Exploring the Impact of Food Safety Standards on Global Tea Trade: A Gravity Model Based Approach

by

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Abstract. Tariff and non-tariff trade barriers have become a common topic in the current trading environment. Food safety and quality standards prevailing at the national and international levels can act as non-tariff barriers for trade, especially for the developing countries like Sri Lanka heavily dependent on agricultural trade. The present study analyzed this issue empirically using the Gravity Model approach, focusing on the special case of the ISO 22000 food safety metasystem and the food safety standards linked with the Maximum Residue Levels (MRL) on major tea exporting nations in the world. Country specific variables such as distance to trading partners, country’s GDP and population, whether the country is landlocked or not, whether the nation shared a common language and had colonial ties with trading partners, were examined together with the effects of the introduction of quality standards such as ISO22000 and Minimum Residue level requirements. The results revealed that the impact of the introduction of ISO 22000 had been positive. A unit increase of the standards has led to more than three-fold increase in total global tea exports. The MRL requirement, however, surprisingly indicated an insignificant negative impact. Relaxation of quality standards by major importing countries would reduce the export volumes. Total population and the importing and exporting countries being landlocked were also found significant. The study thus found evidence to conclude that a metasystem like ISO 22000 could have trade facilitating effect, quite contrary to the common belief that food safety standards hinder global agricultural trade, and that Sri Lanka could secure long-term positive effects on tea exports to the European Union and Japan through the adoption of such a metasystem.

Key words: Agricultural trade, Food safety standards, Gravity model, Tea exports, Technical barriers to trade (TBT)
JEL classification: C23, F1, F14, F15

1 Introduction

Taking precautions against health, environmental and safety risks associated with food and agricultural trade has become a major subject discussed at the global level. However, the national and international standards that are increasingly getting stringent in view of addressing such issues, also has become a major concern. This is because, stricter standards would constitute a trade barrier, in the current trading environment, vis-à-vis exports of food and agricultural produce to developed countries, which might negatively affect the producers, mainly in the developing world.

At the center of this debate is the role of the ‘precautionary principle’, which provides a framework for decision making, and holds that precaution against health, environmental and safety risks may be exercised even when scientific evidence of risk is unclear (Otsuki et al, 2001). While traditional trade barriers like tariffs in agriculture continue to decline, the Sanitary and Phyto-sanitary (SPS) measures and other Technical Barriers to Trade (TBT) of the WTO are increasingly subject to debate. According to Henson et al., (2000), such barriers may prohibit trade by imposing an import ban or by prohibitively increasing production and marketing costs or divert trade from one trading partner to another by laying down regulations that discriminate across potential suppliers, or that consist of trade reducing measures leading to cost escalations or to raise barriers for all potential supplies.

The attention of the World Trade Organization (WTO) Ministerial held in Doha, Qatar, in November 2001 also was drawn on the subject of standards and their impact on market access for developing countries, which are likely to continue to be important issues in trade policy discussions. The evidence from recent analyses leads to believe that food safety standards could affect the ability of agricultural producers,
particularly those in the developing world, to meet the increasingly stringent regulatory standards set by the importing countries. For instance, a 10 percent increase in regulatory stringency of restrictions on the pesticide chlorpyrifos would lead to a 14.8 percent reduction in banana imports. This represents a significant impact on trade, and thus, could negatively affect developing countries which continue to rely on exports of agricultural commodities. Moreover, the lack of consensus on international standards, and divergent national regulations on pesticides, would also be costly. For example, that if the world were to adopt a standard at the level of regulatory stringency suggested by Codex (the body charged with setting global standards), in contrast to what is currently in place in the European Union, the world exports would suffer a US$ 5.3 billion loss.

Tea – the world’s second most popular beverage with 22% global beverage market share – contributes nearly 1.9% to the GDP of Sri Lanka and Rs. Million 136,180 of foreign exchange earnings of the country, with nearly 291 Million Kilograms of production in 2009. Russia, United Kingdom and United States are the main importers of tea globally with about 12, 8 and 7 percent of import shares, respectively. Russia, United Arab Emirates and Syria are the major importers of Sri Lankan tea, while Iran, Turkey and Jordan, individually, import more than 5% of tea produced domestically (International Tea Committee Statistical Bulletin, 2010).

