European Union Cotton Demand: An Application of Demand Systems and Panel Data

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Abstract

A demand system approach incorporating demographic variables is used to estimate the European Union cotton demand parameters. The European Union is the largest cotton importer of the world. Accurate estimation of European demand parameters is critical to evaluate world cotton trends and to realistically simulate future market scenarios. Unlike previous studies, this paper reports a research in which demands of the 15 European Union members are not aggregated. Moreover, unlike available estimations, the study does not use mill consumption data but cotton equivalent consumption at home.

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Introduction

Textiles play an important role in international trade. They have a place in almost every part of our everyday life—tires for our automobiles, clothing for our bodies, parachutes and body armor for military forces, and towels and spreadsheets for homes. Cotton, a key component of textiles, is an important agricultural commodity and/or manufacturing raw material in many industrial countries and provides a significant contribution to farm income and export earnings. Moreover, cotton fiber is produced commercially as an annual cash crop in at least 80 countries located in tropical and temperate climatic zones.

The European Union (EU) contributes significantly to the world cotton trade. Among major cotton-consuming countries, the European Union ranked sixth in world cotton consumption and first in world cotton imports (U.S. Department of Agriculture, 2003b) over the past five years. Even though the aggregated EU's share of the world's cotton mill consumption has been decreasing through time, it can be misleading to think that this is the case in all EU members. It can be argued that cotton mill consumption in Italy, Greece, Portugal and Austria has been increasing, while similar consumption in France, Germany, Belgium-Luxembourg, Netherlands, United Kingdom, Denmark, Ireland, Spain, Finland, and Sweden has been decreasing (U.S. Department of Agriculture, 2003b).

When considering cotton available for home use, which adjusts for the fiber equivalent of textile imports and exports, the above scenario changes. In most cases the cotton mill consumption trend differs from the trend of cotton available for home use (see Lopez, 2004 for more details). It can be argued that the trends are different in France, Belgium-Luxembourg, Netherlands, United Kingdom, Denmark, Ireland, Greece, Austria, Finland, and Sweden; while they are similar in Germany, Italy, Spain, and Portugal (United Nations, 1983, 1985, 1989, 1992, 1994).

While per capita cotton mill consumption and available for home use are different variables and have different trends in some EU countries, previous studies have only used mill consumption to estimate the consumer demand for cotton. Furthermore, although the cotton demand has been increasing in some countries and decreasing in others, most previous studies have used aggregated European Cotton demand, which offsets the increasing trends in some countries with the decreasing trends in others. Therefore, previous methodological choices might not appropriately allow the estimation of the European cotton demand parameters.

Additionally, all cotton trading countries would be affected by the impacts of the complete elimination of the Multi-fiber Agreement's (MFA) quotas on January 1st, 2005. Since the Agreement on Textile and Clothing (ATC) implementation began in 1994, only a few quotas have been eliminated by major importing countries. According to the United Nations (1999), the USA has only eliminated 13 out of 750 quotas by integration in stages one and two. In the same way, the EU has only eliminated 14 out of 219 quotas and Canada 29 out of 295 quotas. These failures of quota liberalization have created what is known as an "end-loading" situation. In other words, importing countries have been delaying the integration to WTO rules of the most important Textile and Clothing products until the end of the transitional period. This elimination at the end of the transitional period by the three major importers of textile and clothing (Canada, the European Union, and the United States) is expected to induce drastic changes in the world trade of cotton, textiles, and clothing. It is possible that the market structure will change significantly with few countries dominating the cotton market, and many others becoming noncompetitive and exiting the market.

The European Union imports textiles and cotton from about 100 countries (European Commission, 2003). According to the U.S. Department of Agriculture (2003b), the EU imports of cotton fiber represent about 14% of world total imports for the last five years. All countries involved in textile, clothing, and cotton trade with the EU will be affected by the ATC quota elimination process and consequently will benefit from a better knowledge of the long-run EU cotton demand changes after the 2005 quota liberalization. The primary objective of this study is to appropriately estimate the European Union cotton demand parameters using country-disaggregated consumption levels and a demand system approach. These parameters could then be used to simulate impact of cotton demand changes on international markets.

