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Investigating differences in safety border notifications on fruit and vegetables imports by selected EU Member States

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Abstract.

The hypothesis that six EU Member States show a common behavior on the implementation of food safety standards on fruits and vegetables imports is examined. To do so, we analyzed food border notifications recorded by the Rapid Alert System for Food and Feed (RASFF). Path dependence and reputation effects of past border notifications were explored for the whole period 2001-13, and for sub-periods 2001-07 and 2008-13. Negative binomial (NB) and zero-inflated negative binomial (ZINB) distributions were used to deal with over-dispersion and excess of zero counts. Our findings suggest that the EU cannot be considered as a single unit when non-tariff measures are studied, although there are some signs that MS behavior is becoming more uniform in the latest period.

Keywords.

RASFF; trade policy; border notifications; EU standards.

JEL codes:

F13, F13, Q17, Q18



1. Introduction

The Sanitary and Phyto-Sanitary (SPS) agreement allows the use of border measures to protect human, animal and plant health as well as environment, wildlife and human safety. Literature on SPS controls applied by OECD countries frequently refers to these measures as a type of Non-Tariff Measures (NTMs) (Cadot and Malouche, 2012). A significant deal of work has provided analysis and data on the impact of NTMs applied by the European Union (EU) and other OECD countries on food imports (Disdier *et al.*, 2008; Nicita and Gourdon, 2012).

The EU aims at becoming an integrated regional actor, able to develop and implement food control measures at its borders. Lezaun and Groentee (2006) argue that the EU Member States (MS) are increasingly capable to interpret food regulations uniformly upon a more integrated geographical space. However, although by law all EU MS adopt the same set of food safety standards at the border, a question of interest is whether MS enforce the pan-EU measures uniformly. The question arises on whether individual MS are managing rules and practices to cooperate with, and to commonly face food safety problems originated in third countries or not. This paper tests such hypothesis by explaining food safety notifications included in the Rapid Alert System for Food and Feed (RASFF) used by the European Commission to monitor and detect food alerts (RASFF, 2013). RASFF data are fed by national authorities, which could involve different interpretations. This contribution addresses this question by analyzing differences within a group of six individual MS that implement food controls at the border.

National differences at border controls may be due, first, to the ways of applying control management measures, also influenced by the specific national sensitiveness to certain risks. Thus, MS differences can depend on different criteria when deciding whether or not to submit information to the RASFF system. The lack of a common approach by national control authorities has led to complaints by the industry on RASFF (CIAA, 2011; European Commission, 2012; Food&DrinkEurope, 2012).

In our contribution, the focus is on measuring the differential border control implementation by EU MS¹. We attempt to explain the border notifications applied by a group of six MS on fruit and vegetable imports, which are largely sensitive to risk controls. Attention will be paid on testing whether the SPS enforcement depends on different MS reactions to the monitoring and compliance rules or if, alternatively, the EU is behaving uniformly as a regional unit.

¹Other approaches have been used to analyse differential food import behavior across EU MS, such as gravity models (Otsuki *et al.*, 2001; De Frahan and Vancauteren, 2006) and the calculation of *ad valorem* equivalents of NTMs (Nimenya *et al.*, 2012).

Jouanjean (2012) introduced, for her analysis on US standards, the notion of reputation or path dependence on past food alerts that affect current food import notifications or refusals. In the EU case, this effect could reflect differences across MS. Little has been written on the differential behavior in food import notifications or refusals by EU MS. Baylis *et al.* (2010) explored whether SPS measures on fish imports were influenced by trade protection but without testing path dependence on past behavior in food border controls. They also considered the EU as a single regional unit, assumption that we question in the present contribution.

The RASFF database has been previously used to analyze the impact of SPS measures on trade flows. Kallumma *et al.* (2013) investigated MS actions on exports of South Asian countries. However, they did not explain why food alerts could be larger in some MS than in others. Kleter *et al.* (2009) analyzed chronological trends for product and hazard categories, regions of origin and notifying countries, putting observed trends into perspective. Jaudet *et al.* (2013) linked food risks to supplier concentration in the EU market, considering the EU as a single import unit.

In the present contribution, the next steps were followed. First, a database was built by drawing on the RASFF information system through the counting of food border notifications implemented by selected MS for 4-digit trade chapters of the Harmonized Standard (HS) classification for the period 2001-13. Second, we analyzed food border notifications that the six selected EU MS issued on fresh fruit and vegetables (HS chapters 7 and 8) and processed fruit and vegetables (HS chapter 20).

In this analysis, count models were analyzed after having tested the over-dispersion of the dependent variable (food import notifications). Negative binomial (NB) and Zero-Inflated Negative Binomial (ZINB) specifications were used to represent the process leading to food import notifications. By explicitly modeling the food alerts in six MS, we tested the hypothesis that the group behaved uniformly. Afterwards, the estimation was subdivided into two periods (2001-07 and 2008-13) in order to explore the evolution of reputation effects overtime and whether or not the hypothesis of uniformity of such effects across MS is being fulfilled as the EU integration process goes ahead.

2. RASFF data in the EU

Since the foundation of the WTO, there has been a boost in the EU sanitary and safety standards. Satisfying food standards is a challenge for non-EU exporters. RASFF supplies information on food border notifications, and they are indicators of which exporting countries and products comply with

food safety and quality requirements imposed by EU MS, with a strong concentration on fruit and vegetables (Graziaet *al.*, 2009; RASFF, 2013). When national food inspectors have any information relating to existence of serious risk to human health deriving from food or feed they shall immediately notify it to the European Commission. National inspection authorities control the product on the market or at the border and decide if a specific finding falls under the scope of the RASFF in order to report a notification where necessary and forward it to the European Commission. They use a notification form to provide details of the findings and measures taken.

Table 1 shows the number of food notifications on fruit and vegetables by trade chapter for six selected MS with a total count of notifications of 3,311 for the period 2001-13². It also presents the most notified exporters, showing a concentration, as expected, on large exporters of fruit and vegetables. As the Table 1 highlights, the larger number of notifications correspond to chapter 08. Germany is the most notifying country, with 943 notifications, followed by United Kingdom, Italy, France, Spain and the Netherlands. This sample of importing countries represents the basis for the present study. These six countries cover 60 per cent of the total notifications in the EU. According to Eurostat, in 2013, the selected six MS represented the 82 per cent of the EU import value in HS chapter 07, 78 per cent in chapter 08 and 71 per cent in chapter 20.

As for exporters in the present study, we acknowledge that there might be an import concentration on a limited number of non-EU exporters for products that present higher risks, as noted by Jaud *et al.* (2013). To avoid the selection bias related to this fact, we selected exporters by noting their share in total world exports. This criterion selects potential exporters based on their relevance at the world level. Hence, we took notifications originated from the top 23 world exporters of fruit and vegetables³ that represent 90 per cent of world exports of the sectors studied.

Table 1 shows the exporting countries that have been most notified by sector and by importing country in this period. It underlines the importance of Turkey, covering 59 per cent of total notifications in HS chapter 08, India with 30 per cent of notifications in HS chapter 07, and Ghana with 28 per cent in HS chapter 20. Most notified countries also vary across MS.

Table 1

²The system has been subjected to changes in the types of notifications considered, which restricts the possibility of a time series analysis by type of notification (eg. alert, information, border rejection). Further details of the system can be found at http://ec.europa.eu/food/safety/rasff/index_en.htm.

³List of top 23 world exporters of fruit and vegetables: Morocco, Mexico, Egypt, Brazil, USA, Argentina, China, Ghana, Turkey, Vietnam, South Africa, New Zealand, Chile, India, Thailand, Canada, Ecuador, Australia, Costa Rica, Peru, Philippines, Israel and Guatemala.

