Trade Effects of SPS Measures in Regional Trade Agreements

Fabio Santeramo

International Agricultural Trade Research Consortium

Commissioned Paper No. 24

Trade Effects of SPS Measures in Regional Trade Agreements

This Commissioned Paper was authored by an individual working in the area of trade economics who responded to a call for Commissioned Papers from the Executive Committee of the IATRC. The author is:

Fabio Gaetano Santeramo
University of Foggia, Italy

The views expressed should not be taken to represent those of the institutions to which the authors are attached, nor to the IATRC and its funding agencies. Correspondence regarding the content of the paper should be directed to the author.

Trade *Effects of SPS Measures in Regional Trade Agreements*
St. Paul, Minnesota: University of Minnesota, Department of Applied Economics, International
Agricultural Trade Research Consortium

Executive summary

Trade negotiations in the agri-food sector have resulted in an exponential increase of sanitary and phytosanitary (SPS) measures and a growing diffusion of regional trade agreements (RTAs). The combined trade effects of SPS measures and RTAs are difficult to ascertain: SPS measures may be either catalysts for or barriers to trade; RTAs also have a dual effect on trade, sometime favouring intra-bloc trade (i.e. among the signatories of the RTA), other times enhancing extra-bloc trade (i.e. among signatories and non-signatories of the RTA). Moreover, RTAs increasingly contain specific SPS commitments whose trade effects may vary according to the depth of the provisions. The joint effect of SPS measures and RTAs on trade is therefore an open empirical question.

After assessing the general effects of SPS measures on agri-food trade, this study examines potential differences in SPS-specific effects between nonsignatories and signatories of RTAs. The study also explores whether the trade effects of SPS measures change when trading partners establish an RTA. Lastly, the study evaluates the extent to which RTAs go beyond WTO trade liberalization requirements.

The results reveal that benefits to signatories of RTAs tend to be reduced by SPS measures that affect indiscriminately all trading partners and are not tailor made for a specific trade relationship.

Overall, both SPS measures and RTAs are catalysts for trade. More importantly, if trading partners implement both types of policy interventions in a staggered fashion, the effects of one policy reinforces the impact of the other. RTAs potentially offer more versatile frameworks for negotiating SPS commitments that facilitate trade, creating conditions for signatory countries to satisfy each other's requirements on adequate levels of safety, thus boosting trade.

To conclude, SPS measures and RTAs tend to facilitate market access, the former by setting standards to ensure an adequate level of safety, the latter by setting a more versatile framework for negotiations related to SPS measures. Although the trade potential offered to RTA signatories seems obstructed by nondiscriminatory (multilateral) SPS measures, the entry into force of a trade agreement can help signatories meet stringent standards, further facilitating market access. This is allowed, in particular, by the provision of concrete commitments with respect to SPS measures within RTAs, the most promising of which are mutual recognition of standards and the institution of joint SPS committees to implement technical cooperation between signatories on SPS issues. Moving towards these solutions would stimulate trade among countries.

Table of contents

List of figures

List of tables

Acronyms

ARG	Argentina
ASEAN	Association of Southeast Asian Nations
AUS	Australia
BEC	Broad Economic Categories
BOL	Bolivia
BRA	Brazil
BRN	Brunei
CAFTA	Central America Free Trade Agreement
CAN	Canada
CHE	Switzerland
CHL	Chile
CHN	China
COL	Colombia
CRI	Costa Rica
ECU	Ecuador
EFTA	European Free Trade Association
EGY	Egypt
EUN	European Union
FAO	Food and Agriculture Organisation
GTM	Guatemala
HKG	Hong Kong
HND	Honduras
HS	Harmonised System
IPPC	International Plant Protection Convention
ISL	Iceland
ISR	Israel
JPN	Japan
KEN	Kenya
KOR	Korea
MAR	Morocco
MEX	Mexico
NAFTA	North American Free Trade Agreement
NIC	Nicaragua
NOR	Norway
NTM	Non-Tariff Measure
NZL	New Zealand
OECD	Organisation for Economic Co-operation and Development
OIE	Office of Epizootics
OLS	Ordinary Least Squares
PER	Peru
PRY	Paraguay
RTA	Regional Trade Agreement
SGP	Singapore
SLV	El Salvador
SPS	Sanitary and Phytosanitary
TBT	Technical Barrier to Trade
THA	Thailand
TUR	Turkey
TZN	Tanzania
UGA	Uganda
UNCTAD	United Nations Conference on Trade and Development
URY	Uruguay
USA	United States
VEN	Venezuela
WTO	World Trade Organisation
ZAF	South Africa

1. Introduction

The agenda of trade negotiation is characterised by an exponential increase of technical measures at the border and a growing diffusion of Regional Trade Agreements (RTAs). The trade effects of sanitary and phytosanitary (SPS) measures and RTAs are controversial. While SPS measures may serve as trade catalysts by ensuring an adequate level of safety in importing markets, these measures may also act as trade barriers due to high compliance costs. By instituting more favourable market-access conditions, RTAs may increase trade among signatories (trade creation), but they may also distort resource allocation and divert trade from nonsignatory countries (trade diversion). The joint effect of SPS measures and RTAs on trade is also puzzling: some RTAs include specific SPS commitments whose trade effects may vary according to the depth of the provisions and the presence of SPS measures.

Focusing on the agri-food sector, I investigate how market access is influenced by SPS measures and RTAs. I address three questions:
- What are the overall effects of SPS measures on trade, and what are the main differences between the experiences of nonsignatories and signatories of RTAs?
- Are these differences attributable to the entry into force of RTAs between trading partners?
- To what extent do RTAs go beyond WTO requirements in terms of trade liberalisation?

Most countries have improved their market access through trade agreements. In fact, while multilateral negotiations have stalled, several collective trade agreements have entered into force. Trade agreements may facilitate market access by lowering tariffs and providing other market access concessions (OECD, 2015). For instance, Koo et al. (2006) find that agricultural trade between signatories of RTAs increases by 95%. Baier and Bergstrand (2007) show that trade flows tend to be twice as large between such signatories. Similar results are found by Grant and Lambert (2008), who report a 149% increase in agricultural trade between signatories of RTAs. The trade-creating benefits of regionalism are also highlighted by Lambert and McKoy (2009), who assess trade increases in the agricultural sector (+153%) and the food sector (+101%). Case studies document that trade agreements favor the creation of intra-bloc trade: this is the case of intra-EU trade in agri-food products (Sarker and Jayasinghe, 2007), the North American Free Trade Agreement (NAFTA) (Jayasinghe and Sarker, 2008), and other major trade agreements (i.e. ASEAN-China preferential trade agreement, EU-15, EU-25, and Southern African Development Community agreements) (Sun and Reed, 2010).

However, RTAs are not universally trade creating: some RTAs provide limited benefits in terms of trade and, more importantly, the benefits usually depend on the scope and depth of the economic integration resulting from the agreement (Grant, 2013). Trade flows may be promoted or limited to the extent to which RTAs are able to improve transparency, harmonization and equivalence of regulatory frameworks (OECD, 2011). Little attention has been paid to the linkages between SPS measures and RTAs. As suggested in a meta-analysis on the trade effects of nontariff measures (NTMs), it is not always true that SPS measures limit trade: the effects are highly dependent on the products and countries involved due to differences in food safety regulations and standards (Santeramo and Lamonaca, 2019).

Among the few studies on the interaction between technical measures and RTAs, Cadot and Gourdon (2016) explore how RTAs affect the impact of NTMs on prices, concluding that countries can expect to gain from transparency provisions in RTAs. The focus of their article is NTMs in general, and no evidence is provided on the effects of NTMs in terms of trade. Disdier et al. (2015) analyze trade effects of provisions for technical regulations within economic integration

agreements involving partners with different levels of economic development. Their results reveal that the harmonization of regional standards negatively affects exports of developing countries to developed countries. However, the study focuses on technical barriers to trade (TBTs) and not SPS measures. A study by the OECD (2011) examines chapters on SPS measures and finds that only a few of these chapters contain specific commitments that go beyond the core principles set in the WTO Agreement on the Application of SPS Measures (WTO SPS Agreement, for short). The study provides an interesting qualitative synthesis of SPS-specific provisions in RTAs, but achievements in terms of trade are not detected. Assessing the combined effect of SPS measures and trade agreements with related SPS-specific provisions remains an open empirical question.

The contribution of this IATRC commissioned paper is at least three-fold. First, the paper evaluates the overall effects of SPS measures on trade and how those effects may differ for nonsignatories and signatories of RTAs. SPS measures have the potential to change traded quantities and/or prices, thus affecting trade levels (UNCTAD, 2012). Trade agreements, tending to have a dual trade response (intra-bloc creation and extra-bloc diversion), may foster or minimise the effects of SPS measures on trade.

Second, the paper examines the extent to which the trade effects of SPS measures might change after an RTA enters into force between trading partners sharing SPS measures. The WTO SPS Agreement recalls that SPS measures are often applied on the basis of country-specific agreements: although this allowance may increase the number of SPS measures and related requirements (Cadot and Gourdon, 2016), it may alter the effects of these measures and facilitate trade.

Third, the paper provides empirical evidence on the role of SPS-specific commitments contained within RTAs. SPS-specific commitments negotiated in a more versatile framework, such as an RTA, may create conditions for signatory countries that facilitate the application of requirements and thus the achievement of adequate levels of safety, contributing to shape trade (Lejarraga and Shepherd, 2013).

The study is organised as follows. Section 2 presents an overview of the policy interventions analysed, focusing on trends and the evolution of RTAs and SPS measures. This section also includes a detailed description of the provisions of the WTO SPS Agreement and SPS-related basic principles (i.e. harmonisation, equivalence, assessment of risk, regionalisation, transparency). Section 3 describes the theoretical framework used to evaluate the impact of policy interventions, the roll-out of a policy, and its implementation in gravity-based empirical models. Section 4 describes in detail the data used to develop the empirical analysis and the main characteristics of the sample in terms of level of imports, incidence of RTAs and SPS measures, and specific SPS provisions in selected RTAs. The econometric results are reported in section 5 and organised in two subsections: a comparison of results for nonsignatories and signatories of RTAs that highlights the effects of SPS measures after the entry into force of RTAs; and an analysis of the effects of deeper commitments on SPS measures provided in RTAs. The last section concludes with policy reflections.

2. Context analysis

2.1. An overview of RTAs

While multilateral agricultural trade negotiations have stalled during the last decades, numerous RTAs have entered into force (fig. 1). Since 2000, the number of new RTAs notified to the WTO has increased significantly. In 2017, there were 301 such agreements in total, compared with less than 100 in 2000 and just 23 in 1990.

Figure 1. RTAs on goods by year of entry into force, 1997-2017.
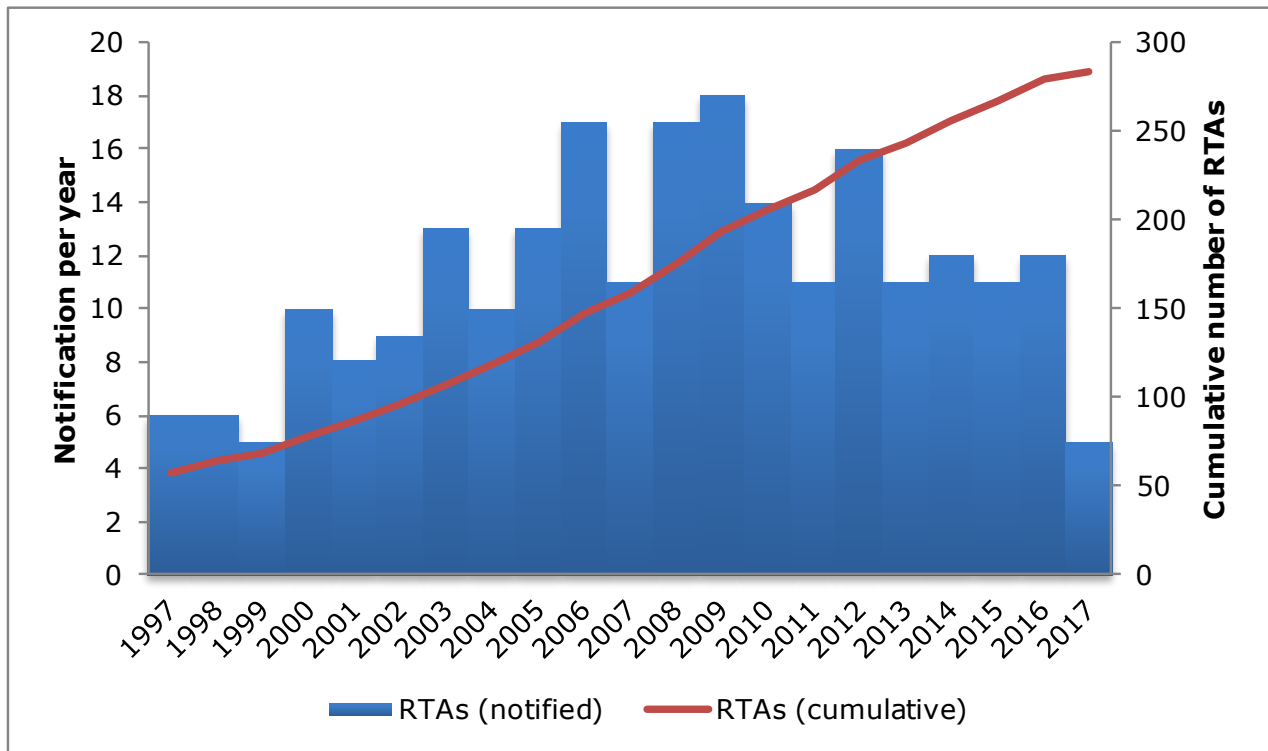
Source: Elaboration on data from RTA-IS.

