Does Sanitary and Phytosanitary regulation stringency affect developing countries exports? Evidence from Chilean fruit exports.

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ABSTRACT
Increasing awareness of food safety issues has brought a boost in sanitary and phytosanitary regulations and standards. Although is likely that these regulations have increased health and welfare in the countries that impose them, they may also have an important effect in exporting countries, affecting especially small producers in developing countries. Other papers have found that individual quantitative measures of regulatory stringency have an impact on trade, but none has looked into broader SPS regulation stringency indicators. Through a survey that asked Chilean fresh fruit exporters to evaluate the stringency for 16 countries and four fresh fruits, we create and index that incorporates several aspects of SPS regulation. Our estimations suggest that, on average, quality standards and packaging and labeling issues are considered the most stringent. We also estimate a gravity model and find that SPS regulatory stringency, measured by this broad index, has negative and significant effect on traded volume.

KEYWORDS: Sanitary and Phytosanitary regulations, standards, non tariff barriers, gravity model, fruit trade

1. Introduction

In the last twenty years, consumer awareness on food and health issues has been increasing worldwide and media coverage of food threats has become more frequent and detailed. This has pushed governments' food safety policy agendas and the establishment of new regulatory bodies that dictate and monitor regulations and standards food producers and exporters have to comply with. Examples of these include contaminants and residue limits, process standards like Good Agricultural practices or, microbiological standards (Kim, 2009). The private sector has also established new requirements and certifications. The impact of regulations and standards on international trade are varied and complex. Among positive impacts, Jaffee and Henson (2004) recognize that safety regulations provide a common language within the supply chain that allows consumers to increase their trust in the products they are buying. Regulations and standards also provide a means for differentiation, allowing firms to better compete in the market. However, there is also evidence of losses to exporting countries due to stricter regulations and standards, which are particularly experienced by developing countries. (Otsuki et al., 2001a,b; Gebrehiwet et al., 2007; Disdier, 2008; Chen et al., 2008; Jongwanich, 2009; Yue et al., 2010). In turn, regulations and standards, and their stringency do not evolve equally across countries and regions, imposing additional complexities to export supply chains. The potentially negative impacts, especially on developing countries, can be aggravated if they lack adequate institutions and technical capacities, all which leads to the marginalization of weaker economic players, such as small farmers.

The effects in food safety regulations variation has been studied extensively. Yue et al. (2010), Jongwanish (2009), Diesdier *et al.* (2008), Otsuki *et al.*(2001) among others, have shown that stricter and more heterogeneous SPS standards can have a negative impact on trade, generally using as SPS measure the actual value of Maximum Residue Limits (MRL), toxin limits, or a detention or notification index. Thus, most studies have only analyzed one aspect of the SPS, measured as a quantitative index such as limits or number of notifications and detentions. Nevertheless, it is widely recognized that when accounting and comparing regulations, the number of requisites as well as their stringency need to be taken into account, as they translate into different levels of compliance difficulty for the exporter (Korinek *et al.*, 2008). To the best of our knowledge, no study has attempted to estimate the impact of broad measures of regulations and standards across a range of relevant export markets.

This study fulfills this gap in the literature by estimating the impact on trade of stricter SPS by creating an index that measures different dimensions and complexity of compliance of SPS measures. The index was constructed using the perception of exporters regarding the most relevant SPS regulations and standards in a 0 - 7 Likert scale. The index is then used in a gravity equation to measure its impact on trade volume. Gravity models have been widely used in the literature on estimating the impact of SPS standards and other non-tariff barriers using indexes as explanatory variables (Otsuki, et al. and b, 2001; Moenius, 2004; Fontagne et al., 2005; Kox and Lejour, 2005; Jayasuriya et al., 2006; Babool and Reed, 2007; Gebrehiwet et al., 2007). Therefore, the objective of this paper is fourfold: (i) to identify the most relevant measures of SPS regulations and standards for the case at hand (ii) to measure the perception of a sample of exporters regarding the stringency of specific SPS regulations and standards, (iii) to construct an index based on these perceptions, and (iv) to estimate the impact of the index on trade volume.