One methodological challenge that could explain why RASFF database has not been widely used for the analysis of EU food alerts is the need to link RASFF data with trade data expressed in terms of a recognized nomenclature such as the HS. RASFF contains the complete information regarding products but these are not classified using HS code. Therefore, a great deal of effort was made in this study to transform RASFF text data into notifications classified by HS code. Jaudet *et al.* (2013) used a similar database to explain the relationship between food alerts and the concentration of EU suppliers for the period 2001-2005. As RASFF contains complete information regarding products in a lexical form and products are not coded into the HS system, the conversion was, as the quoted authors recognized, “painstaking”. Our research widens the scope by considering the differential behavior of MS, so product destination has to be considered in the notification counts, which substantially increases the database size⁴. We considered the unit of observations as formed by product-exporter-importer-year sets, which increased the complexity of the conversion exercise and multiplied the number of observations. For that, an Excel lexicographic tool was defined to facilitate the conversion of 74,589 observations, between 2000-2013, identified by a product, a supplying country and a country of destination. The coding process included the whole range of products at the 4-digit level of the HS⁵ for the before mentioned chapters. As the database has to allow the analysis of agri-food trade products, zero counts were also included, which considerably increased the total number of observations up to 69,264⁶. We opted for a 4-digit level of the HS to minimize inaccuracies in the reclassification of RASFF events expressed in verbal mode into HS codes. Each observation refers to a given product with specific origins and destinations, with over 7,000 product-exporter-importer references per year.

3. Theoretical background

In this paper, we use a path dependence notion of the EU food safety system. We aim at testing the hypothesis that the history of notifications significantly influences individual MS behavior on current notifications. The underlying idea is that one product’s alerts in one year may affect the probability of future alerts, and that such effects may appear at product, sector and exporting country level. Path dependence has several explanations. The first one is the reputation concept used by Jouanjean (2012) for the analysis of US border safety controls. This concept in turn draws

⁴It is worth noting that one exporter adds 2886 observations to the analysis, significantly increasing the costs of conversion of RASFF data into HS codes.

⁵A total of 37 HS 4 digit products for chapters 07 (fresh vegetables), (08 fresh fruits) and 20 (processed fruits, vegetables and nuts).

⁶A total of 74,589 observations were coded by the Excel lexicographic tool. However, by introducing a lagged variable (t-1) the total number of observations reduced to 69,264.

on Tirole (1996) who introduced the notion of collective reputation that influence consumer behavior based on the past behavior⁷. The dynamic reputation concept can explain a dependency between one country's exports and food alerts and the history of related food safety issues. Over time one product can appear safe for importers but their control behavior may be affected by the collective reputation of the exporting country or of the sector where the specific product is included. Jouanjean *et al.* (2012) looked at import refusals providing a first evidence of how reputation affects the enforcement of SPS measures in USA. Another path dependence effect can be related to the increase in food tests in year (t) understood as warnings that food hazards detected in year (t-1) will continue until real product improvements take place or imported products meet the standard requirements.

We hypothesize that inspections in EU MS are not necessarily random and that can vary according to the product, the exporting country, and the importing country, which relate to specific path dependence effects. A higher number of recorded notifications on exports to the EU could affect the way the system could consider future imports of the given product. Repeated notifications affect directly stakeholders in exporting countries and the whole supply chain and may lead compliance actions that could reduce their future impact.

The RASFF is first and foremost designed for national control authorities and they are responsible for feeding the information system. We wonder if some countries are more sensitive to collective reputation of certain products than others so RASFF does not necessarily function as a uniformly applied European-wide system and can reflect diverging interpretations of RASFF at a MS level.

We name the number of notifications for a given product (i) from an exporter(j) to an importer (k) at year (t) as N_{ijkt} . Three path dependence effects are then underlined with respect to the MS reaction to food safety problems:

- **Product dependence** refers to the relationship between the number of notifications for a given product-exporter-importer-year combination N_{ijkt} and the number of notifications for that product-exporter-importer in the previous year $N_{ijk(t-1)}$.
- **Sector dependence** refers to the relationship between the number of notifications for a given product-exporter-importer-year combination N_{ijkt} and the number of notifications for all products included in the same HS2chapter-exporter-importer in year t-1:

⁷See and extension of this concept in Winfree and McCluskey (2005) to the framework of "quality" Jouanjean's and our contribution refers to "safety".

$$N_{ijk(t-1)} = \sum_{vi \in I}^{j,k} N_{ijk(t-1)} \quad \text{Equation. (1)}$$

Where (I) refers to a HS2chapter, which in fresh and processed fruit and vegetables are HS 7, 8 and 20. In such cases, the hypothesis to be tested is whether the collective reputation at a sector level matters for specific products' controls.

- **Exporter dependence** refers to the relationship between the number of notifications for a given product-exporter-importer-year combination N_{ijkt} and the total number of notifications applied on the corresponding exporter in the previous year. Here the collective reputation refers to the full record of notifications received by a given exporter in year t-1:

$$N_{jk(t-1)} = \sum_{vi \in J}^k N_{ijk(t-1)} \quad \text{Equation. (2)}$$

Where (J) refers to an exporting country.

At each year (t), the MS authorities may implement controls based on updated criteria on risk assessment, but are also influenced by the past. And we can test whether the considered MS have a uniform reaction or if the responses are different among them.

Import notifications can be also related to the development of the exporting country. We take the logarithm of GDP per capita lagged one period ($\ln GDP_{j(t-1)}$) as a relative measure of economic development and the capacity of the exporting country to face NTMs. However, the GDP per capita is also related to the actual ability to face foreign standards, which could have a reducing effect on importer's notifications. Robust food safety systems and controls involve recalls of health and sanitary problems sourced in the country of origin (European Commission, 2013), so notifications can also be positively linked to the GDP per capita of the exporter.⁸ NTMs are employed for many purposes, including the correction of information asymmetries and market failures often related to food safety concerns (Disdier *et al.*, 2014). They may also have potential protectionist purposes as they can be used as a disguised protection aiming at restricting the entrance of foreign products (Hoeckman and Nicita, 2011; Nimenya *et al.*, 2012). Nevertheless, tariffs were not computed in our exercise as a covariate due to, firstly, the difficulties in estimating the true tariff-equivalent of those fruit and vegetables involving a large number of complex tariffs, including provisions linked to the entry price system, which acts as a minimum price for certain seasons (Jean *et al.*, 2008; Garcia

⁸We used GDP in PPP terms from the World Development Indicators. See National Accounts Main Aggregates Database (<http://unstats.un.org/unsd/snaama/dnllist.asp>).

Alvarez-Coque *et. al.*, 2009, 2010); and secondly, the fact that most EU fruit and vegetables have already received very low tariff protection during the studied period. Thus, Jean *et al.* (2008) report that the percentage of tariff lines (8 digits) under 20 per cent of ad-valorem equivalents of MFN duties is 89.3 per cent products in chapter 7, and 69.7 per cent in chapters 8 and 20. As an attempt to capture the EU response to foreign competition, we followed an alternative way of testing the impact of market opening on food alerts: the volume of imports for each product-exporter-importer lagged one period $M_{ijk(t-1)}$, was considered as a covariate, in terms of total volume, and in terms of import change ΔM_{ijkt} .⁹ In the case of a protectionist behavior, we expect that an import surge would involve a further increase in the notification count. Import level and import changes were expressed in volumes (tons) and not in logarithms to avoid neglecting zero trade values, which were explicitly considered to test a zero inflated count model (see below).

