restricting trade flows. As previously noted, the major trade agreements that affect textile and apparel trade are the WTO and NAFTA agreements. WTO and NAFTA membership enter the estimable form of the equation as dummy variables. Additionally, we substitute distance between the exporting country and the U.S. for cost of transportation, since data on the latter is not readily available.

The empirical reduced form gravity model to assess the impacts of policies on U.S. imports of textile and apparel from Asia is specified as follows:

$$TEXIMP_{iust} = \beta_0 + \beta_1 GDP_{it} + \beta_2 GDP_{ust} + \beta_3 PCI_{it} + \beta_4 PCI_{ust} + \beta_5 EXRATE_{iust} + \beta_6 DIST_{ius}$$

$$+ \beta_7 DWTO + \beta_8 DNAFTA + \varepsilon_{ius} \qquad\qquad (9)$$

Where:

$TEXIMP_{ius}$	=	value of annual textile/apparel imports (in million dollars) by the United States from the exporting country i;
GDP_i	=	Gross domestic product of the exporting country i;
GDP_{us}	=	Gross domestic product of the United States
PCI_i	=	Per capita income of the exporting country i;
PCI_{us}	=	Per capita income of the United States;
$EXRATE_{ius}$	=	Exchange rate of the currency of country i to the U.S. dollar;
$DIST_{ius}$	=	Distance in kilometers between the exporting country i and the U.S.;
$DWTO$	=	Dummy variable identifying the membership of country i in the WTO (1 if country i is a member of WTO in year t, and 0 otherwise); and
$DNAFTA$	=	Dummy variable representing pre- and post NAFTA periods (1 for post NAFTA years, and 0 otherwise)
ε_{ius}	=	random error term
t	=	time (1989 – 2002)

Data Sources and Estimation Procedure

The empirical evaluation of equation 9 is based on secondary data obtained from the

following sources: (i) GDP, exchange rate and population for the calculation of per capita GDP were obtained from the *International Marketing Data and Statistics* (2004); (ii) distance in kilometers between the U.S. and the exporting country was obtained from the research aid website of the Macalester College of Economics at www.macalester.edu/research; and (iii) trade values were obtained from the United States International Trade Commissions trade data website at www.dataweb.usitc.gov. Textile and apparel trade values, classified in SIC code 22 and 23, respectively, were used for years 1989-1996. The new NAIC code, which commenced in 1997, was used for the years 1997-2003. Under this new industrial code, NAIC 313 and 314 are specified as equivalent to the old SIC code 22 (for textile products); and NAIC 315 is equivalent to SIC 23 (for apparel products). Finally, annual dummies were used to capture trade policy effects for both WTO and NAFTA membership by each country. The variables and summary statistics are presented in Table 1.

The major textile and apparel exporting countries in Asia included in this study are Hong Kong, South Korea, India, Taiwan, Indonesia, Bangladesh, Thailand, the Philippines, and Pakistan. China was excluded in this analysis because of its use of export tax rebates to devalue its currency. Currently, specific sector rebates values are not available.

The gravity model was effectively parameterized through a SAS estimation program by utilizing time series and cross-sectional panel data. Two separate regression runs were conducted for textile and apparel imports, respectively. A major advantage in using panel data is its ability to control for the presence of individual variable effects which are common to the individual agent (or country) across time, but which may vary across agents at any one-time period. In addition, the combination of time series with cross-sectional data can enhance the quality and quantity of data in ways that would be impossible to achieve by using only one of

these two dimensions (Gujarati, 2003). However, the presence of individual variable effects can potentially create correlation problems among individual variables and the covariates. This can be corrected by specifying the model to capture the differences in behavior over time and space. Conceptually, the difference in the nature of individual effects can be classified into the fixed effects which assume each country differs in its intercept term; and the random effects which assume that the individual effects can be captured by the difference in the error term.

From an *a priori* point of view, the random effects model is more appropriate when a sample for the analysis is drawn randomly from a larger population, while the fixed effects model is appropriate for the analysis of an *ex ante* predetermined selection or the use of an entire population (see Egger, 2000). Since the sample for this study was drawn from a randomly selected set of countries from Asia, by intuition the authors presume the use of the random effects model. Furthermore, Maddala (2001) argues that if a study makes inferences about the population from which cross-section data is gathered, then the intercept should be treated as random. Nevertheless, the F test was run to check if the fixed effects model is more efficient. The null hypothesis states that $FEM = 0$ (i.e. there are no fixed effects). Results from the F test indicate a value of 38.58 at (P < 0.0001) and 29.02 at (P < 0.0001) for the specified models for textile and apparel imports, respectively. Thus the fixed effects are statistically equal to zero and therefore the random effects model is more likely to give unbiased and more efficient estimates.

