Food Safety Regulations and Global Food Trade Patterns

Tsunehiro Otsuki[*,a]

John S. Wilson[b]

[a b] *Development Research Group (DECRG), The World Bank, 1818 H Street NW, Washington DC 20433, USA*

Selected Paper for the 2001 AAEA Annual Meeting

[*,a] Corresponding author. *E-mail address:* totsuki@worldbank.org (Tsunehiro Otsuki)

I. Introduction

The need to understand in a more precise manner how food safety and animal and plant health regulations affect trade is being driven, to a great extent, as a function of challenges apparent in full implementation of the Agreement on the Application of Sanitary and Phytosanitary Standards (the "SPS Agreement") which entered into force with the establishment of the World Trade Organization (WTO) on 1 January 1995.

Harmonization of regulatory requirements and product standards often is an inevitable process of an integrated global trade regime. Despite potential gains from trade liberalization, difficulties that trading countries have faced in the course of harmonization have become clear. This process necessarily requires reform of domestic trade policies among trading countries, and is expected to incur substantial costs to several countries during the transition period, including the costs of the establishment of modern and technology-intensive inspection and quality control infrastructure, and production techniques.

Current situation of regulatory requirements and product standards are substantially different across countries, typically between developed and developing countries (World Bank, 2000). The fact that the cumulative number of notifications to WTO from developed and developing countries with regard to SPSs and other non-tariff barriers has increased by 26 percent from 1995 to 1998 reflects the difficulties to achieve concordance on harmonizing these standards (Wilson, 2000). This implies that a harmonization of domestic regulations and standards among the trading countries might significantly alter current trade patterns.

In December 2000 European Union (EU) harmonized maximum allowable level of aflatoxins in cereals, dried and preserved fruits and nut imports at a level that was far more stringent than levels in the other part of the world. This policy reform is estimated to reduce trade of these products by US$ 400 million or a half of the total imports from nine African countries (Otsuki, Wilson and Sewadeh, forthcoming). Among the firms opposing the limits were Argentina, Australia, brazil, Canada, Colombia, India, Indonesia, Malaysia, Mexico, the Philippines, Senegal, South Africa, Thailand, Turkey, Uruguay and the US (1998, CRC Press LLC).

This paper reviews the current global pattern of trade in cereals, dried and preserved fruits and nuts between world regions. It also analyzes the growth of trade in these products by world region. It then estimates the elasticity of bilateral trade flow in these products with respect to Aflatoxin B1 standard. The analysis extends Otsuki, Wilson and Sewadeh by broadening the country coverage to the global scope and by explicitly incorporating free trade areas. It finally simulates how global trade pattern of these products will change when differing levels of harmonization of Aflatoxin B1 standard are assumed.

II. Econometric Model

When combined with data on food safety standards in importing countries, bilateral trade flow data allow analysis of how differing level of standard affect promote or limit trade between a particular pair of importing and exporting countries. Various combination of importing and exporting countries provides sufficient variation for regression type of analysis. We employ a gravity model in which value of trade flow is regressed on variables to measure size of a country's economy, geographical distance, and stringency of standards.

Our specification of gravity model is as follows:

$$ln(V_{ij}) = b_0+b_1ln(GNP_i) + b_2ln(GNP_j) + b_3ln(GNP_i) + b_4ln(GNP_j) + b_5ln(DIST_{ij}) + b_6\ ln(STi)+e_{ij}$$

where V_{ij} denotes value of trade from country *j* to country *i*. It is obtained from trade data of the United Nations Statistical Office. Products that are included in this analysis include wheat (SITC041), rice (SITC042), maize (SITC044), dried and preserved fruits (SITC052), and nuts (SITC05171 and 05172). We use data for the time period between 1995 and 1998. Parameter *b*'s are coefficient and e_{ij}^{k} is the error term that is assumed to be normally distributed with mean zero. G*NPi* and *GNPj* are real GNP of importing country *i* and exporting country *j* in 1995 U.S. dollars, respectively. *POPi* and *POPj* are population of importing country *i* and exporting country *j*, respectively. *DIST* is geographical distance between country *i* and *j*.

ST_i is maximum level of Aflatoxin B1 imposed on import by importing country *i*. It is expressed as contamination in parts per billion. It is obtained from FAO survey of mycotoxin standards on food and feed stuffs in 1995 (FAO, 1995). A greater value of this variable implies a more lax regulation of Aflatoxin B1 contamination, and vise versa. If this standard is applied at the border, products with Aflatoxin B1 contamination equal to or below *ST* successfully enter the importing country. Products with Aflatoxin B1 contamination above *ST* are retained in the exporting country or rejected at the importing country's border. The coefficient for this variable in our gravity model generally implies changes in exports associated with an incremental change (relaxation or tightening) in *ST*. If this standard does limits trade, this coefficient is expected to be positive.