To achieve our objectives we analyze Chilean fresh fruit exports to 16 different markets (countries). Chile represents an interesting case for exploring the impact of SPS regulation and standards across countries and time, because although Chile is a middle-income country (World Bank, 2011) it is ranked as the top fresh fruit exporter of the Southern Hemisphere (Asociación Chilena de Fruta Fresca, 2011). In the last decade, fruit exports value has increased by more than 50%, reaching more than 100 destination markets (ODEPA, 2011). Furthermore, Chile's current agricultural policy is lead by a goal to become one of the top ten food exporters by 2015. In this context, Chile has adopted a proactive strategy, adapting institutions, instruments and business to comply with international standards and regulations and to become a relevant player in the agricultural export markets, in particular for fresh fruit exports.

2. Chilean fruit export sector

The Chilean agricultural sector is based on exports (mainly fruits). Hence, the implications of safety regulations are of high relevance. According to ODEPA (Oficina de Estudios y Políticas Agrarias) (2011), the three major agricultural exports are fresh grapes, wine, and fresh apples, which during 2010 represented export values of FOB USD 1,306 million, USD 1,442 million, and USD 625 million, respectively. Fresh fruit exports represent 25% of the total agricultural and forestry exports and 50% of the agricultural exports. The agricultural export sector in Chile evolved rapidly since the mid 70's with the economic liberalization of the country's economy. Chilean farmers began to plant apple orchards and vineyards in the Central Valley of Chile, convinced of the comparative advantages that Chile had on these products respect to the world markets. Later, producers started to diversify towards other fruit products and expanded to other regions of the country, and even to other countries.

This dynamic growth has positioned Chile as the world's leading exporter in table grapes, apples, plums and blueberries (Asociación Chilena de Fruta Fresca, 2011) and among the top exporters in most vegetable species of Mediterranean climate. In 2010, fruit exports reached USD 3,416 million, with table grapes, apples, kiwi and cherries comprising near 65% of this value (ODEPA, 2011). Chilean destination markets for fresh fruit produce are diverse, counting over 70, although the European Union (EU) and Unites States (US) represent the most important markets. This is relevant for our objectives since the EU and US have the most stringent market regulations worldwide (Gebrehiwet et al., 2007).

According to Asociación Chilena de Fruta Fresca (2010), the fruit export sector is composed by nearly 7,800 producers and more than 500 exporters. Exporters include large multinational and national companies to medium and small national companies. Among small exporters there are also producers handling the exporting process. Generally, large to medium exporters use a strategy of offering a broad range of fruit species to target a large number of markets, while small exporters focus on fewer species and target a smaller number of markets. Currently, Chile is exporting 75 fresh fruit species to over 100 markets (Asociación Chilena de Fruta Fresca, 2011). Fruit production is also relevant for the local economy in providing permanent and temporary employment (Bravo, 2011).

Production of fresh fruits in Chile is concentrated in the central regions of the country (32º 02' and 36 º 33' S) which comprises nearly 272,469 hectares and 81% of the total planted area (ODEPA, 2011). The productive advantages of the country are based on the mild Mediterranean climate, its condition as an off-season producer, and its natural geographic barriers which create exceptional phytosanitary conditions (Agosin and Bravo, 2009). Moreover, Chile has developed an institutional setting capable of supporting the export sector in compliance with the increasing requirements imposed by destination countries. On the one side, the Ministry of Agriculture and the Agricultural and Livestock Service, in charge of sanitary and phytosanitary regulations, have played an important role in aiding exporters and producers in the export certification procedures and in the negotiation of SPS aspects with partners all over the world. On the other side, the private sector has been working closely with the public sector in generating programs and instruments to help producers and exporters reach export standards mainly in the form of technical assistance and training programs for different levels of the export chain (Fulponi, 2007). The programs focus on technical aspects, irrigation, Integrated Pest Management, pest monitoring, among others; as well as Good Agricultural Practices and Quality Assurance Systems.

