Trade impact of "new" and "old" sanitary standards over MERCOSUR´s beef exports: is it worth fishing in troubled waters?

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Abstract

This article quantifies the trade impact of relatively "new" and "old" sanitary standards for bovine meat. In particular, the European Union´s decision to ban hormone-treated beef and the recognition of Foot-and-Mouse-Disease status (FMD) on Argentina, Brazil, Paraguay and Uruguay exports. Counterintuitively, given that MERCOSUR´s countries have never produced meat with animals treated with growth promotants, I found a negative and significant impact of this new standard. However, when the impact is measured only for the boneless meat, proxy of high-quality meat, I found a positive impact. Moreover, it is widely known that the recognition of freedom status of certain disease by a country is not only a sanitary issue neither an automatic process. While a country loses its free-status of certain disease as soon as an outbreak is detected, the recovery of its free-status is a slow and long process. To take account for this asymmetry I construct a new measure, the difference of status between importer and exporter, as a proxy of the impact of the delay on the recovery of the status. I found a negative and significant association between exports and the technical variable, number of outbreaks per year of the FMD, and also between exports and the differences in FMD status. These result shows that I would underestimate the trade effects of sanitary standards if I include only the technical variable.

Key Words: gravity model, Poisson regression, agri-food trade

JEL: F14, Q17, C23

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1 Introduction

In recent years, some developed countries have adopted new and more stringent measures in order to protect human and animal health and life. The exporters firms have complied with these new regulations to ensure to have market access to importing countries. This article quantifies the trade impact of a relatively new sanitary standard, the European Union´s decision to ban hormone-treated beef (fully implemented in 1989), and a classic sanitary standard: the recognition of Foot-and-Mouse-Disease status (FMD) in Argentina, Brazil, Paraguay and Uruguay beef exports (1983-2013). Counterintuitively, given that MERCOSUR´s countries have never produced meat with animals treated with growth promotants hormones, I found a negative and significant impact of this new standard. However, when the impact is measured only for the boneless meat, proxy of high-quality meat, I found a positive impact.

Moreover, in agricultural trade it is widely known that the recognition of freedom status of certain disease or pest by an importing country is not only a sanitary issue neither an automatic process. While a country loses its free-status of certain disease as soon as an outbreak is detected, the recovery of its free-status is a slow and long process.. For instance, the APHIS Veterinary Services of the United States reports that in the case of Foot and Mouth Disease (FMD), the recognition of the free-status takes an average of 429 days following the last case[2]. So, I would be underestimating the effect of the non compliance if only a technical variable is used, as is usual in the literature, such as the number of outbreaks or the maximal residual level, to estimate the impact of the measure. In order to to quantify the impact of the delay on the recovery of the status, I propose and construct a new measure. I propose a linear combination, the difference of the status recognition given by the World Organization of Animal

[2] See: https://www.aphis.usda.gov/animal_health/emergency_management/downloads/fmd_rrg_freedom_and_vaccination.pdf

Health (OIE)[3] between the exporter and the importer countries as a new variable to be included in the estimation. I found a negative and significant association between exports and the technical variable and also between exports and the differences in FMD status.

In the last decades there has been a gradual but steady process of reducing "traditional" components of trade costs. The negotiations at multilateral level, the signing of Regional Trade Agreements (RTA) and the unilateral opening of the economies has led to a significant reduction of tariff barriers over the last 30 years. Additionally, the increased cargo containerization, with the availability of larger ships and the intensification of competition among shipping firms has determined a significant reduction in transport costs (Blyde 2014). Likewise, the development of new information and communication technologies allowed the reduction of costs of coordinating tasks remotely (Baldwin 2011).

These trends have redirected the focus of the analysis to trade effects of tariff barriers to non-tariff barriers (NTB), especially to technical requirements, sanitary and phytosanitary measures and private standards. The rationality behind the existence of such measures is the asymmetric information between producers and consumers. In order to overcome this market failure, the provision of public goods to protect human and/or animal life and health raise as a necessary action. A standard provides more information (guarantees) to consumers about the characteristics, production process and safety of the product. By certifying its products with the standards, firms show the quality of their products enabling a better market access and the possibility to sell them at market prices, probably higher than international prices. Therefore, through the compliance of a standard, firms can differentiate their products and enhance their exports.

[3] The recognition of a certain status is a national procedure. So, in fact, the recognition by the OIE is only the first step for regain the status in international markets.

However, the certification process has implementation costs[4]. For example, the compliance may demand new certificates, provide evidence of some way of production or even lead to new controls and inspections. These costs can hamper exports by imposing sizeable costs in terms of money, time or both.

There is a trade-off between implementation costs and the potential gains from an increased market access. The effect of a sanitary standard on trade flows between countries is basically an empirical question. The most commonly strategy used in the literature to address the trade impact of a specific sanitary measure is the estimation of a gravity model. Following Silva and Tenreyro (2006), in this paper I use the Poisson Pseudo-Maximum Likelihood (Poisson PML) estimator to estimate a gravity type model. This methodology overcomes some of the problems associated to the use of Ordinary Least Squares (OLS): first, includes the observations of the dependent variable with zeros (avoiding selection bias), and second, allow for the specification and estimation in their multiplicative form. Silva and Tenreyro (2006) show that under heteroskedasticity, the parameters of log-linearized models estimated by OLS lead to biased estimates of the elasticities.

According to modern trade theory, the trade impact of these measures can affect the value (volume) of exports to a particular country (intensive margin) and/or the number of qualified exporters that sell to that market (extensive margin)[5].

Due to the existence of these standards, multilateral disciplines on Sanitary and Phytosanitary Measures (SPS) have been adopted in the last round of concluded negotiations at the World Trade Organization (WTO) (SPS Agreement of GATT). The agreement allows countries to adopt sanitary measures if: 1) the measure is based on scientific evidence and 2) it does not

[4] Even the standard could be constituted as an arbitrary discrimination between domestic production and imports, with similar effects like a tariff or an import quota. In this paper I ignore this kind of misuse of the standard.

[5] Due to the inexistence of disaggregated data, this important issue is not addressed in this paper. See Schuster and Maertens (2013) and Disdier, Fontagné and Cadot (2015) for interesting findings on these issues.

arbitrarily discriminate between importing countries. As is shown in this paper, the first is the core of the beef hormone dispute between United States (US) and the European Union (EU), while fulfillment of the second point impacts MERCOSUR exports. Before the approval of the new standard, Argentina, Brazil, Paraguay and Uruguay did not have to prove that they do not use growth promotants. After the implementation, it is mandatory for all the countries (MFN) to prove its status in order to sell to EU. Thus, it is not only enough to being disease free but is necessary to prove it.

