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**FORMULATION OF MODELS AND ESTIMATION OF SELECTED
TEXTILE AND APPAREL IMPORT, OUTPUT AND EMPLOYMENT
ELASTICITIES FOR THE UNITED STATES**

A Thesis

Presented for the

Master of Science

Degree

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ABSTRACT

The purpose of this study is to estimate the impact of textile and apparel imports upon employment in the domestic US textile and apparel industries, upon the production level of US domestic textiles and apparel, and upon selected textile and apparel production resources. The objectives are to formulate and estimate models and elasticities for policy utilization. The models that were estimated are textile and apparel import demand functions, textile and apparel output functions, and resource or input adjustment functions. Separate equations were estimated for textiles and apparel.

The resulting elasticities that were estimated include direct price elasticity of import demand, cross price elasticity of import demand, income price elasticity of import demand, employment elasticity of output, import elasticity of output, and output elasticity of employment.

The data set consisted of monthly time series observations for the time period 1974-1987. Data was primarily from published secondary sources, but some unpublished series were obtained from the Federal Reserve Board and the International Trade Commission.

Estimation of the statistical models was accomplished by Ordinary Least Squares and Generalized Least Squares. The variables were transformed to their natural logarithms and the regressions were run on the transformed variables to obtain constant-elasticity functions.

Import demand was hypothesized to be a function of relative prices, consumer income, and adjustment variables. Output was posited as a function of the level of employment, capital price, and imports. The input adjustment functions were expressed as functions of relative factor prices, exogenous output, trend, and lagged factors.

The empirical results were quite reasonable. Most coefficients were statistically significant, and their signs were consistent with a priori theoretical considerations. Thus, the elasticities provided by this study should be very useful in policy applications.

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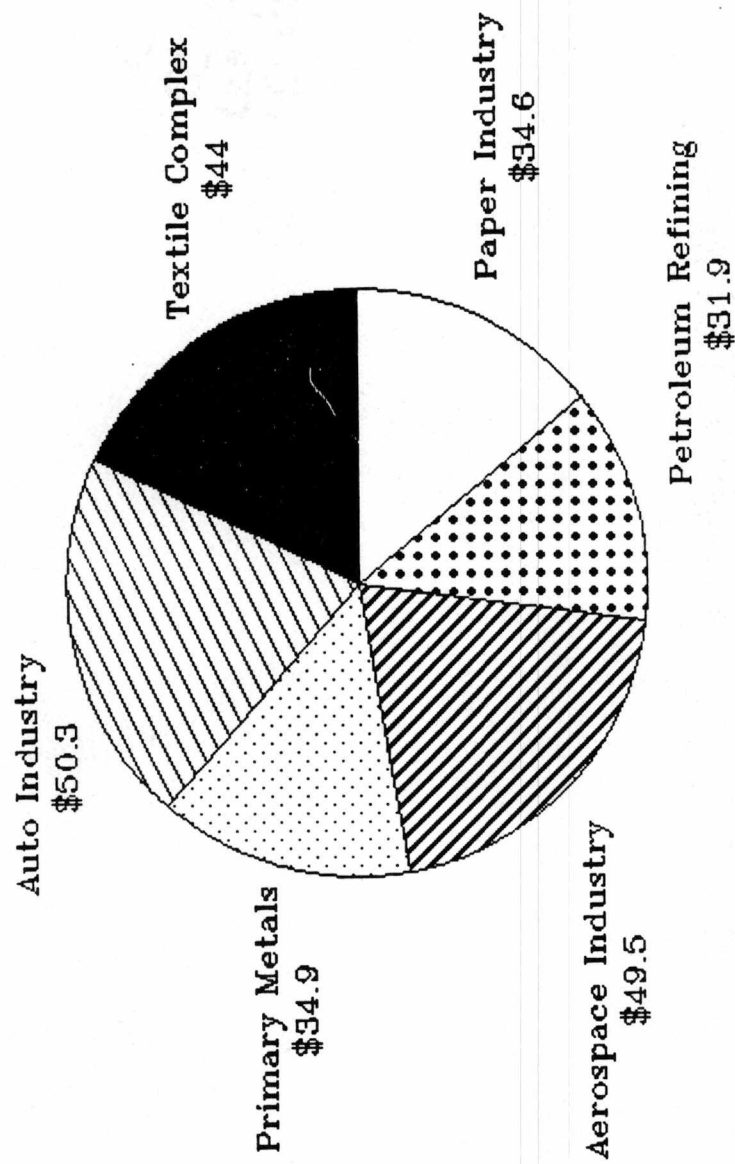
CHAPTER I

INTRODUCTION

1. INTRODUCTION TO THE PROBLEM

"The textile complex is involved in the production of natural and man-made fibers and their conversion into apparel, home furnishings, and industrial goods" (Toyne, et al., 1983, p. 2-1). The textile complex is a larger component of the US economy than generally known, contributing over \$44 billion to GNP in 1985. As shown in Figure 1.1, the size of the textile complex is comparable to the automobile and aerospace industries and larger than petroleum refining and primary metals.

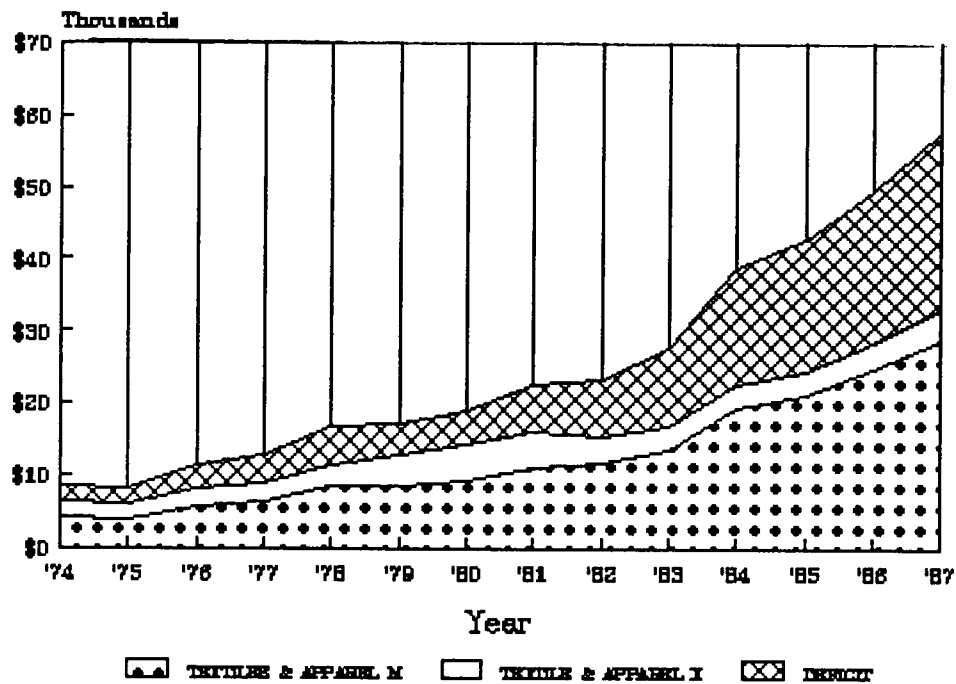
Imports are present in many aspects of the textile complex, from the raw materials to the finished product, and have been increasing significantly in recent years. This is shown by Figure 1.2 in dramatic fashion. Table 1.1 indicates that textile and apparel imports have increased from about \$4.3 billion in 1974 (C.I.F. value) to almost \$29 billion in 1987 (C.I.F. value), an almost 700 percent increase in current dollar terms. Over the same time period textile and apparel exports increased less than 200 percent, from \$2.2 billion to \$4.1 billion. The corresponding trade deficit in textiles and apparel expanded from almost \$2.1 billion in 1974 to almost \$25 billion in 1987, approximately a 1200 percent increase. Import and deficit growth of such magnitude has caused considerable outcry from US producers and labor and has caught the attention of politicians



Billion Dollars, 1985 GNP

Figure 1.1 Textile Complex Contribution to GNP, 1985.

Source: ATMI "Crafted With Pride in U.S.A." Booklet.



C.I.F. Import Values
 F.A.S. Export Values
 (Millions of Dollars)

Figure 1.2 US Textile and Apparel Trade.

Source: US Department of Commerce, FT-135, FT-140, SITC Classification 65 and 84.

Table 1.1 Textiles and Apparel Trade for the US, 1974-1987. (\$ Millions)

YEAR	T&A IMPORTS	T&A EXPORTS	TRADE BALANCE
1974	4,269.00	2,195.00	-2,074.00
1975	4,162.00	2,028.00	-2,134.00
1976	5,726.00	2,480.00	-3,246.00
1977	6,432.00	2,567.00	-3,865.00
1978	8,508.00	2,902.00	-5,606.00
1979	8,690.00	4,120.00	-4,570.00
1980	9,525.00	4,834.00	-4,691.00
1981	11,258.00	4,851.00	-6,407.00
1982	11,703.00	3,737.00	-7,966.00
1983	13,752.00	3,168.00	-10,584.00
1984	19,387.00	3,169.00	-16,218.00
1985	21,330.00	3,121.00	-18,209.00
1986	24,705.00	3,469.00	-21,236.00
1987	28,885.00	4,089.00	-24,796.00

Source: US Department of Commerce, FT-135, FT-140, SITC Classification 65 and 84.

bearing political "solutions." The Textile Trade Bill(s) of 1985 and 1988 is(are) example(s), and such actions do not enhance the position of consumers and retailers who benefit from imports.

Nordquist (1985, p. 35) states that "imports affect consumers, producers, workers and retailers as well as the relationship between the US and foreign countries." The US Government has frequently sought political involvement in international trade, both through agreements to enhance free trade and agreements that restrict trade. There is considerable debate as to whether or not the government should interfere with the movement toward free trade enacted by the General Agreements on Tariffs and Trade (GATT) by implementing policies to restrict imports. In recent history exceptions to GATT have become prominent, particularly the Short-Term Arrangement (STA) in 1961, the Long Term Arrangement (LTA) in 1962 and the Multi-Fiber Arrangement (MFA). The STA and LTA were replaced by the Multi-Fiber Arrangement (MFA) in 1973, which has had three revisions and is still in effect today. The effect of each of these agreements was to reduce textile and apparel imports into the US.

Economic theory suggests that as product prices increase, the quantity demanded of that product decreases, and quantity demanded increases for a decrease in price. Interest often centers upon proportional change. Price elasticity is defined as the "proportional change in the quantity purchased divided by the proportional change in price" (Hirshleifer, p. 131). Similarly, direct (or own) price elasticity of import demand is a sensitivity relationship between quantity of a given import product and its own import price. Cross price

elasticity is the percentage change in quantity demanded with respect to the price of another good, either a complement or a substitute. Domestically produced textile products and imported textile products are examples of substitute goods whose cross price elasticity is of interest, as is the cross price elasticity of domestic and imported apparel.

In terms of relative prices, high import prices (for competitive products) relative to prices of the domestic goods generally induce consumers to purchase the domestic good. However, if the import is less expensive and is viewed as having equivalent, or better quality, the consumer will generally purchase the imported good. Imported textile and apparel goods of equal or better quality than domestic US goods tend to be less expensive, resulting in high levels of imports. This is essentially the import problem as perceived by US textile and apparel producers, workers, unions and suppliers to the textile and apparel industries.

2. STATEMENT OF THE PROBLEM

It is generally accepted that, ceteris paribus, as protectionism increases, the production level and market share of domestic textiles and apparel increases, textile and apparel employment increase, prices increase, and the cost to consumers increases in terms of increased prices and in terms of reduced consumer surplus. Presumably, reduced protection for the US textile and apparel industries would result in reductions in output, market share, employment, and prices in the US, and increased gains for US consumers. Textile and apparel

trade policy in the US has been strongly protectionist, particularly since the advent of the MFA in 1973 (effective 1974) with particular emphasis upon employment and output effects of imports. This study focused upon these effects. The purpose of this research is to estimate the impact of textile and apparel imports upon employment in the domestic US textile and apparel industries, upon the production level of US domestic textiles and apparel and upon selected production resources with consideration of policy decisions, past, present and future.

Toward this end, objectives were to estimate three types of functions for textiles and apparel and to provide elasticities relevant to policy decisions. The functions estimated were: (a) import demand functions, (b) output or production functions, and (c) resource or input adjustment functions. Each of these were estimated separately for textiles and apparel. Elasticities of interest included: (1) direct price elasticity of import demand, (2) cross price elasticity of import demand, (3) income elasticity of import demand, (4) employment elasticity of output, (5) capital elasticity of output, (6) direct price elasticity of output, (7) import elasticity of output, (8) output elasticity of employment, and (9) input elasticities with respect to each other. Very few studies have undertaken these tasks relative to textiles and apparel, and most empirical studies were prior to 1980. This thesis is the only textile and apparel study known to the author to utilize monthly data, which should provide more precise estimates of the parameters of the models specified.

3. HYPOTHESES

The hypotheses of this study are succinctly stated in this section; they appear as H_i , $i = 1,2,3,4,5,6$

$$H_1: M = f(P_m, P_d, Y, T)$$

where,

M = Quantity of textile and apparel import demanded in the US,

P_m = Price of textile and apparel imports in the US,

P_d = Price of the US produced textiles and apparel consumed in the US,

Y = Consumer income at the aggregate level,

T = Exogeneous demand shifters.

$$H_2: \frac{\partial M}{\partial P_m} < 0, \frac{\partial M}{\partial P_d} > 0, \frac{\partial M}{\partial Y} > 0, \frac{\partial M}{\partial T} > 0, \text{ or } \frac{\partial M}{\partial T} < 0$$

$$H_3: Q = h(E, K, P, I, C, M)$$

where,

Q = Textile and apparel output in US,

E = Level of textile and apparel employment,

K = Capital stock in textile and apparel,

P = Price of textile and apparel output in the US,

I = Textile and apparel product inventory,

C = Textile and apparel capacity utilization,

M = Quantity of textile and apparel imports into the US, and,

$$H_4: \quad \frac{\partial Q}{\partial L} > 0, \quad \frac{\partial Q}{\partial K} > 0, \quad \frac{\partial Q}{\partial P} > 0, \quad \frac{\partial Q}{\partial C} > 0,$$

$$\frac{\partial Q}{\partial I} < 0, \text{ and } \frac{\partial Q}{\partial M} < 0$$

$$H_5: \quad X_i = f(Q, w/c, X_{i,j})$$

$$i, j = 1, 2, 3, 4, 5$$

where,

X_i = Quantity of the i^{th} textile and apparel input in the US,

Q = Textile and apparel output in the US,

w/c = Relative US textile and apparel factor prices,

$X_{i,j}$ = Lagged quantity of the j^{th} textile and apparel input in the i^{th} input demand equations in the US, and

$$H_6: \quad \frac{\partial X_i}{\partial Q} > 0, \quad \frac{\partial X_i}{\partial w/c} < 0, \quad \frac{\partial X_i}{\partial X_{i,j}} < 0, \quad \text{or} \quad \frac{\partial X_i}{\partial X_{i,j}} > 0$$

The preceding hypotheses will be statistically tested in Chapter IV after formulation of theoretical models in Chapter III. Chapter II provides an overview of the textile complex and the international trade issues that are of importance to a study of the impact of textiles and apparel imports on the United States. Chapter V provides a summary of this study and conclusions forthcoming from evaluation of results.

CHAPTER II

TEXTILE COMPLEX AND TRADE

To provide perspective for textile and apparel imports, this chapter will provide a brief overview of textile and apparel trade and the textile complex. Included in this overview is a brief description of the textile and apparel complex, current employment and productivity levels, and the nature of textile and apparel trade.

The textile complex of the United States consists of three major segments: (1) the fiber industry (man-made and natural fiber), (2) the textile mill products industry, and (3) end-use manufacturing products industries, including apparel manufacturing, home furnishings, and industrial (and consumer) products. The major import problems for the US textile complex are in the textiles and apparel manufacturing industries, which are the focus of this study. Within these two industries there are approximately 5,000 textile companies and 20,000 apparel firms. Their combined sales exceed \$100 billion, and together they employ almost two million people; therein lies much of the concern by industry and workers about imports--large industry employing large numbers of people but vulnerable to imports. Consumers are vulnerable to protection against imports. This will be discussed in Chapter III.

