FOREIGN IMPORT DEMAND FOR COTTON

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Abstract

Updated estimates of price and income effects on import demand for major Asian cotton importers are calculated using Armington demand models. Value and volume trade data from the United Nations are used to derive price and well as trade volume information. Compared with earlier studies, slightly lower elasticities for U.S. exports are calculated.

Introduction

A substantial share--more than 40 percent on average--of all U.S. cotton produced in a given year is exported, so the nature of foreign import demand is an important concern for U.S. cotton producers and consumers. This study estimates Armington demand models for cotton in Indonesia, Thailand, Japan, and South Korea: 4 countries accounting for about one-quarter of world cotton imports. While there are a number of studies of Arminton import demand models extant--such as Babula (1987), Alston et al (1990), Duffy et al (1990), and Sissoko and Duffy (1993)--it is always preferable to have the most up-to-date estimates possible of such crucial variables. An Armington model is used despite the methodological concerns raised by Alston et al (1990) and Davis and Kruse (1993). The Armington model's parsimony still makes it attractive, and the defects highlighted in the literature should be considered by policy-makers and others when drawing conclusions depending on its results.

In addition to timeliness, this study also differs from earlier studies in the sources of its data. The previous studies used the International Cotton Advisory Committee's (ICAC) marketing year data for bilateral trade data volumes, and the Northern European price quotes published by Cotton Outlook for prices. The ICAC data are ideal for these purposes, but it is less clear how price data should be developed. This study uses United Nations calendar year bilateral trade data for trade volume, and the associated import unit values (IUVs) derived from the bilateral volume and value data as prices.

Sources of Price Information

The difficulty of finding appropriate price information is a long-standing one in import demand estimation (see Orcutt (1950)). Incorrect price data introduce bias and inconsistency into parameter estimates through an errors-in-variables problem. While the average of the Northern European quotes is widely recognized as the best available measure of the world price of cotton, it is worth noting that the measure was probably devised when Northern Europe accounted for a substantially larger share of world cotton consumption and imports than has been the case for some time.

IUV's for a relatively homogenous commodity like raw cotton could be better measures of actual transaction prices than some other price measures for other reasons in addition to geography. Rather than assigning a weight of 100% to one specific quality of cotton, and rather than assigning equal weights to every part of the year, IUV's embody the actual weights of the various qualities of cotton demanded by a given country's industry, and embody the actual weights of the sub-annual periods when the decisions to lock in cotton purchases occurs.

Babula (1987), and the subsequent studies mentioned above, restricted themselves to using prices of one quality of cotton (SM 1-1/16 inch), while using trade data encompassing all qualities. Cotton Outlook does publish quotes on a few other qualities, but utilizing more than one quality requires discerning the appropriate weights. Similarly, these studies presumably derived annual averages of these daily price quotes through simple averages, with no effort to discern the varying weights of the months when different exporters' and importers' transactions peak.

Shiells (1991) notes that even aggregated commodities can be modeled with IUVs as prices. For a good comprised of an aggregation of somewhat dissimilar commodities, the change in IUV can be to a significant extent determined by changing weights of the commodities in the composition of that good. Raw cotton is relatively homogenous compared to most of the goods considered by Shiells and Orcutt, and weights of the different qualities of cotton imported by a given country will largely represent the technical requirements of their industry, mitigating the prospect of large shifts.

Import Demand

The first-stage utility maximization problem of the importer can be modified such that national-income does not completely describe the boundary of the budget set, which is instead described by national income plus textile exports. Data from the United Nations Food and Agriculture Organization (FAO) show that in 1988, 38 percent of the volume Korea's cotton textile output was exported, 24 percent of Indonesia's, and 50 percent of Thailand's. Given the large role of external trade, domestic income alone inadequately captures the constraints within which raw cotton import decisions are made. Since most of these cotton textile exports are destined ultimately for consumption in industrialized countries, industrial country GDP was used as a readily available instrument for textile

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trade, yielding an import demand function for cotton of the form:

$$M_c = m(P_c , P_o, Y_d, Y_i , Z)$$

where M_c is the total cotton imports by a given country, P_c is the price of cotton, P_o is the price of competing goods, Y_d is domestic income of the importing country, Y_i is income in the industrialized countries, and Z represents exogenous shocks.

