



# COMMITTEE ON COMMODITY PROBLEMS

## INTERGOVERNMENTAL GROUP ON TEA

### Twenty-second Session

Naivasha, Kenya, 25-27 May 2016

## THE EFFECTS OF MAXIMUM RESIDUE LEVELS IN TEA ON INTERNATIONAL TEA TRADE

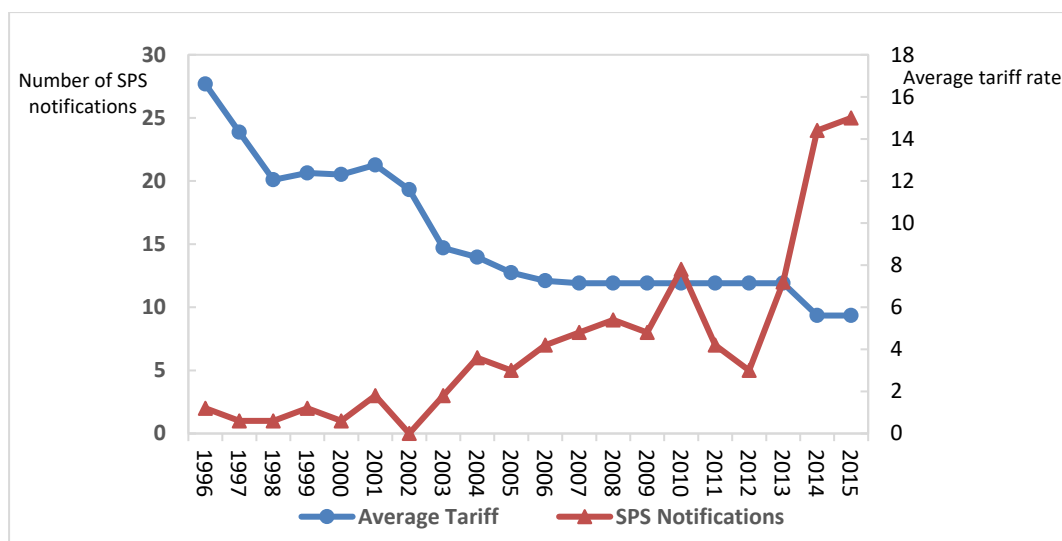
### I. INTRODUCTION

1. At its last Session, the Intergovernmental Group on Tea (IGG/Tea) examined the implications of maximum residue levels (MRLs) on tea trade with the help of document CCP:TE 14/3 that was prepared by the Secretariat. The Group concurred that MRL standards could have a substantial deterring effect on trade flows when exporters are unable to comply with them and/or when MRLs are fixed at various levels at the discretion of tea importing countries. In response to the Group's request for further detailed studies, the Secretariat produced this document (CCP:TE 16/2) examining the impact of MRLs on tea trade, including an empirical comparison between the effects of MRLs standards and import tariff rates on tea trade.

2. Since the 1990s, there has been much concern over the increase in tea food safety standards and their impact on international trade. As Figure 1 shows, while average import tariff rates applied to tea have declined since 1996, the number of sanitary and phytosanitary (SPS) notifications relevant to MRLs in tea has grown significantly. Studies show that MRL measures on tea established by importing countries added to trade costs faced by exporters, and in several instances led to significant declines in trade flows (Sun *et al.* 2007, Gu and Niu 2007 and Wei *et al.* 2012). Other studies highlighted that, in general, food safety standards impacted negatively developing countries' exports of agricultural products to developed countries (Disdier *et al.* 2008).

3. MRLs are applied by all major tea importing developed countries, although a number of tea producing and exporting countries have begun setting their own residue limits on tea (e.g. China, India, Kenya and Sri Lanka). These limits are equivalent to those established by Codex Alimentarius. The Working Group (WG) on MRLs of the IGG/Tea, which includes tea producing and exporting countries, has played a critical role in advancing the world tea economy towards fixing MRLs for tea and reducing cost of compliance, by generating data from trials conducted nationally by their tea research institutes. These MRLs trial data are submitted to the Codex Committee on Pesticide Residues (CCPR) for adoption and chemical registration. There are now 17 pesticides registered by Codex following submission of their MRLs by the WG.