1. INTRODUCTION TO THE TEXTILE COMPLEX

Fibers are classified as natural or man-made depending upon their origin. Man-made fibers are further subdivided into cellulosic and non-cellulosic fibers categories. Natural fibers are a product of agriculture and include such fibers as cotton, flax, wool, ramie, and silk. Cellulosic fibers are derivative products of naturally occurring celluloses and include rayon, acetate and triacetate. Non-cellulosics, also referred to as synthetics, are produced using petrochemical derivatives and include such fibers as polyester, nylon, acrylic, and the olefins--polypropylene and polyethylene.

The textile mill products industry produces basically two products, yarns and fabrics. Yarn is an intermediate product of the textile complex and is defined as either continuous filament or spun staple. Staple fiber spun yarn is produced by spinning together discontinuous fibers, one to several inches in length to form the yarn. Continuous filament yarns are made by passing fluid chemicals through a spinneret after which the filaments are solidified and stretched. Modifications to these basic processes produce a variety of fiber with desirable characteristics.

Another intermediate segment of the textile complex and the primary output of the textile mill products industry is fabric production. Fabrics are formed by weaving, knitting or nonconventional method (termed nonwovens). In weaving, yarns are interlaced at right angles on a loom; in knitting, yarns are interlooped by latched or spring needles arranged in a circular or linear array; and in

nonwovens, fibers are compressed or interlocked by mechanical, thermal, chemical and/or fluid methods.

To provide ease of care, ease in processing, improved durability and enhanced aesthetic properties for all stages of the production of a yarn, fabric, or final garment, finishes may be applied. These include dyes, pigments, stain resistant chemical, and water-repellant additives. Scouring, bleaching, and sizing are other forms of processing/finishing which give the resulting fiber and/or fabric its desired characteristics.

Apparel, home-furnishings, and industrial products make up the three partitions of the end-use manufacturing products segments of the textile complex. The apparel segment is the largest of these three partitions and is the most fragmented consisting of almost 20,000 firms of widely diverse size, product mix, geographical location, management structure, and customer base (Freeston, et al., 1983, p.13). An apparel manufacturer usually produces one garment type such as t-shirts, children's dresses or men's shirts. In addition they focus on a particular price and fashion range, such as expensive, classic women's suits or inexpensive men's pants. The apparel segment also has the lowest barriers to entry with regard to capital and technical knowledge requirements. The basic capital needs are sewing machines, (which are fairly inexpensive), cutting tables, cutting knives, and a building (which may be rented). Sewing knowledge is the basic "technical requirement" which is not as nearly as complex as required of most manufacturing industries. Some of the larger apparel firms have advanced machinery for the "cut and sew" process and are capable of producing a wider

variety of garments at various price and fashion ranges as opposed to smaller firms which usually have a more narrowly defined product line.

The home furnishings segment consists of floor coverings, bed linens, table linens, drapes, upholstery and towels and bath sets. The industrial segment includes end-uses such as dryer belts, filter bags, auto interiors, geotechnical and medical applications.

2. EMPLOYMENT

The textile complex provides jobs for approximately 2.3 million Americans. Over 1.8 million of those jobs in 1987 were in textiles and apparel manufacturing as shown in Table 2.1. Table 2.1 also indicates that one in every ten people working in manufacturing is a part of the textile complex (America's Textiles, 1987). Every state has employees in the textile or apparel industry as shown by Table 2.2. Table 2.2 also shows that the leading textile employment states are primarily in the Southeastern states. The textile and apparel complex is the nation's largest manufacturing employer of women (65 percent) and minorities (29 percent) (American Textile Manufacturers Institute, (ATMI, 1987). Laborers account for 85 percent of the total workforce in the textile and apparel industry (Office of Textiles and Apparel, 1987, p.2). Not only are jobs directly associated with the textile and apparel industries, the textile complex relies on several related industries such as textile machinery, chemical and agriculture which contribute approximately one million additional jobs (Toyne, et al., 1983, p. 2-2). Approximately 70 to 75 percent of the jobs in the textile and apparel

Table 2.1 Textile and Apparel, All Manufacturing Industries and Total Non-agricultural Employment in the US, 1974-1987.

Year	Total Non-Agricultural Employees	All Manufacturing Industries	Textile Mill Products Industry	Apparel & Related Products	Textiles & Apparel
Thousands of Employees					
1974	78,265	20,077	965	1,263	2,328
1975	76,945	18,323	868	1,243	2,111
1976	79,382	18,997	919	1,318	2,237
1977	82,471	19,682	910	1,316	2,226
1978	86,697	20,505	899	1,332	2,231
1979	89,823	21,044	885	1,304	2,189
1980	80,406	20,285	848	1,264	2,112
1981	91,160	20,171	823	1,245	2,068
1982	89,570	18,783	750	1,161	1,911
1983	90,200	18,434	741	1,163	1,904
1984	94,496	19,378	746	1,185	1,931
1985	97,519	19,260	702	1,121	1,823
1986	99,610	18,994	705	1,106	1,811
1987	102,101	19,104	730	1,113	1,843

Source: US Department of Commerce and US Department of Labor.

Table 2.2 US Textile and Employment by State, 1982-1986 Average.

State	EMPLOYMENT		
	Textile Mill Products	Apparel	Total
Alabama	37,500	53,700	96,429
Alaska	*	*	30
Arizona	*	4,800	20,344
Arkansas	1,800	10,800	21,510
California	14,800	113,200	169,416
Colorado	*	*	2,600
Connecticut	4,700	8,500	14,276
Delaware	+	1,400	18,298
Florida	2,600	36,000	38,600
Georgia	103,000	69,800	176,885
Hawaii	+	3,300	3,300
Idaho	*	*	2,600
Illinois	3,000	15,600	24,323
Indiana	+	9,500	14,500
Iowa	*	4,400	16,400
Kansas	*	3,400	5,400
Kentucky	5,900	27,000	33,971
Louisiana	*	7,800	16,941
Maine	6,700	4,300	11,720
Maryland	1,200	10,800	12,900
Massachusetts	17,700	27,700	47,546
Michigan	1,400	22,400	26,483
Minnesota	+	4,800	9,647
Mississippi	6,300	36,500	64,254
Missouri	+	24,500	31,498
Montana	*	*	2,900
Nebraska	+	2,000	5,300
Nevada	*	*	300
New Hampshire	3,500	2,400	6,767
New Jersey	13,700	45,100	60,045
New Mexico	+	2,400	6,703
New York	29,500	126,800	158,964
North Carolina	211,300	86,700	304,945
North Dakota	*	*	1,800
Ohio	+	16,300	23,989
Oklahoma	*	9,500	17,605
Oregon	1,500	2,300	9,400
Pennsylvania	30,600	93,300	129,110
Rhode Island	10,400	3,100	14,282
South Carolina	103,200	45,000	169,814
South Dakota	*	*	5,100
Tennessee	23,000	64,600	100,658
Texas	4,300	52,600	122,471
Utah	+	5,700	8,000
Vermont	*	1,400	2,353
Virginia	42,600	30,200	88,321
Washington	*	6,100	8,300
West Virginia	*	3,600	6,300
Wisconsin	3,900	6,400	13,500
Wyoming	*	*	1,400

*Data withheld by source agency.

+Textile Employment included in apparel.

Source: ATMI "Americas's Textiles," 1987.

complex require low and semi-skilled workers. The industry is also associated with low wages and profit margins. The average hourly wage for textile workers is \$7.45. For apparel workers, the average is \$6.20. The national industrial wage is \$10.27 (Booker, 1988, p. A14).

3. OUTPUT AND PRODUCTIVITY

"The total output of the US textile complex has continued to expand while direct employment and average number of hours worked per week have declined" (Toyne, et al., 1983, p. 2-26). Table 2.3 shows that dollar sales of the US textile industry grew from \$32.9 billion in 1974 to \$56.4 billion in 1987, measured in current dollars. Segments of the textile complex which have productivity rates nearly double the national average include synthetic fibers, floor coverings, and hosiery/knit goods. Production growth rates for apparel and fabric/yarn and thread (the largest employment segments) were slightly below the national average (Toyne, et al., 1983, p. 2-27).

Many industries depend on the output of the textile fiber industry as shown in Figure 2.1. Ninety-nine percent of the man-made fibers are demanded by the US textile and apparel industries, and the remaining one percent is intermediate demand. About 53.6 percent of the cotton fiber processed is demanded by the US textile and apparel industry, about 34.5 percent is demanded as a final product, and about 11.9 percent as intermediate demand. Approximately 55.1

Table 2.3 Textile Shipments and Inventories, 1974-1987.

Year	Shipments and Inventory			
	Total Shipments (Million \$)	Monthly Average Inventories (Million \$)	Annual Inventory Turnover Rate	Average Monthly Inventory/ Shipments Ratios
1974	32,791	4,918	6.67	1.80
1975	31,065	4,676	6.64	1.80
1976	36,387	5,104	7.13	1.67
1977	40,558	5,524	7.34	1.63
1978	42,342	5,806	7.29	1.65
1979	45,141	6,005	7.52	1.60
1980	47,280	6,413	7.37	1.63
1981	50,275	6,838	7.35	1.63
1982	47,479	6,823	6.96	1.72
1983	53,350	7,060	7.55	1.59
1984	55,507	7,778	7.14	1.68
1985	53,249	7,322	7.28	1.65
1986	54,638	6,812	7.99	1.50
1987	56,418	6,857	8.23	1.46

Source: U.S. Department of Commerce, Bureau of the Census, M-3.

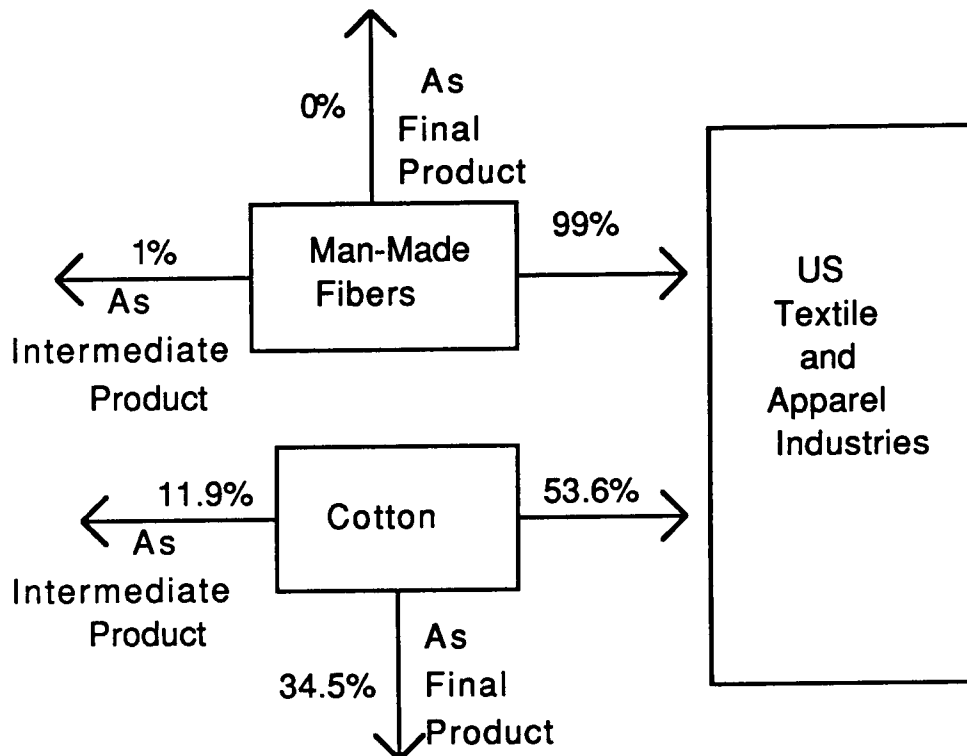


Figure 2.1 Demand of Cotton and Man-Made Fiber Industries.

Note: Data based on 1972 data, man-made fibers going to US Textiles and Apparel may be less than 99 percent because of an increasing percent of man-made fibers being exported as final demand.

percent of the fabric, yarn and thread produced by the textile mill products industry goes to the apparel industry alone, as seen in Figure 2.2.

4. NATURE OF TEXTILE AND APPAREL TRADE

Textile and apparel imports entering the US have continued to climb each year since 1979 and have generally increased since the early 1950's. Over 70 percent of the apparel imports originate from Hong Kong, Taiwan and the People's Republic of China ("The US Textile Industry," 1987, p. 17). In 1981, imports of textile mill products and apparel rose 5.8 billion square yard equivalents, in 1982, 5.9 billion, in 1983, 7.7 billion, in 1984, they rose 10.2 billion, for 1985, 10.8 billion and in 1986, 12.7 billion. The current apparel import penetration is estimated to be over 50 percent, increasing from 28 percent in 1980 (ATMI, 1987).

Cotton square yard equivalents equalled 3.5 million bales of cotton in 1986 even though raw cotton is limited to 30,000 bales a year to "insure a healthy domestic market for US-grown cotton" (ATMI, 1987, p. 2). Wool import penetration in 1986 was over 65 percent, 269 million square yard equivalents in 1986 compared to 130 million in 1980. Man-made fiber products, which accounts for over the half of the total imports, nearly tripled over the period from 1980 to 1986; 7.3 billion square yard equivalents of man-made fibers were imported in 1986, whereas in 1980, only 2.7 billion (ATMI, 1987). Figure 2.3 illustrates the quantity of fiber imports into the US from 1974 through 1987, and shows the steady increase in imports of cotton and man-made fibers since 1974.

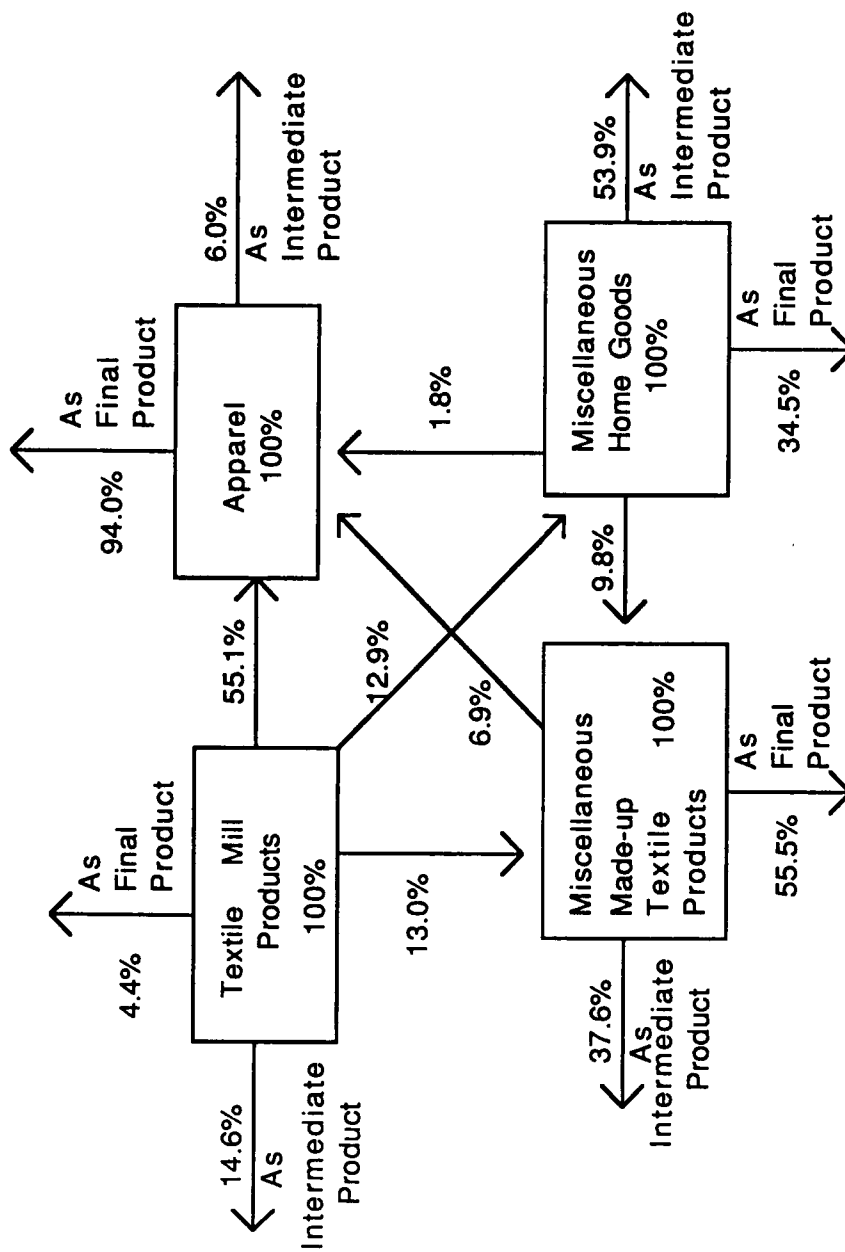


Figure 2.2 Industrial Demand of the Textile Complex.