If the implementation costs have negative effects on exports, at least for developing countries, then is worth using institutions or mechanisms to reduce them. These costs could be minimized by signing a Mutual Recognition Agreements (MRA). An MRA is a Trade Facilitation (TF) agreement between two or more countries to accept conformity assessments each other[6]. Essentially, the harmonization of certain rules between countries based on internationally accepted practices promote greater predictability and efficiency. Then, an MRA is a tool that reduces implementation costs. So, the higher the implementation costs, the greater the gains from an MRA. An optimal MRA is one based on international standards and when these standards do not exist, it is crucial that is based and maintained with scientific evidence (see article 2 of SPS Agreement). This paper shows there are significant gains derived from an MRA agreement in this industry.

As already mentioned, gravity models[7] have been the most frequently tool used to estimate the effects of sanitary measures. As in the estimation of the effects of any other NTBs, data issues arise as the main challenge to incorporate the standards in the estimation. The enforcement of a sanitary requirement has often been introduced in different ways into gravity models. Some authors employ the inventory approach, using coverage or frequency indexes (Fontagné, von Kirchbach and Mimouni 2005; Schlueter, Wieck and Heckelei

[6] Conformity assessment is any activity to determine that a process or a product meets sanitary standard.

[7] Disdier and Van Tongeren 2010 provide a useful survey of all the methodologies applied to explore SPS/TBT impacts, gravity-type models included.

2009), others use a dummy variable (presence/non-presence) (Disdier, Fontagné and Mimouni, 2008; Disdier and Fontagné 2010). In other studies, an ad-valorem equivalent (AVE) is computed (Goetz, Nunes de Faria, Rau, Otsuki, Shutes and Winchester 2012). Other authors introduce the standard in a more direct way, by introducing the technical variable that the exporter must comply (maximum residual level, Disdier and Mariette 2010; level of aflotaxin allowed, Beghin, and Xiong 2012). A variant of this last approach uses the similarity in the technical regulation (e.g. Drogué and Demaria 2010; Olper, Raimondi and Vigani 2010).

Inventory approach uses coverage or frequency[8] indexes. These indexes allow the estimation of the extent of trade covered by NTBs. The main sources of information used to construct these indexes are World Trade Organization (WTO) notifications and government publications. This approach can introduce a significant bias for at least two reasons. First, a WTO notification may not necessarily indicate that more trade limitations are imposed. Secondly, the standard maybe is not the binding restriction to the exporter[9]. Additionally, following Laird (1997), while the frequency index does not reflect the relative value of the affected products, the coverage index has the opposite problem, the endogeneity of the import value weights. The latter also arises in case of computing the ad-valorem equivalent (AVE) for the standard. The AVE is the difference between the domestic and the international (free world) price of the product, so it takes into account all the factors that make that domestic and international prices differ, e.g, NTB, market structures and transports costs.

The use of the technical variable (and/or the similarity approach) allows the impact analysis of a specific measure, but in this case the standard would be the binding restriction. This research is related to the literature of the effects of technical standards on trade. Disdier and Marette (2010) explore the impact on trade of chloramphenicol MRL standards on crustacean products by European

[8] According to the OECD Glossary, the frequency ratio is the number of tariff lines subject to an NTB, while the coverage ratio refers to the sharing of a country´s import that is affected by the NTB.

[9] Assume that imports are forbidden and the country also changes its sanitary standards. In this case, nothing relevant has change for the exporters.

Union (EU), US, Canada and Japan from 2001 to 2006 using a gravity model. They found that traded volumes were negatively affected by reinforcement of the standard. Xiong and Beghin (2012) assessed the impact on African agricultural exports as a result of the harmonization of the MRL for aflatoxins (2002). Using a gravity model, the authors did not find significant effects of the aflatoxins on exports from 1989 to 2006.

Vigani, Raimondi and Olper (2009) addressed the impact on trade of similarity (dissimilarity) between GMO regulations in exporting and importing countries for 60 countries from 2005 to 2007. They show that countries with greater similarities in GMO regulations reported higher bilateral trade flows. They suggest that regulation stringency is not the only significant variable for trade, and show that harmonization also impact trade flows. Disdier, Fontagné and Cadot (2012) follow a similar approach to study the effects of TBT clauses in trade agreements between north-south countries. They find that, as expected, trade agreements with TBT clauses increased their bilateral trade. However, they find a negative impact of these agreements on south-south trade.

This paper contributes the literature on the effects of sanitary standards and harmonization of sanitary measures in three ways. First, it shows that the effects of the sanitary status have an asymmetrically impact on the country's exports. While losing a free-status disease occurs as soon as an outbreak is detected, the recovery of the status is a slow and long process. To the best of my knowledge, this paper proposes a measure that takes into account this asymmetry, using a combination of both, a technical variable and the similarity in status between countries. Second, it shows that even harmless seemingly measures adopted for third countries have impacts on trade. It was shown above how a dispute between EU and US brought new and stricter standards for all the countries and how these new standards affect trade. And finally, reflects that as important as reaching a sanitary status is to be able to prove it to buyer countries.

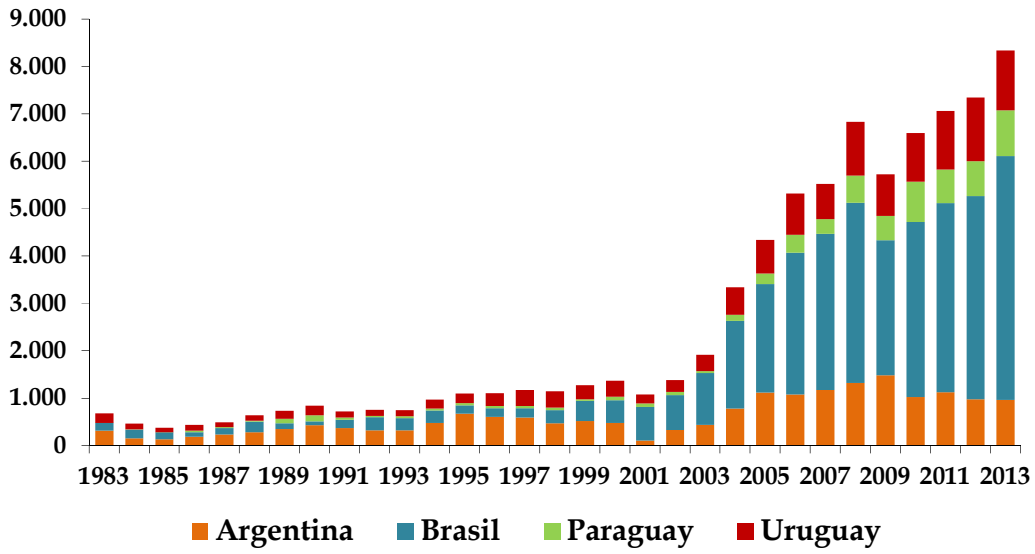
The rest of the paper is organized as follows. Section 2 provides some brief statistics of beef's MERCOSUR production and its demand. It also

introduces the relevance of the FMD status and summarizes the hormone dispute between EU and US. Section 3 describes the econometric specification and the data. Section 4 reports the estimation results. Finally, section 5 concludes.