The following functional form was specified for each country:

$$\ln M_c = \alpha + \beta_1 \ln IUV_c + \beta_2 \ln P_o + \beta_3 \ln GDP_{dom} + \beta_4 \ln GDP_{indus} + \beta_5 \text{Trend}$$

where M_c is calendar year cotton import volume, IUV_c is that year's cotton import unit value, P_o is ICAC's index of competing fiber prices, GDP_{domes} is domestic GDP from World Bank data, and GDP_{indus} is industrialized country GDP derived from World Bank data. Prices and income are deflated and in local currency terms, and data were 1977-95.

The second stage of the Armington model is a cost minimization allocation of total import demand for the product in question among the various suppliers, with their shares determined by relative prices (see Babula and subsequent studies for details). This second stage model can be expressed in terms of market shares and price ratios:

$$\ln MS = \alpha + \delta \ln PR$$

where MS is a given exporter's share of the importer's total imports, PR is the ratio of the price of the good from that exporter and the world price available to that importer, and δ is the elasticity of substitution.

Duffy et al (1990) refined this model to account for changes in preferences. Sissoko and Duffy (1993) suggest that Alston et al's (1990) rejection of the restrictions implicit in the Armington model might have been influenced by changes in taste during the time period tested. Note that Alston et al use cotton data for 1969-84. Since the U.S. Cotton Research and Promotion Program was only authorized in 1966, the 1969-84 period probably includes a period of changing tastes. While the change in tastes has been most pronounced in North America (MacDonald, 1997), textile exports to North America are important to many Asian cotton importers.

Interestingly enough, while Alston et al, Duffy et al, and Duffy and Sissoko were all published during the 1990's, each study confines itself to the period preceding the enactment of the 1985 U.S. farm legislation. This legislation marked a significant change in the relative price competitiveness of U.S. cotton due to the introduction of the marketing loan program. The transition into this new trade policy regime can be clearly discerned by a one year dip in the U.S. market share in virtually every importing country. During the transition period when the future U.S. policy of lower loan rates and marketing loan repayment levels was expected but not yet implemented, competitors had a great incentive to reduce inventories while in the U.S. holding cotton in anticipation of greater competitiveness made sense.

Duffy et al's function form was therefore adjusted by adding a dummy variable for 1986:

$$\ln MS = \alpha + \beta_1 \ln PR + \beta_2 \ln MS(t\text{-}1) + \beta_3 TR + \beta_4 D86$$

where MS(t-1) is the market share lagged one year and D86 is the dummy for 1986.

Results

The parameter estimates for the first stage import demand model of each country are listed in Table 1. The cotton price variable has the expected sign in each case, and, except for Thailand, is statistically significant.

The expected signs are also observed for domestic GDP and other textile fibers, and for industrial country GDP in 3 of the 4 cases. The domestic GDP parameters were significant in 3 out of 4 cases, the other textile parameters significant in 2 cases, and industrial country GDP was insignificant in each case. Perhaps industrial country GDP is not the best instrument to capture the effect of textile exports on cotton imports, but it does have the advantage in the wide availability of reputable forecasts.

The Indonesia model's Durbin-Wastson statistic indicates a problem with autocorrelation. Correcting for first-order autocorrelation reduces the elasticity of cotton price to -0.51 and reduced the domestic GDP parameter estimate to 0.11, so that it was no longer significant. The serial correlation may be indicative of mispecification; growth in Indonesia's cotton imports may have been determined by changing rates of foreign direct investment, which neither domestic nor industrial country GDP adequately capture.

The second stage models were estimated for U.S. market share as a system of seemingly unrelated regressions in order account for contemporaneous correlation across the equations. The Durbin-Watson statistics for each equation estimated with ordinary-least-squares suggested that serial correlation was not a problem. The equations for all but Korean imports showed no sign of serial correlation, and the results for Korea were indetereminent.