Source: Freeston, et.al, (1983), p. 4

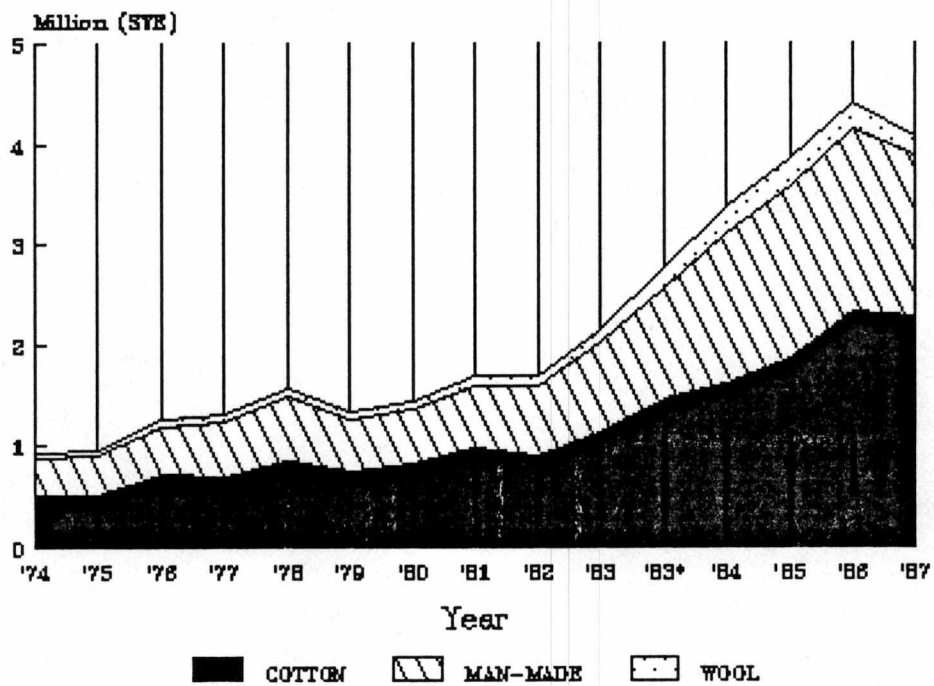


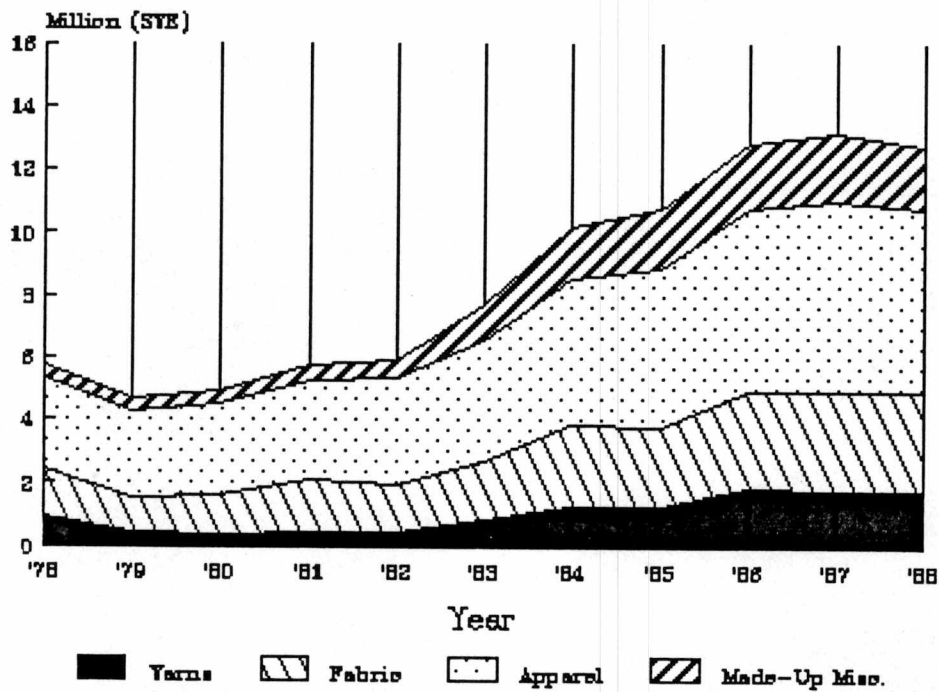
Figure 2.3 Fiber Imports.

Source: US Department of Commerce

Figure 2.4 illustrates the imports of yarns, fabric, apparel and miscellaneous made-up articles and shows the general increase in each of those items, particularly apparel. Tables B.1 and B.2 in Appendix B provide support data for Figures 2.3 and 2.4 respectively. Figure 2.5 and Figure 2.6 illustrate apparel trade and textile trade, respectively, for the US from 1974-1987. Table 2.4 provides the data from which the graphs were constructed. The dramatic growth of imports, particularly for apparel, is shown clearly as is the size of the trade deficit.

However, the Retail Industry Trade Action Coalition (RITAC) claims these figures are exaggerated. They conclude import penetration to be at less than one forth of the total textile fiber consumption and 26.4 percent for finished apparel consumption. The home furnishings and industrial textile market penetrations are much less, estimated by RITAC to be about 4.0 percent (RITAC, 1985, p. 8-10).

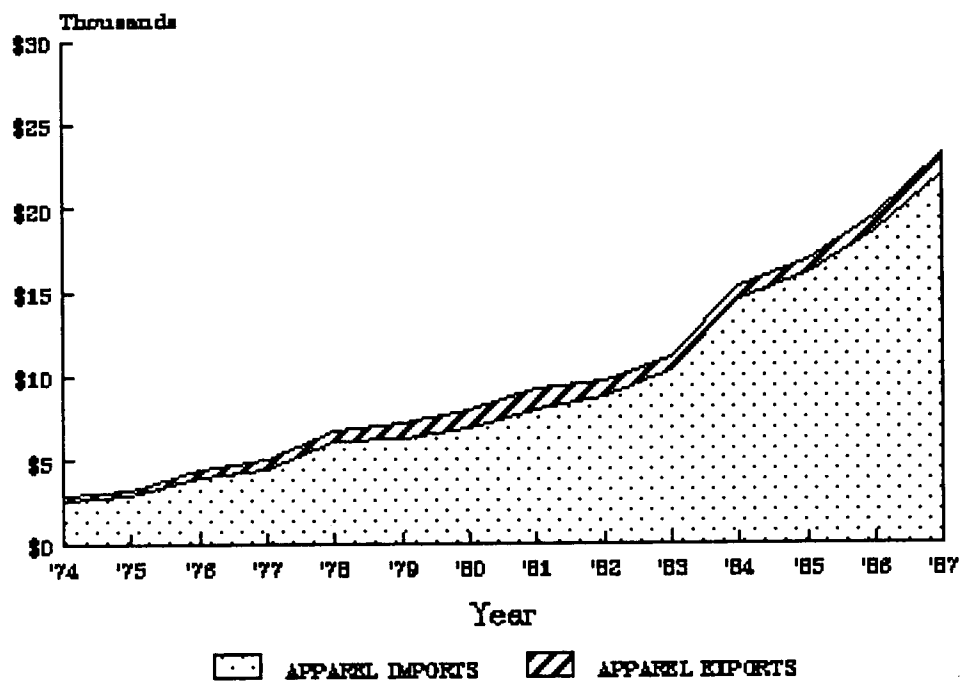
The textile complex and other advocates of protection believe the solution to the loss of jobs, and to the incidence of hardships associated with the influx of textile and apparel (and other) imports is to "protect" the industry. For the textile complex, the most common arguments supporting protection include, balance of payments problems, national security, reindustrialization, employment, (jobs) in the textile complex, especially the textiles and apparel industries, market share for US firms in the US market, and the "fair trade" argument. None of these arguments are accepted by the majority of economists in the US as acceptable solutions, particularly as long-run solutions.



1988 data based on first 6 months

Figure 2.4 Imports of Textile Manufacturers.

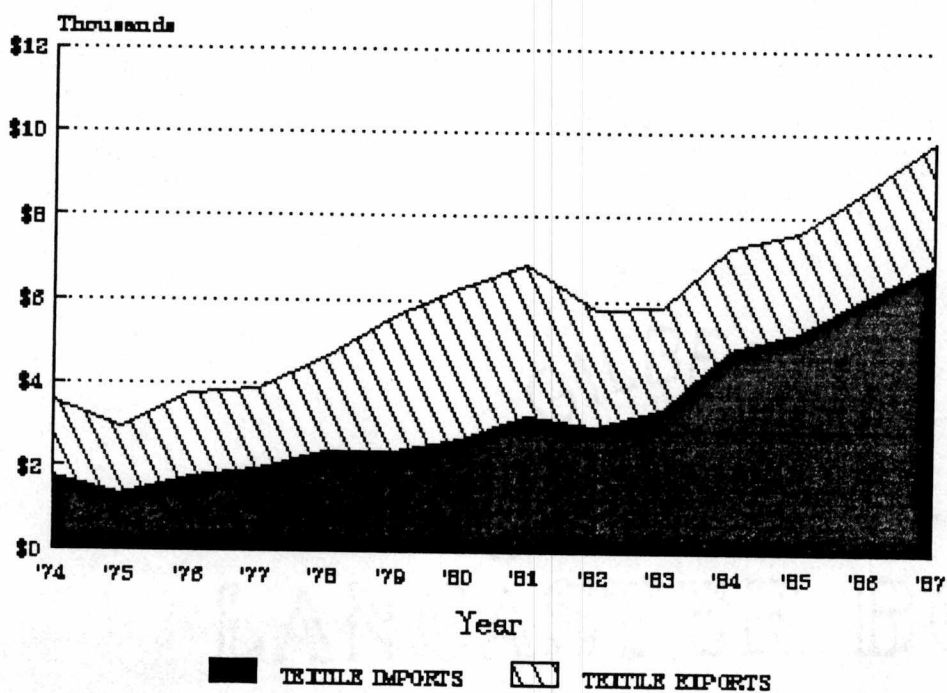
Source: US Department of Commerce



C.I.F. Import Values, F.A.S. Export Values

Figure 2.5 Apparel Trade.

Source: US Department of Commerce, FT-135, FT-140, SITC Classification 65 and 84.



C.I.F. Import Values, F.A.S. Export Values

Figure 2.6 Textile Trade.

Source: US Department of Commerce, FT-135, FT-140, SITC Classification 65 and 84.

Table 2.4 Textile and Apparel Trade for the US, 1974-1987. (\$ Millions)

Year	TEXTILES			APPAREL		
	Imports	Exports	Trade Balance	Imports	Exports	Trade Balance
1974	1,752	1,795	+ 43	2,517	400	- 2,117
1975	1,336	1,625	+ 289	2,826	403	- 2,423
1976	1,791	1,970	+ 179	3,938	510	- 3,428
1977	1,939	1,959	+ 20	4,493	608	- 3,885
1978	2,400	2,225	- 175	6,108	677	- 5,431
1979	2,399	3,189	+ 790	6,291	931	- 5,360
1980	2,676	3,632	+ 956	6,849	1,202	- 5,647
1981	3,250	3,619	+ 369	8,008	1,232	- 6,776
1982	3,000	2,784	- 216	8,703	953	- 7,750
1983	3,460	2,368	-1,092	10,292	818	- 9,474
1984	4,874	2,382	-2,492	14,513	807	-13,706
1985	5,274	2,366	-2,908	16,056	755	-15,301
1986	6,151	2,570	-3,580	18,554	900	-17,652
1987	6,918	2,900	-3,993	21,960	1,132	-20,828

Source: US Department of Commerce, FT-135, FT-140, SITC Classification 65 and 84.

5. INSTITUTIONAL ENVIRONMENT OF TEXTILE TRADE

General Agreement on Tariffs and Trade (GATT) establishes rules for international trade and acts to see that the rules are carried out on a multilateral bases. The first such agreement became effective in January of 1948 and now has a 92 country membership with an additional 31 nations applying GATT rules without formal membership.

The fundamental principles and aims of GATT as reported in Dickerson (1988, p. 18) include establishing trade without discrimination, allowing for protection through tariffs, providing a stable basis for trade, offering consultation, conciliation and settlement of differences, the opportunity to "waiver" and take emergency action under certain circumstances, prohibiting quantitative restriction on imports and arranging regional trade agreements.

"Market disruption" in the late 1950's gave rise to the treatment of textiles as a special case (Dickerson, 1988, p. 19). In 1961, the textile and apparel industry had its own set of guidelines for international trade separate from those established by GATT. The first such set of rules was the STA, which established guidelines for controlling cotton imports into the US which opposed the general rules of GATT. The STA was replaced by the LTA and October 1962 and remained until 1973.

With the evolution of man-made fibers in the 1970's, the need for an alternative solution for textile trade problems arose. In 1974, MFA I became effective applying the regulations of the LTA to include non-cotton products.

Restrictions included certain established quotas. The quota levels were subject to a base level not lower than previously achieved, with a specified level of growth rate and flexibility. Flexibility includes: (1) swing, the adjustment among the restraint levels for various products during a year, (2) carry forward, the adjustment between the restraint levels of a particular product during the year under consideration and the following year, and (3) carry over, the adjustment between the restraint levels of a particular product during the year under considerations and the previous year (Das, 1983, p. 97).

The MFA I was renewed as MFA II in 1977, MFA III in 1981 and MFA IV in 1986. A textile and apparel trade bill was vetoed by President Reagan in 1985 and attempts by proponents of the bill to override the veto failed by 8 votes in July of 1986. In early 1988 a revised bill was passed by the Senate but faces certain veto by the President. Other types of government policy, directly and indirectly affect textile trade patterns. Direct examples include tariffs, export tax rebates, tax credits for developing overseas markets, and general assistance in developing programs such as funding for research and data analysis pertaining to trade. Other examples suggested by Freeston, et al. (1983, p.51) include training in government-funded programs, encouraging incoming foreign investment aiding the start up of a domestic textile complex, investment aid, incentives for offshore production, or restructuring.

Indirect policies which affect trade include policies pertaining to environmental protection, product standards, and working conditions. Freeston, et al. (1983, pp. 52-54) gives specific examples of such policies to include

flammability standards, cotton dust and noise level standards, waste water quality restrictions, and wage rate regulation. Policies of this type tend to increase the cost of production of domestic textiles and apparel and to make them less competitive with foreign produced goods which typically have few, if any, restrictions of this type.

Another type of policy indirectly affecting trade is the Textile Labeling Bill. This bill requires the country of origin to be printed on the product label in order to be easily recognized. The "Made in U.S.A." label, highly recognizable and advertised, has been an effort to encourage US consumers to "Buy American" and to discriminate against imports of textiles and apparel.

The MFA provides high levels of protection for producers and workers of the US textile complex. Freeston, et al. (1983, p. 50) states, "Probably no other manufactured products receive as much protection as fabric and apparel." However, by restricting imports of textiles and apparel the MFA imposes costs upon the US retailer and especially the consumer.

The costs of protection are numerous, including both economic and social, moral and psychological, political and diplomatic, current and future. However, members of the textile complex do not argue questions of protection versus costs, they debate the question of whether or not the level of protection domestic workers and producers currently receive is sufficient and effective in protecting the jobs of textiles and apparel workers, in protecting the market share of US produces goods, and whether such protection will allow textile and apparel manufacturers to be competitively priced in domestic markets.

Proponents of free trade argue that more efficient means of production and opportune consumption patters are obtained with liberalized trade. Kreinin (1987, p. 248) argues that dynamic gains from trade include increased volume of resource made available to, or employed by, the trading country, rising incomes, savings and investment, and changes in relative price. He later (1987, p. 318) states that static gains include "trade creation" and lower prices, a favorable consumption effect.