Tea was declared as a food item by the Food and Agriculture Organization item in 1995. Since then, the tea exporting nations are now required to comply with specific food safety and quality standards to meet the demand for safer foods, which include those on usage of approved pesticides with minimum residue limits, microbiological parameters, and the limits on heavy metals. Moreover, the basic standard on black tea exports was ISO 3720 until 1995, but later in the same year, tea was subjected to meet three additional requirements, namely (i) usage of only approved pesticides within approved residue limits, (ii) conformity to microbiological parameters, and (iii) conformity to limits on heavy metals (Samarasingham, 2009). Since 2006, the European Union’s Parliamentary Directive on Hygiene of Food Stuff has made it compulsory to have a system of Hazard Analysis Critical Control Points (HACCP) in place, and it is now extended to impose the ISO 22000 and Maximum Residue Level (MRL) requirements for exportation.

This paper summarizes findings of an empirical research conducted on the possibility of food safety and quality standards acting as a non-tariff barrier vis-à-vis global tea trade, and against major tea exporting nations, with particular focus on the ISO 22000 food safety metasystem and the food safety standards associated with the Maximum Residue Levels (MRL).

Previous studies that focused on the issues pertaining to food safety and SPS related regulations appear to have adopted three distinct approaches: Inventory type analysis, Welfare analysis, and Political economic analysis. The inventory type approaches focused on the identification and description of such measurers and aimed at collecting and systematizing the available information pertaining to different countries or on particular commodities. By recognizing the possibility that some SPS regulations may also shift domestic demand, Sumner and Lee (1997), for example, developed a comprehensive model to analyze such effects on SPS regulations. Nevertheless, it did not incorporate consumer attitudes towards uncertainties into the model. Apparently, such gaps also existed in the studies which modeled the impact of governmental SPS policies as determinants of shifts in supply. MacLaren (1997) pointed out the importance of incorporating risk, uncertainty and ambiguity aversions in such analyses, but did not provide guidance as to how such could be approached. Orden and Romano (1996) managed to incorporate uncertainty in their analysis of modeling the risk of a pest infestation associated with Mexican avocado imported by the United States. The third group of SPS studies focused on the political economic aspects of SPS regulations, and a number of such studies concentrated on the effectiveness...
of international trade agreements like the WTO in preventing the enactment of unfair SPS regulations (Abbot, 1997; Stanton, 1997; Thiermann, 1997). In the South Asian context, Cato (1998) examined the cost of upgrading sanitary conditions in the Bangladeshi frozen shrimp industry to satisfy the European Union’s hygiene requirements. The total industry cost required to maintain Hazard Analysis Critical Control Points (HACCP) in production plants was estimated to be US$ 2.2 million per year. In the context of Africa, Mutasa and Nyamandi (1998) assessed the degree to which SPS standards impede exports from developing countries in Africa through a survey of Codex Alimentarius contact points. Henson et al. (2000) qualitatively explained the impact of hygiene requirements on fish exports from Kenya to the European Union as an illustration of the impact that food safety measures in developed countries could have on export oriented supply chains in developing countries. They have shown that this would become a particularly salient issue for developing countries with limited alternative markets for their export agricultural products.

Economic analyses revealing global impacts of food safety standards on food and agricultural trade are not many. Otsuki et al. (2001) and Wilson and Otsuki (2002) used Gravity Model approach and concluded that agricultural exports could be negatively affected by importer-specific standards. According to Otsuki, the effects of varying regulatory standards on trade in agricultural products are at the forefront of policy debate. Estimating the impact of changes in aflatoxin standards on trade flows of groundnut products using trade data for Europe and Africa during 1989-1998, Otsuki (2001) concluded that a 10 per cent tighter aflatoxin standard in European countries would cause 18 percent reduction of edible groundnut imports, and a new European Union regulation on aflatoxins would result in a 63 percent lower trade flow than when the Codex Alimentarius international standards were followed. In a rather in depth analysis, Wilson and Otsuki demonstrated how governmental regulations on food safety and environmental protection, including pesticide residue levels, would bear implications on trade. In another study that specifically focused on tea trade, Yue et al. (2010) found that stricter pesticide residue standards would bear severe negative implications on the trade in developing countries, and particularly would lead to a considerable decrease in their exports. For instance, not being able to conform to the maximum residue requirements would limit their entry opportunities into the developed markets. It is demonstrated how the new European Union’s Food Safety Act had a significant negative impact on the major tea exporters of the world: the tea export volume reduced by 61.6 percent following the tightening of the MRL requirement to 5 percent level.