One of the main difficulties that fruit exporters and producers face today, which challenges their competitiveness, is the need to satisfy the requirements of many clients located in different countries and regions with their own regulations and standards and varying stringency levels. This requires firms to have multiple certifications which translate in multiple additional costs. To address this complexity, in 2002 ASOEX (Association of Chilean Exporters) started to develop the "ChileGAP" standard. The objective of this standard is to combine in one certification the requirements of the most important international clients. At present "ChileGAP" is recognized only by the EU and it is still in the process of obtaining a wider international recognition.

3. Methodology

3.1 Products and country selection

To construct and index of regulatory stringency we selected four fresh fruit products, namely grapes, apples, cherries and kiwifruit, and 16 destination markets. Because the information was obtained by a survey to fruit agents we had to concentrate in the most import species and markets. The fruits were selected since they represent more than 50% of the total Chilean fruit exports for past three years (ODEPA, 2011). In turn, the selection of importing markets was based on the following two criteria: (a) the countries are relevant destinations for all selected fruits; and (b) the countries comprise a diverse group from different continents and cultures, such that they represent a wide range of SPS regulations and standards. In 2010, grapes, apples and kiwifruit were exported to over 70 destinations. Ten of these countries comprised 68% to 87% of the total exports of each product. Cherries were shipped to 50 different countries and four markets accounted for 78% of the total exports (ODEPA, 2011). Using this information the selected countries were: USA, Canada, México, Colombia, Brazil, United Kingdom, The Netherlands, Spain, Russia, Taiwan, Hong Kong, Japan, China, India, United Arab Emirates and Saudi Arabia.

3.2 Sanitary and Phytosanitary regulation and standards perception stringency index

Exporters' perceptions were assessed regarding the stringency of SPS regulations and standards for each of the 16 markets using seven relevant items of regulations and standards. The items were selected using a panel of experts that stated, with a high degree of agreement, the following measures as the most relevant for fresh fruit: (i) Pests and quarantine treatments; (ii) Maximum Residue Limits (MRL) (iii) Microbiological regulations; (iv) Labeling, marking and packaging requirements (v) Good Agricultural Practices (GAP) (vi) quality standards (QS) ; and (vii) monitoring of pests.[1]

A simple closed-ended questionnaire was developed, tested and applied to a sample of fruit export firms. The questionnaire was divided into three sections. The first section provided a general description of the firm. The second section asked the respondents to evaluate the stringency of the seven different items in eight of the 16 markets considered in the study on a Likert scale from 0 to 7, where 0 was not stringent and 7 very high stringency. Two criteria were used to select the markets about which each firm would be asked: (i) the firm has to export to the market and (ii) at least 10 interviewees refer to that market. Information about the market destinations of each firm was obtained from Prochile, an export promoting public institution. The number of markets was reduced to only 8 since interviewees could not discriminate regarding stringency beyond this number of markets. The final section asked the respondents two additional questions: (i) to evaluate the efforts in terms of monetary and human resources that each of the seven measures imply for the firm, and (ii) the trend of stringency by market over time considering 2005 the starting year that represented 100% stringency and how the stringency increased year by year until 2009 in percentage terms.

The survey was pre-tested and validated with three exporting firms of differing size in April, 2010. The final version of the survey was applied in person to the managers in charge of quality and certifications for a sample of fresh fruit exporting firms between April and June, 2010. The sample of firms covered the O'Higgins and Maule regions in Chile (33º 50 'and 36º 33' S) and accounted for 46% of the fruit area in 2009, and, therefore, can be considered representative of the fresh fruit exporting sector. Prochile reported 63 fresh fruit exporting firms in 2009 that exported at least one of the selected species for values above USD 2,500 thousands FOB in that year. We restricted the sample based on the magnitude of sales to reduce the probability of selecting a firm which did not export to a high diversity of countries. In general, larger exporters go to a broad range of destinations, while smaller firms tend to specialize in fewer markets. From this total, 40 firms were selected randomly, representing 63% of the population.

