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The impact of EU trade preferences on the extensive and intensive margins of agricultural and food products

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Abstract: In this paper we study the trade creation effects of the EU preferential trade agreements (PTAs) in the agriculture and food sectors for a large sample of developing countries in the period 1990-2006. We build upon the existing literature on trade with heterogeneous firms, by investigating the extent to which the effect of PTAs occurs mainly through the extensive – number of exported products – or the intensive – volume of existing products – margins. A direct measure of the extensive margin based on a theoretically-founded decomposition of trade into the two margins is used. Empirically, we use a gravity framework in a panel data setting, and different estimators to deal with the issues of zero trade flows and of the presence of an upper bound in the dependent variable, which has recently been shown to raise new problems in the most common gravity econometric approaches. Main results show that the EU PTAs positively affect agricultural extensive margins, especially through other than tariff impacts linked with the PTA, while in the food industry the results are more sensitive to the estimator used. As far as the intensive margin is concerned, the PTA effect is only driven by the role of tariffs, while other effects of the PTAs do not exert any relevant impact on agricultural and food products.

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1. Introduction

Export diversification has long been a primary concern for policy-makers of developing countries. A concentrated structure of exports, often in few primary products, is considered as potentially harmful because it leaves export revenues, and consequently the national income of developing countries, exposed to the high volatility of a small number of commodities markets. Export concentration in commodities is commonly associated with a lower rate of growth, the traditional argument, originally developed by Prebisch (1950), being that specialization in primary commodities implies a worsening of the terms of trade. The relevance of export diversification for low-income countries has been confirmed by recent empirical studies, which, by and large, have provided support to the hypothesis of a positive correlation between export diversification and growth (Cadot *et al*, 2011 and 2013).

Reduction of the dependency on the export of a small number of commodities has been a priority for many developing countries and is still now among the core objectives of the preferential trade policy of the EU. [1] Whether and to what extent the preferential policies of developed countries actually contribute to the objective of export diversification of developing countries is, however, a widely debated issue. As for the EU, it has often been argued that preferences have contributed much less than expected to export diversification for a number of reasons (e.g. Collier, Venables, 2007; Brenton, 2003). Indeed, the limited product coverage has stimulated concentration of exports to the EU in a few highly preferred commodity tariff lines, instead of in manufacturing industries. Further, the instability of the preferential schemes, which are subject to frequent revision, may have discouraged long-term investments in new products/industries. Finally, strict rules of origins are likely to reduce the utilization of preferences and contribute to preventing diversification toward a broader range of exports. The impact of preferences on export diversification has recently been addressed by a number of papers based on the firm-heterogeneity models of international trade, which have decomposed the overall trade effects of preferential policies into the

[1] The promotion of export diversification is one of the objectives stated in the section "Economic and Trade Cooperation" of the Cotonou Agreement between the EU and the African, Caribbean and Pacific countries. Diversification is also mentioned as one of the main aims of the EU Generalised Tariff Preferences Scheme.

intensive and extensive margins of trade, that is, an increase in the volume of traded products and in the number of exported products (Gamberoni, 2007; Foster *et al* 2011; Cipollina, Salvatici, 2011; Persson, Wilhelmsson, 2013). Export diversification is thus investigated in terms of an increase in the number of products exported.

This paper focuses on the impact that EU preferential policies have on the extensive and intensive margins of trade in the agriculture and food industries. Indeed, the role of EU policies in diversifying the agricultural exports of developing countries is hotly debated.[2] On one hand, because of the exclusion of many agricultural products from the full preferential regime, the product coverage of EU preferences for agriculture has long been considered very limited. On the other hand, it is often argued that agricultural preferences are, in general terms, more effective than in other industries, mainly because of the higher preferential margins with respect to manufacturing industries for which the MFN tariffs are very low; also for this reason, preferences are used more in agriculture than in other industries (Bureau *et al.* 2007). If this is the case, then EU agricultural preferences should be expected to contribute to diversification more than preferences granted to other industries.

Despite the fact that this appears to be a key policy issue in the debate about the effectiveness of EU trade preferences, the empirical evidence to date has been rather scant. The few papers we are aware of, using different data and methodologies, have found evidence of a positive impact of the EU preferential policies on the agricultural extensive margin of developing countries (e.g. Cipollina, Salvatici, 2011; Gamberoni, 2007).

To investigate the effect of the EU preferential trade agreements (PTAs) on the extensive and intensive margins, we build upon the existing literature on trade with heterogeneous firms (Melitz, 2003; Chaney, 2008), which offers insights on the impact that preferential liberalization has on the number of products exported and on the traded volume. Empirically, we use a gravity framework in a panel data setting and different econometric estimators to deal with the particular nature of one of our key dependent variables, the extensive margin. Indeed, as recently shown by Santos Silva *et al.* (2013),

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[2] It is worth clarifying that this paper deals with *product* diversification. Geographic diversification is a relevant policy issue as well, which has also been investigated (e.g. Helpman *et al* 2008); however, the focus here is on the impact of the EU policies on the exports of developing countries to the EU markets; their impact on other than EU markets is beyond the scope of this article.

the number of exported products has both a lower and an upper bound, implying that the partial effects of the explanatory variables on the conditional mean of the dependent variable cannot be constant and must approach zero as the conditional mean approaches its bounds. As a consequence, by ignoring this double-bounded nature of the dependent variable, the majority of current estimators used in the recent gravity literature [3] run the risk of leading to erroneous conclusions due to serious misspecification in the model.

Our contribution to this literature is three-fold. First, unlike most papers focusing on the EU, and particularly those on agriculture and food products which use indirect approaches to measure the margins, we consider a direct measure of export diversification based on the theoretically-founded decomposition of the overall trade into the extensive and intensive margins, as originally proposed by Feenstra (1994 and 2004) and further developed by Hummels and Klenow (2005) and Feenstra and Kee (2008). Second, to deal with the recent findings by Santos Silva *et al*. (2013), we estimate our gravity model on the extensive margin by using three different estimators: other than the standard OLS and the Heckman two-stage estimator to correct for potential selection bias, we also use the flexible estimator recently proposed by Santos Silva *et al*. (2013), which is based on the Bernoulli pseudo-maximum likelihood. In this way, we are able to deal with the upper bound of the extensive margin, and to test whether there are any significant differences between this estimator and the standard ones in this specific context. Finally, to assess the impact that PTAs have on the two margins, most papers have used dummies, while very few have included a continuous variable, such as tariffs or the preferential margins; indeed, a continuous variable is better able to capture the impact of trade preferences, because these vary greatly across countries, products and over time. In our empirical specification we include preferential tariffs in order to capture the impact of a reduction in the variable costs associated with the PTA. In addition, we also consider the other than tariffs reduction impacts of a PTA, by including the preferential dummy. There is consensus that PTAs, on one hand, positively affect trade through the reduction of the variable trade costs, by means of the decrease in tariffs or by the reduction of non tariff-barriers; however, on the other hand, PTAs may imply some fixed costs of trade due, for example, to the cost of complying

[3] A comprehensive review of the debate about the estimators to be used in gravity equations is offered by De Benedictis, Taglioni (2011).

with the rules of origin. By including both tariffs and PTAs dummies our aim is to distinguish these different possible impacts.

The paper is organized as follows. The next section provides an overview of the theoretical background and previous evidences about the expected impact of PTAs on the two margins of trade. The third section illustrates the measures of the extensive and intensive margins used and offers a preliminary look at these margins as computed for the EU agricultural and food imports from PTAs and non-PTAs countries. The fourth section deals with the empirical specification and the econometric issues, while the next illustrates the data used. The sixth section discusses the results, while the last provides some concluding remarks.