To complete the theoretical background, fixed effects can be also considered to express the specific characteristics in terms of sector (I) HS 7, 8 and 20, exporting country(j) and importing MS(k). Independently of specific risks and health problems, a function will depict the possibility of a control behavior that reflects specific path product dependence, sector reputation, exporting country characteristics and the import dynamics. The model must also consider that the EU does not behave necessarily as a single unit and for that the importing country behavior is explicitly included in the model.

4. Estimation procedure

We expressed food notifications as a dependent variable in a count model. Modeling count variables is a common quantitative practice in social sciences (Zeileis *et al.*, 2008). For this, several strategies are possible. One approach is the Poisson (log-linear) regression model that explicitly takes into account the non-negative integer-valued aspect of the dependent count variable. The Poisson model requires the equi-dispersion property, meaning that the conditional variance must be equal to the conditional mean. According to Burger *et al.* (2009) the standard Poisson model is sensitive to problems of over-dispersion and excess zeros in the dependent variable. The NB count model, which belongs to the family of modified Poisson models, is believed to offer a solution to correct over-dispersion (Cameron and Trivedi, 2013). The expected value of the observed

⁹Bilateral trade volumes were extracted from the WITS database, in terms of yearly imports expressed in thousand tons of net weight. WITS is data consultation and extraction software. It contains import and export data from the United Nations COMTRADE data base and from UNCTAD's TRAINS data base. See: <http://wits.worldbank.org/wits/>.

dependent variable in the NB regression model is the same as for in Poisson regression model (Long, 1997), but the variance here is specified as a function of both the conditional mean and a dispersion parameter, thereby incorporating unobserved heterogeneity into the conditional mean. More formally, and following Cameron and Trivedi, we assume that N_{ijkt} , the notification count of the product (i) exporter (j) and importer (k) at period (t) has a conditional mean N_{ijkt} which is a function of a matrix of covariates, and the probability mass function:

$$Pr[N_{ijkt}] = \frac{\Gamma(N_{ijkt} + \alpha^{-1})}{N_{ijkt}! \Gamma(\alpha^{-1})} \left(\frac{\alpha^{-1}}{\alpha^{-1} + \mu_{ijkt}} \right)^{\alpha^{-1}} \left(\frac{\mu_{ijkt}}{\alpha^{-1} + \mu_{ijkt}} \right)^{N_{ijkt}} \quad \text{Equation. (3)}$$

Where Γ is the gamma function, and α is the rate of over dispersion. A likelihood ratio test of α can test whether over dispersion is present and it is wise to prefer the NB over the Poisson distribution.

The conditional mean is given by Equation 4:

$$N_{ijkt} = \exp \left(\delta_0 + \sum_{k=1}^n \beta_k N_{ijk(t-1)} + \sum_{k=1}^n \gamma_k N_{ljk(t-1)} + \sum_{k=1}^n \rho_k N_{jk(t-1)} + \sum_{k=1}^n \sigma_k \ln GDP_{j(t-1)} + \tau M_{ijk(t-1)} + \phi \Delta M_{ijkt} + \delta_I + \delta_j + \delta_k \right) \quad \text{Equation. (4)}$$

Where δ_I, δ_j and δ_k represent the fixed effects for sector (I), exporter (j) and importing MS (k). In the estimated specification, we express MS parameters $\beta_k, \gamma_k, \rho_k$ and σ_k , as follows:

- Product dependence by importing MS: $\beta_k = \beta_1^* + \beta_k^* Z_k$;
- Sector dependence by importing MS: $\gamma_k = \gamma_1^* + \gamma_k^* Z_k$;
- Country dependence by importing MS: $\rho_k = \rho_1^* + \rho_k^* Z_k$;
- Exporter's GDP effect by importing MS: $\sigma_k = \sigma_1^* + \sigma_k^* Z_k$;

Where Z_k is a dummy variable that takes value of one for country (k), and it is used to examine the differentiated behavior on specific EU MS imports ($Z_1 = 0, k = 1$ for Germany).

Specification in equation 4 allows to understand the interpretation of equation coefficients, with fixed effects understood as a percentage change in N_{ijkt} resulting from individual sector δ_I , exporter δ_j and importer effects δ_k , these coefficients being expressed as percentages of notification changes due to one unit change in product, sector and country notifications; the coefficient of the

$\ln \text{GDP}_{j(t-1)}$ variable as percentage of notification change due to one percent change in per capita GDP; and the coefficients of import volume variables, M_{ijkt} and ΔM_{ijkt} , as the percentage of notification change due to a change in one ton.

Whether or not this excess zero problem involves a bias in the NB approach has to be explored with care. Burger *et al.* (2009) considered such problem when they modeled trade flows, taking into account that not all pairs of countries have the potential (or are at risk) to trade because serious constraints that prevent exports. The quoted authors distinguished two different kinds of zero-valued trade flows: countries that never trade and countries that do not trade now, but potentially could trade in the future. In our case, the most important problem caused by excessive zeros in the data stems from the fact that two different processes can produce zero notifications. The first is the full compliance of a product exported to the EU food control system, which is reflected by inexistence of food notifications. The second process is the absence of exports to the EU, which can be due to structural factors depending on resources, distances, preferences and specialization. In this case, food alerts do not appear because the probability of trade is zero, and notifications cannot be applied to the corresponding product and partner. The possibility of such double process led to test a ZINB model that considers the possible existence of two latent groups within the sample of exporting countries: a group having strictly zero counts and a group having a non-zero probability of having counts other than zero (Lambert 1992).

Consequently, the estimation process of the ZINB contains two parts. The first part includes a logit regression of the probability that there is no possibility of positive counts. The second part contains a NB analysis of the notification count for the group that has a non-zero probability of food alerts. A ZINB model with extra proportion of zeros (p) was defined by the following probability density function:

$$\text{Prob}(N = N_{ijkt} | \Omega) = \begin{cases} p + (1 - p)\pi(N_{ijkt} = 0 | \Omega) & \text{If } N_{ijkt} = 0 \\ (1 - p)\pi(N_{ijkt} | \Omega) & \text{If } N_{ijkt} > 0 \end{cases}$$

Equation. (5)

Where we consider a NB distribution for $\pi(N_{ijkt} | \Omega)$.

The logit part of the ZINB model contains variables that are correlated with the probability of zero notifications, including the lagged product notifications $N_{ijk(t-1)}$, the lagged exporting country notifications $N_{jk(t-1)}$, the logarithm of GDP per capita $\ln \text{GDP}_{j(t-1)}$ and the import variation ΔM_{ijkt} .

Following Portugal-Perez *et al.* (2010) and Reyes (2012) we also included the lagged decision to export, a dummy variable that takes value of one if country (j) exported product (i) to country (k) in (t-1), is $M_{ijk(t-1)} \neq 0$, which can be correlated with the probability of $N_{ijkt} \neq 0$ but is uncorrelated with the actual notification count N_{ijkt} .

However, the choice of the econometric model specification should be based on standard statistical tests because “having many zeros in the dataset does not automatically mean that a zero inflated model is necessary” (Cameron and Trivedi, 2010, p. 605). In this article, we used the Vuong statistic (Vuong, 1989) that can be employed to discriminate between the ZINB model and the standard NB counterparts. The Vuong statistic follows a standard normal distribution with large positive values favoring the ZINB model and large negative values favoring the NB model.

