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Federica Demaria, Sophie S. Drogue

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DeMaria, F. ; Drogué, S.

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Federica DeMaria[1] ; Sophie Drogué[2]

[1]University of Calabria, Department of Economics and Statistics, Italia
[2]INRA, UMR 1110 MOISA, F-34000 Montpellier, France

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Abstract

This article explores the effect of European Union (EU)'s food safety regulations on the trade of baby food products. A large number of medical studies have shown that pesticides and contaminants contribute to various health problems including cancer, lung disease or reproductive, endocrinal and immune system disorders. They also agree that children are more vulnerable to the dangers of pesticides and contaminants because as soon as they start eating solid foods, they eat a limited number of food items most of which are fruits and vegetables. In order to protect the health of the most vulnerable part of the population, the EU's regulations establish that no more than 0.01 mg/kg of any single pesticide residue is permitted in baby food products. In this respect, the EU differs from most of its trading partners, the majority of which do not differentiate food safety regulations according to the consumer population age. The purposes of this paper is to compare the EU regulations on Maximum Residual Level of pesticides to those of its major trading partners through a severity index and quantify the impact of the specific European regulations on the trade of baby food products. Results show that the specific EU regulations may be considered as a tool protecting vulnerable population.

Keywords

Food safety, Pesticides, Baby food products, Market access, Gravity modeling

Résumé

Cet article explore l'effet des réglementations de l'Union européenne (UE) sur la sécurité des aliments sur le commerce d'aliments pour bébé. Un grand nombre d'études médicales ont montré que les pesticides et les contaminants contribuent à divers problèmes de santé comme cancers, maladies pulmonaires ou des désordre du système immunitaire, endocrine ou reproducteur. Ces études s'accordent aussi sur le fait que les enfants sont plus vulnérables aux dangers des pesticides et contaminants car dès qu'ils commencent à manger des aliments solides, ils mangent un nombre limité de produits dont la plupart sont des fruits et légumes. Pour protéger la santé de la partie la plus vulnérable de sa population, l'UE a mis en place une réglementation qui établit que la limite maximale de résidus (LMR) pour n'importe quel pesticide ne doit pas excéder 0.01 mg/kg dans les aliments pour bébé. A ce niveau, la réglementation européenne est très différente de celle de la plupart de ses partenaires commerciaux qui ne différencient pas les réglementations en fonction de l'âge. L'objectif de cet article est de comparer la réglementation de l'UE sur les LMR de pesticides par rapport à celle de ses partenaires commerciaux grâce à un indicateur de sévérité et de quantifier l'impact de de cette réglementation européenne spécifique sur le commerce des produits pour bébé. Les résultats montrent que la réglementation de l'UE représente une barrière à l'entrée sur ses marchés, mais qu'elle a aussi un effet positif sur le volume du commerce.

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Mots clefs
Sécurité des aliments, Pesticides, Alimentation infantile, Accès au marché, Modèle gravitaire

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CIHEAM IAM MONTPELLIER   cirad   Montpellier SupAgro   INRA

1- Introduction

Food safety and food quality are the two sides of the same coin. Food safety is a fundamental requirement of food quality and this is particularly true when children are involved. A large number of medical studies have shown that pesticides and contaminants contribute to various health problems including cancer, lung diseases or reproductive, endocrinal and immune system disorders. They also agree that children are more vulnerable to the dangers of pesticides and contaminants because as soon as they start eating solid, they eat a limited number of food items among which fruits and vegetables take an important part. This increases children's exposure to substances they are less capable of metabolizing than adults (Mühlendahl *et al*. 1996; Koletzko *et al*. 1999).

In order to protect children from deleterious substance intake, the EU has erected very severe rules concerning baby and infant processed food. Since 2006, MRL of pesticides in baby and infant food in the EU are covered by Directive 2006/125/EC on processed cereal-based foods and baby foods for infant and young children (European Commission, 2006a) and Regulation EC 1881/2006 setting maximum levels for certain contaminants in foodstuffs (European Commission, 2006b). This legislation rules out processed cereal-based foods and baby foods that contain residues of individual pesticides at levels exceeding 0.01 mg/kg. Non-European trade partners may raise concerns about the obstacles to trade this Directive can create. "On one side, regulations are often necessary to alleviate market failures, but on the other side, domestic regulations may be imposed simply to impede imports of foreign competitors "(Disdier and Marette 2010, p. 713).

In this paper we take advantage of a recent part of trade literature which aims to develop indicators which aggregate over food safety regulations and standards (Achterbosch *et al.*, 2009; Rau *et al.*, 2010; Drogué and DeMaria, 2012; Winchester *et al.*, 2012; Li and Beghin, 2012; Vigani *et al.*, 2012). These indices allow capturing asymmetries or dissimilarities between importing and exporting countries' safety regulations and are further used in econometric analysis. Our paper reinforces this literature as it is to our knowledge, the only paper to apply this methodology to agro-food processed products. In their 2009 working paper Achterbosch *et al.* develop a heterogeneity index to compare sanitary regulations and apply it to the Chilean fruits exports. Rau *et al.* (2010) build a similar heterogeneity index and apply it at various agricultural products among which the only processed product is cheese. But cheese does not encompass the same kind of issues as baby food because it can easily be reduced to milk its almost only component. Drogué and DeMaria (2012) proposed another measure they call regulatory distance which is the Pearson distance between MRL of pesticides in apples and pears. Winchester *et al.* (2012), introduce the heterogeneity index developed by Rau *et al.* (2010) and introduce it in a gravity equation assessing trade impacts of dissimilarity in regulations between 10 regions and 8 product groups (beef, pig meat, cheese, barley, maize, rape and some fruits and vegetables). Vigani *et al.* (2012) study the trade impacts of Genetically Modified Organisms and finally Li and Beghin (2012) build an original aggregation index of non-tariff measure and apply it to an impressive list of 340 raw products.

The other originality of this article is that it is the only one to deal with baby food international trade while this market has experienced noticeable annual growth in the recent years. In certain regions of the world (Brazil, Russia, China and Argentina) this growth can reach more than 10% (Agriculture and AgriFood Canada, 2011). Most papers dealing with baby foods apply on consumer preferences (Maguire *et al.*, 2006; Peterson and Li, 2011).

The article is structured as follows. After introducing the EU specific regulation on baby and infant food in Section 2, we propose the specification of the gravity equation and an index used in order to estimate the degree of severity imposed by the EU on contaminants in food for children under the age of three (Section 3). Then we introduce the estimation techniques (Section 4). The data are described in Section 5. Section 6 presents the estimation results. Section 7 concludes.

