

Export Demand Elasticity Estimation for U.S. Cotton

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Introduction

- The elasticity of export demand plays an important role in analyzing U.S. agricultural policy.
- Magnitude of export demand elasticity for U.S. cotton is in need given the constantly changing world economic environment, while the relevant study in this area was published over 20 years ago (Duffy, Wohlgenant and Richardson, 1990).
- New estimates of the elasticity of export demand for U.S. cotton are provided using updated data and empirical techniques. Results from this paper are useful for policy makers as well as for researchers interested in parameterizing simulation models.

Armington's Framework

- The Armington model was used to estimate the export elasticity for U.S. cotton.
 - *The Armington model offers a powerful method for modeling crop exports and estimating the elasticity of import demand for a given region.*
- Armington assumes that the elasticity of substitution between any two products is constant and equal to the elasticity of the substitution between any other product pair in the market. The resulting import demand function can be written as:

$$X_{ij}/X_i = b_{ij}^{\sigma}(P_{ij}/P_i)^{-\sigma} \quad (1)$$

Where,

X_{ij} ----- Quantity of cotton from country j consumed by country i

X_i ----- Total cotton demand from country i

P_{ij} ----- Price of cotton from country j in country i

P_i ----- Price index of cotton in country i

σ ----- Elasticity of substitution between any two products in a given market

Continued

- This structure of demand implies that the direct price elasticities of demand in country i have the form:

$$N_{ijj} = -(1 - S_{ij}) * \sigma_i + S_{ij} * \eta_i \quad (2)$$

Where,

N_{ijj} ----- Demand elasticity for cotton from country j with respect to its cotton price in country i

S_{ij} ----- Expenditure share of cotton from country j in country i

η_i ----- Total demand elasticity for cotton in country i

- Although the Armington approach can be used in linear equations where parameters are relatively easy to estimate, some efforts are needed to estimate σ directly. Given the importance of the σ in finding the export demand elasticity, this parameter will be estimated in our study using equation 1.

Market Share Equations Estimation

- Modifications of the basic Armington Model were made:
 - *A lagged dependent variable was included; and*
 - *A trend variable, which accounts for possible changes over time that are unrelated to relative prices, was also included.*
 - *And price Ratio is assumed:*
 - (i). (U.S. cotton price + transportation costs) * Exchange Rate / Price Index;*
 - (ii). (U.S. cotton price + transportation costs) * Exchange Rate / Average Domestic Price.*
- Annual time-series data from 1978 to 2015 were used in the estimations.
- U.S. cotton exports and exporting prices are obtained from the U.S. Department of Agriculture Global Agricultural Trade System (USDA GATS, 2016).
 - *Prices are deflated, the base year = 2010.*

Table 1. U.S. Cotton Market Shares in Major Importing Countries, 1978 – 2015

	β_0 Constant	β_1 MS _{t-1}	β_2 Price Ratio	β_3 Trend	R ²
China	0.02 (0.03)	0.62 (0.14)	-4.77E-7 (1.38E-6)	6.97E-4 (8.85E-4)	0.56
	0.03 (0.03)	0.64 (0.14)	-0.28 (0.34)	1.51E-4 (1.13E-3)	0.56
Japan	0.35 (0.11)	0.18 (0.17)	6.96E-8 (2.48E-7)	1.00E-3 (1.87E-3)	0.51
	0.34 (0.11)	0.18 (0.17)	0.14 (0.39)	9.43E-4 (1.88E-3)	0.53
South Korea	0.55 (0.14)	0.26 (0.16)	2.76E-8 (1.07E-8)	-0.01 (3.57E-3)	0.74
	0.52 (0.14)	0.15 (0.17)	2.98 (1.05)	-0.01 (3.13E-3)	0.75
Taiwan	0.29 (0.11)	0.32 (0.16)	-8.09E-7 (9.12E-7)	2.01E-3 (4.29E-4)	0.15
	0.22 (0.12)	0.33 (0.16)	-0.03 (0.43)	1.40E-3 (2.27E-3)	0.13
Pakistan	0.03 (0.02)	0.28 (0.16)	-9.04E-8 (5.06E-8)	4.51E-4 (4.29E-4)	0.50
	0.02 (0.02)	0.30 (0.17)	-0.05 (0.05)	2.79E-4 (7.18E-4)	0.47
Indonesia	0.14 (0.10)	0.63 (0.13)	-2.81E-11 (2.00E-9)	-7.17E-4 (1.59E-3)	0.46
	0.09 (0.11)	0.59 (0.14)	0.01 (0.02)	1.10E-3 (3.57E-3)	0.47

Table 1. U.S. Cotton Market Shares in Major Importing Countries, 1978 – 2015 (continued)