Over the years, RTAs have increased in number, depth, and complexity. While older RTAs cover tariff liberalization and related rules, more complex (and recent) RTAs develop more integrated unions, harmonising domestic and nontariff policies (Grant, 2013). Many countries participate in multiple RTAs, with a consequent overlap across trade agreements of market access rules and regulatory frameworks that may potentially have detrimental effects on trade (OECD, 2011).

Most of the RTAs currently in force are bilateral, half of which have come into being since 2000. According to the WTO, there is a growing tendency to create new plurilateral agreements: by developing common rules for all signatories, these agreements have the potential to overcome the fragmentation created by bilateral agreements. The term 'regional' does not necessarily refer to agreements concluded among neighbouring countries (i.e. belonging to the same region). Indeed, several RTAs are cross-continental (OECD, 2011).

Despite these many complexities: RTAs have a simple aim: to favor trade between signatories, rather than to raise trade barriers against third parties. RTAs are discriminatory as only their signatories enjoy more favorable market-access conditions than nonsignatories. Accordingly, the effects of RTAs on trade liberalization may be diverse: RTAs are designed to benefit signatory

countries; however, expected benefits may be undercut without minimising potential trade diversion.

2.2. An overview of SPS measures

While tariffs have been lowered to an average below 5%, several border measures, such as SPS measures, for several agri-food categories have remained high and, indeed, have increased over time (Disdier et al., 2015). As NTMs, SPS measures are policy instruments that can potentially affect international trade in goods by changing quantities traded, prices, or both (UNCTAD, 2012). According to the definition proposed in the WTO SPS Agreement (Annex A), SPS measures are applied:

- to protect animal or plant life or health from risks arising from the entry, establishment or spread of pests, diseases, disease-carrying organisms or disease-causing organisms;
- to protect human or animal life or health from risks arising from additives, contaminants, toxins or disease-causing organisms in foods, beverages or feedstuffs;
- to protect human life or health from risks arising from diseases carried by animals, plants or products thereof, or from the entry, establishment or spread of pests;
- to prevent or limit other damage from the entry, establishment or spread of pests.

The sensitive nature of the issues covered explains the pervasiveness of SPS measures in the agri-food sector. Figure 2 shows greater incidence of SPS measures for the agri-food sector as compared to other sectors (left panel) and the number of SPS measures implemented in each product category (right panel). The two most affected categories are fish and meat, with 491,379 and 279,979 SPS measures, respectively, in place in 2017. In third and fourth place are fruit (198,597) and vegetables (189,804). SPS measures tend to be applied to fresh products. The greater perishability of these products implies higher risks of disseminating disease or pests (Santeramo, 2019).

Figure 2. Incidence of SPS measures in 2017.
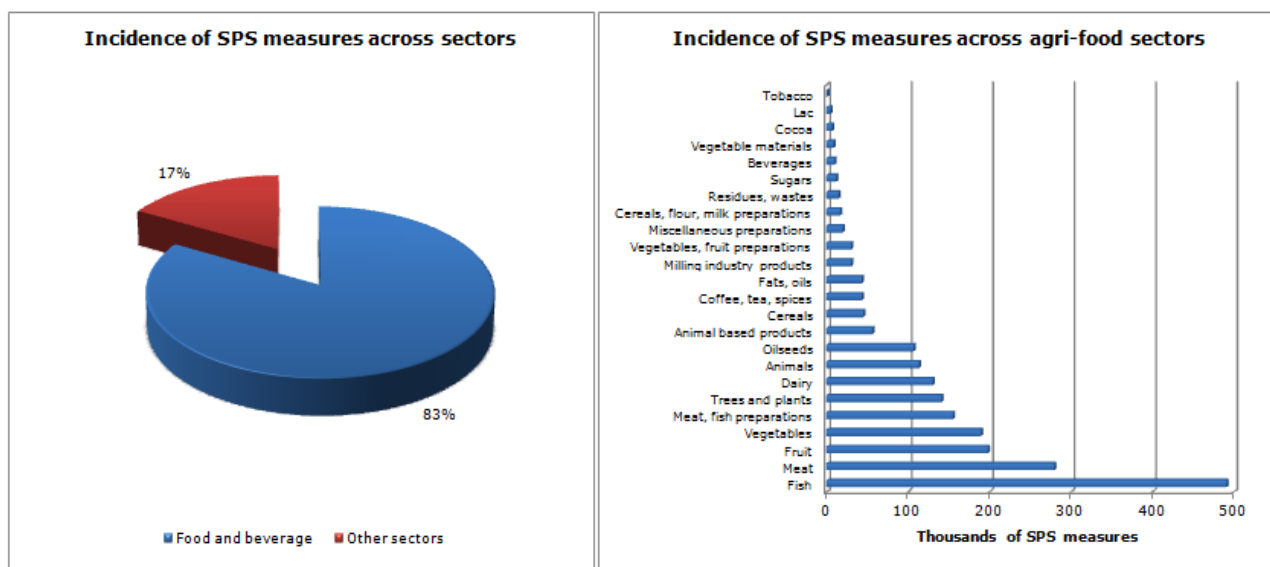
Source: Elaboration on data from UNCTAD database on nontariff measures.

SPS measures are developed and implemented by the regulatory institutions of a country and need to be consistent with international standards, guidelines and recommendations developed under the auspices of the Codex Alimentarius Commission (for food safety), the International Office of Epizootics (OIE) (for animal health and zoonoses), and the Secretariat of the International Plant Protection Convention (IPPC) in cooperation with regional organizations operating within the framework of the IPPC for plant health.

Inspection organizations have the responsibility to determine the compliance of consignments with SPS-specific requirements. The result of inspections may be the acceptance, detention, or rejection of consignments, as well as the decision to require further analysis (FAO, 2005). For instance, National Plant Protection Organizations are responsible for "the inspection of consignments of plants and plant products moving in international traffic and, where appropriate, the inspection of other regulated articles, particularly with the object of preventing the introduction and/or spread of pests" (Article IV.2c of the IPPC, 1997).

According to guidelines from FAO (2001) for the notification of noncompliance and emergency action, exporters should investigate (and report to importers, if required) relevant instances of noncompliance to identify potential causes and to avoid recurrence. Similarly, importers should promptly assess new or unexpected phytosanitary situations and implement emergency actions: the persistence of emergency actions implies the adjustment of SPS measures and the transmission of this information to exporters.

At regional level, there are programs to facilitate the harmonization of standards: an example is the Asia and Pacific Plant Protection Commission, which develops regional standards for SPS measures as part of the plant protection program of the Commission's contracting parties (FAO, 2004).

2.2.1. The WTO Agreement on the Application of SPS measures

All SPS measures shall be developed and applied in accordance with the provisions of the WTO SPS Agreement (art. 1) which establishes that WTO Members have the right to take SPS measures necessary to protect human, animal or plant life or health, ensuring that any SPS measure (i) is applied only to the extent that is necessary to protect human, animal or plant life or health, (ii) is based on scientific principles and is not maintained without sufficient scientific evidence, (iii) does not arbitrarily or unjustifiably discriminate between WTO Members, and (iv) is not applied in a manner which would constitute a disguised restriction on international trade (art. 2).

In order to adjust to, and comply with, SPS measures necessary to achieve an appropriate level of protection, WTO Members should provide technical assistance to other WTO Members (art. 9). Such assistance, provided either bilaterally or through appropriate international organisations, may be in the areas of processing technologies, research, and infrastructure and may take the form of advice, credits, donations, and grants. In addition, special and differential treatments may be provided to developing country WTO Members (art. 10). Upon request, developing country WTO Members may be granted longer time frames for compliance to maintain opportunities for their exports (if allowed by an appropriate level of SPS protection) or time-limited exceptions in whole or in part from obligations under the WTO SPS Agreement. Overall, WTO Members are expected to encourage and facilitate active participation by developing-country WTO Members in relevant international organizations.

According to the WTO SPS Agreement, the development and application of SPS measures should follow five basic principles: harmonization (art. 3), equivalence (art. 4), assessment of risk (art. 5), regionalization (art. 6), and transparency (art. 7, annex B).

2.2.1.1. *SPS basic principles: harmonization*

The harmonization principle regards the establishment, recognition, and application of common SPS measures by different WTO Members. In order to achieve a wider harmonisation of SPS measures, WTO Members shall base their SPS measures on international standards, guidelines, or recommendations (provided by Codex Alimentarius Commission, OIE, IPPC, etc.). If there is a scientific justification, WTO Members may introduce or maintain SPS measures which result in a level of SPS protection higher than the level achieved by measures based on international standards, guidelines, or recommendations.

Harmonizing imported and domestically produced products makes them more homogeneous and better substitutes—potentially increasing competition, reducing prices, and increasing trade. However, as Cadot and Gourdon (2016) emphasize, additional costs to comply with a specific standard—even a harmonised one—may constitute a barrier to trade and should not be neglected.

2.2.1.2. *SPS basic principles: equivalence*

According to the equivalence principle, WTO Members shall accept SPS measures of their trading partners as equivalent, even if these measures differ from their own or from those used by other WTO Members trading the same product. The equivalence principle establishes that the exporting WTO Member objectively demonstrates to the importing WTO Member that its measures achieve the appropriate level of SPS protection of the importing WTO Member. An appropriate level of SPS protection, often referred to as acceptable level of risk, is the level of protection deemed appropriate by the WTO Member establishing a SPS measure to protect human, animal or plant life or health within its territory. However, upon request, the importing WTO Member shall have access to inspection, testing, and other relevant procedures.

2.2.1.3. *SPS basic principles: assessment of risk*

The principle of assessment of risk establishes that any SPS measure implemented by WTO Members shall be based on an assessment of risks to human, animal or plant life or health, taking into account risk assessment techniques developed by relevant international organizations (i.e., Codex Alimentarius Commission, OIE, and IPPC). The assessment of risk consists of the evaluation of:

(i) the likelihood of entry, establishment, or spread of a pest or disease within the territory of an importing WTO Member: the evaluation refers to SPS measures which might be applied, and is related to potential biological and economic consequences; and

(ii) the potential for adverse effects on human or animal health arising from the presence of additives, contaminants, toxins, or disease-causing organisms in food, beverages, or feedstuffs.

In the assessment of risks, WTO Members shall take into account:

- available scientific evidence;
- relevant processes and production methods;

- relevant inspection, sampling and testing methods;
- prevalence of specific diseases or pests;
- existence of pest- or disease-free areas;
- relevant ecological and environmental conditions; and
- quarantine or other treatment.

The identification of the appropriate level of SPS protection (i.e. the acceptable level of risk) should minimise negative trade effects, net of other economic factors (e.g. loss of production/sales in the event of the entry, establishment/spread of a pest/disease), costs of control or eradication, and the cost-effectiveness of alternative approaches to limiting risks. No arbitrary or unjustifiable distinctions should be applied in the identification of the appropriate level of SPS protection to avoid discrimination or restrictions in international trade. In fact, when establishing or maintaining SPS measures to achieve the appropriate level of SPS protection, WTO Members shall ensure that such measures are not more trade-restrictive than what is sufficient to achieve the appropriate level of SPS protection.

In cases of insufficient scientific evidence, WTO Members may provisionally adopt SPS measures on the basis of the available information, seeking additional information as necessary and reviewing the SPS measure accordingly, within a reasonable period of time.

2.2.1.4.   SPS basic principles: regionalization

According to the regionalization principle, WTO Members shall ensure that their SPS measures are adapted to the SPS characteristics of the area from which the product originated and to which the product is destined. For the assessment of the SPS characteristics of a region, pest or disease-free areas and areas of low pest or disease prevalence[1] shall be determined based on such factors as geography, ecosystems, epidemiological surveillance, and effectiveness of SPS controls. Exporting WTO Members claiming that areas within their territories are pest- or disease-free or are of low prevalence of a particular pest or disease should provide objective evidence of these aspects. Importing WTO Members may carry out inspection, testing, and other relevant procedures.

2.2.1.5.   SPS basic principles: transparency

In order to ensure transparency, each SPS measure shall be published promptly and made known to interested WTO Members. Except for urgent circumstances, there should be a reasonable time between the publication of a SPS measure and its entry into force. This time difference would allow producers in exporting WTO Members to adapt their products and methods of production to the requirements of the importing WTO Member.

Each WTO Member shall ensure an enquiry point responsible for the provision of answers or documents related to: (i) SPS measures adopted or proposed; (ii) control and inspection procedures, production and quarantine treatment, pesticide tolerance, and food additive approval procedures; (iii) risk assessment procedures and appropriate level of SPS protection.

---

[1] A pest- or disease-free area is an area—whether all of a country, part of a country, or all or parts of several countries, as identified by the competent authorities—in which a specific pest or disease does not occur. The area may surround, be surrounded by, or be adjacent to an area—whether within part of a country or in a geographic region which includes parts of or all of several countries—in which a specific pest or disease is known to occur but is subject to regional control measures. Examples of such regional control measures are the establishment of protection, surveillance, and buffer zones which will confine or eradicate the pest or disease in question. An area of low pest or disease prevalence is an area—whether all of a country, part of a country, or all or parts of several countries—as identified by the competent authorities, in which a specific pest or disease occurs at low levels and which is subject to effective surveillance, control or eradication measures.