2- Background information

Physicians have alerted policy makers on the health problems posed by pesticide exposure through food intake from the sixties. In 1967 the World Health Organization (WHO) Scientific Group on Procedures for Investigating Intentional and Unintentional Food Additives discussed the effects of age on toxicity and found that *"in general, the young animal is more sensitive to the toxic effects of exposure to chemicals". (...) The Scientific Group stated that "pertinent information derived from reproduction (multi-generation) studies provides some assurance on the safety of compounds that might be present in the diet of babies" but felt that "since babies constitute a special population, close observation of epidemiology in this group is an important practical aspect of the evaluation of the effects of exposure." (...)* The report concluded that *"useful information may be obtained from studies in newborn or young animals, from reproduction studies, and from biochemical studies"* and called for further research on *"the development of enzyme systems in the human young, with particular emphasis on those enzymes responsible for* *dealing with foreign chemicals. With respect to the latter research, the Scientific Group concluded that "this information is essential in assessing the safety of additives in baby food."* (WHO, 1987).

However this concern has only recently been taken into account. Until 1999 there was no unified European policy regulating pesticide residues in baby food. MRL of pesticides were set at national levels. Few countries had specific rules on food intended for infants (children under the age of 12 months) and toddlers (between one and three). Mühlendahl *et al*. (1996) report that in Europe, only France, Switzerland, Belgium, Germany and Luxembourg have specifically ruled lower limits.

At the European level food for babies or toddlers was regulated by Directive 91/321/EEC concerning infant formulae and follow-on formulae (European Commission, 1991) and Directive 96/5/EC on cereal-based foods and baby foods for infants and toddlers (European Commission, 1996), establishing in their article 6 that such products "shall not contain any substance in such quantity as to endanger the health of infants and young children. Where necessary, the maximum levels of any such substance shall be stipulated at a later date". The legislation was rather ambiguous and not compulsory to set specific limits. However, in 1993 attention was drawn to the question of pesticide residues in baby food because "excessive lindane concentrations (0.04 ppm) were found in imported vegetables from Spain prepared as baby food". The manufacturer whose product was withdrawn from the market complained to the EC "with the aim of getting the §14 of the German Dietetic Directive – setting the limit at 0.01ppm – revoked on the ground that it constituted an illegal barrier to trade" (Mühlendahl *et al.*, 1996). Thus, the EU commissioned a scientific report on pesticide residue and baby food. On 23 September 1994 the Scientific Committee for Food concluded that "it had no reason to believe that a content of 0.04 mg of lindane per kg of baby food would cause reason for concern" (European Commission, 1994). But three years later the same committee "concluded that if the maximum residue limit were to be set at 0.01 mg/kg in foods intended for infants and young children, there is a possibility that an infant could exceed the Acceptable Daily Intake (ADI) for pesticides having an ADI at 0.0005 mg/kg b.w. (per kilo of body weight) or lower." (European Commission, 1999a).

In 1996 the EC has set a specific directive (Directive 96/5/EC) on processed cereal-based foods and baby foods for infants and young children (European Commission, 1996) stipulating in its Article 6 that: "Processed cereal-based foods and baby foods shall not contain any substance in such quantity as to endanger the health of infants and young children. Necessary maximum levels shall be established without delay." The directive of 1996 was amended a first time in 1998 with no impact on pesticides limits. In 1999 it was amended again by Commission Directive 1999/39/EC of 6 May 1999 replacing the former Article 6 adding that "processed cereal-based foods and baby foods shall not contain residues of individual pesticides at levels exceeding 0.01 mg/kg, except for those substances for which specific levels have been set in Annex VII, in which case these specific levels shall apply" (European Commission, 1999b). However, the prohibition of trade in products not complying with this Directive was delayed until the 1 July 2002. It was finally amended by Directive 2003/13/EC which has added new limits under 0.01 mg/kg for a short list of substances (European Commission, 2003).

Since 2006, MRL of pesticides in baby and infant food in the EU are covered by Directive 2006/125/EC (which put together the Directive of 1996 and its successive amendments) and Regulation EC 1881/2006 (European Commission, 2006a and 2006b). These texts rule out baby food products which pesticides residues are over the 0.01 ppm limit. Thanks to this very strict rule, a 2010 report from the Canadian Ministry of Agriculture reads "Consumers are becoming aware that under EU regulations pesticide levels are so low in baby food that standard items are virtually the same as organic varieties…" (Agriculture and Agri-Food Canada, 2010, p. 4).

No other country specifically regulate foodstuff for children. Some countries such as the USA or Canada consider sensitive subpopulations as children in their risk assessment process rather than setting specific MRL for them. The USA incorporated into the Food Quality Protection Act of 1996 many recommendations issued in the National Research Council 1993 publication "Pesticides in the Diets of Infants and Children". This leads for instance to ban the use of organophosphate pesticide from "kid food" like apples (US EPA, 2010).

In order to protect the health of the most vulnerable part of its population, the EU's regulation establishes that no more than 0.01 mg/kg of any single pesticide residue is permitted in baby food products. This creates a difference in regulations between the EU and most of its trading partners, the majority of which do not differentiate food safety regulations according to the consumer population age. Thus the specific European policy, albeit consumer-driven, may be seen as a form of protection constraining other countries to export primary product rather than processed products to the European markets. This issue is particularly acute as the emerging market of baby food has increased by 30% in the EU these recent years according to UN COMTRADE data.

In order to quantify the impact of the specific European regulation concerning MRL of pesticides on trade of baby food products, firstly, we compare the EU regulation to the regulations of its major trading partners by developing an indicator based on the methodology described in Li and Beghin (2012). This index is hereafter called "severity index" as it indicates if the EU regulation on MRL of pesticides in infant and baby foods is more or less stringent compared to the one of its major trade partners. Secondly we introduce this indicator as an exogeneous variable in a gravity equation. Our objective is to assess the trade implications of the regulatory standard levels in the baby food sector.

3- Gravity model specification and severity indicator

Gravity modeling is now a widespread tool in trade research. It allows taking into account a wide range of trade issues from which those concerning food safety regulations constitute the core of a growing literature (DeMaria *et al.*, 2011).

The standard gravity equation can be written as follows:

$$\begin{aligned}\ln(\mathrm{M}_{ijt}^{k}) = \beta_0 + \beta_1 \ln(\mathrm{GDP}_{it}) + \beta_2\left(\mathrm{GDP}_{jt}\right) \\ + \beta_4 \ln(\mathrm{InfantPop}_{it}) + \beta_5 \ln(\mathrm{InfantPop}_{jt}) + \beta_3 \ln\left(\mathrm{Dist}_{ij}\right) + \beta_5 \ln\left(\mathrm{t}_{jt}^{k}\right) \\ + \beta_6 \ln(\mathrm{severity}_{j}^{k}) + \beta_7 \mathrm{Border}_{ij} + \beta_8 \mathrm{lang}_{ij} + \beta_9 \mathrm{conlony}_{ij} + \mathrm{fe}_i + \mathrm{fe}_j + \mathrm{fe}_t \\ + \mathrm{fe}_{\mathrm{product}} + \varepsilon_{ijt}^{k} \qquad (1)\end{aligned}$$

Where M_{ijt}^{k} are the imports of country *i* from exporter *j* at time *t* of product *k*. As suggested by De Benedictis and Taglioni (2011) this term is in nominal values. GDP_{it} and GDP_{jt} are respectively the Gross Domestic Products (GDP) in current US dollars of the importing and exporting countries at time *t*. $\mathrm{InfantPop}_{it}$ and $\mathrm{InfantPop}_{jt}$ are the infant population of importing and exporting countries respectively, they are used as proxies of consumption. $Dist_{ij}$ reflects the impact of transport costs, proxied by the distance between countries. $\mathrm{t}_{jt}^{k} = 1 + \mathrm{tarif}_{jt}^{k}$, is the EU applied ad-valorem tariff.