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[1] A definition of each of these categories can be obtained in Non-Tariff measures proposed by TRAINS (http://ntb.unctad.org/about.aspx)

The responses of the survey allowed us to construct an index of stringency by item of regulation or standards and country. The stringency perception r_{in} of a specific regulation or standards by country is the simple average of the score given by the sample to this measure and country. On the other hand, the stringency perception of a country (market) as a whole for the year 2009 is estimated as the average of the stringency perception of each of the seven measures weighed by the percentage of effort that this category implies for the firms, as shown in equation 1. The effort invested in each category by the export firm is part of the complementary questions of the survey.

$$I_i = \sum_{n=1}^{N=7} r_{in} * w_n \quad (1)$$

In equation 1, I_i represents the stringency perception of country *i* and w_n is the percentage of effort required by the regulation or standard *n*. As explained before r_{in} is the stringency that country *i* give to standards or regulation *n*, therefore the index is just an weighted average of the perception a country has on the seven items of regulations and standards. The index estimated for 2009 was adjusted by the perceived increase in stringency declared by the exporters in section 3 of the survey. Therefore, we were able to estimate a changing stringency index by country over time (2005 - 2009)

3.3 Econometric model

Gravity models were developed to estimate the border effect in trade. These models rely on Newton's Law of Universal Gravitation formula, in which the attraction force between two objects is given by the masses of the objects, the distance between them, and a gravitational constant. Economists adapted this concept to explain trade flows between countries. In this case the "attraction force" would be the trade flow between two countries, the masses of the objects would be the sizes of their economies, and the distance is the distance between them (Tinbergen, 1962). Later on, several authors have tried to derive a theoretical model for the gravity equation, concluding that several theoretical approaches will lead to the same empirical model (Helpman and Krugman, 1985; Bergstrand, 1989; Deardorff, 1998; Evenett and Keller, 2002 and Anderson and Wincoop, 2003). In its simplest version, a gravity model states that the volume of exports between two trading partners is an increasing function of the national incomes and a decreasing function of the distance between them. Gravity models have been used in addressing the impact of regulations on trade because of their good performance and their reasonable data requirements to perform the estimations. Many of the studies that use this approach have focused on estimating the impact of a SPS standard or other non-tariff barriers using indexes as explanatory variables (Otsuki, et al. a and b, 2001; Moenius, 2004; Fontagne et al., 2005; Kox and Lejour, 2005; Jayasuriya et al., 2006; Babool and Reed, 2007; Gebrehiwet et al., 2007).

We used the model specification proposed by Anderson and Wincoop (2003, 2004) and applied by Emlinger *et al.*, (2008) since it assumes product differentiation applied at a product level. The estimated equation is the following:

$$\ln IMP_{ijt} = \beta_0 + \beta_1 \ln CONS_{ijt} + \beta_2 SHARE_{ijt} + \beta_3 \ln RELPRICE_{ijt} + \beta_4 \ln DIST_j + \beta_5 AGREE_{jt} + \beta_6 TARIFF_{ijt} + \beta_7 SINDEX_{ijt} + \beta_8 t + \beta_9 KIWI + \beta_{10} APPLES + \beta_{11} GRAPES + u_{ijt} \quad \text{Eq.1}$$

Where, *ln* represents natural logarithm; IMP_{ijt} are fruit *i* imports in volume of country *j* from Chile in year *t*; $CONS_{ijt}$ is consumption in volume of each fruit by the importer country *j* in year *t*, estimated as imports + production – exports; $SHARE_{ijt}$ is country *j* participation on world production in volume of each of the fruits; $DIST_j$ is the distance between Chile and the importing country; RELPRICE_{ijt} corresponds to the ratio between FOB and CIF price for each fruit and importing country; $AGREE_{ij}$ is a binary variable that reflects the existence of a Free Trade Agreement in year *t*; $TARIFF_{ijt}$ is the simple average tariff rate applied by the importing country in year *t* for each fruit; $SINDEX_{ijt}$ is the stringency index that measures the perception of relative stringency of each countries SPS measure for each fruit, as explained in the previous section, *t* is a linear trend to capture long run growth rate increase in volume imports, *KIWI*, *APPLES* and *GRAPES* are binary variables to isolate the impact of particular fruit product markets, and u_{ijt} is the error term. Data were collected for different sources for the 16 countries and four fruits from years 2002 to 2009. $SINDEX_{ijt}$ was estimated through the perception survey and the variation along time was estimated using the variation perception of exporters from 2005 to 2009. For the period 2002 to 2005 was fixed using the 2005 value. To avoid scale problems in the variables and to be able to estimate elasticity values, natural logarithm was applied to all variables except variables expressed in percentage, binary variables, the trend and the index. Table 1 provides the definition of each variable and the source of information.

