

Fiber consumption in Korea and other regions of the world

Hae kyung Yu

Incheon University, Department of Clothing

한국과 세계 다른 지역의 섬유소비에 관한 연구

유 혜 경

인천대학교 자연대학 의생활학과

(1993. 3. 8 접수)

Abstract

섬유소비는 인구증가 및 경제발전 정도와 밀접한 상관관계를 가지고 있으며, 여러 산업과도 연관되어 있다. 천연섬유와 인조섬유와의 시장 점유 경쟁은 인조섬유가 처음 일반에게 소개된 20세기 초부터 시작되었고, 그후 인조섬유의 품질향상과 신섬유의 개발로 더욱 가열되었다. 섬유의 시장 점유율은 가격, 품질 등 여러 요인으로부터 영향을 받으며, 지역적 특성에 따라서도 많은 차이를 보이고 있다. 본 연구는 한국에서의 주요 섬유의 시장점유율을 분석하고, 또한 이를 다른 지역과 비교하는 것을 주요 목적으로 하였다. 시장점유율은 한국과 미국, 기타 선진국, 개발도상국에서의 면, 양모, 재생 cellulose섬유, 합성 섬유의 1979년부터 1986년까지의 연간 내수용 소비량을 기초로 하여 산출되었다. Minimum Absolute Deviations method를 사용하여 Markov process에 의거한 이진확률(transition probability)을 구하였다. 한국의 섬유시장은 주요섬유의 시장점유율의 크기와 변화 그리고 이진확률면에서 미국의 섬유시장과 유사하였으며, 개발도상국과는 차이를 보였다. 또한, 같은 선진경제임에도 불구하고 미국의 섬유시장은 기타 선진국과는 차이점을 보임으로써 지역에 따른 섬유 선호성과 다른 요인들이 섬유 소비에 영향을 미친다는 것을 시사하였다.

I. INTRODUCTION

Textile fibers are used in many end-uses such as apparel, carpets, tire cords and etc. The development of the man-made fibers in early twentieth century increased competition for the natural fibers. Competition among the fibers increased further with continued modification of man-made fibers and the development of specialty fibers designed to meet the requirements of specific end-use markets.

The relative importance of man-made and natural fibers varies significantly in different regions of the world. The man-made fibers are the most important fiber in Korea (Republic of Korea) as in many developed countries including the United States, whereas cotton has remained the dominant fiber in the world.

Consumption of a specific fiber can be viewed as a two-step consumer decision process. First, the consumer determines the total fiber consumption. Then, the consumer seeks to find the combination of fibers that will maximize

his/her satisfaction within the limited resources. While the total fiber consumption is influenced mainly by the growth of population and economic conditions,¹ the consumption of a specific fiber is affected by many factors including price, quality and promotion. In addition to price, quality and promotion, there are other factors affecting interfiber competition. For instance, cotton consumption in developed countries is strongly affected by cyclical economic conditions.

The main purpose of this study was to examine the changes in the market shares of major textile fibers in Korea and other regions of the world. The study would be important in understanding the changes in fiber consumption patterns in Korea where rapid economic and social changes occurred during the last few decades. The results should be also of great interest to Korean business community exporting textile products, since the results will show the changes in the market shares of major textile fibers in other regions of the world.

II. INTERFIBER COMPETITION

The size of a fiber market for any given time period is determined through the interaction of various forces (economic, political and demographic) during that period. Within that market, a number of various types of fibers compete for a market share. Competition among the fibers are influenced by many variables which are often interrelated. The consumption of a specific fiber is affected not only by own price but also by prices of competing fibers.²
^{3, 4, 5, 6} Price is not the only factor in interfiber competition since fibers are not perfect substitutes. Quality and promotion also play important roles in interfiber competition.⁷

In addition, other factors such as fashion, climate, stage of economic development and government regulation influence the competition among the fibers.^{8, 9} Fashion can bring popularity to products made of certain fibers and thus increase demand for the fibers. The popularity of blue denim was a great advantage in increasing demand for cotton. Some fibers are more suitable in certain geogra-

phical areas. For instance, wool is preferred in cold climates without central heating systems. All fibers may not be equally available in less developed countries, where man-made fiber production is negligible and imports of man-made fibers is limited. In such cases, substitution among fibers is limited by fiber availability. Government regulation may increase the costs of manufacturing products from one fiber relative to others or reduce the usage of a particular fiber.