5. Findings and discussion

NB and ZINB versions of the models were estimated and compared to test the hypotheses examined in this paper. The model parameters were estimated, distinguishing specific MS coefficients for product, exporter and sector dependence, and for GDP per capita. Goodness-of fit criteria were used to evaluate whether the models provide a good fit to the data. Finally, we tested the hypothesis for two relatively homogenous sub-periods, 2001-07 and 2008-13¹⁰ in order to explore the evolution of dependence effects along time and verify whether the EU integration process goes ahead.

The descriptive statistics of the set of variables used in the estimation are given in Table 2. A look to the mean and standard deviations of the notification count N_{ijkt} suggests that overdispersion can be a problem. The over-dispersion parameter α was estimated at 2.512, which strongly signals against the assumption of equi-dispersion ($p < 0.001$). This led the estimation strategy to disregard the Poisson distribution and move to NB and ZINB.

Table 2

The excessive zeros is a further feature of the database. In our case, as we consider all the HS 4-digit trade chapters included in HS2 chapters 7, 8 and 20, the count data have a large number of

¹⁰In 2007 a reform of the EU regime for fruit and vegetables was passed. This reform did not have noticeable consequences on the RASFF system, though it responded to the recognition by the EU Commission of the stagnation of the consumption of the fruit and vegetables in the European Union. See details in http://ec.europa.eu/agriculture/fruit-and-vegetables/2007-reform/index_en.htm.

zero counts. Thus, in our sample of 69,266 observations, 98.5 per cent of total observations showed a zero notification count.. This is shown in Figure 1, which presents the percentage of HS4-digit chapters with zero trade flows from each exporter to the set of EU MS considered, ranging from 28 per cent (Morocco) to 77per cent (Guatemala).

NB and ZINB can both handle the excess of zero notifications and over-dispersion. Empirical results for both models are shown in Table 3. With respect to the ZINB model there are two sets of parameter estimates: one set for the logit model, which pairs of countries that never show notifications, and one set for the NB part, which predict the probability of a count belonging to the group of countries that have theoretically non-zero notifications. As can be observed in Table 3, the signs of the coefficients in the logit model are usually opposite to those in the negative binomial part.

Figure 1

Analyzing the results, product dependence appears to be statistically significant for both models in most importing countries. This means that, the increase in lagged notifications $N_{ijk(t-1)}$ would increase the number of expected notifications N_{ijkt} , which can reflect that reputation matters in EU MS safety controls. The regression coefficients estimated are generally greater under the NB model. However, in both models there are two extreme positions: Germany with the lowest product dependence and United Kingdom with the highest. The other countries remain in an intermediate position. As indicated above, product dependence in both models were statistically significant for most importers, except for Italy and the Netherlands in the ZINB model, suggesting that notifying decisions appear to be affected by the past history of notifications registered at product level for the MS studied with clear variations across importers.

Findings for the rest of effects are less convincing. Exporter and sector dependence effects, where significant, have a negative sign and with lower intensity than the product dependence. Negative signs of coefficients in both cases would suggest that exporters and sector-exporters affected by notifications are taking measures to counteract border measures, which reflect in further lower counts. Significant effects are found in exporter dependence for Germany, Italy and Spain in the ZINB model, and for France in both models. Significant sector dependence effects were found for France in the ZINB model, and for Spain and United Kingdom for the NB model. Exporter and sector dependence effects were not significant for the Netherlands in either ZINB or NB models.

Table 3

As for comparison with Jouanjean *et al* (2012) findings for the USA using a NB model, it is worth noting that these authors studied import refusals by plant inspections in USA, which are not directly comparable with the more general concept of food notifications followed in our exercise with the RASFF database at EU. Product dependence effects are found positive in both works. In our NB model, the import volume parameter is positive and significant. However, import change is not significant neither in our ZINB or the NB, suggesting that the EU safety controls are not affected by the imports' dynamics as it appears in some of the models estimated by the quoted authors. Therefore, food safety alerts in fruit and vegetables would not appear to be a reaction to import surges from various origins.

Figure 2

Ln GDP per capita is not significant in the quoted exercise for USA and it is not as well in our ZINB model for EU. Ln GDP per capita coefficient is, however, significant and positive in our NB model although only the coefficient for United Kingdom appears to be significant and of little intensity. The discussion on the relationship between food notifications and GDP per capita is still open as suggested above in the theoretical background section of this work. Figure 2 depicts the relationship between the simple average of notifications by the sample of EU MS studied and exporters GDP per capita. Exporters do not follow a general pattern although some major exporters (China, Thailand, India) and countries with relatively medium (Turkey) and high development levels (USA) are among the most notified.

The model comparison methods proposed in Table 4 are Akaike Information Criterion (AIC), the Bayesian Information Criterion (BIC), the likelihood ratio test, and the Vuong statistic. All four statistical tests are computed for determining the best model choice. The different statistics do not all point to the same conclusion. Thus, the likelihood ratio, the AIC and the BIC favor the ZINB over the NB. However, the Vuong test suggests that the NB model is more appropriate than the ZINB. In addition, when model fits for different count levels are compared, NB predicts a 98.68 per cent of zero counts, which is closer to the observed percentage of zero counts (98.55 per cent) than the percentage predicted by the ZINB (97.86 per cent). This is consistent with the idea expressed by Cameron and Trivedi (2010) that assuming a ZINB distribution is not always the best solution for modeling excess zero counts.

Table 4

Once the models were estimated the uniformity of the MS behavior in their safety control behavior was analyzed. Starting from the general unrestricted model (saturated model), the models with the

restrictions imposed (constrained models) were estimated. Because the restricted models are nested with the general one, the change in the goodness of fit of the model with and without the restriction imposed can be compared (Table 5). If the restriction is true, the loss in fit should be small. Otherwise, if the restriction is false the loss in fit will be large. We complement the assessment of common MS behavior with the analysis of a constrained model estimation that accepts uniform values for all the parameters, that is to say, by imposing all the five aforementioned restrictions (restriction6).

Table 5

Table 5 shows six different goodness-of-fit tests comparing the constrained models to the saturated model. They allow to test whether a different MS behavior is accepted (H_1) compared to the common behavior (H_0) represented in the six constrained models defined. As regards to restrictions 1 to 3, the general model with different MS behavior was confirmed with respect to the constrained models that consider the indicated restrictions (see p-values in Table 5). Consequently, we find that analyzing the EU behavior on safety border controls, as a single unit, is not acceptable. This is supported by restriction 6, which compares the saturated model with the constrained model where all restrictions were accepted. A different story occurred when exporter dependence(restriction 4)was considered. Here H_1 was rejected by the NB model and accepted by the ZINB. This would mean that there are no clear signs that the total record of total notifications for a given exporter (collective reputation) affects the individual MS control behavior. H_1 is also rejected for the Ln GDP per capita effect (restriction 5), confirming that the EU control system behaves in a uniform way when considering the characteristics of exporting countries.

Table 6

A question could be raised on whether, in line with the opinions by Lezaun *et al.* (2006) and De Frahan and Vancauteran (2006), the single market is progressing towards a uniform implementation of food safety standards. The progress in harmonizing the safety controls can be tested by breaking the period 2001-13 into sub-periods 2001-07 and 2008-13. The general NB model was estimated for each period, with the estimation results presented in Annex 1. Both are in general consistent with the model estimated for the complete period 2001-13, with perhaps less pronounced product dependence effects in the second sub-period compared to the first. The six restrictions were also tested for both periods, with results summarized in Table 6. It is observed that p-values for different MS behavior for product and sector dependence are larger in the second sub-period estimation, signaling the possibility that such behavior is becoming more common across MS, but still H_1 is

accepted. Restrictions 4 and 5 were clearly accepted for the second sub-period, indicating a common MS behavior as regards to the exporting country characteristics. The analysis by sub-periods, in summary, would indicate that the selected MS still behave differently in the food alert implementation, but there are some signs that such behavior is becoming more uniform as the experience in applying RASFF is making progress.