2. Margins of trade and PTAs: background and previous evidences

The impact that trade liberalization can have on the extensive and intensive margins of trade has been one of the core issues addressed by the heterogeneous-firms international trade literature. Indeed, the monopolistic competition models with firm-heterogeneity in productivity developed by Melitz (2003) and Chaney (2008) conclude that a reduction of trade costs, including tariffs, by lowering the productivity threshold, allows more firms to export and, hence, increases the extensive margin. At the same time, trade liberalization also increases average exports by incumbent exporters, i.e. the intensive margin of trade. In these models, the extent to which trade liberalization affects the two margins essentially depends upon the elasticity of substitution in the industry. Indeed, as shown recently by Chaney (2008), with high substitution elasticities (homogeneous goods) lower trade costs mainly increase the intensive margin, while the extensive margin effect is weak, as only few firms become new exporters; on the contrary, when the elasticity of substitution is low (differentiated products) the reduction of trade costs mainly increases the extensive margin of trade, i.e. a large number of firms enters the export market while the average exports per firm do not increase significantly.

Preferential trade policies imply not only a reduction of tariffs, but also involve an increase in trade costs, due to the various requirements that the exporters have to comply with, in order to be eligible for preferential treatment. The most significant source of these compliance costs concerns the rules of origin (ROO), which may increase both the fixed and variable costs of trade. Binding ROO may increase the marginal cost of production of firms because of the constraint of sourcing with (more expensive) local inputs. In addition, fixed costs may arise because of the administrative costs exporters have incurred in complying with the ROO; these can be considered as fixed because they involve the firm in finding the relevant information and setting up *ad hoc* administrative procedures (Candau, Jean 2009; Cherkashin, *et al* 2012).

As for the EU, these costs have been considered as possible determinants of the underutilization of EU preferences by many developing countries (Manchim, 2006; Bureau *et al*, 2007; Candau, Jean 2009; Agostino *et al* 2011). ROO in principle are likely to affect traders' costs in different ways depending on a number of factors. For example, agreements allowing for full cumulation, [4] such as the ACP-Cotonou agreement, should be less restrictive than those allowing only diagonal cumulation, as in the GSP case. In addition, the level of tolerance of non-originating material, that is the percentage of non-originated inputs that could be used in manufactured goods to be eligible for preferences, is also likely to affect the compliance costs (Manchim, 2006). Finally, variable costs associated with ROO are likely to be lower for raw materials, than for manufactured products.

Table 1 summarizes the expected impact of trade policies on the exporters fixed and variable trade costs and, consequently, on the extensive and intensive margins of trade. As the administrative costs are likely to impact traders mainly by increasing fixed costs, they are expected to negatively influence the number of firms and the number of exported varieties, but not to affect the average exports of individual firms. Non-tariff barriers may affect both the fixed and the variable costs of traders and, hence, negatively influence both margins.

The overall impact of preferential trade agreements on the margins of trade, therefore, depends on whether the (positive) tariff reduction effect on margins prevails over the (negative) impact of the cost of complying with the preferential scheme, and on how the preferential scheme affects the non-tariff barriers.

Papers assessing the impact of trade costs and preferences on the margins of trade

[4] Under full cumulation if a manufacturer in an ACP State uses materials from one or more other ACP States, the materials are treated as obtained in the ACP State in which the products are manufactured.. Under diagonal cumulation, cumulation applies only if materials originate from a limited number of low developing countries.

differ in the samples used, in how the extensive and intensive margins are measured, in the different proxies used for the trade policy variable and, last but not least, in the type of empirical model and estimator employed. For the purpose of this paper, those studies using trade data at the country-industry level and not firm-level data are particularly relevant. In fact, as in previous contributions using country-industry trade data, the basic idea here is that if firms produce differentiated products, the firm-level extensive and intensive margins translate into product-level margins; hence, the main predictions of the Melitz/Chaney models apply also to the extensive and intensive *product* margins (see Helpman *et al*. 2008).

As for the measurement of the extensive product margin of trade, three types of indexes have been used: the number of products with positive trade flows; indexes of concentration/inequality in exports shares; and theoretically-founded indexes developed on the basis of the methodology originally proposed by Feenstra (1994) and further developed by Hummels and Klenow (2005) and Feenstra and Kee (2008). The next section illustrates the features of these latter indexes. The trade policy variable most frequently introduced is a dummy equal to one if the country is member of a multilateral or of a PTA; only few papers have explicitly introduced the tariffs (Feenstra, Kee, 2008; Dennis, Shepherd, 2011; Persson, 2013) or the preference margin (Cipollina, Salvatici, 2011; Raimondi *et al.* 2012). A number of papers have used a gravity model (Buono, Lalanne, 2012; Dutt *et al*, 2013; Foster *et al* 2011; Grant, Boys, 2012; Cipollina, Salvatici, 2011; Persson, Wilhelmsson, 2013), while others have followed different empirical strategies (e.g., Gamberoni, 2007; Cherkashin, *et al* 2012; Dennis, Shepherd, 2011; Feenstra, Kee, 2008).

Given the variability of data and specifications used, results are somewhat controversial and not fully comparable. Among the studies assessing the impact of trade agreements on margins by means of a gravity model, Dutt *et al* (2013), for a sample of 150 countries and almost thirty years, [5] found that WTO membership increases the extensive margin – measured as the number of exported products - while it decreases the intensive margin (equal to the exports per product). According to the authors, this is because WTO membership mainly acts as a reduction in fixed costs and, by increasing

[5] The dataset used is the World Trade Flows Database by Feenstra *et al* (2005).

the number of exporting firms, it decreases the average exports by firms; on the other hand, preferential trading agreements (PTAs) do not appear to significantly affect the margins, while the GSP exerts a positive influence on both margins of trade. By using the same data set, and the methodology of Hummels and Klenow (2005), Foster *et al* (2011) estimated the impact of PTAs on the margins of trade and found a positive impact on the extensive margin, but no influence on the intensive margin. Persson and Wilhelmsson (2013) found that ACP preferences had initially a positive impact on the extensive margin – measured by the number of products and by concentration indexes – while in the last Cotonou Agreement export concentration tends to rise. On the contrary, both GSP and EBA have a positive impact on the extensive margin, while the Mediterranean preferences did not exert any influence. Grant and Boys (2012) have estimated the impact of WTO membership and GSP for a sample of 215 countries for 25 years on overall trade; they assessed the role of the intensive and extensive margins by estimating the model, first, only with positive trade flows (to capture the increase in trade due to existing trade relationship, i.e. the intensive margin) and then by considering zero trade flows as well to capture the increase in trade due to new trade relationships. They decompose the agricultural products from non-agricultural products and found that the increase of agricultural trade due to WTO membership is driven mainly by the extensive margin. Cipollina and Salvatici (2011) use the Heckman two-step procedure, applied to cross-sectional data, to distinguish the impact of EU preferences at the extensive margin (an increased probability to register a positive trade flows, i.e. the first stage) and at the intensive margin (larger trade flows, i.e. the second stage); their results show that EU preferences (measured by the preference margin) have a significant positive impact on the extensive margin only for the agricultural and food products, while in manufacturing industries they tend to reduce the number of exported products.

Among studies using other types of models, Gamberoni (2007) found that the ACP preferences exerted a positive impact on both the extensive margin (measured as the change in the probability of having positive trade flows) and the intensive margin of trade, but only for agricultural products, while they have an anti-diversification effect on trade overall; as for the GSP this turns out not to influence the extensive margin in the agricultural sector, though positively affecting it for overall trade. Feenstra and Kee

(2008) have estimated the impact of US tariffs on the export variety (the extensive margin) in various industries and found that all of them, including agriculture, are negatively correlated with tariffs except for the textile and electronics industries.

3. Measuring the intensive and extensive margins

As aforementioned, a number of papers have used an indirect approach to decompose the impact of trade policies on the extensive and intensive trade margins (Gamberoni, 2007; Cipollina, Salvatici, 2011; Grant, Boys, 2012). Other papers have used direct measures, such as the number of products exported within a certain industry/category or exports concentration indexes (Cadot *et al.*, 2011; Dennis, Shepherd, 2011; Persson, Wilhelmsson, 2013). However, the simple counting of the number of products, although transparent, is flawed by the assumption that products have the same economic weight, which is clearly not the case.