Among others, Meyer (2000) and Coleman and Thigpen (1991) have calculated the EU cotton demand parameters. However, they made use of country-aggregated and/or mill consumption data and did not include wool as a competitive commodity of cotton. Additionally, their models consisted of single ad-hoc demand equations. This paper uses available for home use data, which adjusts fiber equivalent consumption for imports and exports of textiles; therefore, it more appropriately represents the consumer consumption of fibers.

Methods and Procedures

The Almost Ideal Demand System (AIDS) was developed by Deaton and Muelbauer in 1980 as an arbitrary first order approximation of any demand system. It satisfies the axioms of choice exactly and aggregates perfectly over consumers up to a market demand function without invoking parallel linear Engel curves. The functional form is consistent with household-budget data, can be used to test the properties of homogeneity and symmetry through linear restrictions on fixed parameters, and is not difficult to estimate. In the AIDS model, the Marshallian demand function for commodity "i" in share form is specified as:

(1) $$w_{it} = \alpha_i + \sum_j \gamma_{ij}\, log(p_{jt}) + \beta_i\, log[Y_t/P_t] + \varepsilon_{it}$$

where w_{it} = budget share of commodity i in period t,
p_{jt} = price of commodity j in period t,
Y_t = total expenditure on set of commodities,
α_i, β_i and γ_{ij} are parameters,
ε_i = disturbance term, and
P_t = a price index.

In a nonlinear approximation, the price index P_t is defined as:

(2) $$Log\,(P_t) = \alpha_0 + \sum_k \alpha_k\, log\,(p_{kt}) + \frac{1}{2} \sum_k \sum_j \gamma_{kj}\, log(p_{kt})\, log(p_{jt}).$$

The theoretical classical properties of demand are imposed on the system by restricting the model parameters as follows:

(3) Adding-up: $$\sum_i \alpha_i = 1, \sum_j \gamma_{ij} = 0, \text{ and } \sum_i \beta_i = 0;$$

(4) Homogeneity: $$\sum_i \gamma_{ij} = 0;$$

(5) Symmetry: $$\gamma_{ij} = \gamma_{ji}$$

In this paper, three commodities are considered: cotton, manmade fiber, and wool. One equation is omitted in the estimation of this system, but the parameters of that equation are recovered by making use of the theoretical classical properties. Usually the equation excluded is the one holding the smallest budget share.

The introduction of demographic variables in demand systems has been discussed by Barten (1964), Muellbauer (1977), and Pollak and Wales (1978, 1980, 1981). Pollak and Wales (1981) discuss five general procedures for incorporating demographic variables into classes of demand systems: demographic translating, demographic scaling, the "Gorman procedure," the "reverse Gorman procedure," and the "modified Paris-

Houthakker procedure." The procedures are general, can be used in conjunction with any complete demand system, and do not assume a particular functional form for the original demand system. In these cases the demand systems describe the allocation of expenditure among an exhaustive number of consumption categories. All procedures replace the original demand system with a similar specification, which uses parameters that depend on the demographic variables. Following Medina's (2000) Ph.D. dissertation, this study uses demographic translating as part of the AIDS model specification. According to Pollak and Wales (1981), translating can sometimes be understood as allowing necessary or subsistence parameters of a demand system to depend on the demographic variables.

Following Medina (2000), when demographic variables are introduced into the AIDS model;

$$w_{ict} = \alpha_i + \sum_r \Theta_{irct} + \sum_j \gamma_{ij}\, log(p_{jct}) + \beta_i\, log[Y_{ct}/P_{ct}] + \varepsilon_{it} \tag{6}$$

then, the price index, P_t, is given by:

$$Log\,(P_{ct}) = \alpha_0 + \sum_r \Theta_{irct}\, log\,(p_{kct}) + \sum_k \alpha_k\, log\,(p_{kct}) + \frac{1}{2} \sum_k \sum_j \gamma_{kj}\, log(p_{kct})\, log(p_{jct}) \tag{7}$$

where Θ_{irct} includes the demographic and geographical variables, and i = cotton, manmade fiber, or wool; r = demographic or geographic, and c = country (i.e., France, Germany, Italy, Belgium-Luxembourg, Netherlands, United Kingdom, Denmark, Ireland, Greece, Spain, Portugal, Austria, Finland or Sweden), and t = time period (i.e., 1979, 1980, 1981, etc.). Notice that the subscript "c" is implicit when working with only one country.