Since data on aflatoxin standards are not available for most exporting countries in this analysis, differences across exporting countries with respect to aflatoxin standards cannot be measured. This may cause omitted variable bias on the coefficient estimates. Dummy variables for exporting countries consequently included to control for systematic differences across exporting countries, which can partly capture the their differences with respect to aflatoxin standards. Dummy variables for products and year, and exporting countries also are included in the model in order to control for systematic differences across products and time.

III. Results

Two regression results are reported in Table 1. The first column provides the result of OLS and the second column provides the result of WLS. The OLS result indicates that distance is negative and significant as anticipated. It shows that the positive effect of GNP in importing countries but only at the 10 percent significance level. If it is considered to be significant, the sign is consistent with our anticipation. Population of importing countries is positive and significant at the one percent level. While multicollinearity is likely between these two variables, these positive signs suggest size effect and income effect of importing countries. Exporting countries GNP and population are not significant. This is perhaps because domestic consumption of food products may have offset the size effect on their exports.

Aflatoxin B1 standards in importing countries are found to have had a negative effect on trade flow. This result is consistent with the findings in Otsuki, Wilson and

Sewadeh. Even when global trade is examined, it is found that a more stringent standard tends to limit trade.

The EU dummy is found to be positive and significant, and the Mercosur dummy is found to be positive and significant only at the 10 percent level. The ASEAN dummy is insignificant and the NAFTA dummy is negative and marginally significant. This indicates that regional arrangement does not always promote trade, or that trade promotion effect due to liberalization have yet come into effect.

The WLS result generally supports the OLS result. Only the Mercosur dummy turns insignificant from marginal significance. The OLS result can be said to be robust against heteroscedasticity of the standard error.

The OLS result then is used to predict change in trade flow associated with different levels of aflatoxin B1 standards. Figure 1 presents the simulated relationship between aflatoxin standard and total trade flow between the 31 exporting countries and 15 importing countries. At the level recommended as international standard by Codex, the total change is positive $11 billion or 5.3 percent from the 1998 total value of trade of these products. At the level implemented by EU, the total change is negative $ 12.5 billion or 6 percent from the 1998 total value of trade of these products.

We finally predict how trade patterns can be changed if Aflatoxin B1 standard is harmonized at a level within the range of the standard. One reasonable level would be the level where gains and losses in trade flow from all the countries are equal. This break-even point provides a zero sum condition. The break-even point is computed to be 4.81 ppb. Changes in value of trade flow are computed for each importing and exporting country. The trading partner within the sample countries which account for the largest gain and loss of trade flow is then identified.

Table 2 presents the result for importing countries. Export to Germany is estimated to increase by 2.7 billion, which is the greatest among the importing countries. Four EU countries, Germany, UK, France and Austria account for 100 percent gains from the harmonization at the break-point level. This reflects the fact that EU countries have had the most stringent standard in the world. The major exporting partners to these countries are France, Germany and USA. Except USA, these trading countries are in EU. The harmonization thus will tend to increase intra-regional trade in EU or industrialized countries in general. The country which is estimated to reduce imports most is India since it had the most lax standards among the exporting countries in the sample.

Table 3 shows the result of the same exercise for the exporting countries. The result indicates that France will increase exports most. The seven EU countries account for more than 90 percent of gains in exports. Their trading partners are also EU countries, Germany, France, UK and Austria. This also confirms that the harmonization at the break-even point will greatly increase intra-EU trade. On the other hand, most developing countries lose their export as a result. USA and Canada will also decrease their exports due to the contraction of mutual trade. Their standards are also more lax than the break-even level.

In sum, the change in trade patterns due to harmonization of Aflatoxin B1 standards at intermediate level is found to increase intra-EU trade. It tends to reduce trade flow among outside EU countries except for several transition economy. The result in general depends on the previous level of aflatoxin standards and dependency in terms of trade between countries. The result illustrates the potential difficulty of harmonization of standards globally, and likely loss of exports and imports among developing countries.