The theoretically-founded decomposition of trade in the two margins, originally proposed by Feenstra (1994) and further developed by Hummels and Klenow (2005) and Feenstra and Kee (2008) also takes into account the economic weight of the products. [6] This measure of the extensive margin is very similar to a count of the exported varieties within a certain industry, but the latter is weighted by comparisons with other reference countries, such as the rest of the world or the world as a whole.

Let *k* be a given industry and *r* the category of a product within this industry. R_{ijt}^{k} is the exporting country *j*'s categories set exported (i.e., with positive trade flows) to the EU country *i*, in year *t*; while R_{iW}^{k} is the world's categories set exported to the EU country *i* over all the years here considered. If $\bar{V}_{iWr}^{k}$ is the average value of the world's exports to country *i* of the category *r* over the years, then the bilateral extensive margin for industry *k* in year *t* is:

$$EM_{ijk,t} = \frac{\sum_{r \in R_{ij,t}^{k}} \bar{V}_{iWr}^{k}}{\sum_{r \in R_{iw}^{k}} \bar{V}_{iWr}^{k}} \quad (1)$$

Hence, the extensive margin can be considered as a weighted count of the exporter *j*'s

[6] As shown by Feenstra (1994), the two indexes can be formally derived exploiting the property of the constant elasticity of substitution utility function.

categories in the year *t*, relative to the average world categories exported to *i* during the whole considered period. It is worth noting that this bilateral margin changes over time only because of a change in the set of the categories exported by *j* to the country *i*; the denominator is constant over time and across exporters, and is importer-specific. The advantage of using the trade values of the reference country, instead of those of country *j*, is that it prevents a category from appearing important solely because country *j* exports a lot of that category to country *i*.

On the other hand, the intensive margin compares the export trade values of country *j* to country *i* of products in a certain set of goods in year *t* with the average export trade values of the world to country *i* for the same set of products. Again, if $V^k_{ijr,t}$ is the value of exports of country *j* to *i* of the category *r* at time *t*, the bilateral intensive margin in industry *k* is:

$$IM_{ijk,t} = \frac{\sum_{r \in R^k_{ij,t}} V^k_{ijrt}}{\sum_{r \in R^k_{ij,t}} \bar{V}^k_{iWr}} \tag{2}$$

Thus, the intensive margin equals *j*'s nominal exports relative to the *W*'s (world) average exports in those categories *r* in which *j* exports to *i* at time *t*. Hence, it measures country *j's* overall market share within the set of categories it exports to *i*. Note, moreover, that the product of the two margins equals the share of country *j* on the world exports to *i*:

$$EM_{ijkt} * IM_{ijk,t} = \frac{\sum_{r \in R^k_{ij,t}} V^k_{ijr,t}}{\sum_{r \in R^k_{iW}} \bar{V}^k_{iWr}} = \frac{X_{ijk,t}}{\bar{X}_{ik}} \tag{3}$$

where $X_{ijk,t}$ is the total export of product sector *k* from *j* to *i* and $\bar{X}_{ik}$ is total imports of *k* to *i*. Thus the product of two margins equals total bilateral exports as a fraction of the destination country's average (world) imports. In a gravity context, this relation has an intuitive appeal, as the log of coefficients of the extensive and intensive margins added together yields exactly the traditional gravity coefficients, once importer-country-sector fixed effects, which sweep out the term $\bar{X}_{ik}$, are included.

Figures 1 and 2 report the average values of the two margins computed as in (1) and (2) for the agricultural and food EU imports, based on the COMEXT trade data. In our empirical exercise, the industry *k* is defined at the 4-digit level of the ISIC rev. 3 classification, and the *r* category at the 8-digit level.[7]

As for agricultural products (Figure 1), countries benefitting from EU preferences show a different pattern. Indeed, while PTA countries have increased the extensive margin over the whole period, since the second half of the nineties the extensive margin of the other countries has significantly declined. On the contrary, during the whole period, both groups of countries have increased the intensive margin. Interestingly, the opposite time patterns of the extensive margin between PTA and other countries, is consistent with the finding of Cadot *et al.* (2013), who showed that product diversification displays an inverted U-shaped pattern with the level of income.[8]

A slightly different pattern can be observed for the food industry (Figure 2). In fact, while PTA countries have increased their extensive margin also in this industry, in the case of non-preferred countries the extensive margin, after an initial increase in the early nineties, does not show appreciable changes thereafter. The intensive margin increased for both groups of countries.

This preliminary look at the data provides some useful facts. First, PTA countries have sharply increased their export diversification toward the EU in the past 25 years, both for food and agricultural products. Second, and conversely, non-preferred countries have concentrated their agricultural exports to the EU, in terms of categories exported, and this is particularly true after the mid nineties, while for food products the set of exported goods has been more stable (but has not increased). Third, both groups of countries/industries have increased the intensive margin. Assessing the role of trade policies in determining this pattern of the margins is the objective of our econometric work in the following sections. However, it can be preliminary noted here that the sharp decrease of the agricultural extensive margin for non-preferred countries dates from the mid nineties, when the Uruguay Round Agreement on Agriculture started to be enforced. In other words, agricultural exports concentration for non-preferred countries occurs along with the progress in the multilateral trade liberalization. On the other hand, during the same period PTA countries have continued to increase their export

[7] More details about the data used are provided in section 5.

[8] Indeed, PTA countries include mainly developing and emerging countries, while non-PTA countries are largely high income ones.

diversification toward the EU despite the progress towards multilateral liberalization that generated, to some extent, an erosion of preferences.

4. The empirical model and econometric issues

4.1 The empirical model

Following a consolidated tradition, we investigate the impact of PTAs on the trade margins by using a gravity-like equation on panel data.

The standard gravity model on cross-sectional data can be represented by the following equation:

$$\ln m_{ij} = \beta_0 + \beta_1 \ln d_{ij} + \beta_2 PTA_{ij} + \ln GDP_i + \beta_2 \ln GDP_j + \varepsilon_{ij} \qquad (4)$$

where m_{ij} is the trade flow to country *i* from country *j*; d_{ij} reflects the impact of trade costs, proxied by bilateral distance between countries, plus other trade facilitators like the share of a common language and a common border; PTA_{ij} is a dummy variable equal to 1 if country *i* grants a preferential tariff to country *j*; and finally GDP_i (GDP_j) is the nominal gross domestic product in the destination (origin) country.

In this specific context, the dependent variable is decomposed into the extensive and intensive margins; furthermore, because of the panel structure of the data, our specification includes a time dimension and a number of fixed effects, as discussed below (Baier, Bergrstrand, 2007). A key feature of our approach is how the PTA effect is identified. To capture the impact of trade agreements on the two margins most papers have used a simple dummy variable as in equation (4), while very few have used direct measures of trade policies such as tariffs (Buono, Lalanne, 2012; Dennis, Shephard, 2011) or the preference margin (Cipollina, Salvatici, 2011; Raimondi *et al* 2012). Our approach is slightly different, in that we incorporate in the gravity equation both the applied tariffs and a dummy for the PTAs of the EU.

The basic idea is that, once the tariff component of the preferences is controlled for, then the PTA dummy captures all other aspects related to the preferential policy different from tariffs, such as the increase in fixed and variable costs due to the ROO or changes in the traders cost due to a modification of non-tariff barriers under the PTA regime (see Feenstra, Kee, 2008).

Thus, rewriting equation (4) by introducing the time dimension and considering both the extensive ($EM_{ij,t}$) and ($IM_{ij,t}$) margin, and the ad valorem equivalent tariff (τ), our benchmark panel gravity model, omitting the term k for simplicity, can be written as follows:

$$\ln EM_{ij,t} = \beta_{e1} \ln\left(1 + \tau_{ij,t}\right) + \beta_{e2} PTA_{jt} + \gamma_e Z_{ij} + \mu_{ij,t}, \qquad (5)$$

and, similarly, for the intensive margin (*IM*), with subscript *s*, (namely β_{s1}, β_{s2}, and so on). In equation (5), $\tau_{ij,t}$ is the *ad valorem* tariff of country *i* faced by country *j*; PTA_{jt} is a dummy equal to 1 for countries that benefit from a preferential scheme, and 0 otherwise; Z_{ij} is a vector of other covariates including standards (time-invariant) bilateral gravity terms (distance, common language, border, and colonial relationships) and fixed effects; β_{e1}, β_{e2} and γ_e are parameters to be estimated, and finally $\mu_{ij,t}$are assumed to be log-normally distributed error terms.