At least in theory, the problems of serial correlation and heteroscedasticity tend to arise with pooled time series cross-section data (Hicks, 1994). Therefore, in this study we correct for the potential presence of those panel problems by using the Parks (1967) and Kmenta (1986) methods (hereafter referred to as the Parks-Kmenta method) inherent in the SAS program in the estimation procedure. This procedure assumes a first-order autoregressive error model structure

with contemporaneous correlation between cross sections. The covariance matrix is estimated by a two-stage procedure leading to the estimation of model regression parameters by General Least Square (GLS) procedures.

Results

The results of textile imports analysis indicate that recent trade agreements and exchange rate policies significantly explain the increasing imports of textiles and apparel from Asia to the U.S. Table 2 presents estimated results for the gravity model on textile imports from Asia. All the variables are statistically significant at the 99% confidence level except per capita income for the U.S. which was significant at the 90% confidence level. However, the GDP of the United States was insignificant. The fit statistics indicates R^2 of 0.87.

The positive sign on the WTO dummy variable indicates that membership of these Asian countries in the WTO may have increased their access to the U.S. market, presumably by taking advantage of the reduction of tariffs and other trade liberalization policies stemming from recent negotiations. The estimated coefficient for exchange rate shows that a unit decrease in the exchange rate of the local currency to the dollar will result in an increase of $ 55.6 million in value of textile imports to the U.S. The variable for distance shows a negative relationship with import values; explaining the possibility that over time, the long distance between Asia and the U.S. may cause trade with the U.S. in textiles to decline. Conversely, the negative relationship between the dummy representing the effect of NAFTA and imports from Asia shows that potentially as NAFTA policies create greater access to the U.S. market for Mexico, less import of textiles would originate from Asia. The GDP of the exporting Asian country shows a small but growing capacity to export textiles into the U.S.

10

The estimated results for apparel imports are delineated in Table 3. The results show that all the variables are significant at 99% confidence level except the estimated coefficients for U.S. GDP, per capita income and the dummy variable representing WTO policies which are significant at the 95% confidence level. Also, the dummy variable representing NAFTA was significant at the 90% confidence level. However, although insignificant, the distance between Asia and the U.S. exhibits the usual negative relationship with imports into the U.S. Therefore, unlike the proximity of the Mexican market to the U.S. and the yarn forward rule of NAFTA, it is not certain that U.S. investors would be looking to invest in apparel plants in Asia to produce clothing and re-export to the U.S. market. The fit statistics show the R^2 of 0.84. Additionally, the estimated coefficient for exchange rate reveals that for every unit fall in the exchange rate of the local currency of the exporter to the U.S. dollar, there will be an increase of $347.8 million in the value of apparel imports from Asia.

Concluding Comments

It is clear from the gleaned results that global trade liberalization and exchange rate policies have contributed to the escalating imports of textile and apparel products into the U.S. But far beyond concerns about trade agreements such as NAFTA, most textiles executives lament the fact that the textile industry complex has experienced global overcapacity in production since it provides the easiest means of value-added manufacturing activity for developing countries. In fact, all recent U.S. agreements, such as the African Growth and Opportunity Act (AGOA), the U.S.-Caribbean Basin Trade Partnership Act, and the U.S.-China Bilateral Trade Agreement have provided greater access to the U.S. market for textile products.

To become more competitive and profitable, U.S. textile manufacturers have focused on achieving greater speed, efficiency, and high quality production by investing heavily in

automated technology and more integrated relationships. Of course these structural changes have been achieved by the textile behemoths that could afford to diversify their final products; but the changes have called for massive reductions in employment that have contributed to job losses at home. The relative ease of substituting imported textile products in U.S. apparel manufacturing has also intensified competition between U.S. firms and the top Asian textile exporters.

There are those who argue that free trade is ravaging the economies of textile-dependent communities in the U.S. On the other hand, there are others who argue that the ongoing deterioration in the economies of textile-dependent communities is merely rapidly manifesting the painful effects of globalization. Regardless of which group one favors, one cannot ignore the potential implications of ending the MFA on January 1, 2005. To date, only Canada, the European Union, (EU) and the U.S. continue to impose quotas (about 1,007 among them). The changes stemming from the liberalization of textile product categories, which followed the third stage of the ATC in January 2002, provide a clue as to potential developments in the aftermath of the abrogation of quotas on January 1, 2005. At the time, the U.S. integrated seven categories of products into the WTO that abolished quotas and added tremendously to existing changes in trade flows. In all liberalized quota categories, China greatly increased its exports to the U.S. market. Whereas other countries increased exports in some categories, only China did so across the board. Therefore, China's market share which was only 9% in 2001 and 31% in 2002 grew to 53% in 2003 and is projected to reach 75% in 2005. This is a source of concern for U.S. managers of textile industries, who strongly believe that they stand to lose market competitiveness to China.

