MODELING OF U.S. MEN'S APPAREL CONSUMPTION TRENDS AND ITS IMPLICATION ON TEXTIL MILL COTTON CONSUMPTION

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Abstract

A structural model and a simple analytic model have been developed to estimate the amount of cotton processed by U.S. textile mills and consumed in U.S. for men's and boys' bottom. Three databases were employed for the modeling and analysis work; NPD consumer panel data, NCC fiber shipment data, and Werner import/export data. By using AR(1) model and a linear model, the cotton consumption estimates for year 1998, 1999 and 2000 have been obtained. The results show that the overall cotton demand for those categories is likely to increase continuously whereas the U.S. textile mill production for filling the need will increase only marginally. This preliminary work has demonstrated a possibility of estimating the portion of U.S. textile mill production of all cotton goods which is consumed in U.S. perhaps by making similar analyses for other major product categories.

Introduction

Cotton is one of the most important agricultural commodities. While cotton's share in U.S. and international apparel and other textile markets has been steadily increasing, there is a growing concern as to how much of the consumer demand will have to be met by the U.S. textile industries. As the future of U.S. cotton production and import/export prospects hinge on the size and wellbeing of textile industry, the U.S. textile mill share of the consumed goods has large implications.

To estimate the U.S. textile mill share of the consumed cotton apparel, we must first estimate the total cotton demand within U.S. While the apparent cotton consumption data may be obtained from such consumer panel data as NPD, the figures also include the imported apparel. In addition, the U.S. mill share of the exported cotton apparel must be accounted for. For this reason, we must first obtain the "*total amount of cotton processed by U.S. textile mills for apparel that is also consumed in U.S.*" from the total amount of cotton consumed in U.S., then add the exported amount of cotton apparel, and subtract the imported apparel. This logic, simple as it may appear, is not easily applicable in practice, as there has never been an attempt follow this route. In this study, we show the schematics and a preliminary analysis for doing this for the first time.

It is noted that most of the apparel data are categorized by product line as it is important for making key strategic decisions. The primary objective here is to demonstrate that a modeling and analysis method developed may be applicable to other product lines, providing an avenue to estimate the same for the entire textile industry across all product lines.

Modeling and Data Structure

Modeling Strategies

From raw material to delivery of final product to consumers, textile process is a long sequential process as illustrated briefly in Figure 1. In each process, it is essential to know the expected future consumer demand for inventory control, purchase decisions and strategic planning. In this study, we chose to examine "Men's and Boys' Bottom" to see if the objective stated above can be accomplished.

This conceptual frame for estimation may be written in a simple linear algebraic form as follows:

$Y = X_1 - cX_2 + X_3$

Y = NCC (Total Textile Mill Cotton Consumption)
X_1 = NPD (M/B's Bottom Cotton Consumption)
c = 0.617 (Conversion factor from square meters to 480 pounds bale)
X_2 = Werner (Imported Cotton M/B's Bottom)
X_3 = Werner (Exported Cotton M/B's Bottom)

The left hand side (LHS) of equation (Y), if the conventional logic holds, should be equal to the right hand side (RHS) the equation ($X_1 - cX_2 + X_3$). In fact, the entire analytic effort is to see if the two sides are the same after we estimate the RHS.

The data structure is also shown in Figure 2. Under the equality of the LHS and RHS of the model, the area overlapping NCC and NPD is the amount of cotton goods produced and consumed in U.S.

Data Structures

- ***NPD data*** : NPD data consist of panel members' diaries with detailed information on the products (style, color, size, fiber contents, and etc.), the consumers (age, sex, income, education, and etc.), and purchase specifics (store type, price, and etc.). Table 1 shows Men's and Boys' (M/B) apparent apparel consumption for 1990-97 in three categories; total fibers, total cotton fiber only, and total M/B bottom only. All data points are in units of 1000 bales of 480 pounds each.

- ***National Cotton Council (NCC)*** : It estimates of cotton and competing fibers consumed for producing specific

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textile products manufactured in the United States. The data reflects the total shipment to textile processing mills for each category. The overall data consist of two sections. The first section summarizes the end-use consumption of cotton and competing materials in 92 major product classifications, whereas the second section shows detailed tabulation of statistical data for each end-use item within the major product classification. Tables 2 and 3 show the NCC data structure and a few selected columns of Men's and Boys' apparel, respectively, for our analysis.

- ***Werner Import/Export Data*** : Werner provides import and export data on apparel annually. The import data are given in square meters whereas the export data are given in kilograms unlike the measurement units used in NPD and NCC data.