Table 1. Regression Results (Dependent Variable = Value of Trade Flow)

	OLS	Regression with Robust standard errors
Intercept	8.478	8.478
	(32.157)	(32.877)
Importer's GNP	0.130*	0.130*
	(0.071)	(0.078)
Exporter's GNP	1.211	1.211
	(1.904)	(1.996)
Importer's population	0.262***	0.262***
	(0.089)	(0.098)
Exporter's population	-1.864	-1.864
	(4.575)	(4.775)
Distance	-1.155***	-1.155***
	(0.106)	(0.102)
Standard	0.468***	0.468***
	(0.091)	(0.093)
Mercosur Member	1.071*	1.071
	(0.597)	(0.676)
ASEAN Member	-0.332	-0.332
	(0.817)	(0.773)
EU Member	1.448***	1.448***
	(0.267)	(0.243)
NAFTA Member	-0.830*	-0.830*
	(0.485)	(0.470)
Wheat	1.358***	1.358***
	(0.420)	(0.352)
Rice	0.108	0.108
	(0.403)	(0.319)
Maize	0.085	0.085
	(0.410)	(0.330)
Nuts 1	4.865***	4.865***
	(0.408)	(0.339)
Nuts 2	-0.433	-0.433
	(0.400)	(0.314)
R-squared	0.457	0.457
Adjusted R-squared	0.448	
Number of observations	3030	

The time and exporter dummies are suppressed.

Figure 1. Estimated Relationship between Aflatoxin B1 Standards and Trade Flow

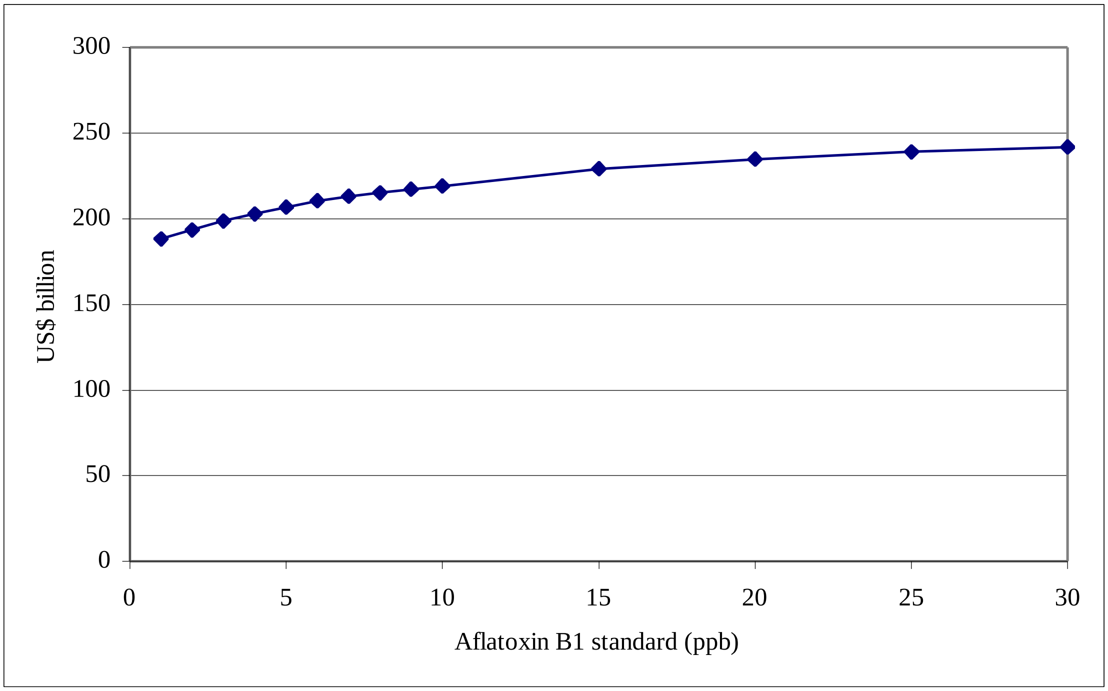

Table 2. Predicted Change in Trade Flow at the Break-even Point

Importer	Change (US$ million)	Share in total positive (negative) change	Change (%) in country's export	Partner whose trade flow will increase most	Change (US$ million)	Partner whose trade flow will decrease most	Change (US$ million)
Germany	+2720	33	+66	France	641		
UK	+2492	30	+66	France	643		
France	+2192	27	+89	Germany	460		
Austria	+797	10	+100	USA	188		
Israel	-19	0	-2			Tanzania	5
Spain	-51	-1	-2			USA	14
Italy	-63	-1	-2			USA	14
Brazil	-66	-1	-2			Argentina	22
Australia	-122	-1	-15			USA	37
USA	-687	-8	-24			Canada	174
Malaysia	-809	-10	-34			India	209
Japan	-820	-10	-24			USA	251
Canada	-901	-11	-17			USA	774
Nigeria	-1151	-14	-36			Tanzania	348
India	-3523	-43	-39			Tanzania	820