CHAPTER III

LITERATURE REVIEW AND THEORETICAL CONCEPTS

1. INTRODUCTION TO COSTS

The benefits whether gained, transferred, or lost from trading within a domestic market without foreign trade or with imports, can be "measured" as consumer and producer surpluses. Figure 3.1 shows, in the absence of foreign trade, consumer surplus as the area under the demand curve D , but above the equilibrium price line PE . Consumers, or buyers are able to buy as many units as they desire at the equilibrium price P , even though they are willing to pay more for the good, as high as price A , but receive a smaller number of units. Producer surplus is represented by the area below the equilibrium price line PE and above the supply curve S . Producers, or sellers, are able to sell Q units at a price as high as P , even though they are willing to supply fewer units at a lower price such as B .

The effects of quotas on consumer and producer surplus can be seen in Figure 3.2. Equilibrium is established at a price P and quantity produced Q . However, with a quota, the quantity available decreases, thus increasing the price (assuming the goods to be normal). The upper shaded area $PP'CG$ represents the consumer surplus that is lost due to the imposed quota which is transferred to the producer. The area CFE represents the dead-weight loss due to inefficiency. Dead-weight loss is the amount of income that is wasted in the process of

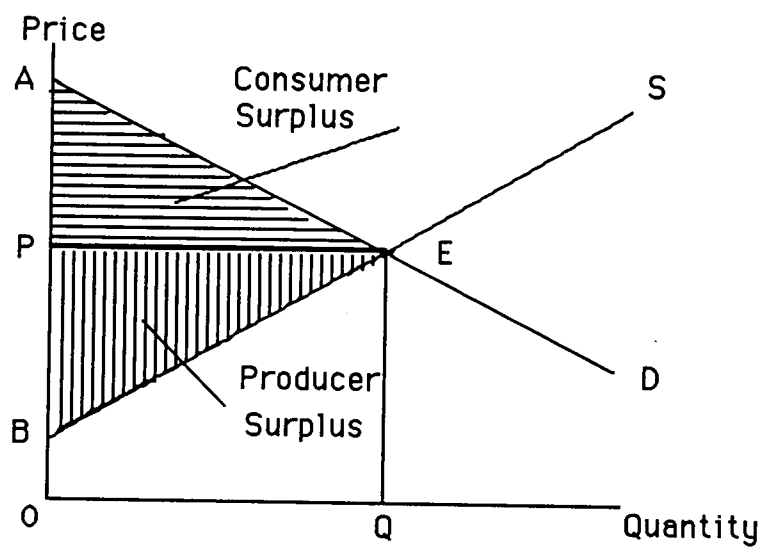


Figure 3.1 Consumer and Producer Surplus.

Source: Hirschleifer, Jack (1984), p. 219.

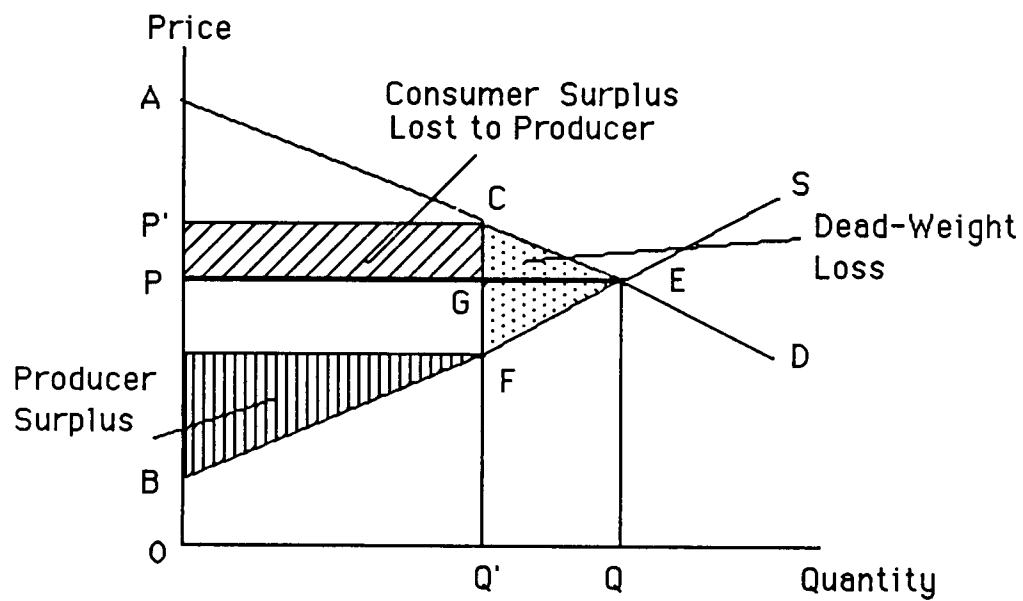


Figure 3.2 Effects of Quotas.

Source: Hirschleifer, Jack (1984), p. 223.

increasing domestic production and reducing domestic consumption of the protected items, plus any transfers of income abroad that occur in the case of export restraints. Producers, on the other hand, retain their surplus, and, on an aggregate level, may benefit from the restrictions if their transfer gain is greater than their dead-weight loss due to inefficiency and reduced number of transactions.

The amount of dead-weight loss is dependent on the price elasticity of demand. A slight reduction in quantity, in response to a substantial increase in price for a good, suggests that the demand for the good is highly price inelastic. A price elastic demand exists when the percent increase in quantity demanded is larger than the percent decrease in price. If a price increases, the consumer surplus loss is greater for the goods with an inelastic demand, but the dead-weight loss is greater for the good with an elastic demand.

The effects of a tariff, which are a major form of trade restraint used in the textile and apparel industry, (Morkre and Tarr, 1980), can be seen in Figure 3.3 where domestic equilibrium price would be at P_1 . Under free trade and in the absence of transport costs, the domestic price is equal to the world price, assumed to be P_2 . At the world price, P_2 , domestic consumption is the amount O_d and domestic production is O_a . The quantity of imports is equal to ad . A tariff imposed would raise the price to P_3 . Domestic consumption declines to O_c (a reduction by the amount cd). This is known as the consumption effect, or dead-weight loss (of area h). Consumers are forced to decrease consumption of the taxed good and switch to less desirable substitutes. Domestic production

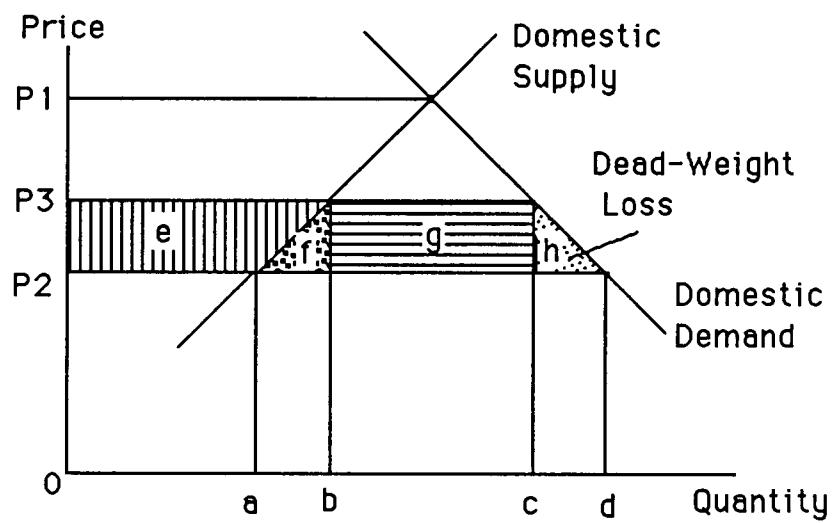


Figure 3.3 Effects of Tariffs.

Source: Kreimin, Mordechai (1987), p. 297.

increases (from a to b), known as the production effect of the tariff, and imports decline by the sum of ab and cd (Krein, 1987, p. 297).

The sum of the areas e + f + g + h represent the loss of consumer surplus. This area is greater than the area e + g which represents the gain in producer surplus and the tariff revenue for the government. When protection is removed, and price falls to P₂, the social gains of areas f + h, representing the loss due to the production effect and the dead-weight loss, accrue each period and are not offset by adjustment costs. Morkre and Tarr (1980) estimate the net welfare gain, the benefits from eliminating deadweight consumption losses minus the cost of unemployment, to be \$1,319 million, for a four year period. The FRBNY (1985) reported the cost to consumers to protect the clothing industry to be \$8.5-12 billion with a 26 percent tariff plus quantitative limits on import growth.

2. THE CASE FOR FREE TRADE

"The most important reason for free trade is that free trade permits greater general welfare" (Morkre and Tarr, 1980, p. 1). Consumers can purchase goods which cost less and have access to a wider variety of products. Comparative advantage suggests that the US should import products that can be produced less expensively elsewhere and specialize in manufacturing products that can be produced more profitably domestically. The United States has generally an abundance of skilled labor and research and development facilities, relative to the rest of the world. Therefore, the United States, in order to be competitive, must focus on these strengths and use them in the products they produce.

The textile and apparel industry has received some sort of protection as early as the 1930's (Dickerson, 1988). The question rises, how long does the government protect an industry, and at what costs? Once an industry is protected, that protection is very difficult to eliminate. "Persistent protection cannot cure the problems of these industries; it merely transfers them from government to successive government" (Michalski, et al., 1985, p. 128). A vicious cycle results. Protectionism inhibits factor adjustments and decreases competitiveness, giving rise to the reason for protection.

The textile and apparel industry seeks "protection" from the government believing that as protectionism increases, the production level and market share of domestic textiles and apparel also increases. However, protectionism imposes costs to the consumer. Several studies have been conducted which estimate the welfare costs or dead-weight loss of protecting the textile and apparel industry. The Council on Wage and Price Stability (1978) estimated the clothing dead-weight loss in 1975 to be 206.7 million dollars. Morkre and Tarr (1980) estimated the clothing dead-weight loss in 1977 to be \$406.2 million and \$4.1 million for made-up and miscellaneous textile products. For textile products, Pelzman and Bradberry (1980) estimated the dead-weight cost to be \$1.2 million in 1976. In addition, Hartman (1979) concludes that the public pays over three billion dollars each year to protect the textile industry. In 1986, Gary Hufbauer, a professor of finance at Georgetown University and an international trade expert, and Howard Rosen, a research associate at the Institute for International Economics in Washington, calculated that consumers spent \$27 billion in

subsidies alone to protect the textile and apparel industry. This translates into approximately \$42,000 per job with an average wage of \$12,000 (McFadden, 1987, p. 123).

It is generally assumed that tariffs raise the price of the imported goods which in turn reduces purchasing power due to the higher price. Quotas reduce the quantity of foreign goods available, and generally results in higher per unit value. A study conducted by Vladimir Pregelj, reported in Business Week (September 5, 1977, p. 61-62), concluded that consumers do not receive price benefits from low cost imports, since, he concluded, retailers charge nearly the same price for imported and domestically produced goods.

Theoretically, free trade is better, but the textile and apparel industries are finding it difficult to compete in a free trade market when many of the United States's trading partners do not practice free trade. "The major developing countries maintain by far the most restrictive system of import protection in textiles and apparel" (Wolff, et al., 1987, p.7). As presented in Figure 3.4, the United States receives the largest share of developing country exports of apparel products. The Soviet Union and Eastern Europe (Eastern Trading Area) do not import significant amount of textiles and apparel, and non-MFA Developed countries such as Japan (an MFA signatory), Australia, and New Zealand, have chosen to restrict textiles and apparel imports to a greater degree than the countries under MFA guidelines. Not only do these countries restrict imports, they maintain high levels of exports through forced export programs and

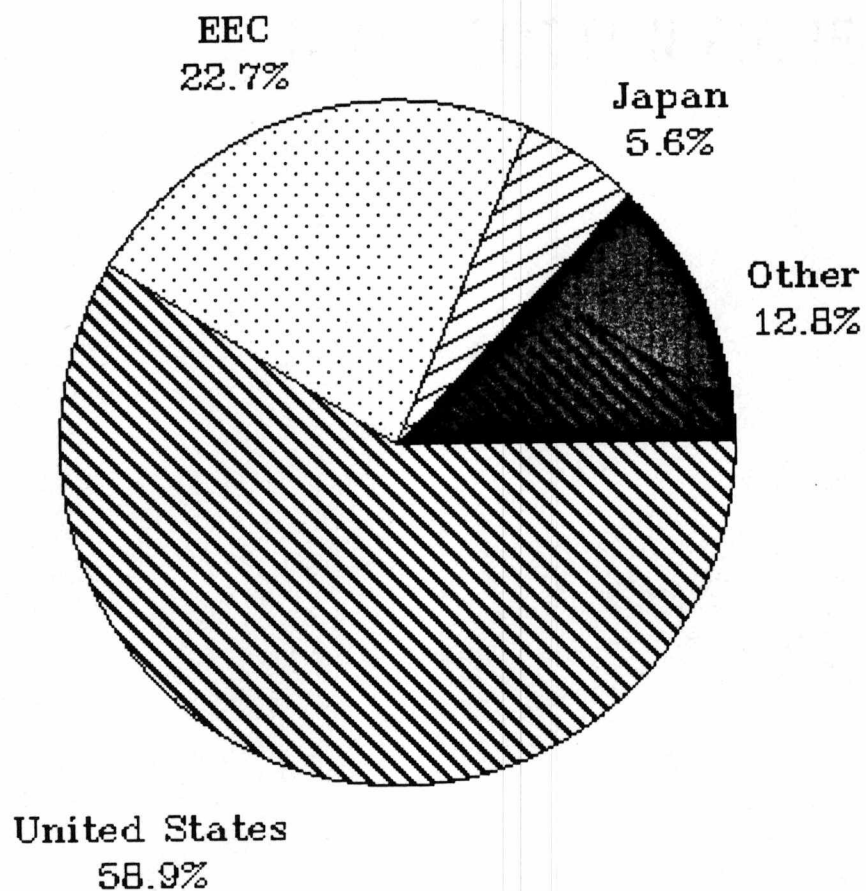


Figure 3.4 Share of Apparel Exports (From Developing Countries).

Source: Wolff, Alan Wm. et al., (1987).

export subsidies, establishing cartels, dumping, and domestic subsidies (Wolff, et al., 1987).

The employment argument for protecting the textile and apparel industry is not supported by research or theory. Emotional distress and social "costs", such as adjustment costs of finding a different job, recovery from unemployment, and destroying a traditional life style, or entire town or region, are valid. However, in the long run, with flexible factors, it can be shown that trade restrictions are not beneficial to the economy as a whole. Protectionists often argue that protection saves jobs. In the short run, this may be true. However, a study on initial unemployment by the Canadian Government (1979), as reported by Wolf, et al., (1984) found that the majority of workers did find employment. At least two-thirds of all displaced workers do find alternative employment. This government project showed also that the probability of subsequent unemployment increased, due to lay-offs. One cannot assume that experience before the job loss is representative of what would have happened without the lay-off. Also, the estimates relate to only the first three years after the initial lay-off and are unlikely to be representative of an entire working life for the workers (Wolf, et al., 1984, p. 117). It has been further stated that "unemployment is less a function of the individual, but rather the labor market conditions at the time of desired reemployment" (Cable, 1983, p. 139). Subsequent unemployment may be also a result of taking a new job too quickly. An individual with a newly acquired job may soon find oneself unhappy, and find themselves unemployed soon thereafter (Cable, 1983, p. 141).

Comparative advantage further suggests that no relation exists between a decline in employment in any one sector and aggregate unemployment (Wolf, et al., 1984). Even though imports have increased approximately 50 percent since 1981, the US has generated 7.6 million new jobs (McFadden, 1987, p.123). Many of these new jobs are considered as being in the high pay range; with 3.3 million high paying jobs (over \$29,048); 2.4 million included in the middle pay range (\$7,263-\$29,048); and 1.9 million considered as low pay salaries (under \$7,263) (McFadden, 1987, p. 123).

In a survey of employment studies discussed in the Thames Essay (1984), several conclusions regarding unemployment were given. First, when considering the effects on earnings of laid off workers, wages were higher in the new job in many cases. Next, overall, women have much larger gross and net-earning losses than men. In addition, women have more difficulty in finding alternative jobs. While women may suffer more than men, financially and emotionally, the study further concluded that, workers were actually better off financially after finding alternate employment and government benefits seemed to be effective in supplementing for most of the lost earnings.

Further supporting the free trade argument is that trade restraints generally increase prices. An increase in import price may decrease production of domestic goods utilizing the imported good as an input. A reduction in supply, yet another possible effect of trade restraints, may cause supply problems for the US producer, especially if an import is the only source for a particular input.