Conversion Process

The units used in the Werner data must be converted to number of 480-pound bales in order to be merged with the NPD and NCC data. Kilograms used in the exported data are easily converted to number of 480-pound bales. However, an additional information is needed to convert the square meters to the pounds. For our analysis the optimal conversion factor "c" was so determined to maximize the correlation between the LHS and RHS of the equation. By applying the least-square method, c=0.617 was found to be the optimal value. In turn, this value corresponds to 8.26 ounces per square yard across all garment types.

Table 4 shows the steps for obtaining the "c" value. Because of the difficulty in accessing the data sources, the exported garment data from 1989 to 1992 were deleted.

Estimation and Results

Table 1 shows Men's and Boys' apparent apparel consumption for 1990-97 in three categories. All three columns show that the fiber consumption in Men's and Boys' apparel increased each year.

NCC data were tabulated in Tables 2 and 3. The trend shown in NCC data was matched in NPD data with an exception in 1997. The abrupt decrease in 1997 may not reflect an actual drop since the figure is a preliminary one as the last data point is revised twice and finalized in the third year. This 1997 data has yet to be finalized. The details are shown in Tables 2 and 3.

Werner import and export data for garment are shown in Table 4. While both the import and export show increases, the export outpaced the import with a wide margin.

Using the simple linear algebraic model, we were able to estimate the textile mill cotton consumption shown in Table 5. The results show that the NCC data (LHS) and the estimated figures (RHS) matched quite well except in 1997 for the same reason stated earlier.

Tables 6 through 10 show the projected production for year 1998, 1999 and 2000. The same linear model was used to project the U.S. textile mill's cotton consumption for men's and boys' bottom cotton apparel. First, the total cotton consumption for men's and boys' total apparel and for bottom only were projected from NPD men's and boys' total cotton consumption. A simple AR(1) auto regressive model was used. Similarly, men's and boys' imported and exported cotton garments were projected from the Werner import/export data. Projected data were then applied to the linear model to obtain estimates for the total cotton mill consumption for year 1998, 1999 and 2000. The actual and predicted values are given in Figures 3 to 7. In Figures 3 to 5, the actual and the predicted data are shown to agree very well. The export figures shown in Figure 6, however, show some differences between the actual and predicted values due to the abrupt increase in the export data. The last three points in Figure 7 show the estimated total cotton mill consumption for year 1998, 1999 and 2000. From these, it can be said that the cotton consumption in men's and boys' bottom will increase continuously in the next three years although the rate of increase is not as great as that of the overall consumer demand in U.S.

Summary and Conclusions

An attempt has been made to estimate the textile mill share of cotton consumption for men's and boys' bottom market by applying three separate databases (NPD, NCC, and Werner) through a structural model and a simple linear model for analysis. The results are highly encouraging in that both the concept and analytic technique produced reliable estimates.

Statistical methods developed for unifying different measurement units were also found to be useful.

The "by product line" segmented approach is quite promising for forecasting and estimation of total U.S. textile mill demand of cotton assuming that the same methods can be applied to other major products.

Total cotton consumption for U.S. men's and boys' bottom can be projected by using a simple AR(1) model. The estimates show that the mill demand of cotton will increase moderately in the next several years

Table 1. Men's and Boys' Apparel Consumption; 1990-1997. Unit : 1,000 Bales (1 Bales = 480 Lbs.)

year	M/B's all fibers used in all cateries	M/B's cotton fiber only in all categories	M/B's cottonfiber only in bottom
1990	5779	3583	1444
1991	5786	3756	1540
1992	6086	4063	1647
1993	6421	4335	1695
1994	6675	4612	1763
1995	6924	4926	1898
1996	7203	5261	2020
1997	7476	5460	2097

(source: NPD)

Table 2. Fiber consumption in U.S. ; 1990-1997. Unit : 1,000 Bales(1 Bale=480 Lbs)

year	all fibers used in total industry	cotton fiber used in total industry	all fibers used in total apparel	cotton fiber used in total apparel
1990	26269	9162	9654	5829
1991	25503	9229	9454	5839
1992	27760	10415	10576	6795
1993	28655	10952	10788	7048
1994	30495	11758	11183	7320
1995	30319	11387	10812	7317
1996	30159	11511	10800	7330
1997	29754	11205	10241	6859

year	M/B's all fibers used in all categories	M/B's cotton used in all categories	M/B's cotton used in bottom
1990	5459	3682	1182
1991	5127	3535	1219
1992	5859	4172	1371
1993	5933	4277	1408
1994	6145	4477	1508
1995	5815	4266	1577
1996	5913	4347	1611
1997	5172	3705	1264

year	M/B' cotton used in sports	M/B's cotton used in jean-cut	M/B's cotton used jean & dungarees	M/B's cotton used in shorts
1990	106	92	825	28
1991	106	97	843	31
1992	108	113	962	47
1993	101	119	990	62
1994	132	130	1061	50
1995	103	152	1095	81
1996	118	225	1046	77
1997	138	79	898	38