Notification of standards and the setting up of enquiry points for standards may facilitate trade by reducing the search costs required for acquiring information about the standards adopted in another country: different national standards may not be detrimental to trade if they provide easy access to information about the preferences of a country (Cadot and Gourdon, 2016).

2.2.1.6. Committee on SPS measures

A Committee on SPS measures is established to provide a regular forum for consultations (art. 12). The Committee reaches its decisions by consensus and carries out the functions necessary to implement the provisions of the WTO SPS Agreement. The Committee also facilitates *ad hoc* consultations or negotiations among WTO Members on specific SPS issues and encourages the use of international standards, guidelines, or recommendations by sponsoring technical consultation.

2.3. SPS measures in the context of RTAs

As suggested in the WTO SPS Agreement, SPS measures are often applied on the basis of bilateral agreements or protocols. This is particularly true in cases in which countries sharing SPS measures are signatories of RTAs. Indeed, RTAs may contain provisions on SPS measures. Such provisions may be related to general cooperation on SPS issues (e.g. inspection, quarantine, capacity building for implementation of SPS measures) or the respect of regulations on SPS measures established in the signatory counties.

In most cases, RTAs specifically reaffirm or incorporate rights and/or obligations established under the WTO SPS Agreement. This occurs for RTAs either by having a general reference to the WTO (i.e., the RTA has no specific paragraphs or chapters dealing with SPS measures) or by reproducing a substantive part of the text of the WTO SPS Agreement (i.e., the RTA has a short chapter dealing with SPS, limited to a few paragraphs). In some cases, RTAs encourage their signatories to coordinate SPS measures through a variety of approaches that include basic SPS principles and mutual recognition (Cadot and Gourdon, 2016). Some examples of these types of RTAs are provided in appendix A.1.

3. Methodological framework

3.1. Impact evaluation of policies

The present analysis considers several different policy interventions: (i) the implementation of SPS measures, (ii) the entry into force of an RTA, and (iii) the provision of SPS-specific commitments in RTAs.

Implementation of SPS measures, as NTMs, may have an economic effect on international trade in goods, changing quantities traded, or prices, or both (UNCTAD, 2012).

RTAs are thought to promote economic integration between their members. According to the WTO, the main scope of RTAs is to facilitate trade between signatories of the agreements, as long as the RTAs do not raise barriers to non signatories.

Agreements between trading partners may also include specific requirements that SPS measures between members of a certain RTA go beyond the basic principles established in the WTO SPS Agreement. Additional requirements on SPS measures have the potential to affect trade flows between members of the agreements.

As suggested by de Janvry and Sadoulet (2015), one method to evaluate the impact of a policy and to quantify the magnitude of changes in outcomes is the roll-out of the policy. The approach is a generalisation of the difference-in-differences method, applied to cases in which a policy is implemented on a staggered fashion and the units of observation are affected by the policy at different points in the time. The rationale is that the units that have not yet implemented the policy at time *t* may serve as the control group for the units that have already done so. By observing all units over a long period (before and after the implementation of the policy for a specific unit), one can estimate the impact of becoming beneficiary.

In a panel regression framework, the empirical specification is as follows:

$$Y_{it} = \mu_i + \gamma_t + \delta T_{it} + u_{it}$$

(1)

where, for each unit of observation *i* at time *t*, the level of the outcome (Y_{it}) is a function of the policy (T_{it}), net of fixed effects for each unit *i* (μ_i) and for each period *t* (γ_t); u_{it} is the error term.

The use of fixed effects accounts for cross-sectional differences in the level of the outcomes (μ_i) and for time trends (γ_t). The policy variable T_{it} equals 1 after the unit has implemented the policy and 0 before.

Including this framework within a structural gravity model, we can observe how policy interventions—such as the implementation of SPS measures (T_{it}^1), the entry into force of a RTA between trading partners (T_{it}^2), and the provision of SPS-specific commitments in RTAs (T_{it}^3) — affect the level of imports (Y_{it}) between country-pairs (the unit of observation *i*).

3.2. Structural gravity models

3.2.1. Estimating the effects of SPS measures and RTAs

The first part of the study aims at evaluating the impact of the implementation of SPS measures (policy intervention 1) and the entry into force of a RTA between trading partners (policy intervention 2) in terms of trade levels (outcome of the policies). The scope of the analysis is to

examine the overall effect of a staggered introduction of SPS measures on trade, how the trade effects differ for nonsignatories and signatories of RTAs, and how these effects change after an RTA between trading partners sharing SPS measures enters into force.

Equation (1) estimated as a structural gravity model:

$$\overbrace{\ln(X_{ijt})}^{Y_{it}} = \alpha + \overbrace{\widetilde{\boldsymbol{\beta}_{ij}}}^{\mu_i} + \overbrace{\boldsymbol{\beta}_{it} + \boldsymbol{\beta}_{jt}}^{\gamma_t} + \overbrace{\boldsymbol{\gamma}'\boldsymbol{SPS}_{ijt}}^{T_{it}^1} + \varepsilon_{ijt} \tag{2}$$

The (log) value of imports of the *i*-th importer from the *j*-th exporter at time t ($\ln(X_{ijt})$) is the outcome variable (Y_{it}). $\boldsymbol{\beta}_{ij}$ is a vector of time-invariant country-pair fixed effects (i.e. fixed effects for each unit of observation, μ_i) and allows for the removal of the correlation between observed determinants of trade (i.e. SPS measures) and other unobserved, pair-specific determinants of trade (Mayer et al. 2019). $\boldsymbol{\beta}_{it}$ and $\boldsymbol{\beta}_{jt}$ are vectors of time-varying importer and exporter fixed effects and proxy time trends in origin and destination countries (γ_t): they remove both cross-section and time series correlation (Baldwin and Taglioni 2006). $\boldsymbol{SPS}_{ijt}$ is a vector of SPS-specific variables (i.e. total, bilateral, and multilateral SPS measures) which are the policy interventions of our interest (T_{it}^1). $\boldsymbol{\gamma}'$ is the vector of parameters of interest, α is a constant, and ε_{ij} is an error term assumed to be independently and identically distributed (i.i.d.).

The model is estimated using Ordinary Least Squares (OLS):

(i)   on the entire sample to evaluate the effects of a staggered introduction of SPS measures;
(ii)   on subsamples (i.e. nonsignatories and signatories of RTAs, regardless of the year of entry into force of the agreements) to assess if and how trade effects differ between countries that tend to be signatories (or nonsignatories) of RTAs.

In order to evaluate the impact of different policy interventions (i.e. the implementation of SPS measures and the entry into force of a RTA between trading partners), imports ($\ln(X_{ij})$) are regressed on SPS- and RTA-specific variables and on interaction terms for the two policy interventions. The specification is as follows:

$$\overbrace{\ln(X_{ijt})}^{Y_{it}} = \alpha + \overbrace{\widetilde{\boldsymbol{\beta}_{ij}}}^{\mu_i} + \overbrace{\boldsymbol{\beta}_{it} + \boldsymbol{\beta}_{jt}}^{\gamma_t} + \overbrace{\boldsymbol{\gamma}'\boldsymbol{SPS}_{ijt}}^{T_{it}^1} + \overbrace{\boldsymbol{\delta}'\boldsymbol{RTA}_{ijt}}^{T_{it}^2} + \overbrace{\boldsymbol{\zeta}'(\boldsymbol{SPS}*\boldsymbol{RTA})_{ijt}}^{T_{it}^1*T_{it}^2} + \varepsilon_{ijt} \tag{3}$$

where α, $\boldsymbol{\beta}_{ij}$, $\boldsymbol{\beta}_{it}$, $\boldsymbol{\beta}_{jt}$, $\boldsymbol{SPS}_{ijt}$, and ε_{ij} are defined as above; $\boldsymbol{\gamma}'$, $\boldsymbol{\delta}'$, and $\boldsymbol{\zeta}'$ are the vectors of parameters of interest. $\boldsymbol{RTA}_{ijt}$ is a vector of RTA-specific variables (i.e. total, bilateral, and multilateral RTAs), and $\boldsymbol{SPS}*\boldsymbol{RTA}_{ijt}$ is a vector of interaction variables between SPS measures and RTAs.

Estimates on the entire sample are used to evaluate the extent to which the impact of SPS measures varies after the entry into force of an RTA between trading partners sharing SPS measures.

Sensitivity analyses are conducted to test the model's robustness. First, potential endogeneity between SPS measures and imports is controlled. In fact, the level of imports may justify the adoption of trade measures, yet measures tend to influence imports. Following Trefler (1993), I estimate an SPS equation to predict the SPS measures to introduce in equations (2) and (3) (see

appendix A.2 for methodological details). Second, sector-specific analyses are performed using the models in equations (2) and (3) in order to highlight potential differences between nonsignatories and signatories of RTAs.

3.2.2. Estimating the effects of SPS-specific commitments provided in RTAs

The second part of the study aims at evaluating the impact of the provision of SPS-specific commitments (policy intervention 3) in terms of trade levels (outcome of the policy) between signatories of RTAs. The scope of the analysis is to examine the trade effects of commitments that go beyond the provisions of the WTO SPS Agreement.

The empirical specification is as follows:

$$\underbrace{\ln(X_{ijt})}_{Y_{it}} = \alpha + \underbrace{\boldsymbol{\beta}_{ij}}_{\mu_i} + \underbrace{\boldsymbol{\beta}_{it} + \boldsymbol{\beta}_{jt}}_{\gamma_t} + \underbrace{\boldsymbol{\gamma}'\boldsymbol{SPS}_{ijt}}_{T_{it}^1} + \underbrace{\boldsymbol{\theta}'\boldsymbol{Commitment}_{ijt}}_{T_{it}^3} + \varepsilon_{ijt} \qquad (4)$$

where α, $\boldsymbol{\beta}_{it}$, $\boldsymbol{\beta}_{jt}$, $\boldsymbol{\beta}_{ij}$, $\boldsymbol{SPS}_{ijt}$, and ε_{ij} are defined as above. $\boldsymbol{\delta}'$ and $\boldsymbol{\theta}'$ are the vectors of parameters of interest. The vector $\boldsymbol{Commitment}_{ijt}$ contains specific information related to SPS-specific commitments provided by each RTA, modelled as time-specific dummy variables.

In particular, model (4) considers whether an RTA:

(i)   reaffirms or incorporates rights and/or obligations established under the WTO SPS Agreement;
(ii) provides additional commitments for basic SPS principles established by the WTO SPS Agreement;
(iii) provides for technical cooperation on SPS measures through a specific Committee;
(iv) provides for mutual recognition of SPS measures.

OLS estimation of model (4) is provided for a subsample of signatories of RTAs. In particular, 49 RTAs are considered between 39 selected countries, corresponding to those analysed in OECD (2011). The trade relationships between these signatories are examined regardless of the year when the agreement entered into force in order to assess if and how SPS-specific commitments affect trade between countries that tend to be signatories (or nonsignatories) of RTAs.

15

4. Data collection and sample description

The empirical analysis relies on a rich dataset of annual bilateral data (described in table 1) collected from 1997 to 2017 for 39 countries. The selected timeframe captures the exponential increase in the number of trade agreements notified to the WTO (*cfr.* fig. 1). The countries analysed are: Argentina (ARG), Australia (AUS), Bolivia (BOL), Brazil (BRA), Brunei (BRN), Canada (CAN), Chile (CHL), China (CHN), Colombia (COL), Costa Rica (CRI), Ecuador (ECU), El Salvador (SLV), Egypt (EGY), European Union (EUN), Guatemala (GTM), Honduras (HND), Hong Kong (HKG), Iceland (ISL), Israel (ISR), Japan (JPN), Kenya (KEN), Korea (KOR), Mexico (MEX), Morocco (MAR), New Zealand (NZL), Nicaragua (NIC), Norway (NOR), Paraguay (PRY), Peru (PER), Singapore (SGP), South Africa (ZAF), Switzerland (CHE), Tanzania (TZN), Thailand (THA), Turkey (TUR), Uganda (UGA), United States (USA), Uruguay (URY), and Venezuela (VEN).

The first part of the study (i.e. the analysis of the trade effects of SPS measures, on nonsignatories and on signatories of RTAs, after the entry into force of RTAs) considers all bilateral trade relationships between the selected countries.[2] The second part of the study (i.e. the analysis of the trade effects of SPS-specific commitments provided in RTAs) considers only 49 RTAs between the 39 selected countries (the RTAs are listed in table 2).

The Regional Trade Agreements Information System (RTA-IS) provides information on RTAs that either have been notified to the WTO or for which an early announcement has been made. The RTA-IS makes available information on (i) the coverage of the agreement (goods or services), (ii) type of agreement (Customs Union, Free Trade Agreement, Partial Scope Agreement), (iii) year of entry into force and year of end of implementation, and (iv) signatory countries and involved regions.