2 Bovine meat industry in Argentina, Brazil, Paraguay and Uruguay.

Bovine meat industry has been an historical and traditional sector in Argentina and Uruguay since the end of XIX century and became a very important source of economic growth and exports throughout the entire twentieth century. Likewise, this sector has acquired relevance in Brazil and Paraguay. In fact, 2012 COMTRADE United Nations report shows that Argentina, Brazil, Paraguay and Uruguay are among the fifteen major exporting countries of bovine meat and account for one fifth of the 2012 world exports[10].

Figure N°1: Mercosur´s bovine meat exports (Million U$S)



Source: Own elaboration based on COMTRADE data

[10] See: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CB4QFjAAahUKEwiYjPz28dPHAhWIHR4KHYyHDvM&url=http%3A%2F%2Fcomtrade.un.org%2Fpb%2FFileFetch.aspx%3FdocID%3D3136%26type%3Dcommodity%2520pages&ei=wpTkVZijB4i7eIyPupgP&usg=AFQjCNH4pwwAesSniAs7P2Tvr-TcYauE1Q&sig2=1UOV_tt-oTjLdfEo7iBiZw&cad=rja

Figure No. 1 shows beef exports values by country between 1983 and 2013. It is noted that exports rise since nearly U$S 700 million in 1983 to more than U$S 8,300 million in 2013. Significant changes are also observed in the share by country. During the eighties and nineties Argentina was clearly the largest exporter, followed by Uruguay or Brazil, who alternated as second regional supplier. Paraguay did not report exports at the beginning of the eighties and had a marginal market share since middle eighties, which increased significantly at the beginning of the twenty first century. Similarly, in this period, Brazil's share rise sharply and the country consolidates as the major exporter of the region and the second exporter in the world[11]. Meanwhile, Argentina remained quite stable from the beginning of the century. In fact, in 2013, Paraguay and Argentina reported similar export values.

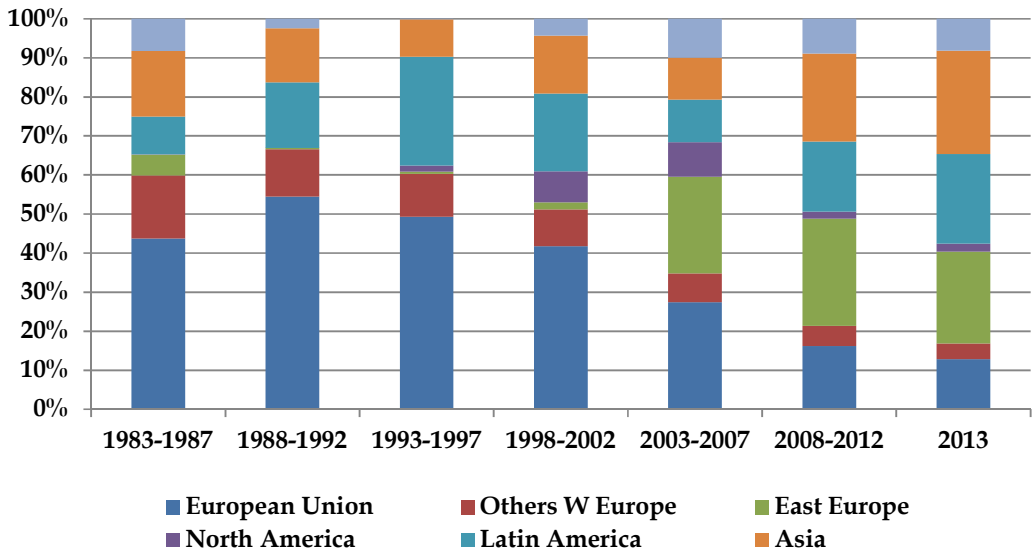
The emergence of Brazil and Paraguay as relevant exporters of bovine meat is also noticeable when the market access conditions to the strictest markets are analyzed. While in the eighties only Argentina and Uruguay exhibited an open tariff-quota for high-quality beef at the European Union (EU), nowadays also Brazil (since 1994) and Paraguay (since 2002) benefit from it[12]. As an example, the Resolution N° 593/2013[13] of European Commission (EC), which provides current conditions for the administration of a tariff-quota for high quality bovine meat (commonly knows as Hilton Quota), establishes an ad valorem tariff of 20% for 29,500 tons from Argentina, 6,300 tons from Uruguay, 10,000 tons from Brazil and 1,000 tons from Paraguay. In the case of US, market access conditions are similar with the exception that Paraguay is still excluded from the quota.

These tariff-quotas are available to use by countries only if they comply with a list of detailed rules that include: all requisites established in the system of import or export licenses, certificates of sanitary status, among others formal

[11] See the link in footnote 10. Australia is the first exporter of bovine meat.
[12] See Annex 1
[13] See http://eur-lex.europa.eu/legal content/EN/TXT/HTML/?uri=CELEX:32013R0593&from=EN

requirements. Therefore, benefitting from a tariff-quota is a necessary condition to have market access but in no case is a sufficient condition.

Figure N°2: MERCOSUR's exports by destination region



Source: Own elaboration based on COMTRADE data

Figure N°2 shows that in the twentieth century, EU was the main destination market for bovine meat produced in MERCOSUR´s countries. EU's countries bought between 42% (1998-2002) and 54% (1988-1992) of the total value exported. The second region of importance was Latin America. This pattern changed at the beginning of twenty-first century, before the 2008 financial crisis. Nowadays, Asia is the most important destination accounting for 26% of MERCOSUR's exports, followed by Eastern Europe and Latin America (both with nearly 23%). Figure N°2 also shows that North America highest share was reached over the 2003-2007 period when 9% of the exports were acquired by this market.