Population characteristics of developed or developing countries also influence consumption of specific fibers. For example, there are differences in preference for cotton and wool according to the different regions of the world.¹⁰

In investigating the interfiber competition and the variables influencing the competition, previous research were limited to focus on the US due to the limited availability of reliable data for other regions of the world. Few analytical studies have been reported concerning the fiber consumption in different regions of the world. Some organization of the United Nations and the World bank have published a few descriptive reports on the fiber consumption in the world with emphasis on natural fibers such as cotton, wool and jute.^{11, 12}

III. METHODS

1. Definitions and data

Four major fibers—cotton, wool, cellulose and non-cellulose—were identified for the study. Cellulose and non-cellulose are man-made fibers. Cellulose were rayon and acetate and non-cellulose included nylon, polyester, acrylics and olefins.

The changes in the market shares of major fibers were examined for Korea and three other regions (the United States, the other developed countries, and the Less Developed Countries). The other developed countries included all non-socialist developed countries except the US. The LDC comprised of non-socialist developing countries including three UN-member Newly Industrialized Countries (Korea, Singapore and Hong Kong). The grouping of the

countries, who are all members of the United Nations, followed the system used by the Food and Agriculture Organization of the United Nations. It is believed that countries in each region share economic and political similarities. The US was separated from other developed countries, since it had been a lead country in the development and acceptance of new fibers. In addition, the US is the largest market for the textile exports from Korea.

The market shares were based on domestic consumption which included mill consumption and the balance of foreign trade in both semi-manufactured and manufactured goods. Semi-manufactured goods refer to the goods such as yarns and fabrics for further manufactures. Manufactured goods are finished products such as apparel. Domestic consumption was selected as the most appropriate variable since it indicated final consumption and hence consumer preference for different kinds of fibers. The selection of domestic consumption was particularly important in studying the changes in the fiber consumption patterns in Korea due to the fact that Korea is one of the major textile exporting countries in the world, and thus large portion of mill consumption in Korea reflects consumption for exports. Domestic consumption for the major regions were obtained by summing the domestic consumption of the countries in each region.

The consumption of four major fibers in 1970, 1980 and 1986 were examined separately according to the regions. However, in the Markov process annual data from 1979 to 1986 were used since the annual data for some regions were not available for some years prior to 1979. It was assumed that the time periods from 1979 to 1986 were long enough to yield good estimates of transition probabilities, but not long enough to violate the assumption of unchanging conditions for the stationary Markov process. The data were collected from the *World Apparel Fibre Consumption Survey* published by the Food and Agriculture organization of the United Nations.

2. Methods of analysis

The Markov process was used to analyze the market shares of major textile fibers in Korea and other regions

of the world. The Markov process is a stochastic process in the sense that it develops in time and/or space according to probabilistic laws.¹³ The stochastic process is an appropriate tool for studies of social science because of time and chance involved in social phenomena.¹⁴ Social systems evolve in time under the changing and partly unpredictable behavior of their members. Other reasons for the relevance of stochastic process in social science are errors and shocks.¹⁵ Few social observations are free of errors and shocks. The errors and shocks make observations random variables and thus future outcomes are always associated with probabilities.

The stationary first order Markov process used in this study assumes that the transition probability, P_{ij} , depends on the immediately preceding states, where P_{ij} refers to the probability moving from fiber i to fiber j in next time period. In an equation,

$$S(1) = S(0) \cdot P \text{ or } S(N) = S(0) \cdot P^{N-1}$$

where $S(N)$ is a vector of market shares in time period N and P is the transition probability matrix consisting P_{ij} 's. In this study, P is a 4×4 matrix of transition probabilities either staying in one fiber or moving from one of four fibers to others. $S(N)$ is a 1×4 matrix containing market shares of four fibers in time period N . The equation above can be used in estimating the market shares in any time period once the transition probabilities and the initial vector of market shares, $S(0)$ are known.

