AJAE Appendix: Tariff Equivalent of Technical Barriers to Trade with Imperfect Substitution and Trade Costs

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Estimation of Parameters s and a

Specification

The derivation of the elasticity of substitution s and home-good preference parameter a is as follows. First, equation system (4) is used to obtain ratio *D/I*, which is then solved for p_I:

$$\text{(A.1)} \quad p_I = \left(D/I\right)^{\frac{1}{s}} \frac{(1-a)}{a} p_D .$$

We do not observe p_I directly as it is a function of TBT_T. We substitute p_I into equation (2) and rearrange terms to obtain:

$$\text{(A.2)} \quad \frac{M}{p_D D} - 1 = \left(I/D\right)^{1-\frac{1}{s}} \left(\frac{1-a}{a}\right),$$

where M is the expenditure on all apples evaluated at wholesale price. The left-hand term is just the ratio of expenditure shares.

After taking natural logarithms, (A.2) becomes

$$\text{(A.3)} \quad \ln\left(\frac{M}{p_D D} - 1\right) = \left(1 - \frac{1}{s}\right) \ln\left(\frac{I}{D}\right) + \ln\left(\frac{1-a}{a}\right).$$

Estimation Method

We run two-stage least-square regression (2SLS) on (A.3) since the right hand side variable $\ln\left(I/D\right)$ is endogenously determined.[1] In the first stage, we regress $\ln\left(I/D\right)$ on all available exogenous variables instruments and get the least-square estimator of the coefficients of the instruments and the estimated value of $\ln\left(I/D\right)$, $\widehat{\ln}\left(I/D\right)$; in the second stage, we regress the left hand side of (A.3) on $\ln(I/D)$ and use the regression coefficient of $\ln(I/D)$ and intercept to recover s and a (Greene 2002).

Data

We use the 2000-2004 monthly data for *M*, *D*, *I* and p_D from Monthly Statistics of Japan; Japan Customs; and MAFF. I is the aggregate imports since the individual imports from each country are too small to derive the parameters. We have 42 data points because for some of the months, apple imports are zero. Expenditure M is computed as the sum of expenditure on both domestic imported apples. Expenditure on domestic apples is $p_D D$. Expenditure on imported apples is $p_I I$. p_I is approximated by

$p_I \approx p_{CIF} + TR + Tariff + \overline{TBT_2}$, where $\overline{TBT_2}$, an approximation of TBT_2 , is assumed small (5% of the CIF price). The approximation of TBT_2 has little influence on the estimation of the parameters since the expenditure on imported apples is less than 0.35% of the total expenditure on average. $I{*}TBT_2$ represents a very small percentage of the expenditure on all apples. We have varied TBT_2 from zero to 10% of the CIF price, and the estimation results remain very close to the 5% case (see results section below). The exogenous variables are the price p_{CIF} , the Japanese real wage index, RWI , and year dummy variables in the first stage. The source for p_{CIF} and *RWI* is Monthly Statistics of Japan.

Results

We develop the instrument for $\ln(I/D)$ using exogenous price p_{CIF} and the Japanese real wage index, RWI, and year dummy variables in the first stage. We regress $\ln(I/D)$ on year dummy variables year1 (which is 2000), year2, year3, year4, p_{CIF}, p_{CIF}^2, RWI, and RWI^2. The results of the first-stage estimation are shown in table A.1.

The R^2 of the regression is 0.93 and adjusted R^2 is 0.92, indicating good fit. We developed alternative instruments using other exogenous variables such as monthly dummy variables, higher orders of CIF price and *RWI*. Results are very robust to variation in instruments. From the regression results above, we get the fitted value of $\ln(I/D)$, $\widehat{\ln}(I/D)$. In the second stage, we regress the left-hand side of (A.3) on $\widehat{\ln}(I/D)$. The results are shown in table A.2.

The R^2 and adjusted R^2 of the regression are both 0.90. Combining the results in table A.2 and equation (A.3) allows us to obtain $\hat{s}$ and $\hat{a}$, results reported in table A.3. The estimates' standard deviations are calculated using the Delta method (Greene 2002). We also used nonlinear least square on the second stage of the estimation, the results were $\hat{s}_n$ =7.15 and $\hat{a}_n$ =0.67, quite close to those obtained using 2SLS. Further, since we do not have an exact estimate of TBT_2, there may be some measurement error in the estimating results of s and a. The larger the approximation of TBT_2, the larger of the estimation results of the two parameters, but the difference is quite small. For instance, when TBT_2 is set to be 10% of the CIF price, $\hat{s}_n$ =7.14 and $\hat{a}_n$ =0.65.

Footnotes

1. The Hausman Test was conducted, and the P-value for the test was found to be <0.01, so $\ln(I/D)$ is endogenous. The estimation procedure used addresses the endogeneity.

Table A.1. First-Stage Estimation Results of the 2SLS

Variable	Estimated Coefficients	Standard Deviation
Constant	16.649*	2.281
year1	-2.474*	0.304
year2	-5.306*	0.613
year3	-2.457*	0.325
year4	-2.674*	0.333
p_{CIF}	-0.091*	0.020
p_{CIF}^2	0.00026*	0.00004
RWI	-0.01890*	0.00442
RWI^2	0.00004*	0.00001

Note: * the coefficient is significant at 1%.

Table A.2. Second-Stage Estimation Results of the 2SLS

Variable	Estimated Coefficients	Standard Deviation
Intercept	-0.579*	0.220
$\ln(\hat{I}/D)$	0.860*	0.041

Note: *the coefficient is significant at 1%.

Table A.3. Estimated Results of s and a

Parameter	Estimated Value	Approximate Standard Deviation
s	7.12*	2.09
a	0.64*	0.05

Note: *the coefficient is significant at 1%.