Table 1. Variable description and sources

Variable	Description	Source
IMP	Import volume of each fruit from Chile	ODEPA, Chile
CONS	Fruit consumption in each country. It was estimated by the equation Production+ imports - exports	FAO
SHARE	Fruit production divided by world fruit production	FAO
RELPRICE	FAO Chilean value by ton/ average CIF price in the import country by ton	FOB value: ODEPA CIF value: Comtrade
DIST	Lineal distance between capital of Chile and the exporting country	www.horlogeparlante.com/spanish/distance.php
AGREE	Binary variable that represent the existence of a Free Trade Agreement	DIRECON, Chile
TARIFF	Simple average tariff rate imposed by the exporting country to Chile.	WITS
SINDEX	Stringency index estimated by the authors	Own construction
Trend	Lineal trend starting from 0 incresing by 1 unit each year.	Own Construction

4. Results and discussion

4.1 Perception of stringency in SPS regulations and standards

Table 2 outlines the main characteristics of the sample used to measure perception on food safety stringency for the selected markets. It can be seen that there is a large range of firm sizes providing diversity in the study. Along with the diversity in size, the number of exported fruits and number of markets also varies. Moreover, we can see that 70% of the sample is associated with ASOEX (Exporters Association) and 70% also has productive orchards.

Table 2. Characteristics of the fruit exporting firms included in the analysis

Firm characteristic	Average	Range
Annual export value (in million USD)	27.8	2.8 – 136.8
Number of employees (including temporary employment)	853	6 – 7,000
Lifespan (in years)	20	3 – 57
Number of exported fruits species	9	1 – 20
Number of destination markets	21	3 – 47
Percentage of firms that own productive orchards	70%	
Percentage of firms associated to ASOEX	70%	

Note: Values refer to year 2009

On the other side, Table 3 shows the perception in 0 – 7 Likert scale regarding stringency. In pests and quarantine treatments Mexico appears as the most stringent country, and moreover according to the interviewed firms this score is also the highest among all other measures and countries. China is next in the ranking with a score of 5.5, followed by Taiwan and Colombia with 4.8 and 4.7, respectively. The least stringent countries in this category are European countries and those in the Middle East, with Saudi Arabia perceived as the least complex. At the same time, pests monitoring regulation is highly correlated with pests and quarantine treatments (correlation coefficient of 0.96), giving most of the countries practically the same score in both regulatory measures. This is no the case with contaminants regulation where there the ranking of countries for MRL and microbiological regulations are different.

First, in microbiological regulation the perceived stringency is the lowest among all other regulations, with scores between 1.8 and 3.0, which suggests that this is not a relevant issue for exporters. Nevertheless, the countries perceived as the most stringent are China, in first place, followed by the US and the United Kingdom, in second, and Mexico in third. The countries that generate a perception of stringency do in effect have a microbiological regulation in the description of sanitary measures in section 4.1, except for the UK, that does not present an official requirement. The perception in this case could be influenced by private standards, that in the UK are stringent in terms of contaminants.

The highest stringency perception of MRL reached a score of 5.6, for the UK. It is interesting to observe that the other European countries considered in this study (Spain and The Netherlands) obtained lower scores (4.9 and 4.3, respectively), whereas they share the same regulation in sanitary issues. Retailers in each country may have different private standards that could influence the perception of exporters because of their experience in compliance with both public and private requirements. Two other countries that appear with a relatively high score are Russia and Taiwan, even higher than Spain and the Netherlands. The countries perceived as the least stringent are Saudi Arabia, United Arabs Emirates and India. According to the table of official regulations, the least stringent countries in this matter were Colombia and Hong Kong which share the Codex regulation.