To the best knowledge of the authors, the impact of food safety standards on global tea trade with special focus on Sri Lanka has not yet been studied, and the specific objective of this study was to fill that research gap.

2 Methodology
2.1 Theoretical Framework

As cited above, not many scientific studies could be found which have used ‘empirical data’ to quantify the trade effects of various food safety related regulations. A typical approach of quantifying the value of trade foregone appears to look at the residuals in econometric regressions of trade flows on the various determinants of trade. Otsuki et al. (2001) indicated the advantages of using an econometric approach when direct measures of stringency of standards were available. Under these circumstances, ‘Gravity Model’ approach, which is based on the Newton’s ‘Law of Universal Gravitation’, is of particular interest since they have long been used in estimating ‘home biases’ or ‘border effects’ in trade, a part of it reflecting national regulations that hamper trade. The gravity model of bilateral trade, for example, postulates that the volume of trade between two countries is proportional to their gross domestic products (GDP) and inversely related to the geographical distance between them (DIS).
The earliest application of the gravity model was by Tinbergen (1962) and Poyhonen (1963) on international trade volume research. Through empirical study, they discovered that the trade volumes between two nations would be positively proportional to the economic scale between those two countries and negatively proportional to the distance between them. Linnemann (1966) was the first to include several additional variables such as population, income per capita, exchange rates into the basic Gravity Model, obtaining what has been successively called the “Augmented Gravity Model”. Later applications of the gravity model in trade related research involved several dummy variables to reflect whether the two countries shared borders, whether they used a common language or currency, or if they all belonged to one favorable trade zone, among others (Deardorff, 1995; Head, 2003).

In an attempt to measure the trade impact of technical barriers to trade using gravity-based analysis of bilateral trade volumes, Moenius (1999) estimated the impact of a one-percent increase in the number of bilaterally shared standards. Soloaga and Winters (2001) used the gravity model to effectively analyze the impact of regional integration on the trade within and outside the region, as well as the effects of trade creation and trade transfer. Further developments in the usage of this approach could be found in Hummels (2000) and Anderson and van Wincoop (2001).

Combining gravity models or spatial trade models with econometric estimates is a potentially useful approach to identify the role of regulations in forgone trade (Beghin and Bureau, 2001). Although the approaches taken by Otsuki et al. (2001) are not characterized by econometric refinements, they appear to have exploited the possibility of using the level of standards itself as an explanatory variable, reflected by the maximum residue of aflatoxins indicating statistical variation in their panel. Agriculture and food sector specific gravity equation models have been estimated by Burfisher et al. (2001) and Vido and Prentice (2001).

At the empirical level, the Gravity Model gives very robust estimates and provides a good fit to the observed data. In fact, most of the estimations for bilateral trade volumes with respect to GDP, distance, and other explanatory variables, have given values for the determination index (R2) ranging between 0.65 and 0.95, depending upon the specification of the equation (Harrigan, 2001).

Despite its success in empirical analysis of trade patterns, the Gravity Model was extensively criticized as not having a sound theoretical foundation. However, several authors have worked on reconciling international trade theories with the Gravity Model specification. Starting with the work of Anderson (1979), it has been shown that the formulation of the Gravity Model could be derived from different theoretical frameworks such as Ricardian or Hecksher-Olin (H-O) models and Increasing Returns to Scale (IRS) models of the New Trade Theory (Serlenga et al, 2004). Also, the efforts of Helpman and Krugman (1985), Bergstrand (1985; 1989), Deardorff (1995), Evenett and Keller (2002) and Wilson and Otsuki (2004) helped establishing a basic theoretical footing for the gravity model approach. As highlighted by Davis (2000), it is remarkable that in a short period of time, the Gravity Model has switched from being a ‘theoretical orphan’ to a model for which many people were claiming its maternity.