Between 1983 and 2013 some new sanitary standards were introduced by importing countries and also the "old" ones got stricter by the addition of new conditions.

In first place, and as pointed out by Sutmoller, Barteling, Casas and Sumption (2003), even though foot-and-mouth disease (FMD) has been known for hundreds years, in the nineties, the disease was controlled and eradicated

along the EU as a result of a systematic vaccination programs and EU became a FMD-free region. After that, vaccination was discontinued in EU. Following these episodes EU and USA, where FMD has not been detected since 1929, set regulations not allowing the introduction of meat from countries that were not FMD-free. These regulations also applied for some countries that hold the status of FMD-free with vaccination. On the basis that FMD is not eradicated in MERCOSUR's countries and considering that, even an endemic disease was registered in some of those years, a negative impact of these measures on meat exports is expected.

In 1986, the United Kingdom was diagnosed for the first time with the Bovine Spongiform Encephalopathy (BSE) disease, commonly known as "mad cow disease". Since that, a new sanitary standard has been incorporated for exports of bovine meat. MERCOSUR's countries are free of BSE, a positive impact of this new standard on beef exports is expected.

And last but not least, in 1989 the EU fully implemented a ban on imports of meat and meat products form cattle treated with growth promotants[14]. By that time, this technology was basically used by US and Canada. Given that MERCOSUR countries have never employed this production technique, the introduction of the ban, decreased the competition faced in the EU's market by MERCOSUR meat. In response to the ban, the US imposed retaliatory tariffs of 100% ad-valorem duty on some food products, including bovine meat. This retaliation remained in effect until 1996 but in 1999, the US introduced it again. Finally, by 2009 an agreement was reached by the EU and US resolving the dispute and signing a memorandum of understanding (MOU). Currently, EU has granted market access to US exports of beef (free from growth promotants), and US has suspended the application of higher duties for imported EU products. In summary, new and strictest standard has been imposed on how to produce bovine meat if the country wants access to the

[14] See Johnson and Hanrahan (2010) and Johnson (2015) for a detailed survey of the long-standing trade dispute between EU and US.

EU market. It is expected that this long-standing trade dispute between EU and US has a positive impact on MERCOSUR[15].

3 Data issues and econometric specification

Since the sixties, gravity equation has been used in empirical studies to determine the impact of certain policies on trade flows. The gravity equation applied to trade flows, established that trade flows between two countries was proportional to the product of their Gross Domestic Products (GDP) and inversely proportional to the distance between them. This application of Newton's gravitational law has evolved to achieve the following structural design:

$$X_{ij} = \frac{Y_i}{\pi_i^{-\theta}} . T_{ij}^{-\theta} . \frac{E_j}{P_j^{-\theta}} \quad (1)$$

where Y_i refers to the production of country *i*; E_j is the total expenditure of country *j*; T_{ij} captures the trade costs from *i* to *j* and θ the elasticity of trade flows to trade costs. Finally, $P_j^{-\theta}$ and $\pi_i^{-\theta}$ are the "multilateral resistance" indexes defined by Anderson and van Wincoop (2003). As pointed by Anderson (2011) the "inward" *i´*s resistance to trade with all regions, a kind of openness index, and "outward" *j´*s resistance to trade with all regions, a kind of market access index, should satisfy the following constraints for consistency:

$$P_j^{-\theta} = \sum_i \frac{Y_i T_{ij}^{-\theta}}{\pi_i^{-\theta}} \quad (2)$$

$$\pi_i^{-\theta} = \sum_j \frac{E_j T_{ij}^{-\theta}}{P_j^{-\theta}} \quad (3)$$

The structural gravity equation is defined as the trade flows that satisfy (1) subject to (2) and (3). As Anderson and Yotov (2010) shown when we find a $P_j^{-\theta}$ and $\pi_i^{-\theta}$ that satisfy equations (2) and (3), then $\alpha P_j^{-\theta}$ and $\pi_i^{-\theta}/\alpha$ are also

[15] See Johnson (2015) for a complete and detailed chronology of the U.S-EU beef hormone dispute.

solutions, given any α>0. In order to solve this indeterminacy a normalization is necessary for a benchmark importer. As Fally (2015) pointed out this specification is consistent with various types of models; it can be derived from classical models as Krugman (1980) and also with more recent theoretical developments such as Eaton and Kortum (2002), Anderson and van Wincoop (2003), Melitz (2003) or Chaney (2008), among others. For the purpose of estimating equation (1), this work uses the reduced form of the model. Taking logs in equation (1), introducing exporter and importer fixed effects to capture the terms of the exporter ($e_i = Ln\ (\frac{Y_i}{\pi_i^{-\theta}})$) and the importer ($m_j = Ln\ (\frac{E_j}{P_j^{-\theta}})$), and finally applying *exp* for return to work in levels, the equation (1) can be re-written as:

$$X_{ij} = exp\left[e_i - \theta Ln\, T_{ij} + m_j\right] + \varepsilon_{ij} \qquad (4)$$

where ε_{ij} represents an error term.[16] The use of fixed effects instead of log GDPs and other variables has at least three advantages (Head and Mayer (2014)): First, fixed effects do not need to impose major assumptions about the underlying model and gives consistent estimates of T_{ij}. Second, the production level could be a bad proxy to measure the amount of exports (or imports) of a country. The growing importance of transit trade shows that production and consumption location is not enough to explain certain patterns of trade (regional hubs, and so on). Finally, fixed effects make equation (4) easy to estimate without imposing any bias and therefore allowing concentrate the efforts in measuring the effects of T_{ij} on trade flows. The trade cost variable $Ln\, T_{ij}$ is assumed to be a linear combination of the log of physical distance, free trade agreements, measures of bilateral non-tariff barriers (NTB) and other control variables.

[16] Note that a functional form of this type for the conditional mean is obtained starting from a Poisson density. However, the estimate for "pseudo -MV" done, the only thing needed is to assume the functional form of the medium and not the distribution of the variable. There are also no modifications to introduce disruption in multiplicative or additive manner.