As mentioned before, our expectation is that tariffs should negatively influence both margins − i.e. preferential liberalization positively affects both the number of exported products and the export value per product. Thus, our expectation is that $\beta_{e1} < 0$ and $\beta_{s1} < 0$ in the extensive and intensive margin equation, respectively. The impact of all other provisions of the PTA may or not positively influence the margins, depending on whether the (positive) impact of a possible reduction of non-tariff barriers associated with the PTA more than offsets the negative impact of the costs of complying with the ROO. Thus, the coefficients β_{e2} and β_{s2} are, *a priori*, of uncertain sign.

One shortcoming of the above specification is that the tariff coefficient captures the average effect of tariff protection on the trade margins of both PTA and non-PTA countries. Thus, it cannot be used to estimate directly the elasticity of trade margins to preferential tariffs. To do this we propose a second specification where we interact the tariff with the PTA dummy:

$$\ln EM_{ij,t} = \beta_{e4} \ln\left(1 + \tau_{ij,t}\right) + \beta_{e5} \ln\left(1 + \tau_{ij,t}\right) * PTA_{jt} + \\ + \beta_{e6} PTA_{jt} + \gamma_e Z_{ij,t} + \mu_{ij,t}. \qquad (6)$$

In equation (6), the coefficient β_{e4} captures the elasticity of the extensive margin to tariff for *non*-preferential countries. Instead, the coefficient on the PTA dummy, β_{e6}, now captures the effect of preferences on the extensive margin when the tariff is zero,

$\tau_{ij,t} = 0$. Finally, $\beta_{e6} + \beta_{e5} \ln(1 + \tau_{ij,t})$ represents the PTA effect when tariffs is higher than zero, $\tau_{ij,t} > 0$.

A final issue of our gravity specification is how to control for multilateral price terms and country-pair heterogeneity or, to put it differently, which kind of fixed effects are included in the gravity equation (see Anderson, van Wincoop, 2003; Baier, Bergstrand, 2007). In a panel data setting, the multilateral price terms tend to be time-variant, and so we should include exporter-year and importer-year fixed effects, which also control for the variation in GDPs. However, working with the EU countries as importers, neither the PTA dummy nor tariffs vary across (EU) countries. So, the exporter-year fixed effects also absorb the PTA dummy. For this reason, our specification, instead of the exporter-year effects, always includes exporter fixed effects, importer-year fixed effects, and time/product fixed effects to control for any common time/product shocks.

In our baseline specification we use the standard gravity covariates, like distance, language, contiguity and colonial ties to control for this heterogeneity. [9] This is because we also want to study how these covariates impact on the extensive and intensive trade margins.

4.2 Econometric issues

From an econometric point of view, the main issue in estimating the above gravity equations is related to the choice of the best estimator to identify the PTA effect on the trade margins. As recently highlighted by Santos Silva *et al*. (2013), the number of exported products used as dependent variable, can give rise to new and specific problems. This is because, first the number of products being exported from origin country *j* to destination country *i* is a count variable, and therefore it is bounded below by zero. This is the standard problem in the gravity literature, which is tackled by using different strategies such as the Heckman selection correction (Helpman *et al*. 2008) or the Poisson Pseudo Maximum Likelihood (PPML) estimator (Santos Silva, Tenreyro, 2006). Yet, because products are defined on a classification of economic activities,

[9] Concerning country-pair heterogeneity, as robustness check we have used alternative specifications including also bilateral fixed effects to control for both observed and unobserved bilateral characteristics; the results, which are not reported for space constraints but are available upon request to the authors, do not change.

measures of the extensive margin are not only bounded from below by zero, but also from above by the number of the respective product categories, or by 1 if exporting sectors are normalized by the existing product categories, as in our *EM* index. This double bound in the data implies that the partial effect of the regressors on the conditional mean of the extensive margin (the dependent variable) cannot be constant and must approach zero as the conditional mean approaches its bound (Santos Silva *et al*. 2013). Thus, the OLS estimator could be unsuitable as the linear model assumes that the partial effects are constant, a property that is inconsistent with the nature of the data in hand. Note, moreover, that the standard estimators accounting for zero trade, like the Heckman correction, the PPML or other count data estimators, cannot be used here either, because these approaches ignore the upper bound of the extensive margin (see Santos Silva *et al*. 2013).[10]

For this reason, Santos Silva *et al.* (2013) proposed a specific functional form directly derived from the Helpman *et al.* (2008) firm heterogeneity model. In this setting, the (normalized) number of sectors exporting from *j* to *i*, omitting for simplicity the time and sectors subscripts, can be written as:[11]

$$EM_{ij} = 1 - \left(1 + \omega \exp\left(x_{ij}' \beta\right)\right)^{\frac{-1}{\omega}} + u_{ij}, \tag{7}$$

where $\omega > 0$ is a shape parameter, and x_{ij} denotes a vector of regressors, including tariffs and the PTA dummy, standard gravity covariates, as well as importer and exporter fixed effects. This model has the complementary log-log model as a limit case when $\omega \to 0$, and for $\omega = 1$ reduces to the logit specification suggested by Papke and Wooldridge (1996). Note moreover that, EM_{ij} is bounded between 0 and 1, and u_{ij} can simply be defined as $u_{ij} = EM_{ij} - \mathrm{E}\left(EM_{ij} \middle| x_{ij}\right)$, which implies that $\mathrm{E}\left(u_{ij} \middle| x_{ij}\right) = 0$. Estimation of the parameters β and ω is then obtained following Papke and Wooldridge

[10] These authors have shown that estimators for count data, like the Poisson or the negative binomial regression, used by Dennis and Shepherd (2011) and Persson and Wilhelmsson (2013) to study the determinants of the extensive margin, are even less reliable than the simple OLS linear model.

[11] Note that this particular functional form, derived from the standard assumptions in a Melitz (2003) type model, assumes that the distribution of firm productivity for a randomly picked sector is a generalized Pareto, with location parameter equal to 0 and scale parameter equal to 1. (see Santos Silva *et al*. 2013 for details).

(1996) by Bernoulli pseudo-maximum likelihood, which is consistent under very general conditions and more efficient than the least square (Santos Silva *et al*. 2013).

A final issue is the interpretation of the estimated parameter of the model (7). Indeed, given the non-linearity of its functional form and the fact that it is interpreted as an approximation to the probability that a randomly drawn sector in country *j* will export to destination *i*, then the estimation of β is not particularly informative in terms of the magnitude of the economic effect. In theory, inference could be based on average partial effects of the regressors of interest and not on the parameter estimates. However, when the specification includes interaction terms, as in equation 6, then the computation and interpretation of these partial effects, aside their complexity, is not meaningful in this context.

Taking into account this consideration, the use of the Bernoulli pseudo-maximum likelihood estimator proposed by Santos Silva *et al*. (2013), still represents a crucial innovation when studying the extent to which the sign and the significance of the estimated policy effects are sensitive to the double-bound property of the extensive margin.