Retaliation may also result as trade restrictions are imposed. If the United States does not purchase other countries' exports, the exporting countries, in turn, will not have the foreign exchange to purchase US exports and the trade level of both parties falls. According to Bergsten (1974):

US Exports generate much higher wages because US exports largely high-productivity, advanced products and imports low-productivity, standardized products. Import restriction and the resulting loss of export opportunities would thus significantly reduce total American incomes and national wealth (p.133).

Retaliation by exporting countries may also result in indirect reductions in US export values further reducing the US terms of trade.

Two loopholes that exist in the free trade debate are the optimal tariff argument and the infant industry argument. However, these are not appropriate for the textile complex for the following reasons.

A country with a small ratio of imports with free trade in an economy with a highly elastic foreign offer curve will see smaller welfare gains from the optimal tariff (Johnson, 1968). The optimal tariff is a tariff that maximizes net gain by improving a country's terms of trade. The gain in the terms of trade appears to exceed the loss of real income due to probable reduced volume of trade. As for the United States, with its relatively small ratio of imports to domestic production and an elastic foreign demand, the welfare gains would be small (Magee, 1972). Although the textile and apparel industry receives a large ratio of imports to domestic production, the US economy as a whole receives a small ratio of imports to domestic production; therefore making the optimal tariff argument invalid.

The infant industry argument proposes that an industry in the early stages of development may need protection in order to have a chance to compete effectively with established industries in other countries, i.e., the "infant" needs time to "grow up." This protection is not valid for the textile and apparel industries since these industries have existed as mature industries in the US for decades, if not longer.

A shift from the manufacturing sector to the service sector is occurring in today's US economy. The protectionists argue the manufacturing sector needs protection because growth of productivity is higher in the manufacturing sector and should be conserved. However, this inaccurately identifies low productivity with services as compared with manufacturing (Bhagwate, 1985). While the textile industry is by no means "infant," it is, perhaps, in a stage of restructuring. It is suggested that in order to get high-technologically orientated and information oriented industries established, impose trade restraints to benefit these industries. Many feel "high-tech" is the trend of the future and in order to survive, companies with an effort to become more competitive through advanced technology should be protected.

Theoretically, free trade is better for the US economy. Earlier studies have indicated the high costs to consumers for protecting the textile and apparel industry. Studies have also found that workers in the textile and apparel industry were actually better off financially when they found alternative employment. This was found to be the case for almost two thirds of those unemployed.

A more recent study of the effects of imports on the aggregate production level of domestic textiles and apparel including all fibers is needed to determine the costs and benefits of protecting the textiles and apparel industry. Especially needed are good estimates of import and impact elasticities.

3. PREVIOUS IMPORT STUDIES

Past research regarding the estimation of import demand elasticities has yielded a number of suggestions for appropriate specifications of the functions used to determine import elasticities. Estimation of import elasticity of demand for the textile and apparel industries using a log-log linear-regression equation with lagged dependent variables can be used assuming infinite supply elasticity. With this assumption, the problem of identifying supply and demand inverse interaction is eliminated. When firms are operating at less than full capacity, a decrease in demand will force the firm to reduce production rather than decrease price. An increase in demand will cause production to expand, and a rise in price will not be seen until the industry is operating at full capacity, giving rise to the horizontal supply curve until full capacity is reached. That is, at less than full employment, infinite elasticity exists, and the supply curve will be horizontal. (Murray and Ginman, 1976, p. 75).

Thursby and Thursby (1984) examined aggregate import demand functions and determined that models with lagged dependent variables and log specifications are more appropriate than lagged independent variables such as price and income with non-log specification. Thursby and Thursby also suggest

two models which performed the "best" according to their standards and popularity of use. The two models are: (1) the Houthakker-Magee Model, and (2) a variant of Houthakker-Magee, using price, income and lagged imports.

These models are:

$$(1) \quad Q_t = f(P_t/P_{t-1}, Y_t/Y_{t-1}, Q_{t-1}) \text{ and}$$

$$(2) \quad Q_t = f(P_t, Y_t, Q_{t-1}),$$

where

Q_t = quantity of imports in time t ,

Y_t = income in time t ,

P_t = price of imports in time t .

A variant of the Houthakker-Magee Model was used by Pelzman and Martin (1981) to test the hypothesis that the quantity of textile imports is determined by the price of imports, the price of domestic substitutes, income, and lagged imports. Murray and Ginman (1976) concluded that the relative price specification was not appropriate at the aggregate level. However, this was not the case for disaggregated models, and it would seem relative prices could be used in the models of the textile and apparel industry. Murray and Ginman (1976) suggested testing the relative price formulation before its adoption. Stone (1979, p. 307) suggested that quantitative restrictions could be incorporated in the model, assuming that the import price the exporter charges reflects the effect of the restriction.

Lagged variables are used to take into consideration the period of adjustment between actual and long run demand for imports. Yadov (1975), in his study of

the process of lagged adjustments, found that lags are statistically significant. He also states that less than half of the adjustment occurs within the first quarter, but that the adjustment is seen by the end of the fourth quarter. Further evidence supporting the use of lag variables is in Kreinin's (1973) study of disaggregated import demand functions. Kreinin used lagged independent variables, one quarter behind the dependent variables to determine if demand pressure had an adverse influence on a country's exports, independent of price effects.

Price and Thornblade (1972) have also estimated import demand elasticities using yet another set of specifications. However, their model is inappropriate for this study because it incorporates both commodity and country into the equation. They limited the model to include manufactured goods of generally the three-digit SITC level of aggregation from developed countries. Their reason for this restriction is that complications arise when incorporating import quotas and imports from less-developed countries. This eliminates the use of this model for the textile and apparel industry because quotas and less-developed countries do have a significant impact on the textile and apparel industry.

Price and other elasticities are important because they help predict the flow of imports and exports. In relation to trade balance, Houthakker and Magee (1969) suggest that differences in income elasticities of demand for other's exports affect the trade balance and thus the exchange rate. The quantity of imports demanded should decrease as price of imports rises relative to other goods, and demand should increase with an increase in income or an appropriate shifter or activity variable. Elasticities can be used to estimate welfare costs, the

impact on employment levels, and can be used to guide individuals making policy decisions regarding the textile and apparel industry.

4. THEORETICAL MODEL

The mathematical model for textile import demand, based upon economic theory was:

$$M_t = f(PM_t, PD_t, Y_t, Z_t) \quad (3.1)$$

where,

M_t = Quantity demanded in the United States of textile imports in time period t (current period),

PM_t = Price of textile imports in the United States in time period t ,

PD_t = Price of domestically produced textiles in the United States in time period t ,

Y_t = Aggregate consumer income in time period t ,

Z_t = Taste and preference variable, or activity variable in time period t .

Consistent with theory, it is expected that:

$$\frac{\partial M}{\partial PM} < 0, \text{ i.e., } \quad \text{the quantity demanded of textile imports will vary inversely with import price;}$$

$$\frac{\partial M}{\partial PD} > 0, \text{ i.e., } \quad \text{the quantity demanded of textile imports will vary directly with the domestic US price of textiles; textile imports and domestic textiles are expected to be substitutes but not perfect substitutes;}$$

$\frac{\partial M}{\partial Y} > 0, \text{ i.e.,}$	the quantity demanded of textile imports will vary directly with consumer income;
$\frac{\partial M}{\partial Z} > 0, \text{ i.e.,}$	the quantity demanded of textile imports will vary directly with the demand shifters if the shift variables reflect positive tastes and preferences for imports; if the shift variables represent negative tastes and preferences for imports, the quantity demanded will vary indirectly with those variables.
$\text{or } < 0,$	

Similarly, the corresponding model for the US demand for apparel imports can also be symbolically expressed as:

$$M_t = g(PM_t, PD_t, Y_t, Z_t) \quad (3.2)$$

where all variables are defined as before except they represent apparel instead of textiles. The signs of the partial derivatives are expected to be the same as they were for the textile import demand equation.

The mathematical model for textile output, based on economic theory was:

$$Q_t = f(L_t, K_t, P_t, I_t, C_t, M_t) \quad (3.3)$$

where,

Q_t = Textile output in the US in time period t (current period),

L_t = Level of textile employment in time period t ,

K_t = Capital stock in textile in the time period t ,

P_t = Price of US textile output in time period t ,

I_t = Textile product inventory in time period t ,

C_t = Textile capacity utilization in time period t ,

M_t = Quantity of textile imports into the US in time period t .

Consistent with theory, it is expected that:

$\frac{\partial Q}{\partial L} > 0$, i.e., the level of textile output will vary directly with the level of US textile employment;

$\frac{\partial Q}{\partial K} > 0$, i.e., the level of textile output will vary directly with the level of US capital stock in textiles;

$\frac{\partial Q}{\partial I} < 0$, i.e., the level of textile output will vary indirectly with the level of US textile product inventory;

$\frac{\partial Q}{\partial P} > 0$, i.e., the level of textile output will vary directly with the US price of textile output;

$\frac{\partial Q}{\partial C} > 0$, i.e., the level of textile output will vary directly with US textile capacity;

$\frac{\partial Q}{\partial M} < 0$, i.e., the level of textile output will vary indirectly with the level of textile imports into the US.

Similarly, the corresponding model for the US level of apparel output can also be symbolically expressed as:

$$Q_t = g(L_t, K_t, P_t, I_t, C_t, M_t) \quad (3.4)$$

where all variables are defined as before except they represent apparel instead of textiles. The signs of the partial derivatives are expected to be the same as they were for the textile output equations.

Following Nadiri and Rosen (1973), the input equation to be estimated for textiles can be expressed as:

$$X_{it} = f_i(Q_t, W/C_t, X_{j,t-k}) \quad (3.5)$$

$$i = 1,2,3,4,5$$

$$j = 1,2,3,4,5 \text{ for each } i,$$

where

X_{it} = Input quantities at time t ,

Q_t = Textile output in the US in time period t , and

W/C_t = Relative factor prices for textiles (wages of textile employees divided by the price of capital) stock in time t .

Consistent with theory, it is expected that:

$$\frac{\partial X}{\partial Q} > 0, \text{ i.e., } \quad \text{the input quantities will vary directly with the level of US textile output,}$$

$$\frac{\partial X}{\partial (w/c)} < 0, \text{ i.e., } \quad \text{the input quantities will vary indirectly with US relative factor price,}$$

$$\frac{\partial X_i}{\partial X_j} < 0, \text{ i.e., } \quad \text{the input quantities will vary indirectly with the level of lagged inputs for production substitutes,}$$

or,

$$\frac{\partial X_i}{\partial X_j} > 0, \text{ i.e., } \quad \text{the input quantities will vary directly with the level of lagged inputs for production compliments.}$$

Similarly, the corresponding equations for apparel input quantities are expressed as follows:

$$X_{it} = g_i(Q_i, W/C_i, X_{j,t-k}) \quad (3.6)$$

$$i = 1,2,3,4,5$$

$$j = 1,2,3,4,5 \text{ for each } i,$$

where all variables are defined as before except that they represent the apparel industry. The sign of the partial derivatives are expected to be the same as they were for the textile industry.

A useful formulation for this study is that for a change in the tariff rate for textiles or apparel (or tariff equivalent) that the impact upon the level of imports of textiles or apparel, textile and apparel production, and textile employment can be obtained from the following relationships.

$$\frac{dM_i}{M_i^*} = \frac{\lambda_i t_j}{1 + t_j} \quad (3.7)$$

$$\frac{dQ_i}{Q_i^*} = \delta_i dM_j \quad (3.8)$$

$$\frac{dE_i}{E_i^*} = \Phi_i dQ_i \quad (3.9)$$

where

M_i = Quantity of imports of commodity i , either textiles or apparel, into the US,

- $\lambda_i =$ Direct price elasticity of demand for commodity i,
 $M^*_i =$ A given level of M_i ,
 $t_i =$ ad-valorem tariff rate on commodity i,
 $Q_i =$ Output of commodity i in the US,
 $Q^*_i =$ A given Level of Q_i ,
 $\delta_i =$ Import elasticity of output in the US,
 $E_i =$ Employment level in US industry producing commodity i,
 $E^*_i =$ A given level of E_i ,
 $\Phi_i =$ Output elasticity of employment for commodity i in the US,
 $d(\bullet) =$ Differential.

CHAPTER IV

ESTIMATION MODELS AND EMPIRICAL RESULTS

1. INTRODUCTION

In order to estimate the impact of textile and apparel imports upon employment in the domestic US textile and apparel industries, upon the production level of US domestic textile industries, and upon selected production resources, the elasticities of various domestic textile and apparel explanatory variables were estimated. The estimation models utilized monthly data for the time period 1974-1986. The data were national aggregates or averages.

Four models were selected to estimate import demand, two each for textiles and apparel, and two models were selected to estimate output functions, one each for textiles and apparel. Ten additional equations, five for textiles and five for apparel, were estimated for the input functions. The variables were transformed to their natural logarithms, and the estimation equations were expressed in these transformed variables. Using OLS or GLS regression equations on the transformed variables, each model was run using the variables required by theory, as presented in Chapter III, whenever the data was available. Some variables are not truly observable or data not collected for them, so they were measured by very similar variables or by proxy variables.

There are many factors which influence the import demanded of textiles and apparel. Such factors include import prices, domestic prices, taste and

preferences, and income available for consumption. These variables and their data sources are described in Appendix A. Likewise there are also many factors that effect the adjustment of textile and apparel inputs toward equilibrium levels and influence the output level of the textile and apparel industries. These variables are also described in Appendix A.

The remainder of this chapter will present the estimation models and the parameter estimates and elasticities of those models. Sections 2 and 4 present the textile import demand results, and Sections 3 and 4 provide the corresponding results for apparel. Output models for both textiles and apparel are in Section 5. Sections 7 and 8 present the input models for textiles and apparel, respectively. Emphasis was placed upon building theoretically sound models, estimating their parameters with appropriate statistical procedures, and evaluating the results properly.

2. TEXTILE IMPORT DEMAND MODELS

It is generally expected that the quantity of imports demanded will be positively, or directly related to income and negatively, or indirectly, related to import price. A rise in income will result in an increase in demand whereas a rise in import price will result in a decrease in quantity of imports demanded. This positive relationship between income and demand for a good holds true for normal goods but not for inferior goods (rise in income results in a decrease in demand of the good). Textiles and apparel are assumed to be normal goods in this study.

Domestically produced and imported textile and apparel products are typically substitutes. With this assumption, a rise in import price will decrease the quantity demanded for imports, increase the demand for domestically produced goods, and increase domestic price. Consequently in import demand equations, a positive coefficient for income is expected, a negative coefficient for import price, and a positive coefficient for domestic price.

There were two textile import demand models specified in this study. The models were an attempt to specify the separate effects of import and domestic textile prices as well as relative price effects, the effect of income and the effect of imports in previous time periods.

The estimation equation for the first textile import demand model was specified to be of the general form:

$$M_t = \beta_0 + \beta_{1t}PM_t + \beta_{2t}PD_t + \beta_{3t}Y_t + \beta_{4t}M_{t-k} + \xi_t \quad (4.1)$$

where the β 's are parameters to be estimated, the ξ_t is a random error term, and the other variables are as previously defined, i.e.,

M_t = quantity of textile imports in time period k,

PM_t = import price in time period t,

PD_t = domestic product price in time period t,

Y_t = aggregate consumer income in time period t, and

M_{t-k} = textile imports in time period t-k.

It is expected that $\beta_{1t} < 0$, and β_{2t} , β_{3t} , β_{4t} , all > 0 ; this is consistent with theory as discussed previously. This model estimates the effects of import textile price

and domestic textile price separately. Relative price effects are provided by the second model.

The specific estimation equation for this variant of the textile import demand equation, expressed with variables in logarithmic form is:

$$\begin{aligned} \text{Ln}M_t = & \beta_0 + \beta_1\text{Ln}PM_t + \beta_2\text{Ln}PD_t + \beta_3\text{Ln}Y_t \\ & + \beta_4\text{Ln}M_{t-3} + \xi_t \end{aligned} \quad (4.2)$$

where

$\text{Ln}M_t$ = log of the quantity of textile imports expressed in square yard equivalents (SYE),

$\text{Ln}PM_t$ = log of the price of textile imports expressed as \$/SYE,

$\text{Ln}PD_t$ = log of the domestic textile price expressed as the producer price index for textiles (wholesale price),

$\text{Ln}Y_t$ = log of domestic consumer income expressed by a proxy variable, Personal Disposable Income (PDI),

$\text{Ln}M_{t-3}$ = log of the quantity of textile imports lagged three periods, and

ξ_t = random error term in time period t.