**Figure 1. Average Applied Tariff Rate for selected countries<sup>1/</sup> and Notifications (MRLs) on tea**



1/ Countries included are Canada, China, Egypt, EU, Japan, Morocco, Pakistan, Russian Federation, United States, Saudi Arabia, South Africa.

Source: WITS and WTO

4. This document discusses some of the main issues related to MRLs in tea and their likely impact on trade flows by reviewing available empirical literature and recent trade patterns. The study then uses a gravity model to measure the effect of MRLs on tea exports, taking China as a case study. Using the results from the estimated model, we assess the impact of MRLs on tea trade in terms of import tariff rate equivalent. The next section reviews the literature, while the third and fourth sections present the methodological approach and results, respectively.

## II. LITERATURE REVIEW OF MRLs IN TEA AND THEIR TRADE IMPACT

5. As Figure 1 illustrates, the number of notifications increased significantly between 1996 and 2014, and these were often concerned with fixing MRLs of various pesticides applied in tea production. It seems that the number of regulated pesticides has implications for trade in tea. For example, the number of regulated pesticides in the EU rose from 63 in 1999 to 185 in 2004, which was concomitant with a decline in China's tea exports to the EU during the same period. Tea imports into the EU stabilised afterwards at a lower level, before rising between the period of 2006 and 2008. An increase in the EU regulated pesticides to 227 in 2007 may have contributed to a decline in tea imports into the EU in 2009. However, imports began to rise again from 2010 to reach their highest level in 2015. Similarly, in 2006, Japan introduced new regulations for 273 pesticides under a food safety standards referred to as the "Positive List System". Subsequently, China's exports to Japan fell by 43 percent in 2009, in comparison to 2005, and continued to remain relatively low up to 2015, when they represented 47 percent of their 2006 level. Also, the Republic of Korea introduced new regulations for 22 pesticides in 2006, which was followed by a 73 percent decline in tea volumes shipped from China the following year. Imports fell further between 2008 and 2015, when they were 90 percent, on average, lower than in 2006.

6. As the discussion above demonstrates, a broad survey of MRLs in tea seems to be associated with changes in trade flows, at least in the case of China and a number of its trading partners. A review of the literature showed that studies that looked at the impact of MRLs on tea trade typically applied a gravity model approach to empirically establish the relationship between MRLs and changes in trade patterns. Often the gravity equation accounted for key variables likely to have had an impact on tea

export from one country (often China) to the main destination markets (e.g EU, Japan, etc), over time. Typically, estimation issues that came up with this type of approach were related to endogeneity and high covariance amongst explanatory variables. To address some of these empirical issues, the gravity specification was generally estimated based on a fixed-effects model approach that controlled for fixed factors (e.g. distance between markets, preferences, etc). Variables that were included explicitly in the equation consisted of values for MRLs for specific pesticides, dummy variables to account for the years when MRLs measures on tea were introduced, distance between markets, import tariff rates, and GDP per capita.

7. A gravity model approach was applied by Chen et al. (2008) to look at the impact of MRLs on China's vegetable exports. Results showed that food safety standards applied by destination markets had a negative and statistically significant effect on exports of agricultural products from China. Their findings also demonstrated that food safety standards had a larger effect on trade than import tariffs. Similarly, Wei et al. (2012) found that MRLs significantly reduced tea exports from China, while, using both importer and exporter regulations in the form of similarity index, Drogue and De Maria (2012) found that differences in MRLs regulations deterred fruit trade. Likewise, Xiong and Beghin (2014) used a gravity model approach to investigate the impact of MRLs on import demand of members of the Organization for Economic Cooperation and Development (OECD). They found that MRLs had a negative effect on non-compliant export supplies, but at the same time, stimulated import demand as consumers' perception regarding tea safety issues improved. The study also revealed that the least developed countries (LDCs) were the most affected by MRLs regulations than exporters from the developed countries.

8. Overall, empirical evidence highlighted the negative relationship that prevails between increases in MRL standards and tea trade, at least in the short run. These studies, however, did not address some of the possible long-term implications, such as whether MRLs standards did ultimately enhance tea consumption, which may help offset some of the negative trade effects incurred in the short-term.