5. Data

Our database includes exports from 173 exporting countries to 27 EU countries over the period 1990-2006. Trade data derive from ComExt-Eurostat dataset and are classified according to the Combined Nomenclature (CN) system, an eight-digit subdivision of the Harmonised System (HS). In order to keep the maximum amount of information about the number of products exported by each country to the EU, we have used the highest level of disaggregation available for EU trade data; hence, *r* is the eight-digit CN level product. In our empirical applications *k* is the four-digit ISIC Revision 3 industry, which includes five sectors for agriculture and eighteen sectors for food. By calculating the extensive and intensive margins at this level of disaggregation, instead of computing them for the whole agricultural sector and the whole food industry, the impact of tariffs – which are defined at the six-digit level – on the two margins can be assessed more accurately and any potential bias due to tariff aggregation is significantly reduced. We have chosen the four-digit ISIC industry classification, rather than the two-digit HS one (which includes overall 24 agri-food industries), because in the former agricultural raw materials and food products are, by and large, separated, while this is not always the case in the latter. In the context of this paper, the reason for keeping the agricultural sector separate from the food industry is that there are so many differences between them, in terms of structure and behavior of firms, product characteristics, demand or trade policies; the extensive and intensive margins are thus likely to react in different ways to trade liberalization

Bilateral tariff data come from the Unctad-TRAINS database at the six-digit level of the Harmonized System (HS). Average tariffs are computed by aggregating at the ISIC 4-digit level the HS 6-digit bilateral tariffs using import weights based on the reference group method by Bouët *et al*. (2008). Tariffs here do not include non-tariff barriers, such as quotas, but do include tariff rate quotas, largely used by the EU in the agricultural and food sectors, by considering the in quota-tariff. [12]

The PTA dummy has been built by considering, for each year, the presence of a PTA with the EU already in force. Hence, in addition to the GSP preferential schemes, we have included the PTAs signed with the ACP, South Africa, the Mediterranean countries, Chile and Mexico and the initiative Everything but Arms.

Data on distance, with dummies for other trade costs normally used in similar exercises (contiguity, language, and colony), are taken from CEPII (Centre d'Etude Prospectives et d'Informations Internationales).

Finally, in estimating the Heckman correction for sample selection, we follow the strategy proposed by Helpman *et al* (2008), by using the common religion index as the variable that, being significant only in the first-stage probit extimation, affects fixed costs of exporting, but not variable trade costs (see also Dutt *et al* 2013). Thus, the common religion index used for the exclusion restriction is built from ARDA, the Association of Religion Data Archives, by considering the share of followers of religion in exporting and importing countries at time *t*, revealed every five years.

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[12] This implicitly means that when tariff rate quotas are in place and there are positive out-of-quota imports, then TRAINS data may underestimate the degree of protection, as the average applied tariff should take into account also of the out-of-quota tariff. The database Macmap treats in a more accurate way tariff rate quotas, by taking into account both in and out-of quota tariffs. However, these data are available only for few years and not for the whole period here considered.

6. Results

6.1.The impact of PTAs on the extensive margin

Table 2 reports the results of the different estimations based on our baseline equations (6) and (7), and by considering the extensive margin for agricultural products as the dependent variable. We use three alternative estimators. A simple OLS model that disregards the problem of zero; the Heckman selection model to account for the zero in the trade matrix; and finally, the pseudo-maximum likelihood estimator proposed by Santos Silva *et al*. (2013), that accounts also for the lower and upper bounds of the extensive margin. We label this estimator as SSTW. For each estimator we run four alternative specifications: the first includes only the *ad valorem* tariff as policy variable; the second adds the PTA dummy, but excludes the tariff; the third adds both tariff and the PTA dummy; and, finally, the fourth specification also includes the interaction between tariffs and the PTA dummy.

The estimated effect of the standard gravity covariates are almost always significant and with the expected sign across all specifications and estimators. Distance is negatively related to the extensive margin, while common language, contiguity and colonial ties display a positive effect.

As for the policy variables (tariffs and PTAs), it should first be noted that the signs of the coefficients are the same across the OLS and the Heckman estimations. When we consider only tariff as a proxy for the EU trade policies, the impact on the extensive margin is always negative, albeit not significant. Similarly, the PTA dummy alone is negative and insignificant in the OLS and Heckman models and the same result is obtained when we introduce both the tariff and the PTA dummy. By contrast, when considering the SSTW estimator the results are quite different. Tariffs turn out to be significant and negative both when included alone and with the PTA dummy, while the PTA dummy is significant and positive but only when introduced alone. Thus, across these specifications, the SSTW estimator appears to work differently. Conversely, in the final specification that includes the two policy variables and their interacted term, coefficients go along the same direction and are significant with all the estimators considered. These results confirm our preliminary expectations that neither the tariff nor the PTA dummy alone are likely to fully capture the complex impact of PTAs on the extensive margin, as emphasized in Table 1. Further the significance of the interaction term confirms the importance of distinguishing the impact of tariffs within and outside the PTAs. In other words, the effect of tariffs on the extensive margin is conditional on the PTA dummy.

In what follows, we focus the discussion on the results of the last specification (columns 4, 8 and 12), given our interest in distinguishing the impact of preferential tariffs from the effect of other than tariff PTAs effects. The sign of the coefficients provide us with some apparently surprising results. First, tariffs on countries without a PTA have exerted a positive impact on the extensive margin; this means that trade liberalization with developed countries has reduced the number of products exported to the EU rather than increasing it, as predicted by the Melitz/Chaney models. This finding represents a confirmation of the pattern reported in Figure 1, which shows a clear decrease in the extensive margin of non-PTA countries during the year of the Uruguay Round Agreement implementation. Second, and conversely, preferential tariffs exert a negative impact on the extensive margin with the partial effect ranging between 0.57 and 0.67;[13] this means that a decrease in the preferential tariff of 1% produces an increase in the extensive margin of 0.57–0.67%. Third, the positive and significant coefficient of the PTA variable suggests that when tariffs are equal to zero membership of a PTA may contribute to an increase in the extensive margin of about 20%.[14] Finally, when tariffs are greater than zero the overall effect of other than tariff impacts of a PTA, measured by $\beta_{e6} + \beta_{e5} \ln\left(1 + \tau_{ij,t}\right)$, turns out to be negative irrespective of the estimator used. This result confirms our expectations that a PTA, on one hand, positively affects the extensive margin by means of the preferential tariffs, but on the other hand it may imply a reduction in export diversification because of the increase in the fixed costs due to the cost of complying with the rules of origin.

The results are slightly different for the food industry (see Table 3). While for the standard gravity covariates (distance, common language, colonial ties and contiguity) expectations are confirmed also for the food industry, as regards the trade policy variables results are not straightforward and partially differ from those illustrated for

[13] The partial impact of preferential tariffs as for the OLS and the Heckman second-stage estimations is equal to $\beta_{e4} + \beta_{e5}$ (see equation 6).
[14] This partial effect is computed as the $exp\ (\beta_{e6}) - 1$.

agricultural products. One major difference is that, in the OLS and Heckman estimations, tariffs turn out to positively affect the extensive margin both when considered alone and with the PTA dummy; conversely, the PTA dummy is never significant, except in the last specification. Tariffs exert a positive effect for the whole sample of countries, for PTA and for non-PTA countries. The results of the SSTW estimations reported in the last four columns seem not to wholly confirm the OLS and Heckman findings. Here tariffs do not, in fact, significantly affect the extensive margin in the first three specifications (9-11), while the policy variables are confirmed to be significant in the final specifications with the interaction term included. A reason of that may be found in the highest percentage of country-sectors that are close to the upper bound of the extensive margin in the food industry. Indeed, 2.3% of food industry's observations present an extensive margin higher than 0.8, while in agricultural sectors these high values of extensive margin concern only the 0.5% of data. This probably leads to an overestimation of the partial effects for the upper tail of the distribution, leading to a disproportionately large influence on the mean partial effect (see Santos Silva *et al*. 2013). As above mentioned, the partial effect of the variables in the SSTW estimation is not derived from the parameters reported in Table 3; hence, we cannot directly compare the overall effect of tariffs and non-tariff effects of PTAs across the three estimators. However, our results for the food industry seem to support the Santos Silva *et al*. (2013) hypothesis, i.e. the SSTW estimator can yield to slightly different results with respect to the most standard gravity model estimators.