When pooling cross sectional and time series data in this study, the error term captures country differences in fiber consumption. However, these country differences in fiber consumption are separated from the error term by introducing dummy variables into the model. Differences in demographic and geographic characteristics among European Union countries are taken into account in:

$$\sum_r \Theta_{irct} = D_{i1}\, D_{France} + D_{i2}\, D_{Germany} + D_{i3}\, D_{Italy} + D_{i4}\, D_{Belgium\text{-}Luxembourg} + D_{i5}\, D_{Netherlands} + D_{i6}\, D_{United\ Kingdom} + D_{i7}\, D_{Denmark} + D_{i8}\, D_{Ireland} + D_{i9}\, D_{Greece} + D_{i10}\, D_{Spain} + D_{i11}\, D_{Portugal} + D_{i12}\, D_{Austria} + D_{i13}\, D_{Finland}. \tag{8}$$

Where D_{France}, $D_{Germany}$, D_{Italy}, $D_{Belgium\text{-}Luxembourg}$, $D_{Netherlands}$, $D_{United\ Kingdom}$, $D_{Denmark}$, $D_{Ireland}$, D_{Greece}, D_{Spain}, $D_{Portugal}$, $D_{Austria}$, and $D_{Finland}$ are country dummy variables and D_{i1}, D_{i2}, D_{i3}, D_{i4}, D_{i5}, D_{i6}, D_{i7}, D_{i8}, D_{i9}, D_{i10}, D_{i11}, D_{i12}, D_{i13} are parameters to be estimated. Notice that the excluded dummy variable is D_{Sweden}.

In order to disaggregate the European Union demand parameters, the above dummy variables are introduced in (6) as real expenditure shifters. Real expenditure shifters state that per capita real expenditure affects differently the consumption on the "i" fiber in each European Union country.

(9) $$w_{ict} = \alpha_i + \sum_r \Theta_{irct} + \sum_j \gamma_{ij}\, log(p_{jct}) + (\beta_i + \beta_{i1} D_{France} + \beta_{i2} D_{Germany} + \beta_{i3} D_{Italy} + \beta_{i4} D_{Belgium\text{-}Luxembourg} + \beta_{i5} D_{Netherlands} + \beta_{i6} D_{United\ Kingdom} + \beta_{i7} D_{Denmark} + \beta_{i8} D_{Ireland} + \beta_{i9} D_{Greece} + \beta_{i10} D_{Spain} + \beta_{i11} D_{Portugal} + \beta_{i12} D_{Austria} + \beta_{i13} D_{Finland})\, log[Y_{ct}/P_{ct}] + \varepsilon_{it}.$$

Equation (8) is replaced in (9) and (7) to run the AIDS model.

The Marshallian (uncompensated) price elasticities and the expenditure elasticities are obtained from (9) by taking partial derivatives. The Hicksian (compensated) price elasticities are obtained from the Marshallian price elasticities. The detailed derivation of the elasticities is provided in Lopez (2004). The resulting set of elasticities are calculated from the estimated coefficient as follows:

(10) Mashallian Price Elasticity: $$\varepsilon_{ij} = -\delta + \frac{\gamma_{ij} - \beta_i \phi_i}{w_i}$$

(11) Hicksian Price Elasticity: $$\varepsilon^*_{ij} = -\delta + \eta_i w_j + \varepsilon_{ij}$$

(12) xpenditure Elasticity: $$\eta_i = 1 + \frac{\beta_i}{w_i}$$

where δ is the Kronecker delta equal to one if i = j and equal to zero otherwise, and

(13) $$\phi_i = \alpha_i + \sum_r \Theta_{ir} + \sum_{j=1}^{3} \gamma_{ij} \ln(p_i).$$

Data

Data on fiber home consumption for the European Union countries for the period 1979 to 1992 are taken from *World Apparel Consumption Survey* (United Nations, 1983, 1985, 1989, 1992, 1994). Data on country level consumption is originally reported in thousand tons but it was transformed in per capita consumption in kilograms by using the population provided by the same source. Fiber consumption of Belgium and Luxembourg are reported together; therefore, Belgium-Luxembourg in this study is considered as one country.