6. Conclusions

The present paper has raised the question on the adequacy to consider the EU as a single integrated unit when considering the implementation of NTMs. When the question refers to food safety standards, it is true that the EU MS are evolving towards more common risk control procedures, which are actually reflected in RASFF. However, control measures are still monitored and applied by national authorities, with differing interpretations, so the harmonization process remains imperfect. The RASFF database was adapted in this contribution to link the recorded food notifications with the corresponding trade codes at HS4. This allowed exploring the pathway to the common implementation of food safety border measures, represented in the number of food alerts in six EU MS (France, Germany, Italy, the Netherlands, Spain and United Kingdom). Thus, the hypothesis of uniformity of dependence effects across the six MS selected was tested. For that, we explored the dependence effects on notifications on food alerts on fruit and vegetables imports registered by the RASFF across the selected EU MS. Three types of path dependence were considered; product, sector and exporter, the three of them referring to the collective effect over time of having received previous food alerts.

Notification numbers were explained through count models. Two main problems found because the inherent characteristics of the food alert data (1) the over-dispersion in the data and (2) the excess of zeros in the observations. NB and ZINB count models were applied to consider the large number of observations with zero notifications, which could be motivated by two processes of generating zero counts, one being the absence of a bilateral trade flow, and the other being the absence of a risk in the corresponding food import. The model selection process was not conclusive between the NB and the ZINB distributions, though the NB performs better in predicting zero counts, which would make the ZINB version less needed.

Our findings uphold the idea that reputation matters at the EU borders, supporting the evidence found by Jouanjean *et al.* referred to the US SPS border controls. Such results relate to the collective reputation represented by a product, HS2 sector or an exporting country, although

collective sector and exporter effects were found to be of lower intensity than the product specific dependence effect. In sector and exporter effects, it appears that having many notifications by a sector-exporter in previous year decreases the expected number of product notifications in the next year. It seems that in this case the notion of collective reputation must be qualified by the ability of a sector or an exporter to implement measures to react and reduce the notifications in the following years.

Food alerts at the EU border seem to be little influenced by the characteristics of the country of origin (GDP per capita effect). While food safety can be correlated with development of exporting countries (the higher GDP per capita, the less number of food alerts), food awareness, controls at origin and cooperation with EU authorities may also be correlated with the degree of development of the country of origin with an increase in safety controls as the exporter becomes a larger or/and more developed actor. As for the impact of the import volume level and the import volume change, their effects on food notifications were marginal or non-significant. This disregards a protectionist behavior of MS authorities in the implementation of food safety controls.

Our analysis tested the hypothesis that the EU behaves as a single unit in the implementation of safety border controls and found that this is not the case for the whole period 2001-13. However, once the sub-period 2001-07 is compared with the sub-period 2008-13, common border restrictions on the count models analyzed tend to be more significant in the second sub-period than in the first, which could suggest that there is a tendency for the EU MS to show a common behavior in the implementation of food safety measures.

Policy substitution between tariffs and non-tariffs measures could not be explicitly tested in our analysis of the factors influencing food alerts in the EU fruit and vegetables trade. Most of this trade is not restricted by high tariffs at the EU borders, except for a series of products affected by the entry price system, whose equivalent tariffs are seasonal and cumbersome to estimate. However, the low significance of the parameters related to the import volume level and change would suggest that food alerts may be influenced by individual and collective reputation but not by a substituting behavior between tariffs and non-tariffs, so a protectionist approach does not seem to motivate safety controls in the studied EU MS. This would support the idea by Disdier *et al.* (2014) that estimates that one part of ad valorem equivalents is explained by the correction of market failures and risk management considerations, and not by a merely protectionist behavior.

A final warning on the empirical analysis is that although we have tested the hypothesis of a uniform enforcement of food standard across six MS, path dependence could be accumulative over past history. If, for example, an exporter cleans its own record by staying out of the market for a

year, it would choose to export inspected products in every other year. The concepts of product, sector and exporter reputation could make reference, in further investigations, to longer past periods and to test if the MS reactions tend to be more uniform in the long term.

Acknowledgments

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References

- Baylis, K., Nogueira, L., Pace, K., 2010. Food Import Refusals: Evidence from the European Union. *American Journal of Agricultural Economics*.93: 566-572.
- Burger, M., Van Oort, F., Linders, G. J., 2009. On the specification of the gravity model of trade: zeros, excess zeros and zero-inflated estimation. *Spatial Economic Analysis*, 4(2): 167-190.
- Cadot, O., Malouche, M., Sáez, S.,2012. *Streamlining Non-Tariff Measures: A Toolkit for Policy Makers*. World Bank Publications.
- Cameron, C. A., Trivedi, P.K., 2010. *Microeconometrics using Stata: Revised Edition*.Stata Press.
- Cameron, A.C., Trivedi, P.K., 2013. *Regression analysis of count data*. Cambridge university press.
- CIAA., 2011. *CIAA Response to the Commission Consultation on the Single Market Act I*.Confederation of the Food and Drink Industries in Europe , 28 February 2011
- De Frahan, B. H., Vancauteren, M., 2006. Harmonisation of food regulations and trade in the Single Market: evidence from disaggregated data. *European Review of Agricultural Economics*.33(3): 337-360.
- 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.
- Disdier, A. C., Fontagné, L., Cadot, O., 2014. North-South standards harmonization and international trade. *The World Bank Economic Review*, 1ht039.
- European Commission, 2012.Agriculture in the European Union - Statistical and economic information.Directorate-General for Agriculture and Rural Development, European Union.
- European Commission, 2013.Impact Assessment Report on the future of EU-US trade relations. Commission Staff Working Document, Strasbourg, 12.3.2013, European Union.
- Food & Drink Europe.,2012. Priorities for the development of an EU industrial policy for food Competitiveness Report 2012. Available at (<http://www.fooddrinkeurope.eu/publication/food-industry-calls-for-an-eu-industrial-policy-for-food/>).
- Garcia-Alvarez-Coque, J. M., Martinez-Gomez, V., Villanueva, M., 2009. A trade model to evaluate the impact of trade liberalisation on EU [European Union] tomato imports. *Spanish Journal of Agricultural Research*, 7(2): 235-247.