6.2.The impact of PTAs on the intensive margin

Table 4 reports estimation results for the intensive margin for the agricultural sector. The structure of the table is similar to the previous ones, but now it displays only the OLS and Heckman (II stage) estimators, as the intensive margin does not suffer of the upper bound problem discussed above. Concerning the effect of the standard gravity covariates, the pattern of the intensive margin regressions is quite different. Only the distance coefficient is systematically negative and significant with a magnitude quite close to the extensive margin regressions. Colonial ties exert a significant positive effect only in the OLS specification, but turn out to be insignificant when selection bias is accounted for. On the contrary, both the contiguity and language dummies tend not to be significant. These results simply suggest that the intensity of EU countries agricultural imports is relatively low with partners sharing a common border and cultural ties. Note, moreover, that the Mill ratio in the second stage of the Heckman regressions is significant, but only at 10%. Indeed, apart from the significant difference related to the colonial tie variable, results from the OLS and Heckman regressions are quite similar.

As regards the policy variables of interest, we find a strong negative and significant effect of tariffs in every specification, with trade elasticity ranging between −1.5 and −2.0. This means that a decrease of 1% in the *ad valorem* tariff, on average, induces an increase in the intensive margin of about 1.5%−2.0%. Thus, the intensive trade margin is more sensitive to variable trade costs than the extensive margin. However, the effect of tariffs on the intensive margin does not display any heterogeneity when considering the countries with and without preference. Surprisingly, the effect of the PTA dummy is never significantly different from zero in every specification. Therefore, the intensive margin does not appear to be affected by the PTA policy, other than tariffs.

In table 5, we report the same set of regressions for the food sector. Overall, the results are quite similar to those concerning agricultural products. However, some differences are worth noting. First, the variable capturing cultural ties, namely sharing a common border and a common language, systematically displays the correct sign and a higher marginal effect compared to the agricultural intensive margin. Second, the elasticity of food products intensive margin to tariff is significantly lower than that of agricultural products. This result is not surprising, if one considers that the higher degree of differentiation in food products translates into lower substitution elasticity.

Summarizing, we find robust evidence that, as far as the intensive margin of trade is concerned, in both agricultural and food sector the EU preferential policy exerts an effect mainly through the tariff component.

7. Conclusions

The issue of the impact of EU PTAs on agriculture and food export diversification of developing countries has been addressed in this paper by means of a panel gravity model and by decomposing the overall trade effect into the extensive and intensive margins of trade. Unlike previous papers we have used theoretically-founded direct measures of the extensive and intensive margins; further, we have distinguished the preferential tariffs impact from the effect of other effects of PTAs which may affect export diversification, including the rules of origin or other trade costs linked with the eligibility to the preferential access to the EU market. Finally, besides the usual panel gravity estimation procedures to deal with the zero trade flows issue, we have also used the recent approach proposed by Santos Silva *et al* (2013) to overcome potential econometric problems arising from double-bounded dependent variables.

From a policy perspective, the main message coming from our results is that, as for the agricultural products, lower EU preferential tariffs positively contribute to the increase in the extensive margin of trade. However, our results also show that, when agricultural tariffs are still in place, this positive effect is partly offset by other-than-tariffs negative impacts of PTAs on export diversification, probably linked with the costs of complying with the rules of origin and the other administrative burdens that the exporters face in accessing the preferential treatment. The estimation results also show a clear asymmetry between PTA and non-PTA countries. Indeed, tariffs reductions to developed countries produce an overall reduction of the agricultural extensive margin, which is a somewhat unexpected, even though robust, result. As aforementioned, recent literature has shown an asymmetry in the effects of growth on export diversification, with low-income countries showing an increase of export diversification with the level of income and developed countries showing export concentration with the increase in income (Cadot, *et al* 2013). In the present case we observe a similar asymmetric pattern in the export diversification responsiveness to EU tariffs reductions. Our results also confirm the strong negative impact that tariffs have on the intensive margin, regardless of whether the country is or is not a member of a PTA. Hence, whatever the context, a reduction in agricultural tariffs increases the volume of existing traded products and this positive effect of trade liberalization is not counterbalanced by any negative impact on fixed or variable costs, due to the rules of origin and administrative burdens.

Things are rather different for the manufactured food products; indeed, in the latter case we find no robust or clear-cut evidence of a positive effect of preferential tariffs on the extensive margin of developing countries, while again the positive (although weaker) impact of tariff reductions on the intensive margin is confirmed, whatever the third country involved.

Beside the policy implications, we believe that our results provide insight into a number of relevant issues in empirical trade policy analysis. First, results confirm our hypothesis that the effect of tariffs is conditional on the PTA dummy and that there could be other than tariff impacts of PTAs on the extensive margin. Hence, when the dependent variable is the extensive margin, the specification used, including tariff, the PTA dummy and an interaction term, seems to be effective in capturing the complex effects that trade policies may have on the extensive margin. This does not hold for the intensive margin, which shows the same responsiveness to tariffs regardless the PTA membership, and no influence of other-than-tariffs PTA impacts. Second, our results confirm a rather different pattern for agricultural and food products, considered separately. The responsiveness of the margins is clearly different for the two industries and this may be partly explained by the different demand features, in terms of degree of differentiation and elasticities of substitution. Finally, we found evidence that when the dependent variable, as the extensive margin, has a double-bounded nature, the estimator used can seriously affect the results, as argued by Santo Silva *et al* (2013). In this paper, this is particular evident in the estimations for the food industry, because of the higher percentage of observations close to the upper bound of the extensive margin. This is obviously a front–line issue, which calls for further research.

In conclusion, we believe that the effort to disentangle the impact of tariffs and of the other effects of EU PTAs on the intensive and extensive trade margins of food and agricultural products has provided some valuable preliminary findings which, nevertheless, call for further work in a number of directions. One is the improvement in the use of the SSTW estimator, among others, by computing the partial effects – one issue which has not been tackled in this paper as the presence of an interaction term introduces further complexity and uncertainty (see Norton *et al.* 2004) – and comparing them with those resulting from the more consolidated estimation procedures. In addition, by working with a longer time period, it would be interesting to investigate whether the impact of PTAs changes across the different EU arrangements, such as those with the ACP, the EBA or the GSP.

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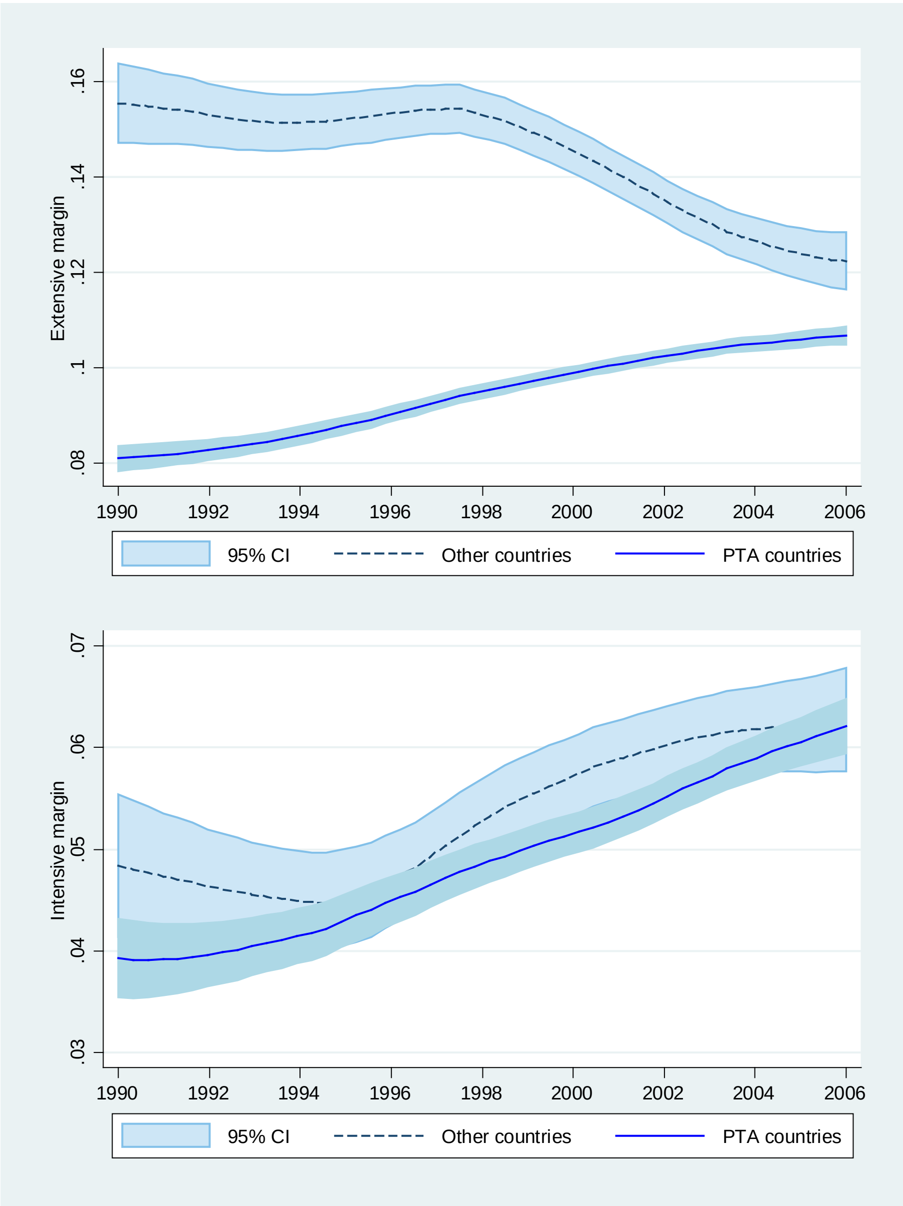