$\mathrm{severity}_{j}^{k}$ is our key variable. As previously said it is based on the one proposed by Li and Beghin (2012). It is a protectionism index and it also allows aggregation over a multitude of substances. But for our specific issue this indicator must be adapted. Indeed, in their paper Li and

Beghin consider the MRL as being protectionist if their values exceed those set by the Codex. Conversely we consider the European legislation as protectionist if the values of the MRL set by the EU are lower than the corresponding MRL of its trading partners. We are interested in the EU exclusively as an importer. Adapting the methodology of Li and Beghin (2012), leads to compute their index of severity as follows:

$$severity_{EU-ROW}^{k} = \frac{1}{N}\left(\sum_{p=1}^{N} I_{(MRL_{EUp}^{k} < MRL_{ROWp}^{k})} * exp\left(\frac{MRL_{ROWp}^{k} - MRL_{EUp}^{k}}{MAX\_MRL_{p}^{k}}\right)\right) \quad (2)$$

Where $severity_{EU-ROW}^{k} = severity_{j}^{k}$; MRL_{EUp}^{k} is the MRL set in the EU for pesticide *p* and product *k;* MRL_{ROWp}^{k} stands for the MRL of exporting countries for pesticide *p* and product *k;* in order to normalize our index and avoid division by zero $MAX\_MRL_{p}^{k}$ is the greatest MRL found in all regulations for products *k* and substance *p*, *N* is the total number of substances and it is equal to 894.

$I_{(MRL_{EUp}^{k} < MRL_{ROWp}^{k})}$ is an indicator function which is equal to 0 when $MRL_{EUp}^{k} \geq MRL_{ROWp}^{k}$ and equal to 1 when $MRL_{EUp}^{k} < MRL_{ROWp}^{k}$.

The score of the severity index allows us to compare the regulations by their relative severity. As stressed by its designers this index is invariant to scale and lower and upper bounded by 0 and e ≅ 2.72.

$Border_{ij}$, $lang_{ij}$ and $colony_{ij}$ are binary variables equal to 1 if countries *i* and *j* respectively share the same border, speak the same language and have had a colonial relationship and zero otherwise. In the specification importing, exporting, products and time fixed effects are included[1]. Finally ε_{ijt}^{k} is the error term. The model is tested both on the set of variables and on the functional form. The T-test, Wald-tests and Ramsey Reset Test are carried out.

We are interested in assessing the effects of the EU discipline over time. But we do not have data on the evolution of the regulation of MRL of pesticides before 2008. As we know the implementation year of the EU Directive, we estimate equation 1 using the Least Square Dummy Variables technique (LSDV)[2] adding a dummy called *eureg2002* which catch up the effect of the EU

[1] Fixed effects provide a solution to unobserved heterogeneity and account for multilateral resistance terms and provide more consistent specification (Baldwin and Taglioni 2006).

[2] The fixed effects model is also called the Least Squares Dummy Variable (LSDV) model because the fixed effects may just be entered as dummies in a standard regression.

regulation and equal to 1 between 2002 and 2006 and zero otherwise. Moreover, since we consider panel data, we have to take into account the multilateral resistance term[3] by including in the equation 1 an interaction term between country and time fixed effects.

4- Estimation procedures

The simplest way to estimate Equation (1) is using ordinary least squares (OLS). But in this case, a first problem arises because too many zeros are present in the dataset. This is often the case when very disaggregated data are used. Excluding zero observations creates a selection bias and adding a small constant to trade flows introduces a measurement error. This matter has already been discussed extensively and several alternative approaches as Pseudo Poisson Maximum Likelihood method (PPML), Two-Step Models (Helpman *et al*., 2008; Martin and Pham, 2008) and Zero-Inflation Models (ZIM) (Burger *et al*., 2009) have been proposed to handle zero trade.

As showed by Santos Silva and Tenreyro (2006) truncation of trade flows at zeros produce biased OLS estimations. In addition, if heteroskedasticity is present, the estimates from the log-linearized gravity equation may produce inconsistent estimates of the coefficients. The PPML estimator overcomes these problems. Thanks to its multiplicative form, the PPML specification provides a natural way to deal with zero trade flows. The estimation of the gravity model by PPML is consistent in the presence of heteroskedasticity and is reasonably efficient, especially when large samples are involved. The objective function is log-linear instead of log-log, implying that the dependent variable do not have to be transformed logarithmically. Therefore the expected value of the trade flow, given *z*, is given by:

$$\mathrm{E}\{\mathrm{M}_{\mathrm{ijt}}^{\mathrm{k}}|z\} = \exp\left(\mathrm{z}_{\mathrm{ijt}}^{\mathrm{k}}\beta\right) + \varepsilon_{\mathrm{ijt}}^{\mathrm{k}} \qquad (4)$$

With $\mathrm{M}_{\mathrm{ijt}}^{\mathrm{k}} > 0$ and $E\left[\varepsilon_{\mathrm{ijt}}^{\mathrm{k}}|\mathrm{z}_{\mathrm{ijt}}^{\mathrm{k}}\right] = 0$, where *z* is the vector of the explanatory variables and β is the vector of the coefficients to be estimated and ε is the error term.

If the trade flow variable $\mathrm{M}_{\mathrm{ijt}}^{\mathrm{k}}$ is assumed to follow a Poisson distribution, then a likelihood function can be derived which first and second order moment conditions can be solved to obtain the vector of coefficients (Gourieroux *et al.*, 1984).

Our specification can be written as follows:

[3] For relatively short time periods we can use non time varying exporter and importer fixed effects.

$$E(M^k_{ijt}|Z^k_{ijt}) = \exp[\beta_0 + \beta_1 \ln(GDP_{it}) + \beta_2 \ln(GDP_{jt}) + \beta_5 \ln(Dist_{ij}) + \beta_6 \ln(tariff^k_{ijt}) + \beta_7 \ln(severity^k_j) + \beta_8 Lang_{ij} + \beta_9 Border_{ij} + \beta_{10} Colony_{ij} + fe_i + fe_j + fe_t + fe_k + \ln\varepsilon^k_{ijt}] \quad (5)$$

where Z^k_{ijt} is the matrix including all explanatory variables. The consistence of the PPML estimator is ensured assuming that the conditional mean is equal the conditional variance $var(M^k_{ijt}|Z^k_{ijt}) \infty E(M^k_{ijt}|Z^k_{ijt})$. Countries time invariant specific fixed effects are included to capture unobserved country heterogeneity such as multilateral resistance term (Anderson and van Wincoop, 2003).