The typical method to estimate equation (4) implies the application of logs to (4) and then estimates the coefficients by Ordinary Least Squares (OLS). This empirical approach has at least two problems: first, in many cases trade between several pair of countries is zero (selection bias) in which case log-linearization is infeasible and, second, under heteroskedasticity the parameters estimated by OLS can be highly biased estimates (Tenreyro and Santos Silva (2006)). In order to overcome these problems Tenreyro and Santos Silva (2006) suggest the estimation of (4) in levels using Poisson pseudo-maximum-likelihood (PPML) estimation technique. The word "pseudo" refers to the only condition required for consistency is the correct specification of the conditional mean (Gourieroux et al. (1984)[17].

I use equation (4) to estimate the effects of sanitary standards and the US-EU hormone dispute on beef exports from Argentina, Brazil, Paraguay and Uruguay for 1983-2013. Exports data are taken from the trade statistics database of the United Nations (COMTRADE) in Standard International Trade Classification (SITC Rev. 1) for two products: (1111) bovine meat with bone and (1112) bovine meat boneless. Over this period, data shows exports to 204 destinations. In order to select the destination markets of the sample I chose the world's leading meat importers according to the report prepared by COMTRADE 2013 and the top 10 customers from MERCOSUR countries that are not listed as major global buyers. The sample include: Algeria, Angola, Austria, Belgium-Luxembourg, Brazil, Bulgaria, Canada, Chile, China, Croatia, Cyprus, Czech Rep, Denmark, Egypt, Finland, France, Germany, Greece, Hungary, Iran, Ireland, Israel, Italy, Japan, Lebanon, Libya, Malta, Mexico, Netherlands, Poland, Portugal, Rep. of Korea, Romania, Russian Federation, Saudi Arabia, Spain, Sweden, Switzerland, United Arab Emirates, United Kingdom, US, Venezuela. Therefore, there are 42 destination markets[18], 2

[17] See chapter 22 of Cameron and Trivedi (2009) for an analysis of the technique and assumptions of the Poisson pseudo maximum-likelihood estimation.

[18] Not all the units are countries and some countries have had dramatically changes in size: Germany, Russia Federation. A correlation used for these changes is available upon request.

products, 4 exporting countries and 31 years[19]. Given that, the sample accounts for 95.1% of exports value between 1981 and 2013. Additionally, from 10,354 observations 66.2% are zeros.

The way to introduce sanitary variables in T_{ij} in equation (4) has followed different approaches. As in the estimation of the effects of any other NTBs, data issues constitute the main challenge to incorporate the standards in the estimation. In this sense, the enforcement of a sanitary requirement has often been introduced in different ways into gravity models. Some authors use the inventory approach, using coverage or frequency indexes (Fontagné, von Kirchbach and Mimouni 2005; Schlueter, Wieck and Heckelei 2009), others use a dummy variable (presence/non-presence) (Disdier, Fontagné and Mimouni, 2008; Disdier and Fontagné 2010). Others scholars compute the ad-valorem equivalent (AVE) (Goetz, Nunes de Faria, Rau, Otsuki, Shutes and Winchester 2012).

Following Disdier and Mariette 2010 and Beghin, and Xiong 2012, this paper directly incorporates the standard, by introducing the technical variable that the importer must comply. In this case, the technical variable is the number of outbreaks of the disease in each year.

Moreover, while countries lose its free-status as soon as an outbreak is detected, the recovery of this status is a slow and long process. To take into account this asymmetry between the loss of the status and its recovery process, I propose a similarity approach, which approximates the impact delay of having different sanitary status.

Specifically, this paper aims to study the effect on MERCOSUR exports of foot-and-mouth disease (FMD), Bovine Spongiform Encephalopathy (BSE), popular known as "mad cow disease" and US-EU beef hormone dispute (US-EU dispute).

[19] 42*2*4*31=10.416. However, Brazil is considered as origin and destination market in the sample. Due to there is no data, these observations were excluded. The gravity models need some theoretical improvement to deal with this lack of information. See Fally (2015) who propose a new method to deal with this lack of information.

To capture the effect of FMD I construct two variables. The first one is a technical variable: the number (in thousands) of outbreaks per year for the four analyzed countries. This data is available in database format on the website of the World Organization for Animal Health (OIE) for the period 1996-2013. From 1983 to 1996 the series were reconstructed based on OIE yearbooks available on the website of the Organization[20]. This variable (FMD outbreaks) aims to capture the immediate impact of outbreaks of disease on exports.

To take into account for aforementioned asymmetry I calculate a new measure as a proxy of the delay impact of FMD status, using the difference between the exporter and the importer FMD status given by the World Organization of Animal Health (OIE)[21] (FMD status).

Since 1995, the OIE publishes an annual resolution of the sanitary status of each member. Before 1995 countries annually self-declared their status. Based on these data sources, I constructed a qualitative variable, per year and for all the countries of origin and destination, that take into account the possible status given by the OIE: 0 if the country is free of FMD without vaccination, 1 if the country has some free zones without vaccination of FMD and other free zones with vaccination (all country free from FMD), 2 if the country is free of FMD with vaccination, 3 if the country has some free zones without vaccination, 4 if the country has some free zones with vaccination, 5 for countries without status of FMD but no outbreaks and 6 for countries with outbreaks of FMD. The first four values of the ordinal variable were created according to the official OIE status. It is worth that a country that had outbreaks of FMD would remain at level 5 until the OIE recognizes their sanitary status in any of the four categories mentioned above. In order to incorporate the variable "distance of FMD sanitary status", the FMD status variable is equal to the difference in sanitary status between the exporter and the importer country. Thus the FMD status lies between -6 (importer country with status of FMD free without vaccination and

[20] The period 1983-1996 is self-declaration of the sanitary status. For the period 1996-2013 is OIE status. Maybe some no minor impact is missing in this change.

[21] The recognition of a certain status is a national procedure. So, in fact, the recognition by the OIE is only the first step for regain the status in international markets.

exporter with FMD outbreaks this year) and 6 (importer country with outbreaks of FMD this year and exporter country with status of FMD free without vaccination).

In fact, the recovery of the sanitary status at the OIE is only the first step of a long way to recover the market access to certain country. After the recognition of the sanitary status by the OIE, begins a slow process for comply with the established procedures of the competent national authorities of each country.