According to the RTA-IS, the selected countries are involved in 41% of the RTAs currently in force. Regardless of the year when the RTA entered into force, country-pairs in the dataset may be classified into non signatories and signatories of RTAs. This classification identifies country-pairs that tend to be involved in reciprocal preferential trade agreements between two (bilateral RTAs) or more parties (plurilateral RTAs). Signatories of RTAs account for 32% of the sample (table 1).[3]

---

[2] This part of the study does not consider specific trade agreements but analyses 1,482 bilateral trade relationships (39 importers times 39 exporters) for each year. Some of these country-pairs share trade agreements, while others do not. For instance, Australia and Singapore have an RTA in place, but Singapore does not share an agreement with Canada. However, trade relationships between Canada and Singapore are analysed in the first part of the study. Trade relationships between each country-pair are regulated by SPS measures in 65% of cases, of which 20% are bilateral SPS measures (cfr. table 1).

[3] For each RTA considered in OECD (2011), a dummy variable identifies the country-pairs involved in the agreement, starting from the year of entry into force of the agreement. These dummy variables are not limited by a specific year if the RTA entered into force before 1997 (e.g. Mexico and Colombia, NAFTA), or the year of entry into force of the RTA is not available in the RTA-IS database (e.g. MERCOSUR and Andean Community, MERCOSUR and Peru). Similarly, a dummy variable for each of the agreements in table 2 identifies the specific country-pair involved in the agreement, regardless of the year of entry into force of the RTA: this allows us to identify countries that tend to sign agreements with their trading partners.

Table 1. Average values of dependent variable and regressors

Variable	Type	All countries	Signatories of RTAs (32% of the sample)	Signatories of RTAs in OECD (2011) (14% of the sample)
Imports (billion US$)	Numerical [0; 27][a]	0.24 (±1.23)	0.25 (±1.02)	0.48 (±1.99)
SPS	Dummy [0, 1]	0.65 (±0.48)	0.70 (±0.46)	0.87 (±0.33)
SPS (bilateral)	Dummy [0, 1]	0.20 (±0.40)	0.26 (±0.44)	0.36 (±0.48)
RTA	Dummy [0, 1]	0.32 (±0.46)	0.97 (±0.16)	0.81 (±0.39)
RTA (bilateral)	Dummy [0, 1]	0.05 (±0.21)	0.15 (±0.36)	0.21 (±0.41)
SPS within RTA	Dummy [0, 1]	0.22 (±0.42)	0.69 (±0.46)	0.72 (±0.45)
SPS (bilateral) within RTA	Dummy [0, 1]	0.08 (±0.27)	0.25 (±0.43)	0.31 (±0.46)
SPS within RTA (bilateral)	Dummy [0, 1]	0.04 (±0.18)	0.11 (±0.31)	0.18 (±0.38)
SPS (bilateral) within RTA (bilateral)	Dummy [0, 1]	0.02 (±0.13)	0.06 (±0.23)	0.10 (±0.30)
SPS-specific commitments provided in RTAs[b]				
Chapter on SPS (none or limited)	Dummy [0, 1]	n.a.	n.a.	0.40 (±0.49)
Harmonization	Dummy [0, 1]	n.a.	n.a.	0.30 (±0.46)
Equivalence	Dummy [0, 1]	n.a.	n.a.	0.38 (±0.48)
Regionalization	Dummy [0, 1]	n.a.	n.a.	0.32 (±0.47)
Assessment of risk	Dummy [0, 1]	n.a.	n.a.	0.32 (±0.46)
Transparency	Dummy [0, 1]	n.a.	n.a.	0.46 (±0.50)
Committee on SPS	Dummy [0, 1]	n.a.	n.a.	0.35 (±0.48)
Technical cooperation on SPS	Dummy [0, 1]	n.a.	n.a.	0.27 (±0.44)
Mutual recognition	Dummy [0, 1]	n.a.	n.a.	0.12 (±0.32)

Notes: Standard deviations are in parentheses; minimum and maximum values are in brackets. Bilateral SPS measures are country-pair specific, regardless of potential RTAs between the trading partners. Bilateral RTAs refer to RTAs in place between two trading partners; this allows to distinguish them from plurilateral RTAs involving more parties.
[a] Zero trade flows are 15% for all countries, 10% for the subsample of signatories of RTAs, 3% for the subsample of signatories of RTAs in OECD (2011).
[b] Descriptive statistics for SPS-specific commitments provided in RTAs are not available (n.a.) for all countries and for the subsample of signatories of RTAs but only for the subsample of signatories of RTAs analysed in OECD (2011).

Table 2. List of RTAs analysed in OECD (2011) and related SPS-specific commitments provided in RTAs

RTA	Year of entry into force (RTA-IS)	SPS chapter	Harmonisation	Equivalence	Regionalisation	Assessment of risk	Transparency	Joint Committee	Mutual Recognition
		(**A**)	(**B**)	(**C**)	(**D**)	(**E**)	(**F**)	(**G**)	(**H**)
AUS-SGP	2003	Yes	Yes	Plus WTO-SPS	Yes	Yes	Plus WTO-SPS	Yes	Yes
AUS-THA	2005	Yes	Yes	Plus WTO-SPS	Yes	Yes	Yes	SPS issues	No
AUS-USA	2005	Yes	Yes	Yes	Yes	Yes	Yes	SPS issues	No
CAN-PER	2009	Yes	Yes	Yes	Yes	Yes	Yes	SPS issues	No
CentralAmerica-CHL[a]	2002	Yes	Yes	Yes	Yes	Plus WTO-SPS	Yes	SPS issues	No
CHL-CHN	2006	Yes	Yes	Yes	Yes	Yes	Plus WTO-SPS	SPS issues	No
CHL-EUN	2003	Yes	Plus WTO-SPS	Plus WTO-SPS	Plus WTO-SPS	Yes	Plus WTO-SPS	SPS issues	Yes
CHL-KOR	2004	Yes	Yes	Yes	Plus WTO-SPS	Yes	Plus WTO-SPS	SPS issues	No
CHL-MEX	1999	Yes	Plus WTO-SPS	Yes	Plus WTO-SPS	Yes	Plus WTO-SPS	SPS issues	No
CHL-PER	2009	Yes	Plus WTO-SPS	Yes	Plus WTO-SPS	Yes	Plus WTO-SPS	SPS issues	No
CHN-NZL	2008	Yes	Yes	Plus WTO-SPS	Plus WTO-SPS	Plus WTO-SPS	Plus WTO-SPS	SPS issues	No
MERCOSUR-AndeanCommunity[b]	n.a.	Yes	Plus WTO-SPS	Plus WTO-SPS	Plus WTO-SPS	Plus WTO-SPS	Plus WTO-SPS	Yes	No
MERCOSUR-PER	n.a.	Yes	Plus WTO-SPS	Plus WTO-SPS	Yes	Plus WTO-SPS	Plus WTO-SPS	Yes	No
MEX-COL	1995	Yes	Yes	Yes	Yes	Plus WTO-SPS	Plus WTO-SPS	SPS issues	No
MEX-CRI	2012	Yes	Yes	Yes	Yes	Yes	Plus WTO-SPS	SPS issues	No
MEX-NIC	n.a.	Yes	Plus WTO-SPS	Yes	Plus WTO-SPS	Yes	Plus WTO-SPS	SPS issues	No
MEX-NorthernTriangle[c]	2012	Yes	Plus WTO-SPS	Yes	Plus WTO-SPS	Plus WTO-SPS	Plus WTO-SPS	SPS issues	Yes
MEX-PER	2012	Yes	Yes	Yes	Yes	Yes	Yes	SPS issues	No
MEX-URY	2004	Yes	Yes	Yes	Plus WTO-SPS	Plus WTO-SPS	Plus WTO-SPS	SPS issues	No
NAFTA[d]	1994	Yes	Yes	Plus WTO-SPS	Yes	Yes	Plus WTO-SPS	SPS issues	No
NZL-SGP	2001	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
NZL-THA	2005	Yes	Yes	Yes	Yes	Yes	Plus WTO-SPS	SPS issues	No
PER-THA	n.a.	Yes	Yes	Yes	Yes	Yes	Plus WTO-SPS	SPS issues	No
AUS-CHL	2008	Limited	Yes	Yes	Yes	Yes	Yes	No	No
CAFTA[e]	2006	Limited	Yes	Yes	Yes	Yes	Yes	SPS issues	No
CAN-CRI	2002	Limited	Yes	Yes	Yes	Yes	Yes	SPS issues	No
CHL-JPN	2007	Limited	Yes	Yes	Yes	Yes	Yes	SPS issues	No
CHL-USA	2004	Limited	Yes	Yes	Yes	Yes	Yes	SPS issues	No
EFTA-CHL[f]	2004	Limited	Yes	Yes	Yes	Yes	Yes	No	No
KOR-SGP	2006	Limited	Yes	Yes	Yes	Yes	Yes	No	No
MERCOSUR-BOL	n.a.	Limited	Yes	Yes	Yes	Yes	Yes	No	Yes
MERCOSUR-CHL	2017	Limited	Yes	Yes	Yes	Yes	Yes	No	Yes
MEX_ISR	2000	Limited	Yes	Yes	Yes	Yes	Yes	Yes	No

MEX-BOL	n.a.	Limited	Yes	Yes	Yes	Yes	Plus WTO-SPS	SPS issues	No
MEX-EFTA	2001	Limited	Yes	Yes	Yes	Yes	Yes	No	No
MEX-EUN	2000	Limited	Yes	Yes	Yes	Yes	Yes	SPS issues	No
MEX-JPN	2005	Limited	Yes	Yes	Yes	Yes	Yes	SPS issues	No
P4[g]	n.a.	Limited	Yes	Plus WTO-SPS	Yes	Yes	Plus WTO-SPS	SPS issues	No
TUR-EGY	2007	Limited	Yes	Yes	Yes	Yes	Yes	No	No
USA-COL	2012	Limited	Yes	Yes	Yes	Yes	Yes	SPS issues	No
USA-MAR	2006	Limited	Yes	Yes	Yes	Yes	Yes	SPS issues	No
USA-PER	2009	Limited	Yes	Yes	Yes	Yes	Yes	SPS issues	No
CHL-CAN	1997	No	No	No	No	No	No	No	No
CHN-HKG	2003	No	No	No	No	No	No	No	No
EFTA-TUR	1992	No	No	No	No	No	No	No	No
EUN-EGY	2004	No	No	No	No	No	No	No	No
EUN-ZAF	2000	No	No	No	No	No	No	No	No
JPN-THA	2007	No	No	No	No	No	No	No	No
USA-SGP	2004	No	No	No	No	No	No	No	No

Notes: 'Yes' = RTA has chapter on SPS measures, or commitments on SPS basic principles, or a joint Committee, or provides for mutual recognition ('No' otherwise); 'Limited' = the RTA has a chapter on SPS measures limited to few paragraphs reaffirming rights and obligations set in the WTO SPS Agreement; 'Plus WTO' = the RTA assumes commitments on SPS basic principles beyond the WTO SPS Agreement; 'SPS issues' = the RTA has a joint Committee working on SPS issues. Country abbreviations are: Australia (AUS), Singapore (SGP), Thailand (THA), United States (USA), Canada (CAN), Peru (PER), Chile (CHL), China (CHN), European Union (EUN), Korea (KOR), Mexico (MEX), New Zealand (NZL), Colombia (COL), Costa Rica (CRI), Nicaragua (NIC), Uruguay (URY), Japan (JPN), Bolivia (BOL), Israel (ISR), Turkey (TUR), Egypt (EGY), Morocco (MAR), Hong Kong (HKG).
[a] Central American countries in the sample shared agreements with CHL staggered over time: CRI and SLV since 2002, HND since 2008, GTM since 2010, NIC since 2012.
[b] MERCOSUR involves ARG, BRA, PAR, URY, VEN, BOL, CHL, PER, COL, ECU; Andean Community involves BOL, COL, ECU, PER.
[c] Northern Triangle involves GTM, HND, SLV.
[d] NAFTA involves USA, CAN, MEX.
[e] CAFTA involves CRI, DOM, GTM, HND, NIC, SLV, USA.
[f] EFTA involves ISL, NOR, CHE.
[g] P4 involves CHL, NZL, SGP, BRN.

The scope of an RTA is to facilitate trade flows between signatories of that RTA, without imposing barriers to trade with countries out of that agreement. However, trade measures (e.g. SPS measures) regulating relationships between the signatories of an RTA may affect the trade of those countries. These effects are analysed by collecting information on trade flows and SPS measures for selected countries: bilateral import data are from the UN Comtrade database[4]. Import data at the one-digit level of classification by Broad Economic Categories (BEC) (specifically, the BEC category 'Food and beverages' [BEC 1996: 01]) are used for the global analysis in order to avoid potential endogeneity bias implied by measures implemented for protectionist purposes or to control imports in the absence of sizeable tariffs. For case-specific analyses, import data at the two-digit level of the Harmonised System classification (HS 2-digit) for the following five categories are used to capture variance among groups of products: 'Meat and edible meat offal' (HS 1996: 02), 'Fish and crustaceans, molluscs and other aquatic invertebrates' (HS 1996: 03), 'Edible vegetables and certain roots and tubers' (HS 1996: 07), 'Edible fruit and nuts' (HS 1996: 08), and 'Beverage' (HS 1996: 22).

The selected HS 2-digit product categories cover 37% of both global agri-food imports and exports during the period 2014-17 and account for 54% of SPS measures implemented on agri-food products. Meat, beverages, fruit, and fish are the four most traded agri-food products: each of them accounted for 8% of global agri-food imports during 2014-17, followed by vegetables (5%). Fish, meat, fruit, and vegetables are the four most regulated HS2-digit categories. Respectively, they account for 23%, 13%, 9%, and 9% of SPS measures implemented on agri-food products, whereas SPS measures have a lower incidence on beverages (1%) (*cfr*. fig. 2).