Greece's cotton price, the United States actual polyester price, and the United Kingdom wool price are representative of the cotton price, manmade fiber price, and wool price in each European Union country. The cotton price in Greece is reported in *Cotton: World Statistics* (International Cotton Advisory Committee, 2002) in SM 1-1/16 inches prior to 1981, and Middling 1-3/32 inches since. The United States polyester price is reported in *Cotton and Wool Situation and Outlook Yearbook* (U.S. Department of Agriculture, 2003a) at f.o.b. producing plants. The United Kingdom wool price is provided by the *International Monetary Fund.* This study uses the 64s c.i.f. EQ wool price. The Greece cotton price and the United States polyester price are originally reported in U.S. cents/pound, but they are converted to U.S. cents/kilogram. However, the United Kingdom wool price is reported in U.S. cents/kilogram. All three prices are converted to real prices by using the U.S. GDP deflator (1995=100). Consequently, all real fiber prices are in 1995 U.S. cents/kg.

Results

Estimation of the nonlinear system of equations by maximum likelihood is performed using Shazam econometric software. The parameters are estimated using the imposed theoretical neoclassical restrictions. Correction for autocorrelation is performed in the determination of the parameters and supporting statistics. The estimation algorithm uses numeric derivatives. The explanation of this procedure can be found in Shazam (2001).

As explained before, equation (9) allows for the estimation of the European Union country-disaggregated elasticities. The AIDS model parameter estimates are reported in Table 1. In the cotton equation, most of the dummy variables are positive and significant at a 90% statistical certainty level. Similarly, in the cotton equation, most of the real expenditure shifter variables are negative and significant at a 90% statistical certainty level. Parameters α_i, γ_{i1}, and γ_{i2} are significantly different from zero in both equations with less than 0.01% probability of error (Table t at 0.01% = 2.576). Each equation explains about 82% of the total variation in cotton or manmade fiber share and the Durbin Watson shows a successful correction for autocorrelation.

Uncompensated (Marshallian) and compensated (Hicksian) price elasticities and expenditure elasticities for each European Union country are presented in Table 2. Hicksian elasticities are net of income effects, thus providing a more accurate interpretation of the coefficient estimates determined in Table 1. All own price elasticities are negative, except for the Hicksian cotton own price elasticity in Denmark. An increasing available for home use cotton consumption in Denmark from 1979 to 1992 combined with small consumption variability during this period influences the Hicksian cotton own price elasticity estimate.

The Marshallian cotton own price elasticity ranges from -0.63354 in Germany to -0.31590 in Austria while the Hicksian cotton own price elasticity ranges from -0.04441 in Italy to 0.13320 in Denmark. Similarly, the Hicksian cotton-manmade cross price elasticity ranges from -0.29927 in France to 0.42875 in Austria. Therefore, cotton and manmade fiber are complements in some countries (Sweden, France, Germany, Spain, and Finland) while they are substitutes in others (Italy, Belgium-Luxembourg, Netherlands, United Kingdom, Denmark, Ireland, Greece, Portugal, and Austria). This is not the case when the cotton-manmade cross price elasticity is calculated using EU aggregate data (i.e., Table 3). Consequently, more accurate cotton-manmade cross price elasticity values are obtained when disaggregating EU countries. Compared to the Marshallian and Hicksian cotton own price elasticities, more variability is found in the Hicksian cotton-manmade cross price elasticity.

The negative Hicksian cotton-manmade cross price elasticity in Sweden, France, Germany, Spain, and Finland may reflect the consumption of cotton mainly through textiles composed of a mixture of fibers. For example, an increase in the price of manmade fiber will increase the price of cotton-manmade textiles; therefore, decrease the consumption of cotton. This might also be the case for most of the European Union countries' Hicksian cotton-wool cross price elasticity.