Our dependent variable has a mixed distribution characterized both by the long right-tail and a mass of zeroes. As specified by Chaney (2008) or Helpman *et al*. (2008), zeros may reflect the existence of fixed costs or entry cost impeding countries to sell their products in the destination's markets. As a further check we also use the Heckman Two-Step procedure (Heckman, 1979), which corrects the possible biases and allows us to investigate the effects of the variables on both the probability of trade (extensive margin) and the volume of trade (intensive margins). The full marginal effect of this variable is the sum of the extensive and intensive margins. The procedure includes two equations: a selection equation incorporating a binary decision variable "whether to trade or not" and an outcome equation determining the intensity of trade.

The selection equation is given by:

$$d^*_{ij} = z_{ij}\gamma' + u_{ij} \quad (6)$$

Where d_{ij} is a latent variable, z_{ij} is a vector of explanatory variables influencing d^*_{ij} and u_{ij} is the error term. d_{ij} is not observed but we observe whether countries trade or not, therefore:

$$d_{ij} = \begin{cases} 1 \ if \ d^*_{ij} > 0 - there\ is\ trade \\ 0 \ if \ d^*_{ij} \leq 0 - no\ trade\ occurs \end{cases}$$

The outcome equation determines the value of trade:

$$M^*_{ij} = x_{ij}\beta' + \varepsilon_{ij} \quad (7)$$

x_{ij} is a vector of independent variables determining the natural logarithm of M_{ij}, it is observed if d = 1; the error terms u_{ij} and ε_{ij} are independently across observations and jointly normally distributed with covariance $\rho\sigma_e$: $u_{ij}, \varepsilon_{ij} \sim N\left(0, \begin{bmatrix} 1 & \rho\sigma_e \\ \rho\sigma_e & \sigma^2_\varepsilon \end{bmatrix}\right)$. The variance of u is normalized to 1 because only d is observed; not d^*. The expected value of M_{ij} is conditional expectation of M_{ij}^* conditionated on it being observed ($d_{ij} = 1$):

$$E(M_{ij}|x_{ij}, z_{ij}) = E(M_{ij}^*|d_{ij} = 1, x_{ij}, z_{ij}) = x_{ij}\beta + \rho\sigma_\varepsilon \frac{\phi(z_{ij}\gamma)}{\Phi(z_{ij}\gamma)} = x_{ij}\beta + \rho\sigma_\varepsilon\lambda(z_{ij}\gamma) \quad (8)$$

Where $\lambda(\alpha) \equiv \frac{\phi(\alpha)}{\Phi(\alpha)}$ is the Inverse Mill Ratio (Greene, 2008).

For robust identification, Helpman *et al*. (2008) suggest that both the selection and outcome equations include the same independent variables except one, that is, a variable influencing the fixed costs and not the costs of trade, of EU and trading partners. In our case the selection equation, includes also the severity measure. Its exclusion from the outcome equation provides the exclusion restriction. Our empirical versions are:

$$\begin{aligned} d_{ij}^* = {} & \beta_0 + \beta_1 \ln(GDP_{it}) + \beta_2(GDP_{jt}) + \beta_3 \ln(InfantPop_{it}) + \beta_4 \ln(InfantPop_{jt}) + \beta_5 \ln(Dist_{ij}) \\ & + \beta_6 \ln(tariff_{ijt}^k) + \beta_7 \ln(severity_{ij}^k) + \beta_8 Lang_{ij} + \beta_9 Border_{ij} + \beta_{10} Colony_{ij} \\ & + fe_i + fe_j + fe_t + fe_{product} + u_{ijt}^k \qquad (9) \end{aligned}$$

$$\begin{aligned} \ln(M_{ijt}^k) = {} & \beta_0 + \beta_1 \ln(GDP_{it}) + \beta_2(GDP_{jt}) + \beta_3 \ln(Dist_{ij}) + \beta_4 \ln(tariff_{ijt}^k) + \beta_5 Border_{ij} \\ & + \beta_6 lang_{ij} + \beta_7 colony_{ij} + \beta_\lambda IMR_{ijt}^k + fe_i + fe_j + fe_t + fe_{product} \\ & + \varepsilon_{ijt}^k \qquad (10) \end{aligned}$$

The equation 10 includes the inverse mill ratio (IMR_{ijt}^k); all variables are listed in table 2 in appendix. The equations can be estimated simultaneously, through the maximum likelihood method, or successively (Cameron and Trivedi, 2009). For robustness we use both procedures, in the latter the selection equation is estimated by a probit, we use the standard OLS to estimate the outcome equation.

5- Data

The baby food sector is very competitive and dominated by multinationals among which the leading companies are Nestlé, Danone, Heinz and Kraft (Agriculture and Agri-Food Canada, 2011). This industry has seen its production increase rapidly in parallel with the increasing women employment rate. In 2010 the global baby food market represented 36.7 billion of US$ where dried baby food account for 3.7 billion, milk formula 25.2 billion, prepared baby food 6.5 billion and other baby food 1.4 billion. This sector is forecast to reach 55 billion of US$ in 2015. According to Euromonitor International the Asia Pacific region accounts for 37%, Western Europe 22%, North America 18%. The baby food global market involves both developed and emerging countries, however few actors are involved. Beside the EU27 countries which we consider as the importing markets, Argentina, Australia, Brazil, Canada, Chile, China, India, Korea, Japan, Mexico, New Zealand, Norway, Philippines, Russia, South Africa, Switzerland, USA are included as exporters in our analysis. This market is also evolving in terms of variety and the range of products supplied by the baby and infant food industry is becoming impressive. For instance Blédina (leader on the French market) has not less than 96 products in its range of baby foods and Nestlé (another actor on the French market) counts 18 brands[4].

The time dimension of our analysis is performed on two periods, 1998-2010 for which we do not have the MRL but which encompass the date of the entry in force of the European regulation and 2008-2010 for which the MRL are available. Our data on MLR come from DG Sanco for EU and from FAS USDA for other countries. But since limits vary across countries, and country policies regarding the implementation of international standards are not always transparent, we have checked, as far as possible, all limits against the domestic regulations.

At this point something must be said on the computation of our severity index. A first difficulty stems from what Li and Beghin (2012) call regulatory intensity. Each country holds its own list of pesticides but the absence of a pesticide from a list may have diverse interpretation: the “missing” substance may be either unregulated (when the country considers it innocuous), or regulated by default (a default limit applies) or it may just be “missing” for various reasons (such as a problem in data collection). To tackle this issue Li and Beghin (2012) use a list of substances common for all countries, the one drawn up by the Codex Alimentarius, hereafter Codex. We think that using this list produces a loss of information because the Codex does not regulate many substances (127 overall). We decide to work on the longest list of pesticides. To deal with missing substances we follow Drogué and DeMaria (2012): (i) when the country has information on the default value, we replace the missing value by the default value (see table 1 in Appendix); (ii) if the pesticide is not regulated and information on default limit is missing we replace the missing value with the maximum value found in the data.

[4] Including all types of foods and beverages.