- Garcia-Alvarez-Coque, J. M., Martinez - Gomez, V., Villanueva, M., 2010. Seasonal protection of F&V imports in the EU: impacts of the entry price system. *Agricultural Economics*, 41(2): 205-218.
- Grazia, C., Hammoudi, A., Malorgio, G., 2009. Regolamentazione della qualità sanitaria degli alimenti e accesso dei Paesi della riva Sud del Mediterraneo ai mercati europei: un'analisi empirica, Comunicazione XLVI Convegno di Studi, SIDEA, Piacenza 16 – 19 settembre 2009.
- Hoekman, B., Nicita, A., 2011. Trade policy, trade costs, and developing country trade. *World Development*, 39(12): 2069-2079.
- Jaud, M., Cadot, O., Suwa-Eisenmann, A., 2013. Do food scares explain supplier concentration? An analysis of EU agri-food imports. *European Review of Agricultural Economics*, jbs038.
- Jean, S., Laborde, D. Martin, W., 2008. *Formulas and Flexibilities in Trade Negotiations: The Case of Sensitive Agricultural Products in the WTO*, mimeo.
- Jouanjean, M.A., 2012. Standards, reputation, and trade: evidence from US horticultural import refusals. *World Trade Review*. 11(03): 438-461.
- Jouanjean, M-A., Maur, J-C. Shepherd, B., 2012. Chapter 5: *Reputation Matters: Spillover Effects in the Enforcement of US SPS Measures*. Non-Tariff Measures-A Fresh Look at Trade Policy's New Frontier. The International Bank for Reconstruction and Development/The World Bank. NW, Washington: USA.
- Kallummall, M., Gupta, A., Varma, P., 2013. Exports of Agricultural Products from South-Asia and Impact of SPS Measures: A Case Study of European Rapid Alert System for Food and Feed (RASFF). *Journal of Economic Policy and Research*. 8(2).
- Kleter, G. A., Prandini, A., Filippi, L., Marvin, H.J.P., 2009. Identification of potentially emerging food safety issues by analysis of reports published by the European Community's Rapid Alert System for Food and Feed (RASFF) during a four-year period. *Food and Chemical Toxicology*, 47(5): 932-950.
- Lambert, D., 1992. Zero-Inflated Poisson Regression, With an Application to Defects in Manufacturing, *Technometrics*, 34, 1, 1992: 1-14.
- Lezaun, J., Groenleer, M., 2006. Food control emergencies and the territorialization of the European Union. *European Integration*. 28(5): 437-455.
- Long, J., 1997. *Regression models for categorical and limited dependent variables*. California, USA: Sage.
- Nicita, A., Gourdon, J., 2012. A Preliminary Analysis on Newly Collected Data on Non-Tariff Measures. In *United Nations Conference on Trade and Development, Policy Issues in International Trade and Commodities Study Series* (53).
- Nimenya, N., Ndimira P.F., De Frahan, B. H., 2012. Tariff equivalents of nontariff measures: The case of European horticultural and fish imports from African countries. *Agricultural Economics*. 43 (6): 635-653.
- Otsuki, T., Wilson, J. S., Sewadeh, M., 2001. Saving two in a billion: quantifying the trade effect of European food safety standards on African exports. *Food Policy*. 26(5): 495-514.
- Portugal-Perez, A., Reyes, J. D., Wilson, J.S., 2010. Beyond the Information Technology Agreement: Harmonization of Standards and Trade in Electronics. *The World Economy*, 33(12): 1870-1897.
- RASFF., 2013. The RASFF annual report 2013. Rapid Alert System for Food and Feed. European Commission. Available at: http://ec.europa.eu/food/safety/rasff/reports_publications/index_en.htm

Reyes, J.D., 2012. Chapter9:*The Pro-Competitive Effect of International Harmonisation of Product Standards*. Non-Tariff Measures-A Fresh Look at Trade Policy's New Frontier. The International Bank for Reconstruction and Development/The World Bank. NW, Washington: USA.

Tirole, J., 1996. A theory of collective reputations (with applications to the persistence of corruption and to firm quality). *The Review of Economic Studies*, 63(1): 1-22.

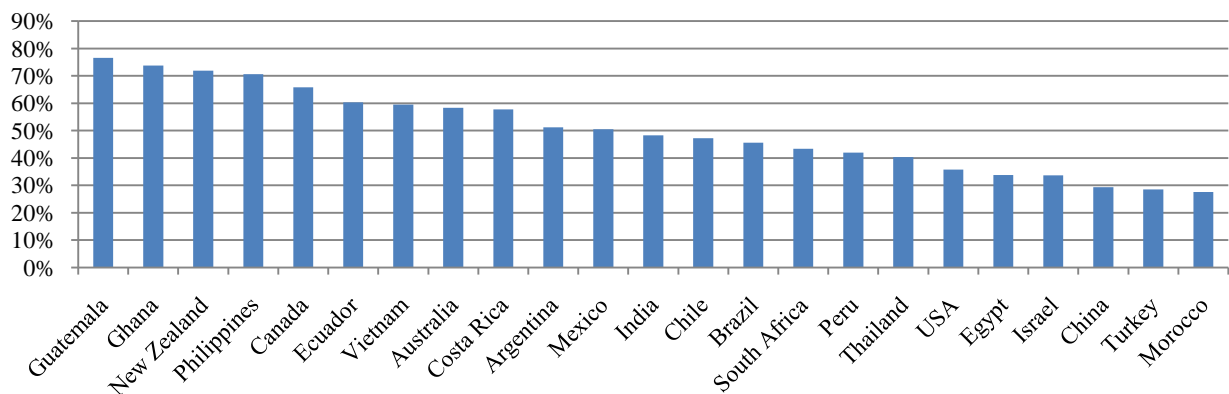
Vuong, Q.H., 1989. Likelihood ratio tests for model selection and non-nested hypotheses. *Econometrica: Journal of the Econometric Society*, 307-333.

Winfrey, J. A., McCluskey, J. J., 2005. Collective reputation and quality. *American Journal of Agricultural Economics*, 87(1): 206-213.

Zeileis, A., Kleiber, C., Jackman, S., 2008. Regression Models for Count Data in R. *Journal of statistical software*, 1-27.