Certainly, this calls for U.S. textile and apparel firms to adopt new market strategies. In addition to the "quick response" production approach adopted in the aftermath of NAFTA, many

firms are shifting their market focus. Traditionally, textile firms sell to apparel firms, which in turn sell to retailers. A study by the U.S. Department of Commerce (2004) reported that some firms are shifting away from this traditional channel in an attempt to directly reach the end-consumer through niche markets. For example, some textile firms are selling home furnishings such as sheets and towels directly to the retailer, and other textile firms are selling industrial products such as car seat covers, rugs, and carpets to firms in other sectors. Many such firms are adopting e-commerce through their corporate websites.

To further mitigate foreign competition, U.S. textile firms would also need to change their sourcing strategies by taking advantage of recent trade agreements by setting up large volume manufacturing plants in Mexico and the Caribbean Basin, and U.S-based operations for quick response. But the industry's ability to source products in the regional market will depend in large part on the relative costs of investing in facilities and equipment, production units, labor availability, quality control, timing, risks (language, culture, political, etc.) and reliability of demand in the regional market.

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Table 1. Descriptive Statistics

	Mean	Std. Deviation	Minimum	Maximum	Skewness
TEXIMP	342.84	291.85	3.00	1294.00	1.002
APPIMP	1610.42	1148.71	61.00	4584.00	0.972
GDP_i (Billion.)	565.9	1212.2	6.98	5290.13	2.783
PCI_i	7837.69	10734.97	313.38	42172.66	1.508
GDP_{us} (Billion)	7782.9	1665.9	5438.7	10445.6	0.191
PCI_{us}	29415.87	5132.15	22159.88	37264.99	0.152
$EXRATE_{ius}$	0.90	0.27	0.22	2.00	0.441
$DIST_{ius}$	13004.72	1638.40	10910.27	16370.82	0.522
DWTO	0.51	0.50	0.00	1.00	-0.058
DNAFTA	0.64	0.48	0.00	1.00	-0.603

Table 2. Gravity Model Estimates on the Import of Textiles from Asia

Variable name	Point Estimate	P-value
Intercept	1026.76	0.0001***
GDP_i	0.00008	0.0001***
PCI_i	-0.0074	0.0001***
GDP_{us}	-0.00012	0.225
PCI_{us}	0.0618	0.063*
$EXRATE_{ius}$	-55.605	0.005***
$DIST_{ius}$	-0.11	0.0001***
DWTO	14.216	0.369***
DNAFTA	-53.50	0.0025***
R^2	0.87	

***   Refers to significance at 99% confidence level
 **   Refers to significance at 95% confidence level
  *   Refers to significance at 90% confidence level

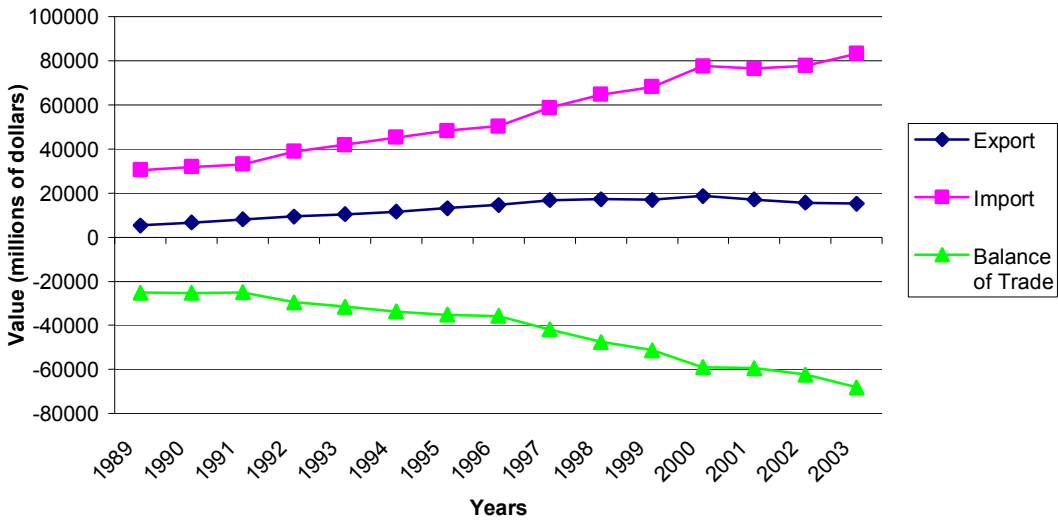**Table 3.   Gravity Model Estimates on the Import of Apparel from Asia**

Variable name	Point Estimate	P-value
Intercept	1395.924	0.0663*
GDP_i	-0.00134	0.0001***
PCI_i	0.124544	0.0001***
GDP_{us}	-0.00064	0.022**
PCI_{us}	0.209	0.022**
$EXRATE_{ius}$	-347.829	0.0001***
$DIST_{ius}$	-0.05683	0.1431
DWTO	34.2933	0.4246**
DNAFTA	21.4798	0.6481*
R^2	0.84	

***   Refers to significance at 99% confidence level
 **   Refers to significance at 95% confidence level
  *   Refers to significance at 90% level

Figure 1. **U.S. Trade in Textile and Apparel**