The negative Hicksian cotton-manmade cross price elasticities may also be explained by the textile and clothing companies' strategies in Europe to improve competitiveness. A focus on innovation and products with high quality and/or fashion content is enhancing the use of textile mixtures. For example, the industrial sector is becoming more reliant on the so-called technical (or industrial) textiles, which include products which are as diverse as filters, conveyer belts, optical fibers, packing textiles, carpets, air bags, insulation and roofing materials, etc. (Stengg, 2001). These products account for 21% of the textile industry (Stengg, 2001) and they likely combine fibers rather than using only one fiber. Consequently, this trend may influence fibers in some countries to be complementary commodities.

As anticipated, wool elasticities are found larger than cotton or manmade fiber elasticities because of a small wool expenditure share. Low cotton and manmade fiber price elasticities are expected because the price of fibers accounts for a very small proportion of the price of the final good and thus the consumer is insensitive to fiber prices. Consequently, consumer demand for fibers can be expected to be highly inelastic and this has been supported empirically in a number of studies (Meyer, 2002; Clements and Lan, 2001; Coleman and Thigpen, 1991; Magleby and Missaien, 1971).

The expenditure elasticities measure the change in the demand of cotton, manmade fiber, or wool, as the allocation of expenditures among these commodities changes. Expenditure elasticities for each European Union country are provided at the bottom of Table 2. In general, wool presents the lowest expenditure elasticity, while manmade fiber has the highest values. Consequently, manmade fiber has the largest relative gain (loss) if total expenditure increases (decreases). Negative expenditure elasticities mean that the commodity is inferior. For instance, if total expenditure increases, consumption of a particular commodity decreases. This is the case of wool in Sweden, Italy, Denmark, Ireland, and Austria.

Cotton appears to be a normal luxury commodity in Sweden, France, Germany, United Kingdom, Denmark, Greece, Spain, Portugal, and Finland while it is a normal necessary commodity in Italy, Belgium-Luxembourg, Netherlands, Ireland, and Austria. Similarly, manmade fiber is a normal luxury commodity in some European Union countries while it is a normal necessary commodity in others. However, depending on the European Union country, wool is a normal luxury commodity, normal necessary commodity, or even an inferior commodity. These differences in expenditure elasticities are not captured when they are aggregated in one expenditure elasticity value (i.e., Table 3). Lopez (2004) presents a complete discussion of the European Union aggregated and disaggrested price and expenditure elasticities.

Conclusion

The EU is the world's largest importer of cotton and it contributes significantly to the world cotton trade. This study explores the cotton demands of the 15 European Union members using home consumption levels. Unlike previous studies, this research uses available for home use data and a demand system approach, and it includes wool as competitive commodity of cotton. One of the advantages of a demand system approach is that it better captures the strong interrelationship among commodities, providing more accurate parameter estimates. Having a precise empirical measure of the European Union cotton demand is fundamental to identify how the EU might react to changes in the price of cotton and the elimination of quotas. World cotton demand analysts can use the results provided in this study and connect them into a world model to simulate different scenarios for the EU after the 2005 quota liberalization.

Unlike most of the positive Hicksian cotton-manmade cross price elasticities, the Marshallian cotton-manmade cross price elasticities are negative. However, Hicksian elasticities are net of income effects, thus they provide a more accurate interpretation. Positive Hicksian cross price elasticity values suggest that the two commodities are complements while negative Hicksian cross price elasticity values suggest that the two commodities are substitutes. Cotton and manmade fiber appear to be complements in Sweden, France, Germany, Spain, and Finland, while they are substitutes in Italy, Belgium-Luxembourg, Netherlands, United Kingdom, Denmark, Ireland, Greece, Portugal, and Austria. Negative Hicksian cross price elasticity values illustrates the consumption of the two commodities in textiles composed of mixture of fibers.