As for trade in food and beverages, the value of imports between the selected countries averages $239 million. Signatories of RTAs show higher import values ($251 million) as compared to the entire sample (table 1). However, by comparing trends in average import values of nonsignatories and signatories of RTAs (fig. 1), it is evident that the value of imports between nonsignatories is systematically larger than the value of imports between signatories across years. During the period 1998-2002, the imports of nonsignatories are about $200 million greater than the imports of signatories. Remarkable differences in these values also occurred in 2016 (+$386 million) and 2017 (+$158 million). In addition, the imports of the subsample of signatories of RTAs analysed in OECD (2011) are greater than or equal to $483 million on average (table 1).

Annual data on SPS measures are drawn from the UNCTAD's global database on NTMs, which provides information on official measures implemented at the country and product level. The UNCTAD database contains the SPS measures implemented by WTO Members against specific countries (bilateral measures) or all trading partners (multilateral measures). Information on the number of SPS measures that country-pair relationships (regardless of potential RTAs between them) are available for each product at the HS 6-digit level. In order to facilitate the match between trade and SPS data, information on SPS measures is aggregated at the HS 2-digit level for the case-specific analyses and at the one-digit level of BEC classification using the conversion table from HS 1996 to BEC 1996 of the UN Trade Statistics for the global analysis. The UNCTAD database also provides, for each measure, information on the date of entry into force and the expiry date: this allows the validity of SPS measures to be tracked.

In the resulting sample, about two thirds of bilateral trade relationships are regulated by SPS measures: 70% are between country-pairs sharing trade agreements. Bilateral SPS measures

---

[4] As suggested in Baldwin and Taglioni (2006: 13), "there is an old tradition in the gravity literature of using only import data on the grounds that nations spend more on measuring imports than exports."

account only for 20% in our total sample, 26% among signatories of RTAs (in the subsample of signatories of RTAs analysed in OECD the percentage is 36%) (table 1) Indeed, it is likely that bilateral measures tend to be put in place when trade agreements are established (Santeramo et al., 2019). Apart from the periods 2000-02 and 2014-17, SPS measures tend to be lower for nonsignatories of RTAs (fig. 1).

Figure 3. Trends in average import values and number of SPS measures of non signatories and signatories of RTAs (regardless of the year of entry into force of RTAs)
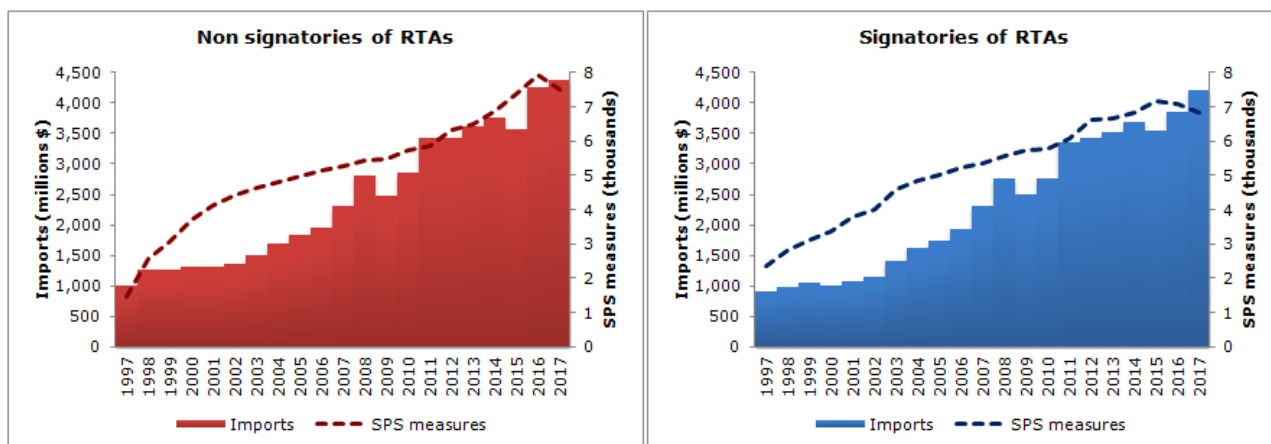
Source: Elaboration on data from UN Comtrade and UNCTAD.

Regardless of the year of entry into force of RTAs or the implementation of SPS measures, 23% of the country-pairs in the sample share both RTAs and SPS measures (table 3). In addition, it is more frequent that country-pairs share at least a SPS measure but not an RTA (43%) than country-pairs share an RTA but not an SPS measure (9%). Similar patterns are present for specific product categories.[5] Overall, 22% of the country-pairs within RTAs have at least one SPS measure in place, while bilateral SPS measures are less frequent (8%). The occurrence of SPS measures increases considering only signatories of RTAs (i.e. 69% for signatories of RTAs in general and 72% for signatories of RTAs analysed in OECD (2011)) (table 1).

Table 3. Incidence of SPS measures and RTAs within the sample.

		RTA	
		Yes	No
SPS	Yes	23%	43%
	No	9%	25%

RTAs are a more versatile negotiating environment than multilateral agreements, in which trade partners may converge on a deeper and mutually beneficial liberalization of trade (Disdier et al., 2015). RTA negotiations frequently cover behind-the-border measures, such as SPS measures. However, negotiation about SPS-specific commitments may vary on a case-by-case basis.

Focusing on the subsample of signatories of RTAs analysed in OECD (2011), qualitative data were gathered on SPS provisions within RTAs. Starting from the analysis presented in OECD (2011), indicators were constructed using the main information on the SPS-specific

---

[5] Further details are in appendix A.3.

commitments in each agreement. These indicators are modelled as time-specific dummy variables.

A first indicator discriminates between RTAs that do not go further than what is required by the WTO SPS Agreement and those that do. The variable equals 1 if the agreement does not have a specific chapter on SPS measures or, if available, a chapter on SPS measures limited to one or two paragraphs, instructing the parties to observe the rights and obligations set forth in the WTO SPS Agreement (*cfr. No* and *Limited* in column A, table 2), and 0 otherwise (*cfr. Yes* in column A, table 2).

A second set of indicators identifies the RTAs with commitments on a specific SPS principle beyond the WTO-SPS Agreement. For each basic SPS principle (see section 2.2.1), a dummy variable is defined to equal 1 if the RTA makes a commitment beyond what is required by the WTO SPS Agreement by specifying the steps and/or timeframe to apply the principle (*cfr. Plus WTO-SPS* in columns B-F, table 2); otherwise, the variable equals 0 (*cfr. Yes* and *No* in columns B-F, table 2).[6]

Further indicators are used to model the creation of an institutional framework to monitor the implementation of SPS commitments (joint SPS Committees). One dummy variable indicates if an RTA includes an institutional component mandating the creation of a special committee or working group to address SPS issues but does not provide for technical cooperation (*cfr. SPS issue* in column G, table 2). Another dummy variable identifies RTAs that provide for technical cooperation (*Yes* in column G, table 2).

The last indicator discriminates between RTAs that establish a commitment to work toward the identification of areas for mutual recognition agreements and specify their scope (i.e. standards relating to packaging and labelling) (*cfr. Yes* in column H, table 2) and RTAs that do not establish mutual recognition (*cfr. No* in column H, table 2).

Most of the RTAs covered by the sample contain a separate chapter regarding SPS measures. However, less than half (23) of the RTAs in the sample emphasize their role in fostering the application of the WTO SPS Agreement with specific SPS-related commitments that move beyond the general SPS principles of the WTO. The remaining 40% of the agreements (26 RTAs) do not go further than required by the WTO SPS Agreement. In particular, 7 of these RTAs do not have a specific chapter on SPS measures: Mexico-Peru, Chile-Canada, China and Hong Kong, Japan-Thailand, US-Singapore, the EU and South Africa, EU-Egypt, and finally the agreement between Turkey and the European Free Trade Association (EFTA, which encompasses Iceland, Norway, and Switzerland). The remaining RTAs include separate chapters on SPS measures, instructing the parties to observe additional requirements as compared to the rights and obligations set forth in the WTO SPS Agreement (table 2). The widespread inclusion of SPS chapters in the agreements highlights the importance of SPS-specific provisions to agri-food trade (OECD, 2011).

For most of the WTO's basic SPS principles, few RTAs in the sample really move beyond the general language of the WTO SPS Agreement (tables 1 and 2). Of the 49 RTAs covered by the sample:

▪   7 harmonize their national measures on the international standards (harmonization),

---

[6] In table 2 (columns B-F), *Yes* is associated with RTAs having a commitment on a specific SPS principle that does not go beyond the WTO-SPS Agreement, whereas *No* is related to RTAs without a specific chapter on SPS measures in the text of the agreement.

- 8 accept SPS measures of trading partners as equivalent (equivalence),
- 9 ensure that their SPS measures are adapted to the SPS characteristics of the region of origin and destination of the product (regionalization),
- 7 ensure that their SPS measures are based on an assessment of the risks to human, animal or plant life or health (assessment of risk),
- 19 establish national enquiry points and notify the creation or change of any SPS regulation before they are adopted to ensure transparency (transparency).

Overall, SPS-specific commitments going beyond the rights and obligations provided in the WTO SPS Agreement are found to be more frequent in RTAs involving mostly emerging economies.

With respect to the harmonization principle, most of the agreements indicate only that the harmonisation of SPS requirements should be achieved through the adoption of international standards (*cfr. Yes* in column B, table 2). Only a handful of RTAs (Chile-EU, Chile-Mexico, Chile-Peru, Mercosur-Andean Community, Mercosur-Peru, Mexico-Nicaragua, and Mexico-Northern Triangle) include specific requirements in the text of their agreements.[7] One type of requirement is the harmonization of procedures such as sampling methods, diagnosis, or inspection and certification. Another type is the application of additional standards, guidelines and recommendations of regional organizations of which the signatory parties are members (OECD, 2011).

Achieving a certain degree of harmonization may facilitate recognition of the equivalence principle between trading partners. In fact, some RTAs providing for harmonization of SPS measures also contain specific provisions on the implementation of equivalence: Chile-EU, Mercosur-Andean Community, and Mercosur-Peru. Other RTAs providing for equivalence are Australia-Singapore, Australia-Thailand, Chile-New Zealand, NAFTA, and the P4 agreement between Chile, New Zealand, Singapore, and Brunei. Although the equivalence of SPS measures may stimulate trade, the vast majority of RTAs only refer to the provisions established in the WTO SPS Agreement (*cfr. Yes* in column C, table 2).

Regionalization allows for flexibility in the implementation of SPS measures while ensuring safety of imports. Nevertheless, commitments more specific than those provided in the WTO SPS Agreement are included only in the following RTAs covered by the sample: the RTAs signed by Chile with the EU, Korea, Mexico, New Zealand, and Peru; the RTAs signed by Mexico with Nicaragua, the Northern Triangle countries, and Uruguay; and the agreement between Mercosur and Andean Community (*cfr. Plus WTO-SPS* in column D, table 2).

In the case of risk assessment, specific provisions (e.g. procedures to implement risk assessment measures, obligation to notify the scientific basis of the non-acceptance of imports) not included in the WTO SPS Agreement are found in a few RTAs (Central America-Chile, Chile-New Zealand, Mercosur-Andean Community, Mercosur-Peru, Mexico-Colombia, Mexico-Northern Triangle, and Mexico-Uruguay) (*cfr. Plus WTO-SPS* in column E, table 2).

Transparency is the most commonly adopted SPS principle in our sample; in particular, the RTAs involving Chile, Mexico and countries in the set of Asia Pacific agreements (e.g. Australia, New Zealand, China, Singapore, and Thailand) (*cfr. Plus WTO-SPS* in column F, table 2).

---

[7] Mercosur (Southern Common Market) includes Argentina, Brazil, Paraguay, Uruguay, and Venezuela as full members, but Venezuela's status as a full member was suspended in December 2016. The Andean Community is a customs union encompassing Bolivia, Colombia, Ecuador, and Peru. The Northern Triangle countries are Guatemala, Honduras, and El Salvador.

All but 11 RTAs in our sample address the technical cooperation issue and establish an institutional framework to do so. The related provisions specify the committee composition, functions, and mode of operation. The development of a joint SPS committee may be helpful in fostering greater transparency and harmonization among signatories (OECD, 2011).

In only one case (New Zealand-Singapore) do the RTAs include commitments on mutual recognition of SPS certificates or inspection or control systems. Mutual recognition provisions are found between Mexico and Northern Triangle, Mercosur and Bolivia or Chile, Chile and the EU, and Singapore and New Zealand or Australia. The provision simply encourages the parties to make efforts to identify areas that allow mutual recognition of SPS inspection, control and certification procedures, which is far from a binding commitment (OECD, 2011).

5. Results and discussion

5.1. Trade effects of SPS measures

The results of the OLS estimates of equation (2) are reported in table 4. The estimates allow an examination of the overall effect of a staggered introduction of SPS measures on trade and the disentangling of the effect of SPS measures for nonsignatories and signatories of RTAs. The analysis of impacts also discriminates between bilateral and multilateral SPS measures.

Table 4. Effects of SPS measures on imports of signatories and nonsignatories of RTAs.