The theoretical framework used in the present study stems from the conventional and tractable gravity model of international trade. The basic model was further expanded by incorporating other important variables, including: population (POP), language (LAN), colonial relationships (COL), whether the country is landlocked (LOCK) (Yue et al., 2010), and adoption of food safety standards (ISO 22000, MRL) (Equation 1):

$$
\ln Q_{ij} = \beta_0 + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j + \\
\beta_3 \ln POP_i + \ln POP_j + \beta_5 \ln DIS_{ij} + \\
\beta_6 DCOL_{ij} + \beta_7 DLAN_{ij} + \beta_8 DLOCK_{ij} + \\
\beta_9 DISO22000_i + \beta_{10} DMRL_j + e_{ij}
$$

where, \(\beta\) denotes the coefficients and \(i\) and \(j\) are exporting and importing countries, respectively (the notation D in the last five variables denotes dummy variable).
2.2 Collection and Analysis of Data

The secondary data for the study were obtained from the United Nations Commodity Trade Statistics Database (total tea export values), International Monetary Fund’s World Economic Outlook Database (GDP, population), and CEPII Database (distance, colonial ties, common language, landlocked). Exporting nations with more than 5 percent global market share (i.e. Kenya, China, Sri Lanka, India, Viet Nam and Indonesia) and countries which imports at least 5 percent of global production of tea (i.e. countries of the European Union, CIS countries, USA) was considered for the analysis.

The cross-sectional data gathered on tea trade for the year 2009 were initially analyzed without a simulation. It was of interest to further explore the impact of non-tariff barriers, such as food safety controls, on trade. To understand the situation which would arise if the importing countries relaxed food safety standards, the model was re-estimated relaxing the variable “safety standards” representing the scenario that the developed importing countries released all tea imports from ISO 22000 and MRL standards.

The data used in this study belongs to a single point in the cross-sectional data, which eliminates the issues arising from serial correlation. The outcomes of Breusch-Pagan and the White tests showed that linear model exhibits heteroskedastic error, which is usually the case with cross-sectional data. To minimize the errors, the variables were transformed and the outcome from the logarithmic specification of model provided favorable results.

A Hierarchical Cluster Analysis was carried out to identify the similarity clusters among the importing countries in 2009. Countries importing more than 1 percent in 2009 were the grouped objects, and the ones exporting more than 5 percent were used as cluster variables. The Statistical Package for Social Sciences (SPSS) (Version16) was used to estimate the Gravity Model and carry out the Cluster Analysis.

3 Results and Discussion

Regression analysis yielded that the signs of coefficients of the traditional gravity variables including, population, GDPs of exporter and importer countries, and their distance were as expected (Table 1).