The cotton expenditure elasticity estimates under available for home use data reveal that cotton is a normal luxury commodity in Sweden, France, Germany, United Kingdom, Denmark, Greece, Spain, Portugal, and Finland while it is a normal necessary commodity in Italy, Belgium-Luxembourg, Netherlands, Ireland, and Austria. Some previous studies show that cotton is a normal necessary commodity (Meyer, 2002; Mangleby and Missaien, 1971) while others show it is a normal luxury commodity (Coleman and Thigpen, 1991). However, European Union country differences in expenditure elasticities are not captured when all European Union country expenditure elasticities are aggregated in one expenditure elasticity value.

Given the large variability in the fiber demand elasticities among the EU counties, a more accurate description of the European Union cotton demand is obtained by calculating individual country elasticities. Further, variability of the elasticities in each country depends on the commodity being analyzed. Variability in elasticity values across countries reflects that consumers' choices and preferences on cotton, wool, and manmade fiber are different in the European Union countries.

Unlike mill consumption, home equivalent consumption adjusts fiber equivalent consumption for imports and exports of textiles; therefore, it more appropriately represents the consumer consumption of fiber. Since available for home use data is a better approximation of the consumer demand of fibers, previous methodological choices that use mill consumption data might not appropriately represent the European Union cotton fiber demand. Further, given that available for home use data is more consistent with demand theory, this approach should be used when estimating the EU fiber demand elasticities. Therefore, we suggest that a greater effort should be done to keep collecting available for home use data and to use it in the estimation of fiber demand parameters.

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Table 1 Parameter Estimates for AIDS Model, Available for Home Use Data.

	Cotton		Manmade Fiber	
	Coefficient Estimates	Coefficients t-values	Coefficient Estimates	Coefficients t-values
α_i	0.346060	6.46170	0.484510	6.38460
D_{i1}	0.026470	0.48506	0.036362	0.82609
D_{i2}	0.079657	1.41190	0.050925	0.97850
D_{i3}	0.063746	1.65150	0.083224	2.14350
D_{i4}	0.075946	1.71940	0.306770	1.77060
D_{i5}	0.070016	1.79990	0.093180	1.78640
D_{i6}	-0.068774	-0.45720	0.114950	1.25020
D_{i7}	-0.940920	-3.58310	0.659830	2.39240
D_{i8}	0.032103	0.61979	0.107860	1.67270
D_{i9}	0.220230	2.27560	-0.427150	-2.24880
D_{i10}	-0.168450	-1.22470	0.113410	1.57750
D_{i11}	0.126100	1.84790	-0.149650	-0.68529
D_{i12}	0.071370	1.86470	0.094274	2.09840
D_{i13}	-0.099054	-0.57821	0.051814	0.99327
γ_{i1}	0.227250	15.39800	-0.198030	-12.99200
γ_{i2}	-0.198030	-12.99200	0.235180	12.69700
β_i	0.132630	1.87200	-0.017465	-0.20053
β_{i1}	0.047966	0.27293	-0.158130	-0.80175
β_{i2}	0.029047	0.22934	-0.077401	-0.52865
β_{i3}	-0.230920	-2.51740	0.242540	2.22010
β_{i4}	-0.177650	-2.00670	0.104340	1.02400
β_{i5}	-0.254590	-1.73890	0.205890	1.19520
β_{i6}	-0.113550	-1.37040	0.013979	0.15784
β_{i7}	-0.058967	-0.86223	0.100650	1.11740
β_{i8}	-0.160240	-1.92520	0.165240	1.79960
β_{i9}	-0.123570	-1.75640	0.061422	0.74000
β_{i10}	-0.100370	-1.56110	-0.028072	-0.33197
β_{i11}	-0.123410	-1.71020	0.062499	0.78803

Table 1 Continued

	Cotton		Manmade Fiber	
	Coefficient Estimates	Coefficients t-values	Coefficient Estimates	Coefficients t-values
β_{i12}	-0.289610	-2.25870	0.255560	1.60330
β_{i13}	-0.062339	-1.10960	-0.069990	-0.63022