Variables	All countries	Nonsignatories	Signatories
SPS	10.752 ***	3.185 ***	-0.959 *
SPS (bilateral)	0.115 **	0.174 *	0.151 *
SPS (multilateral)	4.285 ***	-2.247 **	-3.034 ***

Notes: Ordinary Least Squares (OLS) estimation of equation (2). Dependent variable is log of imports. The explanatory variables are modelled as dummy variables. The table synthesizes results of six specifications: the effect is estimated first for SPS measures in total (results above the horizontal dashed line) and then discriminating between bilateral and multilateral SPS measures (results below the horizontal dashed line), on all importing countries and on subsamples of nonsignatories and signatories of RTAs. SPS includes both bilateral and multilateral SPS measures. Bilateral SPS measures are 31% for all countries, 27% for nonsignatories of RTAs, 37% for signatories of RTAs. All specifications include time-varying importer, time-varying exporter, and country-pair fixed effects. Constant included. N = 24,778 for all countries, 16,264 for nonsignatories, and 8,514 for signatories.
*** Significant at 1-percent level.
 ** Significant at 5-percent level.
  * Significant at 10-percent level.

- **All countries**: imports are positively correlated with both bilateral and multilateral SPS measures, with a greater effect for multilateral than for bilateral measures.
- **Nonsignatories** (66%): SPS measures tend to be pro-trade, but contrasting effects are found for bilateral measures (trade catalysts) and multilateral measures (trade barriers).
- **Signatories** (34%): SPS measures tend to hinder trade, but contrasting effects are found for bilateral measures (trade catalysts) and multilateral measures (trade barriers).

Without distinguishing between signatories and nonsignatories of RTAs, the level of imports is found to be positively correlated with SPS measures: both bilateral and multilateral SPS measures have a positive impact on trade. The estimated effect on imports is much greater for multilateral (4.285) than for bilateral SPS measures (0.115). in other words, introducing an SPS measure that applies to all trade partners has a stronger impact than introducing an SPS measure that is specific for country-pairs. Our results are consistent with Santeramo (2019),

who analyses the effects of SPS measures on trade of the most regulated agri-food products for 19 countries (both developed and developing economies). He finds a clear positive link between SPS measures and the level of imports.

The results of econometric specifications that control for the impact of SPS measures for signatories and nonsignatories of RTAs reveal that, overall, SPS measures tend to be trade barriers for signatories and trade facilitators for nonsignatories. While bilateral SPS measures are always pro-trade for both signatories and nonsignatories, multilateral SPS measures hinder trade between countries sharing an RTA. These results are consistent with the findings of Crivelli and Gröschl (2016), who conclude that multilateral SPS measures exert a negative impact on the intensive margin of trade for all potential trading partners, whereas trade flows of countries regulated by a bilateral SPS measure increase to the detriment of other trade partners.

The OLS estimates of equation (3) are reported in table 5. They show how the trade effect of a staggered introduction of an SPS measure changes after the entry into force of an RTA between trading partners sharing SPS measures. Tests are performed for the joint effects of SPS measures and RTAs overall (specification A); in these tests, bilateral and multilateral SPS measures (specification B-F) as well as bilateral and plurilateral RTAs (specification E) are distinguished; by controlling for the interaction between SPS measures and RTAs (specifications C, D, F), a test may also be performed for the effect of SPS measures after the introduction of an RTA.

Table 5. Effects of SPS measures on imports after the entry into force of a RTA.

Variables	(A)		(B)		(C)		(D)		(E)		(F)	
SPS	6.776	**										
SPS (bilateral)			0.115	**	0.115	**	0.116	*	0.114	**	0.115	**
SPS (multilateral)			3.753	***	12.420	***	2.942	**	10.270	***	10.210	***
RTA	0.082	**	0.082	**	-0.026		-0.028					
RTA (bilateral)									0.024		-0.008	
RTA (plurilateral)									0.072		-0.024	
SPS*RTA					0.170	**	0.199	**			0.173	**
SPS*RTA (bilateral)							-0.094					
SPS (bilateral)*RTA							-0.014					
SPS (bilateral)*RTA (bilateral)							0.106					

Notes: Ordinary Least Squares (OLS) estimation of equation (3). Dependent variable is log of imports. Explanatory variables are modelled as dummy variables. SPS includes both bilateral and multilateral SPS measures. Bilateral SPS measures are 31%. All specifications include time-varying importer, time-varying exporter, and country-pair fixed effects. Constant included. N = 24,778. Specification A controls for SPS measures and RTAs; specification B controls for bilateral and multilateral SPS measures and RTAs; specification C controls for the interaction between SPS measures and RTAs; specification D controls for the interaction between different combinations of bilateral and multilateral SPS measures and RTAs; specification E controls for SPS measures and RTAs both bilateral and multilateral; specification F controls for SPS measures and RTAs both bilateral and multilateral and for the interaction between SPS measures and RTAs.
*** Significant at 1-percent level.
 ** Significant at 5-percent level.
  * Significant at 10-percent level.

- **Overall**: Imports are always positively correlated with total SPS measures (both bilateral and multilateral), with a greater effect for multilateral than for bilateral SPS measures (columns A-F); where statistically significant, the RTAs favor the level of imports (columns A and B); no significant effect is found for bilateral and plurilateral RTAs (columns E and F).
- **Effects of SPS measures after the entry into force of RTAs**: The positive effect of SPS measures (total) is greater after the entry into force of an RTA (columns C, D and F); no significant effect is found controlling for different combinations of bilateral and multilateral SPS measures after the entry into force of bilateral or plurilateral RTAs (column D).

The results confirm previous findings: SPS measures favor imports, with a greater effect from multilateral SPS measures than from bilateral SPS measures. Our results are robust to different econometric specifications that control for alternative combinations of SPS measures and RTAs.

In addition, the level of imports is found to be positively correlated with RTAs (0.082) (columns A and B), suggesting that such agreements are trade enhancing. Similar results are found by Sun and Reed (2010), who demonstrate that trade agreements tend to increase trade. However, the effect of RTAs tends to be overcome by other factors (i.e., the estimated coefficients are not more statistically significant after controlling for other determinants of bilateral trade, *cfr.* columns C-F). In this regard, Grant (2013) suggests that RTAs may be economically insignificant with lack of political motivation, divergent liberalization agendas, product exclusions especially in the agri-food sector, and long transitional periods of trade liberalization.

Positive relationships between imports and the interaction term 'SPS*RTA' are also found, indicating that the positive effect of SPS measures is greater after the entry into force of an RTA.

The sector-specific analyses capture the variance among product categories (for brevity, results are reported in appendix A.4). For meat, the observed effects resemble those found for the agri-food sector as a whole. In addition, RTAs are observed to favor imports of meat only if those

agreements are bilateral; the opposite is true for plurilateral RTAs. For fruit, multilateral SPS measures functioning as trade barriers. Vegetable imports positively react to bilateral but not multilateral SPS measures. Fish and beverage imports are not shown to be sensitive to bilateral and multilateral SPS measures at a statistically significant level.

When controlling for potential endogeneity between agri-food trade and policy interventions (results reported in appendix A.4), the results confirm previous findings: while bilateral SPS measures are always catalysts for trade, multilateral SPS measures are trade-impeding between countries sharing an RTA. However, the coefficients from these regressions are much greater than those in table 4. For instance, the coefficient estimated for multilateral SPS measures in a single equation (-3.034) is much lower than the same coefficient estimated simultaneously with the SPS equation (-6.769). These results confirm the suggestions of Trefler (1993), who concludes that treating mechanisms of protection as exogenously set policy instruments yields downward-biased estimates of the impact of protection on imports.

5.2. Trade effects of SPS-specific commitments in trade agreements

The effects of commitments going beyond the provisions of the WTO SPS Agreement on trade between signatories of RTAs are examined by estimating equation (4) using OLS (tables 6 and 7). The results in table 6 reveal these effects net of the impacts of SPS measures, whereas the results in table 7 look at differences between bilateral and multilateral SPS measures.

The tables report the results of different specifications of equation (4). One specification (Chapter on SPS) includes a dummy variable indicating whether an RTA simply reaffirms or incorporates rights and/or obligations established under the WTO SPS Agreement and thus does not go beyond the rules established at the WTO level. Another specification (SPS principles) evaluates the impact of additional commitments for each of the basic SPS principles established in the WTO SPS Agreement. A third specification (Technical cooperation) controls for the effects of technical cooperation on SPS measures through a specific Committee. The last specification (Mutual recognition) looks at the impact of mutual recognition of SPS measures as provided in RTAs.

Table 6. Effects on imports of SPS measures and SPS-specific commitments in RTAs.

Variables	Chapter on SPS	SPS principles	Technical cooperation	Mutual recognition
SPS	-5.453 ***	-5.506 ***	-2.733 ***	-1.750 ***
Chapter on SPS: none or limited	-0.317 ***			
Harmonization		-0.212		
Equivalence		-0.392 ***		
Risk assessment		0.405 **		
Regionalization		0.183		
Transparency		0.053		
Committee on SPS			-0.018	
Technical cooperation on SPS			0.696 ***	
Mutual recognition				0.312 ***

Notes: Ordinary Least Square (OLS) estimation of equation (4). Dependent variable is log of imports. Explanatory variables are modelled as dummy variables. All specifications include time-varying importer, time-varying exporter, and country-pair fixed effects. Constant included. N = 3,994.
*** Significant at 1-percent level.
 ** Significant at 5-percent level.

Table 7. Effects on imports of bilateral and multilateral SPS measures and SPS-specific commitments in RTAs.

Variables	Chapter on SPS		SPS principles		Technical cooperation		Mutual recognition	
SPS (bilateral)	0.049		0.053		0.058		0.063	
SPS (multilateral)	-2.772	***	-3.104	***	-1.415	*	-3.136	***
Chapter on SPS: none or limited	-0.315	***						
Harmonization			-0.212					
Equivalence			-0.390	***				
Risk assessment			0.403	**				
Regionalization			0.180					
Transparency			0.057					
Committee on SPS					-0.014			
Technical cooperation on SPS					0.692	***		
Mutual recognition							0.312	***

Notes: Ordinary Least Squares (OLS) estimation of equation (4). Dependent variable is log of imports. Explanatory variables are modelled as dummy variables. Bilateral SPS measures are 31% of the total. All specifications include time-varying importer, time-varying exporter, and country-pair fixed effects. Constant included. N = 3,994.
*** Significant at 1-percent level.
 ** Significant at 5-percent level.
  * Significant at 10-percent level.

- **Effects of SPS measures for signatories of RTAs**: SPS measures tend to hinder trade; no significant trade effects are found for bilateral SPS measures, whereas multilateral SPS measures are found to function as barriers for trade.
- **Chapter on SPS measures**: RTAs that simply reaffirm the rules set by the WTO SPS Agreement do not favor import levels.
- **SPS principles**: imports are positively correlated with additional commitments on assessment of risk but negatively correlated with more stringent provisions on equivalence; no significant effects are found for other SPS principles.
- **Technical cooperation on SPS issues**: The presence of a committee working on SPS measures has no statistically significant effect on the level of imports, whereas technical cooperation on SPS measures is positively correlated with imports.
- **Mutual recognition of SPS measures**: Mutual recognition of SPS measures is found to be beneficial to import levels.

The results suggest that, if the role of an RTA is limited to instructing the parties to observe the rights and obligations set forth in the WTO SPS Agreement, the trade-impeding effect of SPS measures for signatory countries is much greater (the level of imports further decreases by 0.3%).

Considering the core SPS principles, only the RTAs that contain commitments on assessment of risk beyond the WTO SPS Agreement result in more trade, while additional commitments on equivalence that specify the steps and/or timeframe for applying the principle result in less trade. Moreover, if an RTA includes an institutional component mandating the creation of a specific committee or working group to address SPS issues and also provides for technical cooperation, trade between signatories tends to increase. Trade between signatories also tends to be higher if the RTA establishes a commitment to work toward the identification of areas for mutual recognition agreements.

6. Main conclusions and implications

The objective of this study was to provide empirical evidence about the role of sanitary and phytosanitary (SPS) measures and regional trade agreements (RTAs) in providing additional market access for agri-food trade.

In a first step, the study evaluated the trade effects of the implementation of SPS measures and the entry into force of an RTA between trading partners. Taking the overall effect of a staggered introduction of SPS measures as a starting point, it was examined whether this effect differs for nonsignatories and signatories of RTAs and changes after an RTA enters into force between trading partners sharing SPS measures.

The empirical analysis revealed that SPS measures tend to be catalysts for agri-food trade. If trading partners adopt trade measures to regulate bilateral trade relationships, the magnitude of their imports tends to be 10.8% larger as compared to trading partners that do not have SPS measures in place. Discriminating between multilateral and bilateral SPS measures, a greater effect is found for multilateral than for bilateral SPS measures. Introducing an SPS measure that applies to all trade partners (+4.3%) has a greater impact than introducing an SPS measure specific for country-pairs (0.1%). These results are consistent with findings of Santeramo (2019), who reports a positive effect of SPS measures on the magnitude of imports and suggests that the introduction of a bilateral SPS measure is associated with 0.05% higher level of imports. The lower impacts estimated for SPS measures in Santeramo (2019) may be associated with commodity and country coverage of the analysed sample. Santeramo (2019) analyses the impact of SPS measures on imports of meat, fish, dairy, fruit, vegetables, cereals, oilseeds, preparations of meat and fish, and considers 19 countries, including both developed and developing economies. The present analysis is a general assessment of the food and beverage sector and involves a larger sample of countries.