Figure 1: The EU agricultural extensive and intensive product margin

Notes: The figures show the evolution of the (smoothed) average extensive (intensive) margin, and their 95% confidence interval (computed using Stata's lpolyci), calculated across PTA and non-PTA countries.

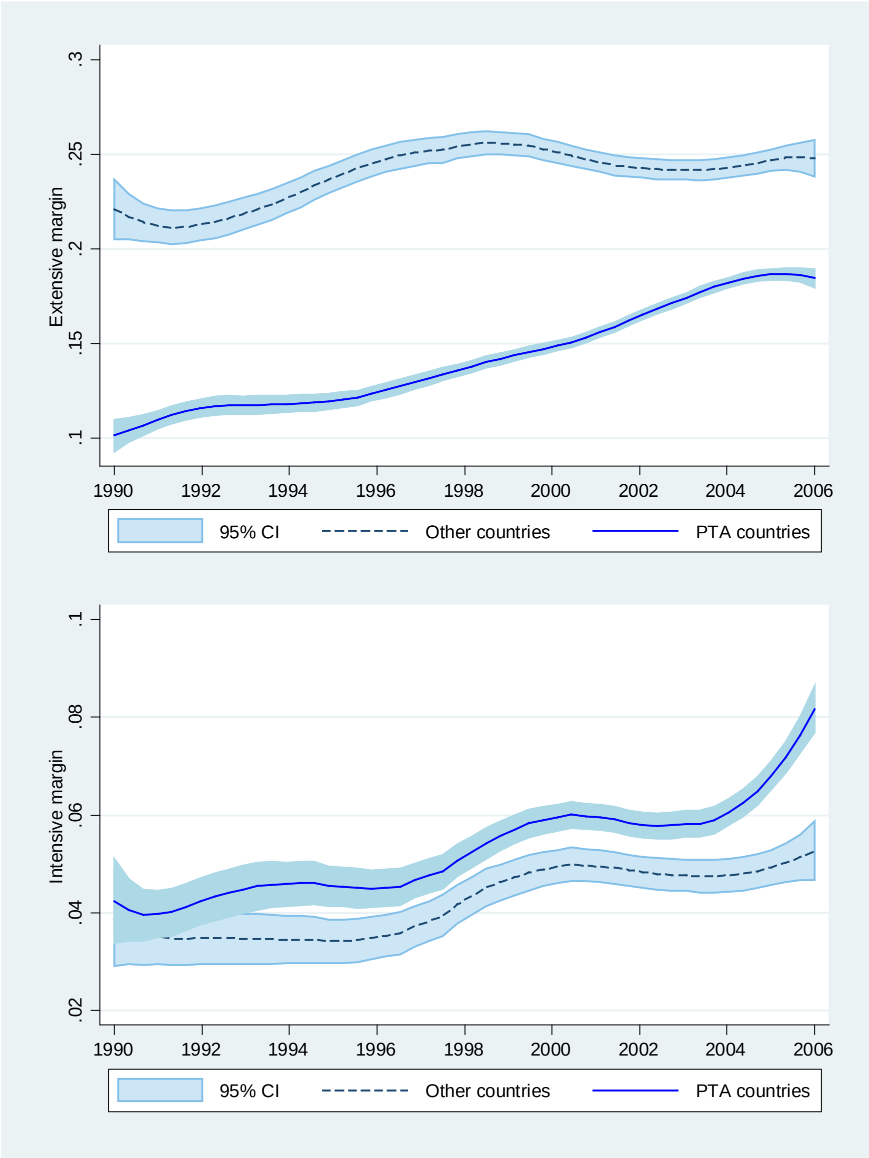

Figure 2: The EU food extensive and intensive product margin

Notes: The figures show the evolution of the (smoothed) average extensive (intensive) margin, and their 95% confidence interval (computed using Stata's lpolyci) calculated across PTA and non-PTA countries.

Table 1.
The expected impact of trade policies on the extensive and intensive margins

	Fixed costs	Variable costs	Extensive margin	Intensive margin
Tariffs	0	+	-	-
Rules of origin				
• Administrative costs	+	0	-	0
• Input sourcing requirements	0	+	-	-
Non-tariff barriers	+	+	-	-

Table 2.
PTA effect on the extensive margin: regression results for agricultural products

	OLS				II stage Heckman				SSTW			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Log distance	-0.70***	-0.70***	-0.70***	-0.70***	-0.45***	-0.45***	-0.45***	-0.49***	-1.54***	-1.50***	-1.54***	-1.53***
	(0.11)	(0.11)	(0.11)	(0.11)	(0.15)	(0.15)	(0.15)	(0.14)	(0.07)	(0.07)	(0.07)	(0.07)
Contiguity	0.65***	0.65***	0.65***	0.65***	0.62***	0.60***	0.61***	0.61***	1.22***	1.20***	1.22***	1.21***
	(0.15)	(0.15)	(0.15)	(0.15)	(0.19)	(0.19)	(0.19)	(0.19)	(0.15)	(0.14)	(0.15)	(0.15)
Common Language	0.20***	0.20***	0.20***	0.20***	0.17**	0.16**	0.17**	0.16**	0.35***	0.32***	0.35***	0.35***
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.05)	(0.05)	(0.05)	(0.05)
Colonial tie	0.33***	0.33***	0.33***	0.33***	0.15	0.13	0.15	0.16	0.78***	0.77***	0.78***	0.77***
	(0.09)	(0.09)	(0.09)	(0.09)	(0.12)	(0.13)	(0.12)	(0.12)	(0.06)	(0.06)	(0.06)	(0.06)
Log (1 + tariff)	-0.20		-0.20	1.42***	-0.29		-0.28	1.56**	-0.81***		-0.80***	1.12***
	(0.34)		(0.34)	(0.51)	(0.38)		(0.38)	(0.61)	(0.11)		(0.11)	(0.27)
PTA		-0.01	-0.01	0.18**		-0.02	-0.06	0.23**		0.22***	-0.02	0.20***
		(0.05)	(0.06)	(0.08)		(0.06)	(0.06)	(0.10)		(0.06)	(0.06)	(0.07)
Log (1 + tariff) * PTA				-1.99***				-2.23***				-2.37***
				(0.59)				(0.70)				(0.30)
Lambda/Omega					-0.53**	-0.43*	-0.55**	-0.38*	13.26***	12.59***	13.25***	13.09***
					(0.24)	(0.22)	(0.24)	(0.20)	(0.97)	(0.92)	(0.97)	(0.96)
Exporter fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Importer-year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
No. of obs.	61,499	61,499	61,499	61,499	54,530	54,530	54,530	54,530	127,604	127,604	127,604	127,604

Notes: Robust standard errors clustered within exporting countries in parenthesis. *, **, *** indicate significance at 1, 5, and 10 per cent levels, respectively; Each regression includes an omitted constant. The inclusion of the religion variable in the first stage of the Heckman procedure reduces the final number of observations. SSTW estimations include zeros.