A new sanitary standard arose in 1986 when the United Kingdom was diagnosed for the first time by the Bovine Spongiform Encephalopathy (BSE), commonly known as "mad cow disease". Also for BSE, the OIE publishes an annual resolution about the sanitary status of each member since 2001. Once again, I constructed a qualitative variable that considers the possible statuses given by the OIE: 0 negligible BSE risk, 1 country provisionally free, 2 controlled risk of BSE and 3 outbreaks of BSE. Before 2001, the countries self-declared their sanitary status in this disease. Given that MERCOSURs countries are free of BSE, the variable reflects only the status of the destination market. (BSE status)

Finally, a new standard arose in 1989 when EU fully implemented the ban on imports of meat and meat products form cattle treated with growth promotants. As it was mentioned above, in response to the ban, the US had imposed retaliatory tariffs of 100% ad-valorem duty on some food products, bovine meat among others. To capture the effects of these measures four variables was constructed. One dummy variable that takes the value 1 for the EU countries when the EU imposed the ban (1989-2013) and also for US when the 100% ad-valorem tariff is in force for beef from EU (1989-1996 and 1999-2011) and 0 otherwise (EU US dispute).

Another dummy variable, that takes the value 1 for the EU countries if the ban is in force and for US when the retaliatory tariff is effective and if the MERCOSUR country (Argentine, Brazil, Paraguay and Uruguay) has market access for the high-quality bovine meat in the EU. The market access is proxy by

had quota allocation and high-quality beef is proxy by boneless meat (EU US dispute quality).

Finally, third and fourth dummy variables were constructed like the first and second but leaving aside the US retaliation. It means that these variables measure the effects produced by the EU countries.

I also include other commonly used gravity models variables like distance, contiguity and common language. To incorporate these variables, I use the Center for Prospective Studies and International Information database (CEPII database). Additionally, some control variables were incorporated: the agreements of the end of the Uruguay Round of the General Agreement on Tariffs and Trade (WTO), the Common Market of the South (MERCOSUR), the MERCOSUR-Chile Agreement (MS-Chile), the Free Trade Agreement between MERCOSUR and Israel (MS-IS), the Agreement between MERCOSUR and Venezuela (MS-VZ), the Free Trade Agreement between Uruguay and Mexico (UY-MX), and the export taxes applied by Argentina to bovine meat exports (AR_exptax)[22].

In order to estimate the model proposed in equation (4) is also necessary to incorporate in addition to all the variables specified above, and given the panel data nature of the sample, fixed effects by exporter-year and by importer-year.

[22] Annex 1 shows more detailed analysis of the sources and the construction of these variables.

4 Results

The estimated equation is as follows:

$$X_{ijt} = exp\Bigg[\beta_1 FMD\_outbreaks_{ijt} + \beta_2 FMD\_status_{ijt} + \beta_3 BSE\_status_{jt} + \beta_4 EU\_US\_dispute_{jt} + \beta_5 EU\_US\_dispute\_quality_{ijt} + \beta_6 Contiguity_{ij} + \beta_7 lang_{ij} + \beta_8 Ln(dist_{ijt}) + \sum_{s=1}^{7} \alpha_s agreements_{ijt} + \sum_{t=1}^{31}\sum_{i=1}^{4} \gamma_{it} fe\_exp_{it} + \sum_{t=1}^{31}\sum_{j=1}^{42} \varphi_{jt} fe\_imp_{jt}\Bigg] \eta_{ijt} \quad (5)$$

Where X_{ijt} is million dollar value of country *i´*s exports to country *j* in year *t*. The first five variables (through beta 1 to 5) on the right side are the variables constructed for this paper. The next two are dummies to control for contiguity and common language. The next one is the natural log of the distance between *i* and *j*. $agreements_{ijt}$ is the vector of dummies accounting for some changes on bilateral tariffs over time, specifically the end of the Uruguayan Round (WTO), the Common Market of the South (MERCOSUR), the MERCOSUR-Chile Agreement (MS-Chile), the Free Trade Agreement between MERCOSUR and Israel (MS-IS), the Agreement between MERCOSUR and Venezuela (MS-VZ), the Free Trade Agreement between Uruguay and Mexico (UY-MX), and the export taxes applied by Argentina to bovine meat exports (AR_exptax). fe_exp_{it} and fe_imp_{jt} are the time-varying exporter and importer fixed effects, respectively. Finally, $\eta_{ijt} = \exp(u_{ijt})$, with u_{ijt} is the error term. I use cluster regression by exporter-importer to deal with the problem of clustering errors.

Table N°1 presents the results of the estimation of 2 models. The first is the complete model presented in equation (5). The second model only changes the specification of the variables that account for the EU-US trade dispute

taking account only for the effect in the EU and ignoring the retaliation in the US.

Table No.1 Results[23]

	(1) PPML Complete	(2) PPML Dispute only EU
Contiguity	0.416	0.414
	(0.42)	(0.42)
Common Lang	0.241	0.241
	(0.36)	(0.36)
Ln(dist)	-0.515	-0.515
	(0.62)	(0.62)
WTO	2.667***	2.717***
	(0.65)	(0.67)
MERCOSUR	0.382	-0.168
	(1.54)	(1.38)
MERCOSUR-Chile	5.084***	5.084***
	(1.18)	(1.18)
MS-Vza	-0.640	-0.689
	(0.67)	(0.69)
MS-Israel	-1.579**	-1.579**
	(0.57)	(0.57)
UY-Mexico	19.90***	19.90***
	(0.66)	(0.66)
Export taxes AR	-0.833	-0.833
	(0.48)	(0.50)
FMD outbreaks	-3.859*	-4.057**
	(1.52)	(1.34)
FMD status	-0.502**	-0.502**
	(0.19)	(0.24)
BSE status	-0.197	-0.448
	(0.59)	(0.65)
US-EU Dispute	-2.636**	
	(0.86)	
US-EU Disp quality	3.809***	
	(0.29)	
Dispute EU		-2.556**
		(0.86)
Dispute EU quality		3.727***
		(0.30)
Obs	8,370	8,370
Pseudo R-sq	0.427	0.428

[23] Data-set and code for reproduce the estimation is available upon request.

Reset Test	-0.0006	0.0018
	(0.015)	(0.014)
Fixed Effects		
Exporter-Year	Yes	Yes
Importer-Year	Yes	Yes
BIC	139257.1	142458.5

Standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001
Source: Own estimation based on models of the type proposed in equation (5), where the dependent variable is exports by origin, destination and year, and the explanatory variables are listed. The results are the following: the point estimate of the coefficient and, in brackets, the estimated standard error. Cluster standard errors by exporter-importer (167 clusters). The two models include fixed effects by exporter-year and importer-year, whose estimates are not reported. It also presents the pseudo R2, Bayesian Information Criteria and Reset test for the 2 models. In non-linear models where the conditional mean is exponential, the estimated parameters are the semi-elasticity of y with respect to x (proportional change in y associated with a one-unit change in x).