Another aggregation issue arises because MRL of pesticide are generally defined for raw products and very seldom for processed ones. In the trade nomenclature of the European Union baby food products are defined at the NC8-digit level by 6 codes: 16021000 homogenized preparation of meat; 20051000 homogenized vegetables; 20071010 and 20071099 homogenized preparation of fruits; 21041000 soups and broth preparations; 21042000 homogenized composite food preparations. We must find out how to associate the pesticide MRL to these six NC8 commodities. As we are interested in baby food, we focus on foodstuffs which make up baby and infant 'ready-to-eat' meals. We select them based on the various recipes proposed by the two leading French companies Blédina and Nestlé. This selection makes us consider 26 raw products allocated among 4 class of which 6 fruits (apples, apricots, bananas, orange, peaches and pears); 11 vegetables (eggplants, green beans, carrots, leek, peas, pepper bell, potatoes, spinach, squash, tomatoes, zucchini); 5 cereals (barley, corn, oats, rice, wheat) and 4 meats (bovine, hog, poultry and turkey). We compute for each country pair (EU versus its main importers) and substance, the severity index for these 26 products. We then derive the severity index by class considering the minimum index value by substances within a class. Finally we associate the class and NC8 commodities by their main common ingredients: meats for NC8 (16021000), vegetables for NC8 (20051001), fruits for NC8 (20071010), for NC8 (21041000) which is a composite of cereals and vegetables or cereals and fruits or meat and vegetables or meat, vegetables and cereals we take for each substance the minimum value over the 4 class.

Table 1 shows the values of the severity index by NC8 commodities and countries. They range between 0 and 1.26. A value equal to 0 means that the EU regulation is equally or less stringent than the exporter's regulation; conversely a high value implies that the EU applies a stricter regulation. Our intuition is that a higher index value should reduce trade and vice-versa. South Africa, Norway and Switzerland report an index value of the index equal to zero because they apply the same regulation as the EU. Argentina, Australia, China, Korea, Mexico, Russia and USA report a value of severity close to 0, which means that in general their regulations are very close to that of the EU, this is due to the fact that these countries apply zero tolerance provisions or a very low maximum level for those substances. On the contrary Brazil, Chile, India, Japan and Philippines display larger values between 0.77 and 1.26.

Table 1 Severity index by product at NC8-digit level

	16021000	20051000	20071000	21040000
Argentina	0.015	0.009	0.020	0.009
Australia	0.021	0.002	0.025	0.002
Brazil	0.819	1.086	1.251	0.819
Canada	0.300	0.407	0.491	0.300
Switzerland	0	0	0	0
Chile	0.773	1.096	1.231	0.773
China	0	0	0.003	0
India	0.798	1.095	1.256	0.798
Japan	0,299	0.400	0.478	0.299
Korea	0,030	0.015	0.033	0,015
Mexico	0,015	0,003	0,018	0.003
New Zealand	0.302	0.408	0.487	0.302
Norway	0	0	0	0
Philippines	0.773	1.096	1.233	0.773
Russia	0.013	0.004	0.019	0.004
USA	0.037	0.022	0.034	0.022
South Africa	0	0	0	0

Our data are drawn from several sources: EU imports are collected from Eurostat Comext database, GDP and total population are from World Bank Developed Indicators (WBDI); infants populations come from United Nations Population Information Network (UNPIN), EU's tariffs come from EU Taric database; distance, common language and colony are from the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII). The female employment rate and the number of children per woman (or fertility rate) come from Eurostat Database, finally consumption of baby food products come from Agriculture and Agri-Food Canada, 2011.

The matching of our different sources leads to an original database that associates trade, MRL and country level variables at product line. We consider only countries for which the information on MRL is available. We exclude from our original sample influential outliers, i.e. observations with too high values of trade.

Finally we get a database including only 20 EU's members' states as importing countries and 37 exporting countries[5], over the period 1998-2010 and sub-period 2008-2010. We take intra-EU trade into account. The descriptive statistics of our variables of interest are displayed in Table 6.

[5] Argentina, Australia, Brazil, Canada, Chile, China, India, Korea, Japan, Mexico, New Zealand, Norway, Philippines, Russia, South Africa, Switzerland, USA and EU20 Members (Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands Poland, Portugal, Romania, Slovakia, Spain, Sweden, United Kingdom).

The Table 7 reports the simple correlations among the variables used in the empirical model. As expected, trade is positively correlated with GDP, female employment rate, fertility rate, common border and common language while trade and tariff, distance and NTM are negatively correlated. Finally, the positive correlation between tariff and severity measures suggests complementarity between these protectionist variables.

6- Estimation results

The empirical analysis includes six processed product lines and four estimation techniques. Results are displayed in Table 3, 4a, 4b and 5 in appendix.

In Table 3 are displayed the OLS estimators (column 2) and LSDV estimators (column 4). These first two estimations have been performed over the period 1998-2010 in order to assess the impact of the entry in force of the EU regulation on MRL of pesticides in 2002. While the other estimation procedures concern the period 2008-2010, for which data on MRL are available. Tables 4a and 4b report results from the PPML procedure. Finally, table 5 reports the results obtained from the Heckman procedure. The estimations of the outcome equation are reported in column 2, those of the selection equation in column 4. To control for country, importer, exporter, time and product specific characteristics; fixed effects are considered in all the estimations even if they are not reported.

Table 3 Column 2 shows that the standard gravity variables have the expected signs. The GDP are positive and statistically significant (0.46 for importers and 0.38 for exporters), distance and tariff variables display negative and significant coefficients (-0.60 and -0.53 respectively), common language and common border have the expected positive signs (0.51 and 0.63 respectively). We also control for the infant population of the importing and exporting countries. The first term is negative and statistically significant (-0.0001) but very close to zero, on the contrary the second one is positive but not statistically significant[6]. The *eureg2002* term which captures the entry in force of the EU regulation on MRL of pesticides in baby food reports a negative but low coefficient (-0.28). We also control for the enlargement of the EU but this term does not seem to have any impact on trade.

Turning to LSDV estimation, we find positive and statistically significant coefficient of importers GDP (1.27) while non-significant coefficient of exporters GDP. Distance, common Border

[6] Infant population has been used as a proxy of consumption, other proxies have also been used (Number of children per woman, the consumption value in baby food products and Female employment rate). Curiously all these proxies do not seem to have any influence on baby food trade flows.

and common language have the expected sign (-0.77, 0.54 and 1.10 respectively). The dummy variable *eureg2002* displays a positive and significant coefficient (2.66) showing a positive impact of the European regulation on EU's imports of baby food products. It seems that the imposition of this regulation acts as a booster of baby food imports. This is consistent with the market data which underline the growth of the EU27 baby food market from 2003 (Agriculture and Agri-Food Canada, 2010). Finally, the EU enlargement dummy variable displays a positive and significant coefficient (1.55).