Distinguishing between trading partners that tend to be signatories of RTAs and country-pairs that do not regulate their trade relationships in the context of regional negotiations, SPS measures were found to boost import levels of nonsignatory countries; vice-versa, the SPS measures seem to be detrimental for trade between signatories of RTAs. Multilateral SPS measures were found to function as trade barriers, while bilateral SPS measures were found to serve as trade catalysts for both nonsignatories and signatories of RTAs. On average, bilateral imports of signatories (nonsignatories) increase by 0.15% (0.17%) when bilateral SPS measures are in place but decrease by 3.03% (2.25%) if affected by multilateral SPS measures. This evidence is not surprising. Multilateral SPS measures constitute a market entry barrier for all exporters, while bilateral SPS measures allow the trading partner to expand its market access, once it meets the stringent standard, to the detriment of other countries not subject to the same standard. Similar evidence is found by Crivelli and Gröschl (2016), who suggest that, on average, bilateral SPS measures increase agri-food trade by 0.71%, whereas multilateral SPS measures reduce agri-food trade by 0.10%.

To sum up, the results suggest that, for nonsignatories of RTAs, SPS measures tend to be pro-trade, with the general effect mostly arising from bilateral SPS measures; vice-versa, SPS measures tend to hinder trade between signatories of RTAs, and the overall effect is driven by multilateral SPS measures. All in all, nonsignatories of RTAs tend to be favored by SPS measures applied on the basis of country-specific agreements, compensating for the lack of a reciprocal preferential trade environment. In contrast, benefits associated to the status of signatories of RTAs tend to be minimized by the SPS measures that affect indiscriminately all trading partners and are not tailor made for a specific trade relationship.

As for the impacts of SPS measures after an RTA enters into force, the analysis revealed that if at least an SPS measure (bilateral or multilateral) regulates trade relationships between country-pairs, bilateral imports are favoured. This boosting effect is found to be much larger after the entry into force of a trade agreement between (or among) the countries. Similarly, the benefits of RTAs increase after the introduction of a SPS measure. Indeed, import levels between trading partners were found to be 0.1% higher on average if they were involved in an RTA. This result provides further evidence in support of the long-held view that RTAs have the potential to be trade-creating, as highlighted in previous studies (e.g. Koo et al., 2006; Baier and Bergstrand, 2007; Grant and Lambert, 2008; Lambert and McKoy, 2009). Similar to Vollrath et al. (2009), the results provided evidence that RTAs have a small but direct impact on the agri-food trade of signatory countries, after controlling for other explanatory factors (e.g. SPS measures).

In a nutshell, both SPS measures and RTAs are catalysts for agri-food trade, and if trading partners share both types of policy interventions in a staggered fashion, the effects of one type of policy reinforces the impact of the other.

In a second step, the study evaluated the effects of SPS-specific commitments in RTAs on agri-food trade between signatories of RTAs by asking whether commitments that go beyond the provisions of the WTO SPS Agreement influence trade.

The results suggested that RTAs that simply reaffirm the rules set under the WTO SPS Agreement do not provide an additional impetus to trade through these rules. If an RTA limits its role to instructing the parties to observe the rights and obligations set forth in the WTO SPS Agreement, the trade-impeding effect of SPS measures for signatory countries is much greater (the level of imports further decreases by 0.3%). Considering the basic SPS principles of the WTO, only RTAs that assume commitments on assessment of risk beyond the WTO SPS Agreement show larger trade values (+0.4%). In contrast, additional commitments on equivalence specifying the steps and/or timeframe to apply the principle decrease imports by 0.4%: although the SPS measures of trading partners should be accepted as equivalent, the importing countries seem not prone to realize trade at these conditions.

Findings also revealed that, if a RTA includes an institutional component mandating the creation of a specific committee or working group to address the SPS issues and also provides for technical cooperation (e.g. definition of committee composition, functions, mode of operation), agri-food trade between signatories increases by 0.7%. As argued in OECD (2011), development of a joint SPS committee may foster greater transparency and harmonization among signatories. Agri-food trade between signatories of RTAs tends to be favoured also if the RTA establishes a commitment to work toward the identification of areas for mutual recognition agreements on such topics as SPS inspections, control, and certification procedures. Although far from a binding commitment, the presence of such a provision increases agri-food imports by 0.3% on average. As suggested in Cadot and Gourdon (2016), mutual recognition of standards and of conformity assessment reduces trade costs generated by different national standards, boosting trade between signatories of the agreements. Thus, except for additional commitments on the equivalence principle, SPS-specific commitments negotiated in the more versatile framework of an RTA tend to create conditions for signatory countries to meet each other's requirements on adequate levels of safety, thereby facilitating higher levels of agri-food trade.

To conclude, SPS measures and RTAs tend to facilitate market access—the former by setting standards to ensure an adequate level of safety, the latter by creating a more versatile framework for trade negotiations. Although the trade potential of partners that tend to sign RTAs

seems obstructed by nondiscriminatory (multilateral) SPS measures, the entry into force of an RTA helps signatories to meet stringent standards that facilitate further market access. This is allowed by the provision of concrete commitments with respect to SPS measures within RTAs. The most promising are mutual recognition of standards and institution of joint SPS committees to implement technical cooperation between signatories on SPS issues. Moving towards these solutions would stimulate trade among countries.

The findings have important implications for regulatory policy. Given the catalyst effects of SPS measures and trade agreements, signatories to RTAs should expect further trade gains from RTAs that contain SPS-specific commitments. Indeed, such commitments should be extended as much as possible among trading partners. To achieve such an objective, technical cooperation in regulatory policy among signatories to RTAs should have a pivotal role. Lastly, technical cooperation in SPS issues through mutual recognition may help improving market access.

References

Baier, S.L., Bergstrand, J.H. (2007). Do free trade agreements actually increase members' international trade? *Journal of International Economics*, 71(1), 72-95.

Baldwin, R., Taglioni, D. (2006). *Gravity for dummies and dummies for gravity equations*. National Bureau of Economic Research (NBER) Working Paper 12516, Cambridge, MA.

Cadot, O., Gourdon, J. (2016). Non-tariff measures, preferential trade agreements, and prices: new evidence. *Review of World Economics*, 152(2), 227-249.

Crivelli, P., Gröschl, J. (2016). The impact of sanitary and phytosanitary measures on market entry and trade flows. *The World Economy*, 39(3), 444-473.

de Janvry, A., Sadoulet, E. (2015). *Development economics: Theory and practice*. Routledge.

Disdier, A.C., Fontagné, L., Cadot, O. (2015). North-South standards harmonization and international trade. *The World Bank Economic Review*, 29(2), 327-352.

Disdier, A.C., Fontagné, L., Mimouni, M. (2008). The impact of regulations on agricultural trade: evidence from the SPS and TBT agreements. *American Journal of Agricultural Economics*, 90(2), 336-350.

FAO (2001). *Guidelines for the notification of non-compliance and emergency action*. ISPM No. 13, FAO, Rome.

FAO (2004). *Regional standards for phytosanitary measures*. APPPC RSPM No. 2, FAORegional Office for Asia and the Pacific, Bangkok.

FAO (2005). *Guidelines for inspection*. ISPM No. 23, FAO, Rome.

Grant, J.H. (2013). Is the growth of regionalism as significant as the headlines suggest? Lessons from agricultural trade. *Agricultural Economics*, 44(1), 93-109.

Grant, J.H., Lambert, D.M. (2008). Do regional trade agreements increase members' agricultural trade?. *American Journal of Agricultural Economics*, 90(3), 765-782.

Jayasinghe, S., Sarker, R. (2008). Effects of regional trade agreements on trade in agrifood products: Evidence from gravity modeling using disaggregated data. *Review of Agricultural Economics*, 30(1), 61-81.

Koo, W.W., Kennedy, P.L., Skripnitchenko, A. (2006). Regional preferential trade agreements: Trade creation and diversion effects. *Applied Economic Perspectives and Policy*, 28(3), 408-415.

Lambert, D., McKoy, S. (2009). Trade creation and diversion effects of preferential trade associations on agricultural and food trade. *Journal of Agricultural Economics*, 60(1), 17-39.

Lejárraga, I., Shepherd, B. (2013). *Quantitative evidence on transparency in regional trade agreements* (OECD Trade Policy Papers 153). Paris: OECD Publishing.

Mayer, T., Vicard, V., Zignago, S. (2019). The Cost of Non-Europe, Revisited. *Economic Policy* [In press].

OECD (2011). *Regional Trade Agreements - Treatment of Agriculture*. OECD Food, Agriculture and Fisheries Papers, No. 44, OECD Publishing, Paris.

OECD (2015). *Regional trade agreements and agriculture*. OECD Food, Agriculture and Fisheries Papers, No. 79, OECD Publishing, Paris.

Santeramo, F.G., Lamonaca, E. (2019). The Effects of Non-tariff Measures on Agri-food Trade: A Review and Meta-analysis of Empirical Evidence. *Journal of Agricultural Economics*, 70(3), 595-617.

Santeramo, F.G., Lamonaca, E., Nardone, G., Seccia, A. (2019). The benefits of country-specific non-tariff measures in world wine trade. *Wine Economics and Policy*, 8(1), 28-37.

Santeramo, F.G. (2019) *On non-tariff measures and changes in trade routes: from North-North to South-South trade?* IATRC Commissioned Paper, No. 938-2019-1580.

Sarker, R., Jayasinghe, S. (2007). Regional trade agreements and trade in agri-food products: evidence for the European Union from gravity modeling using disaggregated data. *Agricultural Economics*, 37(1), 93-104.

Sun, L., Reed, M.R. (2010). Impacts of free trade agreements on agricultural trade creation and trade diversion. *American Journal of Agricultural Economics*, 92(5), 1351-1363.

Trefler, D. (1993). Trade liberalization and the theory of endogenous protection: an econometric study of US import policy. *Journal of Political Economy*, 101(1), 138-160.

UNCTAD (2012). *International Classification of Non-Tariff measures, February 2012 version (UNCTAD/DITC/TAB/2012/2)*. New York, Geneva: United Nations.

Vollrath, T.L., Gehlhar, M.J., Hallahan, C.B. (2009). Bilateral import protection, free trade agreements, and other factors influencing trade flows in agriculture and clothing. *Journal of Agricultural Economics*, 60(2), 298-317.

A. Appendix

A.1. Examples of provisions on SPS measures within RTAs

A.1.1. No paragraph or chapter dealing with SPS measures in the Canada-Chile Free Trade Agreement

A.1.2. Limited chapter dealing with SPS measures in Australia-Chile Agreement

In the Australia-Chile Free Trade Agreement, Chapter 6 contains provisions for SPS measures. In particular, article 6.4 (General Provisions) is aligned with the WTO SPS Agreement and establishes that:
1. the Parties affirm their rights and obligations under the SPS Agreement.
2. the Parties shall cooperate on priority proposals for technical assistance and capacity building to enhance the capability on SPS related aspects to further the achievement of the objectives of this Chapter.
3. the Parties shall cooperate in relevant international bodies engaged in work on SPS related issues, including the WTO SPS Committee, the various Codex Committees (including the Codex Alimentarius Commission), the International Plant Protection Convention, the World Organisation for Animal Health (OIE) and other international and regional fora on food safety and human, animal and plant life or health.

Similarly, article 6.5 (Consultations on and Implementation of Sanitary and Phytosanitary Measures) establishes that:
1. each Party shall identify an overall contact point relating to SPS measures ("SPS Contact Point"). For the purpose of this Article, the SPS Contact Point shall be:
    a) in the case of Australia, the Department of Agriculture, Fisheries and Forestry, or its successor; and
    b) in the case of Chile, the General Directorate of International Economic Affairs, Ministry of Foreign Affairs, or its successor.
2. on request of a Party for consultations on a matter arising under this Chapter, the Parties shall enter into consultations between relevant government agencies with responsibility for that matter under the scope of the SPS Contact Point.
3. each Party´s SPS Contact Point shall:
    a) coordinate requests for technical assistance and capacity building programs on SPS matters;
    b) review progress on addressing SPS matters that may arise between the Parties;
    c) communicate SPS priorities between the Parties;
    d) facilitate the consideration of requests for information and clarification of issues with the other Party;
    e) facilitate communication between relevant experts when the consideration of scientific or technical issues requires such contact;
    f) promote and facilitate cooperation on SPS issues between the Parties;
    g) perform any other activities that facilitate transparency in the implementation of SPS measures; and
    h) ensure that all relevant government agencies participate in the above activities as appropriate and arrange meetings between relevant experts of each Party on these activities when required.
4. the Parties acknowledge the value of exchanging information on their respective SPS measures and, to ensure transparency in the implementation of SPS measures, each Party shall:
    a) exchange a list, to be updated as appropriate, of officials responsible for SPS matters in the agencies of the Parties; and

b) provide notifications to a nominated SPS official of the other Party of measures imposed in response to an urgent threat to human, animal or plant life or health.

5. the SPS Contact Point shall be included in all communications between the Parties made pursuant to this Article.

A.1.3. Chapter dealing with SPS measures in EU-Chile Agreement

Many parts of the EU-Chile Agreement contain provisions for SPS measures.