The transition probabilities were estimated using the minimum absolute deviations method. In the minimum absolute deviations method, the sum of the absolute deviations, $\sum_i \sum_j (F_{jt} - G_{jt})$ is minimized with the constraints:

$$S_{jt} = \sum_i P_{ij} S_{i,t-1} + (F_{jt} - G_{jt}) \text{ and } \sum_j P_{ij} = 1$$

where S_{jt} is the market share of fiber j at time period t , and F_{jt} and G_{jt} are vertical deviations above and below the fitted line. This problem can be solved as a linear programming problem. The properties of minimum absolute deviations estimators have been discussed by several researchers.^{16, 17, 18, 19} They found that overall, the minimum

absolute deviations method provide satisfactory basis for estimating the transition probabilities in addition to the advantages of the ease of placing constraints on the parameters. The actual computation was done using the LINDO program.

IV. RESULTS

Table 1 shows the consumption and the market shares of major fibers in Korea from 1970 to 1986. Total domestic consumption in Korea increased by 296.5 percent during the period exceeding the increases of domestic consumptions in any other regions of the world. Total domestic consumption increased by 39.4 percent in the US during the same period, and by 63.8 percent in LDC. Such tremendous increases in fiber consumption in Korea is not surprising in light of rapid economic changes in the country during the period.

The market shares of four major fibers show that cotton and non-cellulosics are dominant fibers in Korea, whereas wool and cellulotics have relatively small market shares. The market share of cotton decreased from 45.0 percent in 1970 to 34.5 percent in 1980, and then increased to 39.1 percent in 1986. In contrast, the market shares of non-cellulosics and wool increased from 1970 to 1980, but decreased later. The market share of cellulotics remained stable during the whole period.

The market shares of major textile fibers in other regions of the world are shown in table 2. The market share of cotton decreased in the US during the 1970 to 1980 period and then increased from 1980 to 1986, whereas the market share of non-cellulosics increased from 1970

to 1980 and then decreased. The changes in the market shares of cotton and non-cellulosics in the US show similar trends to the changes in Korea. In addition, the market shares of non-cellulosics are relatively high in both Korea (52.1 percent) and the US(54.9 percent) in comparison to 41.9 percent and 31.2 percent in other developed countries and LDC, respectively.

In LDC, the market share of cotton decreased from 71.5 percent in 1970 to 56.6 percent in 1980 and remained relatively stable since 1980. In contrast, the market share of non-cellulosics continued to increase from 12.0 percent 1970 to 31.2 percent in 1986. The market share of cotton continued to increase in the other developed countries during the 1970 to 1986 time period, whereas the market share of non-cellulosics increased from 1970 to 1980 and then remained stable at 41.9 percent in 1986. The market shares of wool and cellulotics decreased during 1970 to 1986 in all regions of the world including Korea, except in the US where the market share of wool showed a little recovery during the 1980's.

Overall, the changes and the sizes of the market shares of major textile fibers in Korea showed similarity to those in the US market. It should be noted that the fiber market in Korea differed from that in LDC indicating that Korea, at least in terms of fiber consumption, is closer to developed countries than to developing countries. The differences between the fiber markets in the US and the other developed countries should be also noted. The differences between two developed regions suggest that other factors besides stages of the economic development are important in affecting the consumption of fibers.

The transition probability matrices for Korea and other regions are given in Table 3. The diagonal elements in

Table 1. Domestic consumption and the market shares of major fibers in Korea(1,000tons)

Year	Cotton	Wool	Cellulosics	Non-cellulosics	Total
1970	67.8(45.0)	2.3(1.5)	10.3(6.8)	70.1(46.6)	150.5
1980	126.4(34.5)	12.6(3.4)	24.6(6.7)	203.2(55.4)	366.8
1986	233.4(39.1)	12.8(2.1)	39.8(6.7)	310.7(52.1)	596.7

Note : Numbers in parentheses are market shares in percent.