Table 1. Outcome of Gravity Model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Exp. Sign</th>
<th>Scenario 1</th>
<th>Scenario 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>16.18**</td>
<td>11.54**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(4.44)</td>
<td>(4.30)</td>
<td></td>
</tr>
<tr>
<td>ln POPi</td>
<td>(-)</td>
<td>-1.34***</td>
<td>-0.74</td>
</tr>
<tr>
<td></td>
<td>(0.57)</td>
<td>(0.56)</td>
<td></td>
</tr>
<tr>
<td>ln POPj</td>
<td>(+)</td>
<td>1.08***</td>
<td>0.96***</td>
</tr>
<tr>
<td></td>
<td>(0.39)</td>
<td>(0.28)</td>
<td></td>
</tr>
<tr>
<td>ln GDPi</td>
<td>(+)</td>
<td>1.08***</td>
<td>0.54</td>
</tr>
<tr>
<td></td>
<td>(0.50)</td>
<td>(0.51)</td>
<td></td>
</tr>
<tr>
<td>ln GDPj</td>
<td>(+)</td>
<td>0.06</td>
<td>0.20</td>
</tr>
<tr>
<td></td>
<td>(0.26)</td>
<td>(0.18)</td>
<td></td>
</tr>
<tr>
<td>ln DISij</td>
<td>(-)</td>
<td>-1.50***</td>
<td>-0.93*</td>
</tr>
<tr>
<td></td>
<td>(0.51)</td>
<td>(0.49)</td>
<td></td>
</tr>
<tr>
<td>DISO22000j</td>
<td>(-)</td>
<td>2.00*</td>
<td>3.47***</td>
</tr>
<tr>
<td></td>
<td>(1.00)</td>
<td>(0.86)</td>
<td></td>
</tr>
<tr>
<td>DMRLj</td>
<td>(-)</td>
<td>-0.69***</td>
<td>-2.64**</td>
</tr>
<tr>
<td></td>
<td>(1.67)</td>
<td>(1.04)</td>
<td></td>
</tr>
<tr>
<td>DLOCKij</td>
<td>(-)</td>
<td>-1.02*</td>
<td>-0.06</td>
</tr>
<tr>
<td></td>
<td>(0.53)</td>
<td>(0.50)</td>
<td></td>
</tr>
<tr>
<td>DCOLij</td>
<td>(+)</td>
<td>0.99</td>
<td>0.12</td>
</tr>
<tr>
<td></td>
<td>(0.81)</td>
<td>(0.74)</td>
<td></td>
</tr>
<tr>
<td>DLANij</td>
<td>(+)</td>
<td>0.89</td>
<td>1.16</td>
</tr>
<tr>
<td></td>
<td>(0.86)</td>
<td>(0.79)</td>
<td></td>
</tr>
<tr>
<td>No of Observations</td>
<td>66</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R² adjusted</td>
<td>0.506</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Notes: ***, ** and * denote the significance at 1%, 5% and 10%, respectively. Standard Errors are in parentheses.</td>
<td></td>
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</tbody>
</table>

The negative sign associated with exporting country’s population highlights that higher population would decrease the quantity exported due to considerable amount of domestic consumption. The results further emphasized that the exporting country’s GDP would have a significant impact, though that of importing country was insignificant for tea trade. The positive and significant coefficient of ISO 22000 revealed that complying with the metasystem was seen as an added advantage augmenting the quantity traded.

On the contrary, compliance to MRL indicated having a significant negative effect. It is conventionally expected that a country being
landlocked is a hindrance to trade. The variable DLOCK carrying a negative sign confirmed this effect. This could be owing to high cost of transportation in landlocked countries negatively impacting on tea trade. Surprisingly, sharing a common language and having colonial ties and business linkages did not significantly contribute to tea trade between the major tea trading partners.

The outcome of analysis under the scenario of “relaxed standards” yielded that the sign of GDP, population and distance variables were as expected (Table 1). In this instance, only the importing country’s population and distance variables were seen having a significant impact on trade. Unlike in the first scenario, both ISO 22000 and MRL variables showed significance at $\rho = 0.01$ and 0.05, respectively. The positive coefficient associated with ISO 22000 and the negative coefficient associated with MRL indicates, ceteris paribus, that mandatory ISO 22000 imposed by developed countries result in a threefold increase in tea exported, while enforcement of MRL will decrease quantity by three times as well.

The Dendrogram from Cluster Analysis shows six clusters at 71 percent similarity level (Figure 1). Russian Federation – the largest global tea importer – has been clustered separately at 55 percent similarity level due to exceptional amount of tea quantities imported. The other cluster consists of mostly the developed countries and transition economies due to the similarity in population and GDP, implying that most of these nations trade in similar patterns.

4 Conclusions

The importance of complying with standards is not contestable as its beneficial effects at consumer health, environmental and safety angles have been established beyond doubt, even if such compliance imposes consequent pressures on producers and exporters. However, this study has brought evidence to conclude that such compliance would not always impose such inconveniences by demonstrating that complying with ISO 22000 would even be beneficial for both the producers and exporters. This implies that Sri Lanka being a major tea exporter stands to secure beneficial effects on tea exports to certain countries or regions than others in the long run by complying with the standards stipulated through metasystems such as the ISO 22000. Further, quite contrary to the commonly held belief that food safety standards would hinder global agricultural trade, the study prompted the possibility of trade facilitation (in the case of tea) through the adoption of international food safety standards.

References


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