Output from the PPML estimator are considered over the period 2008-2010, even in this case the gravity equation is estimated by changing and adding different proxies of consumption in the importing countries. These estimations include the indicator of severity between the EU and its trading partners (variable *severity*) previously presented. This variable must be read as an indicator of the regulatory distance between the EU and its partners. As in Drogué and DeMaria (2012), the effects are inversed: the greater the distance the lower the trade and *vice-versa*. The results are as reported in tables 4a and 4b. The GDP are not significant, implying that the countries' size does not affect trade flows. The proxy of consumption is not significant as well. In all regressions, as expected, distance, tariff and the severity index display negative and significant coefficients. The effect of severity index is higher than that of tariff (-1.94 and -0.34). The higher the "distance" in terms of MRL between the EU and its partners, the lower the trade. This result is similar to Drogué and DeMaria (2012) who find that regulatory distance has a negative impact on the volume of trade. Sharing a border and/or a language has a positive trade effects. The existence of past colonial relationship does not impact trade. Finally we run a Ramsey specification test (Ramsey, 1969) to detect whether the equation is correctly specified and the significance of the test suggests that the model is well specified (0.64).

Then, in order to verify the effects of the EU regulation by exporters, we run the gravity equation considering an interaction term between the severity index and the exporters fixed effects: $\beta_{10}\ln\left(\text{severity}_j^k\right) * \text{fe}_j$. The effect of the severity index on a specific exporting country is given by $\hat{\beta}_7 + \hat{\beta}_{11}$.

This analysis provides evidence on positive and statistically significant effects of the European "severity" for Chile (4.03), New Zealand (9.08) and the Russian Federation (2.16), and negative and statistically significant effects for Japan (-7.24), the remaining coefficients being non-significant. Positive results for Chile, New Zealand and Russia are rather surprising as they mean that the decrease of the regulatory distance between the EU and these partners would decrease trade. One possible hypothesis is that the EU regulation act as a guarantee of food safety for consumers. As baby food is a sensitive good, if the EU would increase its MRL to move closer to its partners' limits, it would have a disastrous impact on consumption and thus on imports.

To conduct a deeper analysis in our understanding of the link between safety regulation and trade, we analyze the influence of the severity measure on the probability of trade. Indeed our two precedent results may appear as contradictory as the results of the LSDV show positive results of the European regulation and those of the PPML negative ones. Using the Heckman two steps procedure we study in which way the severity measure may influence the probability of export to the EU market. Results are reported in Table 5. The Heckman selection equation displays an unexpected positive but close to zero impact of distance (0.16) and negative and significant impact (-0.23 and -0.66) of tariff and severity. This could be explained by the fact that the baby food market is dominated by few multinational firms, with a highly outsourced production. For this specific high value added market, what matter most are the safety and quality levels rather than the distance or the country's ability to be in a given geographical area. Thus physical distance does not have a big influence on the probability of having positive trade flows. Tariff displays a lower coefficient -0.23 than severity. This result confirms our intuition that a more severe rule on MRL increases the difficulty to export to the EU market because of additional costs to comply with the EU regulation. Here the specific EU's regulation on baby food acts as a fixed entry cost. This result is similar to Jayasinghe *et al*. (2010) which find that sanitary and phytosanitary measures have a negative and significant impact on the probability of trade.

To complement our result, we have re-estimated the gravity model including the severity index in the outcome equation. In this second estimation, results[7] are still the same and the coefficient of the measure of severity is not significant. The estimated selection coefficient ($\hat{\lambda}$) is statistically significant (0.82), confirming that the absence of control for zero flows generates biased results.

The estimates of the outcome equation show that the GDP, consumption and past colonial relationships have no impact on the level of trade, distance displays the correct sign (-1.06) while tariff would impact trade positively (0.36). These results confirm the previous one. These results provide evidence that at aggregated level, the EU requirement may constitute a barrier to entry in its own market but once overcome can help to foster trade.

[7] These results are not reported but available on request.

Even in this case, the Ramsey specification test (Ramsey, 1969) is used to detect whether the outcome equation is correctly specified. The significance of the test suggests that misspecification exist (0.001). Given the result of the Reset test for the Heckman procedure, we need to have a proof on the direction of the sign found in the selection equation, thus we re-estimate the gravity equation using ZIM. The ZIM's results confirm the direction of the sign found in the Heckman procedure. The severity measure has a negative impact on the probability of trade but no impact on the level of trade. Complying with the European requisite is an obligation, and may constitute a barrier to market entry but does not affect the amount of trade. These results are not reported, but available upon request.

As for the robustness check of our results, we have estimated different specifications of the gravity model and each specification confirms our results. We have also checked for European trade preferences granted under the EU Generalized System of Preferences including in the gravity equation a dummy variable accounting them for[8]. Results are not reported but are available upon request. The GSP dummy variable exhibits a positive but not significant coefficient and the severity measure is still negative. As a further robustness check, we have run the gravity equation considering the EU members at the aggregate level. In this case, the one and only variable influencing trade across countries is the severity measure.

In addition, we have also considered two analyses based on a longer period (1998-2010). First, we have considered an interaction term between the EU regulation dummy variable and the severity measure. This term has a negative and a significant influence on trade. Then, we have performed another estimation introducing the severity measure in the specification as an exogenous variable from 2002 to 2010 and results are still confirmed. Results are not reported but are available upon request.

As a final robustness check, we have re-estimated the gravity equation using the Generalized Negative Binomial Regression Model (GNBRM) and the Hurdle Double Models and results are quite similar to the PPPML and the Heckman procedure.

[8] According to COUNCIL REGULATION (EC) No 732/2008 Argentina, China, India, Mexico, Philippines, Russia and South Africa benefit from the EU GSP ordinary preferential scheme. Brazil has been removed from the GSP for the following products: Prepared foodstuffs; beverages, spirits and vinegar; tobacco and manufactured tobacco substitutes.

7- Discussion and conclusion

The medical literature agrees on the fact that pesticides and contaminants contribute to numerous health problems including cancer, lung disease or reproductive, endocrinal and immune system disorders, by stressing the idea that children are more vulnerable to the dangers of pesticides and contaminants than adults (Mühlendahl *et al*., 1996; Koletzko *et al*., 1999). In that respect the EU impose a very severe rule concerning the MRL of pesticide in the food intended for infants and toddlers through its Directive 2006/125/CE which imposes that no more than 0.01 mg/kg of any pesticides should be found in baby foods. The European 2006 Directive can be interpreted as a form of protection of this emerging baby food market constraining other countries to export primary product rather than processed one to the European markets. In this study we assess the impact of the EU food safety regulation on its imports of baby food products using a gravity analysis. In the first two sections of the paper we describe the EU regulation and compare it to those of its main trade partners. Following the recent literature on food safety regulations and standard (Achterbosch *et al*., 2009; Rau *et al.*, 2010, Drogué and DeMaria 2012; Winchester *et al.*, 2012; Li and Beghin, 2012) we build and index to assess the degree of severity of the EU regulation in comparison to its partners. The index ranges between 0 and 1.33: the higher the index the stricter the EU regulation. We introduce this index as an exogenous variable in a gravity model. We run the model on 20 over 27 of the EU member states, on the exporting side and 44 main exporting countries: Argentina, Australia, Brazil, Canada, Chile, China, India, Japan, Korea, Mexico, New Zealand, Norway, Philippines, Russia, South Africa, Switzerland, USA and the EU27 member states. We employ the PPML estimator and the Heckman selection model at the NC8 digit level of trade. The results across estimators are quite robust. The coefficients of interest have a negative and strongly significant effect in both procedures employed (PPML and Heckman procedure). The estimated results show that globally the EU's regulation may constrain trade. This means that the large difference in MRL may constitute a serious barrier to market entry. But as baby foods are processed products with high value added, once internalized the cost of complying with the European requisite, there is no more obstacle to the penetration of the European markets. Furthermore, our results suggest that the effect of tariff is lower than the severity's measure. The results are robust being confirmed by the use of different estimator's technique.