Table 2. The market shares of major fibers in other regions of the world(percent)

Fibers	1970	1980	1986
〈The United States〉			
Cotton	42.7	31.9	36.6
Wool	3.6	1.6	2.9
Cellulosics	16.1	6.7	5.6
Non-cellulosics	37.5	59.7	54.9
〈The Other Developed Countries〉			
Cotton	30.5	37.5	40.4
Wool	11.8	8.6	8.0
Cellulosics	18.0	11.7	9.6
Non-cellulosics	31.6	42.2	41.9
〈Less Developed Countries〉			
Cotton	71.5	56.6	57.2
Wool	4.8	4.2	3.9
Cellulosics	11.7	9.8	7.7
Non-cellulosics	12.0	29.4	31.2

the transition probability matrix are retention rates, and indicate the probabilities that buyers will continue to purchase the same fiber each year. In Korea, cotton has a high retention rate, whereas wool has 0.462 retention rate and cellulosics a zero retention rate. The retention rate of non-cellulosics in Korea is one indicating that all buyers of non-cellulosics will continue to buy the fiber. The off diagonal elements of the transition probability matrix show the probabilities of buyers switching from one fiber to another. Cotton will lose approximately one percent and 15 percent of its market share each year to wool and cellulosics, while it will receive all market share of cellulosics. Wool will lose approximately 54 percent of its market share to non-cellulosics.

The transition probability matrices for other regions can be interpreted in a similar manner. Overall, the transition probability matrix for US shows similarities to that for Korea. Cotton and non-cellulosics have high retention rates, whereas cellulosics has a zero retention rate. In contrast, the other developed countries show the transition

Table 3. The transition probability matrices

Fibers	Cotton	Wool	Cellulosics	Non cellulosics
〈Korea〉				
Cotton	0.833	0.012	0.154	0.000
Wool	0.000	0.462	0.000	0.538
Cellulosics	1.000	0.000	0.000	0.000
Non-cellulosics	0.000	0.000	0.000	1.000
〈The United States〉				
Cotton	0.838	0.000	0.162	0.000
Wool	0.437	0.563	0.000	0.000
Cellulosics	0.810	0.190	0.000	0.000
Non-cellulosics	0.000	0.000	0.012	0.988
〈Other Developed Countries〉				
Cotton	0.448	0.000	0.000	0.552
Wool	0.000	0.000	0.000	1.000
Cellulosics	0.000	0.000	0.714	0.286
Non-cellulosics	0.521	0.203	0.068	0.209
〈Less Developed Countries〉				
Cotton	0.337	0.000	0.146	0.518
Wool	0.184	0.620	0.000	0.196
Cellulosics	0.728	0.175	0.097	0.000
Non-cellulosics	1.000	0.000	0.000	0.000

probabilities quite different from those of US. In other developed countries, cotton and non-cellulosics have 0.448 and 0.209 retention rates, respectively, whereas wool has a zero retention rate. The retention rate of cellulosics, in contrast to those in other regions, is relatively high in the other developed countries. In LDC, the retention rate of cotton is relatively low(0.337). Non-cellulosics has a zero retention rate which is in contrast to relatively high retention rates of cotton and non-cellulosics in other regions. The non-cellulosics in LDC, however, will receive 51.8 percent of cotton's market share in return and 19.6 percent of wool's market share.

Actual and projected market shares for 1986 and 2000 are shown in table 4. The projections were made using the transition probability matrices with 1985 market shares

Table 4. Actual and Projected Market Shares(percent)