Table 1 show that standard gravity variables (contiguity, common language and distance) do not have the expected effect at any level of significance. This could be happened because bovine meat products are still homogenous goods. Regarding agreements covariates, WTO Agreements, MERCOSUR-Chile and the Free Trade Agreement (FTA) between Uruguay and Mexico affects bilateral exports positively and significantly. Contrary to the expected, the Agreement between MERCOSUR and Israel affects bilateral exports negatively and significantly.

In nonlinear models coefficients are more difficult to interpret than in linear models. But, like is pointed out by Cameron and Trivedi (2009) pages 335-336, in the case of the exponential conditional mean the regression coefficients can be interpreted as semi-elasticities[24]. Given that Table 1 shows that the agreements of the Uruguayan round of the GATT, and the adoption of such agreements by new WTO members (China, Russia, among others), is associated with a proportional increase in bilateral exports of 2.66.

Regarding the covariates constructed for this paper, Table 1 shows that the two variables constructed to take account for the effect of the FMD, number of outbreaks and differences in status between importer and exporter, are significant and with the expected negative sign. Both have huge effects on

[24] Proportional change in y associated with a one-unit change in x.

exports. In the case of FMD, a 1,000 increase in the number of outbreaks is associated with a -3.86 proportional decrease in exports. Using the finite-difference method a one unit change in the number of outbreaks implies a percentage change of -98% ($e^{-3.86} - 1$). One explanation for this huge impact could be that countries lost its free-status of FMD and its market access as soon as an outbreak is detected. Additionally, the difference of FMD status has a negative and significant association with exports. One unit difference between the importer country and the exporter has an impact of -39% ($e^{-0.50} - 1$) on exports.

Regarding BSE status, it appears not significant in any of the two variants of the models specified.

Contrary to expectations, the dispute between EU and US has a negative and significant impact on MERCOSUR exports. The presence of a trade dispute has an impact of -93% ($e^{-2.63} - 1$) on exports. This result could be explained because when new requirements and standards are established, they are imposed in a most favored nation (MFN) basis (format). Then, the compliance of these new standards must be proving for all the exporters. Although MERCOSUR´s countries have not ever produced meat with animals treated with growth promotants, they have to prove the compliance of the new and more stringent standards. This result suggests that trade facilitation measures -specifically mutual recognition agreements- have a lot of gains that would be made by the harmonization of certain rules, procedures and via the reduction of the implementation costs. To summarize, once more demanding sanitary standards are imposed, enforcement of that standards have a direct impact even in third countries.

However, measuring the impact of the EU-US trade dispute on the exports of high-quality beef with market access, I found a huge positive and significant association between MERCOSUR exports and the trade dispute. In this case, the presence of the trade dispute has an impact of 4370% ($e^{3.81} - 1$) on exports.

For verifying the robustness of the results, I performed other estimations using OLS and PPML with other fixed effects. Results from these estimations confirm the main findings reported before (see Annex 2).

Given that Poisson PML estimator has first order condition: $\sum_{i=1}^{N}(x_i - \exp(z_i^{'}\beta))z_i = 0$, the unique condition required for Poisson PML estimator consistency is the correct specification of conditional mean. (Cameron and Trivedi (2009), Chapter 20, page 669). The RESET test checks for the correct specification of the conditional mean.

$$x = \exp(z^{'}{}_i\,\beta + \delta(Z^{'}{}_i\beta))$$

Being z_i a matrix that contains all the covariates of (5). Under the null hypothesis δ =0. Table 1 show that for both models, the Reset test not rejects that the conditional mean is well specified.

5 Conclusions

This paper shows the trade impact of relatively "new" sanitary standards. In particular, the European Union´s decision to ban hormone-treated beef (fully implemented in 1989) and the BSE, and an "old" sanitary standard as the recognition of Foot-and-Mouse-Disease status (FMD) on Argentina, Brazil, Paraguay and Uruguay exports. Counter intuitively, given that MERCOSUR´s countries have not ever produced meat with animals treated with growth promotants, I found a negative and significant impact of this new standard. However, when the impact is measured only for the quality meat, I found results that show a positive impact.

Additionally, I construct two variables to measure the impact of the FMD on exports. One of them takes account that countries lost its free-status as soon as an outbreak is detected (number of outbreaks per year). And the other, takes account for the fact that recovering the sanitary status is a slow and long process (differences between importer and exporter in FMD status). Both are negative and significant associated with exports. In the case of FMD outbreaks a

one unit change in the number of outbreaks implies a percentage change of -98%, while the difference in FMD status has a negative and significant association of -39%. It seems to be a lot of knowledge to be achieved for deepening this line of study.

Contrary to the expected, the dispute between EU and US has a negative and significant impact of -93% on MERCOSUR exports. However, when measuring the impact of the EU-US trade dispute on the exports of high-quality beef with market access, I found a huge positive and significant association of 4370%.

It seems to be a lot of gains to be done through the adoption of trade facilitation measures. First, looking for the harmonization of certain rules between countries based on internationally accepted practices and/or scientific evidence. Second, by signing Mutual Recognition Agreements (MRA) that allows to accept one another´s conformity assessments. It would be optimal that an MRA shall be based on international standards.

Finally, the importer's authorization by the sanitary authority is by each meat processing plant; thus, some impacts will be unknowable without the use of firm level data.

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Annex 1

Allocation by country of tariff-rate quota for high-quality fresh, chilled or frozen meat of bovine animals in the European Union

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Argentina	5.000	5.000	12.500	12.500	12.500	12.500	16.500	16.500	16.500	16.500
Australia	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000
Uruguay	1.000	1.000	2.300	2.300	2.300	2.300	4.300	4.300	4.300	4.300
Brazil	0	0	0	0	0	0	0	0	0	0
New Zeland	0	0	0	0	0	0	0	0	0	0
United States - Canada	10.000	10.000	10.000	10.000	10.000	10.000	4.000	4.000	4.000	4.000
Paraguay	0	0	0	0	0	0	0	0	0	0
Total	21.000	21.000	29.800	29.800	29.800	29.800	29.800	29.800	29.800	29.800
In quota tariff			20%	20%	20%	20%	20%	20%	20%	20%