From a policy perspective, this study provides evidence that at global level the EU regulation on MRL of pesticides is a crucial element across trading partners. When countries' analysis is considered the EU regulation acts as barrier to trade of baby food products just for Japan. If a country is able to comply with the EU requisite then the EU regulation does not constrain trade. We are trying to answer to the following question: does the EU regulation protect health or trade? We may think about the EU requisite as a standard of safety and quality which aims to protect the health of the most vulnerable part of the population. In this perspective the EU regulation seems to produce the desired effect. Safety may be considered as a synonymous of quality which determines the level of the trade. The EU imports increase from the countries producing high safety products, in this sense we may read the Heckman's results. These results are also confirmed by the data market. Parents have become more and more demanding in terms of the quality and safety of the food they give to their children. Maguire *et al*. showed that "parents are concerned about the risk posed by pesticides in baby food, and for those who choose to purchase organic foods, the health benefits are a primary motivation" Maguire *et al.* (2006) p.189. Peterson and Li (2011) found in their study that consumers are ready to pay a premium for organic baby foods not for its organic qualities but because it ensures a restriction in the use of pesticides and Genetically Modified Organisms. But in the same time statistics show that in the EU "baby food sales steadily increased from 2003" (Agriculture and Agri-Food Canada, 2010, p.2) the EU regulation having entered into force the year before.

We acknowledge that these findings present some limit especially dependent on the database used. As previously said, no MRL on processed products exists, thus we are compelled to associate the MRL for fresh products to processed ones. Baby food is a limited market and a particular sector involving few actors. The information is not always available and further analysis is needed. This should be considered as the starting point of a deeper analysis of an unexplored market which should encompass the evolution in regulations.

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Appendix

Table 1: Rules on missing value of pesticides

	Rule when a pesticide is not registered
Argentina	1- Codex 2- Zero-tolerance
Australia	Zero-tolerance
Brazil	Codex
Canada	Default limit of 0.1 mg/kg
Chile	Codex
China	1- Codex 2- Limits applied by reference countries (EU, USA)
EU	Default limit of 0.01 mg/kg
India	No default limit
Japan	Default limit of 0.01 mg/kg
Korea	1- Codex 2- Limit of most similar group of product 3- Default limit of 0.01 mg/kg
Mexico	Zero-tolerance
New Zealand	1- Codex recognized for imported food 2- Australian MRLs recognized for food imported from Australia. 3- Default limit of 0.1 mg/kg applies
Norway	EU limit
Philippines	No default limit
Russia	1- Codex 2- Memorandum with Chile and the EU 3- MRL of the most similar product 4- MRL of the country of origin
South Africa	EU limit
Switzerland	EU limit
USA	Zero-tolerance

Table 2: Description of the Variables

Variables	Description
M_{ijt}^{k}	Value of EU imports from country j in product k in year t
d_{ij}^{*}	A binary variable such that $z_{ij}^{*} = 1$ if $M_{ijt}^{k} > 0$
$fe_i, fe_j, fe_t, fe_{product}$	Respectively importing, exporting, year and product fixed effects
$Dist_{ij}$	Distance between partners
$tariff_{ijt}^{k}$	EU's applied tariff for country *j*, products *k* and year *t*
$severity_{ij}^{k}$	measure identifying the severity between EU and its partners *j* for product *k*.
GDP_{jt} and GDP_{jt}	Respectively Gross Domestic product of country *i* and *j* in year *t*
$InfantPop_{it}$ and $InfantPop_{jt}$	Is the infant population in EU country *i* and its trading partners *j*
$Consumption_{imp}$	Measure identifying the value of consumption of baby food in importing country i at time t
$colony_{ij}$	Binary variable which is equal to 1 if trading partners have had a colonial link and zero otherwise
$language_{ij}$	Binary variable which is equal to 1 if trading partners share the same language and zero otherwise
u_{ijt}^{k} and ε_{ijt}^{k}	Error term of the selection and outcome equation
IMR_{ijt}^{k}	Inverse Mills Ratio

Table 3: Basic Estimates

	OLS		LSDV	
	Beta	SE	Beta	SE
GDP_{Imp}	0.4614***	(0.0521)	1.2763***	(0.3692)
GDP_{Exp}	0.3852***	(0.0284)	-0.1143	(0.1480)
$InfantPop_{Imp}$	-0.0001**	(0.0000)	-0.0001	(0.0003)
$InfantPop_{Exp}$	-0.0189	(0.0318)	0.0131	(0.2207)
Distance	-0.6042***	(0.0441)	-0.7792***	(0.0604)
Tariff	-0.5397***	(0.0429)	-0.1247	(0.1224)
1 for contiguity	0.5159***	(0.0796)	0.5437***	(0.0899)
1 for common official of primary language	0.6371***	(0.0954)	1.1096***	(0.1114)
1 for pairs ever in colonial relationship	-0.0708	(0.1162)	-0.6205***	(0.1358)
EURegulation	-0.2809***	(0.0512)	2.6633**	(1.0715)
$EU_{Enlargement}$	0.0182	(0.0877)	1.5529**	(0.7373)
Observations	9690		9690	
Adjusted R^2	0.210		0.286	
RESET Test	0.0001		0.133	

Note: Dependent Variable $\ln(M_{ijt}^{k})$. LSDV include MRT, Product, Importer, Exporter and time fixed effect (not reported); Intercept (not reported). Robust Standard errors in parentheses ; significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4a: PPML Estimates

	(1)		(2)	
	Beta	SE	Beta	SE
GDP_{Imp}	-0.8903	(1.4763)	-1.0426	(1.4803)
GDP_{Exp}	0.5261	(1.4919)	0.4857	(1.4821)
$Consumption_{Imp}$	0.2023	(1.1969)		
$InfantPop_{Exp}$	2.3791	(3.1770)	2.4249	(3.1602)
Distance	-0.1661***	(0.0554)	-0.1662***	(0.0554)
Tariff	-0.3417***	(0.1157)	-0.3417***	(0.1157)
Severity	-1.9420**	(0.9085)	-1.9420**	(0.9090)
1 for contiguity	1.3479***	(0.1142)	1.3478***	(0.1145)
1 for common official of primary language	1.2092***	(0.1722)	1.2190***	(0.1722)
1 for pairs ever in colonial relationship	0.0764	(0.1738)	0.0764	(0.1738)
$InfantPop_{Imp}$			-0.4352	(3.3558)
Observations	15840		15840	
Adjusted R^2	0.44		0.41	
RESET Test	0.649		0.634	
Wald test	Yes		Yes	