Fibers	1986		2000
	Projected	Actual	
〈Korea〉			
Cotton	37.4	39.1	31.9
Wool	1.0	2.1	0.7
Cellulosics	5.9	6.7	5.0
Non-cellulosics	55.8	52.1	61.9
〈The United States〉			
Cotton	35.9	36.6	43.0
Wool	2.7	2.9	3.2
Cellulosics	6.5	5.6	7.5
Non-cellulosics	54.9	54.9	46.4
〈Other Developed Countries〉			
Cotton	39.4	40.4	39.8
Wool	8.5	8.0	8.6
Cellulosics	10.1	9.6	10.0
Non-cellulosics	41.9	41.9	42.2
〈Less Developed Countries〉			
Cotton	57.2	57.2	57.0
Wool	3.9	3.9	4.2
Cellulosics	9.0	7.7	9.2
Non-cellulosics	30.0	31.2	30.4

as bases. Actual market shares are relatively close to projected market shares in all regions. Projections indicate that in Korea the market share of non-cellulosics will increase till the year 2000, whereas the market shares of all other fibers will decrease. It is projected that the market share of non-cellulosics will be greater in Korea than in any other regions in the year 2000. The market share of non-cellulosics in the US is projected to decrease to 46.4 percent in the year 2000, whereas the market shares of all other fibers will increase. The projections made for the US market in this study are in contrast to the results from Lee's study(1988)²⁰ which was based on the data from 1969 to 1982. The study projected that the market shares of cotton and non-cellulosics in the US would remain stable at 32 percent and 58 percent in the year 2000,

respectively. The increase in the market share of cotton projected in this study seems to reflect recent popularity of cotton and other natural fibers in the market.

In comparison to Korea and the US, the market shares of major fibers in the other developed countries and LDC are projected to remain relatively stable till the year 2000. The market share of non-cellulosics in LDC is projected to be approximately 30 percent in the year 2000, which is smaller than its market share projected in the Lee's study(37.5 percent). The difference between two projected market shares of non-cellulosics in LDC may indicate that economic and other social conditions had changed in LDC since 1982.

V. DISCUSSIONS AND LIMITATIONS

Total domestic consumption of major textile fibers increased from 150,500 tons in 1970 to 596,700 tons in 1986 in Korea. The market shares of major textile fibers in Korea had also changed during the same period. The market share of non-cellulosics increased from 45.0 percent in 1970 to 52.1 percent in 1986 mainly at the expense of cotton, even though cotton showed some recovery since 1980. The market shares of wool and cellulosics remained relatively stable over the period.

The results showed that the fiber consumption patterns in Korea are similar to those in the US in several ways. First, in both countries the market share of non-cellulosics increased during the 1970 to 1980 time period mainly at the expense of cotton, and then decreased, while cotton gained some markets from 1980 to 1986. Second, the market shares of major fibers, particularly non-cellulosics, in Korea were also similar in size to those in the U.S. Finally, the transition probability matrix for Korea was also similar to the transition probability matrix for the U.S. In particular, the retention rates of cotton and non-cellulosics were quite high in both countries compared to the retention rates of those fibers in other regions.

In contrast to the similarities between Korea and the U.S., the fiber consumption patterns in Korea differed from

those in LDC. The fiber consumption patterns in the other developed countries also differed from those in Korea as well as from the fiber consumption patterns in the U.S. The differences between the fiber consumption patterns in Korea and LDC may indicate that economic and social conditions in Korea are no longer close to the conditions common in developing countries. The differences between the fiber consumption patterns in the U.S. and the other developed countries seem to indicate that differences in tastes and preferences may have a significant influence on interfiber competition in the other developed countries. The Korean textile exporters should remember that product differentiation may be needed in order to succeed in the U.S. and the other developed countries.

This study showed that the past trend can be effectively used in analyzing and projecting the changes in demand for different fibers. However, it should be noted that the projections of future market shares are based on the assumption that the underlying technological, social and economic conditions which generated the transition probability matrices would remain unchanged. It is possible that these conditions could change in the 1986 to 2000 time period. Cautions should be taken in directly applying the results and projections of this study. However, as Collins and Preston(1960)²¹ pointed out, the projections based on past time periods are still of interest since they indicate what would happen if the same conditions continued. This study has another limitation that the Markov process does not provide information concerning the variables influencing the market shares of major fibers. It would be interesting in future research to examine the variables influencing the market shares of major fibers in Korea and other regions of the world, particularly developing countries.

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