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Argentina	16.500	16.500	16.500	16.500	28.000	28.000	28.000	28.000	28.000	28.000
Australia	5.000	5.000	5.000	5.000	5.000	6.000	6.000	7.000	7.000	7.000
Uruguay	4.300	4.300	4.300	4.300	6.300	6.300	6.300	6.300	6.300	6.300
Brazil	0	0	0	0	5.000	5.000	5.000	5.000	5.000	5.000
New Zeland	0	0	0	0	0	150	150	300	300	300
United States - Canada	4.000	4.000	4.000	4.000	10.000	10.200	10.200	11.500	11.500	11.500
Paraguay	0	0	0	0		0	0	0	0	0
Total	29.800	29.800	29.800	29.800	54.300	55.650	55.650	58.100	58.100	58.100
In quota tariff	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Argentina	28.000	28.000	38.000	28.000	28.000	28.000	28.000	28.000	28.000	28.000
Australia	7.000	7.000	7.000	7.000	7.000	7.075	7.150	7.150	7.150	7.150
Uruguay	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300
Brazil	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	10.000
New Zeland	300	300	300	300	300	800	1.300	1.300	1.300	1.300
United States - Canada	11.500	11.500	11.500	11.500	11.500	11.500	11.500	11.500	11.500	11.500
Paraguay	0	0	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Total	58.100	58.100	69.100	59.100	59.100	59.675	60.250	60.250	60.250	65.250
In quota tariff	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%

	2010	2011	2012	2013	2014	2015
Argentina	28.000	29.375	30.000	30.000	30.000	29.500
Australia	7.150	7.150	7.150	7.150	7.150	7.150
Uruguay	6.300	6.300	6.300	6.300	6.300	6.300
Brazil	10.000	10.000	10.000	10.000	10.000	10.000
New Zeland	1.300	1.300	1.300	1.300	1.300	1.300
United States - Canada	11.500	11.500	11.500	11.500	11.500	11.500
Paraguay	1.000	1.000	1.000	1.000	1.000	1.000
Total	65.250	66.625	67.250	67.250	67.250	66.750
In quota tariff	20%	20%	20%	20%	20%	20%

Source: Own elaboration based on Resolutions of EC 1203/95, 500/96 936/97, 2048/97, 1524/02, 2186/05, 1745/06, 883/09 and 593/13.

Annex 2

To check robustness, first, I estimate by PPML the following equation:

$$X_{ijt} = exp\big[\beta_1 FMD\_outbreaks_{ijt} + \beta_2 FMD\_status_{ijt} + \beta_3 BSE\_status_{jt} + \beta_4 EU\_US\_dispute_{jt} + \beta_5 EU\_US\_dispute\_quality_{ijt} + \beta_6 Contiguity_{ij} + \beta_7 lang_{ij} + \beta_8 Ln(dist_{ijt}) + \sum_{s=1}^{7} \alpha_s agreements_{ijt} + \sum_{t=1}^{31} \delta_t feYear + \sum_{i=1}^{4} \theta_i feExp + \sum_{j=1}^{42} \gamma_j feImp\big]\eta_{ijt} \quad (2.1)$$

I also estimate by OLS the following equation:

$$Ln(X_{ijt}) = \beta_1 FMD\_outbreaks_{ijt} + \beta_2 FMD\_status_{ijt} + \beta_3 BSE\_status_{jt} + \beta_4 EU\_US\_dispute_{jt} + \beta_5 EU\_US\_dispute\_quality_{ijt} + \beta_6 Contiguity_{ij} + \beta_7 lang_{ij} + \beta_8 Ln(dist_{ijt}) + \sum_{s=1}^{7} \alpha_s agreements_{ijt} + \sum_{t=1}^{31}\sum_{i=1}^{4} \gamma_{it} fe\_exp_{it} + \sum_{t=1}^{31}\sum_{j=1}^{42} \varphi_{jt} fe\_imp_{jt} + \eta_{ijt} \quad (2.2)$$

Table No.2.1 Results

	(1) OLS1	(2) OLS2	(3) PPML
contig	23.53**	0.358	0.464
	(7.15)	(0.73)	(0.43)
Comlang	-1.751	0.158	0.305
	(2.60)	(0.25)	(0.35)
lndist	9.058	-0.514	-0.335
	(8.91)	(0.87)	(0.61)
WTO	17.48	-3.452***	-0.649***
	(14.22)	(0.46)	(0.17)
MS	7.937	-4.462***	-0.717
	(32.37)	(0.92)	(0.47)
MS-CH	43.26	3.585	1.717***
	(25.21)	(2.39)	(0.30)
MS-VZ	-6.714	2.058**	2.518***
	(14.66)	(0.68)	(0.49)
MS-IS	-51.60**	-3.040**	-0.196
	(16.89)	(0.94)	(0.23)
UY_MX	12.97	1.026	1.075

	(14.82)	(0.66)	(1.17)
TAX_AR	84.70	0.302	-1.079***
	(70.12)	(1.20)	(0.29)
FMDout	17.10	-1.036	-0.351*
	(37.13)	(0.62)	(0.17)
FMD status	-2.209	-0.631***	-0.0470
	(1.49)	(0.06)	(0.03)
EEB status	-0.210	0.705***	0.257***
	(0.95)	(0.15)	(0.05)
DispUS-UE	-22.72*	-2.489*	-3.313***
	(10.64)	(0.97)	(0.39)
Disp quality	18.76***	4.522***	3.323***
	(4.68)	(0.73)	(0.33)
N	8370	3492	10354
adj. R-sq	0.15	0.37	
pseudo R-sq			
BIC	87595.1	14558.0	175026.3
Fixed Effects			
Exporter	No	No	Yes
Importer	No	No	Yes
Year	No	No	Yes
Exporter-Year	Yes	Yes	No
Importer-Year	Yes	Yes	No

Standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001
Source: The first two panels of the table reports the OLS estimations of equation (2.2). The first column is the OLS estimation with the same sample used in table N°1. In equation (2.2) the dependent variable is the log of exports by origin, destination and year, and the explanatory variables are listed. The results are the following: the point estimate of the coefficient and, in brackets, the estimated standard error. Cluster standard errors by exporter-importer (167 clusters). The second column is the estimation by OLS of equation (2.2) when $x_{ijt} > 0$. The two equations estimated by OLS included fixed effects by exporter-year and importer-year, whose estimates are not reported. It also presents the adjusted R2, Bayesian Information Criteria.
The third column repots the PPML estimation of equation (2.1). The results are: the point estimate of the coefficient and, in brackets, the estimated standard error. The estimation included fixed effects by exporter, importer and year whose estimates are not reported. Cluster standard errors by exporter-importer (167 clusters). It also presents the pseudo R2.