The resulting estimated equation using Ordinary Least Square (OLS) was:

$$\begin{aligned} \text{Ln}M_t = & -11.2635 - 0.8830\text{Ln}PM_t + 0.7051\text{Ln}PD_t + 2.3124\text{Ln}Y_t \\ & (0.0001) \quad (0.0001) \quad (0.0001) \\ & + 0.2975\text{Ln}M_{t-3} \\ & (0.0001) \end{aligned} \quad (4.3)$$

$$R^2 = 0.941$$

$$\bar{R}^2 = 0.939$$

The significance levels of the estimated parameters are shown in parentheses beneath the parameter estimated. The signs of the parameters were all as anticipated, and all parameter estimates were statistically different from zero at the 0.0001 level or greater. The direct price elasticity of textile import demand was estimated to be -0.883, and the cross price elasticity was 0.705. These suggest a competitive environment for textiles. The income elasticity of 2.3124 implies a strong response by imports to income changes. The lagged import elasticity was 0.2975, which is consistent with other studies. The statistical significance combined with correct signs suggests that the parameter estimates may be very good ones.

The second equation for textile import demand was specified as:

$$\begin{aligned} \text{Ln}M_t = & \gamma_0 + \gamma_1\text{Ln}(PM/PD_t) + \gamma_2\text{Ln}Y_t \\ & + \gamma_3\text{Ln}M_{t-1} + \xi_t \end{aligned} \quad (4.4)$$

where the γ 's are parameters to be estimated, and

$\text{Ln}M_t$ = log of the quantity of textile imports expressed in SYE,

$\text{Ln}(PM/PD_t)$ = log of the ratio of textile import price to domestic producer price of textiles, where PM is textile import price expressed as \$/SYE and PD is domestic textile price expressed as the producer price index for textiles,

$\text{Ln}Y_t$ = log of consumer income, expressed as PDI,

$\text{Ln}M_{t-1}$ = log of quantity of textile imports lagged one period, and

ξ_t = random error term in time period t.

Economic theory suggests that $\gamma_{1t} < 0$, $\gamma_{2t} > 0$, and $\gamma_{3t} > 0$. The ratio of the price of textile imports relative to the domestic textile price may be considered one variable, the price ratio. The price ratio will increase if import prices increase faster or decrease slower than domestic prices or if import prices increase while domestic prices decrease. Thus, the price ratio depends upon relative prices and their relative changes over time. The estimation of this equation, Equation 4.4, was done by OLS. The estimated equation is:

$$\begin{aligned} \text{Ln}M_t = & -8.2281 - 0.7313\text{Ln}(PM_t/PD_t) + 1.6850\text{Ln}Y_t \\ & (0.0001) \qquad\qquad\qquad (0.0001) \\ & + 0.4119\text{Ln}M_{t-1} \\ & (0.0001) \end{aligned} \tag{4.5}$$

$$R^2 = 0.944$$

$$\bar{R}^2 = 0.943$$

where the significance probabilities are shown beneath the parameter estimates. In this equation for textile import demand, all variables were significant at the 0.0001 level and had correct signs. The income variable was highly significant, and the estimated income elasticity of textile import demand was 1.685 which is high but not as high as that estimated in Equation 4.3. The lagged quantity of imports was also significant and was relatively inelastic (0.4119) but larger than the 0.2975 of Equation 4.3. This is quite reasonable given that the effect of lagged imports decreases as the lag becomes longer. The estimated coefficient for the price ratio, the price of imports relative to the domestic price of textiles,

had a negative sign (-0.7313) as expected and was in the inelastic range. This result is believable, given the competitive nature of textile imports.

3. APPAREL IMPORT DEMAND MODELS

This section on apparel specifies two import demand models--both with relative price effects. The estimation models for apparel import demand are the general form of the second textile import demand model, i.e.:

$$M_t = \alpha_0 + \alpha_{1t}(PM_t/PD_t) + \alpha_{2t}Y_t + \alpha_{3t}M_{t-k} + \xi_t \quad (4.6)$$

where the α 's are parameters to be estimated, ξ_t is a random error term, and the other variables are as defined previously, i.e.:

M_t = quantity of apparel imports in time period t ,

PM_t = price of apparel imports in time period t ,

PD_t = price of domestically produced apparel in time period t ,

Y_t = consumer aggregate income in time period t ,

M_{t-k} = apparel imports in time period $t-k$.

Given the theory, it is logical to expect that $\alpha_{1t} < 0$ and $\alpha_{2t} > 0$, and $\alpha_{3t} > 0$.

The first apparel estimation equation was specified, with variables in logarithmic form, as:

$$\ln M_t = \alpha_0 + \alpha_{1t}\ln(PM_t/PD_t) + \alpha_{2t}\ln Y_t + \alpha_{3t}\ln M_{t-1} + \xi_t \quad (4.7)$$

where

$\text{Ln}M_t$ = log of the quantity of apparel imports in time period t expressed in square yard equivalents (SYE),

$\text{Ln}(PM_t/PD_t)$ = log of the ratio of apparel import price, in time period t , expressed as \$/SYE, to domestic price in time period t , proxied by the Consumer Price Index (CPI),

$\text{Ln}Y_t$ = log of consumer income in time period t measured by Personal Disposable Income (PDI),

$\text{Ln}M_{t-1}$ = log of quantity of apparel imports lagged one period, and

ξ_t = random error term in time period t .

Expected signs on the parameters are: $\alpha_{11} < 0$, $\alpha_{21} > 0$, and $\alpha_{31} > 0$.

The parameters of this equation were estimated by OLS with the probabilities of rejecting the null hypothesis in parentheses below the parameter estimates:

$$\begin{aligned} \text{Ln}M_t = & -11.3192 - 0.3324\text{Ln}(PM_t/PD_t) + 1.8998\text{Ln}Y_t \\ & (0.0019) \qquad\qquad\qquad (0.0001) \\ & + 0.5573\text{Ln}M_{t-1} \\ & (0.0001) \end{aligned} \qquad (4.8)$$

$$R^2 = 0.869$$

$$\bar{R}^2 = 0.866$$

The signs of the parameters were consistent with a priori expectations.

The price ratio had a negative sign and income had a positive sign, as did lagged apparel imports. All coefficients were statistically significant at the 0.002 level or better. The model appears to be reasonably strong.

The estimated parameter for the price ratio was -0.3324, which suggests that a one percent change in relative apparel prices would result in approximately

one-third of one percent change in apparel imports in the opposite direction of the price change. This estimate is smaller than expected but the parameter would probably be larger (in absolute value) in the absence of the strong market distortions caused by protection of the US apparel industry. The parameters for income and lagged apparel imports, 1.9 and 0.56 respectively, are reasonable but higher than originally expected.

The second apparel import model was specified with the same variables as the first apparel model, except that imports were lagged six months in order to account for the partial influence of the fashion cycle on apparel imports.

$$\begin{aligned} \text{Ln}M_t = \eta_0 + \eta_{1t}\text{Ln}(PM_t/PD_t) + \eta_{2t}\text{Ln}Y_t \\ + \eta_{3t}\text{Ln}M_{t-6} + \xi_t \end{aligned} \quad (4.9)$$

where

$\text{Ln}M_t$ = log of the quantity of apparel imports in time t , expressed as SYE,

$\text{Ln}(PM_t/PD_t)$ = log of the ratio of apparel import price to domestic apparel price in time t ,

$\text{Ln}Y_t$ = consumer income in time t measured by the CPI.

$\text{Ln}M_{t-6}$ = log of the quantity apparel imports lagged six months, and

ξ_t = random error term in time t .

It is expected that $\eta_{1t} < 0$, $\eta_{2t} > 0$, and $\eta_{3t} > 0$, but η_{3t} could be < 0 if fashion effects lag six months.

The resulting estimated equation was:

$$\begin{aligned} \ln M_t = & -24.9316 - 0.4067 \ln P_t + 4.2027 \ln Y_t \\ & (0.0028) \quad (0.0001) \\ & - 0.1508 \ln M_{t-6} \\ & (0.0910) \end{aligned} \quad (4.10)$$

$$R^2 = 0.800$$

$$\bar{R}^2 = 0.796$$

where significance probabilities are shown in parentheses.

For apparel import demand in this model, all of the variables were significant at the 0.003 level or better except for the coefficient of lagged imports, which was significant at the 0.091 level, which is marginally acceptable. The imports lagged six months were not found to be as significant as the imports lagged 1 month, and the sign of the parameter was negative. The signs of the coefficients were as expected, except possibly for lagged imports in this model. As was found with the textile import demand equation and the earlier apparel import demand model, income has a significant impact on the amount of apparel imports demanded. The coefficient of 4.2 in this model is quite high. The relative price variable was also significant, inversely affecting the quantity of apparel imports demanded, as indicated by a negative price coefficient of -0.4, which says that a one percent increase (decrease) in the price ratio would result in a four-tenths of one percent decrease (increase) in the quantity of apparel imports demanded.

4. IMPORT DEMAND ELASTICITIES

Results of the textile and apparel import demand equations are tabulated in Table 4.1. The estimated regression coefficients are presented as elasticities. This is correct since the regression coefficients are also elasticities when the OLS regressions are run on the logarithms of all the variables, this was done in this study.

As discussed previously in Section 2 and Section 3, the signs are generally as prescribed by theory, and all elasticities are strongly statistically significant except for six-month lagged imports for apparel. The import demand functions are all price inelastic with respect to own prices and with respect to cross prices in textiles. Cross price elasticities were not estimated for apparel. The demand functions were quite income elastic for both textiles and apparel, especially apparel, and were inelastic with respect to lagged imports. The lagged import elasticity diminished as the lag lengthened.

5. OUTPUT MODELS

This section is primarily concerned with estimating the effect of textile and apparel imports upon competing domestic products (textiles and apparel). In order to determine this effect most efficiently, the import elasticity of output (or at least the rate of change of output with respect to imports) would be quite helpful if not necessary. Toward this end, two output equations were run, one each for textiles and apparel. The variables were transformed to their natural

Table 4.1 Import Demand Elasticities for Textiles and Apparel.

Dependent Variables	EXPLANATORY VARIABLES						
	PM _t	PD _t	PD _t /PD _t	Y _t	M _{t-1}	M _{t-3}	M _{t-6}
AM (4.8)			-0.3324 (0.0019)	1.8998 (0.0001)	0.5573 (0.0001)		
AM (4.10)			-0.4067 (0.0028)	4.2027 (0.0001)			-0.1508 (0.0910)
TM (4.5)			-0.7313 (0.0001)	1.6850 (0.0001)	0.4119 (0.0001)		
TM (4.3)	-0.8830 (0.0001)	0.7051 (0.0001)		2.3124 (0.0001)		0.2975 (0.0001)	

Significance probabilities are shown in parenthesis under the parameter (elasticity) estimates:

AM = quantity of apparel imports; TM = quantity of textile imports.

logarithms, and the estimation equations were expressed in these transformed variables. Lagged textile and apparel imports were used in textile and apparel output equations, respectively, as explanatory variables and to help determine the effect of textile and apparel imports upon textile and apparel output in the US.

The estimation equation for textile output was of the general form:

$$Q_t = \beta_0 + \beta_1 TH_t + \beta_2 WKA_t + \beta_3 (PD_t/PD_{t-1}) + \beta_4 I_t + \beta_5 CAP_t + \beta_6 M_{t-k} + \xi_t \quad (4.11)$$

where the β 's are parameters to be estimated, ξ_t is a random error term,

Q_t = textile output, or production, in time period t ,

TH_t = average textile employment for time period t ,

WKA_t = capital utilization rate for time period t ,

PD_t = domestic price of textiles in time period t ,

I_t = textile inventories for time period t ,

CAP_t = capital stock for textiles in time period t , and

M_{t-k} = quantity of textile imports lagged k periods.

The expected signs of the coefficients are:

$$\beta_1, \beta_2, \beta_3, \beta_5 > 0; \beta_4 < 0; \beta_6 > 0 \text{ or } \beta_6 < 0.$$

The positive signs for β_1 , β_2 , and β_5 simply imply that as employment, capital utilization rate and capital stock respectively increase, output is expected to increase according to production theory. The positive sign for β_3 implies that increasing domestic price for textile or apparel output is expected to encourage increased output response. The negative sign for inventory implies that

increasing inventories discourage production and tend to encourage reduced output. The sign for imports is somewhat ambiguous. If imports replace domestic production, then clearly $\beta_6 < 0$, thus increased imports cause reduced domestic output. However, if both imports and domestic production are increasing in response to increasing domestic demand for textiles and apparel, then $\beta_6 > 0$. In either case, β_6 should provide an estimate of the direct impact of textile and apparel imports upon domestic US output of textiles and apparel.

The textile output equation was specified with variables in logarithmic form as:

$$\begin{aligned} \text{Ln}Q_t = & \beta_0 + \beta_1 \text{Ln}TH_t + \beta_2 \text{Ln}WKA_t + \beta_3 \text{Ln}(PD_t/PD_{t-1}) \\ & + \beta_4 \text{Ln}(I_t/I_{t-1}) + \beta_5 \text{Ln}CAP_t + \beta_6 \text{Ln}M_{t-2} + \xi_t \end{aligned} \quad (4.12)$$

where the theoretical variables are as defined previously. Textile employment was measured by average weekly labor hours, and capital utilization rate was measured by average weekly active spindle hours. Capital stock was proxied by capacity. Domestic textile price was measured by the Producer Price Index for textiles. Textile inventories and capacity were measured by indices provided by the US Department of Commerce and the Federal Reserve, respectively. Textile output was measured by the Commerce Department's Industrial Production Index for textiles. Textile imports were measured in SYE.

The model was estimated using OLS, and the results were:

$$\begin{aligned}
 \text{Ln}Q_t = & -13.9629 + 0.9835\text{Ln}TH_t + 0.5185\text{Ln}WKA_t \\
 & \quad (0.0001) \quad (0.0001) \\
 & + 0.9057\text{Ln}(PD_t/PD_{t-1}) - 1.3854\text{Ln}(I_t/I_{t-1}) + 2.2062\text{Ln}CAP_t \\
 & \quad (0.0933) \quad (0.0001) \quad (0.0001) \\
 & + 0.0908\text{Ln}M_{t-2} \\
 & \quad (0.0001)
 \end{aligned} \tag{4.13}$$

where rejection probabilities are in parentheses.

The estimation equation for apparel is the same general form as that for textile output:

$$\begin{aligned}
 Q_t = & \alpha_0 + \alpha_{1t}AH_t + \alpha_{2t}WKA_t + \alpha_{3t}(PD_t/PD_{t-1}) + \alpha_{4t}(I_t/I_{t-1}) \\
 & + \alpha_{5t}CAP_t + \alpha_{6t}M_{t-k} + \xi_t
 \end{aligned} \tag{4.14}$$

where the α 's are parameters to be estimated, ξ_t is a random error term, and the other variables are as defined:

Q_t = the apparel output, or production in time period t ,

AH_t = average apparel employment per week for time t ,

WKA_t = capital utilization rate for apparel in time period t ,

I_t = apparel inventories for time period t ,

CAP_t = capital stock for apparel production in time period t ,

M_{t-k} = quantity of apparel imports lagged k periods, and

PD_t = domestic apparel price in time period t .

The expected signs of the coefficients are $\alpha_1, \alpha_2, \alpha_3, \alpha_5 > 0$; $\alpha_4 < 0$; $\alpha_6 > 0$ or < 0 . The reasons for the signs are straightforward and follow the discussions in the previous section on textiles.