Table 3. Predicted Change in Trade Flow at the Break-even Point

Exporter	Change (US$ million)	Share in total positive (negative) change	Change (%) in country's export	Partner whose trade flow will increase most	Change (US$ million)	Partner whose trade flow will decrease most	Change (US$ million)
France	+1250	29.3	+44	UK	643	India	19
Germany	+761	17.8	+46	France	460	India	16
Italy	+711	16.7	+42	Germany	301	India	31
The Netherlands	+696	16.3	+57	Germany	359	India	6
Spain	+469	11.0	+39	France	201	India	18
Hungary	+239	5.6	+32	Austria	158	India	28
Austria	+55	1.3	+32	Germany	29	India	2
Romania	+36	0.8	+11	Germany	24	India	21
Denmark	+34	0.8	+43	Germany	17	India	1
Kazakhstan	+15	0.4	+4	Germany	27	India	37
Russia	+4	0.1	+4	Germany	7	India	9
Nigeria	-1	0.0	-1	France	4	India	8
Egypt	-1	0.0	-3	UK	1	India	2
Israel	-1	0.0	-4	UK	1	India	3
Mexico	-14	0.3	-10	UK	4	India	8
Uruguay	-16	0.4	-6	UK	3	India	7
Paraguay	-22	0.5	-5	UK	4	India	9
Zimbabwe	-26	0.6	-14	France	5	India	19
Senegal	-33	0.8	-6	Germany	19	Nigeria	37
Brazil	-73	1.7	-11	Germany	22	India	42
South Africa	-77	1.8	-13	Germany	16	India	51
India	-135	3.2	-3	Germany	182	Malaysia	209
Argentina	-136	3.2	-6	Germany	29	India	64
Canada	-168	3.9	-13	Germany	29	USA	174
Australia	-197	4.6	-18	Germany	21	India	116
Sri Lanka	-265	6.2	-25	Germany	17	India	219
Vietnam	-280	6.6	-25	Germany	16	India	187
Thailand	-398	9.3	-25	Germany	22	India	264
Pakistan	-708	16.6	-32	Germany	19	India	704
USA	-737	17.3	-5	Germany	480	India	774
Tanzania	-991	23.2	-14	Germany	197	India	820

References

Committee on Sanitary and Phytosanitary Measures, World Trade Organization (1998). Submission by the Gambia. G/SPS/GEN/50, February 10, 1998. World Trade Organization, Geneva.

European Commission (1997). Commission Regulation (EC) No. 194/97 of 31 of January 1997, The European Commission.

European Commission (1998). Commission Regulation (EC) No. 1525/98 of 16 July 1998, European The Commission.

Finger, Michael. J., and Phillip Schuler. (2000) Implementation of Uruguay Round Commitments: the Development Challenge, World Economy v23, n4: 511-25.

Food and Agriculture Organization (1995). Worldwide Regulations for Micotoxins 1995: A Compendium. FAO, Rome.

Maskus, Keith. E. and John S. Wilson, forthcoming. Technical Barriers to Trade: A Review of Past Attempts and the New Policy Context. In Maskus, K.E. and Wilson, J.S. (Eds.) Quantifying Trade Effect of Technical Barriers: Can it be done? University of Michigan Press, Ann Arbor, MI.

Maskus, Keith. E. and John S. Wilson, and Tsunehiro Otsuki. forthcoming. An Empirical Framework for Analyzing Technical Regulations and Trade. In Maskus, K.E. and Wilson, J.S. (Eds.) Quantifying Trade Effect of Technical Barriers: Can it be done? University of Michigan Press, Ann Arbor, MI.

Orden, David and Donna Roberts,. (Eds.), 1997. Understanding Technical Barriers to Agriculture Trade, Proceedings of a Conference of the International Agricultural Trade Research Consortium, University of Minnesota, Department of Applied Economics, St. Paul, MN.

Otsuki, Tsunehiro, John S. Wilson, and Mirvat Sewadeh, forthcoming. Saving Two in a Billion: Quantifying the Trade Effect of European Food Safety Standards on African exports. Food Policy.

U.S. Food and Drug Administration (2000). Foodborne Pathogenic Microorganisms and Natural Toxins Handbook. http://vm.cfsan.fda.gov/~mow/chap41.html

Wilson, John S. (2000). The Development Challenge in Trade: Sanitary and Phytosanitary Standards. Paper submitted to WTO Meeting on Sanitary and Phytosanitary Standards June 19, World Trade Organization, Geneva.

World Bank (2000) Global Economic Prospects 2001 Washington, D.C.