Note: Dependent Variable (M_{ijt}^{k}). Product, Importer, Exporter and time fixed effect (not reported); Intercept (not reported). Standard errors in parentheses; significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4b: PPML Estimates by country

	Beta	SE
GDP_{Imp}	-0.9430	(1.4769)
GDP_{Exp}	0.7340	(1.4914)
$Consumption_{Imp}$	0.1837	(1.1937)
$InfantPop_{Exp}$	2.5225	(3.1941)
Distance	-0.1640***	(0.0551)
Tariff	-0.1390	(0.1227)
Severity	-3.2578*	(1.8972)
1 for contiguity	1.3460***	(0.1143)
1 for common official of primary language	1.1814***	(0.1724)
1 for pairs ever in colonial relationship	0.0946	(0.1712)
EU	-2.9696	(3.1911)
Australia	2.2567	(2.0144)
Brazil	0.4317	(2. 3550)
Chile	7.2893**	(2.9693)
China	2.6623	(3.1943)
India	1.3205	(2.1476)
Japan	-3.9836*	(2.3151)
Mexico	-0.6773	(2.4053)
Korea	-2.7584	(2.2942)
New Zealand	13.0803***	(3.0195)
Norway	-3.0014	(3.1583)
Philippines	-2.2533	(2.2728)
Russia	5.4255**	(2.3142)
South Africa	0.7218	(2.7003)
Switzerland	-0.8632	(3.0773)
USA	2.0057	(2.2337)
Observations	14230	
Adjusted R^2	0.52	
RESET Test	0.319	
Wald test	Yes	

Note: Dependent Variable (M_{ijt}^{K}) Product, Importer, Exporter and time fixed effect (not reported); Intercept (not reported). Standard errors in parentheses ; significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Heckman Two-Step Estimates

	Intensive Margin		Extensive Margin	
	Beta	SE		
GDP_{Imp}	0.7837	(1.4584)	0.0723	(0.5269)
GDP_{Exp}	0.8235	(0.7115)	-0.2359	(0.2111)
$Consumption_{Imp}$	0.6619	(1.0071)	-0.2570	(0.3860)
$InfantPop_{Exp}$	-1.0636	(3.3640)	1.8316	(1.2381)
Distance	-1.0618***	(0.0967)	0.1613***	(0.0281)
Tariff	0.3617**	(0.1517)	-0.2360***	(0.0372)
Severity			-0.6663***	(0.1195)
1 for contiguity	1.3035***	(0.2303)	1.4201***	(0.0677)
1 for common official of primary language	1.1282***	(0.1847)	0.4725***	(0.0805)
1 for pairs ever in colonial relationship	-0.1813	(0.2092)	0.2267***	(0.0869)
mills lambda			0.8253***	(0.3057)
Observations	15840			
RESET test	0.0001			

Note: Selection Equation: dependent variable Prob(M_{ijt}^{k}>0); Outcome Equation: dependent Variable ln(M_{ijt}^{k}). Product, Importer, Exporter and time fixed effect (not reported); Intercept (not reported). Standard errors in parentheses; significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Severity is the excluded variable.

Tables 6: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
year	65208	2004	3.741686	1998	2010
idexp	65208	409.3409	237.5276	32	840
idimp	65208	392.9474	235.6797	40	826
nc8	65208	1.97E+07	1709364	1.60E+07	2.10E+07
trade	65208	83607.56	851527.1	0	3.97E+07
code1	65208	3.5	1.707838	1	6
gdpimp	65208	6.09E+11	8.20E+11	1.29E+10	3.62E+12
gdpexp	65208	8.84E+11	1.95E+12	3.81E+09	1.44E+13
popimp	65208	2.30E+07	2.37E+07	3712696	8.25E+07
popexp	65208	9.23E+07	2.51E+08	377516	1.34E+09
infpopimp	65208	1203.255	1235.521	259	4079
infpopexp	65208	7486.294	22664.85	18	127979
tar	65208	4.889866	7.843961	0	26
mseverity	65208	0.112453	0.2859355	0	1.257502
contig	65208	0.0753589	0.2639715	0	1
comlang_off	65208	0.0514354	0.2208858	0	1
colony	65208	0.0322967	0.1767882	0	1
dist	65208	4136.213	4602.325	59.61723	19335.4
EMR	64680	61.62327	7.952352	39.9	77.2
NCW	64680	1.533061	0.257741	1.11	2.1
Eureg2002	65208	0.3846154	0.486508	0	1

Tables 7: Correlation Matrix Variables

	Trade	GDP_{Imp}	GDP_{Exp}	POP_{Imp}	POP_{Exp}	$InfantP_{Imp}$	$InfantP_{Exp}$	Tariff	Severity	Distance	EMR	NCW	Border	Language	Colony
Trade	1														
GDP_{Imp}	0.0583*	1													
GDP_{Exp}	0.0046*	0.0890*	1												
POP_{Imp}	0.0255*	0.9430*	0.1101*	1											
POP_{Exp}	-0.0328*	0.0875*	0.2796*	0.0861*	1										
$InfantP_{Imp}$	0.0324*	0.9319*	0.0982*	0.9853*	0.0667*	1									
$InfantP_{Exp}$	-0.0335*	0.1116*	0.2081*	0.1088*	0.9738*	0.0879*	1								
Tariff	-0.0809*	0.1055*	0.3879*	0.1106*	0.3551*	0.1232*	0.3373*	1							
Severity	-0.0501*	0.0794*	0.0207*	0.0744*	0.3113*	0.0837*	0.3974*	0.5138*	1						
Distance	-0.1042*	0.1049*	0.1588*	0.0916*	0.1854*	0.1171*	0.1797*	0.7718*	0.4819*	1					
EMR	0.0210*	0.0081*	-0.1450*	-0.1369*	-0.1449*	-0.0971*	-0.1424*	-0.0851*	-0.0301*	0.0147*	1				
NCW	0.1325*	0.1330*	-0.0603*	-0.0203*	-0.0583*	0.0736*	-0.0619*	-0.0347*	0.0026	0.0184*	0.3623*	1			
Border	0.3661*	0.2036*	-0.0395*	0.1581*	-0.0733*	0.1279*	-0.0719*	-0.1440*	-0.1021*	-0.2221*	0.0397*	0.0075*	1		
Language	0.3025*	0.1564*	0.0208*	0.1059*	-0.0572*	0.0964*	-0.0524*	0.0650*	-0.0152*	-0.0130*	-0.1260*	0.1384*	0.4931*	1	
Colony	-0.0084*	0.1006*	0.0258*	0.0943*	-0.0199*	0.1189*	-0.0178*	0.0744*	-0.0316*	0.1052*	-0.0320*	0.0459*	0.0436*	0.3916*	1