R-Sq (equation 1) = 0.8159	R-Sq (equation 2) = 0.8163
DW (equation 1) = 1.9159	DW (equation 2) = 1.9864
Rho (equation 1) = 0.03922	Rho (equation 2) = 0.00291
Period = 1979-1992	Table t at 10% = 1.645 (two-tailed)
Number of Observations = 196	Table t at 20% = 1.282 (two-tailed)
Log likelihood = 883.5252	

Model:

$$w_{ict} = \alpha_i + \sum_r \Theta_{irct} + \sum_j \gamma_{ij}\, log(p_{jct}) + (\beta_i + \beta_{i1} D_{France} + \beta_{i2} D_{Germany} + \beta_{i3} D_{Italy} + \beta_{i4} D_{Belgium\text{-}Luxembourg} + \beta_{i5} D_{Netherlands} + \beta_{i6} D_{United\ Kingdom} + \beta_{i7} D_{i7} D_{Denmark} + \beta_{i8} D_{Ireland} + \beta_{i9} D_{i9} D_{Greece} + \beta_{i10} D_{i10} D_{Spain} + \beta_{i11} D_{Portugal} + \beta_{i12} D_{Austria} + \beta_{i13} D_{Finland})\, log[Y_{ct}/P_{ct}] + \varepsilon_{it}$$

$$Log\,(P_{ct}) = \alpha_0 + \sum_r \Theta_{irct}\, log\,(p_{kct}) + \sum_k \alpha_k\, log\,(p_{kct}) + \frac{1}{2} \sum_k \sum_j \gamma_{kj}\, log(p_{kct})\, log(p_{jct})$$

$$\sum_r \Theta_{irct} = D_{i1} D_{France} + D_{i2} D_{Germany} + D_{i3} D_{Italy} + D_{i4} D_{Belgium\text{-}Luxembourg} + D_{i5} D_{Netherlands} + D_{i6} D_{United\ Kingdom} + D_{i7} D_{Denmark} + D_{i8} D_{Ireland} + D_{i9} D_{Greece} + D_{i10} D_{Spain} + D_{i11} D_{Portugal} + D_{i12} D_{Austria} + D_{i13} D_{Finland}$$

Table 2 Disaggregated European Union Countries Elasticity Estimates for AIDS Model, Available for Home Use Data.

Marshallian Price Elasticity	**Sweden**	**France**	**Germany**	**Italy**	**Bel-Lux**	**Netherlands**	**U Kingdom**
Cotton-Cotton	-0.57971	-0.63022	-0.63354	-0.37557	-0.42593	-0.35085	-0.48345
Cotton-Manmade	-0.56999	-0.62049	-0.62382	-0.36585	-0.41620	-0.34112	-0.47372
Cotton-Wool	-0.17691	-0.22741	-0.23074	0.02723	-0.02312	0.05196	-0.08065
Manmade-Cotton	-0.38142	-0.22588	-0.30528	-0.61998	-0.48404	-0.58393	-0.39517
Manmade-Manmade	-0.50945	-0.35392	-0.43332	-0.74801	-0.61208	-0.71197	-0.52320
Manmade-Wool	-0.05760	0.09794	0.01853	-0.29616	-0.16023	-0.26011	-0.07135
Wool-Cotton	1.13668	0.87649	1.02248	1.16412	0.96353	1.02166	0.90151
Wool-Manmade	-0.23192	-0.49211	-0.34612	-0.20447	-0.40506	-0.34694	-0.46709
Wool-Wool	-1.08876	-1.34895	-1.20296	-1.06131	-1.26190	-1.20378	-1.32393
Hicksian Price Elasticity							
Cotton-Cotton	-0.01763	-0.02016	-0.04241	-0.04441	-0.04149	-0.04335	-0.03491
Cotton-Manmade	-0.09063	-0.29927	-0.22186	0.35605	0.16749	0.34412	0.01961
Cotton-Wool	-0.21835	-0.15869	-0.22383	-0.02583	0.00874	0.05921	-0.02252
Manmade-Cotton	0.18067	0.38417	0.28585	-0.28881	-0.09961	-0.27643	0.05337
Manmade-Manmade	-0.03010	-0.03269	-0.03137	-0.02612	-0.02838	-0.02672	-0.02987
Manmade-Wool	-0.09904	0.16666	0.02545	-0.34922	-0.12836	-0.25285	-0.01322
Wool-Cotton	0.89526	1.27681	1.06274	0.85502	1.14917	1.06393	1.24013
Wool-Manmade	-0.51120	-0.02899	-0.29955	-0.56207	-0.19031	-0.29803	-0.07536
Wool-Wool	-1.13020	-1.28023	-1.19605	-1.11438	-1.23004	-1.19652	-1.26580
Expenditure Elasticity							
Cotton	1.30883	1.42052	1.37647	0.77113	0.89517	0.71601	1.04443
Manmade	0.96485	0.64656	0.80905	1.45303	1.17486	1.37926	0.99298
Wool	-0.56215	0.93216	0.09375	-0.71977	0.43226	0.09844	0.78848