### III. METHODOLOGICAL APPROACH

9. In order to explore the effects of MRL standards of pesticides on international tea trade, the present study used a gravity model applied to tea exports from China. We selected China as a follow up to the Group's request for further country case studies on the impact of MRLs on tea trade. China is also the world's leading producer and exporter of tea. The estimated model was also employed to assess the impact of MRL standards converted into import tariff rate equivalent. The gravity model used in the analysis was specified as:

$$\ln(\text{Exp}_{it}) = \alpha_0 + \alpha_1 \ln(\text{GDP}_{it}) + \alpha_2 \ln(\text{Prod}_{t-1}) + \alpha_3 \ln(\text{tar}_{it} + 1) + \alpha_4 \ln(\text{Dist}_i) + \alpha_5 \ln(\text{END}_{it}) + \alpha_6 D_{it} + \varepsilon_{it} \quad (1)$$

where  $i$  refers to the importing country of China's tea and  $t$  stands for year  $t$ . The  $\alpha$  terms are the coefficients to be estimated, while  $\varepsilon_{it}$  is the error term that is assumed to be normally distributed with mean zero. Equation (1) stipulates that export value of tea from China to country  $i$  in year  $t$  is a function of a set of explanatory variables and an idiosyncratic error term that captures all the other variables that do not consistently affect the dependant variable (i.e. tea exports from China). The first explanatory variable,  $\text{GDP}_{it}$ , stands for gross domestic product of country  $i$  in year  $t$ , and it captures the purchasing power of the importing country. The estimated coefficient  $\alpha_1$  is expected to have a positive value, as an increase in the GDP of the importing country should normally have a positive effect on tea exports from China. The next variable,  $\text{Prod}_{t-1}$ , denotes China's production of tea lagged by one year. It is lagged to avoid any potential endogeneity issue that usually arises in these cases, especially when export values for the current period may influence China's production in the current year.

10. The next variable,  $tar_{it}$ , refers to average import tariffs on tea applied by country  $i$  in year  $t$ . We add a value of 1 to the tariff values since equation (1) is specified in double-log form, and some tariff rates applied to tea have a 0 value.  $Dist_i$  stands for distance between China and the importing country  $i$ . Distance between origin and destination is one of the main explanatory variables in gravity models as proposed by Tinbergen (1962). The greater the distance between two trading partners, the less dynamic the trade flows. Hence, the estimated coefficient attached to the variable  $Dist_i$  is expected to be negative.

11. In order to evaluate the effect of MRLs, we used two different explanatory variables. The first one,  $END_{it}$ , estimates the effect of MRL of endosulfane applied by importing country  $i$  in year  $t$ . Endosulfane was chosen because changes in MRLs for that chemical were available for the countries covered by the analysis and over the sample period (1995-2015), and this was not the case for other chemicals. The estimated parameter is anticipated to take a positive value, such that an increase in the limit, for example from 0.01 ppm to 30 ppm, is positively associated with an increase in export of tea from China. The second variable that captures the effect of MRLs, is  $D_{it}$ , which is a dummy that accounts for the introduction of regulations that expand the coverage of regulated pesticides by country  $i$  in year  $t$ , as described in section 2. The variable takes on the value of one the year when the regulations are introduced and afterwards, and zero otherwise. The estimated coefficient on the dummy is expected to be negative, that is an increase in the coverage of regulated pesticides leads to a decline in tea exports from China.

12. Data used for the analysis were drawn from various sources. GDP values were from the World Development Indicators (WDI) of the World Bank. Tea production data were extracted from the IGG/Tea database, while export of China by destination were taken from the Global Trade Information System (GTIS). Tariff rates applied by major importing countries were from the World Integrated Trade Solutions (WITS) of the World Bank. Values for MRLs of endosulfane were drawn from various sources, including the FAO Codex database on pesticides. The coverage of regulated pesticides was based on various policy documents and literature review. Both China's tea export values and GDP values were deflated using the United States consumer price index (CPI). The analysis carried out for this study covered the period between 1995 and 2015 and was limited to the major importers of China's tea that had an established database for MRLs in tea. These included: Canada, the EU, Japan, Korea (Republic of) and the United States.