(source: NCC)

Table 3. Men's and Boy's Apparel Consumption; 1990-1997. (Source: National Cotton Council)

year	M/B's all fibers used in all categories	M/B's cotton used in all categories	M/B's cotton used in bottom
1990	5459	3682	1182
1991	5127	3535	1219
1992	5859	4172	1371
1993	5933	4277	1408
1994	6145	4477	1508
1995	5815	4266	1577
1996	5913	4347	1611
1997	5172	3705	1264

Table 4. Men's Boys' Consumption Imported / Exported Apparel, 1989-1997

Import Year	**M^2**	**x.617 lbs**	**/480/1000**
1989	244871666	151085818	315
1990	267674652	164869975	344
1991	282543577	174329387	363
1992	378885624	233772430	487
1993	408318032	251932226	525
1994	446106315	275247596	573
1995	538552277	332286755	692
1996	566346077	349435530	728
1997	649713088	400872975	835
Export Year	**M^2**	**x.617 lbs**	**/480/1000**
1993	63878858	140789003	293
1994	66791852	147209242	307
1995	67003653	147676051	308
1996	70914716	156296034	326
1997	83211792	183398790	382

(source: Werner,) unit : 1,000 Bales (1 Bale = 480 lbs)

Table 5. Estimated vs. Actual (NCC) Cotton Consumption for M/B Bottom

unit : 1,000 Bales (1 Bale = 480 Lbs.)

year	NPD M/B's bottom	Werner imports	Werner export	Estimated impts+expts)	y(NPD-	Actual (NCC) M/B bottom
1990	1444	344				1182
1991	1540	363				1219
1992	1647	487				1371
1993	1695	525	293	293		1408
1994	1763	573	307	307		1508
1995	1898	692	308	308		1577
1996	2020	728	326	326		1611
1997	2097	835	382	382		1264

Table 6. Projection of M/B's Total Cotton Consumption. Yt = 197.537 + 1.016Yt-1+e

year	actual*	predicted*
1990	3583	
1991	3756	3839
1992	4063	4014
1993	4335	4326
1994	4612	4603
1995	4926	4884
1996	5261	5204
1997	5460	5544
1998		5830
1999		6121
2000		6416

unit : 1,000 Bales (1 Bale = 480 Lbs.)
(Source : NPD)

Table 7. Projection of Cotton consumption of M/B's Bottom. Yt = 74.545 + 1.011 * Yt-1+e

year	actual*	predicted*
1990	1444	
1991	1540	1534
1992	1647	1632
1993	1695	1740
1994	1763	1788
1995	1898	1857
1996	2020	1994
1997	2097	2117
1998		2214
1999		2313
2000		2413

unit : 1,000 Bales (1 Bale = 480 Lbs.)
(Source : NPD)

Table 8. Projection of M/B's Imported Cotton Garments. Yt = 25.289 + 1.079 * Yt-1+e

year	actual*	predicted*
1990	344	
1991	363	396
1992	487	417
1993	525	551
1994	573	592
1995	692	644
1996	728	772
1997	835	811
1998		900
1999		997
2000		1101

unit : 1,000 Bales (1 Bale = 480 Lbs.)

Table 9. Projection of M/B's Exported Cotton Garments. Yt = -38873 + 19.647 * Yt - 1 + e

year	actual*	predicted*
1990		
1991		
1992		
1993	293	284
1994	307	303
1995	308	323
1996	326	343
1997	382	362
1998		382
1999		401
2000		421

unit : 1,000 Bales (1 Bale = 480 Lbs.)
(Source : Werner)

Table 10. Projection of M/B's Bottom cotton Mill Consumption. Total Mill Consumption = Total M/B Bottom - Imports + Exports

Year	Mill Consumption of Cotton	Projection
1993	1463	
1994	1497	
1995	1514	
1996	1618	
1997	1644	
1998		1676
1999		1699
2000		1714

unit : 1,000 Bales (1 Bale = 480 Lbs.)
Source : Werner, NPD

Table 11. Summary of the Estimates for Total M/B's Cotton Consumption

	1998	1999	2000
Total M/B's Cotton Consumption	2227 (+ 5.16%)	2460 (+10.46%)	2697 (+9.63%)
Total M/B's Bottom	1219 (+ 4.62%)	1370 (+12.43%)	1408 (+ 2.71%)