As with textiles, the estimation model was specified with the variables in logarithmic form:

$$\begin{aligned} \text{Ln}Q_t = & \alpha_0 + \alpha_1 \text{Ln}TH_t + \alpha_2 \text{Ln}WKA_{t-2} + \alpha_3 \text{Ln}(PD_t/PD_{t-1}) \\ & + \alpha_4 \text{Ln}(I_t/I_{t-1}) + \alpha_5 \text{Ln}CAP_{t-2} + \alpha_6 \text{Ln}L_{t-2} \end{aligned} \quad (4.15)$$

where two of the variables are measured with some effort. Capacity and capital stock data were not available for apparel production, so these variables were proxied by lagged textile capacity and lagged average active spindle hours, respectively. These proxies were selected since the apparel industry is the largest customer of the textile industry, and changes in apparel industry capacity and capital stock should be reflected by comparable adjustments in the textile industry. The other variables for the apparel output model were measured by the apparel counterparts of the variables used in the textile output model. The estimated apparel output equation was:

$$\begin{aligned} \text{Ln}Q_t = & -9.5696 + 1.0563 \text{Ln}AH_t + 0.2599 \text{Ln}WKA_{t-2} \\ & \quad (0.0001) \quad (0.0001) \\ & + 2.952 \text{Ln}(PD_t/PD_{t-1}) + 0.2217 \text{Ln}(I_t/I_{t-1}) + 1.6741 \text{Ln}CAP_{t-2} \\ & \quad (0.0001) \quad (0.4323) \quad (0.0001) \\ & + 0.0703 \text{Ln}M_{t-2} \\ & \quad (0.0275) \end{aligned} \quad (4.16)$$

with rejection probabilities in parentheses.

Results for both textile and apparel output elasticities are tabulated in Table 4.2, Output Elasticities for Textiles and Apparel. Most of the variables have coefficients that were significant at acceptable levels, but apparel inventories were not significant. All other apparel coefficients were statistically significant at the 0.0275 level or better. The coefficient for the apparel price ratio of domestic price of apparel to the lagged domestic price was 2.95, which suggests apparel output is very responsive to price. The coefficient of the textile price ratio was 0.91, and it was significant at the 0.09 level. Textile output was fairly responsive to price but not elastic.

For the capacity utilization explanatory variable, (proxied by weekly average spindle hours operated), the results indicate fairly modest responsiveness for textiles, with a coefficient of about 0.52. The corresponding coefficient for apparel was 0.26, which is low as was anticipated. Capacity is significant for both textiles and apparel and has a fairly responsible coefficient, approximately 2.21 for textiles, and 1.67 for apparel.

Lagged imports (two month period) are significant at the 0.0001 level for textiles and the 0.0275 level for apparel, but the coefficients were small, about 0.09 for textiles and about 0.07 for apparel. These elasticities imply that a one percent increase in textile (apparel) imports would induce about 0.09 (0.07) of one percent increase in textile (apparel) production, but the positive sign(s) most likely indicate that production and imports both increased or decreased together

Table 4.2 Output Elasticities for Textiles and Apparel.

Dependent Variables	Textile Explanatory Variables					Apparel Explanatory Variables						
	TH _t	WKA _t	PD _t /PD _{t-1}	TN _t	CAP _t	M _{t-2}	AH _t	WKA _{t-2}	PD _t /PD _{t-1}	AN _t	CAP _{t-2}	M _{t-2}
TQ (4.13)	0.9835 (0.001)	0.5185 (0.0001)	0.9057 (0.0933)	-1.3854 (0.0001)	2.2062 (0.0001)	0.0908 (0.0001)						
AQ (4.15)							1.0563 (0.0001)	0.2599 (0.0001)	2.9522 (0.0001)	0.2217 (0.4323)	1.6741 (0.0001)	0.0703 (0.0275)

Significance probabilities are shown in parenthesis under the parameter (elasticity) estimates:

TQ = Textile Output

AQ = Apparel Output

to meet demand. In periods of steady demand, the import elasticities of output would be expected to be negative.

6. INPUT ADJUSTMENT FUNCTIONS

In order to obtain the output elasticity of employment, a modification of the model developed by Nadiri and Rosen (1973) was utilized. In this modified model output and import quantities are assumed to be exogenous, and long run factor demand functions are assumed to exist and to be theoretically obtained by minimizing total cost constrained by the production function. In this context, the adjustment of the factor inputs toward their long run equilibrium can be expressed in the form:

$$X_t = AQ_t + B(w/c)_t + CX_{t-k} + \xi_t \quad (4.17)$$

where

X_t = 5 x 1 vector of US input quantities for time period t ,

A = 5 x 1 vector of US output coefficients for time period t ,

Q_t = level of US output for time period t ,

B = 5 x 1 vector of US relative factor price coefficients for time period t ,

$(w/c)_t$ = US relative factor prices in time period t ,

C = 5 x 5 matrix of direct and cross adjustment coefficients for US inputs,

and

ξ_t = random error term for time period t .

The outputs are textiles and apparel, and the inputs are for the textile and apparel industry. In this formulation, there would be ten input equations, five each for textiles and apparel. These equations were estimated by OLS in log-linear form. The empirical results are presented in the following sections.

7. TEXTILE INPUT FUNCTIONS

In this section, five input functions are estimated for textiles, one for each input specified. In each equation the following variables are utilized, some with lags:

TE_t = level of textile employment for time period t ,

TH_t = textile labor utilization rate in time period t ,

WKA_t = capital utilization rate for textiles in time period t ,

HAS_t = capital stock in time period t ,

TN_t = textile inventories in time period t ,

Q_t = textile production in time period t ,

WB_t = ratio of factor price in time period t , and

TR_t = time trend.

For these variables, textile employment was total production employees in textiles, the textile labor utilization rate was measured by average number of labor hours per week. The capital utilization rate was measured by a proxy variable--weekly average spindle hours; capital stock was proxied by active spindle hours. Textile inventories were measured by an index of textile inventories at the mill. Output was measured by the index of textile production.

For textile employment, the estimated equation was:

$$\begin{aligned}
 \text{LnTE}_t = & 2.4650 + 0.5180\text{LnTE}_{t-3} + 0.1626\text{LnTH}_{t-3} \\
 & \quad (0.0001) \quad (0.0617) \\
 & + 0.0182\text{LnWKA}_{t-3} + 0.0026\text{LnHAS}_{t-3} - 0.025\text{LnTN}_{t-3} \\
 & \quad (0.5086) \quad (0.8870) \quad (0.8191) \\
 & + 0.1282\text{LnQ}_{t-2} + 0.0148\text{LnWB}_t \\
 & \quad (0.0001) \quad (0.2579) \\
 & - 0.0014 \text{TR}_t \\
 & \quad (0.0001)
 \end{aligned} \tag{4.18}$$

$$R_2 = 0.966 \quad \text{DW} = 0.627$$

$$\bar{R}^2 = 0.964 \quad \text{df} = 142$$

For textile hours, the labor utilization, the estimated equation was:

$$\begin{aligned}
 \text{LnTH}_t = & 3.914 - 0.2752\text{LnTE}_{t-3} + 0.3898\text{LnTH}_{t-3} \\
 & \quad (0.0001) \quad (0.0001) \\
 & - 0.0095\text{LnWKA}_{t-3} + 0.0145\text{LnHAS}_{t-3} + 0.1063\text{LnTN}_{t-3} \\
 & \quad (0.7533) \quad (0.4678) \quad (0.3975) \\
 & + 0.1239\text{LnQ}_{t-2} + 0.0588\text{LnWB}_t \\
 & \quad (0.0001) \quad (0.0001) \\
 & - 0.0009 \text{TR}_t \\
 & \quad (0.0001)
 \end{aligned} \tag{4.19}$$

$$R^2 = 0.498 \quad \text{DW} = 1.274$$

$$\bar{R}^2 = 0.468 \quad \text{df} = 142$$

where the variables are as previously defined.

For textile average spindle hours operated, the estimated equation was:

$$\begin{aligned}
 \text{LnWKA}_t = & 2.0206 + 0.1084\text{LnTE}_{t-3} + 1.0708\text{LnTH}_{t-3} \\
 & (0.6765) \quad (0.0039) \\
 & + 0.2238\text{LnWKA}_{t-3} - 0.1549\text{LnHAS}_{t-3} + 1.0492\text{LnTN}_{t-3} \\
 & (0.0553) \quad (0.0446) \quad (0.0308) \\
 & + 0.1371\text{LnQ}_{t-2} + 0.0584\text{LnWB}_t \\
 & (0.2401) \quad (0.2903) \\
 & - 0.0013\text{TR}_t \\
 & (0.0613)
 \end{aligned} \tag{4.20}$$

$$R^2 = 0.583 \quad \text{DW} = 1.204$$

$$\bar{R}^2 = 0.558 \quad \text{df} = 142$$

where the variables are as previously defined.

For monthly average spindle hours operated, the estimated equation was:

$$\begin{aligned}
 \text{LnHAS}_t = & + 2.3634 + 0.0244\text{LnTE}_{t-3} + 1.155\text{LnTH}_{t-3} \\
 & (0.9320) \quad (0.0046) \\
 & - 0.6236\text{LnWKA}_{t-3} + 0.682\text{LnHAS}_{t-3} + 0.5913\text{LnTN}_{t-3} \\
 & (0.0001) \quad (0.0001) \quad (0.2652) \\
 & + 0.0754\text{LnQ}_{t-2} + 0.0664\text{LnWB}_t \\
 & (0.5564) \quad (0.2745) \\
 & - 0.0011\text{TR}_t \\
 & (0.1485)
 \end{aligned} \tag{4.21}$$

$$R^2 = 0.464 \quad \text{DW} = 1.763$$

$$\bar{R}^2 = 0.431 \quad \text{df} = 142$$

where the variables are as previously defined.

For textile inventories, the estimated equation was:

$$\begin{aligned}
 \text{LnTN}_t = & -0.8152 + 0.0793\text{LnTE}_{t-1} + 0.0137\text{LnTH}_{t-1} \\
 & \quad (0.0706) \quad (0.0283) \\
 & - 0.0383\text{LnWKA}_{t-1} + 0.0296\text{LnHAS}_{t-1} + 0.4154\text{LnTN}_{t-1} \\
 & \quad (0.0254) \quad (0.0222) \quad (0.0001) \\
 & - 0.0367\text{LnQ}_{t-1} + 0.0008\text{LnWB}_t \\
 & \quad (0.3555) \quad (0.9378) \\
 & + 0.0002\text{TR}_t \\
 & \quad (0.1905)
 \end{aligned} \tag{4.22}$$

$$R^2 = 0.300 \quad DW = 2.094$$

$$\bar{R}^2 = 0.257 \quad df = 142$$

where the variables are as previously defined.

The coefficients of these five models are tabulated in Table 4.3, where the coefficients presented are elasticities. The coefficients for output are highly significant for textile employment and textile hours and marginally significant for inventories. Output impacts these three variables with approximately the same strength; but the signs, as expected, show that output is directly related to employment numbers and average hours and inversely related to textile inventories. However, the coefficients of the relative factor cost variables are very small and significant only for average hours worked per week. It is possible that multicollinearity may be a problem for the relative factor prices and the trend variable. Trend is significant for employment and hours worked per week, and its coefficients were negative which is consistent with declining employment in the US textile industry. Four out of five of the own adjustment

Table 4.3 Textile Input Functions.

Dependent Variables	EXPLANATORY VARIABLES					
	(TE) $X_{1,t-3}$	(TH) $X_{2,t-3}$	(HAS) $X_{3,t-3}$	(WKA) $X_{4,t-3}$	(TN) $X_{5,t-3}$	Q_{t-2} w/b Trend
TE (4.18)	0.5180 (0.0001)	0.1626 (0.0617)	0.0026 (0.8870)	0.0182 (0.5086)	-0.0251 (0.8191)	0.1282 (0.0001) 0.0148 (0.2579) -0.0014 (0.0001)
TH (4.19)	-0.2752 (0.0001)	0.3898 (0.0001)	-0.0145 (0.4678)	0.0095 (0.7533)	0.1063 (0.3975)	0.1239 (0.0001) 0.0588 (0.0001) -0.0009 (0.0001)
HAS (4.21)	0.0244 (0.9320)	1.155 (0.0046)	0.6820 (0.0001)	-0.6236 (0.0010)	0.5913 (0.2652)	0.0754 (0.5564) 0.0664 (0.2745) 0.0011 (0.1485)
WKA (4.20)	0.1084 (0.1467)	1.0708 (0.0001)	-0.1549 (0.0009)	-0.2238 (0.2045)	1.0492 (0.0308)	0.1397 (0.2401) 0.0584 (0.2903) -0.0013 (0.0613)
TN (4.22)	0.0793 (0.0706)	0.1337 (0.0283)	0.0296 (0.0222)	-0.0383 (0.0254)	0.4154 (0.0001)	-0.1457 (0.0602) 0.0008 (0.9378) 0.0002 (0.1905)

Significance probabilities are shown in parenthesis under the parameter (elasticity) estimates:

TE = textile employment, TH = textile labor hours, HAS = textile capacity utilization rate, WKA = textile capacity, TN = textile inventories. Explanatory variables are lagged one month for TN model; for Q, lag = 0.

coefficients are highly significant and are positive. For the cross-adjustment coefficients, eleven are statistically significant from zero at the 0.07 level or better, and nine of these are significant at the 0.05 level or stronger. Each equation had at least one significant cross-adjustment coefficient, which suggests that the input adjustments are interrelated. In general, these results appear to be reasonable.

8. APPAREL INPUT FUNCTIONS

In this section, five input models were selected to estimate apparel input factors. The models are similar to and rely upon the same theoretical considerations as those used in the textile input functions.

The apparel input models parallel the textile input models except that the variables are for apparel output, employment, inventories etc. instead of textiles. In the equations that follow in this section, the variables used are: AE is the level of apparel production employment; AH is average hours per week of apparel labor; WKA is average spindle hours lagged to proxy for apparel capital utilization rate; HAS is hours of active spindles lagged to proxy for capital stock; AN is apparel inventory measured by the index of apparel inventories; Q is an index of apparel production; WB is the ratio of factor prices measured by the ratio of apparel wages to the cost of capital as proxied by the 3-year government bond rate; TR is time trend.

For apparel employment, the following equation was estimated:

$$\begin{aligned}
 \text{LnAE}_t = & 2.5738 + 0.4675\text{LnAE}_{t-3} + 0.0944\text{LnAH}_{t-3} \\
 & (0.0001) \quad (0.2952) \\
 & + 0.0562\text{LnWKA}_{t-3} + 0.0136\text{LnHAS}_{t-3} - 0.0216\text{LnAN}_{t-3} \\
 & (0.0105) \quad (0.3738) \quad (0.7703) \\
 & + 0.1313\text{LnQ}_{t-2} + 0.0102\text{LnWB}_t \\
 & (0.0001) \quad (0.3949) \\
 & - 0.0005\text{TR}_t \\
 & (0.0001)
 \end{aligned} \tag{4.23}$$

$$R^2 = 0.883 \quad DW = 0.679$$

$$\bar{R}^2 = 0.876 \quad df = 142$$

For average labor hours of apparel workers, the following equation was estimated:

$$\begin{aligned}
 \text{LnAH}_t = & 3.5203 - 0.2067\text{LnAE}_{t-3} + 0.3000\text{LnAH}_{t-3} \\
 & (0.0011) \quad (0.0006) \\
 & + 0.0116\text{LnWKA}_{t-3} + 0.0327\text{LnHAS}_{t-3} + 0.0542\text{LnAH}_{t-3} \\
 & (0.5731) \quad (0.0255) \quad (0.4419) \\
 & + 0.0427\text{LnQ}_{t-2} + 0.0128\text{LnWB}_t \\
 & (0.1371) \quad (0.2629) \\
 & - 0.00005 \text{TR}_t \\
 & (0.5180)
 \end{aligned} \tag{4.24}$$

$$R^2 = 0.392 \quad DW = 1.552$$

$$\bar{R}^2 = 0.354 \quad df = 142$$

For weekly average hours spindles operated, the following equation was used:

$$\begin{aligned}
 \text{LnWKA}_t = & 3.0592 - 0.0384\text{LnAE}_{t-3} + 0.5269\text{LnAH}_{t-3} \\
 & \quad (0.9119) \quad (0.2725) \\
 & + 0.4329\text{LnWKA}_{t-3} - 0.1471\text{LnHAS}_{t-3} - 0.1214\text{LnAH}_{t-3} \\
 & \quad (0.0003) \quad (0.0716) \quad (0.7579) \\
 & + 0.2540\text{LnQ}_{t-2} + 0.0846\text{LnWB}_t \\
 & \quad (0.1143) \quad (0.1871) \\
 & - 0.0015 \text{TR}_t \\
 & \quad (0.0020)
 \end{aligned} \tag{4.25}$$

$$R^2 = 0.524 \quad \text{DW} = 1.053$$

$$\bar{R}^2 = 0.495 \quad \text{df} = 142$$

For average spindle hours, the following equation was estimated:

$$\begin{aligned}
 \text{LnHAS}_t = & 3.5331 - 0.0548\text{LnAE}_{t-3} + 0.5232\text{LnAH}_{t-3} \\
 & \quad (0.8829) \quad (0.3094) \\
 & - 0.4796\text{LnWKA}_{t-3} + 0.7001\text{LnHAS}_{t-3} - 0.1049\text{LnAH}_{t-3} \\
 & \quad (0.0002) \quad (0.0001) \quad (0.8038) \\
 & - 0.2194\text{LnQ}_{t-2} + 0.0846\text{LnWB}_t \\
 & \quad (0.2024) \quad (0.2089) \\
 & - 0.0012 \text{TR}_t \\
 & \quad (0.0185)
 \end{aligned} \tag{4.26}$$

$$R^2 = 0.418 \quad \text{DW} = 1.604$$

$$\bar{R}^2 = 0.382 \quad \text{df} = 142$$

For apparel inventories, the following equation was estimated:

$$\begin{aligned}
 \text{LnAN}_t = & -1.1364 + 0.1086\text{LnAE}_{t-1} + 0.1404\text{LnAH}_{t-1} \\
 & \quad (0.1265) \quad (0.1530) \\
 & + 0.0192\text{LnWKA}_{t-1} - 0.0091\text{LnHAS}_{t-1} + 0.4118\text{LnAN}_{t-1} \\
 & \quad (0.4229) \quad (0.5852) \quad (0.0001) \\
 & - 0.0610\text{LnQ}_t + 0.0147\text{LnWB}_t \\
 & \quad (0.0700) \quad (0.2795) \\
 & + 0.0002 \text{TR}_t \\
 & \quad (0.1302)
 \end{aligned} \tag{4.27}$$

$$R^2 = 0.141 \quad DW = 1.219$$

$$\bar{R}^2 = 0.089 \quad df = 142$$

The elasticities for each of the five apparel models are shown in Table 4.4.