13. The gravity model as specified in equation 1 was estimated using two estimation methods: ordinary least squares (OLS) and country fixed-effect approach (FE). OLS often gives results that are inconsistent when estimating a gravity model, mainly because of the covariance that often occurs between the error term and the explanatory variables due to omitted variable bias. Country fixed-effect model, however, addresses the issue of omitted variable bias by controlling for country specific variables that do not vary over time such as preferences, geography, and distance (Anderson and van Wincoop, 2003), as these become correlated with the explanatory variables if included in the error term. The estimated coefficients reported in this study are those obtained from the fixed-effect model, as the results were more robust than those obtained using the OLS method.

#### IV. SUMMARY OF MAIN FINDINGS

14. Results of the fixed-effect estimation are reported in table 1. All the coefficients had the expected signs and were generally significant at the 5 percent level, with the exception of the variable  $D2007\_EU$ . For example, the estimated coefficient for GDP, a proxy for per capita income, was statistically significant and positively associated with export demand, and it indicated that a 1 percent increase in real GDP would lead to, on average, an increase of 1.01 percent of China's tea export. Similarly, a 1 percent rise in tea production in China in the previous year, leads to a 0.67 percent increase in tea export from China in the current year. Another variable of interest is the tea import tariff. Results show that a 1 percent hike in the import tariff rates applied by the major tea importing

countries translates into a 0.46 decline in China's tea exports. The minor impact reflects the fact that most of the main importing countries have no, or relatively low, import tariffs on tea.

15. For the purpose of this study, the most relevant results are those obtained for the variables that account for the impact of food safety regulations on tea trade. We first started by looking at the variable  $END_{it}$ , which accounted for the effect of MRLs set for endosulfane. The estimated coefficient based on the FE approach showed that it was positively associated with China's exports of tea at the 5 percent significance level. That is a 1 percent increase in MRL for endosulfane translates into a 0.02 percent increase in export of tea. For example, if limits on endosulfane were relaxed and set at 30 ppm instead of 20 ppm, which corresponds to a 50 percent rise, then tea export values from China would go up by 1 percent. This supports one of the hypotheses of the study that changes in MRL on endosulfane have an effect on tea trade. Note that this estimate applies only to endosulfane. Generally, MRLs in tea apply to other chemicals as well, and their effect is cumulative. Wei *et al.* 2012 found that a 1 percent decrease in default value in MRLs of fenvalerate is likely to lead to a 0.18 percent decline in China's tea export value. Therefore, if MRLs of endosulfane and fenvalerate were to become more stringent changing from 30 ppm to 0.01 ppm, for example, then China's tea export value would decline by 20 percent (i.e.  $(0.02+0.18)*(-99.96)$ ).

16. Likewise, the estimated coefficients that account for the introduction of regulations that expand the coverage of regulated pesticides by importing countries are all statistically significant and negatively associated with China's tea export. For example, the introduction of MRLs on a number of pesticides in 2001 and 2003 by the EU had a negative effect on the dependent variable. On the contrary, the expansion of regulated pesticides in 2007 by the EU did not have a significant effect on China's tea export, probably because most of the relevant pesticides were already covered by the regulated lists in 2001 and 2003. Also, the estimated coefficient to account for an expansion on the coverage of regulated pesticides introduced by Japan in 2006 was negatively associated with China's tea exports and statistically significant at the 5 percent level.

17. On the basis of the regression results, we measured the import tariff equivalent of a change in food safety standards. The import tariff equivalent tells us by how much import tariffs on tea would have to increase to yield the same effect of tighter MRLs on endosulfane. For the purpose of illustration, we took the change in MRL of endosulfane in tea introduced by the EU, when limits changed from 30 ppm in 2004 to 0.01 ppm in 2005, corresponding to a 99.96 percent decline. Given the estimated elasticity of export with respect to endosulfane of 0.02, the percentage change in China's tea export equivalent to a 99.96 percent decline in MRL of endosulfane is equal to -1.99 percent. Given the estimated elasticity of export with respect to tariff of 0.46, as reported in table 1, the change from 30 ppm to 0.01 ppm, was equivalent to a 4.32 percentage point increase in import tariff (i.e.  $-1.99/-0.46$ ). In other words, the effect of tighter MRLs on endosulfane, from 30 ppm to 0.01 ppm, was equivalent to a 4.32 percentage point increase in import tariff rate applied to China's export of tea by the EU. The corresponding effect on trade was a decline by about 2 percentage point of tea export value for China.