Table 2 Continued.

Marshallian Price Elasticity	**Denmark**	**Ireland**	**Greece**	**Spain**	**Portugal**	**Austria**	**Finland**
Cotton-Cotton	-0.36992	-0.44612	-0.48293	-0.48467	-0.48112	-0.31590	-0.51233
Cotton-Manmade	-0.36019	-0.43639	-0.47320	-0.47494	-0.47139	-0.30617	-0.50260
Cotton-Wool	0.03289	-0.04331	-0.08012	-0.08187	-0.07831	0.08691	-0.10953
Manmade-Cotton	-0.48041	-0.54395	-0.44183	-0.35380	-0.44289	-0.63278	-0.31257
Manmade-Manmade	-0.60845	-0.67198	-0.56987	-0.48184	-0.57093	-0.76082	-0.44061
Manmade-Wool	-0.15660	-0.22013	-0.11801	-0.02999	-0.11907	-0.30897	0.01125
Wool-Cotton	1.23513	1.14849	0.98990	0.83332	0.99282	1.05626	0.82414
Wool-Manmade	-0.13347	-0.22011	-0.37870	-0.53528	-0.37578	-0.31234	-0.54446
Wool-Wool	-0.99031	-1.07695	-1.23554	-1.39212	-1.23262	-1.16918	-1.40130
Hicksian Price Elasticity							
Cotton-Cotton	0.13320	-0.04427	-0.04441	-0.02295	-0.04244	-0.04342	-0.01258
Cotton-Manmade	0.21981	0.20821	0.06758	-0.02366	0.07046	0.42875	-0.09324
Cotton-Wool	-0.05024	-0.08975	-0.05942	0.00513	-0.05885	0.07951	-0.01864
Manmade-Cotton	0.02270	-0.14210	-0.00331	0.10791	-0.00421	-0.36031	0.18717
Manmade-Manmade	-0.02844	-0.02739	-0.02909	-0.03056	-0.02907	-0.02590	-0.03124
Manmade-Wool	-0.23972	-0.26657	-0.09731	0.05701	-0.09960	-0.31636	0.10213
Wool-Cotton	0.75089	0.87794	1.11051	1.34012	1.10623	1.01319	1.35358
Wool-Manmade	-0.69366	-0.53309	-0.23917	0.05102	-0.24458	-0.36216	0.06803
Wool-Wool	-1.07344	-1.12339	-1.21484	-1.30512	-1.21315	-1.17657	-1.31041
Expenditure Elasticity							
Cotton	1.17153	0.93571	1.02110	1.07512	1.02147	0.63447	1.16367
Manmade	1.16743	1.29744	1.08848	0.90834	1.09064	1.47924	0.82397
Wool	-1.12755	-0.62997	0.28085	1.18010	0.26408	-0.10028	1.23282

Table 3 Summary of Empirical Cotton Demand Elasticities for the European Union

Reference	Period	Income Elasticity	Own-Price Elasticity	Cotton-Manmade Price Elasticity
Meyer, 2002	1986-1998	0.20	-0.55	0.53
Coleman and Thigpen, 1991	1964-1987	1.08	-0.14	0.14
Magleby and Missaien, 1971	1953-1964	0.63	-	-