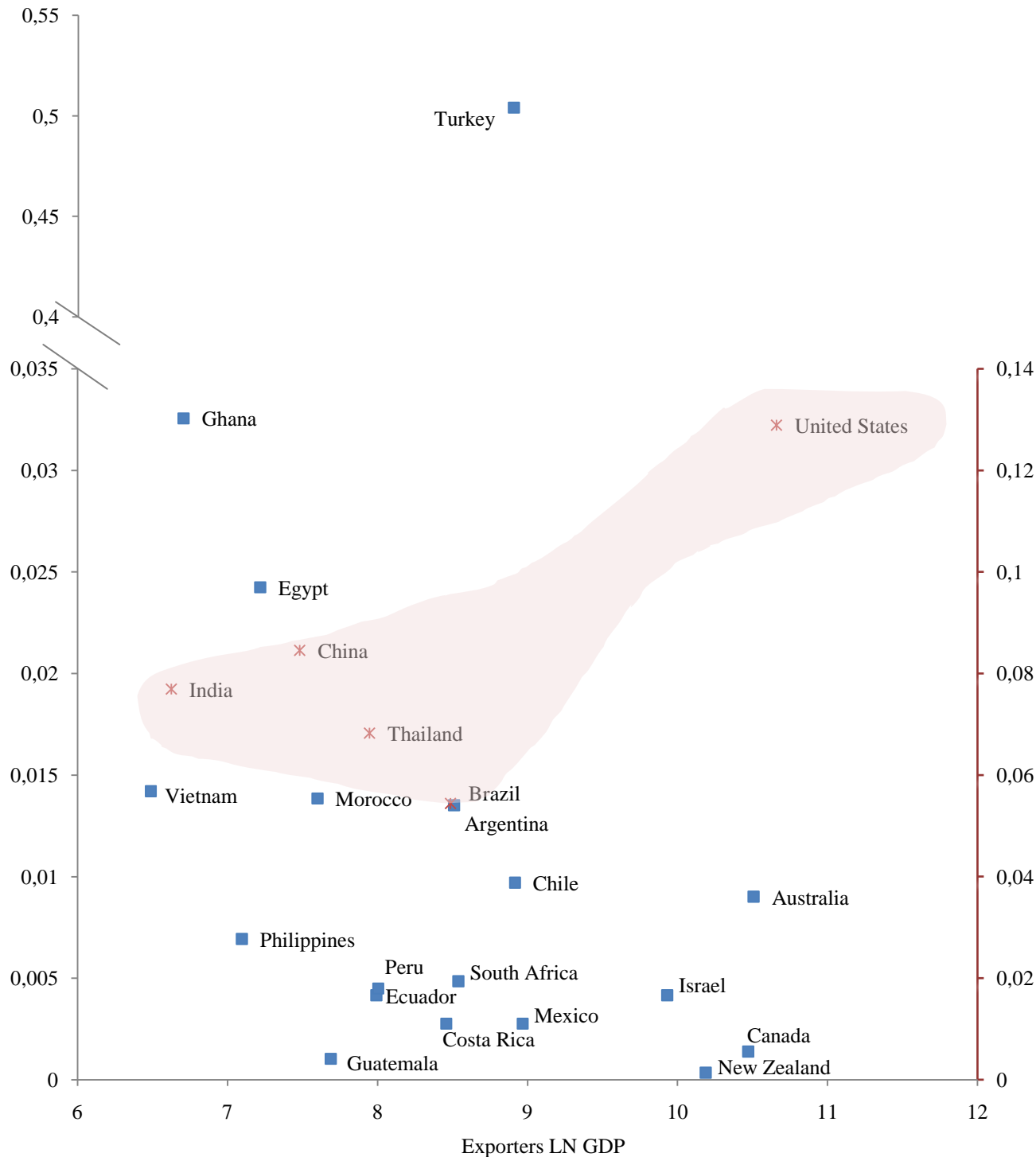
Figures

Figure 2. Percentage of HS4-digit chapters with zero trade flows from each exporter to the set of EU MS



.Source: Authors' calculations.

Figure 2. Relationship between the simple average of notifications by the six EU MS studied and exporters GDP per capita.



Note: United States, China, Brazil, India and Thailand correspond to the right axis. Spain, Italy, Germany, France, Netherlands and United Kingdom as EU MS importing countries considered. *Source:* Authors' calculations.

Tables

Table 2.Number of RASFF notifications by trade chapter for six MS selected for 2001-2013.

	Sector 07 (Vegetables)	Sector 08 (Fruits and Nuts)	Sector 20 (Processed fruit and vegetables)	Total	Most Notified Exporters (*)
France	49	344	6	399	Turkey (73%) China (7%) India (5%)
Germany	176	745	22	943	Turkey (74%) USA (7%) Thailand (6%)
Italy	145	438	33	616	Turkey (44%) USA (11%) China (10%)
Netherlands	61	227	5	293	USA (25%) China (19%) Thailand (18%)
Spain	79	278	23	380	USA (33%) Turkey (26%) China (9%)
United Kingdom	303	276	101	680	India (32%) Turkey (16%) Ghana (11%)
Total	813	2308	190	3311	
Most Notified Exporters (**)	India (30%) Thailand (19%) Turkey (17%)	Turkey (59%) USA (16%) Brazil (6%)	Ghana (28%) Turkey (15%) China (15%)		

Note: (*) Calculated over the total percentage of notifications by importing country. (**) Calculated over the total percentage of notifications by HS2 sector. Source: Authors' calculations from RASFF.

Table 2.Descriptive statistics

Variable	Unit	Mean	Std.	Min.	Max.
N_{ijtk}	Notifications of product (i) from country (j) to exporter (k) in year (t)	0.047	0.851	0	74
$N_{ijk(t-1)}$	Notifications of product (i) from country (j) to exporter (k) in year (t-1)	0.044	0.791	0	62
$N_{ijFR(t-1)}$	Notifications of product (i) from country (j) to France in year (t-1)	0.005	0.337	0	62
$N_{ijGE(t-1)}$	Notifications of product (i) from country (j) to Germany in year (t-1)	0.013	0.510	0	51
$N_{ijIT(t-1)}$	Notifications of product (i) from country (j) to Italy in year (t-1)	0.008	0.257	0	24
$N_{ijNL(t-1)}$	Notifications of product (i) from country (j) to Netherlands in year (t-1)	0.004	0.181	0	26
$N_{ijSP(t-1)}$	Notifications of product (i) from country (j) to Spain in year (t-1)	0.005	0.235	0	27
$N_{ijUK(t-1)}$	Notifications of product (i) from country (j) to United Kingdom in year (t-1)	0.009	0.440	0	74
$N_{Ijk(t-1)}$	Notifications of sector (I) from country (j) to exporter (k) in year (t-1)	0.614	3.703	0	78
$N_{Jk(t-1)}$	Notifications of all products from country (j) to exporter (k) in year (t-1)	5.372	10.973	0	110
$M_{ijk(t-1)}$	Import in volume (miles of tones) of product (i) from country (j) to exporter (k) in year (t-1)	2.064	15.5	0	1280
$\ln GDP_{j(t-1)}$	Ln per capita GDP of exporter country (j) in year (t)	8.353	1.249	6.119	10.715

Note: To simplify the rest of variables has been omitted for reasons of space. The mean is calculated over the total average of observations.

Source: Authors' calculations.

Table 3.Statistical models: estimated parameters

	Zero-Inflated Model (ZINB)		Negative Binomial Model (NBM)
	Neg.bin	Logit	
(Intercept)	-1.352 (0.277)***	3.926 (0.230)***	-4.687 (0.279)***
$N_{ijk(t-1)}$	0.137 (0.023)***	-5.267 (1.318)***	0.482 (0.028)***
$N_{ijFR(t-1)}$	0.131 (0.056)*		0.896 (0.075)***
$N_{ijIT(t-1)}$	0.033 (0.041)		0.400 (0.064)***
$N_{ijNL(t-1)}$	0.115 (0.082)		0.907 (0.095)***
$N_{ijSP(t-1)}$	0.188 (0.079)*		0.397 (0.087)***
$N_{ijUK(t-1)}$	0.602 (0.073)***		3.316 (0.038)***
$N_{jk(t-1)}$	-0.011 (0.004)*	-0.026 (0.004)***	0.005 (0.004)
$N_{jFR(t-1)}$	-0.043 (0.018)*		-0.039 (0.018)*
$N_{jIT(t-1)}$	-0.016 (0.007)*		-0.012 (0.007)
$N_{jNL(t-1)}$	0.007 (0.010)		0.007 (0.009)
$N_{jSP(t-1)}$	-0.025 (0.013)*		-0.009 (0.012)
$N_{jUK(t-1)}$	0.004 (0.006)		0.002 (0.009)
$N_{ijk(t-1)}$	0.008 (0.006)		-0.001 (0.008)
$N_{ijFR(t-1)}$	0.003 (0.024)		-0.093 (0.046)*
$N_{ijIT(t-1)}$	-0.009 (0.016)		-0.014 (0.019)
$N_{ijNL(t-1)}$	-0.093 (0.058)		-0.068 (0.048)
$N_{ijSP(t-1)}$	-0.145 (0.068)*		-0.136 (0.058)*
$N_{ijUK(t-1)}$	-0.091 (0.029)**		-0.157 (0.058)**
$\ln GDP_{jt-1}$	0.006 (0.003)	-0.002 (0.001)**	0.010 (0.003)***
ΔM_{ijkt}	0.00001 (0.00002)	0.00001 (0.00001)	0.00001 (0.00001)
$M_{ijk(t-1)}$	0.00003 (0.00002)		0.00006 (0.00000)***
$\ln GDP_{jFR(t-1)}$	0.00019 (0.00181)		0.00048 (0.00187)
$\ln GDP_{jIT(t-1)}$	-0.00113 (0.00157)		-0.00035 (0.00145)
$\ln GDP_{jNL(t-1)}$	-0.00206 (0.00180)		-0.00074 (0.00164)
$\ln GDP_{jSP(t-1)}$	-0.00130 (0.00167)		0.00036 (0.00160)
$\ln GDP_{jUK(t-1)}$	-0.00281 (0.00168)		-0.00483 (0.00219)*
$f_{jexporter}(\delta_j)$	yes		yes
$f_{jsector}(\delta_i)$	yes		yes
$f_{kimporter}(\delta_k)$	yes		yes
$f_{t-1trade}$	-	1.358 (0.160)***	
Theta	-0.881 (0.088)***		0.074(0.003)***

Note: ZINB consist of two parts. The first part is a negative binomial regression of probability. The second contains a logit regression of the probability. ***p< 0.001, **p < 0.01, *p < 0.05. Standard errors are provided in brackets. All models are estimated using R-language. *Source:*Authors'calculations.