**Table 1. Estimated results for the gravity model**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(GDP)	1.012881	0.144351	7.016815	0
LOG(QP(-1))	0.672366	0.071504	9.403265	0
D2001_EU	-0.555289	0.131109	-4.235309	0.0001
D2003_EU	-0.439346	0.140421	-3.128768	0.0024
D2007_EU	-0.035615	0.065191	-0.546317	0.5862
D2006_JPN	-0.667629	0.125166	-5.333938	0
LOG(TARIFF+1)	-0.459657	0.22648	-2.029571	0.0455
LOG(ENDO)	0.021035	0.00848	2.480635	0.015
C	-16.38823	3.951989	-4.146832	0.0001
Effects Specification				
Cross-section fixed (dummy variables)				
Adjusted R-squared	0.988115			
F-statistic	686.9151			
Prob(F-statistic)	0			

Source: Secretariat of the FAO IGG on Tea.

18. The analysis on endosulfane also revealed that if the EU and Japan were to fix MRLs for endosulfane at the Codex level, which would correspond to moving from a limit of 30 ppm to the Codex fixed limit of 10 ppm, tea export from China would fall by an estimated 1.33 percentage point.

19. Results of the estimated gravity model also showed that the introduction of policies that expand the coverage of regulated pesticides by country  $i$  in year  $t$ , captured through the dummy variable  $D_{it}$ , as described in section 3, had a negative impact on China's tea exports. For example, the introduction by the EU of new regulations expanding the coverage of regulated pesticides in 2001 and 2003 had a statistically significant negative effect on China's tea export value. Similarly, the estimated coefficient on the dummy corresponding to the coverage of regulated pesticide introduced by Japan in 2006 had a negative and statistically significant effect on tea exports from China.

## V. CONCLUSIONS

20. Non-tariff barriers (NTBs), including MRLs measures represents a major source of dispute amongst trading partners. The international tea market is no exception, as the debate on MRLs in tea has shown over the years. To supplement the work of the IGG on Tea and its Working Group on MRLs, this study looked at some empirical evidence linking MRLs in tea and changes in export of tea from China. Using a gravity model that controlled for time invariant factors, the estimated fixed-effect model showed that MRLs of endosulfane in tea and the expansion in the coverage of regulated pesticides had a negative and statistically significant effect on China's tea exports. The analysis also showed that tighter regulations introduced by the EU in 2001 with respect to MRLs for endosulfane, changing from 30 ppm to 0.01 ppm, was equivalent to a 4.32 percentage point increase in import tariff rate applied to China's tea export. This estimate applies to endosulfane only, so the import tariff equivalent value can be higher if the impact of other chemicals were to be taken into account. Similarly, the introduction by Japan in 2006 of tighter food safety standards as reflected in the "positive list system" had a negative and statistically significant impact on China's tea sales to Japan. Hence, the empirical results obtained in this study confirmed the hypothesis that changes in food safety measures do have an effect on tea trade.

21. The fact that the estimated coefficient measuring the impact of MRLs for endosulfane on tea trade was relatively low was most likely a reflection of better compliance over the recent years by producing countries, in general, and China in particular. Trade data showed that tea quantities exported to the EU markets by China went up progressively generally after 2005. Better awareness of

food safety standards by stakeholders and improved international cooperation, through the IGG/Tea and its Working Group on MRLs, were key to developing a common strategy on MRLs that would minimise trade costs and ensure consumer safety. Efforts should continue to focus on reducing large gaps in MRL values that prevail amongst tea trading partners, as well as enabling smallholder tea producers to comply with established food safety standards. Finally, countries are encouraged to provide the IGG/Tea Secretariat with data on changes in the values of MRLs over time for endosulfane and other chemicals to better measure the overall effect of MRLs on tea trade. Also, member countries are requested to assist the Secretariat collect data on cost of compliance (production and export plus other costs to meet MRLs) to be able to assess the impact of MRLs on competitiveness.

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