As expected, the perception of stringency in GAP is highly correlated to MRL (correlation coefficient of 0.73), since both regulations are complementary in their safety objective. The most stringent country in GAP is again the United Kingdom with a score of 5.6 followed by Taiwan, Spain, The Netherlands, and in fourth place Russia. In the case of the European Union countries and Russia, GAP not only focuses on food safety, but also on labor well-being, and this is the reason why it can be considered more stringent.

Quality standards appear to be the most stringent regulation among the other six, with an average stringency score of 4.9, followed by labeling, marking and packaging with 4.6. This is an interesting result that suggests that neither this items which are more commonly associated with private regulations seem to be perceived as the most stringent.

The lowest quality standard score is 4.0, which are the cases of Colombia and Brazil. Saudi Arabia also has a low score with 4.1. There is a middle level stringency group of countries composed by the US, Canada, Russia, India, Spain, The Netherlands, Mexico and the United Arabs Emirates. Except for North American countries (USA, Canada and Mexico), this group does not share specific characteristics; they belong to different continents, represent developed and developing countries and have cultural differences. Looking at the group of most stringent countries in quality standards, it can be seen that Asian countries have the lead. The most stringent country in quality is China with a score of 6.2, followed by Taiwan, Japan and Hong Kong. The UK also appears in this list.

Labeling, marking and packaging requirements are also perceived as stringent regulations among all countries; however, the most stringent are: Mexico, in first place, followed by Taiwan, the United Kingdom and China. In the case of Mexico, Taiwan and China the stringency is related to phytosanitary issues. However, it could also be seen as related to quality issues, since Taiwan, China and the UK also ranked high in quality standards.

Table 3. Values of stringency for SPS regulations and standards in selected markets as perceived by Chilean exporting firms[(1)]

	Pests & Quarantine treatments	Maximum Residue limits	Microbiological Regulations.	Labeling, marking and packaging requirements	Good Agricultural Practives	Quality standards	Pests Monitoring.	**Stringency Index**
USA	3.4	4.1	2.8	4.8	4.4	5.0	3.4	4.8
Mexico	6.5	4.0	2.6	5.8	4.2	4.7	6.1	5.8
Canada	3.0	3.6	2.5	4.4	4.2	5.2	3.0	4.4
Colombia	4.7	3.3	1.9	4.8	3.4	4.0	5.2	4.8
Brazil	4.0	3.2	1.8	4.4	2.9	4.0	4.1	4.4
Netherlands	2.0	4.3	2.3	4.2	4.6	4.9	2.5	4.2

U. Kingdom	2.1	5.6	2.8	5.1	5.7	5.6	2.5	5.1
Spain	2.2	4.9	2.4	4.3	4.6	4.7	2.8	4.3
Hong-Kong	2.7	4.0	1.,8	4.1	3.5	5.4	3.5	4.1
Taiwan	4.8	5.0	2.3	5.2	4.8	5.4	4.9	5.2
China	5.5	4.4	3.0	5.0	3.4	6.2	5.3	5.0
Japan	3.8	4.1	2.5	4.6	2.9	5.5	3.4	4.6
Saudi Arabia	1.6	1.8	1.7	3.5	2.3	4.1	1.6	3.5
Arabs Emirates	2.3	2.7	2.1	3.8	2.5	4.6	2.3	3.8
India	3.6	2.7	1.6	4.0	2.2	4.8	3.1	4.0
Russia	3.4	5.3	1.9	4.8	4.4	4.4	3.3	4.8
Average	**3.5**	**3.9**	**2.3**	**4.6**	**3.8**	**4.9**	**3.6**	--

(1) Stringency is measured on an ordinal scale from 0 to 7, with 0 being the lowest and 7 the highest stringency.

Figure 1 shows the average score of perceived stringency by country and its standard deviation. It can be seen that in general the sample had a high agreement in evaluating the most stringent group, as they present a low standard deviation. On the other hand, the low stringent group presents a high coefficient of variation. It could be thought that, in general, the countries presented here are less known by the respondents and, therefore, the perceptions tend to vary more. The middle group presents, in general, similar coefficients of variation as well as grade values, however, again it is relevant to mention that although the average grade value could be similar, the restrictive regulations in some countries differ from others.