Table 4.NB and ZINB models. Quality of fit indicators

	Zero-Inflated Model (ZINB)	Negative Binomial Model (NBM)
AIC	10197.559	10749.170
BIC	10782.88	11279.619
Log Likelihood	-5034.780	-5316.585
Num. observations	69264	69264
Overdispersion (α)		2.512***
Deviance		3745.748
Vuong Test	-26.60315***	

Note: For overdispersion, the alpha value is displayed, for the Vuong test the z-score

Table 5. Testing common EU MS food control behavior

Restrictions(Ho)		NBM		ZINB	
		LR stat	Pvalue	Waldstatistic	Pvalue
1	Commonfixed MS effects	$\forall \delta_k = \delta_0,$	29.185	0.00002***	-
2	CommonproductMS effects	$\forall \beta_k = \beta_1^* \quad k \neq 1,$	640.531	0.000***	76.667
3	Common sector MS effects	$\forall \gamma_k = \gamma_1^* \quad k \neq 1,$	19.857	0.0013***	16.638
4	Common exporter MS effects	$\forall \rho_k = \rho_1^* \quad k \neq 1,$	9.214	0.1008	16.952
5	Common exporter's GDP per capita MS effects	$\forall \sigma_k = \sigma_1^* \quad k \neq 1,$	6.759	0.2391	4.005
6	All restrictions accepted	$\forall \delta_k = \delta_0, \forall \beta_k = \beta_1^*, \forall \gamma_k = \gamma_1^*, \forall \rho_k = \rho_1^*, \forall \sigma_k = \sigma_1^*$	778.210	0.000***	141.63

Note: H₁: saturated model. Likelihood. Ratio Test (LRTs) have been used to compare the nested binomial and Wald Test for Zero inflated Models.
Source: Authors' calculations.

Table 6. Testing common EU MS food control behavior by sub-periods

Restrictions(Ho)	NB 2001-07		NB (2008-13)		NBM	
	LR stat	pvalue	LR stat	pvalue	LR stat	pvalue
1	Common fixed MS effects	19.72898	0.0005	11.30093	0.0457	29.185
2	Common product MS effects	340.4795	0.0000	294.0599	0.0000	640.531
3	Common sector MS effects	17.16411	0.0041	13.00985	0.0232	19.857
4	Common exporter's MS effects	10.1053	0.0723	3.443741	0.6319	9.214
5	Common exporter's GDP per capita MS effects	10.93435	0.0526	4.422265	0.4903	6.759
6	All restrictions accepted	433.4794	0.0000	361.6581	0.0000	778.210

Note: H₁: saturated model. Likelihood Ratio Test (LRTs) have been used to compare the nested binomial models.
Source: Authors' calculations.

Annexes

Annex 1. Statistical Negative Binomial models: estimated parameters by periods 2001-07 and 2008 -13

	NBM 2001-07	NBM 2008-13	Negative Binomial Model (NBM)
(Intercept)	-5.247 (0.486)***	-4.512 (0.375)***	-4.687 (0.279)***
$N_{ijk(t-1)}$	0.679 (0.045)***	0.399 (0.033)***	0.482 (0.028)***
$N_{ijFR(t-1)}$	1.165 (0.179)***	0.624 (0.086)***	0.896 (0.075)***
$N_{ijIT(t-1)}$	0.425 (0.111)***	0.262 (0.073)***	0.400 (0.064)***
$N_{ijNL(t-1)}$	0.976 (0.234)***	0.748 (0.102)***	0.907 (0.095)***
$N_{ijSP(t-1)}$	0.097 (0.120)	0.542 (0.138)***	0.397 (0.087)***
$N_{ijUK(t-1)}$	4.249 (0.081)***	2.584 (0.041)***	3.316 (0.038)***
$N_{jk(t-1)}$	0.002 (0.007)	0.014 (0.006)*	0.005 (0.004)
$N_{jFR(t-1)}$	-0.109 (0.047)*	-0.020 (0.018)	-0.039 (0.018)*
$N_{jIT(t-1)}$	-0.021 (0.011)	-0.012 (0.010)	-0.012 (0.007)
$N_{jNL(t-1)}$	0.006 (0.021)	-0.006 (0.011)	0.007 (0.009)
$N_{jSP(t-1)}$	-0.019 (0.019)	-0.021 (0.016)	-0.009 (0.012)
$N_{jUK(t-1)}$	0.005 (0.021)	-0.005 (0.010)	0.002 (0.009)
$N_{ijk(t-1)}$	0.003 (0.014)	0.004 (0.009)	-0.001 (0.008)
$N_{ijFR(t-1)}$	-0.052 (0.082)	-0.099 (0.058)	-0.093 (0.046)*
$N_{ijIT(t-1)}$	-0.077 (0.039)*	0.015 (0.021)	-0.014 (0.019)
$N_{ijNL(t-1)}$	-0.034 (0.103)	-0.074 (0.060)	-0.068 (0.048)
$N_{ijSP(t-1)}$	-0.146 (0.082)	-0.182 (0.099)	-0.136 (0.058)*
$N_{ijUK(t-1)}$	-0.918 (0.153)***	-0.088 (0.056)	-0.157 (0.058)**
$\ln \text{GDP}_{jk(t-1)}$	0.041 (0.012)***	0.010 (0.008)	0.010 (0.003)***
ΔM_{ijkt}	-0.00003 (0.00002)	0.00002 (0.00002)	0.00001 (0.00001)
$M_{ijk(t-1)}$	0.00012 (0.00001)***	0.00012 (0.00001)***	0.00006 (0.00000)***
$\ln \text{GDP}_{jFR(t-1)}$	0.00372 (0.00546)	0.00044 (0.00544)	0.00048 (0.00187)
$\ln \text{GDP}_{jIT(t-1)}$	-0.00010 (0.00405)	0.00217 (0.00436)	-0.00035 (0.00145)
$\ln \text{GDP}_{jNL(t-1)}$	-0.00626 (0.00456)	0.00774 (0.00492)	-0.00074 (0.00164)
$\ln \text{GDP}_{jSP(t-1)}$	0.00208 (0.00467)	0.00376 (0.00463)	0.00036 (0.00160)
$\ln \text{GDP}_{jUK(t-1)}$	-0.01637 (0.00674)*	-0.00351 (0.00604)	-0.00483 (0.00219)*
$f_{j\text{exporter}}(\delta_j)$	yes	yes	yes
$f_{i\text{sector}}(\delta_i)$	yes	yes	yes
$f_{k\text{importer}}(\delta_k)$	yes	yes	yes
AIC	4859.490	5854.649	10749.170
BIC	5354.035	6340.253	11279.619
Log Likelihood	-2371.745	-2869.324	-5316.585
Deviance	1638.905	2099.447	3745.748
Num. obs.	37296	31968	69264

Note: ***p < 0.001, **p < 0.01, *p < 0.05. Standard errors are provided in brackets. All models are estimated using R-language. Source: Authors' calculations.