	β_0 Constant	β_1 MS _{t-1}	β_2 Price Ratio	β_3 Trend	R ²
Bangladesh	0.19 (0.07)	0.19 (0.16)	2.37E-7 (1.95E-7)	6.41E-3 (1.92E-3)	0.54
	0.11 (0.09)	0.10 (0.16)	0.17 (0.08)	2.53E-3 (2.38E-3)	0.57
Vietnam	0.01 (0.14)	0.20 (0.23)	-1.10E-9 (1.34E-9)	9.70E-3 (4.12E-3)	0.56
	0.12 (0.30)	0.21 (0.23)	-0.13 (0.19)	0.01 (0.01)	0.55
Malaysia	-0.08 (0.15)	0.50 (0.15)	1.30E-5 (1.23E-5)	2.90E-3 (2.98E-3)	0.32
	-0.10 (0.23)	0.51 (0.15)	0.27 (0.38)	0.01 (4.85E-3)	0.31
Mexico	0.10 (0.08)	0.68 (0.13)	-5.02E-7 (3.84E-7)	4.46E-3 (4.06E-3)	0.78
	0.06 (0.06)	0.67 (0.14)	-2.85E-4 (3.69E-4)	5.48E-3 (4.01E-3)	0.77
Other Asia	0.04 (0.04)	0.58 (0.15)	6.23E-9 (1.04E-7)	1.49E-3 (1.04E-3)	0.53
	0.05 (0.06)	0.57 (0.15)	-0.02 (0.12)	1.37E-3 (1.27E-3)	0.47
Other Latin America	-0.08 (0.04)	0.37 (0.16)	1.18E-8 (9.14E-8)	0.01 (3.42E-3)	0.91
	-0.12 (0.07)	0.32 (0.16)	0.01 (0.01)	0.02 (4.36E-3)	0.91

Export Demand Elasticity Estimates for U.S. Cotton

- In table 2, elasticity estimates are presented for three assumptions concerning the overall elasticity of demand for cotton, η_i .
 - *An upper bound of 0, perfectly inelastic;*
 - *A lower bound of -1, unitary elasticity; and*
 - *The Global Fibers Model estimate of total demand elasticity, -0.094.*

Table 2. Calculation of Export Demand Elasticities for U.S. Cotton

	Average U.S. Market Share 1978-2015	σ	Elasticity		
			$\eta = 0$	$\eta = -0.094$	$\eta = -1$
China	0.063	4.77E-7	-4.50E-7	-0.01	-0.06
		0.28	-0.26	-0.27	-0.33
Japan	0.47	6.96E-8	-3.69E-8	-0.04	-0.47
		0.14	-0.07	-0.12	-0.54
South Korea	0.53	2.76E-8	-1.29E-8	-0.05	-0.53
		2.98	-1.40	-1.45	-1.93
Taiwan	0.37	8.09E-7	-5.09E-7	-0.03	-0.37
		0.03	-0.02	-0.05	-0.39
Pakistan	0.02	9.04E-8	-8.86E-8	-1.88E-3	-0.02
		0.05	-0.05	-0.05	-0.07
Indonesia	0.36	2.81E-11	-1.80E-11	-0.03	-0.36
		0.01	-0.01	-0.04	-0.37
Bangladesh	0.17	2.37E-7	-1.97E-7	-0.02	-0.17
		0.17	-0.14	-0.16	-0.31
Vietnam	0.14	1.10E-9	-9.46E-10	-0.01	-0.14
		0.13	-0.11	-0.13	-0.25
Malaysia	0.25	1.30E-5	-9.74E-6	-0.02	-0.25
		0.27	-0.21	-0.23	-0.46
Mexico	0.45	5.02E-7	-2.76E-7	-0.04	-0.45
		2.85E-4	-1.57E-4	-0.04	-0.45
Other Asia	0.16	6.23E-9	-5.24E-9	-0.02	-0.16
		0.02	-0.02	-0.03	-0.18
Other Latin America	0.27	1.18E-8	-8.60E-9	-0.03	-0.27
		0.01	-4.37E-3	-0.03	-0.27

Conclusions

- When $\eta = 0$, the elasticity of export demand for U.S. cotton ranges from $-1.8E-11$ to -1.4 .
- When $\eta = -0.094$, the elasticity of export demand for U.S. cotton ranges from -0.002 to -1.5 .
- When $\eta = -1$, the elasticity of export demand for U.S. cotton ranges from -0.02 to -1.93 .
- With the exception of South Korea, the results indicate that U.S. cotton demand elasticity is inelastic.
- Relatively large changes in the overall elasticity of demand (η) only have a small effect on the elasticity of demand for U.S. cotton.