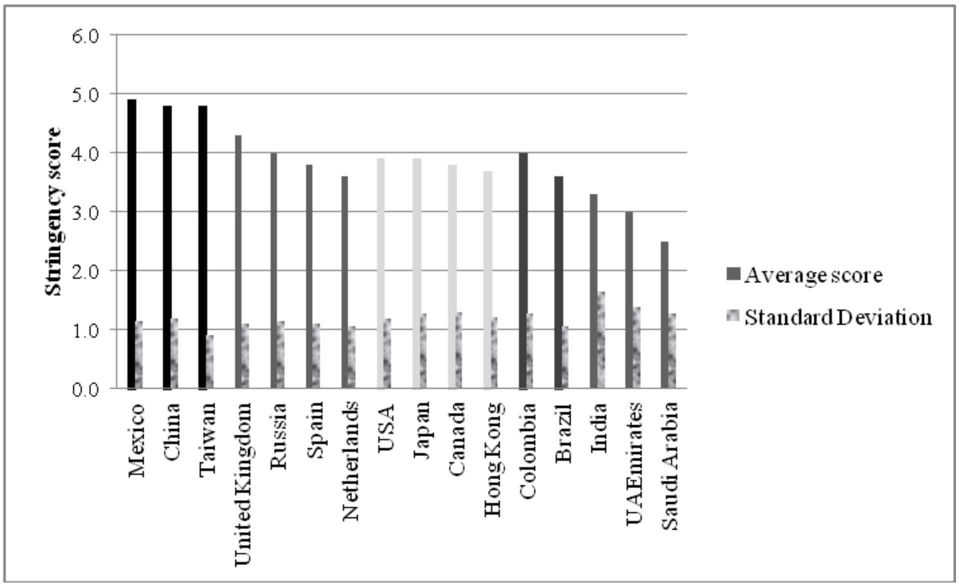

Figure 1. Ranking of markets according to the degree of stringency as perceived by exporting firms.

The question regarding the evolution of stringency since 2005 to 2009 reveal that not all countries share the same evolution regarding overall stringency. The tendency is that countries have become more stringent in the last five years. Only Saudi Arabia and Arabs Emirates show no increments, which is also consistent with the perception of being the least stringent countries. The countries with the highest stringency perception also have the highest increment over time. The average increase for Mexico is 40%, implying that today Mexico exhibits regulations that are 40% more stringent than five years ago. On the other hand, Russia has also experienced a rapid increase in the perception of stringency, with an increment of 29%, followed by Taiwan and the United Kingdom with 22%, and China with a 21% increase. The average increment of stringency among all countries is 15% and the range goes from 40% to 0%, showing that regulations do not evolve in the same way. Moreover, the countries that are considered more stringent today, in general, are the ones with higher increments in the last five years.

4.2 Impact of SPS regulations and standards over trade volume

To evaluate how stringency in SPS regulations and standards measured as the exporter perception affect trade Eq. 1 was estimated. Table 4 shows the results of two estimation procedures, using a pooled regression and panel data. The panel data was estimated using Generalized Lest Squares estimators. In both cases we can observe that the models are significant and present a reasonable adjustment with a R^2 of 0.62 in the case of the pooled regression and 0.55 in the panel data estimation. The variables lnCONS is in both cases, as expected, positive and significant with even a similar value, implying that as consumption of fruits in each country increases, it has a positive impact on the exported volume from Chile with an elasticity of around 0.3. The elasticity value of the distance is also consistent with the theory, being negative and significant in both models. The elasticity value tends to be slightly higher in the panel estimation with -1.1, compared to -0.85 in the pooled estimation. The impact of the relative price, measured as the ratio between FOB and CIF prices is also consistent with the theory, being negative and significant in both estimations. In this case, we can observe that as the price of the Chilean product increases related to the average domestic price of the same product, the exports from Chile decreases. Although, the relation persists in both estimations, it is relevant to notice that the elasticity value of the coefficient changes dramatically, implying that one of the models performs better. A similar conclusion can be derived for the variable SHARE that represents the country size in the global production of the fruit is negative and significant in the pooled regression and negative but not significant in the panel data regression, therefore both models have different performance regarding this variable.