The signs of the price ratio parameter--the elasticity of substitution--are as expected except in the case of Korea (Table 2). Babula dropped Korea from his second stage estimates because of the virtual identity between Korea's imports in total and its imports from the United States.

During the first 5 years of the 1977-95 period, the U.S. market share in Korea averaged 94 percent, but it fell to 74 percent and 63 percent in the next respective 5 year periods. Reestimating without the first 5 years reduced the magnitude of the price ratio variable in the Korea model, but the sign remained positive. Korea was the major participant in U.S. GSM-103 credit guarantee program during much of this period studied. Also, while lower than during earlier years, Korea's 1982-95 66 percent U.S. market share was substantially above next highest share in the other three importers modeled here. Possibly, relative U.S. prices affect Korean purchases from the U.S. differently than in other countries. Note that Korea's total import demand is the least price responsive of the four according to the first stage results. Dropping Korea from the system had little effect on the remaining estimates.

The elasticity of substitution for Japan is the only one that can be compared directly with previous results. While lower than the average of the estimates reported by earlier studies, it is essentially the same as Babula's results.

Conclusions

The price elasticity of U.S. cotton in each individual market can be determined by weighting the average of the elasticity of price substitution and elasticity of total import demand for cotton. The importer's expenditure shares on non-U.S. and U.S. cotton provide the respective weights. Including the counter-intuitive Korean results in this estimate gives a simple average of -0.52. Excluding Korea gives a simple average of -0.81. As with the elasticity of substitution, the elasticity of U.S. exports is lower than the averages reported by earlier studies. These other studies included rest-of-world estimates, but this difference also turns up in comparisons specific to Japan and Other Asia.

Further research is necessary to study import demand in Mexico, Brazil, and China. These countries are significant cotton producers as well as importers, requiring more sophisticated modeling to discern import demand. The European Union is also now a significant cotton producer, so the simple models used in this study are no longer an analytically affordable luxury. The lower elasticities found here may simply reflect a random artifact of the data used. Alternatively, perhaps the increasing importance of these new importers, and the slowing import growth in traditional markets has led to reduced price competition for U.S. cotton in traditional markets. To a greater degree than in the past, firms in these traditional markets may be buying U.S. cotton for reasons other than price competitiveness.

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Table 1. First Stage Parameter Estimates[1]

	Japan	Thailand	Korea	Indonesia
Constant	300.9	541.4	251.0	-282.9
	(6.22)	(1.60)	(1.85)	(4.95)
IUV_c	-0.89	-0.86	-0.45	-0.73
	(4.59)	(1.49)	(2.19)	(2.51)
P_o	0.92	0.10	0.69	0.76
	(3.32)	(0.13)	(2.32)	(1.48)
GDP_{dom}	3.89	3.68	1.76	0.80
	(4.95)	(1.96)	(2.08)	(2.19)
GDP_{indus}	0.06	2.89	0.38	-0.28
	(0.21)	(1.73)	(1.27)	(0.65)
Trend	-0.18	-0.31	-0.13	0.14
	(5.95)	(1.65)	(1.08)	(4.69)
D.W.	1.92	1.90	1.36	1.10
R^2	.89	.90	.80	.94

[1] T-statistics are in parentheses below parameter values.

Table 2. Second Stage Parameter Estimates[1]

	Japan	Thailand	Korea	Indonesia
Constant	-14.3	31.8	44.1	42.2
	(3.60)	(3.46)	(7.43)	(5.09)
PR	-0.93	-0.60	0.62	-0.81
	(4.56)	(4.78)	(1.46)	(6.12)
MS(t-1)	0.33	0.41	0.15	0.20
	(2.96)	(4.06)	(1.70)	(1.66)
TR	0.01	-0.02	-0.02	-0.03
	(3.81)	(3.36)	(7.29)	(4.99)
D86	-0.16	-0.29	-0.35	-0.17
	(4.00)	(3.88)	(7.61)	(0.65)
R^2	.70	.88	.92	.88

[1] T-statistics are in parentheses below parameter values.