Most of the signs of the estimated elasticities are as expected, even though the signs of the cross-adjustment coefficients are sometimes ambiguous. All five own adjustment coefficients are statistically significant and positive except for the capital utilization-rate. The apparel output coefficient is highly significant for apparel employment and marginally significant for apparel inventories. Four of the cross-adjustment coefficients are highly significant and two are significant at the 0.09 level or better. All models except for the inventory model show evidence of interdependencies in the adjustment process. Relative factor price coefficients for apparel are not significant, possibly due to multicollinearity problems with trend whose coefficients were negative and highly significant for apparel employment, average hours worked and capital utilization rate. The

Table 4.4 Apparel Input Functions.

EXPLANATORY VARIABLES							
Dependent Variables	(AE) $X_{1,t-3}$	(AH) $X_{2,t-3}$	(HAS) $X_{3,t-3}$	(WKA) $X_{4,t-3}$	(AN) $X_{5,t-3}$	Q_{t-3}	w/b Trend
AE (4.23)	0.4675 (0.0001)	0.0944 (0.2952)	0.0136 (0.3738)	0.0562 (0.0105)	-0.02160 (0.7703)	0.1313 (0.0001)	0.102 (0.3949) -0.0005 (0.0001)
AH (4.24)	-0.2067 (0.0011)	0.3000 (0.0006)	0.0327 (0.0255)	0.0116 (0.5731)	-0.0542 (0.4419)	0.0427 (0.1371)	0.0128 (0.2629) -0.0001 (0.5180)
HAS (4.26)	-0.0548 (0.8829)	0.5232 (0.3094)	0.7001 (0.0001)	-0.4796 (0.0002)	0.1049 (0.8038)	-0.2194 (0.2024)	0.0864 (0.2089) -0.0012 (0.0185)
WKA (4.25)	-0.0384 (0.0333)	0.8457 (0.0942)	-0.1471 (0.0716)	-0.4329 (0.0003)	-0.1214 (0.7579)	0.2540 (0.1143)	0.0846 (0.1817) -0.0015 (0.0020)
AN (4.27)	0.1086 (0.1265)	0.1404 (0.1530)	-0.0091 (0.5852)	+0.0192 (0.4299)	0.4118 (0.0001)	-0.0610 (0.0700)	0.0147 (0.2795) 0.0002 (0.1302)

Significance probabilities are shown in parenthesis under the parameter (elasticity) estimates:

AE = apparel employment, AH = apparel labor hours, HAS = apparel capacity utilization proxy, WKA = apparel capacity proxy, AN = apparel inventories. Explanatory variables are lagged one month for TN model; for Q, lag = 0.

negative signs are consistent with observation, and the coefficients are quite small. Overall results appear to be reasonable.

CHAPTER V

SUMMARY AND CONCLUSIONS

The debate regarding trade restrictions can be theoretically decided by examining the effects that trade restrictions have on the level of consumer and producer surplus and the costs these restrictions impose on the general economy.

Dead-weight loss is the amount of consumer or producer surplus that is wasted when trade restraints bring about inefficient use of factors of production in an otherwise protected industry. It has been shown that the amount of dead-weight loss incurred when trade restrictions are imposed exceeds the benefits of protecting an industry. Morkre and Tarr (1980) calculated the net gain from eliminating trade restrictions to be \$1,319 million for a four year period. McFadden (1987) estimated that costs to the US consumer are between \$8.5 and \$12 billion to the protect the clothing industry alone. Another study suggested that the consumer does not receive any price benefit from low cost imports ("When Free Trade," 1977).

Many trading partners of the US do not practice the concept of free trade which may make it difficult for some domestic US industries to remain competitive. The US receives 68.9 percent of the total textile and apparel exports from developing countries which suggests that additional trade restrictions would be particularly damaging to those countries.

While protection may save jobs in the short run, protecting jobs in the US textile and apparel industry costs far more to save a job each year than the

annual wage of a job saved. A study discussed in McFadden (1987) reports that consumers spent approximately \$42,000 per year per job saved in the textile and apparel industry where the average annual wage was \$12,000. The Canadian Government Tracking Project (1979) found that close to two thirds of textile workers unemployed do find alternative employment, and that overall, the workers were actually better off financially after finding alternative employment.

Other industries, directly or indirectly related to the textile and apparel industry are affected by trade restraints. Inefficient use of resources may result. An increase in input prices and a reduction in supply are other adverse affects of trade restraints. Retaliation by exporting countries is yet another concern when restraints are imposed. Retaliation may take the form of reduced purchases of US products, decreasing the level of trade for both parties, or a decreased US export value further reducing the terms of trade for the United States.

The two loopholes in the free trade argument, the optimal tariff and the infant industry argument, are not valid for the US economy and the textile and apparel industries. The US has a small enough ratio of imports to domestic production to refute the optimal tariff argument. The textile and apparel industries are by no means infant industries. They are restructuring, which some feel is cause for protection.

In order to determine the effects of textile and apparel imports upon domestic employment and the level of production, a number of elasticities were estimated from models developed in this study.

Import demand equations, domestic textile and apparel output equations, and selected input functions were used to estimate elasticities relevant to the textile and apparel industry. Of particular interest to this study are the price elasticity of import demand, output elasticity of employment and the input elasticity of output. Past research regarding the estimation of effects of imports were useful in formulating appropriate models for this study. The work by Pelzman and Martin (1981) followed the Houthakker-Magee Model, developed by Houthakker and Magee (1969). Pelzman and Martin extended the Houthakker-Magee Model and adapted it to textiles. This thesis extends the Pelzman and Martin Model and adapts the models of Nadiri and Rosen to develop models for both the textile and apparel industries. Other directly helpful studies were Kreinin (1973), Yadov (1975), Dickerson (1988), and Wolf (1984).

This study found, using regression equations (OLS) on the logarithms of the variables, that relative price elasticities of import demand are inelastic for both textiles and apparel, -0.73 for textiles, and -0.33 to -0.41 for apparel. The coefficients for apparel and possibly for textiles are somewhat small, but these results are reasonable given possible market distortions due to protection of the apparel and textile industries. The coefficients of the price variables used in this model were significant. The income elasticity for textile imports ranged from 1.69 to 2.31, a strong response by textile imports to changes in income.

For the output equations, the signs for the coefficients were generally as expected, and most of the variables were significant. For apparel output, all variables had the expected signs and were significant at the 0.0275 level or

better, except for apparel inventories. Positive signs for the lagged quantity of imports most likely indicates that domestic production and the level of imports were increasing to meet demand during the time span of this study. Similar results were true of textile output-all variables had the expected signs and all were significant.

The primary focus of the input functions estimated in this study was to obtain output elasticities of employment for textile and apparel. These were estimated to be 0.128 for textiles and 0.131 for apparel, and both coefficients were highly significant. These short-run import elasticities are small, especially for apparel, and they are surprisingly similar. In each case, a one percent change in output would be associated with about 13/100 of one percent change in employment. In general, the signs of the coefficients of the input equations were consistent with a priori reasoning.

The estimated elasticities can be used to calculate the impact a change in the tariff rate (or tariff equivalent) has upon the quantity of textile and apparel imports demanded, textile and apparel production levels, and the employment level of US textile and apparel workers.

It was not possible in this study to determine whether or not the quotas affecting the level of imports into the US were binding. Also, it was not possible to assess the effect of all other non-tariff barriers on the level of textile and apparel imports into the US. These limitations may cause distortions in the elasticities estimated in this study and can be the basis of future research.

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APPENDIXES

APPENDIX A

VARIABLES AND DATA SOURCES

The variables used in this thesis and their data sources are presented in this appendix. The data is from secondary publishes sources or, on some cases, unpublished data provided by US Government sources, particularly the US Department of Commerce and its divisions and subgroups.

Price of Imports: The price of textile mill products and apparel products are reported as C.I.F. values in the US Bureau of the Census, FT-135 US, General Imports, Table 1, "Value of Schedule A Grouping of Commodities, Division No. 65 and No. 84." The Standard International Trade Classification (SITC) code No. 65 was used for textiles and No. 84 for apparel. No. 65 includes textile yarns, fabrics and made-up articles and related products. No. 84 includes wearing apparel and accessories and articles made of fur. Predicted values for No. 65 and No. 84 for the months of August, September and October of 1986 were used due to missing data in the source.

Domestic Output: The level of output was measured using a proxy variable. An index of industrial production for Textile Mill Products and Apparel Products collected by the US Federal Reserve Board of Governors and tabulated in their Capacity Utilization Statistical Release Supplement, 1977=100.

Price of Domestic Textiles: The producer price index tabulated under the Commodity Prices--Wholesale Prices heading in the US Department of Commerce, Bureau of Economic Analysis Business Statistics, is a proxy variable for domestic price of textiles. For textiles, the "Selected Textile Mill Products" category was used. This series does not exist prior to 1975: therefor, the "Textile House Furnishings" category was multiplied by a constant 0.64875, to adapt the series. The ratio: 1974 "Selected Textiles Mill Products"/1974 "Textile House Furnishings" provides the resulting constant.

Price of Domestic Apparel: The consumer price index will be used as an approximation for the domestic price of apparel. The 'Apparel and Upkeep' consumer price was used and is tabulated in the Department of Commerce, Bureau of Economic Analysis, Business Statistics Appendix "Historical Data for Selected Series, 1967=100."

Employment: Employment figures for 'Textile Mill Products' and 'Apparel & Related Products' were collected from Textile Hi-Lights, selected issues, published by the American Textile Manufacturer's Institute (ATMI), which republishes US Department of Labor data on employment and related categories.

Wages: This variable is the dollar per hour amount textile and apparel workers earned. This data is provided by the US Department of Labor, Bureau of Labor Statistics.

Hours Worked: This variable is the average number of hours textiles and apparel workers worked per week. This data was provided by the US Department of Labor, Bureau of Labor Statistics.

Disposable Personal Income: This measure of aggregate income is personal income less taxes from the National Income Accounts and represents the portions of GNP that consumers have available to spend or save. In this study it was from the Department of Commerce Business Statistics: 1986.

Quantity of Imports: Textile import quantities were calculated using data reported in the Textile Hi-Lights Monthly Supplements published by ATMI, under "Foreign Trade Summary." The data was reported in square yard equivalents (SYE).

Textile Imports = Total Textile and Apparel Imports (SYE) - Cotton Apparel (SYE) - Man-made Apparel (SYE) - Wool Apparel (SYE). US Department of Commerce conversion factors were used to convert units to square yard equivalent. Apparel Imports were calculated by summing the cotton, man-made and wool apparel principal fibers imported.

Inventory: This variable, collected using the US Bureau of the Census Current Industrial Reports, Manufacturers' Shipments, Inventories, and Orders, represents the total inventories of Textile Mill Products and Home Goods and Apparel in millions of dollars. Table 5 --Manufacturers' Total Inventories, By Industry

Groups: End of Month. An estimation was used for inventories for Textile Mill Products and Home Goods and Apparel for the month of August of 1985 due to lack of available data.

Cost of Capital: A High-grade municipal bond rate from Standard & Poor's is tabulated in The Economic Report of the President Table D-46, "Bond Yields and Interest Rates," and was used as a proxy variable to estimate the cost of capital each month of the study, 1974-1986. *106.6 1984*
100.0 1985

Capacity: The capacity level was determined using an index from the Federal Reserve Board of Governor's Capacity Utilization Statistical Release Supplement. For the apparel industry, capacity data is not available, so the textile capacity was lagged three months to serve as a proxy variable for apparel capacity.

Input Factors: Selected variables were chosen to estimate the input function models for textiles and apparel. Along with previously described variables, the following variables were used; "weekly average spindle hours operated"; which was used as a proxy variable for capacity utilization, "hours operated per active spindle"; which was used as a proxy variable for capital stock. To obtain capacity utilization and capital stock proxy variables for apparel, the above mentioned textile variables were lagged one to three months. The assumption was made that the textile industry input (decisions) are largely in response to the apparel industry, their largest customer, and therefor lagged textile industry input

variables should capture a large part of apparel input decisions. These variables were collected using Textile Hi-Lights.

APPENDIX B

SUPPLEMENTAL TABLES

Table B.1 US Imports of Textile Manufacturers. (Millions of SYE)

Period	Cotton	Man-Made	Wool	Total
1974	1463	2862	86	4411
1975	1281	2470	78	3829
1976	1924	2954	109	4987
1977	1639	3195	143	4977
1978	2213	3385	144	5740
1979	1893	2624	122	4639
1980	2009	2746	129	4884
1981	2574	3067	134	5775
1982	2447	3342	146	5935
1983	3030	4237	185	7452
1983*	3030	4704	185	7919
1984	4162	6022	264	10448
1985	4287	6275	267	10829
1986	5241	7358	275	12873
1987	6244	7174	154	13472

*Total and man-made fiber categories include flat goods beginning 1983 and subsequent years.

Source: US Department of Commerce

Table B.2 Import of Textile and Apparel Manufacturers into the US
1978-1988. (Millions of SYE)

Year	Yarns ¹	Fabric	Apparel ¹	Made-Up Misc. ¹
1978	972.50	1,463.90	2,905.40	398.10
1979	438.20	1,116.00	2,671.10	412.90
1980	380.20	1,217.20	2,884.20	402.80
1981	442.70	1,705.70	3,135.90	490.40
1982	496.00	1,477.60	3,382.40	579.10
1983	867.80	1,870.70	3,874.70	1,093.30
1984	1,279.50	2,546.50	4,707.20	1,674.10
1985	1,321.40	2,477.60	5,116.90	1,877.80
1986	1,833.30	3,121.10	5,866.60	2,053.90
1987	1,815.90	3,079.10	6,125.20	2,134.10
1988	1,622.50	2,795.00	5,936.80	1,997.70

¹US Department of Commerce conversion factors used to convert units to Square Yard Equivalents (SYE).

Source: US Department of Commerce

VITA

Julie A. Johnston was born in Clinton, Iowa on July 2, 1964. She attended elementary schools in that city, Richmond, Virginia and Russell, Kentucky, and was graduated from Clinton High School in May 1982. The following August she entered Iowa State University, and in May 1986 she received a Bachelor of Science degree in Textile Science. In the fall of 1986 she accepted a teaching assistantship and later a research assistantship at The University of Tennessee, Knoxville and began study toward a Master's Degree. This degree was awarded in December of 1988.

The author is a member of Omicron Nu and American Association of Textile Chemists and Colorist.