Table 3.
PTA effect on the extensive margin: regression results for food products

	OLS				II stage Heckman				SSTW			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Log distance	-0.59***	-0.59***	-0.59***	-0.59***	-0.38***	-0.36***	-0.40***	-0.36***	-1.39***	-1.39***	-1.39***	-1.39***
	(0.11)	(0.11)	(0.11)	(0.11)	(0.13)	(0.13)	(0.12)	(0.12)	(0.04)	(0.04)	(0.04)	(0.04)
Contiguity	0.48***	0.47***	0.47***	0.47***	0.44***	0.35**	0.40***	0.35**	1.47***	1.47***	1.47***	1.46***
	(0.13)	(0.13)	(0.13)	(0.13)	(0.14)	(0.14)	(0.14)	(0.14)	(0.08)	(0.08)	(0.08)	(0.07)
Common Language	0.13**	0.13**	0.13**	0.13**	0.09	0.06	0.08	0.06	0.54***	0.54***	0.54***	0.54***
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.04)	(0.04)	(0.04)	(0.04)
Colonial tie	0.31***	0.31***	0.31***	0.31***	0.10	0.05	0.09	0.05	0.71***	0.71***	0.71***	0.70***
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.09)	(0.08)	(0.09)	(0.04)	(0.04)	(0.04)	(0.04)
Log (1 + tariff)	0.61***		0.61***	1.03***	0.57***		0.54***	0.99***	0.07		0.07	0.55***
	(0.16)		(0.16)	(0.32)	(0.16)		(0.16)	(0.34)	(0.05)		(0.05)	(0.10)
PTA		0.07	0.06	0.15*		0.00	0.03	0.09		0.04	0.03	0.13***
		(0.08)	(0.07)	(0.09)		(0.08)	(0.08)	(0.09)		(0.04)	(0.04)	(0.04)
Log (1 + tariff) * PTA				-0.64*				-0.66*				-0.66***
				(0.35)				(0.37)				(0.12)
Lambda/Omega					-0.48***	-0.57***	-0.47***	-0.57***	9.42***	9.72***	9.39***	7.06***
					(0.11)	(0.12)	(0.10)	(0.12)	(0.49)	(0.42)	(0.49)	(0.62)
Exporter fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Importer-year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
No. of obs.	96022	96022	96022	96022	88995	88995	88995	88995	221483	221483	221483	221483

Notes: Robust standard errors clustered within exporting countries in parenthesis. *, **, *** indicate significance at 1, 5, and 10 per cent levels, respectively; Each regression includes an omitted constant. The inclusion of the religion variable in the first stage of the Heckman procedure reduces the final number of observations. SSTW estimations include zeros.

Table 4.

PTA effects on the intensive margin: regression results for agricultural products

	OLS				II stage Heckman			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log distance	-0.76***	-0.76***	-0.76***	-0.76***	-0.57***	-0.54***	-0.57***	-0.58***
	(0.05)	(0.12)	(0.13)	(0.13)	(0.13)	(0.14)	(0.13)	(0.14)
Contiguity	0.26***	0.29	0.28	0.28	0.28	0.26	0.28	0.26
	(0.09)	(0.22)	(0.22)	(0.22)	(0.26)	(0.25)	(0.26)	(0.25)
Common Language	-0.02	-0.04	-0.04	-0.04	-0.05	-0.07	-0.05	-0.06
	(0.04)	(0.10)	(0.10)	(0.10)	(0.11)	(0.12)	(0.11)	(0.12)
Colonial tie	0.36***	0.35***	0.35***	0.35***	0.20	0.15	0.19	0.18
	(0.04)	(0.11)	(0.11)	(0.11)	(0.13)	(0.14)	(0.12)	(0.14)
Log (1 + tariff)	-1.96***		-1.49***	-1.86***	-1.80***		-1.79***	-1.98**
	(0.34)		(0.48)	(0.69)	(0.53)		(0.53)	(0.86)
PTA		0.04	0.06	0.03		-0.04	-0.03	0.01
		(0.08)	(0.08)	(0.08)		(0.09)	(0.09)	(0.14)
Log (1 + tariff) * PTA				0.46				0.25
				(0.86)				(1.02)
Lambda					-0.47*	-0.43*	-0.48*	-0.39*
					(0.24)	(0.24)	(0.24)	(0.24)
Exporter fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Importer-year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
No. of obs.	61499	61499	61499	61499	54530	54530	54530	54530

Notes: Robust standard errors clustered within exporting countries in parenthesis. *, **, *** indicate significance at 1, 5, and 10 per cent levels, respectively; Each regression includes an omitted constant. The inclusion of the religion variable in the first stage of the Heckman procedure reduces the final number of observations.

Table 5.
PTA effects on the intensive margin: regression results for food products

	OLS				II stage Heckman			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log distance	-0.54***	-0.55***	-0.54***	-0.54***	-0.46***	-0.51***	-0.54***	-0.52***
	(0.11)	(0.12)	(0.11)	(0.11)	(0.12)	(0.13)	(0.13)	(0.13)
Contiguity	0.66***	0.66***	0.66***	0.66***	0.69***	0.68***	0.70***	0.69***
	(0.21)	(0.21)	(0.21)	(0.21)	(0.22)	(0.21)	(0.21)	(0.21)
Common Language	0.14*	0.14*	0.14*	0.14*	0.11	0.11	0.12	0.12
	(0.08)	(0.08)	(0.08)	(0.08)	(0.10)	(0.10)	(0.09)	(0.09)
Colonial tie	-0.05	-0.05	-0.05	-0.05	-0.12	-0.09	-0.05	-0.07
	(0.10)	(0.10)	(0.10)	(0.10)	(0.12)	(0.13)	(0.13)	(0.13)
Log (1 + tariff)	-1.09***		-1.09***	-1.14**	-1.13***		-1.13***	-1.18**
	(0.33)		(0.33)	(0.52)	(0.34)		(0.34)	(0.54)
PTA		-0.06	-0.04	-0.05		-0.03	-0.02	-0.03
		(0.06)	(0.05)	(0.06)		(0.05)	(0.05)	(0.10)
Log (1 + tariff) * PTA				0.07				0.08
				(0.65)				(0.67)
Lambda					-0.18	-0.08	-0.02	-0.05
					(0.18)	(0.20)	(0.17)	(0.20)
Exporter fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Importer-year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
No. of obs.	96022	96022	96022	96022	88995	88995	88995	88995

Notes: Robust standard errors clustered within exporting countries in parenthesis. *, **, *** indicate significance at 1, 5, and 10 per cent levels, respectively. Each regression includes an omitted constant. The inclusion of the religion variable in the first stage of the Heckman procedure reduces the final number of observations.

FOODSECURE
FOR POLICIES THAT MATTER

The FOODSECURE project in a nutshell

Title	FOODSECURE – Exploring the future of global food and nutrition security
Funding scheme	7th framework program, theme Socioeconomic sciences and the humanities
Type of project	Large-scale collaborative research project
Project Coordinator	Hans van Meijl (LEI Wageningen UR)
Scientific Coordinator	Joachim von Braun (ZEF, Center for Development Research, University of Bonn)
Duration	2012 - 2017 (60 months)

Short description

In the future, excessively high food prices may frequently reoccur, with severe impact on the poor and vulnerable. Given the long lead time of the social and technological solutions for a more stable food system, a long-term policy framework on global food and nutrition security is urgently needed.

The general objective of the FOODSECURE project is to design effective and sustainable strategies for assessing and addressing the challenges of food and nutrition security.

FOODSECURE provides a set of analytical instruments to experiment, analyse, and coordinate the effects of short and long term policies related to achieving food security.

FOODSECURE impact lies in the knowledge base to support EU policy makers and other stakeholders in the design of consistent, coherent, long-term policy strategies for improving food and nutrition security.

EU Contribution	€ 8 million
Research team	19 partners from 13 countries

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