Part III (Cooperation), Title I (Economic Cooperation), art. 24 (Cooperation on agriculture and rural sectors and sanitary and phytosanitary measures):

1. Cooperation in this area is designed to support and stimulate agricultural policy measures in order to promote and consolidate the Parties' efforts towards a sustainable agriculture and agricultural and rural development.
2. The cooperation shall focus on capacity-building, infrastructure and technology transfer, addressing matters such as:
   a) specific projects aimed at supporting sanitary, phytosanitary, environmental and food quality measures, taking into account the legislation in force for both Parties, in compliance with WTO rules and other competent international organisations;
   b) diversification and restructuring of agricultural sectors;
   c) the mutual exchange of information, including that concerning the development of the Parties' agricultural policies;
   d) technical assistance for the improvement of productivity and the exchange of alternative crop technologies;
   e) scientific and technological experiments;
   f) measures aimed at enhancing the quality of agricultural products and supporting trade promotion activities;
   g) technical assistance for the strengthening of sanitary and phytosanitary control systems, with a view to supporting as far as possible the promotion of equivalence and mutual recognition agreements.

Part IV (Trade and trade-related matters), Title II (Free movement of goods), Chapter II (Non-tariff measures), Section 5 (Sanitary and Phytosanitary Measures), art. 89 (Sanitary and phytosanitary measures):

1. The objective of this section is to facilitate trade between the Parties in the field of sanitary and phytosanitary legislation, whilst safeguarding public, animal and plant health by further implementing the principles of the WTO on the Application of Sanitary and Phytosanitary Measures ('the WTO SPS Agreement'). An additional objective of this section is to consider animal welfare standards.
2. The objectives of this section are pursued through the 'Agreement on Sanitary and Phytosanitary Measures Applicable to Trade in Animals and Animal Products, Plants, Plant Products and other Goods and Animal Welfare', which is attached as Annex IV.
3. By way of derogation from Article 193, the Association Committee, when dealing with sanitary or phytosanitary measures, shall be composed of representatives of the Community and Chile with responsibility for sanitary and phytosanitary matters. This Committee shall then be called the 'Joint Management Committee for Sanitary and Phytosanitary Matters'. The functions of the Committee are set out in Article 16 of Annex IV.

4. For the purpose of Article 184, consultations held under Article 16 of Annex IV shall be deemed to constitute the consultations referred to in Article 183, unless the Parties decide otherwise.

Annex IV (Referred to in Article 89(2) of the Association Agreement)
Agreement on sanitary and phytosanitary measures applicable to trade in animals and animal products, plants, plant products and other goods and animal welfare

Objective (art. 1)
Multilateral obligations (art. 2)
Scope (art. 3)
Definitions (art. 4)
Competent authorities (art. 5)
Recognition for trade of animal health and pest status and regional conditions (art. 6)
    A. Recognition of status for animal diseases, infections in animals or pests
    B. Recognition of regionalization
Determination of equivalence (art. 7)
Transparency and trade conditions (art. 8)
Certification procedures (art. 9)
Verification (art. 10)
Import checks and inspection fees (art. 11)
Information exchange (art. 12)
Notification and consultation (art. 13)
Safeguard clause (art. 14)
Outstanding issues (art. 15)
Joint Management Committee (art. 16)
Facilitation of communication (art. 17)
Territorial application (art. 18)

Annex V (Referred to in Article 90 of the Association Agreement)
Agreement on trade in wines

Title IV (Sanitary and phytosanitary measures), art. 26 (Sanitary and phytosanitary measures):
1. The provisions of this Agreement are without prejudice to the right of the Parties to apply sanitary and phytosanitary measures necessary for the protection of human, animal or plant life or health, provided that such measures are compatible with the provisions of the WTO SPS Agreement and of the Agreement on Sanitary and Phytosanitary Measures applicable to Trade in Animals and Animal Products, Plants, Plant Products and other Goods and Animal Welfare, set out in Annex IV of the Association Agreement.
2. Without prejudice to paragraph 1, each Party shall endeavour to inform the other Party under the procedures set out in Article 29 at the earliest reasonable opportunity of developments which could lead, in relation to wine marketed in that Party, to the adoption of such measures, especially those concerning the setting of specific limits on contaminants and residues with a view to agreeing a common approach.

Annex VI (Referred to in Article 90 of the Association Agreement)
Agreement on trade in spirit drinks and aromatised drinks

Title II (Sanitary and phytosanitary measures), art. 13 (Sanitary and Phytosanitary Measures):
1. The provisions of this Agreement shall be without prejudice to the right of the Parties to take sanitary and phytosanitary measures necessary for the protection of human, animal or plant

life or health, provided that such measures are not incompatible with the provisions of the WTO SPS Agreement and of the Agreement on Sanitary and Phytosanitary Measures applicable to Trade in Animals and Animal Products, Plants, Plant Products and other Goods and Animal Welfare, set out in Annex IV of the Association Agreement.

2. Without prejudice to paragraph 1, each Party shall endeavour to inform the other Party, under the procedures set out in Article 19 and at the earliest reasonable opportunity of developments which could lead, in relation to spirit drinks and aromatised drinks marketed in that Party, to the adoption of such measures, especially those concerning the setting of specific limits on contaminants and residues with a view to agreeing a common approach.

A.2. Methodological notes: controlling for endogeneity between trade and policy intervention

Endogeneity may affect the relationship between SPS measures and importsy. In fact, the level of imports may justify the adoption of trade measures, yet measures tend to influence imports. Following Trefler (1993), as sensitivity analysis, an SPS equation is estimated to predict the SPS measures to introduce in equations (2) and (3):

$$SPS_{ijt} = \theta + \boldsymbol{\beta}_{ij} + \boldsymbol{\eta}' \boldsymbol{\Omega}_{ijt-1} + v_{ijt}$$

(A.1)

where the SPS measures at time t (SPS_{ijt}) are regressed on country-pair fixed effects ($\boldsymbol{\beta}_{ij}$) and a set of lagged variables ($\boldsymbol{\Omega}_{ijt-1}$) that includes past imports, the growth rate of imports with a one-period lag, and multilateral SPS measures and RTAs previously introduced. $\boldsymbol{\eta}'$ is the vector of parameters of interest, θ is a constant, v_{ij} is an independent and identically distributed (i.i.d.) random error term.

A.3. Incidence of SPS measures and RTAs

Table A.1. Incidence of SPS measures and RTAs.

SPS measures		RTA	
		Yes	No
Meat	Yes	21%	51%
	No	6%	22%
Fish	Yes	20%	48%
	No	8%	24%
Vegetables	Yes	21%	48%
	No	8%	23%
Fruit	Yes	19%	47%
	No	8%	26%
Beverage	Yes	21%	50%
	No	8%	21%

A.4. Results of the sensitivity analyses

Tables A.2 and A.3 report OLS estimates of equation (2) by product category. Table A.4 highlights the effects for signatories of RTAs.

Table A.2. Effects of SPS measures on imports by sector.

Variables	Meat		Fish	Vegetables	Fruit		Beverages
SPS (bilateral)	0.322	*	-0.513	0.217	-0.129		0.276
SPS (multilateral)	-0.095		0.233	0.169	-0.314	*	0.187

Notes: Ordinary Least Squares (OLS) estimation of equation (2). Sample: all countries. Dependent variable is log of imports. Explanatory variables are modelled as dummy variables. All specifications include time-varying importer, time-varying exporter, and country-pair fixed effects. Constant included. N = 7,937 for Meat, 15,302 for Fish, 14,294 for Vegetables, 15,029 for Fruit, and 16,731 for Beverages.
  ** Significant at 5-percent level.
   * Significant at 10-percent level.

Table A.3. Effects of SPS measures on imports of signatories of RTAs by sector.

Variable	Meat		Fish	Vegetables		Fruit	Beverages
SPS (bilateral)	1.608	***	-0.119	0.447	**	0.250	-0.215
SPS (multilateral)	-1.975		0.707	0.616		1.253	-0.374

Notes: Ordinary Least Squares (OLS) estimation of equation (2). Sample: signatories of RTAs. Dependent variable is log of imports. Explanatory variables are modelled as dummy variables. All specifications include time-varying importer, time-varying exporter, and country-pair fixed effects. Constant included. N = 2,244 for Meat, 4,269 for Fish, 4,286 for Vegetables, 4,122 for Fruit, and 4,857 for Beverages.
*** Significant at 1-percent level.
  ** Significant at 5-percent level.

- **All countries**: Bilateral SPS measures are catalysts for meat imports, whereas multilateral SPS measures act as barriers to fruit imports; no significant effect is found for fish, vegetables, or beverages (table A.2).
- **Signatories of RTAs**: Bilateral SPS measures are positively correlated with imports of meat and vegetables; no significant effect is found for bilateral or multilateral SPS measures for fish, fruit, or beverages (table A.3).
- **Meat sector**: The marginal effect of bilateral SPS measures is greater for countries within RTAs (tables A.2 and A.3).

OLS estimation of equation (3) by product category (table A.4) allows for the influences that SPS measures exert on imports of specific products before and after the introduction of an RTA to be disentangled.

Table A.4. Effects of SPS measures by sector after the entry into force of an RTA.

Variables	Meat		Fish	Vegetables	Fruit		Beverages
SPS (bilateral)	0.392	**	-0.506	0.218	-0.132		0.280
SPS (multilateral)	-0.369		0.194	0.124	-0.336	**	0.210
RTA (bilateral)	1.042	***	-0.014	-0.091	-0.075		0.012
RTA (multilateral)	-0.995	***	0.066	0.100	0.134	*	0.010
SPS*RTA	0.494	***	0.123	0.119	0.079		-0.060

Notes: Ordinary Least Squares (OLS) estimation of equation (3). Dependent variable is log of imports. Explanatory variables are modelled as dummy variables. All specifications include time-varying importer, time-varying exporter, and

country-pair fixed effects. Constant included. N = 7,937 for Meat, 15,302 for Fish, 14,294 for Vegetables, 15,029 for Fruit, and 16,731 for 'Beverages.
*** Significant at 1-percent level.
 ** Significant at 5-percent level.
  * Significant at 10-percent level.

- **Overall**: Multilateral SPS measures exert a negative influence on imports of fruit, while bilateral SPS measures favor imports of meat, confirming previous results (see table A.2); imports of meat are limited (favored) by multilateral (bilateral) RTA, and total RTAs enhance imports of fruit.
- **Effects of SPS measures after entry into force of RTAs**: The positive effect of SPS measures (total) on imports of meat is greater after an RTA enters into force; no significant effect is found for other sectors.
- **Fish, vegetable, and beverage sectors**: No significant effects of SPS measures and RTAs are found, neither pre- nor post-RTAs.

Tables A.5 and A.6 present OLS estimates of the effects of SPS measures, controlling for potential endogeneity between imports and SPS measures. Table A.5 shows the results of the model in equation (A.1) used to predict bilateral SPS measures. Table A.6 reports the results of the model in equation (2) regressed on bilateral SPS measures while controlling for endogeneity: evidence is presented for both nonsignatories and signatories of RTAs.

Table A.5. Endogeneity of imports and SPS measures: SPS equation.

Variable	Estimated coefficient
$Imports_{t-1}$	0.030 ***
$(Imports_{t-2} - Imports_{t-1})$	0.013 ***
SPS_{t-1}	0.232 ***
RTA_{t-1}	0.089 ***

Notes: Ordinary Least Squares (OLS) estimation of the equation (A.1). Sample: all countries. Dependent variable is SPS measures. Country-pair fixed effects and constant included. N = 21,556.
*** Significant at 1-percent level.

Table A.6. Endogeneity of imports and SPS measures: import equation.

Variables	Nonsignatories of RTA	Signatories of RTA
SPS (bilateral, hat)	16.030 ***	10.970 ***
SPS (multilateral)	1.442	-6.769 ***

Notes: Ordinary Least Squares (OLS) estimation of equation (2). Dependent variable is log of imports. Explanatory variables are modelled as dummy variables. Bilateral SPS measures (estimated in the first stage) are 31%. All specifications include time-varying importer, time-varying exporter, and country-pair fixed effects. Constant included. N = 13,532 for Nonsignatories and 7,630 for Signatories.
*** Significant at 1-percent level.

- **Countries within and outside of RTAs**: Bilateral SPS measures are found to increase agri-food trade, whereas multilateral SPS measures are trade barriers for signatories of RTAs, confirming previous results (see table 4)
- **Endogeneity between imports and SPS measures**: The marginal effect of SPS measures (both bilateral and multilateral) within and outside of RTAs is greater when controlling for endogeneity (*cfr.* table A.6 and table 4)

Results of the OLS estimates of equation (2) (table A.7) compare signatories of RTAs in general and signatories of RTAs analysed in OECD (2011). This analysis also discriminates between the impact of bilateral SPS measures and the impact of multilateral SPS measures.

Table A.7. Effects of SPS measures on imports of signatories of RTAs.

Variables	Signatories of RTAs	Signatories of RTAs in OECD (2011)
SPS	-0.959 *	-2.654 ***
SPS (bilateral)	0.151 *	0.063
SPS (multilateral)	-3.034 ***	-1.995 ***

Notes: Ordinary Least Squares (OLS) estimation of equation (2). Dependent variable is log of imports. Explanatory variables are modelled as dummy variables: the effect is estimated first for SPS measures in total, and then discriminating between bilateral and multilateral SPS measures. Bilateral SPS measures are 37% for signatories of RTAs, 42% for the subsample of signatories of RTAs from OECD (2011). All specifications include time-varying importer, time-varying exporter, and country-pair fixed effects. Constant included. N = 8,514 for Signatories of RTAs and 3,994 for Signatories of RTAs in OECD (2011).

*** Significant at 1-percent level.
   * Significant at 10-percent level.