In the model, we included two variables related to the access to the market, AGREE and TARIFF. The first variable, although positive is not significant in both estimations. AGREE is a binary variable that captures if Chile had a trade agreement with the specific country, therefore was expected to be positive. Since it is not significant, this implies that the agreement does not capture a special effect on trade. This result could have two explanations: (i) since most of the countries in the sample does have an agreement with Chile the variable may not have enough variability to capture the effect, or (ii) the effect is captured by other variables like TARIFF, which represent the simple average tariff rate that Chile has with each country and for each fruit in a specific year. TARIFF is significant and negative, implying that higher tariff rates restrict exports. Again, both models although, show consistent results with the theory, generate different coefficient values.

It is relevant to mention as well, that in both estimation the trend variable has a significant and positive value and in both cases very similar, 0.13 and 0.14. This value implies that imports from the 16 countries have increase on average around a 14% each year, showing that there is a long run trend in the import-export series. The model also supports the idea that each fruit has on average, a different level of imports from all countries, since the binary variables that reflect the fruit impact are significant in all cases and in both models. This is a reasonable result since cherries, kiwifruits, apples and grapes are fruits with different market dynamics. Cherries are almost a specialty product, expensive and with a small market compared to apples and grapes. Kiwi can be considered an intermediate case.

Finally, the stringency index (SINDEX) has a significant and negative impact in both variables. This result confirms that more stringent regulations and standards in SPS do impact negatively exports of developing countries as also concluded by Otsuki et al. (2001a,b), Gebrehiwet et al. (2007), Disdier (2008), Jongwanich (2009); You (2010) and Chan (2010). The difference of our results are that we conclude so by using a more complex dimension of SPS and not particular or specific items of SPS regulations as before. Although our findings are preliminary results of this study, they are a strong suggestion that we can expect that non tariff barriers in fruit trade, are restricting international trade, and in most cases affecting developing countries, such as Chile.

Table 4. Estimation results of panel and pooled gravity model

	Pooled Regression			Random Effect Panel regression(1)		
Variable	Estimated coefficient	Standard Error	P-value	Estimated coefficient	Standard Error	P-value
Constant	12.83	1.82	<0.001	13.38	4.91	<0.001
LnCONS	0.36	0.05	<0.001	0.32	0.10	<0.001
SHARE	-3.21	1.67	0.05	-2.09	3.59	0.56
LnRELPRICE	-1.40	0.18	<0.001	-0.37	0.15	0.02
LnDIST	-0.85	0.18	<0.001	-1.13	0.45	0.01
AGREE	0.04	0.22	0.84	0.12	0.13	0.33
TARIFF	-0.04	0.006	<0.001	-0.001	0.007	0.78
SINDEX	-0.81	0.18	<0.001	-0.34	0.10	<0.001
Trend	0.14	0.04	<0.001	0.13	0.02	<0.001
KIWI	1.41	0.25	<0.001	2.24	0.68	<0.001
APPLE	2.07	0.33	<0.001	2.61	0.79	<0.001
GRAPES	1.7	0.31	<0.001	2.54	0.76	<0.001
R-sq	0.62			0.55		
Significance of the model	F(11,446) = 67.63			Wald chi2=158.03		
Number of observations	458			458		

(1) Random effect was estimated using GLS estimator

5. Conclusions

In many countries, SPS regulations are becoming increasingly stringent in an effort to address food safety issues that threat their population health. But this new regulations and standards can have a detrimental effect on developing countries exports. This paper analyzes the effect that stricter regulations and standards, as perceived by exporters, have had on fresh fruit exports from Chile. The evidence supports other results in the literature in that stricter regulations do have a negative impact in trade. Moreover, the results also show that exporters perceive difference in stringency across countries and that this stringency has become higher in time and not in the same proportion, leaving to the question of how far are countries and markets going to go in generating higher barriers to trade and how much more are developing countries to loose in this increasing spiral. We also find that on average, quality standards and packaging and labeling issues are considered the most stringent.

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