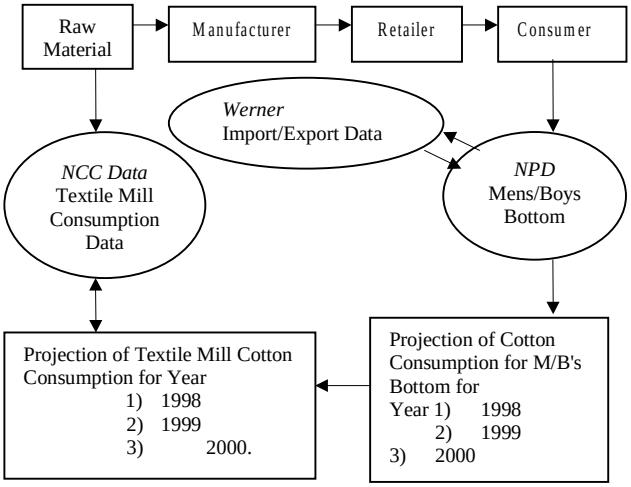

Figure 1. Flow Chart of the Modeling Process

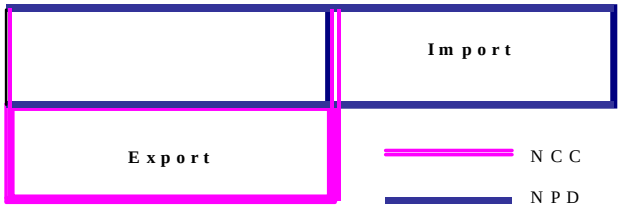

Figure 2. Modeling of Data Structure

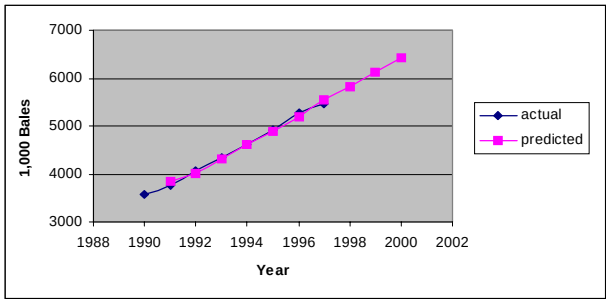

Figure 3. Projection of M/B's Total Cotton Consumption

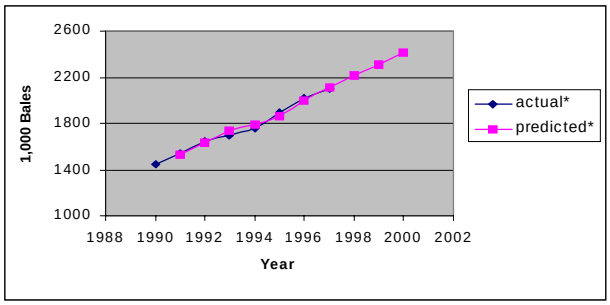

Figure 4. Projection of Cotton consumption of M/B's Bottom

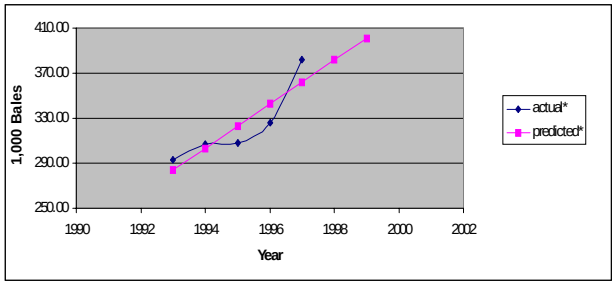

Figure 5. Projection of M/B's Imported Cotton Garments

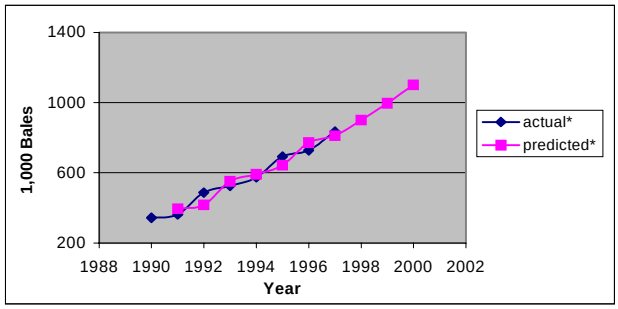

Figure 6. Projection of M/B's Exported Cotton Garments

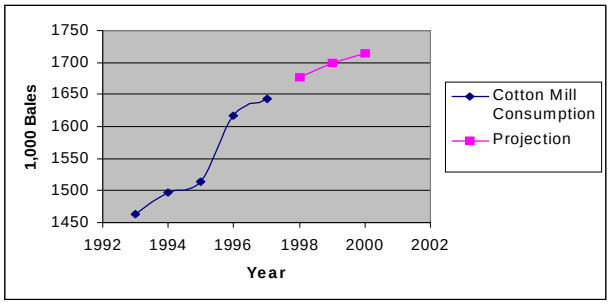

Figure 7. Projection of M/B's Bottom cotton Mill Consumption